

Creditor Rights, Collateral Reuse, and Credit Supply*

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Abstract

Theories linking the repledging of collateral to financial instability have been influential in macroeconomics but empirical evidence on them is limited. I utilize a change to bankruptcy treatment of collateral in short-term capital markets to provide causal evidence that strengthened creditor rights increase credit supply and financial instability by increasing the repledging of collateral. Using novel hand-collected data linking dealers to the mortgage companies they funded, I find that dealers exposed to the bankruptcy treatment change increased their repledgeable collateral – consistent with a *money multiplier* – and their credit supply to mortgage companies during the 2000's. I estimate the money multiplier of private-label mortgage collateral to be 4.5 times that of Treasuries, shedding new light on the previously unknown size of this multiplier. I establish that increased dealer credit provision drove mortgage companies to increase originations and pivot toward risky products. I estimate that the expansion in credit increased originations by 9% and accounted for 38% of defaults on mortgages originated during 2005-2006, driving the “last gasp” in the home price boom and its bust.

Keywords: repo, creditor rights, rehypothecation, money multiplier, bapcpa

JEL Classification: G01, G20, G23, G33

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1 Introduction

The influential work of [Mian and Sufi \(2009\)](#) provides evidence that the expansion and contraction in the housing market, at the heart of the Great Recession, was consistent with either a credit supply increase or a change in expectations about future home price appreciation. Their seminal work spawned a growing debate on whether the main drivers of home price movements were due to credit supply or expectations (see, e.g., [Guerrieri and Uhlig \(2016\)](#), [Mian and Sufi \(2017\)](#), [Adelino, Schoar and Severino \(2018\)](#), [Kaplan, Mitman and Violante \(2020\)](#)). While the many resulting studies have furthered our understanding of credit supply leading up to the Financial Crisis, several important puzzles remain. This paper addresses four of these puzzles. First, why were 2006, 2007 vintage mortgages so much worse than 2000-2004 vintages, defaulting only a few months after origination? Second, why were the majority of mortgage defaults focused in the prime segment – for borrowers with higher credit scores – relative to the subprime segment? Third, was the run in the sale and repurchase (“repo”) market, or failure to roll over short-term loans collateralized by financial securities, central to the Financial Crisis? Fourth, how did the relatively small realized losses, found in [Ospina and Uhlig \(2018\)](#), 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? This paper sheds light on these questions while casually establishing that a new credit supply channel, the reuse of collateral in the repo markets, drove the “last gasp” of the housing boom and its bust. In the appendix, I present a natural extension of the [Gertler and Kiyotaki \(2015\)](#) model, which yields the testable prediction that an innovation to dealer banks’ operational efficiency – interpreted as increased reuse of collateral – increases the price of the asset in the boom time and decreases the price of the asset in the bust consistent with the empirical findings of this paper.

Collateral received by a cash lender in a repo transaction can be repledged, meaning the cash lender can reuse it in another, unrelated, transaction. This creates a multiplier process for collateral, like the familiar *money multiplier* in the reserve banking system ([Fegatelli \(2010\)](#), [Singh \(2011\)](#), [Gottardi, Maurin and Monnet \(2019\)](#)). This paper establishes empirically that increasing the reuse, or rehypothecation, of private-label mortgage collateral increases both credit supply and financial instability. [Gorton and Metrick \(2012\)](#) notes that because there are no official data on repo, the size of this money multiplier is not known. Only recently, official data allowing the calculation of the multiplier on Treasury and agency securities has come available ([Jank and Moench \(2020\)](#), [Infante and Saravay \(2020\)](#), [Gorton, Muir and Laarits \(2020\)](#)). However, prior to this paper, little was known about the size of the multiplier on private-label securities. Using hand-collected data, I provide evidence that

the multiplier for private-label mortgage collateral was 4.5 times that of Treasuries.

I present evidence that dealer-banks' reuse of collateral increases following a strengthening of repo creditor rights. I then establish that the money multiplier effect of repo collateral reuse increases credit supply. Specifically, I establish that following an increase in their mortgage collateral reuse, dealers pass their increased credit supply on to the independent mortgage companies (IMCs) that they fund by increasing credit lines and loosening the covenants on the credit lines, incentivizing the mortgage companies to originate riskier mortgages. I establish that the mortgage companies respond by increasing mortgage originations and originating riskier products. I estimate that the increase in dealers' reuse of private-label mortgage collateral caused a 9% increase in mortgage originations during 2005 and 2006 and establish that these mortgages were responsible for 38% of defaults on all mortgages originated during that time. Consistently, I find causal evidence that during 2005 and 2006, the increased repo credit supply drove up home prices in counties exposed to mortgage originations funded via repo credit lines, and drove down home prices in these areas during 2008. I find significant and consistent results across price of mortgage-backed securities (MBS), dealer repo activity, funding to mortgage companies, mortgage originations, and home prices, lending credibility to the results that occur at each sequential step.

My analysis proceeds in three steps. In the first step ([section 4](#)), I provide evidence that improving creditor rights in the repo market increases the reuse of collateral. I utilize the Bankruptcy Abuse Prevention and Consumer Protection Act (BAPCPA) of 2005 as a natural experiment to strengthen creditor rights on repo. BAPCPA granted preferred bankruptcy status to private-label mortgage backed collateral, including whole mortgage loans, which allowed the final creditor to take immediate control of the collateral in the event of bankruptcy. Private-label collateral is mortgage collateral that does not meet the underwriting standards in the agency market. I hypothesize that once BAPCPA granted this collateral preferred bankruptcy status, demand for rehypothecated repo collateral in this asset class would increase since in the event of bankruptcy, the final creditor would take control of the collateral.

To test this, I utilize institutional detail to create a treatment intensity research design. The first insight of the research design hypothesizes that dealers holding more warehoused private-label mortgage collateral at the time of BAPCPA would be more treated. A larger fraction of their balance sheet would consist of previously illiquid collateral suddenly eligible to rehypothecate. 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 invest

proceeds earned from rehypothecating mortgage collateral into more private-label mortgages, leading to multiple rounds of warehouse lending to the independent mortgage companies and creating a money multiplier effect. I estimate a treatment intensity difference-in-differences specification that tests whether more treated dealers' reported repledgeable collateral increased relative to that of less treated dealers within a narrow window around BAPCPA. To define dealer treatment intensity, I utilize heterogeneity in dealers' underwriting of private-label MBS in 2004 to proxy for variation in their warehousing of private-label mortgages. I establish that post BAPCPA, a one unit increase in private-label mortgage-backed securities (PLS) underwriting in 2004 increased dealers' reported repledgeable collateral significantly by 1.7%, consistent with more treated dealers increasing reuse of collateral post BAPCPA.

In the second step ([section 5](#)), I establish that treated dealers differentially pass their increased credit supply on to the independent mortgage companies that they fund. Prior to the Financial Crisis, IMCs made up close to one third of the mortgage lending market, post crisis their market share has increased to approximately half of the mortgage market. The market for repos played a central role in supplying credit to IMCs, a funding structure still prevalent today. [Stanton, Walden and Wallace \(2014\)](#) and [Echeverry, Stanton and Wallace \(2016\)](#) establish that the IMCs relied heavily on *warehouse* funding lines. However, prior to this paper, there has been no direct evidence about who the funders to the mortgage companies were or how they operated. These questions have important implications for financial stability. I hand collect novel micro-level data that link twelve of the largest public IMCs to their warehouse lenders between 2004Q3 and 2006Q3. I provide evidence that IMCs' total warehouse funding amounted to 61% of their assets on average. These credit lines were implemented as *Master Repurchase Agreements* from the largest most interconnected 29 dealers. I trace the transmission of the credit increase from dealers to the IMCs that they funded.

By connecting a dealer's repledgeable collateral 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, to control for mortgage demand confounders. 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. 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 largest 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 a significant 13.8% increase in overall credit supplied to mortgage companies. 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 analysis 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.

In the third step ([section 6](#)), I establish that IMCs increased funding to households in response to the policy change. I conduct a treatment intensity 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, a 10% increase in treated mortgage company market share led to a significant 2.7% increase in mortgage originations during 2005-2006. The distribution of these originations shifted significantly toward balloon and adjustable rate mortgages with artificially low introductory interest rates. These were “near prime,” or alternative, rather than subprime mortgage products. 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. Although alternative products required a higher credit score, [Foote and Willen \(2016\)](#) note that their structure may increase their risk of default. Consistently, within a five-month window around the shock, I find that the estimated marginal default hazard rate increased significantly from 13% prior to BAPCPA to 70% post BAPCPA. 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. These results inform the puzzles of why 2006 and 2007 vintage mortgage loans were of worse quality than 2001-2004 mortgage loans after controlling for borrower characteristics and why prime mortgages were responsible for the lion’s share of defaults during the Financial Crisis. 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 and to a significant 3.3% decrease in home prices during 2008. The results indicate that the credit supply increase in response to BAPCPA played an important role in the “last gasp” of the home price boom and the steep decline in home prices in 2008.

Related Literature. This paper reconciles the high default rates among mid to high range

credit scores ([Albanesi, De Giorgi and Nosal \(2017\)](#)), the disproportionately high default rates among 2006, 2007 vintage mortgages ([Demyanyk and Van Hemert \(2011\)](#)), and the low mortgage interest rates post 2005 ([Justiniano, Primiceri and Tambalotti \(2017\)](#)). [Mian and Sufi \(2018\)](#) attribute the boom and bust in home prices to housing speculation by “flippers,” or homebuyers purchasing investment properties. This paper explores who was funding these speculators during 2005 through early 2007.

This paper sheds light on the question of how the financial system became so levered that a relatively small shock to the mortgage market destabilized the most systemically important financial institutions in a period of two weeks. [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. Providing the repo lines of credit to IMCs, and rehypothecating the collateral that backed them, exposed the dealers to both repo runs on their liability side and collateral runs, as mentioned in [Infante and Vardoulakis \(2021\)](#), on their asset side when the IMCs failed. 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. This reconciles the evidence from [Gorton and Metrick \(2010a,b, 2012\)](#) that a repo run plummeted asset prices and was at the nexus of the Financial Crisis with the evidence from [Krishnamurthy, Nagel and Orlov \(2014\)](#) that only a small fraction of total outstanding asset-backed securities was exposed to the run.

There is a legal debate ([Edwards and Morrison \(2005\)](#), [Roe \(2010\)](#), [Lubben \(2010\)](#), [Skeel and Jackson \(2012\)](#), [Duffie and Skeel \(2012\)](#), [Morrison, Roe and Sontchi \(2013\)](#)) 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. [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 maintains 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.

There is an existing literature that uses the repo safe harbor provision in the BAPCPA policy change as a natural experiment. [Srinivasan \(2017\)](#) presents evidence that demand for private-label mortgage 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 provi-

sion. 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.

2 Institutional Background

In order to understand the research design and the credit supply increase that BAPCPA generated, it is necessary to understand the institutional details of the repo markets and of the IMC warehouse funding process. This section describes (1) the structure of IMC credit lines from dealers; (2) how dealers operate in the repo market; (3) how BAPCPA affected the interactions between dealers and IMCs.

Independent Mortgage Company (IMC) Warehouse Repurchase Facilities 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 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. In the [Appendix B](#), I present evidence that the warehouse repurchase facilities were structured as Master Repurchase Agreements in the bilateral repo market. For the remainder of the text, I will refer to these as Master Repurchase Agreements, warehouse repurchase facilities, or credit facilities. I will discuss the data that I collect in [section 3](#), the data section.

Each IMC reports the dealer funding each credit facility and the maximum amount of the credit facility each quarter. These warehouse repurchase facilities make up 61% of IMC assets on average. I find that 29 warehouse lenders were funding these IMCs in the bilateral

¹HomeBanc 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.

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. A subset of these mortgage companies also report their utilization on credit facility 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.

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 main users of repos are large dealer banks and other financial institutions such as money market funds and hedge funds. Most major central banks implement monetary policy using repos. Thus, the repo markets have important implications for market liquidity ([Brunnermeier and Pedersen \(2009\)](#)).

The repo market consists of two segmented markets: the **bilateral** and the **tri-party** market. Dealers play an important role as repo intermediaries between cash lenders and cash borrowers across these markets.⁷ 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, respectively. The tri-party market receives its name because it has a clearing house which is a third party to the cash

³Almost 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.

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

⁵Bevill, 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).

⁶About 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.

⁷Setting the stage for how a change in rehypothecation of collateral between the tri-party and the bilateral market increased credit supply into the repo markets, the tri-party repo market is the market that connects dealers with nonbank cash lenders 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 across dealers and hedge funds, or mortgage companies in this paper.

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.^{8,9} The bankruptcy treatment of collateral affects the clearing house's ability to perform these functions, as I will discuss shortly. Due to the traditionally more credit worthy market participants, the fact that collateral is held by a clearing house in the tri-party market, and the contracts' very short-term nature, lower haircuts are required to borrow in this market than in the bilateral market.

Dealers intermediate lending between these two markets. In practice, dealers receive collateral in the bilateral market. *Rehypothecation* or *reuse* of collateral occurs when dealers borrow against the collateral they receive from the original cash borrowers ([Copeland, Martin and Walker \(2014\)](#)). Dealers borrow in 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 funding for clients seeking cash, such as hedge funds or IMCs. Reuse of collateral allows dealers to take advantage of the differential between haircuts in the bilateral and tri-party markets to generate a liquidity “windfall” ([Infante \(2019\)](#)).

Bankruptcy Abuse Prevention and Consumer Protection Act of 2005 (BAPCPA)

“Market participants have long operated under the assumption that the purchaser of repo securities is entitled to liquidate them if the seller is unable to fulfill the terms of the agreement at settlement, but the validity of this assumption relies importantly on the court’s interpretation.” ([Lumpkin \(1993\)](#)).

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 \(1993\)](#)).

⁸[Copeland, Martin and Walker \(2014\)](#) p. 2350.

⁹When dealers borrow in the tri-party market, they leave their collateral inside a custodial account – called the *box* – at the tri-party clearing house. To conduct a repo, the custodian moves the collateral from the borrower’s box to the lender’s box since the custodian holds both box accounts on its balance sheet ([Ross \(2020\)](#)). There is a nontrivial friction to moving collateral in and out of the box. Dealers carefully choose what collateral to put in the box because they cannot easily access that collateral later.

The contraction of repo in response to Lombard-Wall and Criimi Mae court cases, where the court failed to grant repo collateral preferred bankruptcy status, suggests that collateral must be exempt from automatic stay in order for cash lenders in the tri-party market to lend against it.¹⁰ In the event of bankruptcy, the automatic stay would block the timely settlement of collateral held in the clearing house's custodial accounts. This would interfere with the clearing house's core functions of taking custody of and valuing securities and settling and netting transactions.

BAPCPA was introduced in Congress in February 2005 and signed into law in April 2005.¹¹ BAPCPA expanded the types of collateral that are protected under the safe harbor provisions of the Bankruptcy Code¹² by expanding the definition of "repurchase agreement" to include the following additional instruments: (1) mortgage loans; (2) mortgage-related securities;¹³ (3) interests in mortgage-related securities or mortgage loans.¹⁴ As discussed in [Appendix B](#), to be qualified as a repurchase agreement, only a *transfer* of mortgage loans was required, regardless of who maintained servicing rights of them. This expansion only affected private-label mortgage collateral. By granting private-label mortgage securities and mortgage loans safe harbor, the law exempted them from automatic stay. Agency mortgage collateral had been granted this status by the 1984 amendments to the Bankruptcy Code in response to Lombard-Wall.¹⁵ The exemption from automatic stay meant that the repo

¹⁰Congressman 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>.

¹¹The 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.

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

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

¹⁴Bankruptcy 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))

¹⁵In June 1984, in response to the court case, Congress enacted the Bankruptcy Amendments Act of 1984

cash lender holding the private-label collateral would be the outright owner of the collateral in the event of counterparty 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.

These institutional details suggest that BAPCPA enabled dealers to repledge warehoused private-label mortgage loans or newly minted private-label MBS in the tri-party market in larger quantities than they had been able to prior to the law change. In the sections that follow, I also present evidence from money market mutual funds' N-Q filings, a quote from repo market participants, analyses on dealers' collateralized repo borrowing, and MBS yields that are all consistent with BAPCPA increasing dealers' ability to borrow against warehoused private-label mortgage collateral in the tri-party market. However, the mechanism in my paper will go through even if BAPCPA only increased dealers' reuse of private-label mortgage collateral in the bilateral repo market.

[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. His 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. In [Appendix B](#), I present excerpts from Fidelity Phillips Street Trust and JPMorgan Trust II's N-Q, two MMFs lending to Countrywide, Credit Suisse, Bear Stearns and Goldman Sachs via reverse repurchase agreements secured by mortgage collateral. One report denotes the mortgage collateral as "Mortgage Backed Securities," while the other denotes it as "Mortgage Loan Obligations." The differing names suggest that "Mortgage Loan Obligations" may be warehoused mortgage loans, not yet packaged into a security, that is accepted in the tri-party repo market by an MMF. In Addition, [Adrian, Burke and McAndrews \(2009\)](#) 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.¹⁶

Conceptual Framework In [Figure 1](#), I depict a stylized example of the proposed change

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 whether the court interpreted the repo as an outright purchase and sale or as a secured loan ([Lumpkin \(1993\)](#)).

¹⁶[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.)

in dealers' ability to reuse the mortgage loans in the warehouse repurchase facility posted by a mortgage company prior to BAPCPA in (a) versus after BAPCPA in (b). This framework proposes that prior to the policy change, 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.

To simplify the exposition of the money multiplier made possible by BAPCPA, I depict the tri-party market refusing to lend against loans in the mortgage warehouse, corresponding to a 100% haircut, in (a). In [section 4](#), I provide evidence that following BAPCPA cash lenders' willingness to lend against private-label mortgage collateral increased. I propose that this increased dealers' ability to reuse the collateral as depicted in [Figure 1](#) (b). Although [Figure 1](#) (b) and the argument below focus on reuse of warehoused mortgage collateral in the tri-party market, the argument would go through if dealers increased reuse of collateral in the bilateral market at lower haircuts than they received prior to the policy change. This argument would also go through either if dealers were able to repledge whole mortgage loans from the mortgage warehouse or if they were able to securitize the warehoused mortgaged loans quickly and pledge the securities, newly minted from the warehoused loans, which economically would mean repledging the underlying mortgage loans.^{[17](#)}

[FIGURE 1 about here.]

The literature documents, both theoretically ([Gottardi, Maurin and Monnet \(2019\)](#)) and empirically ([Copeland, Martin and Walker \(2014\)](#), [Infante \(2019\)](#)), that differences in haircuts between the bilateral and tri-party market are larger for riskier collateral classes. The differential between haircuts on the same collateral generates a money multiplier effect when dealers reuse the collateral. This conceptual framework shows that the larger haircut differential implies that the money multiplier potential of private-label collateral was larger than that of safer assets such as Treasury securities.

A subset of the IMCs in my data report the utilization of their warehouse repo facilities 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 the *IMC* posted a 36% haircut to insulate dealers from the IMCs' risk of default. 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. I propose that the improved creditor rights on private-label collateral (securities or whole mortgage loans), following BAPCPA, decreased haircuts on collateral posted by the *dealer*

¹⁷From speaking with market participants, dealers were able to securitize collateral very fast in, a matter of several days or weeks.

in the tri-party market, from close to 100% (refusal to lend against the collateral) to 5%. The earliest estimate of the haircuts charged in the tri-party market reports that the haircut on private-label mortgage collateral in the tri-party market was 5% in July 2008 ([Copeland, Martin and Walker \(2014\)](#)).¹⁸ This example abstracts from an interest rate charged on the repo borrowing in order to focus on overcollateralization.

The above haircuts imply that post BAPCPA, dealers could re-sell the \$136 collateral – posted by the IMCs in the bilateral market – for \$130 in the tri-party market. This haircut differential would lead to a money multiplier that can be calculated using the common ratio for a geometric series calculated as

$$\frac{1.36}{1.05} = 1.30 > |1|. \quad (1)$$

Imagine that pre BAPCPA, the dealer funded the IMC initially with \$100 of capital (the “*first round*” of lending), the IMC posted \$136 worth of collateral to secure the repo loan, and the dealer held the collateral as protection against the IMCs’ risk of bankruptcy. 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 at a haircut of 5%. If the dealer reinvested in warehouse mortgage loans by lending the \$130 back to the IMC (the “*second round*” of lending), and haircuts remained the same, the IMC would post \$176.8 of new mortgage loans. By repledging this \$176.8 of mortgage collateral, the dealer could borrow \$169 in the tri-party market. [Figure 2](#) depicts this 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 equity to fund the overcollateralization charged by the dealer.

[FIGURE 2 about here.]

Continuing this process, the dealer’s initial \$100 of capital could support total lending to IMCs many times, creating a multiplier effect, similar to the money multiplier in the fractional reserve banking system. The final amount of leverage that this multiplier generated would be calculated by the following series

$$1 + 1.3 + 1.3^2 + \dots = \sum_{i=0}^{\infty} 1.3^i = \infty. \quad (2)$$

¹⁸It is likely that the haircut in the tri-party market was also at 5% or lower directly following BAPCPA, since the use of private-label mortgage collateral in the repo markets was at an all time high during this time.

The series in [Equation 2](#) diverges to infinity since the common ratio is $1.30 > |1|$, implying that the bilateral/tri-party haircut differential on private-label collateral would allow dealers to become infinitely levered in this position if the market did not impose a limit.¹⁹ The dealer has incentive to reinvest in private-label mortgages, because the haircut differential alone meant that each dollar invested in private-label mortgages would generate more than a dollar in the dealers' own borrowing potential, lowering the dealers' cost of capital. Additionally, each round of lending to the IMC would allow the dealer to lever up the return that it received from the IMC in the form of interest rates (abstracted from in [Figure 1](#)) on the warehouse repurchase facilities.²⁰

In comparison, treasury securities purchased in the bilateral market could also be rehypothecated in the tri-party market. In contrast to the positive 30% differential between bilateral and tri-party haircuts charged for private-label mortgage collateral, the haircut differential for Treasuries was negative 0.91% in July 2008 ([Copeland, Martin and Walker \(2014\)](#)).²¹ This yields the following common ratio for the multiplier created by Treasuries in the same way

$$\frac{1.00}{1.0091} = .99 < |1|. \quad (3)$$

Therefore an upper bound for the portfolio of securities generated assuming the dealer is fully levered in this position is

$$1 + 0.99 + 0.99^2 + \dots = \sum_{i=0}^{\infty} 0.99^i = 100. \quad (4)$$

Since the common ratio is $0.99 < 1$, the series converges to 100, whereas the multiplier on private-label mortgage collateral in [Equation 2](#) diverges to infinity.

¹⁹In the Online Appendix, I discuss how the 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. 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).

²⁰The interest earned (r) on the dealer's lending depicted in [Figure 2](#) (a) would be $r = \$100 \times i^{IMC}$. While in [Figure 2](#) (b) the dealer's interest earned would be: $r = \$100 \times i^{IMC} + \$130 \times (i^{IMC} - i^{Dealer})$. Where i^{IMC} is the interest rate paid by the IMC on repo funding and i^{Dealer} is the interest rate paid by the dealer on repo funding. Each additional round of lending to the IMC would increase the interest earned by the dealer in this way.

²¹July 2008 is the earliest that this number is available. It remained fairly stable during the collapse of Lehman brothers and through 2010, indicating that it was likely stable and close to this magnitude following BAPCPA in 2005.

While the multiplier calculated in [Equation 2](#) assumed that haircuts in the bilateral market on private-label mortgage collateral did not change for exposition, I see the dealers offering increasingly favorable overcollateralization terms to the IMCs in my data post BAPCPA. The decline in haircuts required by dealers from 2005 to 2006 is consistent with the collateral becoming more valuable to the dealers. In my data the haircut required is 36% in 2005Q4, 26% in 2006Q1, 11% in 2006Q2, 15% in 2006Q3, and 16% in 2006Q4.²² The slight increase in 2006Q3 and 2006Q4 could be driven by an increase in risk of underlying mortgages. The haircuts that I measure in 2006 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%.²³

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 haircuts they charged in the bilateral market until the bilateral/tri-party differential reached zero, holding constant the risk of the underlying mortgages. One potential reason that the haircut charged to IMCs did not reach the haircut charged in the tri-party market could be driven by investors realizing that the system was highly levered and refusing to rollover repos backed by private-label mortgage collateral. The freeze on short-term funding and interbank lending sparked by the funding market run on U.K. mortgage bank Northern Rock in August 2007²⁴ is consistent with this narrative.

The haircuts I calculate for the IMCs from 2005Q4-2006Q4 allow me to calculate an upper bound on the multiplier that dealers could generate during this time. The majority of private-label mortgage securitizations sold in 30 days ([Adelino, Gerardi and Hartman-Glaser \(2019\)](#)). Therefore I use one month as the interval of the rounds of lending that generate the bilateral/tri-party haircut differential.²⁵ Given the quarterly haircut differentials between 2005Q4-2006Q4, 15 rounds of lending across 15 months would create a multiplier:

²²The earliest that IMCs report overcollateralization begins in 2005Q4 and the latest that it is reported as 2006Q4. Dividing one plus each of these numbers by 1.05 as in [Equation 1](#), yields the haircut differential utilized to calculate the money multiplier effect.

²³[Copeland, Martin and Walker \(2014\)](#) p. 2346.

²⁴[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)

²⁵The IMC was paid when the dealer purchased the warehoused loans. If the dealer financed its purchase of the warehoused loans in the tri-party market, then once the security was sold to the final investor, the dealer would pay off the cash lender and begin another round of funding to the IMC.

$$1 + \sum_{i=1}^3 1.3^i + 1.3^3 \sum_{i=1}^3 1.2^i + 1.3^3(1.2^3) \sum_{i=1}^3 1.06^i + 1.3^3(1.2^3)(1.06^3) \sum_{i=1}^3 1.095^i \\ + 1.3^3(1.2^3)(1.06^3)(1.095^3) \sum_{i=1}^3 1.10^i = 66.5.$$

In this process, the dealer can obtain a portfolio of private-label mortgage warehouse collateral worth \$66.5 million with \$1 million in initial capital. This is 4.5 times the multiplier generated by rehypothecating Treasuries in the same way for 15 rounds, given by:

$$\sum_{i=0}^{15} 0.99^i = 14.9. \quad (5)$$

Prior to BAPCPA, the money multiplier effect of private-label collateral would not have been possible at the same scale because its reuse was limited by the risk of collateral being held by automatic stay if a counterparty defaulted.

3 Data

My empirical analysis combines 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 warehouse repurchase facilities 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 provide an example of the data that I collect in [Appendix B](#). 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.²⁶

²⁶For 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.

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.²⁷ 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 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 FR 2004 data included dealers' trading in private-label mortgage collateral in the line item *corporate securities*.²⁸ These data allow me to study whether primary dealers' trading in the repo markets using private-label 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 true 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

²⁷All dealers report data by 2003.

²⁸Corporate Securities includes Collateralized Mortgage Obligations and Real Estate Mortgage Investment Conduit (REMICs) (including residential) issued by entities other than the GSEs, and privately placed securities. 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==>.

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).^{29,30} The FR 2004 data report the primary dealers' aggregate activity in both the tri-party and bilateral repo markets. [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 FR 2004 trading activity is likely to be representative of trading activity in the repo markets as a whole during 2005-2007.

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.³¹

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

3.3 Mortgage Market Data

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

HMDA Data The HMDA data are loan application-level data constructed from disclosure reports submitted by mortgage lenders.³² In order to supervise and enforce fair lending

²⁹[Infante \(2019\)](#) p. 46.

³⁰*Securities out* and *securities in* include repos/securities lending and reverse repos/securities borrowing, respectively. See: FR 2004.

³¹The mortgages that make up the private-label market generally are comprised of "near prime" and "subprime" mortgages. ([Adelino, Gerardi and Hartman-Glaser \(2019\)](#)) As I will discuss in [section 6](#), Alt-A "near prime" deals increased in response to BAPCPA, therefore in 2004, subprime deals comprised the lion's share of the private-label market.

³²<https://www.ffiec.gov/hmda/hmdaproducts.htm>

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 company³³ 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.³⁴

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 high 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 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 monthly performance data over the life of a mortgage in order to study the effect of BAPCPA on likelihood of default. I use the variable “mba_delinquency_status”

³³ Available upon request at Robert.Avery@fhfa.gov.

³⁴I 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).

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 private-label mortgage securities increased reuse of this mortgage collateral, I first examine prices of private-label relative to agency MBS. I study the yields on private-label relative to agency MBS in the secondary market pre versus post the introduction of BAPCPA in Congress.

For MBS index i , in month t , I regress 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 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.

$$\log(yield_{i,t}) = \omega Post_t + \nu PLS_i + \sum_T \beta_T PLS_i \times \mathbf{1}_{t=T} + \epsilon_{i,t} \quad (6)$$

[Figure 3](#) plots the coefficient β_T . The figure indicates that the yield on the PLS index decreased significantly relative to the yield on the agency MBS index following the intro-

duction 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 3 about here.]

Using dealer trading data from the FR 2004, in [Figure 4](#), I show evidence that suggests dealers' ability to borrow against private-label mortgage collateral tripled following BAPCPA and crashed when the repo run on MBS began in August 2007. To produce this measure I follow [Infante \(2019\)](#) and calculate securities out minus securities in to proxy for the total amount of cash the dealers generated through their secured financing activities. I calculate this measure for the collateral class corporate securities.

Dealers are likely to be cash borrowers (send securities out), in the tri-party market³⁵ 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 lending* from the dealer 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 reflected in securities in. *Securities out* reports the *dollar value of funding received* by the dealer. [Tuckman \(2010\)](#) states that dealers prefer to use borrowed capital to finance themselves rather than to use their own scarce capital. Within a collateral class, if a dealer repledged out all of the securities that it received in, and used none of its own capital, securities out minus securities in would capture the value of the haircut differential that dealers were able to generate.

Subtracting securities out minus securities in gives an estimate of the amount of borrowing dealers could access by reusing private-label mortgage collateral post BAPCPA. The increase in this measure post BAPCPA is consistent with a large haircut differential between securities out and securities in. This large haircut differential would allow dealers to implicitly raise private-label collateral (either whole mortgage loans or newly minted securities) in one repo market to borrow against in another. 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 private-label collateral made up a large fraction of corporate securities, there is a steep and pronounced decline in this measure beginning in August

³⁵[Infante \(2019\)](#) p. 44

2007. 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 private-label mortgage collateral), a relatively small segment of the tri-party repo market. The dramatic fall in dealer borrowing at this time suggests that the lion's share of corporate securities comprised of mortgage-backed collateral.

[FIGURE 4 about here.]

In [Figure 5](#), I plot dealers' securities out (borrowing) collateralized by agency³⁶ and by private-label³⁷ mortgage collateral each as a fraction of total securities out (total dealer borrowing). Prior to BAPCPA a relatively constant fraction of dealers' total borrowing was collateralized by private-label and by agency collateral. After BAPCPA, in April 2005, the borrowing collateralized by private-label collateral, as a fraction of total securities out, nearly doubled from about 6% to close to 12%, consistent with an increase in dealers' ability to borrow against this collateral in the tri-party market. Its value also 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. During this time, dealers' fraction of borrowing secured by agency mortgage collateral remained relatively constant at about 22%.

[FIGURE 5 about here.]

To test the statistical significance of dealers' increased use of private-label collateral to borrow following BAPCPA, [Equation 7](#) 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.³⁸ [Table 1](#) reports the regression results. The coefficient on the interaction term estimates a statistically significant 18.6% increase in private-label securities

³⁶Agency MBS is comprised of Federal Agency and GSE MBS in the FR 2004 data.

³⁷Private-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.

³⁸From January 1, 2001 through July 31, 2007, [Equation 7](#) estimates the following regression on both the log value of securities out and the fraction of total securities out (total borrowing).

$$Y_{i,t} = \omega Post_t + \nu PLS_i + \beta Post_t \times PLS_i + \epsilon_{i,t} \quad (7)$$

$Y_{i,t}$ is set equal to both the log value of securities out and the fraction of total securities out. For collateral

out relative to agency securities out in the post period, consistent with an increase in dealers' ability to borrow against private-label mortgage collateral.

[TABLE 1 about here.]

4.2 Empirical Model

To causally test whether BAPCPA increased dealers' ability to repledge mortgage collateral, I study the amount of repledgeable collateral that dealers report in their annual reports from 2002 to 2006. I develop a treatment intensity research design that defines dealers who were holding more private-label mortgage 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 had a larger fraction of their balance sheet exposed to private-label mortgage collateral would be differentially affected by a strengthening of creditor rights – they were holding more illiquid collateral that suddenly became 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 repledge as collateral for secured financing.

I do not directly observe dealers' holding of private-label mortgage collateral in the mortgage warehouse at the time of the policy change so I proxy for it using dealers' underwriting of private-label MBS. The assumption that this relies on is that dealers who were securitizing more private-label MBS were also warehousing more private-label mortgages. 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.

I compute the total value of subprime residential MBS deals underwritten and securitized by dealer in 2004, the year prior to the policy change. The private-label MBS market is split into the "Alt-A" segment and the subprime segment. In 2004 subprime mortgages comprised the lion's share of the private-label MBS segment ([Justiniano, Primiceri and Tambalotti \(2017\)](#)). As I show in [section 6](#) the "Alt-A" mortgage originations really began in response to BAPCPA.³⁹ I scale the total value of deals underwritten by total book value of assets in

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.

³⁹In figures available upon request, I show that two-step and hybrid mortgages expanded greatly following BAPCPA, in addition to the mortgage products discussed in [section 6](#).

2004Q4 for each dealer,⁴⁰

$$PLSUnderwriting_{j,2004} = \frac{\text{Total Value of Deals Underwritten}_{j,2004}}{\text{Total Assets}_{j,2004}}.$$

There had been drafts of the bill in Congress as early as 2002, alleviating concerns that more- versus less- treated dealers had differential information prior to November 2004. It was not thought that the BAPCPA bill would pass in Congress until November 2004 when the Republicans gained seats in Congress. The securitization process generally takes several weeks to complete, indicating that the vast majority of the deals that determine the treatment variable must have been completed before November 2004.

The heterogeneity in dealer exposure to PLS was likely driven by dealers moving into 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.⁴¹ 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 more- versus less- treated dealers had similar total assets, equities, liabilities, number of mortgage originations, and originated mortgages in a similar number of counties in 2004.

[TABLE 2 about here.]

The money multiplier described in the conceptual framework implies that, by repledging their existing mortgage collateral holdings immediately following BAPCPA, more 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 estimate the following difference-in-differences regression to causally identify the effect of BAPCPA on dealers' repledgeable collateral

$$\log(RepledgeableCol_{j,t}) = \eta_j + \omega Post_t + \beta Post_t \times PLSUnderwriting_{j,2004} + \epsilon_{j,t}. \quad (8)$$

⁴⁰This 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.

⁴¹<https://abcnews.go.com/Business/story?id=3664473&page=1>

Where $\log(RepledgeableCol_{j,t})$ is the log of the repledgeable collateral reported by dealer j at year t . The continuous treatment variable, $PLSUnderwriting_{j,2004}$ is the dollar value of private-label deals that each dealer underwrote in 2004, scaled by their total assets in 2004. $Post_t$ is an indicator variable that equals one for 2005 and later – since BAPCPA was passed by Congress on April 20, 2005 – and zero otherwise. β is the coefficient of interest. It is the coefficient on the interaction term, $Post_t \times PLSUnderwriting_{j,2004}$, that measures how different values of PLS underwriting in 2004 affect dealers' repledgeable collateral in the post-period relative to the pre-period. η_j contains fixed effects for each $Dealer_j$.

The 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.⁴²

[TABLE 3 about here.]

I report the results of [Equation 8](#) in [Table 3](#). A one unit increase in a dealer's underwriting of private-label MBS in 2004 significantly increased their reported repledgeable collateral by 1.7% following BAPCPA. This result is consistent with dealers who were warehousing more private-label mortgages at the time of BAPCPA being in a better position to take advantage of the large money multiplier received by repledging, at low overcollateralization rates, the warehoused or newly securitized private-label mortgage collateral. Under this interpretation, the reported increase in repledgeable collateral also functions as an indirect measure of dealers' increased lending to IMCs. The result is consistent with more treated dealers reinvesting their increased credit supply in more private-label mortgage collateral. As they increased investment in private-label mortgage collateral by lending to IMCs – at high overcollateralization rates – dealers would receive more repledgeable collateral to report. More treated dealers would also experience a first mover advantage relative to less treated dealers over and above the initial burst of liquidity they experienced at BAPCPA's passage. This is because they could lend to IMCs before the haircuts charged to the IMCs began decreasing, allowing the more treated dealers to capitalize on the largest haircut differentials between repo markets.

⁴²Imbens 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 \(2018\)](#)).

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

5.1 Motivating Facts

There are several ways in which dealers could increase funding to IMCs in response to BAPCPA, 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 maximum value of credit lines that dealers sent to mortgage companies to focus on credit supply from dealers to the IMCs. 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 first plot the average total value of warehouse credit lines extended to the IMCs 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 value of 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 private-label mortgage collateral, I utilize a within mortgage company, across dealer empirical strategy similar to [Khwaja and Mian \(2008\)](#). I exploit the fact that each of the mortgage companies in my data receives warehouse repurchase facility lines from three or more dealers simultaneously. I utilize the same research design in [subsection 4.2](#) and I define treated dealers to be those whose scaled value of PLS deals underwritten in 2004 was in the top quartile.

The control dealers are the dealers in the bottom three quartiles of PLS underwritten in 2004.

$$Treated\ Dealer_j = \mathbf{1}[Top\ Quartile\ PLSSUnderwriting_{j,2004}]$$

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 BAPCPA. 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. I estimate the change in lending by treated dealers relative to untreated dealers from 2004Q3 to 2006Q3.⁴³ 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. I make the following identifying assumptions: (1) 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 private-label mortgage collateral, (2) 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 both because BAPCPA strengthened creditor rights on collateral, which would directly increase the willingness of dealers to lend against the collateral, and 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. By studying the change in value of credit lines offered by treated dealers relative to control dealers within an IMC, I isolate the change in credit supplied to an IMC that is caused by BAPCPA's shock to the dealer's ability to reuse private-label mortgage collateral, not the IMC's demand for credit.

I estimate the difference-in-differences regression

$$\log(CreditLine_{i,j,t}) = \gamma_{i,t} + \eta_j + \sum_T \beta_T Treated\ Dealer_j \times \mathbf{1}_{t=T} + \epsilon_{i,j,t}. \quad (9)$$

Where $\log(CreditLine_{i,j,t})$ is the log of the credit line extended to IMC i by dealer j in

⁴³Most 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.

quarter t . $Treated\ Dealer_j$ is an indicator variable that equals one for treated dealers. $Treated\ Dealer_j \times 1_{t=T}$ is the interaction term between the indicator variable for treated dealers and for each quarter pre and post BAPCPA.⁴⁴ I set the reference quarter to 2005Q1, the quarter before BAPCPA was passed. β_T is the coefficient of interest, it measures the difference in lending between treated and control dealers each quarter relative to the reference quarter. 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 BAPCPA. 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.

[FIGURE 8 about here.]

[Figure 8](#) traces out the response of dealer lending volume to IMCs following BAPCPA. It presents the FE specification with a total 539 credit lines extended to the twelve IMCs from 27 dealers between 2004Q3 and 2006Q3.⁴⁵ The results indicate a large dealer lending channel effect. Prior to BAPCPA, treated and control dealers' lending volumes within an IMC were similar. Post BAPCPA, however, the treated dealers began lending differentially more than control dealers within an IMC. Being a treated dealer is associated with a significant 28.9% increase in lending on average across the post period relative to control dealers lending to the same IMC.⁴⁶ 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.

[TABLE 4 about here.]

⁴⁴I run the equivalent regression to [Equation 9](#), however with a single pre-period and a single post-period in order to estimate the cumulative effect of the shock in the post period. $Post_t$ is an indicator variable that equals one for 2005Q2 and later and zero otherwise.

$$\log(CreditLine_{i,j,t}) = \gamma_{i,t} + \eta_j + \beta Post_t \times Treated\ Dealer_j + \epsilon_{i,j,t} \quad (10)$$

⁴⁵I 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.

⁴⁶[Table 4](#) presents the results from [Equation 10](#), the regression with a single pre and post period.

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 treated 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 were equally likely to anticipate the policy change within a narrow window around BAPCPA. If the shock was anticipated, I would expect to see the treated dealers increase their lending to IMCs prior to 2005Q2. However, the dynamic response plot of treated versus control dealer lending in [Figure 8](#) 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 the treated dealers are dealers who underwrite more PLS deals and may therefore have incentive to originate more mortgages to capture underwriting fees post BAPCPA. [Puskar and Gottesman \(2012\)](#) cites that underwriting fees on PLS were 35 basis points. Absent the money multiplier effect of rehypothecation, as discussed in [section 2](#), the underwriting fees alone could not generate the increasing effect seen in [Figure 8](#). The underwriting fees would allow a treated dealer who lent \$1 initially to receive \$0.0035 on that dollar, available to be lent out again, this lending would generate \$0.0035² that the dealer could lend out and so on, while a control dealer, who would underwrote \$0 in private-label MBS deals, would lend out \$1 initially and receive \$0 in underwriting fees to lend out in subsequent rounds of lending.⁴⁷ The dynamic coefficient β_T in [Equation 9](#) would be converging to zero and the result in [Figure 8](#) would be decreasing rather than increasing. β_T would further converge to zero as more control dealers began underwriting PLS deals as we saw in 2005 and 2006 ([Nadauld and Sherlund \(2013\)](#)). The increasing result plotted in [Figure 8](#) is consistent with increased rehypothecation allowing treated dealers to be “first movers,” able to take advantage of the largest haircut differentials immediately after BAPCPA, which set them on an increasing trajectory relative to control dealers who began rehypothecating private-label mortgage collateral later and received only lower haircut differentials.

A third 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

⁴⁷The underwriting fees would generate a lending process, for treated dealers, that looked like $1 + 0.0035 + 0.0035^2 + \dots$, while a control dealer underwriting \$0 in MBS deals would have the process $1 + 0 + 0 + \dots$.

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 coefficient of interest is similar in magnitude and significance – being a treated dealer is associated with a significant 37.3% increase in lending on average across the post period relative to control dealers lending to the same IMC.

[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:

$$CreditLine_{i,t} = \sum_j CreditLine_{i,j,t}. \quad (11)$$

In [Table 6](#), I present descriptive statistics showing that the treated and control IMCs had similar total assets,⁴⁸ number of mortgage originations, and originated mortgages in a similar number of counties in 2004.

[TABLE 6 about here.]

$$\log(CreditLine_{i,t}) = \beta Post \times Treated\ IMC_i + \gamma_i + \alpha_t + \epsilon_{i,t} \quad (12)$$

In [Equation 12](#), 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

⁴⁸In 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.

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 significant 13.8% increase in total maximum credit available in the post period relative to control mortgage companies. This evidence suggests that BAPCPA led to an increase in overall lending to mortgage companies with an above median fraction of their credit lines from treated dealers rather than a substitution of lending away from control toward treated dealers within a mortgage company. If BAPCPA caused IMCs to substitute away from control dealers toward treated dealers without increasing their total credit supply, there would be no statistically significant increase in total credit lines for treated IMCs. 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 were eventually 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. This evidence suggests that post BAPCPA, 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.⁴⁹ These were considered risky mortgage products. The funding lines for all of these products doubled post BAPCPA, while I do not observe dealers increasing credit lines for conforming mortgage products following BAPCPA. 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

⁴⁹The typical definition for default is 90 days delinquent.

transfers the loan documents prior to receiving the line of credit. Wet funding is implicitly unsecured funding that 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. Since wet funding was implicitly unsecured, 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 study the effect on mortgages originated by the IMCs receiving funding from dealers. My preferred specification studies the effect on orginations by all IMCs. All IMCs in the United States were likely affected by this policy change. The 12 IMCs, for which I collect data, capture approximately 59% of total IMC mortgage originations as of 2006. Average total dealer provided warehouse repurchase facilities to these IMCs equaled 61% of mortgage company total assets, making dealers their main funders. The dealers lending to the IMCs in my sample were the 29 largest, most interconnected dealers and were likely lending to the IMCs for which I am not able to collect data as [Stanton, Walden and Wallace \(2014\)](#) find that warehouse repurchase facilities dominate the IMC funding model.⁵⁰ While [subsection 4.2](#) and [subsection 5.2](#) exploit heterogeneity in dealer exposure to BAPCPA to causally identify the effect of the policy change, eventually all dealers would have experienced a credit supply shock and increased incentive to invest in private-label mortgages. As a proof of concept, I

⁵⁰[Stanton, Walden and Wallace \(2014\)](#) pp. 267-269.

run a parallel analysis to study whether the six IMCs with an above median fraction of total funding from the most treated dealers increased their mortgage originations by more than all other mortgage originators, including the six IMCs more closely linked to control dealers.

I conduct a county level treatment intensity analysis where I create the variable, $(Treated)IMCMarketShare_{c,2004}$, to capture the exposure of a county to the (treated) IMCs in 2004, the year prior to BAPCPA. I calculate this variable, as follows, using the number of mortgage originations in the HMDA data⁵¹

$$(Treated)IMCMarketShare_{c,2004} = \frac{\text{Number of originations by (treated) IMCs}_{c,2004}}{\text{Total number of all originations}_{c,2004}}.$$

[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 Colorado. 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 private-label mortgage market.⁵² The market share of IMCs however was relatively stable throughout 2004, the year that I define my treatment. The stabilization in the market share of IMCs by 2004 alleviates the concern that the results in this paper are driven by a pre-existing increasing trend in IMC expansion.

In the [Appendix F](#), I provide evidence that the percent of loan officers reporting an increase in mortgage demand in the Federal Reserve's Senior Loan Officer Survey had been declining prior to BAPCPA, consistent with declining mortgage demand 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. As I will discuss in more detail later in the paper, I find parallel pre-trends in home prices between treated and control counties between July 2003 and the passage of BAPCPA. 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 × month*

⁵¹I 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.

⁵²In [Appendix F](#), I find that although the market share of IMCs was rising during 2000 to 2003, the steep decline in agency mortgage originations in 2003 – consistent with the Fannie/Freddie fraud cases resulting in constraining Fannie/Freddie market share – increased the relative share of IMC (and therefore PLS) originations.

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.⁵³ I run the following dynamic regression.

$$Y_{c,t} = \gamma_c + \eta_{s,t} + \sum_T \beta_T (Treated)IMCMarketShare_{c,2004} \times \mathbf{1}_{t=T} + \epsilon_{c,t} \quad (13)$$

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. $(Treated)IMCMarketShare_{c,2004} \times \mathbf{1}_{t=T}$ 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. I set the reference month to March 2005, the month prior to the passage of BAPCPA.⁵⁴ Standard errors are clustered at the county level. I report the regression results with *county* fixed effects alone and with both *county* and $state \times month$ fixed effects. The regression with both *county* and $state \times month$ fixed effects is my preferred specification as this regression compares mortgage characteristics in counties with high versus low IMC market shares within the same state and month, absorbing state-month housing market 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 $state \times month$ 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

⁵³I 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.

⁵⁴I run the equivalent regression to [Equation 13](#), 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.

$$Y_{c,t} = \gamma_c + \eta_{s,t} + \beta Post_t \times (Treated)IMCMarketShare_{c,2004} + \epsilon_{c,t} \quad (14)$$

of IMCs in the mortgage market alone, rather than the effect of BAPCPA, drove up home prices, it should be reflected in a pre-treatment increase in home prices in the treated counties in 2003 when IMCs' market share was 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.⁵⁵ 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. In the all IMC market share analysis, a 10% increase in total IMC market share in 2004 leads to a significant 2.7% increase on average in the post period.⁵⁶ A 10% increase in treated IMC market share results in a 8.7% increase in mortgage originations on average in the post period.^{57,58}

[TABLE 8 about here.]

Next I study the effect of BAPCPA on non-traditional, Alt-A, mortgage products that were near prime in borrower credit score but had riskier payment schedules. 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.

⁵⁵As 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.

⁵⁶[Table 8](#), presents the results from [Equation 14](#), the regression with a single pre and post period.

⁵⁷The 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.

⁵⁸Although 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.

I estimate the dynamic regression in [Equation 13](#), 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. A 10% increase in total IMC market share in 2004 leads to a significant 0.3 percentage point increase in the fraction of balloon mortgages originated in that county on average in the post period. A 10% increase in treated IMC market share results in a statistically significant increase of 1.13 percentage points on average in the post period. Similarly, I find that the fraction of negative amortizing mortgages, which also have high risk of negative equity, increases.⁵⁹ I find evidence that suggests the fraction of owner-occupied 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 13](#) to study the effect of $(Treated)IMCMarketShare_{c,2004}$ on introductory mortgage interest rates. I limit the sample to only ARM originations (including ARM balloons) and study the average initial interest rates charged in a county pre and post shock as a function of IMC market share. In [Figure 14](#), I plot the response of the log($Initial\ Interest\ Rate_{c,t}$). 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 total IMC market share leads to a significant 2.39% decrease in the average introductory interest rate on ARMs in a county on average in the post period.⁶⁰ A 10% increase in treated IMC market share leads to a significant 6.98% decrease in the post period. 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.

⁵⁹A quote from the annual report from a mortgage company in my sample states: “Borrowers with adjustable-rate mortgage loans will likely be exposed to increased monthly payments ... A **decline in housing prices** ... [could] leave borrowers with insufficient equity in their homes to permit them to refinance ... borrowers who intend to sell their properties ... may find that they cannot sell their properties for an amount equal to or greater than the unpaid principal balance of their loans, especially in the case of **negative amortization mortgage loans**. These events could **cause borrowers to default** on their mortgage loans.” HomeBanc 2005 Annual Report p. 56 of 173

⁶⁰In [Table 8](#), I report the results from [Equation 14](#), the regression with a single pre and post period.

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 private-label mortgage market is split into alternate A, (“Alt-A”) and subprime segments according to credit risk. The “Alt-A” segment is also commonly referred to as “near prime,” and it is typically characterized by borrowers with credit scores comparable to 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 before increasing the fraction of “Alt-A” 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.]

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. I limit the dataset to loans that were originated from November 2004 to September 2005, a five-month window around the passage of BAPCPA in April 2005. 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

$$Defaulted\ Loan_l = \gamma_c + \eta_{s,t} + \beta Post_t \times (Treated)IMCMarketShare_{c,2004} + \epsilon_l. \quad (15)$$

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 just prior to BAPCPA. 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. A 10% increase in treated IMC market share significantly raises the default hazard rate post shock by 11.1 percentage points. I report the regression results for [Equation 15](#) 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 \(2011\)](#) 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 13](#) 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 total (treated) IMC market share lead to a significant 2.1% (9.5%) increase in home prices.⁶¹ 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 total (treated) IMC market share lead to a significant 3.3% (15.9%) 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

⁶¹I run the regression in [Equation 14](#) 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.

that they account for relative to all defaults on loans originated during 2005 and 2006. I calculate the effect both under the assumption that only the six treated IMCs receive a credit supply increase in response to BAPCPA and under the assumption that all IMCs receive a credit supply increase in response to BAPCPA.

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.⁶² Following this same methodology assuming that all IMCs were affected by BAPCPA, I calculate that BAPCPA was responsible for a 9.1% increase in mortgage originations.⁶³ 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.⁶⁴ 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 during 2005 and 2006. I describe these calculations in the Online Appendix.

This paper finds that in response to strengthened creditor rights, dealers increased funding for alternative mortgage products. The evidence suggests that these new mortgage products lowered near-term mortgage payments at the peak of the housing boom to increase demand when conforming mortgages would otherwise have been very expensive. Due to their payment structure, these products however were extremely vulnerable to home price declines and interest rate increases. The results suggest that the credit supply increase drove up the price of homes in the counties most exposed to these products, which 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 bankruptcies

⁶²I 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.

⁶³I 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.

⁶⁴These are the IMCs most closely linked to the treated dealers.

would have removed the large “deposits” of warehoused mortgaged loans⁶⁵ that the 29 largest dealers used to borrow against, leading to the form of collateral runs on dealers’ asset side as described in [Infante and Vardoulakis \(2021\)](#). These collateral runs would have triggered instability among the 29 most systemic dealer banks. Their bankruptcies would also 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 further destabilize the IMCs and the dealers funding them, as warehouse repurchase facility lenders’ incentive in times of difficulty is to require the IMCs to post margin calls ([Kim, Laufer, Stanton, Wallace and Pence \(2018\)](#)). This sheds light on the question of how a relatively small shock to the housing market put the most systemically important dealer banks at risk of failure in a period of two weeks.

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 empirically that when overcollateralization requirements differ at each leg of the chain of reuse, increased repo reuse of collateral functions like a money multiplier, creating a positive credit supply shock. Finally, this paper documents that the pass-through of this credit supply shock from the repo market to the housing market, following BAPCPA, was economically large, contributing to both the “last gasp” of the housing boom and its bust.

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. Consistent with the results described in this paper following BAPCPA, the model predicts that relative to the baseline, dealers increase their leverage and the amount of capital that they hold when their operational advantage increases. This amplifies capital’s price increase in a boom and its price decline in a bust, consistent with the empirical results of this paper. It also increases the probability of a bank run in every state, which is consistent with the Great Financial Crisis experienced in 2008.

⁶⁵See American Home Mortgage Holdings, Inc. v. Credit Suisse First Boston Mortgage Capital, LLC. Case No. 07-11047 (CSS) which discusses American Home Mortgage Holdings’ law suit requesting that courts uphold an automatic stay on private-label mortgage repo so that it could retain control of the warehoused mortgage loans that it had posted with its repo lender Credit Suisse.

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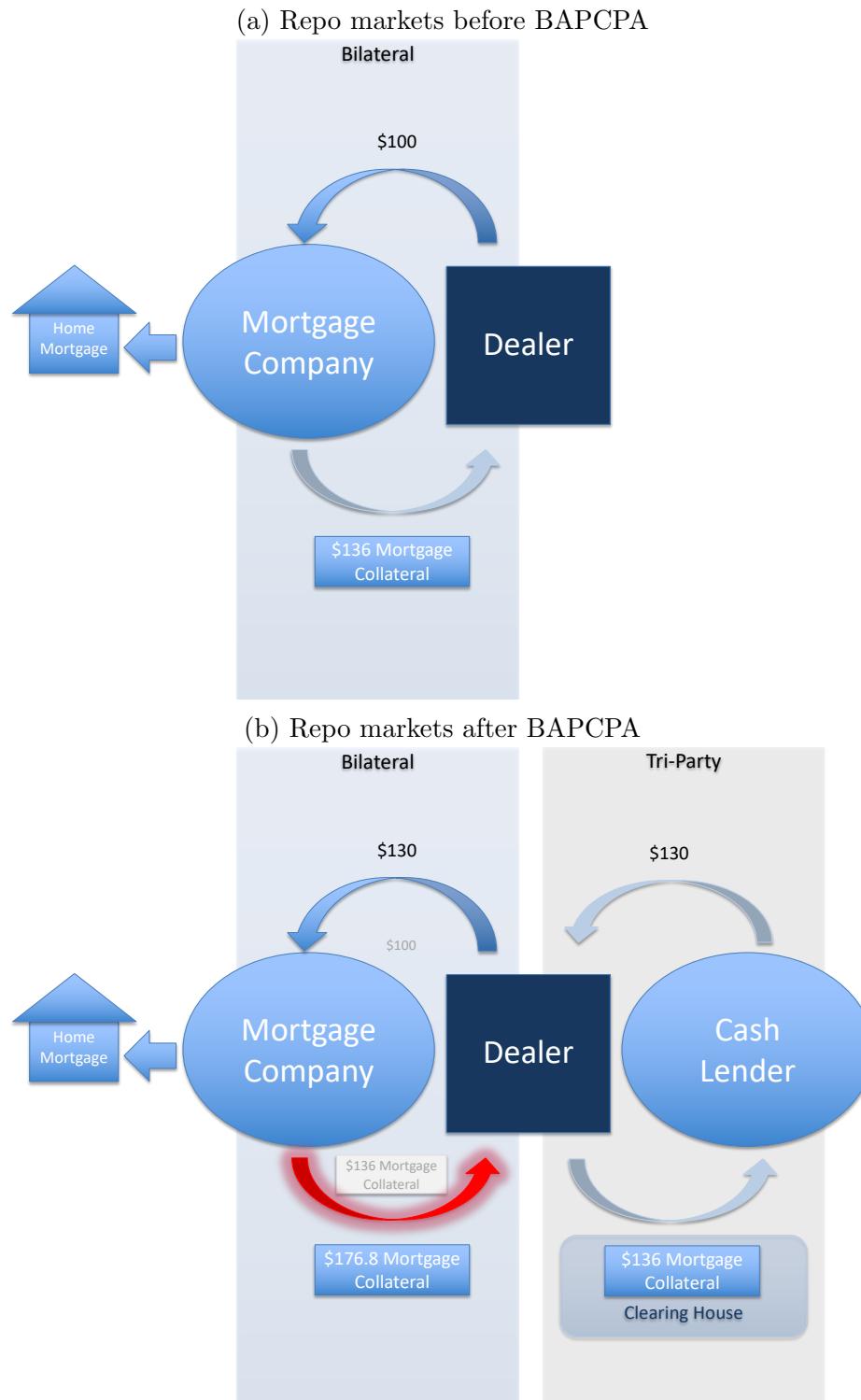
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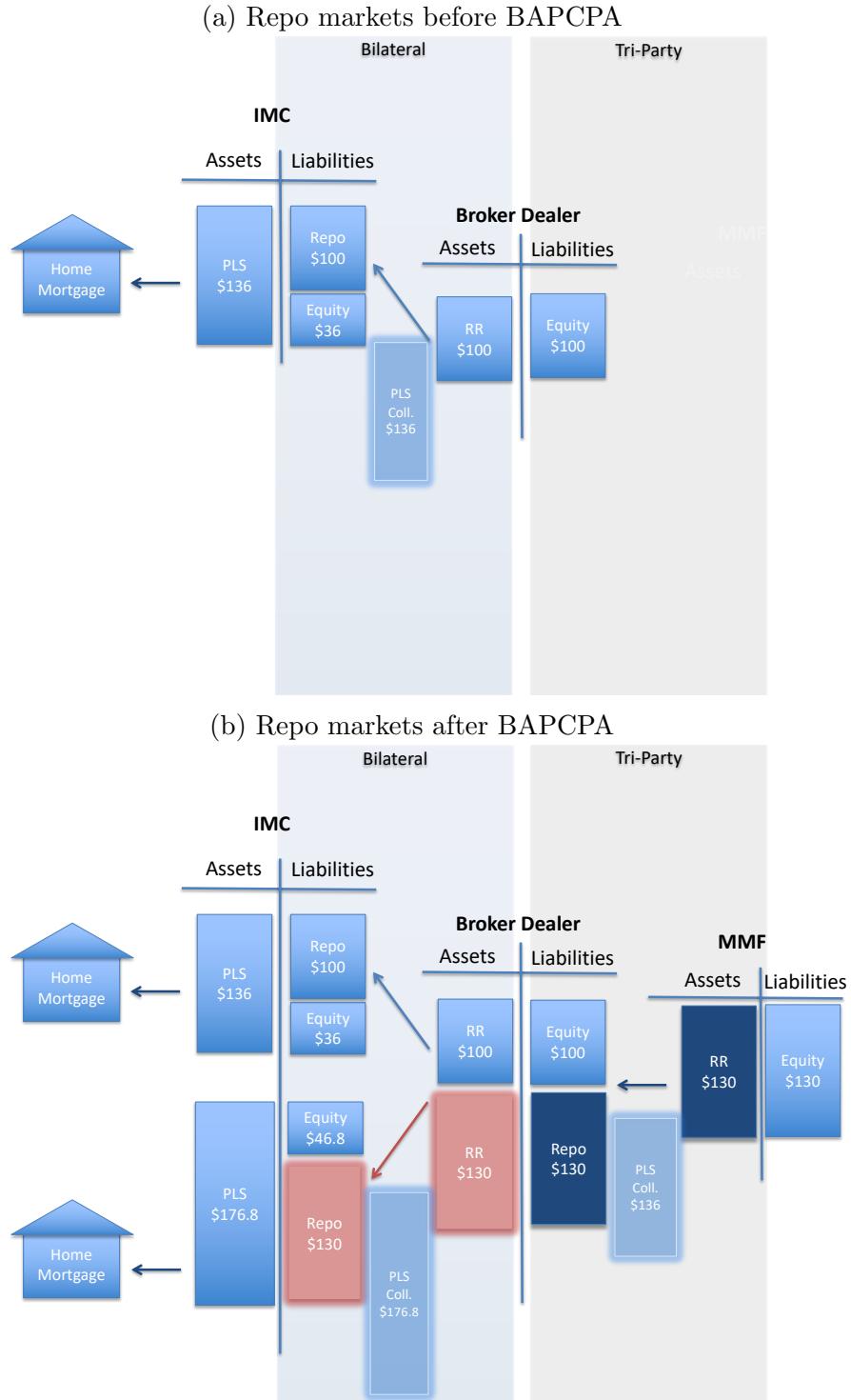
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FIGURE 1: REPO MARKETS BEFORE AND AFTER BAPCPA 2005



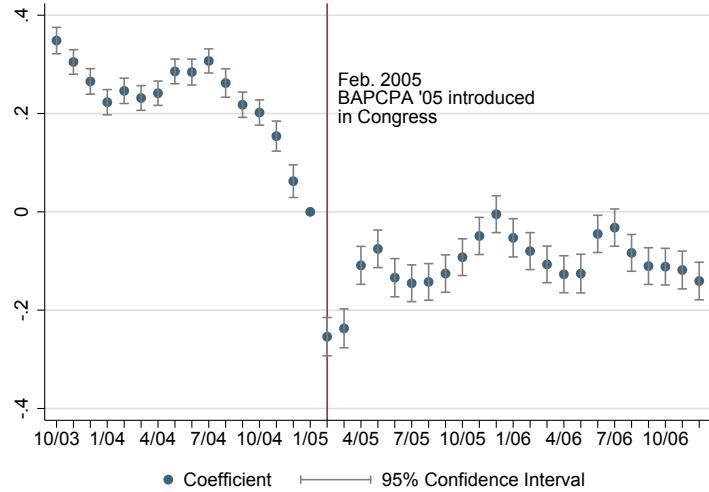
Notes: Figures depict the process by which a dealer can borrow and lend funds via the tri-party and bilateral repurchase market respectively, using the same underlying private-label mortgage collateral provided by the cash borrower for both contracts. Figure (a) depicts the “first round” of lending from 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



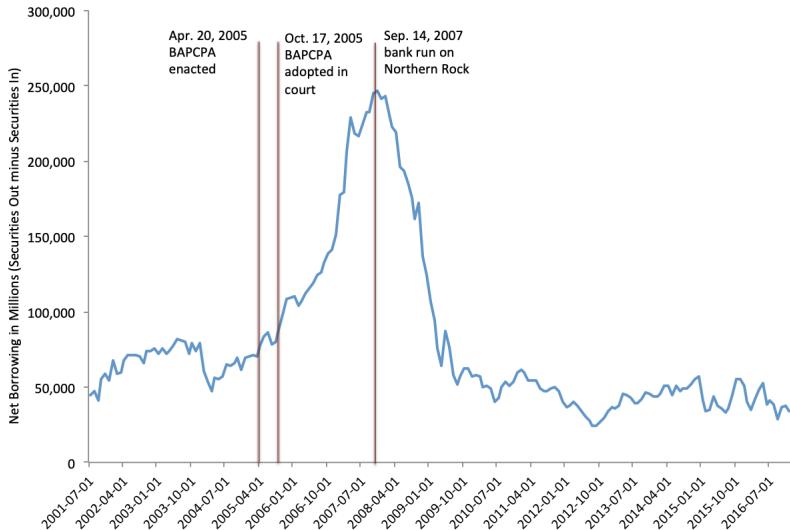
Notes: Figure (a) depicts the “first round” of dealer lending to an IMC. Figure (b) depicts funding after both a “first round” and “second round” have taken place. The figure abstracts from interest rates charged on repo agreements in order to focus on the money multiplier effect generated by different 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: PRIVATE-LABEL VS. AGENCY MBS YIELDS



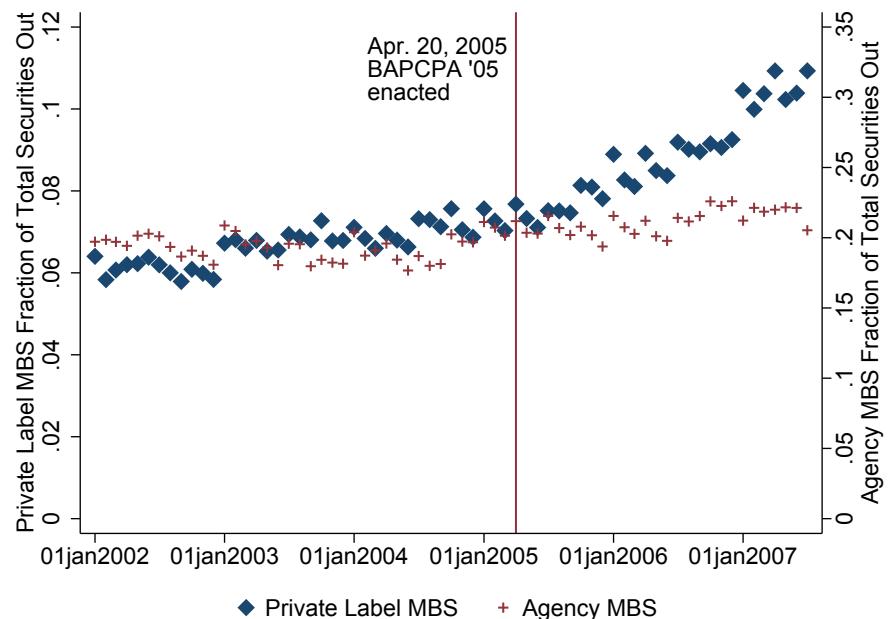
Notes: Figure plots the dynamic response of private-label MBS relative to agency MBS yields pre vs. post the introduction of BAPCPA 2005 in Congress on February 1, 2005. I estimate Equation 6. β_T is the coefficient of interest. It is the coefficient on the indicator variable that interacts the indicator for PLS with an indicator for each month pre and post shock. The results indicate the yield on the PLS index dropped relative to that on the agency MBS index following BAPCPA announcement. This is consistent with a differential increase in the price of these PLS index in February 2005 when BAPCPA was introduced in Congress.

FIGURE 4: DEALER NET BORROWING USING PRIVATE-LABEL MORTGAGE COLLATERAL



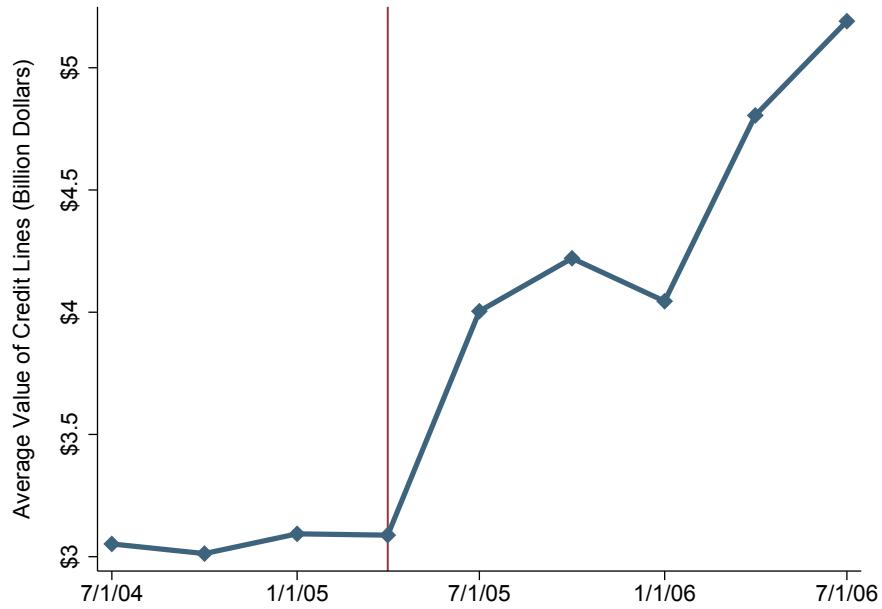
Notes: Figure plots the weekly time series of dealer net borrowing backed by private-label mortgage collateral, calculated by secured borrowing (securities out) minus dealer secured lending (securities in) in the collateral class corporate securities reported in the FR 2004. In subsection 3.2 and in the Online Appendix, I discuss the lower bound estimate of the percent that private-label mortgage 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 5: DEALER BORROWING BACKED BY PRIVATE-LABEL VS. AGENCY MORTGAGE COLLATERAL

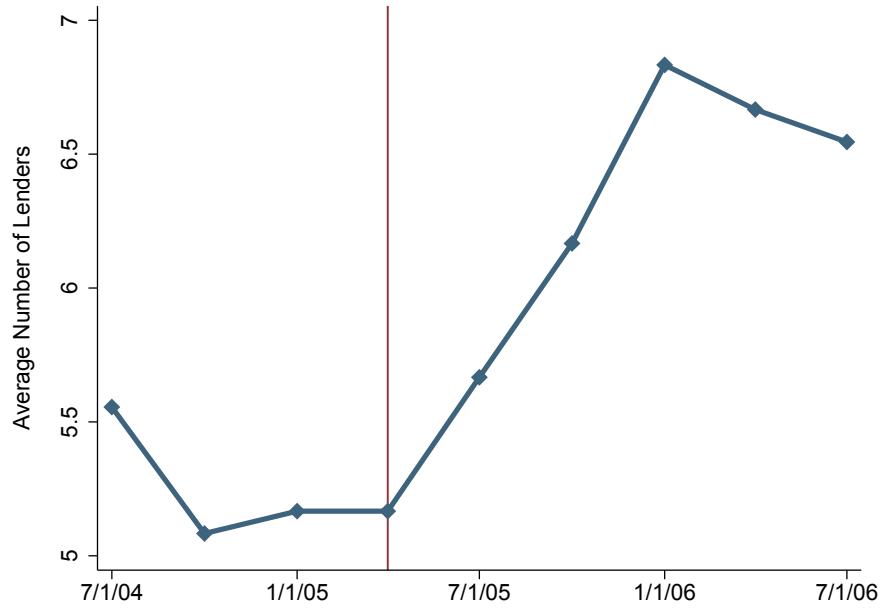


Notes: Figure plots the fraction of total primary dealer securities out that was made up of private-label MBS versus agency MBS pre and post BAPCPA. The variable corporate securities in the FR 2004 proxies for private-label MBS. Agency MBS is comprised of Federal Agency and GSE MBS in the FR 2004 data. 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 private-label mortgage collateral to borrow funds following BAPCPA.

FIGURE 6: AVERAGE CREDIT LINES TO MORTGAGE COMPANIES



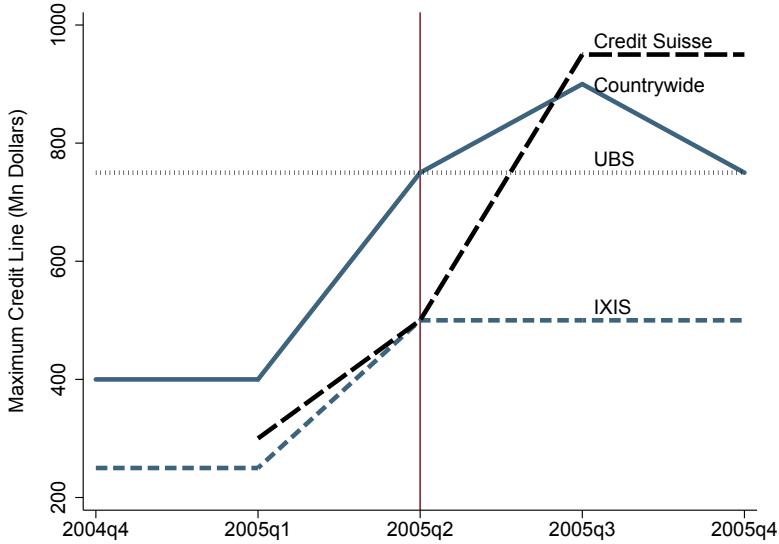
(a) Average Total Value of Credit Lines Available per Mortgage Company



(b) Average Number of Credit Lenders per Mortgage Company

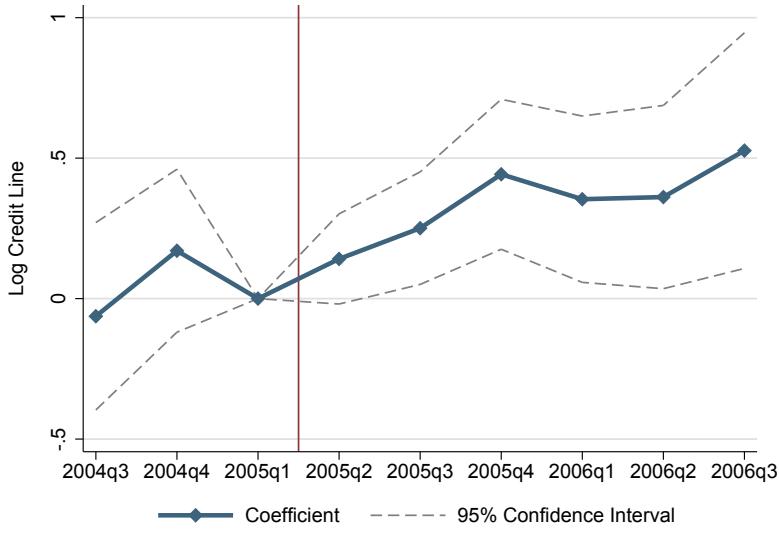
Notes: Figures plot the average number of dealers lending to the independent mortgage companies (IMCs) in my sample pre and post BAPCPA and average total value of credit lines available to an IMC. Post BAPCPA, the average number of dealers lending to an IMC and the average total credit extended to an 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



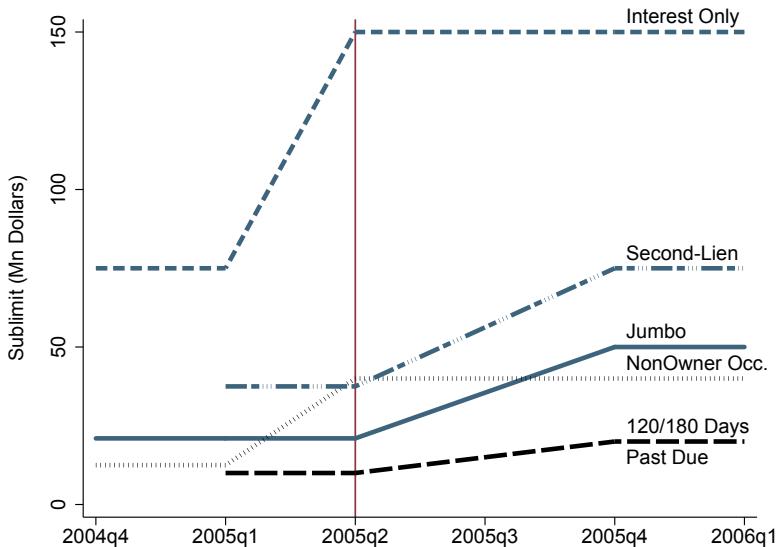
Notes: The figure plots the maximum credit line values extended to an example mortgage company by dealers pre and post BAPCPA. Credit Suisse and Countrywide are treated dealers. Although all credit lines increased following BAPCPA, Credit Suisse and Countrywide increased their credit lines to the mortgage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



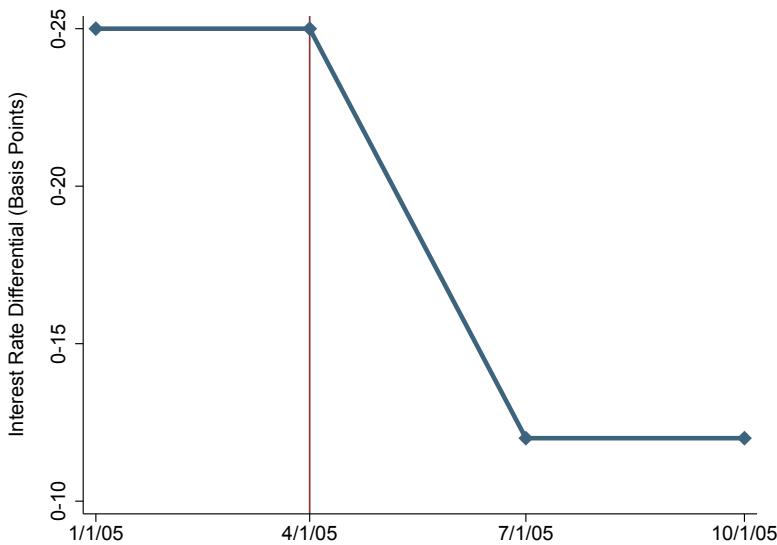
Notes: Figure plots the dynamic response of treated relative to untreated dealer funding within a given IMC pre and post BAPCPA. I estimate [Equation 9](#). I plot the coefficient of interest, β_T . It is the coefficient on the indicator variable that interacts dealer treatment with an indicator for 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



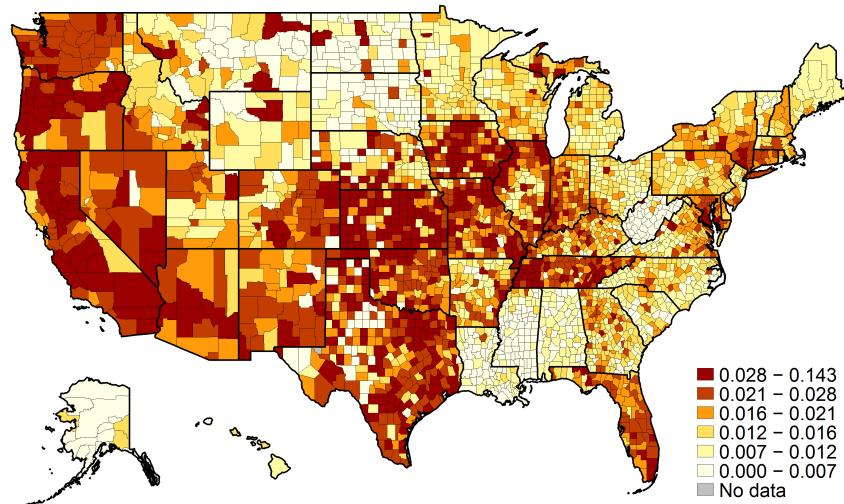
Notes: The figure plots the sublimit of funding available to fund certain mortgage products. The dealers would specify the maximum amount of funding per credit line available to fund certain mortgage products. The figure suggests that following BAPCPA dealers increased funding for riskier mortgage products.

FIGURE 10: INTEREST RATE DIFFERENTIAL BETWEEN SECURED AND UNSECURED CREDIT

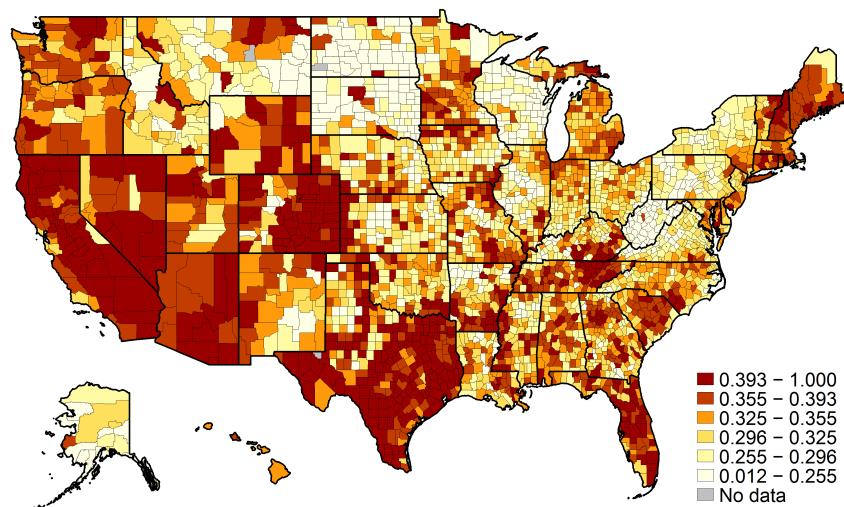


Notes: Figure plots the interest rate differential between credit lines backed by “wet” vs. “dry” collateral for an example mortgage company. Dry funding is secured by collateral that has already been created by the IMC, and requires that the loan documents be transferred to the dealer. Conversely, wet 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



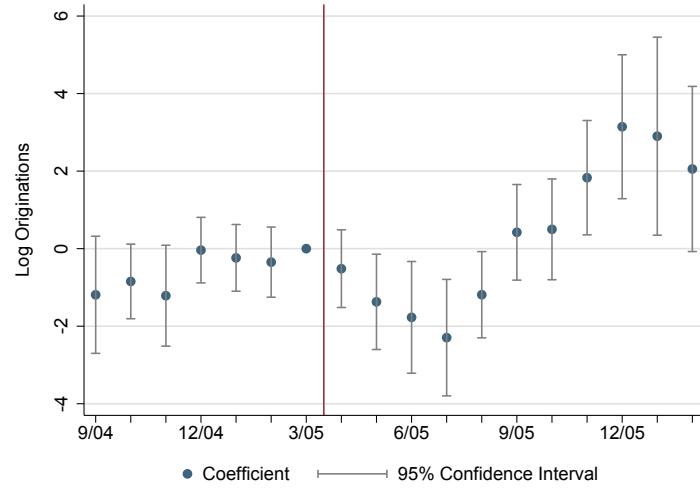
(a) Six Treated IMCs



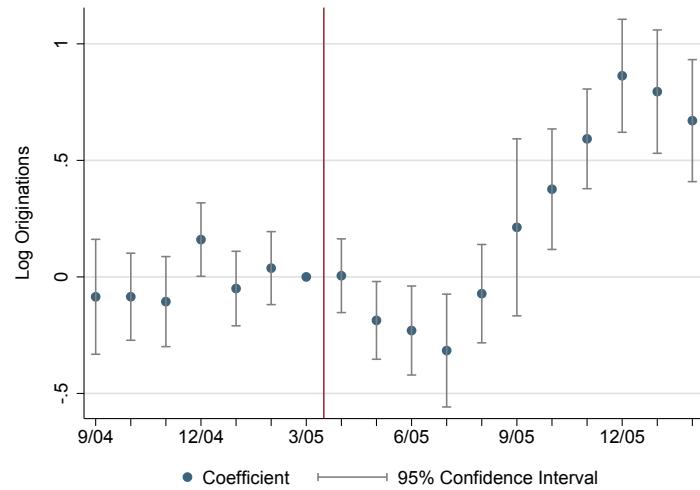
(b) All IMCs

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

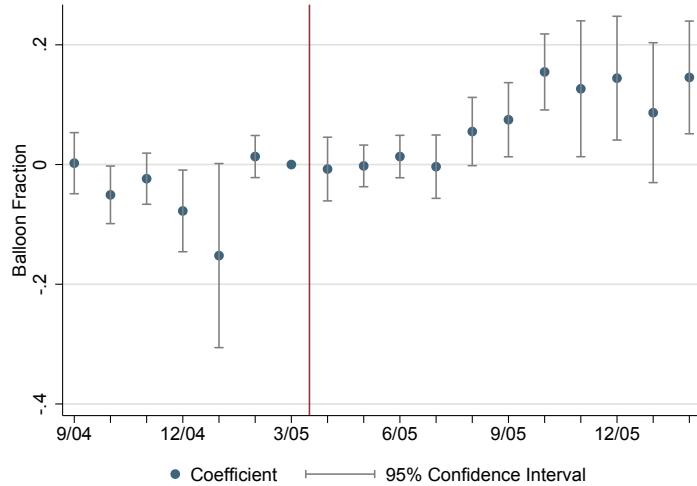


(b) All IMCs

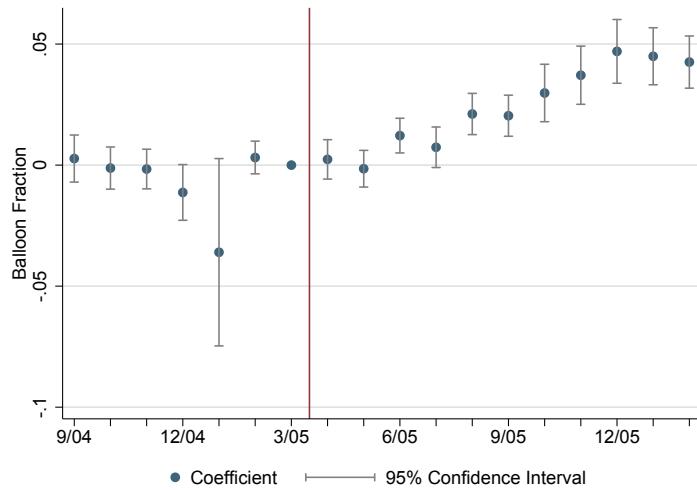
Notes: Figure plots the dynamic response of total mortgage originations in a given county to the 2004 market share of independent mortgage companies (IMCs) in that county. I estimate Equation 13. β_T is the coefficient of interest. It is the coefficient on the indicator variable that interacts $(Treated)IMCMarketShare_{c,2004}$ 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.

^aNeil 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



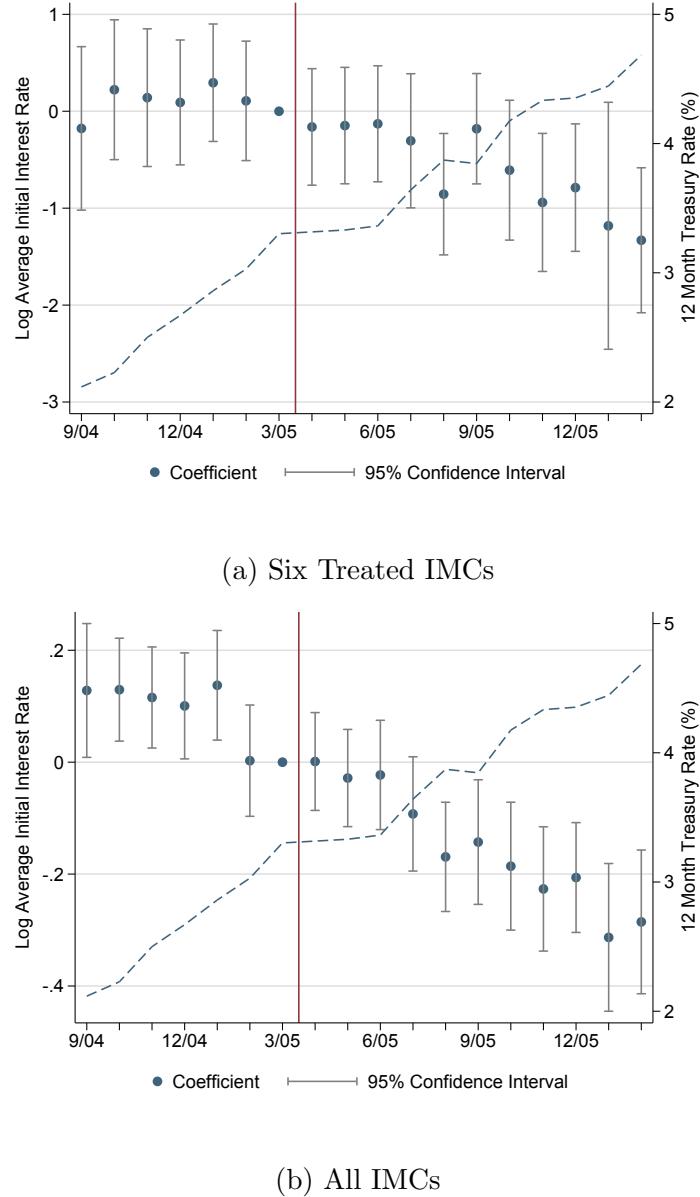
(a) Six Treated IMCs



(b) All IMCs

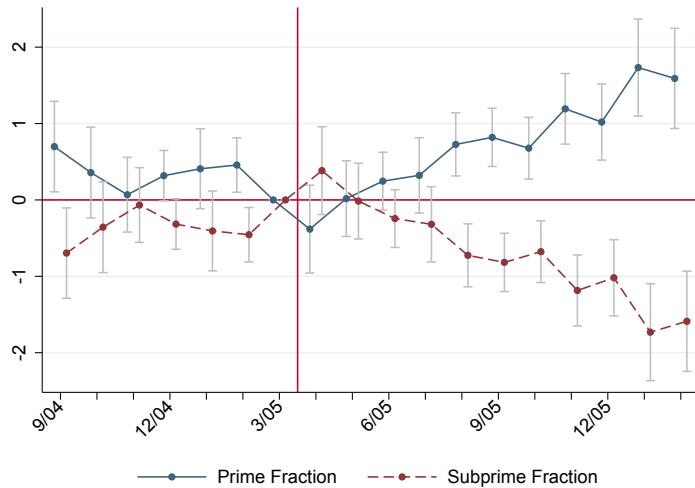
Notes: Figure plots the dynamic response of the fraction of balloon mortgage originations in a given county to the 2004 market share of independent mortgage companies (IMCs) in that county. I estimate Equation 13. β_T is the coefficient of interest. It is the coefficient on the indicator variable that 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

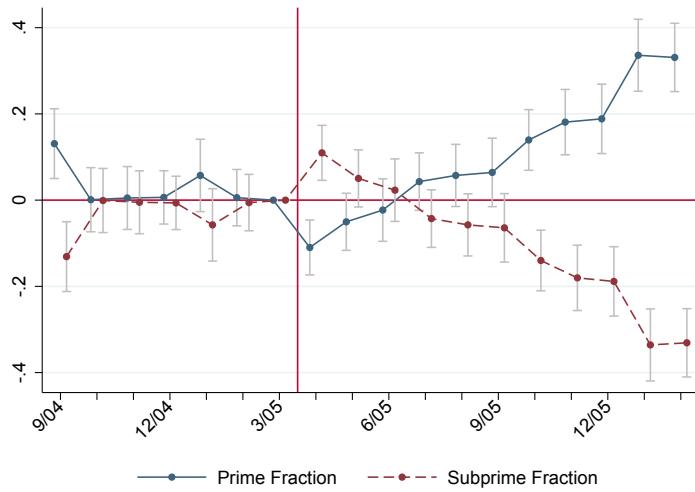


Notes: Figures plot the dynamic response of county level average initial interest rates on adjustable rate mortgages (ARM) as a function of county level market share of independent mortgage companies (IMCs) in 2004. I estimate Equation 13. β_T is the coefficient of interest. It is the coefficient on 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



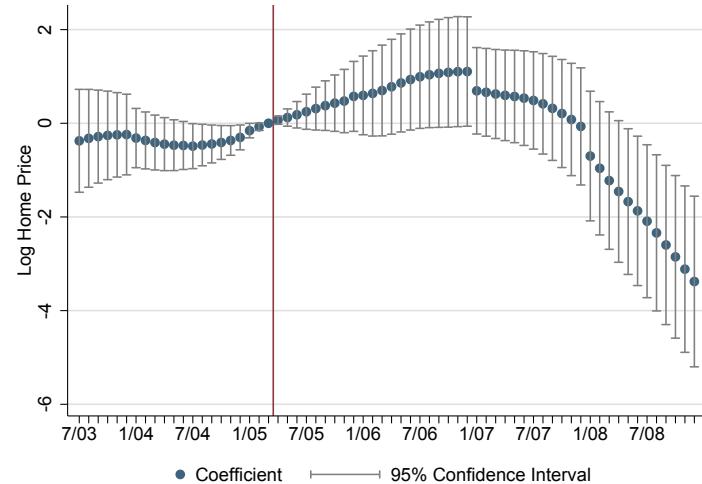
(a) All IMCs



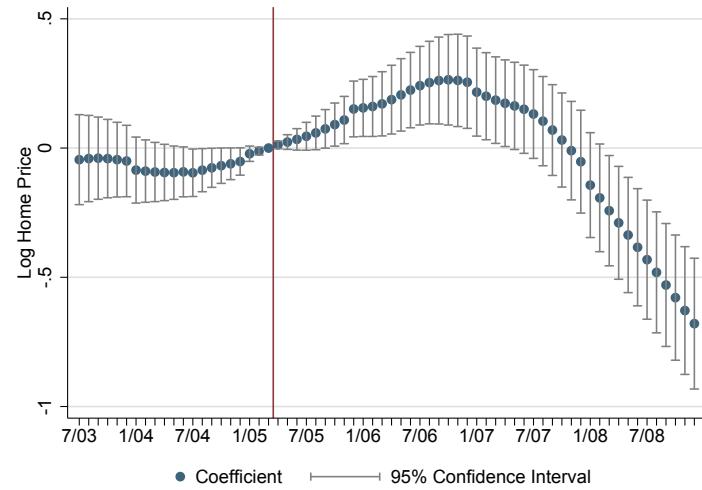
(b) All IMCs

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 13. 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 13. 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) $\log(\text{Securities Out})$
Post	0.018*** (0.001)	0.423*** (0.014)
PLS	-0.126*** (0.001)	-1.063*** (0.020)
Post \times PLS	0.004** (0.002)	0.186*** (0.027)
r2	0.9788	0.9172
N	582	582

Notes: Table reports the results from [Equation 7](#). 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 FR 2004 data.

TABLE 2: DEALER DESCRIPTIVE STATISTICS (2004)

	Mean (Control)	Mean (Treated)	Difference	T-stat	P-value
Number of Counties	1795	1705	90	.14	.890
$\log(\text{Originations})$	6.24	6.17	.07	.06	.955
N	14	7			
$\log(\text{Total Assets})$	20.00	20.00	.01	.01	.989
$\log(\text{Total Liabilities})$	19.94	19.95	-.003	-.005	.996
$\log(\text{Total Equity})$	17.04	16.92	.12	.23	.817
N	16	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 repurchaseable 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.

^aThis 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(RepledgeableCol)
Post	0.080 (0.235)
Post \times PLSUnderwriting _{j,2004}	0.017* (0.008)
DealerFE	Yes
r2	0.9440
N	90

Notes: Table reports the response of dealers' reported repledgeable collateral following BAPCPA as a function of their value of PLS deals underwritten in 2004. The independent variable, PLS deals underwritten in 2004, is scaled by dealers' total assets. I estimate the regression in [Equation 8](#). 19 dealers report repledgeable collateral in their financial reports. The 19 dealers are comprised of the 16 primary dealers in 2004/2005 and 3 additional dealers. The results indicate that dealers who underwrote more PLS deals in 2004 significantly increased their reported holding of repledgeable collateral following BAPCPA, consistent with a money multiplier effect.

TABLE 4: WITHIN MORTGAGE COMPANY ACROSS DEALER ANALYSIS

	log(Credit Line)
Post \times 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 10](#). 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 10](#). 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 12](#). Treated dealers are those who receive an above median fraction of their credit lines from treated dealers (≥ 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												
<i>Post</i> × <i>TrtIMCMktShr_{c,04}</i>	5.533*** (0.291)	0.870 (0.694)	0.095*** (0.009)	0.113*** (0.027)	2.497*** (0.154)	-0.698*** (0.268)	1.887*** (0.383)	1.117*** (0.275)	3.591*** (0.527)	0.953** (0.478)	0.689 (0.799)	-1.589** (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												
<i>Post</i> × <i>IMCMktShr_{c,04}</i>	0.375*** (0.013)	0.268*** (0.080)	0.005*** (0.001)	0.030*** (0.004)	0.175*** (0.006)	-0.239*** (0.033)	0.331*** (0.058)	0.141*** (0.044)	0.443*** (0.094)	0.209** (0.082)	-0.333*** (0.106)	-0.329*** (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

$$Y_{c,t\{l\}} = \gamma_c + \eta_{s,t} + \beta \text{Post}_t \times (\text{Trt})\text{IMCMktShr}_{c,04} + \epsilon_{c,t\{l\}}$$

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 × month fixed effects, $(\text{Treated})\text{IMCMktShr}_{c,04}$ 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 $(\text{Treated})\text{IMCMktShr}_{c,04}$ and the post period. This coefficient measures the change in the dependent variable if $(\text{Treated})\text{IMCMktShr}_{c,04}$ 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.

^aNeil 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:

$$K_t^b + K_t^h = 1 \quad (16)$$

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

$$f^B(K_t^b) = ZK_t^b \quad (17)$$

Households produce the consumption good according to the production function

$$f^H(K_t^h) = ZK_t^h - \frac{\alpha}{2}(K_t^h)^2 \quad (18)$$

they incur a cost, $\frac{\alpha}{2}(K_t^h)^2$, 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:

$$R_t = \begin{cases} \bar{R}_t & \text{if no bank run,} \\ x_{t+1}\bar{R}_t & \text{if bank run occurs} \end{cases} \quad (19)$$

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:

$$U_t = E_t \left(\sum_{i=0}^{\infty} \beta^i \ln C_{t+i}^h \right) \quad (20)$$

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:

$$1 = \bar{R}_{t+1} E_t [(1 - p_t) \Lambda_{t,t+1} + p_t \Lambda_{t,t+1}^* x_{t+1}] \quad (21)$$

where

$$\Lambda_{t,t+1} = \beta \frac{C_t^h}{C_{t+1}^h} \quad (22)$$

$$\Lambda_{t,t+1}^* = \beta \frac{C_t^h}{C_{t+1}^{h*}} \quad (23)$$

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.

$$x_{t+1} = \min \left[1, \frac{(Q_{t+1}^* + Z_{t+1}) k_t^b}{R_{t+1} d_t} \right] \quad (24)$$

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:

$$p_t = 1 - E_t(x_{t+1}) \quad (25)$$

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 effect 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:

$$V_t = E_t \left[\sum_{i=1}^{\infty} \beta^i (1 - \sigma) \sigma^{i-1} \Pi_{t+i} n_{t+i} \right] \quad (26)$$

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

$$n_{t+1} = (Z + Q_{t+1}) k_t^b - R_{t+1} d_t \quad (27)$$

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:

$$Q_t k_t^b = n_t + d_t \quad (28)$$

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.

$$V_t = E_t [\beta(1 - \sigma)\Pi_{t+1}n_{t+1} + \beta\sigma V_{t+1}] \quad (29)$$

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.

$$\theta_t \Pi_t Q_t k_t^b \leq V_t \quad (30)$$

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

$$\psi_t = \frac{V_t}{n_t} \quad (31)$$

$$\phi_t = \frac{\psi_t}{\Pi_t \theta} \quad (32)$$

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:

$$\theta_t \Pi_t Q_t K_t^b = V_t. \quad (33)$$

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

$$W^b \equiv (1 - \sigma)w^b \quad (34)$$

$$N_{t+1} = \sigma [(Z + Q_{t+1})K_t^b - R_{t+1}D_t] + W^b \quad (35)$$

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:

$$C_t^h + D_t + Q_t K_t^h + \frac{\alpha}{2}(K_t^h)^2 = Z_t W^h + R_t D_{t-1} + (Z_t + Q_t)K_{t-1}^h + (1 - \sigma)N_t \quad (36)$$

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

$$Y_t = Z + ZW^h + W^b \quad (37)$$

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

$$Y_t = \frac{\alpha}{2}(K_t^h)^2 + C_t^h. \quad (38)$$

The household marginal utility of consumption can be defined

$$\Pi_t = \frac{1}{C_t^h} \quad (39)$$

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, private-label mortgage collateral, 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 private-label mortgage collateral fell

under.⁶⁶

B Mortgage Collateral in the Repo Markets

B.1 Bilateral Repo Market

In Figure 18, I provide an example documenting that the warehouse credit lines to mortgage companies were structured as Master Repurchase Agreements. For the IMC in this figure, I collect the value of the credit lines from the section of its financial report called “Revolving Warehouse and Repurchase Facilities.” I utilize the expiration date of the Master Repurchase Agreements to match each credit line to the dealer funding it. From speaking with traders on the repo desk during the Financial Crisis, these Master Repurchase Agreements were conducted in the bilateral repo market.

[FIGURE 18 about here.]

In 2007, American Home Mortgage (AHM), one of the IMCs in my sample, filed a lawsuit against Credit Suisse, one of the dealers in my sample. The amicus curiae brief states that the central issue before the court is whether the mortgage loan Master Repurchase Agreement among CSFB and American Home Mortgage Corp., et al., dated September 13, 2006 (the “American Home Repo”), inclusive of the service provisions, is a “repurchase agreement” as defined in §101(47) of the Bankruptcy Code **and therefore, covered by the safe harbor provisions** of Bankruptcy Code §559.⁶⁷ AHM requested that the court uphold the automatic stay and return the warehoused mortgage loans to AHM. The brief states that a mortgage loan repo qualifies as a “repurchase agreement” regardless of the entity servicing the loans and regardless of whether the transaction was an outright sale and repurchase or a transfer. I include relevant excerpts from the amicus curiae brief below.

The brief implored the court to characterize the agreement as a repurchase agreement, stating that “any decision that characterizes and enforces the American Home Repo as anything other than a Repo Agreement governed by §559 of the Bankruptcy Code may well have far reaching negative implications for the U.S. capital markets and the increasingly fragile U.S. economy.” (American Home Mortgage Holdings, Inc. v. Credit Suisse First Boston Mortgage Capital, LLC. Case No. 07-11047 (CSS) p. 2.)

Prior to BAPCPA, “repurchase agreement” was defined as:

⁶⁶American Home Mortgage Holdings, Inc. v. Credit Suisse First Boston Mortgage Capital, LLC. Case No. 07-11047 (CSS) p. 3.

⁶⁷American Home Mortgage Holdings, Inc. v. Credit Suisse First Boston Mortgage Capital, LLC. Case No. 07-11047 (CSS) p. 1.

[A]n agreement ... which provides for the transfer of certificates of deposit, eligible bankers' acceptances, or securities that are direct obligations of, or that are fully guaranteed as to the principal and interest by the United States or any agency of the United States as defined in §101(47) of the Bankruptcy Code and therefore, covered by the safe harbor provisions of Bankruptcy Code §559.

Following the implementation of BAPCPA, the definition of “repurchase agreement” encompassed a more detailed list of products, including:

(i) an agreement, including related terms, which provides for the transfer of one or more certificates of deposit, mortgage related securities (as defined in section 3 of the Securities Exchange Act of 1934), mortgage loans, interests in mortgage related securities or mortgage loans ... against the transfer of funds by the transferee of such certificates of deposit, eligible bankers' acceptances, securities, mortgage loans, or interests, with a simultaneous agreement by such transferee to transfer to the transferor thereof certificates of deposit, eligible bankers' acceptance, securities, mortgage loans, or interests of the kind described in this clause, at a date certain not later than 1 year after such transfer or on demand, against the transfer of funds; (American Home Mortgage Holdings, Inc. v. Credit Suisse First Boston Mortgage Capital, LLC. Case No. 07-11047 (CSS) pp. 12-13)

As set forth above, a “repurchase agreement” means “an agreement, including related terms, which provides for the transfer of one or more certificates of deposit, mortgage related securities (as defined in section 3 of the Securities Exchange Act of 1934), mortgage loans, interests in mortgage related securities or mortgage loans...” (emphasis added). Thus, all that is required is a transfer and retransfer of identified property within a specified time. To that end, Congress has defined “transfer” in Bankruptcy Code §101(54) to include:

- (A) the creation of a lien;
- (B) the retention of title as a security interest;
- (C) the foreclosure of a debtor's equity of redemption; or
- (D) each mode, direct or indirect, absolute or conditional, voluntary or involuntary, of disposing of or parting with –
 - i. property; or
 - ii. an interest in property (emphasis added)

Congress could have, but did not limit itself to the words purchase or sale. Accordingly, whether the Debtors (i) created a lien for the benefit of CSFB; (ii) disposed of merely an interest in property for the benefit of CSFB; or (iii) disposed of property for the benefit of CSFB, there was an agreement to transfer and retransfer mortgage loans, which must be treated as a Repo Agreement. (American Home Mortgage Holdings, Inc. v. Credit Suisse First Boston Mortgage Capital, LLC. Case No. 07-11047 (CSS) pp. 16)

... It is significant that under BAPCPA, Congress expressly included “mortgage loans”, “mortgage related securities”, and “interests in mortgage loans and mortgage related securities” in the new definition of “repurchase agreement”, representing Congressional intent to protect this multi-billion dollar market. Congress recognized that mortgage loan Repo Agreements are distinct from the more traditional government backed obligations underlying certain Repo Agreements. (American Home Mortgage Holdings, Inc. v. Credit Suisse First Boston Mortgage Capital, LLC. Case No. 07-11047 (CSS) p. 13)

The brief states that in order to avoid disrupting the cash flows of the the mortgage loans collateralizing a warehouse repurchase facility, the repurchase agreement was required to be less than one year and the mortgage loans typically resided with the existing servicer to continue servicing the mortgages.

... Equally unique to a mortgage loan Repo Agreement is the servicing component. Again, unlike traditional government backed security Repo Agreements, mortgage loan Repo Agreements are dependent upon the continued performance of the mortgage loans and the mandatory servicing thereof. Such performance includes the timely collection of mortgage payments from obligors and the payment of tax and insurance obligations from escrowed funds held by the servicer on behalf of the obligors. The task of servicing the hundreds of underlying mortgages may be ministerial, but it is integral to the value of the mortgage loans’ underlying Repo Agreements. Any interruption in such servicing could result in tax delinquencies, foreclosures, etc., and will directly affect the value of the mortgage loans and consequently, the value of the Repo Agreements. To minimize the risk of disrupting the cash flow from the mortgage loans, Repo Agreements, which are required to be less than one year in duration and are usually measured in a few months or less, generally provide that the servicing of the mortgages will remain with the existing servicing agent for the benefit of the transferee. (American

Home Mortgage Holdings, Inc. v. Credit Suisse First Boston Mortgage Capital, LLC. Case No. 07-11047 (CSS) p. 19.)

For a subset of IMCs, I see a discussion in the IMCs' filings noting that warehousers also underwrote the securities. Since these were private-label MBS, the IMCs could not sell the MBS directly to the ultimate purchaser, they relied on the dealer to find the buyer. This is no longer the case in the current mortgage environment with the GSEs. GSEs currently will buy directly from the IMCs. The current structure of IMC lines of credit seems to follow the same repo structure. The IMC "call reports," which IMCs were required to file post crisis, report credit lines as "BofA Repo" for example.

B.2 Tri-party Repo Market

Money Market Mutual Funds (MMF) file a portfolio holdings report every quarter on forms N-Q with the Securities Exchange Commission (SEC). The typical report of an MMF lists their holdings of certificates of deposits, commercial paper, and repurchase agreements. In the below figure (a), I present an excerpt from Fidelity Phillips Street Trust's N-Q. Fidelity Phillips Street Trust was lending to Countrywide, Credit Suisse, and Goldman Sachs via reverse repurchase agreements secured by mortgage collateral. The report denotes that the collateral backing the repo was MBS. In (b) I present an example excerpt from JPMorgan Trust II who was lending to Bear Stearns and Goldman Sachs via a reverse repurchase agreement secured by mortgage collateral. The N-Q denotes the collateral as "Mortgage Loan Obligations." The differing names suggest that "Mortgage Loan Obligations" may be warehoused mortgage loans, not yet packaged into a security, that is accepted in the tri-party repo market by an MMF.

[FIGURE 19 about here.]

C 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.”⁶⁸ 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.

D 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.⁶⁹ This line item is likely to underestimate the value of private-label MBS instruments used if it does not include whole loans since BAPCPA exempted whole loans from automatic 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

⁶⁸See 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>.

⁶⁹Matching 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.

and bankers' acceptances.⁷⁰

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 2005.⁷¹ 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 private-label mortgages almost completely stopped.

E 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;
3. The transferor does not maintain effective control over the transferred assets.⁷²

By granting repos backed by private-label mortgage collateral preferred bankruptcy treatment, BAPCPA enabled private-label mortgage collateral to fulfill (1) above.⁷³ When the

⁷⁰See 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==>

⁷¹See June 21, 2018 FR 2004 Form C "Financing by Primary U.S. Government Securities Dealers."

⁷²Lloyd, 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

⁷³In 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.)

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 20](#) 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."⁷⁴ 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 20 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 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.⁷⁵ 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 21](#) through [Figure 24](#), 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

⁷⁴[Morrison, Roe and Sontchi \(2013\)](#) pp. 10, 22 note 68., [Skeel and Jackson \(2012\)](#) pp. 173-80.

⁷⁵Nomura Form 20-F Fiscal Year End March 31, 2005, p. F-18.

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 21](#), 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 24](#), 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 21 about here.]

[FIGURE 22 about here.]

[FIGURE 23 about here.]

[FIGURE 24 about here.]

[FIGURE 25 about here.]

F Additional Mortgage Market Characteristics

In [Figure 26](#) I plot monthly mortgage originations by the dealers in my paper, IMCs, and other originators. Other originators include commercial banks and are primarily made up of agency mortgage originations. IMC originations mainly make up private-label mortgage originations. Although IMC's mortgage originations were growing in 2003, they had begun to plateau by 2004. The large drop in agency originations coincides with the regulations placed debt limits for Fannie Mae and Freddie Mac in response to their accounting fraud cases.

[FIGURE 26 about here.]

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 27](#) 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.^{[76](#)}

[FIGURE 27 about here.]

⁷⁶[Table 9](#), presents the results from Equation 8, the regression with a single pre and post period.

[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 28 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.⁷⁷

[FIGURE 28 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.

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 $state \times month$ 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 2004.⁷⁸ In Table 9, I report the regression results. In the regression with $county$ FE only, there is a statistically significant decrease post BAPCPA

⁷⁷Table 9, presents the results from Equation 8, the regression with a single pre and post period.

⁷⁸The results for pre-treatment trends of negative amortizing and owner-occupied products are not included for brevity, however they are available upon request.

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 $state \times month$ 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 $state \times month$ 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 29](#) 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 29 about here.]

G 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

$$\text{Market share} \times \beta^{orig} = \quad \text{Increase in Originations (\%)} \quad (40)$$

$$0.027 \times 0.87 = \quad 0.024 \quad (41)$$

$$= \quad 2.4\% \quad (42)$$

$$\beta^{HzdRt} = 1.1$$

Increase in average hazard rate in response to BAPCPA

$$\text{Market share} \times \beta^{HzdRt} = \text{Increase in Avg. Hazard Rate} \quad (43)$$

$$0.027 \times 1.1 = 0.0297 \quad (44)$$

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:

$$\frac{100}{102.4} \times 0.13 + \frac{2.4}{102.4} \times X = .1597 \quad (45)$$

$$X = 1.4 \quad (46)$$

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

$$\text{Market share} \times \beta^{orig} = \text{Increase in Originations (\%)} \quad (47)$$

$$0.034 \times 0.268 = 0.091 \quad (48)$$

$$= 9.1\% \quad (49)$$

$$\beta^{HzdRt} = 0.141$$

Increase in average hazard rate in response to BAPCPA

$$\text{Market share} \times \beta^{HzdRt} = \text{Increase in Avg. Hazard Rate} \quad (50)$$

$$0.34 \times 0.141 = 0.0479 \quad (51)$$

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.

H Dealer Reported Repledgeable Collateral

This paper studies the 29 lenders identified as warehouse lenders to 12 Independent Mortgage Companies (IMCs) in the IMCs' quarterly reports between 2004Q3 and 2007Q3. 16 of these dealers were registered as primary dealers in both 2004 and 2005. Countrywide became a primary dealer on January 4, 2004. The list of primary dealers in 2004 and 2005 are largely identical.⁷⁹ ⁸⁰ Nomura and SocGen are included in my analysis of dealer reported repledgeable collateral. However, they are not included in my within IMC across dealer analysis as they are only lending to New York Mortgage Trust between 2006Q3-2007Q3 and 2006Q4-2007Q3 respectively and my analysis utilizes data from 2004Q3 to 2006Q3.

The paper leverages data on reported repledgeable collateral as well as book values of dealer assets, liabilities, and equity. These data are collected from the dealers' financial statements as early as it is reported through 2008 for the following dealers. Discussion of the data collected follows.

⁷⁹Banc One Capital Markets, Inc ceased being a primary dealer on August 1, 2004. Aside from its exit there were 22 primary dealers in both 2004 and 2005, and the list of primary dealers was the same in both years.

⁸⁰Data reported in the Historical Primary Dealer Lists published by the Federal Reserve Bank of New York: <https://www.newyorkfed.org/markets/primarydealers>.

	Dealer	PD (04/05)	Treated Dealer	Repledgeable Col.
1	Bear Stearns	Yes	Treated	Yes
2	Countrywide	Yes	Treated	Yes
3	Credit Suisse	Yes	Treated	Yes
4	Lehman Brothers	Yes	Treated	Yes
5	Greenwich Capital (RBS)	Yes	Treated	Yes
6	Merrill Lynch	Yes	Treated	Yes
7	Morgan Stanley	Yes	Treated	Yes
8	Barclays	Yes	Control	Yes
9	Bank of America	Yes	Control	Yes
10	Citi	Yes	Control	Yes
11	Deutsche Bank	Yes	Control	Yes
12	Goldman Sachs	Yes	Control	Yes
13	HSBC	Yes	Control	Yes
14	JP Morgan	Yes	Control	Yes
15	Nomura	Yes	Control	Yes
16	UBS	Yes	Control	Yes
17	Calyon Financial (Credit Agricole)	No	Control	No
18	Citizens	No	Control	No
19	Colonial Bancgroup, Inc.	No	Control	No
20	Guaranty Bank	No	Control	No
21	IXIS (Natixis)	No	Control	No
22	Bank of Montreal	No	Control	Yes
23	GMAC-RFC	No	Control	No
24	Residential Mortgage Solutions (RMS)	No	Control	No
25	SocGen/SG Americas Securities	No	Control	No
26	State Street	No	Control	Yes
27	Wachovia	No	Control	No
28	Washington Mutual	No	Control	Yes
29	WestLB	No	Control	No

Notes: PD (04/05) indicates whether a dealer was a primary dealer in 2004 and 2005. Repledgeable Col. indicates whether the dealer reported repledgeable collateral in its financial reports. In 2005 GMAC transferred ownership of GMAC Mortgage Corporation and Residential Funding Corporation (GMAC-RFC) to Residential Capital Corporation (ResCap) and transferred \$2 billion in equity.

1. Bank of America - The data collected consist of annual data on Bank of America's

securities received that it was permitted to repledge as well as the fair value of securities sold or repledged. The data are reported annually in the 10-K filings beginning in the fiscal year end of 2000. The data were pulled through fiscal year end 2008. Years 2004 and 2005 alone report increases in securities sold under agreements to repurchase at the quarterly level.

Values for book assets and book net worth were collected from the Factset Database. No minority interest is included in book net worth, so that minority interest is treated as a liability. All data are reported in USD. The data are available via Bank of America's investor relations page at: <http://investor.bankofamerica.com/financial-information/sec-filings>

2. Bank of Montreal - The data collected consist of annual data on Bank of Montreal's non-cash collateral received in security lending transactions that they are permitted by contract to sell or re- pledge. Under United States GAAP this line item is recorded as an asset in the Consolidated Balance Sheet and a corresponding liability is recorded for the obligation to return the collateral. Under Canadian GAAP, such collateral and the related obligation are not recorded in the Consolidated Balance Sheet. As a result, this paper records the difference as Bank of Montreal's securities received that it was permitted to repledge. The data are reported annually in the 40-F filing. The data were pulled from fiscal year ends 2001 through 2008. All data are reported in USD. Filings were retrieved from the SP Global database.

Values for book assets and book net worth were collected from the Factset Database. No minority interest is included in book net worth, so that minority interest is treated as a liability. All data are reported in USD.

3. Barclays - The data collected consist of annual data on Barclay's securities received that it was permitted to repledge as well as the fair value of securities sold or repledged. The data are reported annually in the 20-F filings beginning in the fiscal year end of 2000. The data were pulled through fiscal year end 2008.

Values for book assets and book net worth were also collected from the company's filings. No minority interest is included in book net worth, so that minority interest is treated as a liability. All data were reported in Pounds, then converted into USD using historical exchange rates compiled from the Factset Database. The data are available via Barclay's investor relations page at: <https://home.barclays/investor-relations/reports-and-events/annual-reports/#archive>

4. Bear Stearns - The data collected consist of annual and quarterly data on Bear Stearns's

securities received that it was permitted to repledge as well as the fair value of securities sold or repledged. The data are reported annually in the 10-K filings and quarterly in the 10-Q filings beginning in the fiscal year end of 2002. The data were pulled through fiscal year end 2008.

Values for book assets and book net worth were also collected from the company's filings. No minority interest is included in book net worth, so that minority interest is treated as a liability. All data are reported in USD. Filings were retrieved from the S&P Global database.

5. Calyon Financial (Credit Agricole) - Calyon was created in May 2004 by the transfer of assets from Crédit Lyonnais' Corporate and Investment Banking division to Crédit Agricole Indosuez (CAI). Credit Agricole is a French bank that is not registered with the SEC and does not publish reports 10-K, 10-Q, 6-K or 20-F. The French equivalent of the 10-K and 10-Q does not report data on repo collateral repurchased or repledged.
6. Citizens - Repledgeable collateral data for Citizens Bank of Woodville Texas was not collected.
7. Colonial BancGroup, Inc. - Repledgeable collateral data was not reported in Colonial BancGroup, Inc.'s financial statements.
8. Countrywide - The data collected consist of annual and quarterly data on Countrywide's securities received that it was permitted to repledge, the fair value of securities sold or repledged, assets pledged as collateral, assets pledged as collateral where the counterparty has the right to repledge, securities purchased under agreement to resell, as well as securities sold under agreement to repurchase. The data are reported annually in the 10-K filings and quarterly in the 10-Q filings beginning in September of 2002. The data were pulled through June of 2008.

Values for book assets and book net worth were also collected from the company's filings. No minority interest is included in book net worth, so that minority interest is treated as a liability. All data are reported in USD. Filings were retrieved from the S&P Global database.

9. Credit Suisse - The data collected consist of annual data on Credit Suisse's assets pledged as collateral, assets pledged as collateral where the coutnerparty has the right to repledge, securities received that it was permitted to repledge as well as the fair value of securities sold or repledged. The data are reported annually in the 20-F filings

beginning in the fiscal year end of 2000. The data were pulled through fiscal year end 2008.

Values for book assets and book net worth were also collected from the Factset Database. No minority interest is included in book net worth, so that minority interest is treated as a liability. All data are reported in CHF, then converted into USD using historical exchange rates compiled from the Factset Database. Filings were retrieved from the S&P Global database.

10. Citi - The data collected consist of annual data on Citi's securities received that it was permitted to repledge as well as assets pledged as collateral where counterparty cannot repledge. The data are reported annually in the 10-K filings beginning in the fiscal year end of 2001. The data were pulled through fiscal year end 2008.

Values for book assets and book net worth were collected from the Factset Database. No minority interest is included in book net worth, so that minority interest is treated as a liability. All data are reported in USD. Filings were retrieved from the S&P Global database.

11. Deutsche Bank - The data collected consist of annual data on Deutsche Bank's securities received that it was permitted to repledge as well as the fair value of securities sold or repledged. The data are reported annually in the 20-F filings beginning in the fiscal year end of 2000. The data were pulled through fiscal year end 2008.

Values for book assets and book net worth were also collected from the Factset Database. No minority interest is included in book net worth, so that minority interest is treated as a liability. All data are reported in EUR, then converted into USD using historical exchange rates compiled from the Factset Database. Filings were retrieved from the S&P Global database.

12. GMAC-RFC - The data collected consist of annual and quarterly data on Residential Capital's mortgage loans held for sale, mortgage loans held for investment, available for sale securities, trading securities, investments in real estate and other, FHLB collateral, as well as FHLB repledgeable collateral. The data are reported annually in the 10-K filings and quarterly in the 10-Q filings beginning in the fiscal year end of 2005. The data were pulled through fiscal year end 2008.

Values for book assets and book net worth were also collected from the company's filings. No minority interest is included in book net worth, so that minority interest is treated as a liability. All data are reported in USD. Filings were retrieved from the S&P Global database.

13. Goldman Sachs - The data collected consist of annual and quarterly data on Goldman Sachs's securities received that it was permitted to repledge, the fair value of portion sold or repledged, as well assets pledged as collateral where counterparty cannot repledge. The data are reported annually in the 10-K filings and quarterly on 10-Q filings beginning in the fiscal year end of 2001. The data were pulled through fiscal year end 2008.

Values for book assets and book net worth were collected from the Factset Database. No minority interest is included in book net worth, so that minority interest is treated as a liability. All data are reported in USD.

14. Greenwich Capital (Royal Bank of Scotland) - The data collected consist of annual data on Greenwich Capital's securities received that it was permitted to repledge as well as the fair value of securities sold or repledged. The data are reported annually in the 20-F filings beginning in the fiscal year end of 2001. The data were pulled through fiscal year end 2008.

Values for book assets and book net worth were also collected from the company's filings. No minority interest is included in book net worth, so that minority interest is treated as a liability. All data were reported in Pounds, then converted into USD using historical exchange rates compiled from the Factset Database. Filings were retrieved from the S&P Global database.

15. Guaranty Bank - Repledgeable data for Guaranty Bank (a Temple Inland Company) was not collected.

16. HSBC - The data collected consist of annual data on HSBC's securities received that it was permitted to repledge as well as the fair value of securities sold or repledged. The data are reported annually in the 10-K filings beginning in the fiscal year end of 2002. The data were pulled through fiscal year end 2008.

Values for book assets and book net worth were also collected from the company's filings. No minority interest is included in book net worth, so that minority interest is treated as a liability. All data were reported in USD. Filings were retrieved from the S&P Global database.

17. IXIS (Natixis) - Repledgeable collateral data was not reported in Natixis' financial statements.

18. JP Morgan - The data collected consist of annual data and quarterly on JP Morgan's securities received that it was permitted to repledge, the fair value of securities sold or

repledged, securities purchased under resale agreements, securities borrowed, securities sold under repurchase agreements, and securities received and not repledged. The data are reported annually in the 10-K filings and quarterly in the 10-Q filings beginning in the fiscal year end of 2002. The data were pulled through fiscal year end 2008.

Values for book assets and book net worth were also collected from the Factset Database. No minority interest is included in book net worth, so that minority interest is treated as a liability. All data are reported in USD. The data are available via JP Morgan's investor relations page at: <https://jpmorganchaseco.gcs-web.com/ir/sec-other-filings/overview>

19. Lehman Brothers - The data collected consist of annual data and quarterly on Lehman's securities received and not repledged, securities permitted to be repledged, fair value of portion sold or repledged, assets pledged as collateral where counterparty has the right to repledge as well as assets pledged as collateral where the counterparty cannot repledge. The data are reported annually in the 10-K filings and quarterly in the 10-Q filings beginning in the fiscal year end of 2003. The data were pulled through May 2008.

Values for book assets and book net worth were also collected from the company's filings. No minority interest is included in book net worth, so that minority interest is treated as a liability. All data are reported in USD. Filings were retrieved from the S&P Global database.

20. Merrill Lynch - The data collected consist of quarterly data on Merrill Lynch's securities received that it was permitted to repledge as well as the fair value of securities sold or repledged. The data are reported quarterly in the 10-Q/10-K filings beginning in the fiscal year end of 2004. Prior to the fourth quarter of 2004, Merrill did not report the value of repledgeable collateral received and repledged. The data were pulled through fiscal year end 2008. Merrill Lynch & Co. agreed to be acquired by Bank of America on September 14, 2008, at the height of the financial crisis of 2007–2008, the same weekend that Lehman Brothers was allowed to fail. The acquisition was completed in January 2009.

Values for book assets and book net worth were also collected from the company's filings. No minority interest is included in book net worth, so that minority interest is treated as a liability. All data are reported in USD. The quarterly reports are available via SEC Edgar: <https://www.sec.gov/cgi-bin/browse-edgar?action=getcompany&CIK=0000065100&type=&dateb=&owner=include&start=1120&count=40>

21. Morgan Stanley - The data collected consist of annual and quarterly data on Morgan Stanley's securities received that it was permitted to repledge as well as the fair value of securities sold or repledged. The data are reported annually in the 10-K filings and quarterly in the 10-Q filings beginning in May 2001. The data were pulled through fiscal year end 2008.

Values for book assets and book net worth were also collected from the Factset Database. No minority interest is included in book net worth, so that minority interest is treated as a liability. All data are reported in USD. The quarterly reports are available via Morgan Stanley's investor relations page at: <https://www.morganstanley.com/about-us-ir/sec-filings>

22. Nomura - Nomura annual 20-F filings report securities received as collateral that are permitted to be repledged and the fair value that has been sold or repledged but not yet repurchased. The data are collected annually from March 2001 through March 2010. March 2003 data is utilized for year end 2002 and so on. The data was reported in USD.

Values for book assets and book net worth were also collected from the Factset Database. No minority interest is included in book net worth, so that minority interest is treated as a liability. Balance sheet data was reported in Yen, but converted by the Factset Database into USD. March 2002 balance sheet data was pulled from Nomura 20-F 2002. The annual reports are available via Nomura's investor relations page at: <https://www.nomuraholdings.com/investor/library/sec/>.

23. Residential Mortgage Solutions (RMS) - Quarterly or annual filings for Residential Mortgage Solutions (RMS) were not able to be obtained. Thus repledgeable collateral data was not collected.

24. SocGen/SG Americas Securities - Repledgeable data for SocGen was not collected.

25. State Street - The data collected consist of annual data and quarterly on State Streets' securities lending positions. State Street reports that it requires borrowers to provide collateral in an amount equal to or in excess of 100% of the fair market value of the value borrowed. Collateral funds received are held by State Street as agent and are not recorded in the consolidated statement of condition. The securities and collateral held are revalued daily and reported by State Street. The data are reported annually in the 10-K filings and quarterly in the 10-Q filings. The data were pulled from fiscal year ends 2000 through 2008. Filings were retrieved from the SP Global Database.

Values for book assets and book net worth were also collected from the Factset Database. No minority interest is included in book net worth, so that minority interest is treated as a liability. All data were reported in USD.

26. UBS - The data collected consist of annual data on UBS's securities received that it was permitted to repledge as well as the fair value of securities sold or repledged. The data are reported annually in the 10-K filings beginning in the fiscal year end of 2002. The data were pulled through fiscal year end 2008.

Values for book assets and book net worth were also collected from the Factset Database. No minority interest is included in book net worth, so that minority interest is treated as a liability. All data are reported in CHF, then converted into USD using historical exchange rates compiled from the Factset Database. Filings were retrieved from the S&P Global database.

27. Wachovia - The data collected consist of annual data on Wachovia's securities received that it was permitted to repledge as well as the fair value of securities sold or repledged. The data are reported annually in the 10-K filings beginning in the fiscal year end of 2005. The data were pulled through fiscal year end 2007. The acquisition of Wachovia by Wells Fargo was completed in December 2008.

28. Washington Mutual - The data collected consist of annual data on Washington Mutual's securities received that it was permitted to repledge as well as the fair value of securities sold or repledged. The data are reported annually in the 10-K filings beginning in the fiscal year end of 2001. The data were pulled through fiscal year end 2007. All data were reported in USD.

Values for book assets and book net worth were also collected from the company's filings. No minority interest is included in book net worth, so that minority interest is treated as a liability. Filings were retrieved from the SP Global Database.

29. WestLB - Annual reports are reported under Portigon, the legal successor of WestLB, however the reports begin in 2005Q1. Repledgeable collateral data for WestLB was not collected.

I Exchange Rate Data

Historical Exchange Rates - Historical month-end currency exchange rates were compiled over applicable time periods to convert foreign currency values into USD values. Currency exchanges retrieved include: USDEUR, USDCHF, and USDGBP.

J Mortgage Backed Securities (MBS) Yields

LD10OAS Index - “Bloomberg Barclays U.S. MBS: Agency Fixed Rate MBS Average OAS.” This index was used to capture the evolution of agency MBS yields. Daily average yield was retrieved for this index using a Bloomberg terminal. The range of dates for prices pulled was 9/30/1988-10/29/2020.

BNA10AS Index - The index tracks the OAS of BNA1TRUU Index, which is the “Bloomberg Barclays Non-Agency Investment Grade CMBS: Eligible for U.S. Aggregate Index.” This index was used to capture the evolution of non-agency MBS yields. Daily average yield was retrieved for this index using a Bloomberg terminal. The range of dates for prices pulled was 9/29/2000-10/30/2020.

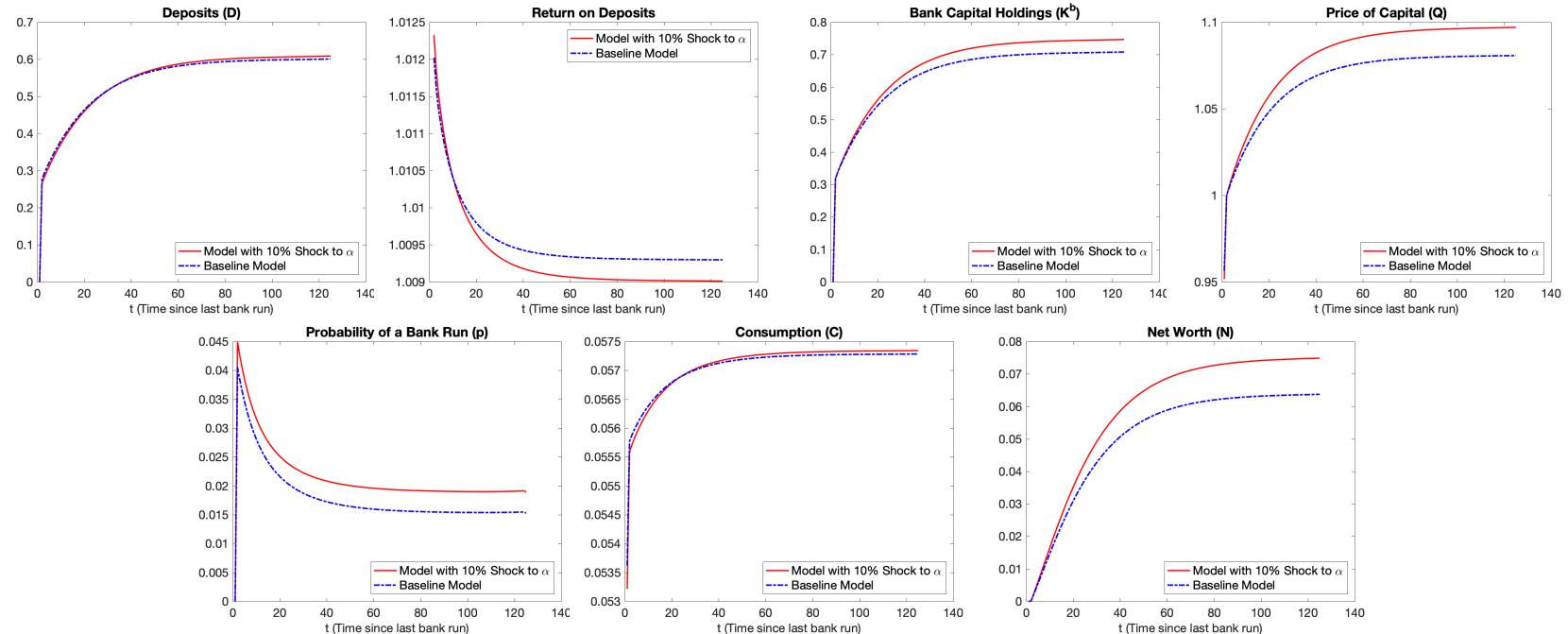


FIGURE 17: EVOLUTION OF VARIABLES IF NO BANK RUN OCCURS

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: MASTER REPURCHASE AGREEMENTS

Revolving Warehouse and Repurchase Facilities. We borrow substantial sums of cash on a regular basis to originate mortgage loans and to hold loans in our REIT portfolio prior to securitization. Therefore, we rely on revolving warehouse and repurchase facilities to finance the origination and holding of mortgage loans prior to securitization or sale.

At December 31, 2005, we had total revolving warehouse and repurchase facilities in the amount of \$2.8 billion, of which \$2.7 billion and \$0.1 billion were committed and uncommitted, respectively. At December 31, 2005, amounts outstanding under our facilities totaled \$1.3 billion, leaving us with \$1.5 billion of available committed borrowing capacity under the facilities. Of the \$2.8 billion of revolving warehouse and repurchase facilities available at December 31, 2005, \$300.0 million, \$700.0 million, \$500.0 million, \$300.0 million, \$500.0 million and \$500.0 million are scheduled to mature on March 24, 2006, April 3, 2006, August 4, 2006, September 29, 2006, December 1, 2006 and January 17, 2007, respectively. While no assurance can be made, we expect to renew our warehouse facilities on the same or similar terms at or prior to their maturity.

Excerpt from Annual Report Section “Revolving Warehouse and Repurchase Facilities”

Third Amendment dated as of January 17, 2006 to the Master Repurchase Agreement Governing Purchases and Sales of Mortgage Loans among Lehman Brothers Bank, FSB, Aames Capital Corporation and Aames Investment Corporation (incorporated by reference to Exhibit 10.11(d) to the September 2005 10-Q).

Excerpt from Exhibit Index of Annual Report

Notes: This figure features excerpts from an example IMC's annual report. It reports the IMC's warehouse repurchase facilities (credit lines) and the dealer who was funding each facility. The facilities are matched to the dealer by the expiration date of the Master Repurchase Agreement.

FIGURE 19: TRI-PARTY MARKET MORTGAGE REPOS

(a) Fidelity Phillips Street Trust

Repurchase Agreements - continued

With: - continued

2.75%, dated 2/28/05 due 3/1/05 (Collateralized by Mortgage Loan Obligations with principal amounts of \$182,911,335, 3.38% - 6.21%, 2/25/17 - 10/15/35)

Citigroup Global Markets, Inc. at 2.68%, dated 2/28/05 due 3/1/05:

(Collateralized by Commercial Paper Obligations with principal amounts of \$511,029,978, 0% - 2.79%, 3/1/05 - 6/20/05)

(Collateralized by Corporate Obligations with principal amounts of \$701,687,098, 1.87% - 9.95%, 6/15/05 - 10/15/49)

Countrywide Securities Corp. at 2.73%, dated 2/28/05 due 3/1/05 (Collateralized by Mortgage Loan Obligations with principal amounts of \$597,593,905, 5% - 9%, 3/10/22 - 4/25/36)

Credit Suisse First Boston, Inc. at:

2.71%, dated 2/28/05 due 3/1/05 (Collateralized by Commercial Paper Obligations with principal amounts of \$306,989,000, 0%, 3/21/05 - 4/20/05)

2.73%, dated 2/28/05 due 3/1/05 (Collateralized by Mortgage Loan Obligations with principal amounts of \$9,844,751,506, 0% - 11%, 8/5/09 - 9/25/42)

Deutsche Bank Securities, Inc. at 2.76%, dated 2/28/05 due 3/1/05 (Collateralized by Corporate Obligations with principal amounts of \$1,126,984,510, 1.66% - 14%, 3/15/05 - 2/15/49)

Goldman Sachs & Co. at:

2.73%, dated 2/28/05 due 3/1/05 (Collateralized by Mortgage Loan Obligations with principal amounts of \$320,610,109, 2.99% - 7.5%, 3/15/30 - 1/25/45)

2.74%, dated 2/18/05 due 3/22/05:

(Collateralized by Corporate Obligations with principal amounts of \$929,621,719, 3.12% - 14%, 3/15/05 - 6/15/25) (b)(c)

(Collateralized by Mortgage Loan Obligations with principal amounts of \$98,772,062, 1.09% - 22.6%, 2/15/14 - 2/25/44) (b)(c)

2.75%, dated 2/18/05 due 3/22/05 (Collateralized by Equity Securities valued at \$252,000,051) (b)(c)

J.P. Morgan Securities, Inc. at:

2.63%, dated 2/3/05 due 3/23/05 (Collateralized by Corporate Obligations with principal amounts of \$642,653,500, 1.63% - 11%, 5/23/05 - 5/1/34)

(b) JPMorgan Trust II

Repurchase Agreements — 7.2%

500,000	Bear Stearns, 2.90%, dated 03/31/05, due 04/01/05, repurchase price \$500,040, collateralized by mortgage backed securities
153,529	Goldman Sachs Group, 2.90%, dated 03/31/05, due 04/01/05, repurchase price \$153,541, collateralized by mortgage backed securities
100,000	Goldman Sachs Group, 2.95%, dated 03/31/05, due 04/01/05, repurchase price \$100,008, collateralized by a non traditional repo
Total Repurchase Agreements	

Notes: Figure (a) depicts reverse repurchase agreements from Fidelity Phillips Street Trust to Countrywide, Credit Suisse, and Goldman Sachs backed by “Mortgage Loan Obligations” (b) depicts reverse repurchase agreements from JPMorgan Trust II to Bear Stearns and Goldman Sachs backed by “Mortgage Backed Securities.”

FIGURE 20: 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	Dealer lends to IMC in form of a Vanilla Secured Loan	IMC pays off loan																								
Balance Sheet of Bank A at Day 0 with Vanilla Secured Loan <table border="1"> <thead> <tr> <th>Assets</th><th>Liabilities and Equity</th></tr> </thead> <tbody> <tr> <td>Other Assets 900</td><td>Total Liabilities 500</td></tr> <tr> <td></td><td>Equity 400</td></tr> <tr> <td>Total Assets \$900</td><td>Total Liabilities & Equity \$900</td></tr> </tbody> </table>	Assets	Liabilities and Equity	Other Assets 900	Total Liabilities 500		Equity 400	Total Assets \$900	Total Liabilities & Equity \$900	Balance Sheet of Bank A at Day 1 with Vanilla Secured Loan <table border="1"> <thead> <tr> <th>Assets</th><th>Liabilities and Equity</th></tr> </thead> <tbody> <tr> <td>Secured Loan to IMC \$ 100</td><td>Total Liabilities 600</td></tr> <tr> <td>Other Assets 900</td><td>Equity 400</td></tr> <tr> <td>Total Assets \$1,000</td><td>Total Liabilities & Equity \$1,000</td></tr> </tbody> </table>	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	Balance Sheet of Bank A at Day 2 with Vanilla Secured Loan <table border="1"> <thead> <tr> <th>Assets</th><th>Liabilities and Equity</th></tr> </thead> <tbody> <tr> <td>Other Assets 900</td><td>Total Liabilities 500</td></tr> <tr> <td></td><td>Equity 400</td></tr> <tr> <td>Total Assets \$900</td><td>Total Liabilities & Equity \$900</td></tr> </tbody> </table>	Assets	Liabilities and Equity	Other Assets 900	Total Liabilities 500		Equity 400	Total Assets \$900	Total Liabilities & Equity \$900
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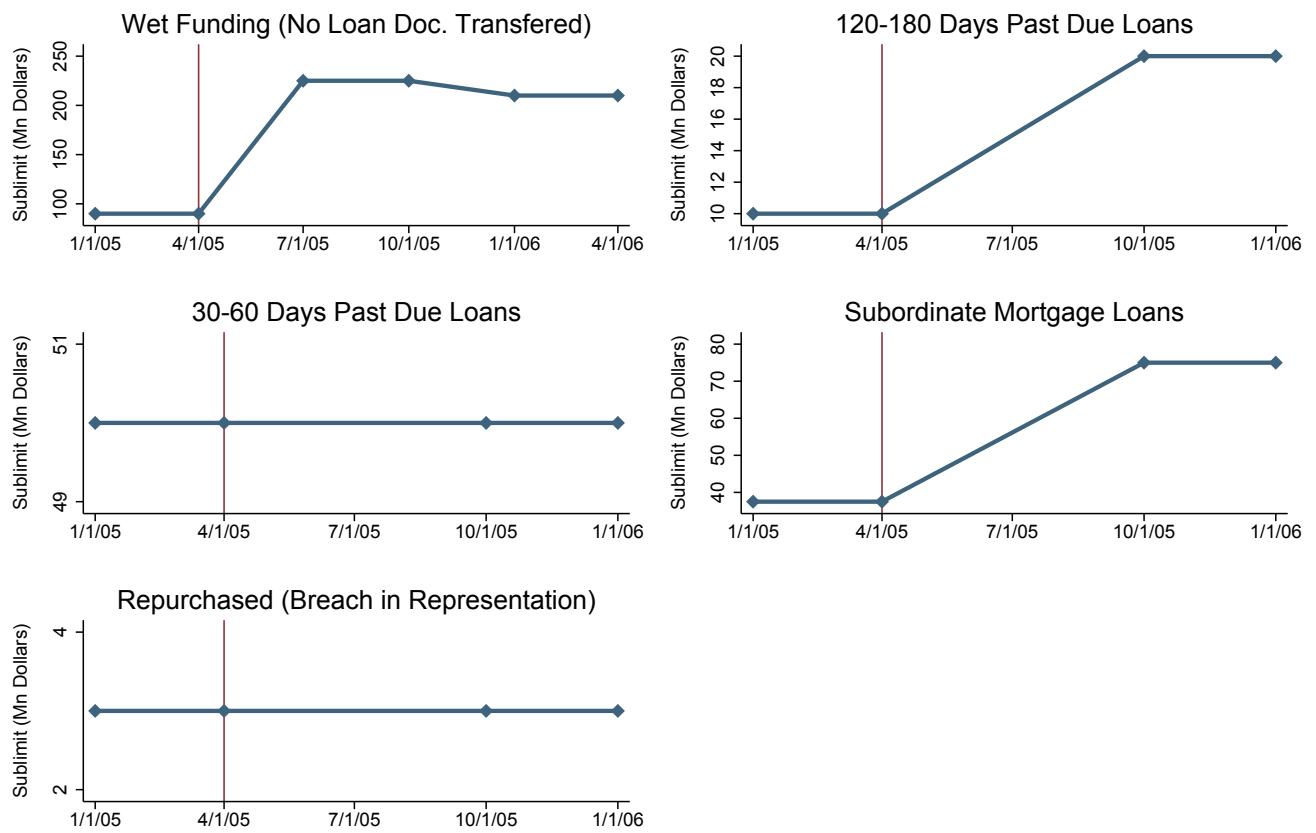
0% interest rates for simplicity. Dealer funds loan to IMC with repo debt from tri-party repo market.

No Relationship with IMC	Dealer purchases securities from IMC as a Reverse-Repo	Dealer sells securities back to IMC																								
Balance Sheet of Bank B at Day 0 with Reverse-Repo treated as Outright Sale <table border="1"> <thead> <tr> <th>Assets</th><th>Liabilities and Equity</th></tr> </thead> <tbody> <tr> <td>Other Assets 900</td><td>Total Liabilities 500</td></tr> <tr> <td></td><td>Equity 400</td></tr> <tr> <td>Total Assets \$900</td><td>Total Liabilities & Equity \$900</td></tr> </tbody> </table>	Assets	Liabilities and Equity	Other Assets 900	Total Liabilities 500		Equity 400	Total Assets \$900	Total Liabilities & Equity \$900	Balance Sheet of Bank B at Day 1 with Reverse-Repo treated as Outright Sale <table border="1"> <thead> <tr> <th>Assets</th><th>Liabilities and Equity</th></tr> </thead> <tbody> <tr> <td>Other Assets 900</td><td>Total Liabilities 500</td></tr> <tr> <td></td><td>Equity 400</td></tr> <tr> <td>Total Assets \$900</td><td>Total Liabilities & Equity \$900</td></tr> </tbody> </table>	Assets	Liabilities and Equity	Other Assets 900	Total Liabilities 500		Equity 400	Total Assets \$900	Total Liabilities & Equity \$900	Balance Sheet of Bank B at Day 2 with Reverse-Repo loan treated as Outright Sale <table border="1"> <thead> <tr> <th>Assets</th><th>Liabilities and Equity</th></tr> </thead> <tbody> <tr> <td>Other Assets 900</td><td>Total Liabilities 500</td></tr> <tr> <td></td><td>Equity 400</td></tr> <tr> <td>Total Assets \$900</td><td>Total Liabilities & Equity \$900</td></tr> </tbody> </table>	Assets	Liabilities and Equity	Other Assets 900	Total Liabilities 500		Equity 400	Total Assets \$900	Total Liabilities & Equity \$900
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Dealer Leverage Ratio (Assets/Equity)

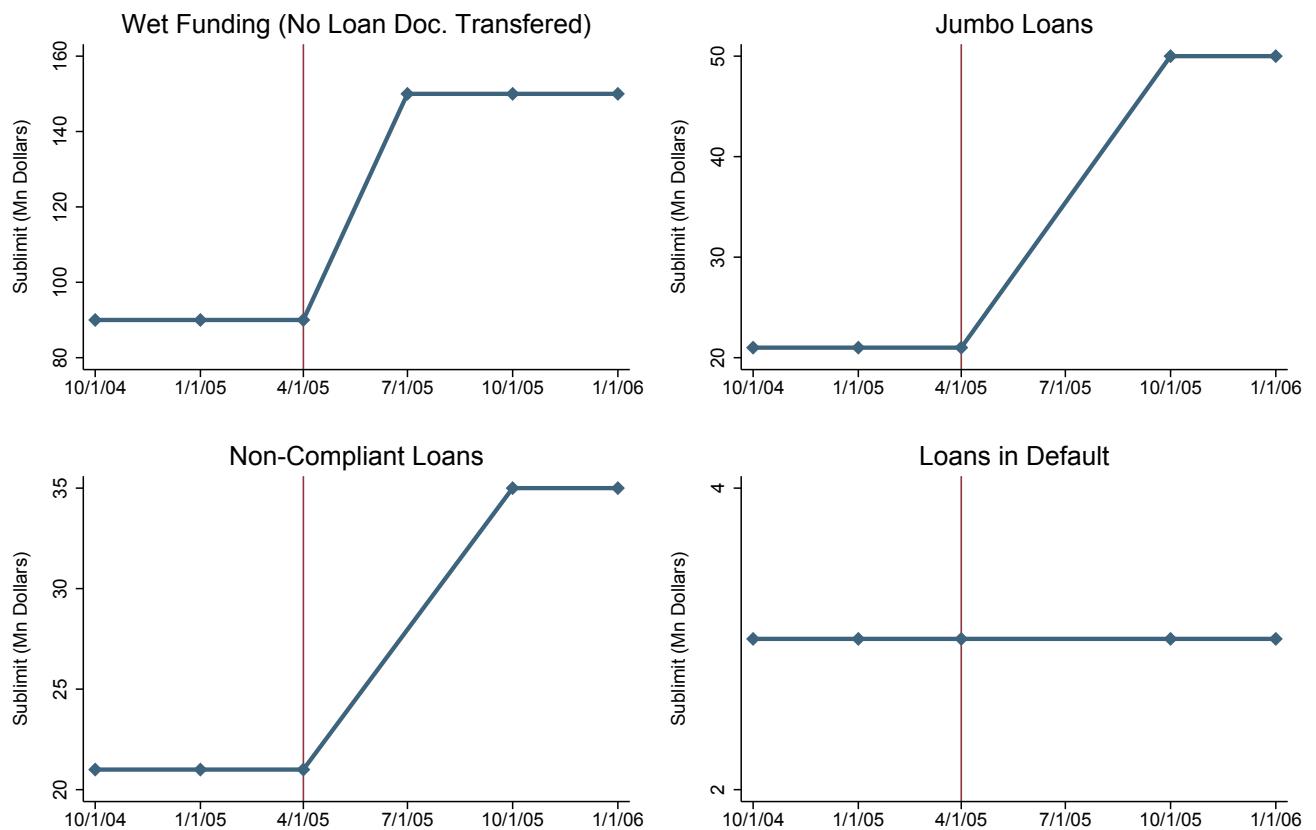
	Day 0	Day 1	Day 2
Secured Loan (A)	2.25	2.5	2.25
Reverse-Repo (B)	2.25	2.25	2.25

FIGURE 21: DEALER 1 COVENANTS ON CREDIT LINE TO EXAMPLE MORTGAGE COMPANY



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

FIGURE 22: DEALER 2 COVENANTS ON CREDIT LINE TO EXAMPLE MORTGAGE COMPANY



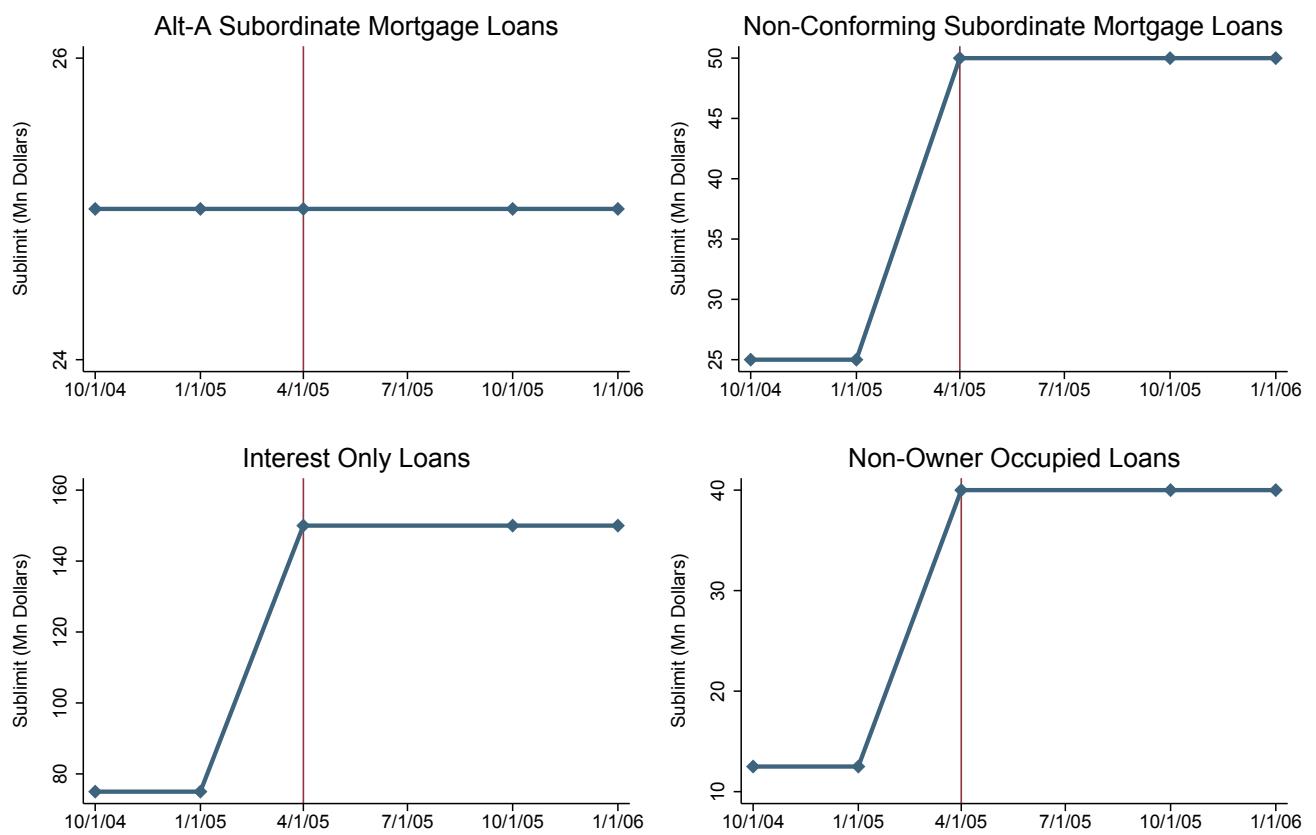
Notes: Figure provides suggestive evidence that the covenants were loosened post BAPCPA.

FIGURE 23: DEALER 3 COVENANTS ON CREDIT LINE TO EXAMPLE MORTGAGE COMPANY



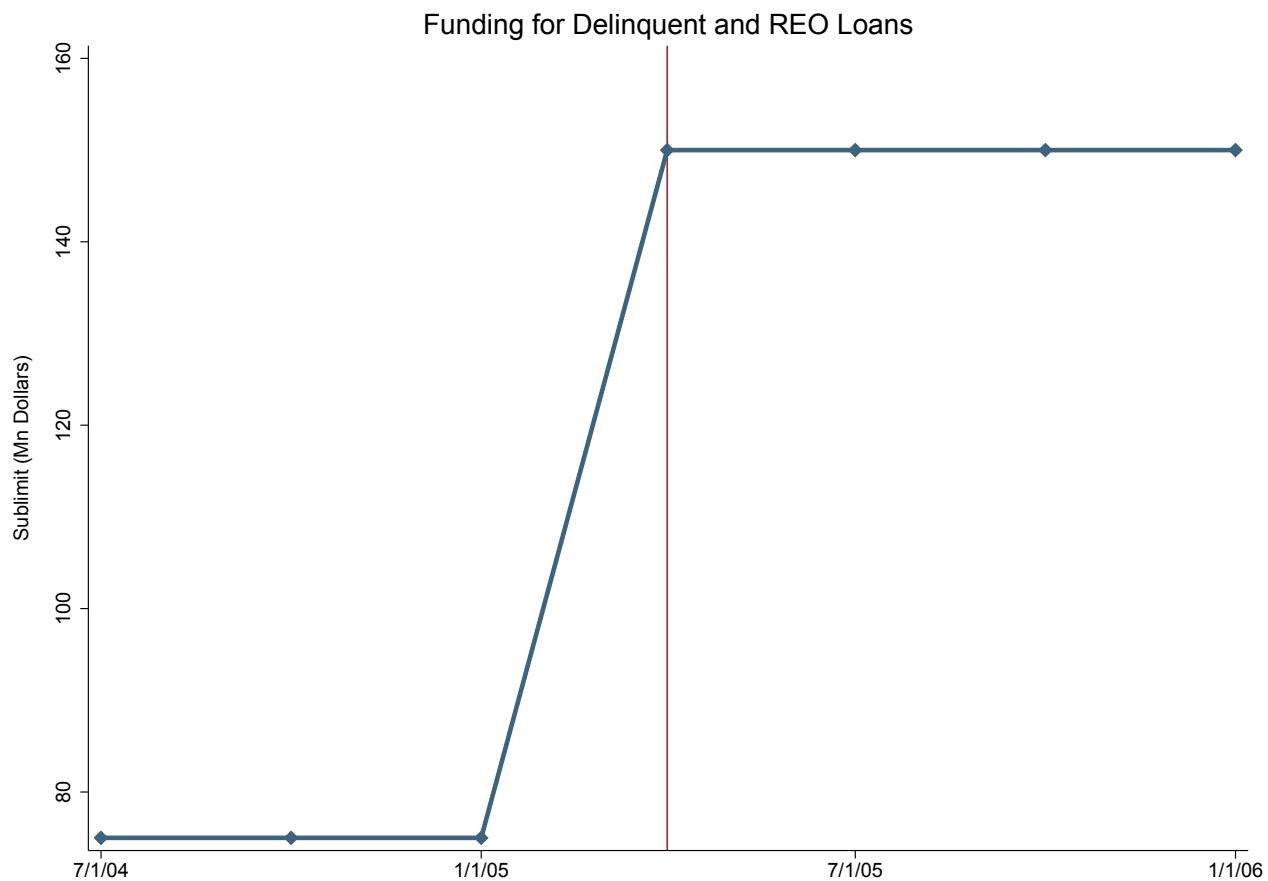
Notes: Figure provides suggestive evidence that the covenants were loosened post BAPCPA.

FIGURE 24: DEALER 4 COVENANTS ON CREDIT LINE TO EXAMPLE MORTGAGE COMPANY



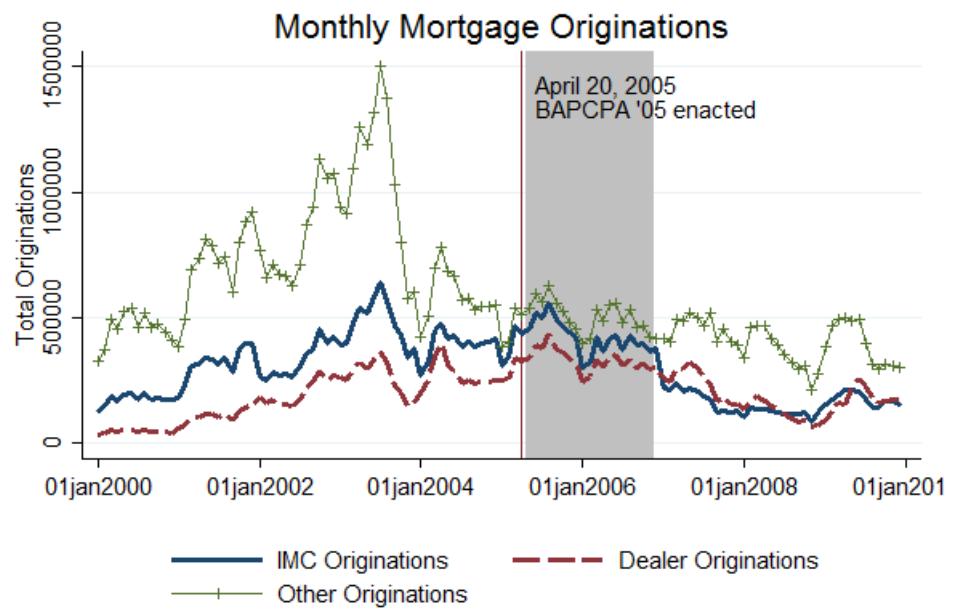
Notes: Figure provides suggestive evidence that the covenants were loosened post BAPCPA.

FIGURE 25: 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.

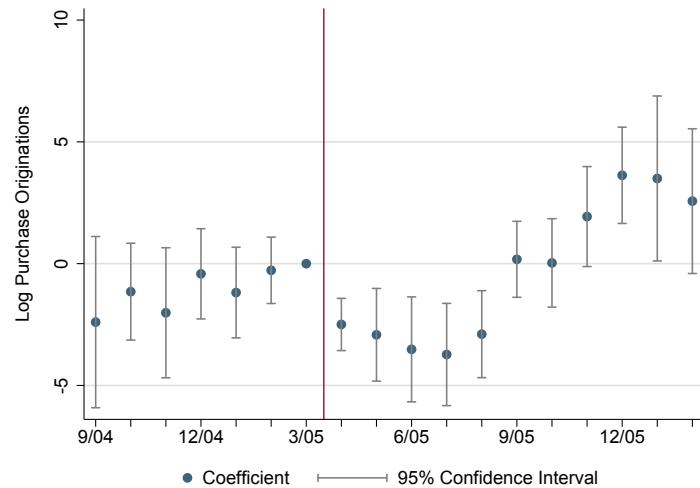
FIGURE 26:



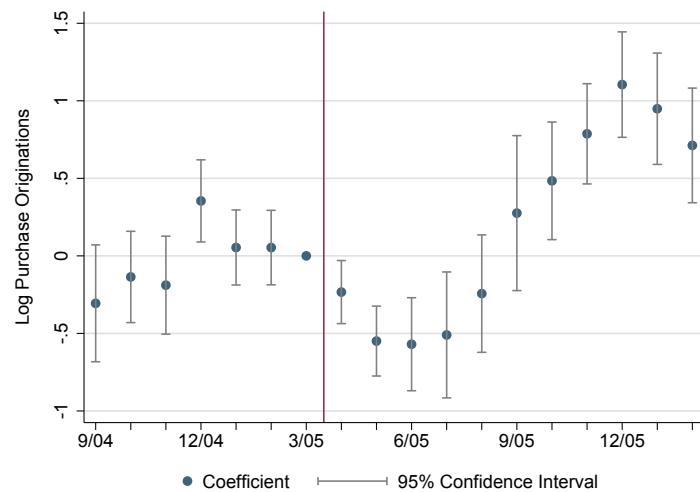
Source: Confidential HMDA Data.

Notes: Figure plots mortgage originations by dealers, IMCs, other originators. Other originators includes commercial banks and mainly represents agency mortgage originations. IMC originations mainly represents private-label originations. The steep fall in agency mortgage originations coincides with the regulations placed debt limits for Fannie Mae and Freddie Mac in response to their accounting fraud cases.

FIGURE 27: IMC COUNTY MARKET SHARE EFFECT ON PURCHASE MORTGAGE ORIGINATIONS



(a) Six Treated IMCs

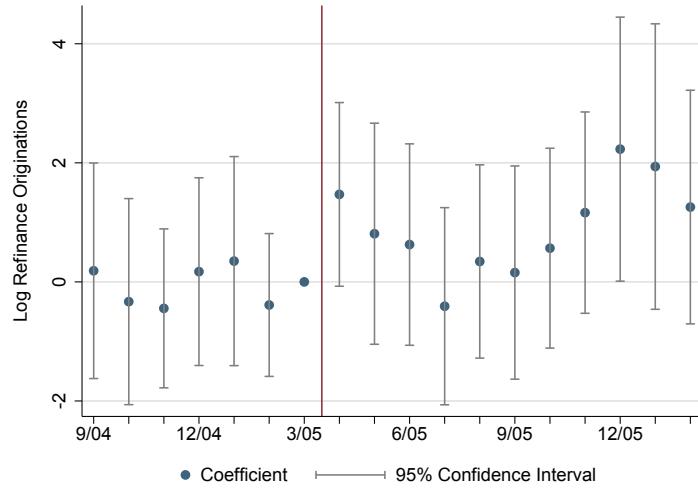


(b) All IMCs

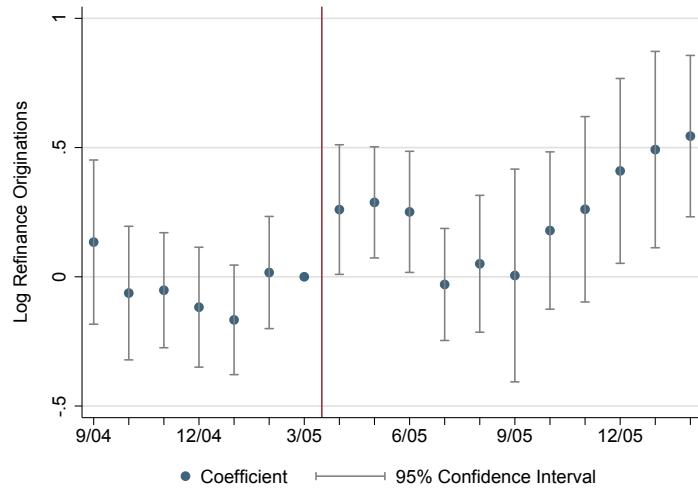
Notes: Figure plots the dynamic response of purchase mortgage originations in a given county to the 2004 market share of independent mortgage companies (IMCs) in that county. I estimate Equation 13. β_T is the coefficient of interest. It is the coefficient on the indicator variable that interacts $(Treated)IMCMarketShare_{c,2004}$ 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.

^aNeil Bhutta publishes the HMDA data reported at the county month level on his personal website: <https://sites.google.com/site/neilbhutta/data>.

FIGURE 28: IMC COUNTY MARKET SHARE EFFECT ON REFINANCE MORTGAGE ORIGINATIONS



(a) Six Treated IMCs

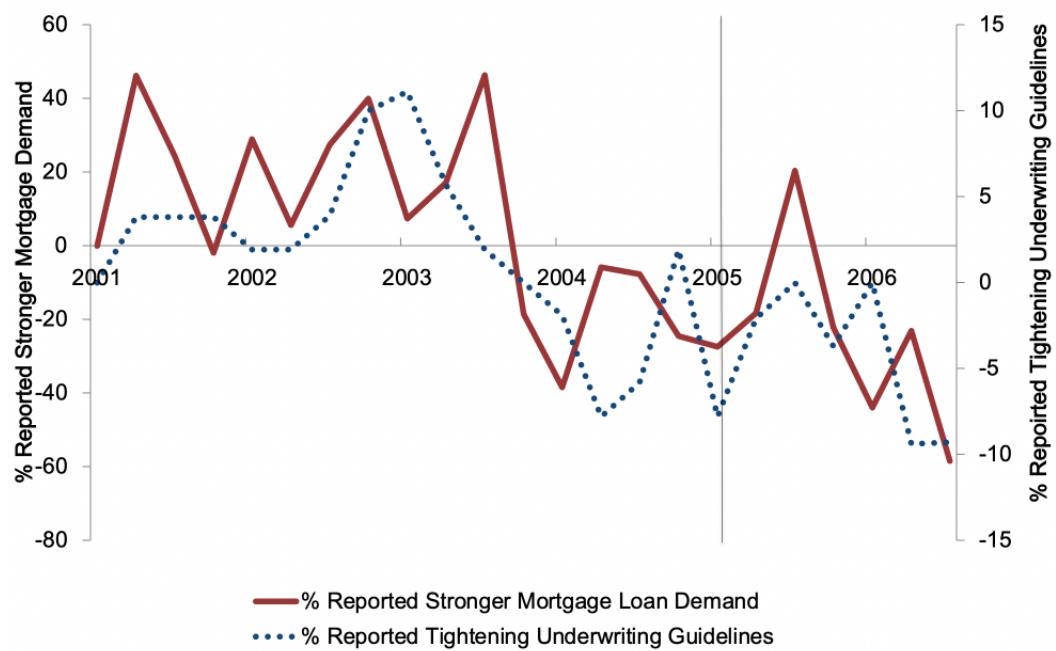


(b) All IMCs

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 13. 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.

^aNeil Bhutta publishes the HMDA data reported at the county month level on his personal website: <https://sites.google.com/site/neilbhutta/data>.

FIGURE 29: 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) log(Purch)	(2)	(3) log(Refi)	(4)	(5)	(6)	(7)	(8)
Panel A: Treated IMCs Affected								
<i>Post</i> × <i>TreatedIMCMarketShare_{c,2004}</i>	8.202*** (0.390)	0.693 (1.036)	2.397*** (0.318)	0.981* (0.558)	0.483*** (0.039)	-0.056 (0.103)	-0.410*** (0.041)	0.098 (0.092)
CountyFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes
r ²	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								
<i>Post</i> × <i>IMCMarketShare_{c,2004}</i>	0.565*** (0.013)	0.226** (0.100)	0.157*** (0.021)	0.285** (0.113)	0.030*** (0.002)	0.057*** (0.015)	-0.030*** (0.002)	-0.024 (0.017)
CountyFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes
r ²	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

$$Y_{c,t} = \gamma_c + \eta_{s,t} + \beta \text{ Post}_t \times (\text{Treated})\text{IMCMarketShare}_{c,2004} + \epsilon_{c,t}$$

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 × month fixed effects, $(\text{Treated})\text{IMCMarketShare}_{c,2004}$ 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 $(\text{Treated})\text{IMCMarketShare}_{c,2004}$ and the post period. This coefficient measures the change in the dependent variable if $(\text{Treated})\text{IMCMarketShare}_{c,2004}$ 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.

^aNeil Bhutta publishes the HMDA data reported at the county month level on his personal website: <https://sites.google.com/site/neilbhutta/data>.