Creditor Rights, Collateral Reuse, and Credit Supply

Brittany Almquist Lewis*

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Abstract

Securities dealers receive mortgages as collateral for credit lines provided to mortgage companies and reuse the same collateral to borrow money. Exploiting the 2005 BAPCPA rule change, which granted mortgage collateral preferred bankruptcy treatment, I find that strengthening creditor rights increases dealers' collateral reuse. Increasing collateral reuse creates a money multiplier that increases credit supply. Using a novel dataset linking dealers to the mortgage companies they fund reveals that post-BAPCPA, dealers supply additional credit to mortgage companies by increasing credit lines and relaxing restrictions on collateral securing them. In response, mortgage companies increase origination volume and shift into riskier products.

Keywords: repo, creditor rights, rehypothecation, money multiplier, bapcpa
JEL Classification: G01, G20, G23, G33

*Olin Business School, Washington University - St. Louis. E-mail: **b.almquist.lewis@gmail.com**, website: **www.brittanylewis.org**. I have greatly benefited from conversations with Dimitris Papanikolaou, Janice Eberly, Lawrence Christiano, John Mondragon, Sebastian Infante, Shane Sherlund, Anat Admati, Ravi Jagannathan, Konstantin Milbradt, Anthony DeFusco, Jacopo Ponticelli, Efraim Benmelech, Craig Furfine, Adam Copeland, Dmitry Orlov, Darrell Duffie, Guido Lorenzoni, Fabrice Tourre, Harald Uhlig, Paul Willen, Johannes Stroebel, Michael Gmeiner, Apoorv Gupta, and Erin Lytwyn. I am thankful to the participants in seminars at Stanford GSB, LBS, Northwestern Economics, Kellogg Finance, Kellogg Strategy, and the Wisconsin School of Business for helpful comments and suggestions. Conversations with Economists from the Board of Governors of the Federal Reserve System, the Federal Reserve Banks of San Francisco and New York, and with traders at Citigroup NY have been very useful for my analysis. I gratefully acknowledge the Guthrie Center for Real Estate Research for their support. Any errors in this manuscript are my own.

1 Introduction

According to theories of money creation, credit expands and contracts in the economy via a money multiplier in the traditional banking system. My paper establishes a chain of lending in the sale and repurchase ("repo") market that could potentially generate an analogous multiplier in the shadow banking system. This chain of lending arises when large securities dealers lend to mortgage companies in exchange for repo collateral and are allowed to reuse, or repledge, the collateral they receive. If dealers reuse the collateral to borrow from cash lenders and then reinvest the cash back into mortgage companies, it could lead to a money multiplier that originates in the repo market. While the money multiplier in the traditional banking system generates less money each round of lending, this repo multiplier could generate more money each round due to differences in the terms at which dealers and mortgage companies can borrow against the same collateral. Despite its potentially explosive effect on credit supply, the economic impact of this repo multiplier has not previously been explored. I exploit a change in repo creditor rights to shock dealer collateral reuse and trace the resulting supply of credit from dealers to mortgage companies and ultimately to mortgage originations.

The mortgage companies that I study are independent mortgage companies (IMCs). Prior to the Global Financial Crisis (GFC), IMCs made up close to one third of the mortgage lending market. Post-crisis their market share has increased to approximately half of the market and their funding structure largely remains the same. Stanton, Walden and Wallace (2014) and Echeverry, Stanton and Wallace (2016) establish that the IMCs rely heavily on credit line funding. However, there has been no direct evidence about who their funders were or how they operated. These questions have important implications for financial stability not only for the housing market but also for commercial real estate and collateralized loan obligations, which have adopted a similar funding structure.

To analyze who IMC funders were and how they operated prior to the GFC, I hand collect data on twelve of the largest public IMCs' credit lines between 2004Q3 and 2006Q3. I establish that these credit lines were collateralized by mortgage loans and implemented as *Master Repurchase Agreements* – contracts defining the purchase and resale of repo collateral – from the largest most interconnected repo dealers. I also collect data on the dealers' reported repledgeable collateral, or collateral eligible for reuse. Connecting a dealer's repledgeable collateral to the same dealer's funding to an IMC allows me to trace the transmission of an innovation in a dealer's repo collateral reuse to their increased credit supply to IMCs. I then use mortgage origination data to analyze the resulting impact on households.

I utilize Congress's passage of the Bankruptcy Abuse Prevention and Consumer Protec-

tion Act of 2005 (BAPCPA) to isolate a plausibly exogenous strengthening of creditor rights for repo mortgage collateral. The policy change exempted repo mortgage collateral from automatic stay. Importantly for my research design, BAPCPA only affected private-label, or risky, mortgage collateral since agency mortgage collateral had already been granted exemption from automatic stay by the Bankruptcy Amendments Act of 1984. Upon a bankruptcy event, exemption from automatic stay allows the final creditor to take immediate control of collateral without waiting in bankruptcy court. I hypothesize that this super senior bankruptcy status increased lenders' willingness to lend against the affected collateral and thus increased dealers' ability to repledge it. However, since private-label mortgage collateral is risky and repo transactions are typically backed by safe assets, it is not obvious that demand for this risky mortgage collateral would increase. Therefore, to empirically test whether BAPCPA increased collateral reuse and in turn credit supply, my analysis proceeds in three steps. First, I study whether the strengthening of creditor rights increases dealers' reuse of repo collateral; second, I study dealers' passthrough of their resulting credit supply increase to mortgage companies; and third, I study the mortgage companies' resulting increase in originations. Establishing consistent results at each step strengthens support for the underlying mechanism.

In the first step (Section 4), I test whether BAPCPA increases dealers' collateral reuse. To generate testable empirical predictions for collateral reuse, I first present a conceptual framework that illustrates the money multiplier potential of reusing risky mortgage collateral. Following BAPCPA, my estimates show this multiplier was large – 4.5 times that of Treasuries. This large multiplier motivates my treatment intensity difference-in-differences research design to test whether strengthening repo creditor rights increases collateral reuse. More-treated dealers are those with a larger fraction of their pre-period balance sheet made up of collateral affected by BAPCPA. They would have a first mover advantage to generate a large money multiplier on a larger fraction of their balance sheet. Following BAPCPA, they could immediately redeploy the previously illiquid collateral by repledging it for cash to invest in more mortgages. If they engaged in multiple rounds of this cycle – lending to an IMC, receiving collateral from the IMC, repledging the collateral to a cash lender, reinvesting the cash by lending to an IMC – the multiplier would compound to persistently increase their credit supply. To test whether more-treated dealers enjoy this persistent increase in credit supply, I study the effect of treatment on dealers' reported repledgeable collateral following BAPCPA. I find that more-treated dealers experience an increase in repledgeable collateral relative to less-treated dealers following the change.

In the second step (Section 5), I test whether, following the policy change, treated dealers differentially increase their credit supply to IMCs relative to control dealers. Isolating

the dealer 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 the same mortgage company receives 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 estimate a difference-in-differences analysis of the credit lines to a given mortgage company from treated versus control dealers. After BAPCPA, treated dealers increase their funding within the same mortgage company by 29% relative to control dealers. While this within-IMC, across-dealer, analysis is only able to establish a credit substitution effect between dealers, I also present evidence that suggests the policy change leads to a 13.8% overall credit supply increase to IMCs.

In addition, I find that post BAPCPA, dealers systematically relax covenants on their credit lines to mortgage companies. Rather than increasing funding for lines collateralized by traditional mortgages, dealers increase funding for "wet" (unsecured) credit lines and for lines collateralized by balloon, interest-only, and 120-180 day delinquent mortgages. This finding is consistent with BAPCPA increasing the expected recovery value of collateral, causing dealers to allow riskier types of mortgages to collateralize credit lines.

In the third step (Section 6), I conduct a treatment intensity difference-in-differences analysis to study whether IMCs pass the credit supply increase on to households. Due to data limitations that prohibit identifying individual IMCs, I utilize variation in the county-level market share of IMCs in 2004, the year before BAPCPA, to define counties more- versus less-exposed to the change. Prior to BAPCPA, I observe no statistically significant difference in mortgage volume and characteristics between counties with high- versus low-IMC market share. Post BAPCPA, a 10% increase in pre-period IMC market share leads to a 2.7% increase in mortgage originations during 2005-2006. The distribution of these originations shifts toward balloon and adjustable rate mortgages (ARMs), including interest-only ARMs; in line with dealers' increased funding for these products. These were "near prime," or alternative, rather than subprime mortgage products. Consistently, I find that an increase in pre-period IMC market share drives an increase in the fraction of prime relative to subprime mortgages post BAPCPA. Although these alternative products boasted higher credit scores, which classified them as prime, Foote and Willen (2016) note that their structure may increase their risk of default. Consistently, within a five-month window around the shock, I estimate that the marginal default hazard rate increases from 13% pre-BAPCPA to 70% post-BAPCPA. A 10% increase in pre-period IMC market share leads to a 2.1% increase in home prices during 2005-2006 and to a 3.3% decrease in home prices during 2008, consistent with an amplification channel of repo funding. The results indicate that the credit supply increase in response to BAPCPA played an important role in the home price boom and its

bust in 2008.

My paper contributes to the literature on collateral reuse in the financial markets. Infante (2019) models how dealers intermediate between repo lenders and borrowers using the same collateral. Fegatelli (2010), Singh (2011), Gottardi, Maurin and Monnet (2019) establish that this kind of intermediation could lead to a money multiplier in the repo market. Jank and Moench (2020), Infante and Saravay (2020), Gorton, Muir and Laarits (2020) shed light on the multiplier of Treasury and agency repo post-GFC. My paper innovates relative to this literature by showing that the multiplier potential of private-label repo collateral is larger than that of safe assets. I also make a notable expansion to this literature by establishing the chain of lending that links the repo market to the housing market and by showing that an innovation to the repo multiplier is passed from the secondary market to the primary market.

My paper also contributes to the debate on whether repo should receive preferred bankruptcy treatment (Lubben (2010), Roe (2010), Skeel and Jackson (2012)). Supporters argue it improves stability of the financial markets (Edwards and Morrison (2005)). However, Duffie and Skeel (2012) propose four risks associated with granting repo preferred bankruptcy status: lowering repo lenders' incentive to monitor collateral; increasing their ability to become too big or interlinked to fail; increasing inefficient substitution toward short-term repo funding; and increasing risk of fire sales. My paper documents the first empirical evidence for each of these risks. Furthermore, one key concern preceding the Bankruptcy Amendments Act of 1984's expansion of repo safe harbors was that the repo collateral must be able to maintain its price in a crisis since granting it preferred bankruptcy status would facilitate fire sales. Consistently, Morrison, Roe and Sontchi (2013) note that preferred bankruptcy treatment for repos was intended for collateral with price stability. However, Maclachlan (2014) notes that a discussion of whether mortgage collateral could maintain its price in a crisis was largely neglected prior BAPCPA's expansion of repo safe harbors. The findings in my paper underscore the importance of verifying collateral's ability to retain its price in a crisis before granting it exemption from automatic stay.

Additionally, my paper sheds light on three puzzles surrounding the GFC. First, how did the relatively small realized losses found in Ospina and Uhlig (2018) on mortgage-backed securities put 12 of the 13 most systemically important financial institutions at risk of failure in a period of two weeks? Rajan (2005) and Acemoglu, Ozdaglar and Tahbaz-Salehi (2015) warn that critical interlinkages exposed the economy to low probability events, yet the exact role played by the financial system's architecture in creating systemic risk remains imperfectly understood. My paper highlights the role of repo rehypothecation, or the reuse of collateral, in increasing critical interlinkages that were backed by risky collateral and

exposed to cross-default clauses leading up to the GFC.

Second, was the run in the repo market – failure to roll over short-term repo loans – central to the GFC as proposed in Gorton and Metrick (2010*a*,*b*, 2012)? While Krishnamurthy, Nagel and Orlov (2014) find evidence of a run, they find that only a small fraction of total repo, repo backed by mortgage collateral, was exposed to the run. My paper illuminates how BAPCPA increased dealer exposure to repo runs on their liability side and the kind of collateral runs described in Infante and Vardoulakis (2021) on their asset side; allowing a run in even a small segment of repo to have devastating effects. Consistently, Singh and Aitken (2010) show that repo collateral reuse increased dealer leverage by 50% more than standard estimates during 2007-2009.

Third, was the build up in home prices leading up to the GFC triggered by credit supply or expectations (Mian and Sufi (2009))? I document evidence consistent with a credit supply expansion. I also shed light on why 2006, 2007 vintage mortgages defaulted faster than 2000-2004 vintages, as found in Demyanyk and Van Hemert (2011), and why the majority of mortgage defaults were focused in the prime rather than subprime segment, as found in Albanesi, De Giorgi and Nosal (2017).

There is an existing literature that uses BAPCPA's repo safe harbor provision as a natural experiment. Srinivasan (2017) shows that BAPCPA increased demand for private-label mortgage collateral in one segment of the repo markets. Bellicha (2016) and Ganduri (2016) study the impact of BAPCPA on the deterioration of mortgage originations. Chircop, Fabrizi and Parbonetti (2018) find that information asymmetry increased for banks exposed to BAPCPA's repo provision. I innovate relative to this literature by studying BAPCPA's effect on dealers' reuse of mortgage collateral in the repo markets and the credit creation that it leads to in the real economy.

2 Data

My empirical analysis combines dealer and mortgage company borrowing and lending data.

2.1 Independent Mortgage Companies

The credit lines IMCs used to fund mortgage originations were called warehouse facilities. To select the sample of IMCs whose warehouse facilities I collect, I narrow the IMCs to public companies. Most IMCs in the sample become public in mid-2004, thus I observe their data beginning in third quarter of 2004. I choose the IMCs that report the dealers from whom they borrow in their quarterly and annual financial statements filed with the SEC from 2004Q3 to 2007Q3. This gives me a sample of 12 IMCs. Each IMC reports the dealers

funding each of its credit facilities and the maximum amount of the facility each quarter. 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.[1] Thus, I limit my sample to 2006Q3 since it is the last quarter that I observe all 12 IMCs in my dataset.

The data capture credit lines reported as warehouse lines of credit, warehouse repurchase facilities, and repurchase agreements. A subset of these mortgage companies also report their utilization on credit facilities and the posted mortgage collateral, allowing me to calculate their overcollateralization. I provide an example of the data that I collect in Appendix A in the Online Appendix and 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.

The IMCs were 12 of the largest public IMCs and generated 59% of all mortgages originated by IMCs in 2006, as discussed in subsection B.3 in the Online Appendix. I calculate that the IMCs' main source of funding is from warehouse repurchase facilities funded by dealers making up 61% of IMC assets on average.

2.2 Dealers

Dealer Repledgeable Collateral There is limited data on the repo markets prior to 2008 (Baklanova, Copeland and McCaughrin (2015)). Therefore, I use IMCs' warehouse lines to link IMCs to the dealers who were lending to them. During 2004Q3-2007Q3, I find that 29 dealers were funding the IMCs and 16 of the 29 were primary dealers. 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. Once I limit the dataset to 2006Q3, the number of dealers falls from 29 to 27, and the number of primary dealers falls from 16 to 15 .

To study reuse of repo collateral by the dealers funding the IMCs, I collect dealers' reported repledgeable collateral for 19 of the 29 dealers – the 16 primary dealers and 3 additional dealers. Dealers report in a footnote of their annual reports the amount of collateral that they receive which is permitted to be re-sold or repledged. I collect these data from year end 2000 through year end 2008, with varying start dates. Year end 2004 is the earliest date in which all dealers report. These data allow me to study the amount of collateral that dealers receive which they are permitted to repledge pre- versus post-BAPCPA.

Dealer Repo Financing Data In addition to the dealers' repledgeable collateral data,

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

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 data included dealers' trading in private-label mortgage collateral in the line item *corporate securities*, as discussed in subsection A.1. In the Online Appendix, I decompose corporate securities into the collateral classes that comprise it.

These data allow me to study whether primary dealers' trading in the repo markets using private-label collateral increased post BAPCPA. 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).[2] 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 assumes 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 mortgage backed securities (MBS) from CoreLogic ABS database and Inside Mortgage Finance's Mortgage Market Statistical Annual. These data allow me to identify dealers who were more heavily exposed to private-label MBS (PLS) securitization and therefore warehoused private-label mortgage collateral in 2004, the year prior to BAPCPA. They 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 in my sample. In 2004, subprime deals comprised the lion's share of the private-label market. The private-label market generally is comprised of "subprime" and "near prime" mortgages (Adelino, Gerardi and Hartman-Glaser (2019)). Alternative A-paper (Alt-A) or "near prime" deals increased in response to BAPCPA, as discussed in Section 6.

In order to study the effect of BAPCPA on the price of PLS in the secondary market,

[2] *Securities out* and *securities in* include repos/securities lending and reverse repos/securities borrowing, respectively. See: FR 2004 and Infante (2019) p. 46.

I study the daily average yields on the LD10OAS Bloomberg Barclays agency MBS index and the BNA10AS Bloomberg Barclays private-label MBS index from October 2003 through December 2006.

2.3 Mortgage Market Data

To establish the effect of BAPCPA on IMCs' lending to households, I utilize the Home Mortgage Disclosure Act (HMDA) data, as well as the CoreLogic data.

HMDA Data In order to supervise and enforce fair lending practices nationwide, the U.S. Congress mandates that all loan applications related to home purchase, refinancing, and home improvement be reported to the federal government. The main variables that I use from these data 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 IMC county level market share in 2004, the year prior to BAPCPA. To identify the IMCs, I use the crosswalk maintained by Robert Avery to match subsidiaries belonging to the same parent company and I aggregate mortgages originated by each 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. I also utilize the county, month data provided by Neil Bhutta in order to study granular time variation around BAPCPA, as the public HMDA data only publishes data at the annual level.[3] At the county month level, the HMDA data no longer tracks individual IMCs.

CoreLogic Data I use the CoreLogic Loan Level Market Analytics (LLMA) data to study mortgage characteristics and originations pre- and post-BAPCPA. Due to data restrictions, I am not able to observe the originator of a mortgage or to identify whether or not it is an IMC. Therefore I am not able to compare the individual mortgages originated directly by my treated versus control IMCs, or other institutions, pre- and post-BAPCPA. To overcome this, I aggregate all variables to the county level and merge with the pre-period IMC county level market share to analyze the effect of exposure to IMC lending on changes in loan characteristics.

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 U.S.. The LLMA data track approximately 5.7 million mortgages each year and in a typical year include 45% of mortgages originated in the U.S. during 2003-2008. The main variables that I utilize are the mortgage's initial interest rate, occupancy status, mortgage product (balloon, negative

[3]For all specifications, I limit the data to the top 500 counties captured in the dataset published by Neil Bhutta: https://sites.google.com/site/neilbhutta/data.

amortizing, adjustable rate mortgage (ARM)), and prime versus subprime status. I use the monthly performance data over the life of a mortgage to study the effect of BAPCPA on likelihood of default. I use the variable "mba_delinquency_status," reported in accordance with the Mortgage Bankers' Association (MBA) standards, which records the status of a borrower's payments on the loan and provides indicators for foreclosure, bankruptcy, and real estate owned (REO) properties. REO properties are properties seized by lenders from borrowers who are unable to pay their mortgages.

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.

3 Institutional Background

In order to understand the research design and the credit supply increase that BAPCPA generated, 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. The repayment of these warehouse credit lines varied by contract but they were often repayable either when the financed loans were sold or on the maturity date of the contract.[4]

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

[4]See: HomeBanc 2005 10-Q3 p 101 of 173.

[5]For a succinct description of repos see *Bevill, Bresler & Schulman Asset Management Corp. v. Spencer Sav. & Loan Ass'n* (1989) 878 F.2d 742, 743 (3d Cir. 1989).

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

banks and other financial institutions such as money market funds (MMFs), hedge funds, and IMCs.

The repo market consists of two segmented markets: the **bilateral** and the **tri-party** market. Lower overcollateralization rates or "haircuts" are charged in the tri-party market on the same collateral, due to lower counterparty risk. This is because traditionally more credit worthy market participants – such as large dealers and cash investors – trade in the tri-party market, the collateral is held by a clearing house (the third party), and the contracts are short-term in nature. The clearing house provides several important roles, such as settling and netting transactions, and the bankruptcy treatment of collateral affects the clearing house's ability to perform these functions. In the event of bankruptcy, the automatic stay would interfere with the timely settlement of collateral held in the clearing house's custodial accounts. The bilateral market is where opaque, less credit-worthy agents seek short-term funding. The cash borrowers in this market are riskier and face larger haircuts to protect the dealers lending to them.

The tri-party market is the market that connects dealers with nonbank cash investors such as 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. Dealers play an important role as repo intermediaries between cash lenders and cash borrowers across these markets. Dealers are likely to be cash borrowers (send securities out), in the tri-party market (Infante (2019)), and to be cash lenders (receive securities in) in the bilateral market (Copeland, Martin and Walker (2014)). Tuckman (2010) states that dealers prefer to use borrowed capital to finance their borrowing rather than to use their own scarce capital. Thus dealer repledge or rehypothecate collateral received in the bilateral market, in the tri-party market (Copeland, Martin and Walker (2014)). This reuse of collateral allows dealers to take advantage of the differential between haircuts in the bilateral and tri-party markets to generate a cash "windfall" (Infante (2019)).

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

Repurchase agreements using collateral defined in the bankruptcy code receive exemption from automatic stay. This grants the holder of the underlying collateral super-senior bankruptcy status since the collateral is exempt from the hold on a firm's assets when the firm enters bankruptcy proceedings. However additional types of collateral, not explicitly defined in the bankruptcy code, are also traded in the repo markets. All repurchase agreements are written with the standard contract in the hopes that the court will interpret them as receiving preferred bankruptcy status. However, the preferred bankruptcy status relies

on the court's interpretation (Lumpkin (1993)). The market contraction in response to two important bankruptcy court cases where the court failed to grant repo collateral preferred bankruptcy status, Lombard Wall (1982) and Criimi Mae (2000)– both heavily funded with repos – underscores this point. The market response to these court cases suggests that collateral must be legally exempt from automatic stay in order for cash lenders in the tri-party market to lend against it. I discuss these court cases further in the Appendix A in the Online Appendix.

BAPCPA was introduced in Congress in February 2005 and signed into law in April 2005.[7] The law expanded the definition of repurchase agreements in the Bankruptcy Code to include: (1) mortgage loans; (2) mortgage-related securities; (3) interests in mortgage-related securities or mortgage loans. This granted private-label mortgage securities and whole loans exemption from automatic stay, giving the final creditor super senior bankruptcy status. This expansion only affected private-label mortgage collateral, since agency mortgage collateral had been exempted in 1984. I hypothesize that this enabled the clearing house in the tri-party market to hold the collateral without worry that a counterparty's failure would trigger automatic stay.

These institutional details suggest that BAPCPA enabled dealers to reuse, or 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 present evidence consistent with this hypothesis from analyses on dealers' collateralized repo borrowing and MBS yields. In Appendix A in the Online Appendix, I provide evidence that participants in the tri-party market increased their lending against mortgage collateral, however, the mechanism will go through even if BAPCPA only increased dealers' reuse of private-label mortgage collateral in the bilateral repo market.

Conceptual Framework This section sets up the conceptual framework that depicts how the money multiplier works and generates predictions, which I empirically test in the following sections. I propose that prior to BAPCPA, 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. Following BAPCPA, I propose that dealers' reuse of mortgage collateral expanded, allowing them to generate a money multiplier by taking advantage of the differential between the haircut that they charged in the bilateral market relative to the haircut that they received in the tri-party market.

[7]The law was introduced in Congress on February 1, 2005 by Republican Senator Chuck Grassley, passed by Congress on April 14, 2005, and signed into law by the president of the U.S. 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. See: Bankruptcy Abuse Prevention and Consumer Protection Act of 2005, Pub. L. No. 109-8, §907, 119 Stat. 23, 171-172 (codified as amended at 11 U.S.C. §101(47) (2012))

In Figure 1, I depict a stylized example of the proposed change in dealers' ability to reuse the warehoused mortgage loans posted by an IMC prior to BAPCPA, in panel (a), versus after BAPCPA, in panel (b).[8] To simplify the exposition of the money multiplier, in (a) I depict the tri-party market refusing to lend against warehoused mortgage loans, corresponding to a 100% haircut. In (b) I propose that BAPCPA increased dealers' ability to reuse the collateral. This argument would go through if dealers were able to repledge whole mortgage loans from the mortgage warehouse, or if they were able to securitize the warehoused loans quickly and pledge the newly minted securities.[9]

[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 larger haircut differentials imply larger money multiplier potential. To establish the size of the haircut that dealers charged the IMCs in my data, I utilize data from a subset of the IMCs that report both their utilization on credit lines and the value of mortgages they post. This information allows me to estimate the haircut that IMCs paid. In 2005Q4 an *IMC* posted a 36% haircut to insulate dealers from the IMC's risk of default. 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* in the tri-party market, from close to 100% to 5%.[10]

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. In Figure 1, I depict this as a dealer paying $100 to buy mortgage collateral valued at $136, from the mortgage company in the bilateral market, with an agreement to sell it back in 60 days at $100. 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. The process would work as follows. If the dealer 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

[8] 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.

[9] From speaking with market participants, dealers were able to securitize collateral very fast, usually several days or weeks.

[10] Copeland, Martin and Walker (2014) documents that the haircut charged in the tri-party market on private-label mortgage collateral was 5% in July 2008. It is likely the haircut was 5% or lower directly following BAPCPA, since the use of private-label mortgage repo collateral was at an all time high.

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 mortgages to secure the repo loan. By repledging this $176.8 of mortgage collateral, the dealer could borrow $169 in the tri-party market. This cycle of lending to an IMC, receiving collateral from the IMC, repledging the collateral to a cash lender, and reinvesting the cash in the IMC could continue for many rounds.

This haircut differential would lead to a money multiplier, similar to the multiplier in the fractional reserve system. Moreover, the dealer has incentive to reinvest each round of cash back into private-label mortgages, because the haircut differential on this collateral means that each dollar reinvested would generate more than a dollar in the dealers' own borrowing potential, lowering the cost of capital. Additionally, although this example abstracts from an interest rate charged on the repo borrowing to simplify the exposition of overcollateralization, continuing this cycle of lending would allow the dealer to lever up the return that it received from the IMC in the form of interest rates on the warehouse repurchase facilities.[11]

Consistent with the collateral becoming a valuable tool to lower their cost of capital, I see the dealers offering increasingly favorable overcollateralization terms to the IMCs in my data post-BAPCPA. The haircut required is 36% in 2005Q4, 26% in 2006Q1, 11% in 2006Q2, 15% in 2006Q3, and 16% in 2006Q4. The slight increase in 2006Q3 and 2006Q4 could be driven by an increase in risk of underlying mortgages. As long as the IMC generated enough money from fees or interest on the mortgages originated, it would have enough equity to fund the haircut charged by the dealer. 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%.

The haircuts I calculate for the IMCs from 2005Q4-2006Q4 allow me to calculate an upper bound on the multiplier that dealers could generate following BAPCPA. 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.[12] Given the quarterly haircut differentials between

[11]Each additional round of lending to the IMC would increase the interest earned by the dealer. The 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.

[12]The 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.

2005Q4-2006Q4,[13] 15 rounds of lending across 15 months would create a multiplier equal to:

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

For comparison, in subsection A.7 of the Online Appendix, I illustrate that dealers could could generate infinite supply of credit and leverage if haircuts remained constant.

Using the multiplier in Equation 1, the dealer can supply $6,650 of credit to the economy with its initial $100 of funding. This implies that the dealer can expand its leverage secured by private-label mortgage collateral to 66.5 times its initial equity. This is 4.5 times the multiplier generated by rehypothecating Treasuries in the same way, described in subsection A.6 of the Online Appendix. This framework indicates that the credit supply increase caused by BAPCPA was larger than any credit supply increase resulting from the expansion of repo safe harbors to agency collateral in 1984 because the private-label collateral was riskier collateral and thus carried larger haircut differentials.

Decreasing the haircut that they charged the IMC would lower the money multiplier 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 quality 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[14] 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 2007, discussed in subsection A.8, is consistent with this narrative.

Figure 2 depicts the effect of the repo transactions from Figure 1 on the IMC's, dealer's, and cash lender's balance sheets. The figure shows that following BAPCPA, economic credit supply and leverage increase and the number of interlinked intermediaries increases from two to four if a clearing house clears the trade for the cash lender. The first round of funding is depicted in Figure 2 panel (a). The second round of funding, made possible by BAPCPA, is depicted in panel (b). I depict the IMC's second round of funding for $130 in red because it

[13]The earliest that IMCs report overcollateralization is 2005Q4 and the latest is 2006Q4. Dividing one plus each of these numbers by 1.05 as in Equation 16, yields the haircut differential utilized.

[14]In subsection A.3 of the Online Appendix, I discuss how the accounting treatment of repos pre-GFC likely allowed dealers to increase their leverage without increasing their reported leverage ratio.

is backed by $176.8 of runnable collateral. If the IMC withdrew the $176.8 of collateral from the dealer, the dealer would suffer collateral runs on its asset side as described in Infante and Vardoulakis (2021). I depict the dealer's $130 of repo funding from the MMF, collateralized by rehypothecated collateral, in dark blue because it is subject to repo runs on a dealer's liability side if cash lenders refuse to roll over their funding.

[Figure 2 about here.]

If BAPCPA's *exemption* from automatic stay, which allowed collateral to pass directly to the ultimate creditor in a bankruptcy event, was not upheld, an IMC bankruptcy could cause collateral runs on a dealer's asset side. Furthermore, since each IMC borrows from multiple dealers, a failure of one IMC could cause collateral runs on multiple dealers. Indeed in its 2007 bankruptcy, American Home Mortgage, an IMC, sued its repo lenders, Credit Suisse, Bear Stearns, and Calyon, asking the court to instate the automatic stay on its mortgage collateral.[15] Although BAPCPA's exemption from automatic stay was eventually upheld, the lawsuit would have frozen the collateral while the cases were decided; causing a form of collateral runs on the dealer's asset side. Additionally, one IMC failure would increase the likelihood of another since dealers respond to one IMC failure by calling margin on another (Kim, Laufer, Stanton, Wallace and Pence (2018)). Consistently, the majority of the 12 IMCs that I observe declared bankruptcy in 2007, triggered by failure to meet repo margin calls.

On a dealer's liability side, BAPCPA increased the fragility of repo interlinkages by decreasing the quality of their underlying collateral and heightening the importance of cross-default clauses built into them. Cross-default clauses stated that if a repo borrower missed a margin call with one lender it was in default with all of its lenders. By granting super senior bankruptcy status to repo mortgage collateral, BAPCPA enabled creditors to sell their collateral en masse during a cross-default event, increasing the risk of fire sales. Whereas prior to BAPCPA, creditors would have needed to wait in bankruptcy court to take possession of the collateral before selling it. In this way, BAPCPA increased dealer exposure to both collateral runs on their asset side and repo runs on their liability side.

[15] See Securities Industry and Financial Markets Association (SIFMA) amicus curiae brief for American Home Mortgage Holdings, Inc. v. Credit Suisse First Boston Mortgage Capital, LLC. Case No. 07-11047 (CSS) discussed further in subsection A.3 of the Online Appendix.

4 Expansion of Repledgeable Collateral

4.1 Motivating Facts

To understand whether enhancing creditor rights on the underlying mortgages increased reuse of the mortgage collateral, I first examine prices of private-label relative to agency MBS. I study the yields on both in the secondary market before and after 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.

$$\log(yield_{i,t}) = \omega Post_t + \nu PLS_i + \sum_T \beta_T \ PLS_i \times \mathbb{1}_{t=T} + \epsilon_{i,t} \tag{2}$$

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 introduction of BAPCPA in Congress, consistent with a relative increase in the price of PLS. This evidence is consistent with demand for PLS increasing after BAPCPA strengthened creditor rights on the mortgages underlying the PLS securities. Prior to the introduction of BAPCPA, 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. There had been drafts of the bill in Congress as early as 2002, however it was not thought that BAPCPA would pass until November 2004 when the Republicans gained seats in Congress.

[Figure 3 about here.]

Using dealer trading data from the FR 2004, in Figure 4, I show evidence suggesting 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 corporate securities, the collateral class containing private-label mortgage collateral. The *securities in* reports 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. Within a collateral class, if a dealer repledged out all of the securities that it received, 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 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.

[Figure 4 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 difference-in-differences (DiD) research design. BAPCPA affected repo at the national level. However, my identifying assumption is that dealers who had a larger fraction of their balance sheet exposed to private-label mortgage collateral at the time of BAPCPA would be more-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 to secure their own 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. I assume 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.

The private-label MBS market is split into the "Alt-A" segment and the subprime seg-

ment. Subprime refers to loans given to borrowers with low credit scores (Adelino, Gerardi and Hartman-Glaser (2019)). The Alt-A segment is commonly referred to as "near prime," and it is typically characterized as loans to borrowers with credit scores comparable to those in the "prime" market, but with either income and/or assets less than fully documented or non-owner occupancy status. In 2004, subprime mortgages comprised the lion's share of the private-label MBS market (Justiniano, Primiceri and Tambalotti (2017)). As I show in section 6 the "Alt-A" mortgage originations really began in response to BAPCPA.[16]

Thus I calculate PLS underwriting in the pre-period as the total value of subprime residential MBS deals underwritten and securitized by dealer in 2004. I scale the total value of deals underwritten by total book value of assets in 2004Q4 for each dealer,[17]

$$PLSUnderwriting_{j,2004} = \frac{\text{Total Value of Deals Underwritten}_{j,2004}}{\text{Total Assets}_{j,2004}}. \tag{3}$$

The drafts of the BAPCPA as early as 2002 alleviate concerns that more- versus less- treated dealers had differential information prior to November 2004. Additionally, 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.

In Table 1, 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. 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. Regulators subsequently imposed limits on the two companies' mortgage debt holdings.[18] The limits restricted Fannie Mae and Freddie Mac's creation of agency MBS, lowering barriers to entry for IMCs and private-label securitizations.

[Table 1 about here.]

The money multiplier described in the conceptual framework implies that, by repledging their mortgage collateral holdings immediately following BAPCPA, more-treated dealers

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

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

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

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 DiD regression to causally identify the effect of BAPCPA on dealers' repledgeable collateral:

$$\log(RepledgeableCol_{j,t}) = \eta_j + \omega Post_t + \beta Post_t \times PLSUnderwriting_{j,2004} + \epsilon_{j,t}. \quad (4)$$

Where $\log(RepledgeableCol_{j,t})$ is the log of the repledgeable collateral reported by dealer j at year t. $Post_t$ is an indicator variable that equals one for 2005 and later and zero otherwise. β 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 consists of 19 dealers, I calculate the 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.[19]

[Table 2 about here.]

I report the results of Equation 4 in Table 2. 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

[19]Imbens and Kolesar present Monte Carlo evidence that the resulting confidence intervals have good coverage even with as few as five clusters or unbalanced cluster size. I follow code provided by Gabriel Chodorow-Reich: https://scholar.harvard.edu/chodorow-reich/data-programs (Chodorow-Reich, Gopinath, Mishra and Narayanan (2018)).

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 them to capitalize on the largest haircut differentials between repo markets.

5 Expansion of Dealer Funding to Mortgage Companies

There are four ways dealers could increase funding to IMCs in response to BAPCPA: (1) increasing the value of credit lines to IMCs; (2) decreasing haircuts that they required IMCs to post; (3) walking down the quality curve on the types of mortgage collateral that they fund; and (4) lowering the interest rate on their credit lines to IMCs. In this section, I focus on the maximum value of credit lines that dealers send to mortgage companies to focus on dealer credit supply and discuss the additional channels at the end of this section.

5.1 Motivating Facts

I plot the average total value of warehouse credit lines extended to the IMCs in my sample pre and post shock in Figure 5. The figure shows that 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, I present the maximum value of credit lines offered to a representative IMC. The IMC receives credit lines from four dealers, Credit Suisse, Countrywide, UBS and IXIS. According to my research design, Credit Suisse and Countywide receive a larger credit supply increase from BAPCPA than do UBS and IXIS. Post BAPCPA, the more affected dealers, Credit Suisse and Countrywide, increased their credit lines by more than UBS and IXIS. All dealers increased or maintained their credit lines to the IMC, consistent with an overall credit supply increase.

[Figure 5 about here.]

[Figure 6 about here.]

5.2 Empirical Model

In order to causally link increased ability to repledge private-label mortgage collateral to increased supply of credit, 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 receives warehouse repurchase facilities from three or more dealers simultaneously.

I utilize the same research design as subsection 4.2. I define treated dealers to be those whose scaled value of PLS deals underwritten in 2004, from Equation 3, was in the top quartile:

$$Treated\ Dealer_j = \mathbb{1}[Top\ Quartile\ PLSUnderwriting_{j,2004}]. \tag{5}$$

The control dealers are the dealers in the bottom three quartiles.

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. 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 collateral post-BAPCPA, and (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 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:

$$\log(CreditLine_{i,j,t}) = \gamma_{i,t} + \eta_j + \sum_T \beta_T\ Treated\ Dealer_j \times \mathbb{1}_{t=T} + \epsilon_{i,j,t}. \tag{6}$$

Where $\log(CreditLine_{i,j,t})$ is the log of the credit line extended to IMC i by dealer j in quarter t. $Treated\ Dealer_j \times \mathbb{1}_{t=T}$ is the interaction term between the indicator variable for treated dealers and for each quarter pre- and post-BAPCPA. 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 can 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 the 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 the standard errors at the dealer level.

[Figure 7 about here.]

Figure 7 shows 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. 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.[20] 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 3 about here.]

The fixed effects strategy I use does not require that dealer supply shocks and IMC demand shocks be uncorrelated. 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 treated dealers could adjust their lending to IMCs prior to it. A benefit of my research design is that since there were early drafts of BAPCPA, 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 7 does not seem to be trending up in the pre-period. Furthermore, if there was an adjustment due to anticipation, this would bias my

[20] I run the equivalent regression to Equation 6, however with a single pre-period and a single post-period in order to estimate the cumulative effect of BAPCPA in the post period. $Post_t$ is an indicator variable that equals one for 2005Q2 and later and zero otherwise. Table 3 presents the results.

result downward since treated dealers would increase their lending relative to control dealers in both the pre-period and the post-period.

Another potential concern is that treated and control dealers are systematically different in ways that are not eliminated by looking at pretreatment dealer balance in Table 1. In order to alleviate this concern, I limit the analysis to just the primary dealers lending to mortgage companies. These are the 15 largest dealers who make the market for the U.S. Treasuries. These dealers likely have similar reputations and access to secured funding. Table 4 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. 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. The underwriting fee incentive would not be sufficient to generate the results found in Figure 7. I provide further discussion of underwriting fees in the subsection A.4 of the Online Appendix.

[Table 4 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. In Table 5, I present descriptive statistics showing that the treated and control IMCs had similar total assets,[21] number of mortgage originations, and originated mortgages in a similar number of counties in 2004.

[Table 5 about here.]

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:

$$CreditLine_{i,t} = \sum_{j} CreditLine_{i,j,t}. \tag{7}$$

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

In Equation 8, 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 the standard errors at the IMC level. As in Equation 4, due to the small number of clusters, I calculate the standard errors using the bias-adjusted cluster version of heteroskedasticity consistent standard errors and apply the "LZ2" correction to the standard errors, following Imbens and Kolesar (2016):

$$\log(CreditLine_{i,t}) = \beta\ Post \times Treated\ IMC_i + \gamma_i + \alpha_t + \epsilon_{i,t}. \tag{8}$$

The results in Table 6 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 increase in credit to treated IMCs over and above that of control IMCs. However, all dealers were eventually affected, which would increase the credit supply to both the treated and control IMCs.

[Table 6 about here.]

My results suggest that in response to BAPCPA, dealers expanded credit for risky mortgage products – consistent with the strengthened creditor rights allowing collateral quality to decrease while leaving its expected recovery value the same. Dealers loosened the covenants that they imposed in the form of funding sublimits on their credit lines. These sublimits specified the maximum amount of the credit line that could be allocated to fund certain types of mortgage loans. A subset of the twelve IMCs report the funding sublimits specified by their dealers. As plotted in Figure 8, the sublimits for interest-only, second-lien, jumbo, non-owner occupied, and 120-180 day past due loans doubled post BAPCPA. I do not observe dealers increasing credit lines for conforming mortgage products following BAPCPA. In subsection A.4 in the Online Appendix, I report sublimits on additional mortgage products and wet, or implicitly unsecured funding, by dealer.

[Figure 8 about here.]

6 Mortgage Company Lending

In this section, I study whether IMCs pass the credit supply increase along to households. Due to data limitations discussed in the data section, I conduct a county level treatment intensity analysis. I create the variable $IMCMarketShare_{c,2004}$ to capture the exposure of a county to the IMCs in 2004. I calculate this variable using the number of mortgage originations in the HMDA data:[22]

$$IMCMarketShare_{c,2004} = \frac{Number\ of\ originations\ by\ IMCs_{c,2004}}{Total\ number\ of\ all\ originations_{c,2004}}. \tag{9}$$

My preferred specification includes all originations by IMCs in the numerator. As discussed in the data section, the 12 IMCs originate the majority of all mortgages originated by IMCs in 2006 and engage in correspondent lending to other IMCs. The 12 IMCs each received the majority of their funding from overlapping subsets of the 29 largest dealers. Since these dealers were the largest, most interconnected, they were likely lending to the IMCs for which I am not able to collect data. Indeed, Stanton, Walden and Wallace (2014) find that dealer funded warehouse repurchase facilities dominate the IMC funding model. While the research design in subsection 4.2 and subsection 5.2 exploits heterogeneity in dealers' initial treatment intensity, all dealers were eventually exposed to BAPCPA; furthermore the research design utilizes both a narrow window around BAPCPA. Thus it estimates a lower bound of the credit supply increase since all dealers experienced an increased ability to reuse collateral that persisted longer than the window studied. The increased collateral reuse would increase all dealer credit supply and incentivize them to increase warehouse lending to IMCs, thereby affecting the vast majority of IMCs. In subsection B.3 of the Online Appendix, I present a robustness test that calculates the $IMCMarketShare_{c,2004}$ variable using just originations by the six IMCs with an above median fraction of total funding from the most-treated dealers and my results persist.

Figure 9 depicts all IMC market share per county in 2004. 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 IMCs to enter the mortgage market. Justiniano, Primiceri and Tambalotti (2017) and Drechsler, Savov and Schnabl (2021) show that events in 2003 led to a sudden surge in the private-label mortgage market.[23] The market share of IMCs

[22] I construct the 2004 IMC county market share using value of mortgage originations and find that the distribution of market share is very similar to the measure using number of originations.

[23] In subsection B.4, I find that although the market share of IMCs was rising during 2000 to 2003, the steep decline in agency mortgage originations in 2003 coincides with the increased relative share of IMC (and therefore private-label) originations. This is consistent with the Fannie/Freddie fraud cases restricting Fannie/Freddie market share.

however was relatively stable throughout 2004, the year that I define my treatment. To alleviate concerns that my results are driven by a pre-existing trend in IMC expansion, I examine pre-period home prices and income and include *state* × *month* and *county* fixed effects. In my home price analysis, I study a longer pre-period – almost two years, June 2003 to March 2005 – and establish pre-treatment parallel trends in home prices for treated and control counties. If an increased presence of IMCs in the mortgage market 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. I also find no statistically significant difference in the 1999 census per capita income in counties with high versus low IMC market share after controlling for state fixed effects. The pre-period balance in home prices and income helps to mitigate concerns that the treatment and control counties were significantly different in ways that varied with BAPCPA after controlling for fixed effects.

[FIGURE 9 about here.]

I investigate how $IMCMarketShare_{c,2004}$ affects county level mortgage characteristics and home prices. I run the following dynamic regression:

$$Y_{c,t} = \gamma_c + \eta_{s,t} + \sum_T \beta_T IMCMarketShare_{c,2004} \times \mathbb{1}_{t=T} + \epsilon_{c,t}. \quad (10)$$

Where $Y_{c,t}$ is the variable of interest in county c, at month t, γ_c denotes county level fixed effects, and $\eta_{s,t}$ denotes *state* × *month* fixed effects. $IMCMarketShare_{c,2004} \times \mathbb{1}_{t=T}$ is the interaction term between the market share variable, and an indicator variable for month of origination.[24] The reference month is March 2005, the month prior to the passage of BAPCPA. Standard errors are clustered at the county level. I report the regression results with *county* fixed effects alone and with both *county* and *state* × *month* fixed effects. The regression with both *county* and *state* × *month* fixed effects is my preferred specification as this regression compares mortgage characteristics in counties with high versus low IMC market shares within the same state and month, absorbing state-month housing market effects. For all of the mortgage characteristic regressions, I study a narrow window around BAPCPA. The narrow window, fixed effects, and stable pre-period IMC market share help to ensure that the pre period is a valid counterfactual for the post period. Callaway, Goodman-Bacon and Sant'Anna (2021) note that continuous treatment in a DiD setting can introduce bias if the estimator's weighting of treatment doses differs from the population-weighted treatment doses. In subsection B.2 in the Online Appendix, I show that the population-weighted

[24] I estimate the analogous regression, with a single pre and post period, for all independent variables studied in Equation 10 and report the results also in Table 9.

doses are close to normally distributed and therefore the estimator closely approximates the population weights, thus the potential bias would be small.

The first dependent variable that I study is $\log(Originations_{c,t})$. Originations include both refinance mortgages, and purchase mortgages.[25] Figure 10 (a) plots the evolution of the coefficient of interest, β_T – the effect of the interaction term between origination month and $IMCMarketShare_{c,2004}$ – from September 2004 to February 2006. The figure 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. A 10% increase in total IMC market share in 2004 leads to a significant 2.7% increase in total mortgage originations on average in the post period. The slight initial drop in originations following BAPCPA is due to IMCs' transition from subprime mortgage products to alternative mortgage products.

[Figure 10 about here.]

[Table 7 about here.]

Alternative products offered more potential to expand originations given their ability to lower initial monthly payments by using low introductory interest rates and negative amortizing features. These alternative mortgage products were classified as prime by CoreLogic. Prior to BAPCPA, the fraction of prime and subprime originations moved in parallel for high versus low IMC market share counties. Figure 10 (b) shows that following BAPCPA, counties with a higher market share of IMCs first began originating a significantly higher fraction of subprime and lower fraction of prime mortgages, before rigorously expanding into the prime market. This transition led to the slight relative decrease initially, followed by the robust expansion in originations in high IMC counties. It likely took a few months following BAPCPA for IMCs to pivot into alternative products as they had never been originated in such volume prior to 2005. This evidence is consistent with an already saturated subprime market limiting opportunities for credit supply expansion. In the subsection B.4, in the Online Appendix, the Federal Reserve's Loan Officer Survey suggests that mortgage demand prior to BAPCPA was declining.

I study the effect of BAPCPA on these non-traditional, alternative (Alt-A), mortgage products that were near prime in borrower credit score but had riskier payment schedules. Balloon mortgages, including ARM balloons, 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

[25] As a robustness test, I estimate purchase and refinance originations using the HMDA data. I also estimate all analyses using CoreLogic mortgage originations aggregated to the county month level. Results remain consistent and are reported in the Online Appendix or on request.

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 the home is sold. Gerardi, Herkenhoff, Ohanian and Willen (2017) find that negative equity is a quantitatively important factor in default for strategic motives.

I estimate the dynamic regression in Equation 10, 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 10 (c) 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. Similarly, I find that the fraction of negative amortizing mortgages increases and the fraction of owner-occupied mortgage originations decreases in counties more exposed to IMCs following BAPCPA (see Table 10 in the Online Appendix).

I also estimate Equation 10 to study the effect of $IMCMarketShare_{c,2004}$ on introductory mortgage interest rates. I limit the sample to only ARM originations and study the average initial interest rates charged in a county pre- and post-BAPCPA. In Figure 10 (d), I plot the response of the $\log(Initial\ Interest\ Rate_{c,t})$, along with the twelve-month Treasury rate, to which IMC financial reports state ARMs were pegged during this period. Prior to BAPCPA, 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 initial interest rate. The twelve-month Treasury rate over this period increased monotonically. This evidence is consistent with mortgage companies originating mortgages with low initial "teaser" rates. These rates did not reflect the interest payment required to fully amortize the loan but rather an artificially low rate advertised to attract potential borrowers. The rates reset to the actual interest rate after a specified point in time, increasing the risk of "payment shock" to the borrower.

The results suggest that BAPCPA's super senior creditor rights on loans in the mortgage warehouse led dealers to expand funding for alternative mortgage products as shown in Figure 8 and the IMCs to increase originations of them. The results suggest these products lowered near-term mortgage payments at the peak of the housing boom to increase demand when conforming mortgages were expensive. Due to their payment structure however, these products were vulnerable to home price declines and interest rate increases.

If the loans originated post-BAPCPA by IMCs are riskier, the default hazard rate should

increase in counties with higher IMC market share as of 2004. To test this, I limit the dataset to loans that were originated from November 2004 to September 2005, a five-month window around the passage of BAPCPA. I set 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:

$$Defaulted\ Loan_l \quad = \quad \gamma_c + \eta_{s,t} + \beta\ Post_t \times IMCMarketShare_{c,2004} + \epsilon_l. \tag{11}$$

A 10% increase in IMC market share significantly raises the hazard rate on mortgages originated post shock by 1.4 percentage points. I report the regression results for Equation 11 in Table 9 (columns labeled HzdRt). This table also reports the regressions estimated in Equation 10 with a single pre- and post-period, to understand the overall effect of BAPCPA on the housing market. I find a 9.1% increase in IMC originations in response to BAPCPA.[26] I utilize my estimate of the default hazard rate to estimate a 70% implied marginal hazard rate on mortgages originated in response to BAPCPA. Applying the marginal hazard rates to the increase in originations, BAPCPA accounts for 38% of defaults among all loans originated during 2005 and 2006. I describe these calculations in subsection B.6 of the Online Appendix.

This increase in defaults has implications for our understanding of the GFC because one key feature of the crisis was an unexpected level of mortgage defaults. The results support the increase in alternative products found in Justiniano, Primiceri and Tambalotti (2017); 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 after controlling for borrower characteristics; as well as the result in Ospina and Uhlig (2018) that prime MBS performed significantly worse than subprime MBS. These events are not likely to be unique to mortgages. If commercial real estate (CRE) loans or collateralized loan obligations (CLOs) were granted preferred bankruptcy status in repo markets, there would likely be a similar chain of events. Private originators, facing a fixed supply of creditworthy borrowers, would originate products with riskier amortization structures or lower credit quality to meet increased capital-market demand for the collateral.

To understand whether increased mortgage originations drove up home prices by increasing the demand for homes, I estimate Equation 10 where the dependent variable is

[26] I multiply 26.8%, the estimated increase in mortgage originations caused by a 100% increase in IMC market share (Table 9), by the total market share of IMCs in the pre-period, which was 34%. This is an underestimate of IMC market share since it is calculated using the HMDA data, which does not account for mortgage purchases from correspondent lenders.

$\log(HomePrice_{c,t})$ over the period from June 2003 to December 2008. Figure 10 (e) shows the dynamic response of home prices in a county to the 2004 market share of IMCs in that county. Prior to BAPCPA, IMC market share in 2004 was not associated with a differential change in home prices. Post-BAPCPA, a 10% increase in market share leads to a significant 2.1% increase in home prices between April 2005 and November 2006 followed by a steep and significant decline in home prices from January to December 2008. A 10% increase in 2004 market share leads to a significant 3.3% decrease in home prices during 2008, relative to their pre-period level. This evidence is consistent with the rise in defaults among loans originated post-BAPCPA as well as with the wave of IMC bankruptcies caused by margin calls on their repo credit lines. The results suggest that the credit supply increase drove up demand for homes in the counties most exposed to alternative products and initially masked their fragility.

In Appendix C 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 increase banks' operational advantage consistent with dealers' increased ability to reuse collateral following BAPCPA. In response, the model predicts that dealers increase their leverage and the amount of credit supplied to the economy. Relative to the baseline model, this amplifies the price increase of capital in a boom and its decline in a bust, consistent with the empirical results of this paper. Increasing banks' operational advantage also increases the probability of a bank run in every state, which is consistent with the GFC experienced in 2008.

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 collateral reuse functions like a money multiplier, creating a positive credit supply shock. Finally, this paper documents that the pass-through of the credit supply increase from the repo market to the housing market, created by BAPCPA, was economically large, contributing to both the housing boom and its bust.

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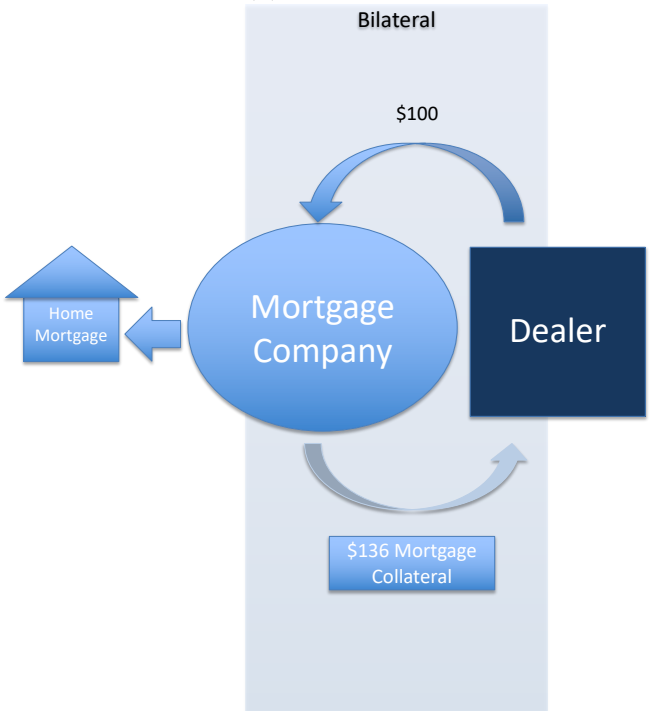
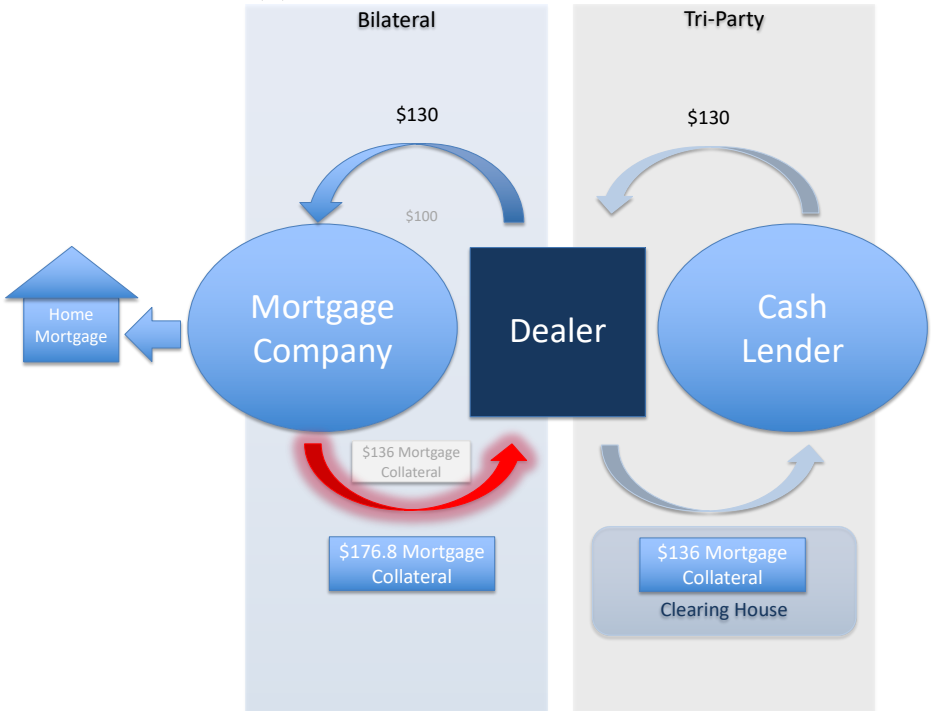
FIGURE 1: REPO MARKETS BEFORE AND AFTER BAPCPA 2005

(a) Repo markets before BAPCPA



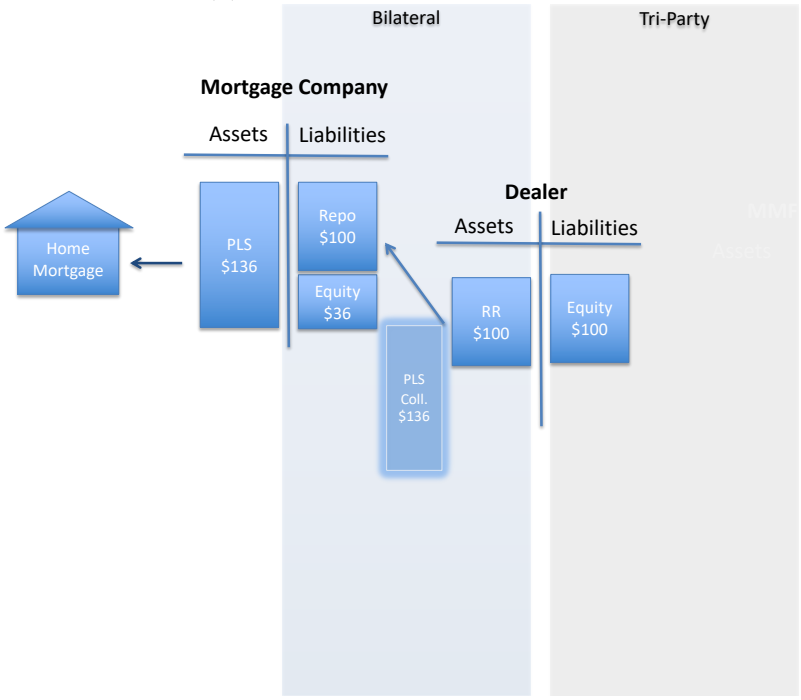
(b) Repo markets after BAPCPA



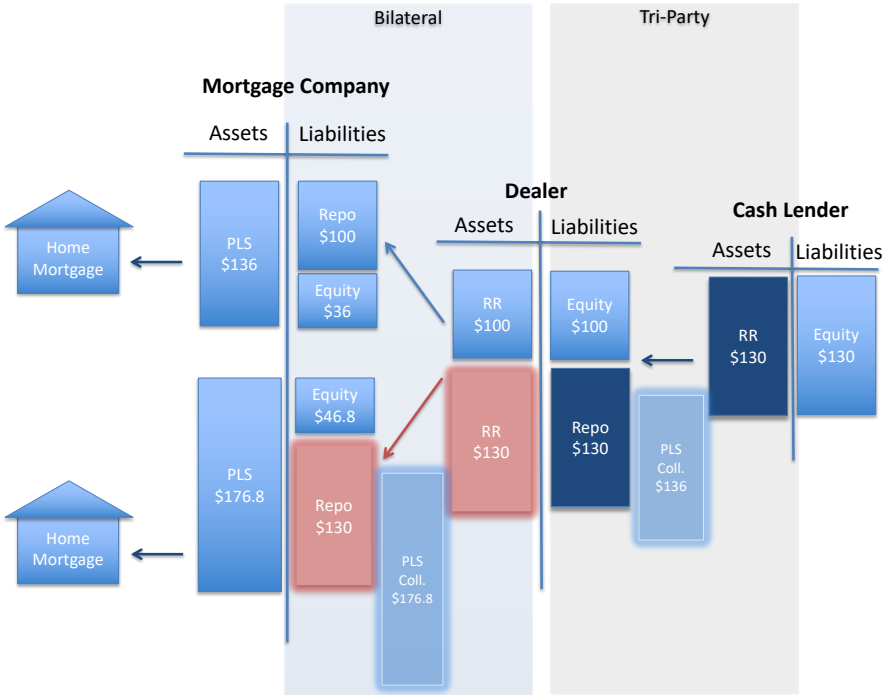
Notes: Figures depict the process by which a dealer can borrow and lend funds via the tri-party and bilateral repurchase market respectively, using the same underlying private-label mortgage collateral provided by the cash borrower for both contracts. Figure (a) depicts the "first round" of lending from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

Figure 2: Repo Money Multiplier

(a) Repo markets before BAPCPA

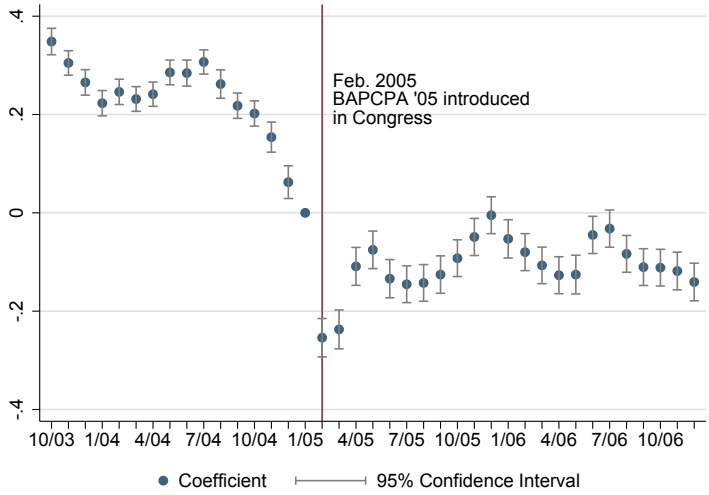


(b) Repo markets after BAPCPA



Notes: This figure depicts the increase in interlinkages, liabilities, and amount of mortgage originations resulting from BAPCPA. "RR" represents reverse repo and "PLS" indicates private-label mortgage collateral. Figure (a) depicts the "first round" of dealer lending to an IMC, possible pre-BAPCPA. Figure (b) depicts balance sheets after both a "first round" and "second round" of funding, possible post-BAPCPA. 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

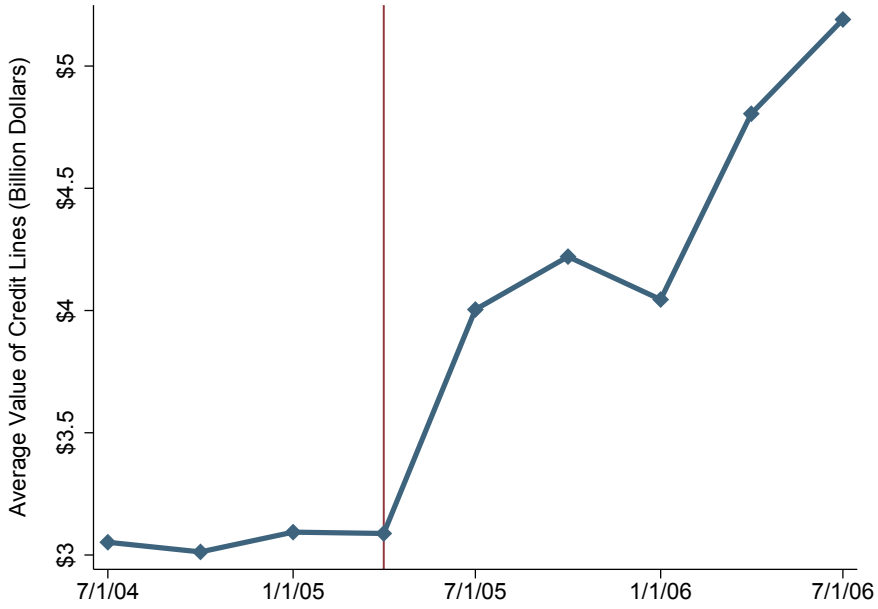


Notes: Figure plots the dynamic response of private-label MBS relative to agency MBS yields pre vs. post the introduction of BAPCPA 2005 in Congress on February 1, 2005. I estimate Equation 2. β_T is the coefficient of interest. It is the coefficient on the variable that interacts the indicator for PLS 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

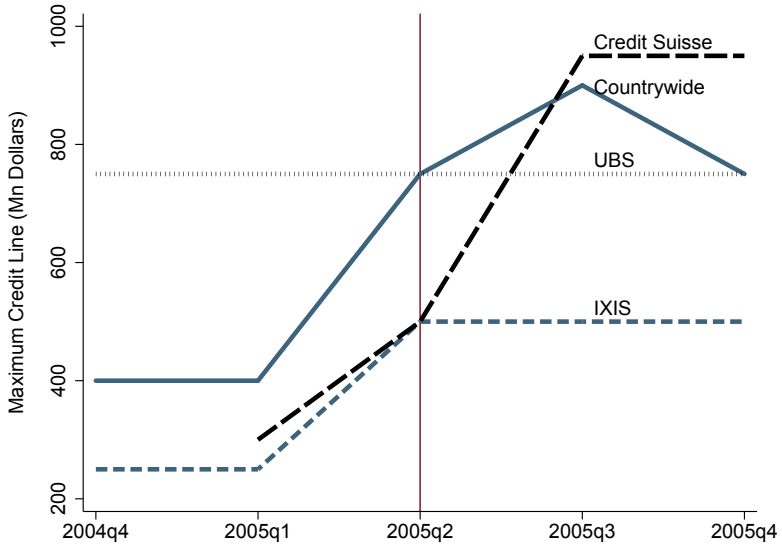
Notes: Figure plots the weekly time series of dealer net borrowing backed by private-label mortgage collateral, calculated by secured borrowing (securities out) minus dealer secured lending (securities in) in the collateral class corporate securities reported in the FR 2004. In subsection 2.2 and in 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: Average Credit Lines to Mortgage Companies



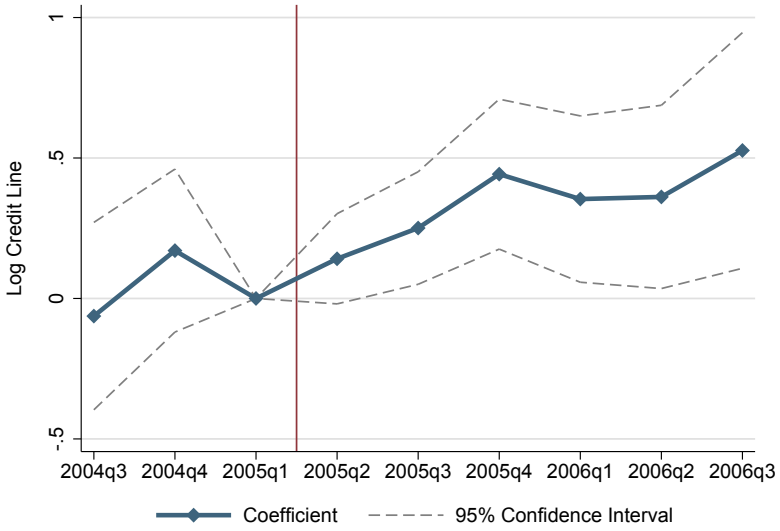
Notes: Figure plots the average total value of credit lines available to an IMC. Post BAPCPA, the average total credit extended to an IMC began to increase. This data is compiled from IMC quarterly filings. Figure includes all twelve IMCs in my regression analysis as well as GMAC which only reports aggregate data on the warehouse credit lines that it receives.

Figure 6: Maximum Credit Lines to an Example Mortgage Company



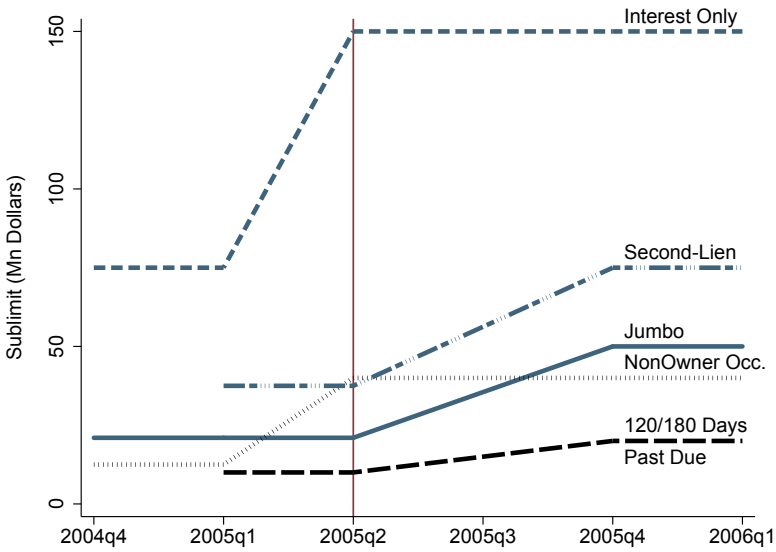
Notes: The figure plots the maximum credit line values extended to an example mortgage company by dealers pre and post BAPCPA. Credit Suisse and Countrywide are treated dealers. Although all credit lines increased following BAPCPA, Credit Suisse and Countrywide increased their credit lines to the mortgage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

Figure 7: Effect of Dealer Treatment on Credit Lines to Independent Mortgage Companies (IMC)



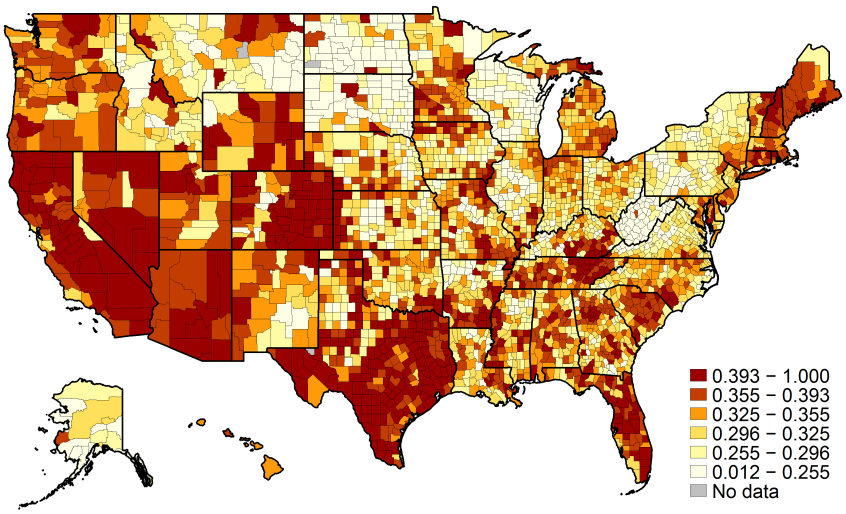
Notes: Figure plots the dynamic response of treated relative to untreated dealer funding within a given IMC pre and post BAPCPA. I estimate Equation 6. I plot the coefficient of interest, β_T. It is the coefficient on the indicator variable that interacts dealer treatment with an indicator for each quarter 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 8: Maximum Credit Lines to an Example Mortgage Company



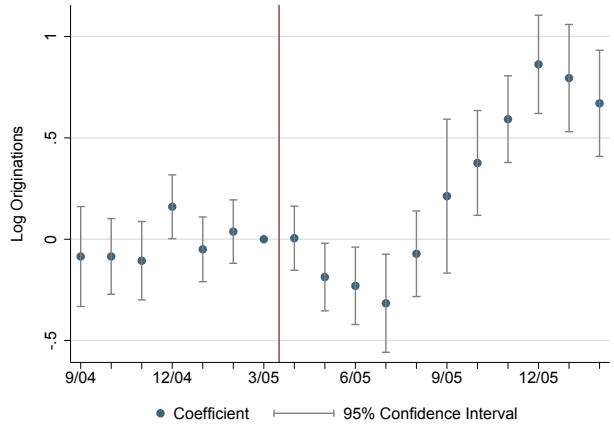
Notes: The figure plots the sublimit of funding available to fund certain mortgage products. The dealers would specify the maximum amount of funding per credit line available to fund certain mortgage products. The figure suggests that following BAPCPA dealers increased funding for riskier mortgage products.

Figure 9: Independent Mortgage Company (IMC) Market Share

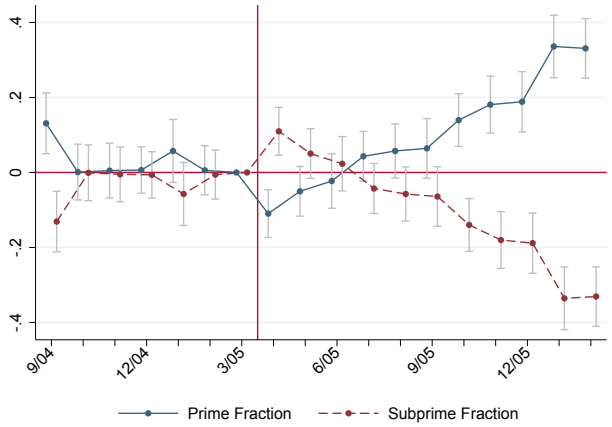


Notes: The figure depicts the county level market share of all IMCs reported in 2004. The market shares are calculated using the 2004 HMDA data.

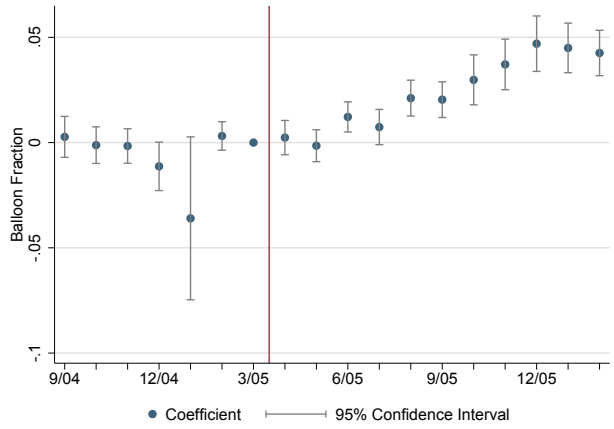
FIGURE 10: IMC COUNTY MKT SHARE EFFECT ON MTG CHARACTERISTICS



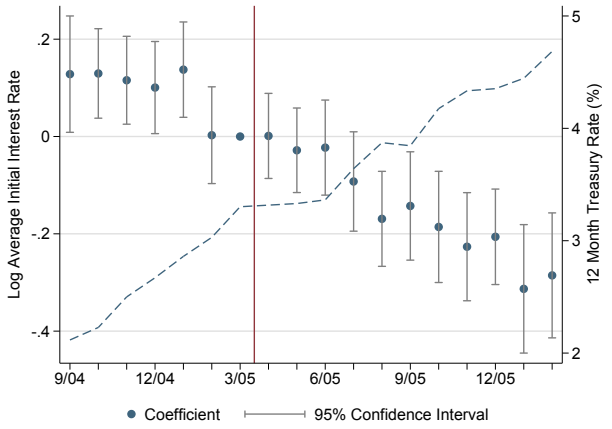
(a) Originations



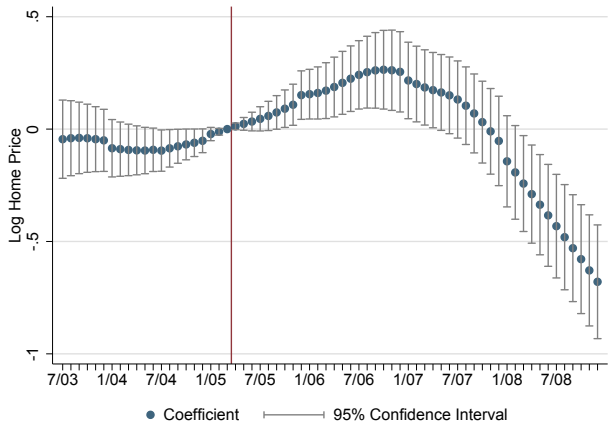
(b) Fraction Prime/Subprime



(c) Fraction Balloon



(d) Initial Interest Rates on ARMs



(e) Home Prices

Notes: Figures plot the dynamic response of mortgage characteristics in a given county to the 2004 IMC market share in that county. I estimate Equation 10. β_T is the coefficient of interest. It is the coefficient on the variable that interacts $IMCMarketShare_{c,2004}$ with month. I use the public HMDA data to compute the 2004 county level IMC market share and CoreLogic and the county month HMDA data to study originations.

Table 1: Dealer Descriptive Statistics (2004)

	Mean (Control)	Mean (Treated)	Difference	T-stat	P-value
Number of Counties	1795	1705	90	.14	.890
log(Originations)	6.24	6.17	.07	.06	.955
N	14	7			
log(Total Assets)	20.00	20.00	.01	.01	.989
log(Total Liabilities)	19.94	19.95	-.003	-.005	.996
log(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 repledgeable collateral (within IMC, across dealer) analysis. 7 (5) of these dealers' balance sheet data I am not able to collect and I do not observe their mortgage originations in the HMDA data. These dealers all underwrote $0 of subprime residential mortgage-backed security deals in 2004.

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

Table 2: Dealer Repledgeable Collateral

	(1) log(RepledgeableCol)
Post	0.080
	(0.235)
Post × 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 4. 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 3: Within Mortgage Company Across Dealer Analysis

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

Notes: Table reports the response of treated dealer funding relative to control dealer funding within a given IMC pre versus post BAPCPA. I estimate

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

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 4: 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

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

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 5: 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 6: 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 8. Treated dealers are those who receive an above median fraction of their credit lines from treated dealers ($\geq$ 0.428) in 2005Q1, the quarter before BAPCPA was passed. The result suggests that treated IMCs receive a significant increase in total credit supplied relative to control IMCs post BAPCPA.

Table 7: 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)	
	All IMCs Affected											
$Post \times IMCMktShr_{c,04}$	0.375***	0.268***	0.005***	0.030***	0.175***	-0.239***	0.331***	0.141***	0.443***	0.209**	-0.333***	-0.329***
	(0.013)	(0.080)	(0.001)	(0.004)	(0.006)	(0.033)	(0.058)	(0.044)	(0.094)	(0.082)	(0.106)	(0.114)
CountyFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
r2	0.9642	0.9947	0.1507	0.5239	0.8543	0.9482	0.0402	0.0447	0.9768	0.9957	0.9702	0.9919
N	8728	8572	9000	8874	9000	8874	355154	355134	19232	18929	15831	15628

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

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

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. At the county level, the specification measures the fraction of loans originated 5 months prior to April 2005, that ever defaulted, and compares it to the fraction originated just post April 2005, that ever defaulted, as a function of all IMC market share. γ_c represents county level fixed effects, $\eta_{s,t}$ represents $state \times month$ fixed effects, $IMCMarketShare_{c,2004}$ is the IMC county level market share in a given county in 2004, the year before the shock occurs. β is the coefficient of interest. It is the coefficient on the interaction between $IMCMarketShare_{c,2004}$ and the post period. This coefficient measures the change in the dependent variable if $IMCMarketShare_{c,2004}$ increased from 0% to 100%. I use the Public HMDA data to compute the 2004 county level IMC market share and the county month HMDA data to study originations.[a] I use CoreLogic LLMA data to study mortgage characteristics and Zillow's ZHVI to study home prices.

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

Appendix for Online Publication

A Mortgage collateral in the repo markets

A.1 Measurement of repurchase agreements from FR2004

Corporate Securities include private-label mortgage backed collateral in the category "other." Indeed, the FR 2004 Government Securities Dealers Reports Instructions for January 2013 and earlier state that the other category included Collateralized Mortgage Obligations and Real Estate Mortgage Investment Conduit (REMICs) (including residentials), issued by entities other than the Government Sponsored Enterprises (GSEs), and privately placed securities.[27] 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.[28] This line item is likely to understate the value of private-label MBS instruments used if it does not include whole loans since BAPCPA exempted whole loans from automatic stay.

After March 27, 2013, the line item previously reported as "corporate securities" is now separated into four different variables: (1) corporate debt, (2) asset-backed securities, (3) equities, and (4) other. Other includes all other dollar denominated debt instruments used as collateral including non-agency or GSE-issued MBS, CMOs, REMICS, and State and Municipal securities, excluding financing arrangements where the underlying collateral consists of international securities, whole loans, or money market instruments such as negotiable CDs and bankers' acceptances.[29]

On June 13, 2018, "other," comprised of private-label mortgage collateral, comprised

[27] Available at: https://www.federalreserve.gov/apps/reportforms/reporthistory.aspx?sOoYJ+5BzDZq2f74T6b1cw==.

[28] Matching instructions from pre March 2013 indicates that Corporate Securities is comprised of: (1) non-agency residential MBS, (2) other CMBS, (3) corporate securities commercial paper, (4) corporate securities investment grade bonds, notes, and debentures of various maturities, (5) corporate securities below investment grade bonds, notes, and debentures of various maturities, (6) State and Municipal government obligations of various maturities, (7) credit card-backed, student loan-backed, automobile loan-backed, other asset-backed securities.

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

14% of the total of corporate debt, asset-backed securities, equities, and other combined.[30] 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 2007, securities lending activity has decreased substantially due to changes in the economics of the business. Following the GFC, originations of private-label mortgages almost completely stopped.

Consistent with the view that private-label collateral made up a large fraction of corporate securities, there is a steep and pronounced decline in the measure in Figure 4 beginning in August 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.

A.2 Repo collateral treatment pre-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)).

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

Congressman Walter Fauntroy, one of the sponsors of the repo exemption from automatic stay in 1984, reported that Lombard-Wall alarmed market participants, magnifying their uncertainty and slowing the growth of repos [31] 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.'" [32] In June 1984, in response to the court case, Congress enacted the Bankruptcy Amendments Act of 1984 which amended Title 11 of the U.S Bankruptcy Code to exempt repurchase agreements in Treasury, agency securities, certain CDs and bankers acceptances from the automatic stay provision of the Bankruptcy Code. This resolved the question about the status of repo collateral in bankruptcy proceedings by enabling lenders to liquidate the underlying securities whether the court interpreted the repo as an outright purchase and sale or as a secured loan (Lumpkin (1993)).

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.[33] The Criimi Mae ruling, that the mortgage repo collateral was not an outright sale and would therefore be subject to automatic stay, profoundly disturbed the repo industry (Schroeder (2002)). It set the precedent that mortgage repo collateral would not receive preferred bankruptcy status.

A.3 Bilateral repo from dealer perspective

In Figure 11, 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.

[31] (statement of Del. Walter Fauntroy).

[32] 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.

[33] See: Schroeder (2002) p. 567. 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.

[FIGURE 11 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 Securities Industry and Financial Markets Association ("SIFMA") submitted an amicus curiae brief stating that the central issue before the court is whether the mortgage loan Master Repurchase Agreement among CSFB and AHM dated September 13, 2006 (the "American Home Repo"), inclusive of the mortgage servicing 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. AHM argued that since servicing rights of the underlying mortgage loans had not been transferred, AHM maintained control of the mortgages posted in the warehouse as collateral, and therefore the lending arrangement should not be classified as a repo. Thus AHM requested that the court uphold the automatic stay and restrict CSFB from seizing all mortgage loan servicing documents in furtherance of its right to liquidate the position.

SIFMA's amicus curiae brief implored the court to characterize the agreement as a repurchase agreement. It stated 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 will have far reaching negative implications for the U.S. capital markets and the increasingly fragile U.S. economy."[34] SIFMA's warning that the court's failure to uphold the exemption from automatic stay would have far reaching negative consequences underscores the importance of the preferred bankruptcy status in allowing mortgage collateral to become so widespread in the repo markets. On page 6, the brief states that the court's decision would affect $6 trillion repos and that CSFB 's rights accorded by the repo included seizing the underlying loan documents to facilitate liquidation. Both the $6 trillion size and the need for loan documents to facilitate prompt liquidation of the collateral are consistent with whole mortgage loans being traded in the tri-party repo market.

The brief goes to lengths to explain 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. This is consistent with both Congress and SIFMA knowing that packages of whole mortgage loans would be pledged and repledged as collateral, and that any quandary as to whether this collateral received preferred bankruptcy status would severely disrupt its use in the repo markets. I include relevant excerpts from the amicus curiae brief below.

Prior to BAPCPA, "repurchase agreement" was defined as:

[34] American Home Mortgage Holdings, Inc. v. Credit Suisse First Boston Mortgage Capital, LLC. Case No. 07-11047 (CSS) pp. 1-2.

> [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.)

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.[35]

By granting repos backed by private-label mortgage collateral preferred bankruptcy treatment, BAPCPA enabled private-label mortgage collateral to fulfill (1) above.[36] When the mortgage company allowed collateral to be repledged, (2) and (3) would be fulfilled.

Treating a repo as a sale would remove the assets from a dealer's balance sheet. Figure 12 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." [37] I observe the language in the quarterly filings of a subset of the IMCs that I study change from "*warehouse lines*

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

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

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

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

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 12 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.[38] 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.

In Figure 5 (b), I plot the average number of dealers that an IMC was borrowing from pre and post BAPCPA. Prior to the shock an average of five dealers were lending to IMCs. Following 2005Q2 the average number of dealers lending to an IMC began to increase. By 2006Q1, the number increased to seven.

[FIGURE 13 about here.]

A.4 Bilateral repo from IMC perspective

Dealer Covenants on Credit Lines Almost all of the IMCs that I observe classify as real estate investment trusts (REITs). Using a snapshot of data from early 2015, Baklanova, Caglio, Cipriani, Copeland et al. (2016) finds that REITs enter into the bilateral repo market to secure funding. Dealers extended credit to IMCs via both *dry* and *wet* funding. Dry funding is when the mortgage company posts as collateral mortgages that have already been created and transfers the loan documents prior to receiving the line of credit. Wet funding is implicitly unsecured funding. It takes place when the IMC has

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

not yet originated the mortgages posted as collateral and therefore transfers no loan documents prior to receiving the line of credit. In Figure 15 through Figure 18, I find that all of the dealers extending credit to an example mortgage company in my sample increased their sublimits on wet funding. Since the collateral backing wet funding has not been created yet, this form of collateral was exposed to more risk and was traditionally more expensive for a mortgage company than dry funding. All four of the dealers that report wet funding in my sample increase their wet funding 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 14, 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 14 about here.]

I also find that credit lines for the riskiest mortgage products increased. For example in Figure 15, 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 18, 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 15 about here.]

[FIGURE 16 about here.]

[FIGURE 17 about here.]

[FIGURE 18 about here.]

[FIGURE 19 about here.]

Dealer Underwriting Fee Discussion 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 3, the underwriting fees alone could not generate the increasing effect seen in Figure 7. 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. Lending \$0.0035 out to the IMC would generate $\$0.0035^2$ that the dealer received in underwriting fees in the second round, available to be lent out again, and so on. This is a converging series and the multiplier that

the dealer can generate is converging to 1.0035, the incremental value in underwriting fees available to be lent out in subsequent rounds is converging to zero.[39] While a control dealer, who 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. The dynamic coefficient β_T in Equation 6 would be converging to zero and the result in Figure 7 would be decreasing rather than increasing. β_T would converge to zero faster as more control dealers began underwriting PLS deals as occurred in 2005 and 2006 (Nadauld and Sherlund (2013)). The increasing result plotted in Figure 7 is consistent with increased rehypothecation allowing treated dealers to be "first movers," able to take advantage of the largest haircut differentials immediately after BAPCPA, as discussed in subsection 4.2.

A.5 Tri-party repo market

The clearing house in the tri-party repo market provides several important roles including taking custody of securities, valuing securities, settling transactions and netting transactions across dealers.[40] When 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.

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 A, 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.

[39] The underwriting fees would generate a lending process, for treated dealers, that looked like $1+0.0035+0.0035^2+...$. The formula to find the value of the portfolio that this process could create is $\sum_{i=1}^{\infty} 0.0035^i = \frac{1}{1-0.0035} = 1.00351$. While a control dealer underwriting $0 in MBS deals would have the process $1+0+0+...=1$.

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

In Figure 20, I plot dealers' securities out (borrowing) collateralized by agency[41] and by private-label[42] 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%. This is 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 20 about here.]

To test the statistical significance of dealers' increased use of private-label collateral to borrow following BAPCPA, Equation 12 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.[43] Table 8 reports the regression results. The coefficient on the interaction term estimates a statistically significant 18.6% increase in private-label securities out relative to agency securities out in the post period, consistent with an increase in dealers' ability to borrow against private-label mortgage collateral.

[TABLE 8 about here.]

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.

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

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

[43] From January 1, 2001 through July 31, 2007, Equation 12 estimates the following regression on both the log value of securities out and the fraction of total securities out (total borrowing).

$$Y_{i,t} = \omega Post_t + \nu PLS_i + \beta Post_t \times PLS_i + \epsilon_{i,t} \quad (12)$$

$Y_{i,t}$ is set equal to both the log value of securities out and the fraction of total securities out. For collateral class i at time t, $Post_t$ an indicator variable that is equal to zero prior to April 15, 2005 and equal to one on this date and later. PLS_i is an indicator term that is equal to one for private-label mortgage collateral and zero for agency mortgage collateral. $Post_t \times PLS_i$ is the interaction of interest. The coefficient on the interaction term measures the difference in borrowing backed by private-label and agency mortgage collateral after BAPCPA, less the difference between the two prior to the shock.

> [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.)

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 21 about here.]

A.6 Money multiplier created by reusing Treasury securities

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)).[44] This yields the following common ratio for the multiplier created by Treasuries in the same way

$$\frac{1.00}{1.0091} = .99 < |1|. \tag{13}$$

[44] July 2008 is the earlist that the 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.

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

$$1 + 0.99 + 0.99^2 + ... = \sum_{i=0}^{\infty} 0.99^i = 100. \tag{14}$$

Since the common ratio is $0.99 < 1$, the series converges to 100, whereas the multiplier on private-label mortgage collateral in Equation 17 diverges to infinity. The multiplier generated by rehypothecating Treasuries for 15 rounds is given by

$$\sum_{i=0}^{15} 0.99^i = 14.9. \tag{15}$$

A.7 Money multiplier created by reusing private-label mortgage collateral - constant haircuts

If haircuts remained constant, the money multiplier that can be calculated using the common ratio for a geometric series calculated as

$$\frac{1.36}{1.05} = 1.30 > |1|. \tag{16}$$

The final amount of both credit supplied to the mortgage companies and dealer leverage resulting from this process would be calculated by the following series

$$1 + 1.3 + 1.3^2 + ... = \sum_{i=0}^{\infty} 1.3^i = \infty. \tag{17}$$

The series in Equation 17 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 supply infinite credit and become infinitely levered in this position if the market did not impose a limit.

A.8 Run on repo - Northern Rock

Shin (2009) (p. 102) 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.

A.9 Federal Reserve's use of 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."[45] 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.

B Mortgage company lending

B.1 Mortgage Demand

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 23 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 20% fewer of respondents reported an increase in mortgage demand from mid-2003 through early-2005. The figure suggests that leading up to BAPCPA there was decreasing reported mortgage demand since mid-2003. Reported demand only began to increase post BAPCPA after a reported decline in

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

underestimating standards, likely driven by BAPCPA for the reasons discussed in the text. The resulting increase in demand fell short of its pre-2003 levels. The figure suggests that the increase in mortgage originations following BAPCPA in counties exposed to IMCs was driven by an increase in credit supply rather than an increase in mortgage demand.

[FIGURE 22 about here.]

B.2 Empirical Model - Continuous DID Weights

Callaway, Goodman-Bacon and Sant'Anna (2021) note that bias in the continuous difference-in-differences setting can arise when the weights of treatment doses used in the estimator are not similar to the actual treatment dose distribution in the population. Theorem 3 part 2 of the paper states that under the strong parallel trends assumption, when the distribution of the treatment dose in the population is symmetric and closer to normal, the two-way fixed effect (TWFE) estimand can be close to or even identical to weighting average causal response (ACR(d)) parameters by the distribution of the treatment dose. In the continuous (Cont) or multivalued (MV) treatment case, the TWFE estimator can be decomposed as follows:

$$\beta^{twfe} = \int_{d_L}^{d_U} w_1(l) ACR(l) dl + w_0 \frac{ATE(d_L)}{d_L}, \qquad (Cont)$$

$$\beta^{twfe} = \sum_{d_j \in D_+} w_l(d_j) \frac{ACR(d_j)}{d_j - d_{j-1}}, \qquad (MV)$$

Where the weights are equal to

$$w_1(l) := \frac{(\mathbb{E}[D|D \geq l] - \mathbb{E}[D])P(D \geq l)}{var(D)} \; and \; w_0 := \frac{(\mathbb{E}[D|D > 0] - \mathbb{E}[D])P(D > 0)d_L}{var(D)}$$

I calculate a histogram of the treatment doses of $IMCMarketShare_{c,2004}$ for the counties used in the regression analysis. I find that $IMCMarketShare_{c,2004}$ is symmetric and close to normally distributed. I then calculate the weights used in the TWFE estimator and find that the weights closely track the population distribution of treatment. Under the strong parallel trends assumption, this indicates that the TWFE estimand found in the regression analysis will be a close approximation of the desired weighted average causal response of treatment.

[FIGURE 23 about here.]

If strong parallel trends does not hold, the population weights being similar to the TWFE will not eliminate bias. This is because there still may be bias in the treatment response at

each dose. In my setting the bias is likely to be small. The Fannie Mae and Freddie Mac fraud cases, which placed limits on Fannie/Freddie debt levels and limited their ability to fund mortgages, plausibly exogenously lowered barriers for entry for IMCs to enter counties, driving variation in the IMC market share. This growth in IMCs was concentrated in 2003 and had stabilized by 2004. I calculate my treatment measure in 2004. Treatment is also well distributed across the United States. IMC populated areas are similar in the pre-period income levels and home prices after taking out $state \times month$ and $county$ fixed effects. This alleviates worries that the areas were significantly different along dimensions that would bias the results. I also conduct my analysis over a relatively short window, ten months post treatment, to help ensure that the post period is a valid counterfactual for the pre-period.

Additionally, although the TWFE weights and the population weights are very similar, the TWFE weights slightly overweight lower treatment doses relative to higher treatment doses. This would bias the estimand downward. If we thought that strong parallel trends may not hold and "selection bias" was likely to be higher at higher treatment levels, this underweighting of higher treatment levels would help to mitigate selection bias in the TWFE estimand.

B.3 Empirical Model - Six Treated IMCs

My preferred specification is the all IMC analysis since Stanton, Walden and Wallace (2014) find that after accounting for both mortgage originations and purchases from correspondent lenders, five of the 12 IMCs in my dataset originate at minimum, 49% of all IMC mortgage lending in 2006. 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, among the 12 in my data, I estimate the total market share of IMCs captured in my data accounts for 59% of all originations made by IMCs in 2006. This number is likely to be a lower bound since HMDA does not allow me to track the correspondent purchases by the additional 7 IMCs in my dataset.

However, I run the parallel analysis where only the market share of the six "most-treated" IMCs, which are linked to the "most" treated dealers, are considered treated. Figure 24 plots the market share for the six most treated IMCs. It tracks the heatmap of all IMCs in Figure 9 fairly closely. The market share measure is calculated the same way as in Equation 9, however it only includes the six most-treated IMCs' mortgage originations in the numerator. The denominator contains all other mortgage originators such as commercial banks, affiliated mortgage companies, credit unions, as well as the six IMCs in my sample who are closely linked to the "control dealers," who I define as "less-treated" for my dealer treatment intensity analysis. These IMCs, however, are still very treated because they are six

of the 12 largest IMCs and are closely linked to the 29 most systemic dealers. Including these six IMCs in the control group should dampen the response post BAPCPA. Additionally the smaller market share measure as an independent variable mechanically increases the standard errors. The finding that my results persist supports the research design – that dealers holding more mortgage collateral at the time of BAPCPA would be more affected.

[FIGURE 24 about here.]

I run the same regression specified in Equation 10, replacing the market share measure with the market share of just the six IMCs most closely linked to the six "most-treated" dealers. I find the following results for this analysis. It is expected to see larger coefficients but wider confidence intervals due to including the six less-treated IMCs are included in the reference group, as well as to the mechanically smaller market shares on the RHS. The fact that the results persist supports the mechanism described in the paper. I estimate the analogous regression to Equation 10 with a single pre and post period:

$$Y_{c,t} \quad = \quad \gamma_c + \eta_{s,t} + \beta \; Post_t \times IMCMarketShare_{c,2004} + \epsilon_{c,t}. \tag{18}$$

A 10% increase in treated IMC market share results in a 8.7% increase in mortgage originations on average in the post period.[46] A 10% increase in treated IMC market share results in a statistically significant 1.13 percentage points increase in the fraction of balloon mortgages on average in the post period. A 10% increase in treated IMC market share leads to a significant 6.98% decrease in the average introductory interest rate on ARMs in the post period. A 10% increase in treated IMC market share significantly raises the default hazard rate post shock by 11.1 percentage points. Between April 2005 and November 2006, a 10% increase in IMC market share led to a significant 9.5% increase in home prices. 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 IMC market share led to a significant 15.9% decrease in home prices during this period. I plot the dynamic response plots in Figure 25.

[TABLE 9 about here.]

[FIGURE 25 about here.]

[46]The coefficients in the specification where the six most treated IMCs make up the treatment group are larger than those of the all IMC regressions because the market shares of treated IMCs is small.

B.4 Empirical Model - Purchase, Refi, NegAm, Non-Owner Occupied Mortgages

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 in Equation 18 to $\log(PurchaseOriginations_{c,t})$ indicating the monthly purchase originations reported in the HMDA data.[47] Figure 26 shows the dynamic response of purchase mortgages to the shock. It is expected to see positive results but wider confidence intervals because the 6 "control", IMCs are also in the reference group. 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.[48]

[Figure 26 about here.]

[Table 10 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 27 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.[49]

[Figure 27 about here.]

Negative amortization occurs whenever a mortgage payment does not cover the incurred interest over that period. 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 amortizing 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

[47] I merge the public HMDA data with the subset of confidential HMDA data to identify IMCs using the TYPE variable. I merge the TYPE variable onto the public HMDA data using the mortgage originator identifiers (HM5RID and CODE). For the HMDA data, see: https://www.ffiec.gov/hmda/hmdaproducts.htm.

[48] Table 10, presents the results from Equation 8, the regression with a single pre and post period.

[49] Table 10, presents the results from Equation 8, the regression with a single pre and post period.

for example. The 4% interest accrued but not paid will be added to the balance of the loan making borrowers more likely to experience negative equity in an environment where home prices are falling. Eventually the loan will enter a recast period when the payments reset to a fully amortizing schedule, adding the additional risk of payment shock.[50]

Table 10 reports the results of the Equation 18 exploring the effect of IMC market share on negative amortizing mortgages. Prior to BAPCPA, the fraction of negative amortizing mortgages originated in counties with higher total IMC market share was not statistically different from other counties. Post shock a 10% increase in total IMC market share leads to a significant 0.57 percentage point increase on average in the post period. The result for the six treated IMCs is positive and significant in the specification with county only FE however not in the specification with *state* × *month* FE as well as *county* FE. The result for the six treated IMCs are negative however not statistically significant. This is likely because counties with less-treated IMCs are considered in the control group in this regression. Once taking out *state* × *month* FE, including treated IMCs in the control group and the large standard errors, due to the smaller market share measure, reduces the explanatory power.

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.[51] In Table 10, I report the regression results. In the regression with *county* FE only, there is a statistically significant decrease post BAPCPA in the use of owner-occupied originations in exposed counties for both the analysis with the six most treated IMCs and with all IMCs in the treated group. 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. In the specification with *state* × *month* FE as well as *county* FE, the result in the specification with all IMCs in the treatment group are close to significant.

B.5 Mortgage Lender Market Shares

In Figure 28, I plot monthly mortgage originations by the dealers in my paper, IMCs, and other originators. Other originators include commercial banks, credit unions, and affiliated

[50] A quote from the annual report from a mortgage company in my sample states: "Borrowers with [negative amortizing] 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

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

mortgage companies and are primarily made up of agency mortgage originations. IMC originations are almost entirely made up of 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 that placed debt limits for Fannie Mae and Freddie Mac in response to their accounting fraud cases.

[FIGURE 28 about here.]

B.6 Housing Market Implications of BAPCPA - Calculations

1.) Only treated IMCs Affected To understand the overall effect of BAPCPA on the housing market if only the six "most-treated" IMCs were affected, I combine my results on the response of mortgage originations and default hazard rates reported above. My analysis on mortgage originations estimates the increase in mortgages originated by IMCs in response to BAPCPA to be 2.4%. I multiply 87%, the estimated increase in mortgage originations caused by a 100% increase in treated IMC market share by the 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 is an underestimate of IMC market share as it does not account for mortgage purchases from correspondent lenders.

The default hazard rate implies that each additional loan originated by the six most treated IMCs in response to BAPCPA defaulted. Applying this to the increase in mortgage originations, BAPCPA accounts for 14% of defaults among all loans originated during 2005 and 2006.

- **Calculations**

  Market share of six treated IMCs = 2.7%

  $\beta^{orig} = 0.87$

  Increase in mortgages originated in response to BAPCPA

$$\text{Market share} \times \beta^{orig} = \text{Increase in Originations (\%)} \tag{19}$$

$$0.027 \times 0.87 = 0.024 \tag{20}$$

$$= 2.4\% \tag{21}$$

  $\beta^{HzdRt} = 1.1$

  Increase in average hazard rate in response to BAPCPA

$$\text{Market share} \times \beta^{HzdRt} = \text{Increase in Avg. Hazard Rate} \tag{22}$$

$$0.027 \times 1.1 = 0.0297 \tag{23}$$

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

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

$$\frac{100}{102.4} \times 0.13 + \frac{2.4}{102.4} \times X = .1597 \tag{24}$$

$$X = 1.4 \tag{25}$$

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 Results are discussed in section section 6, and calculations are provided below.

- **Calculations**

  Market share of all IMCs = 34%
  $\beta^{orig} = 0.268$
  Increase in mortgages originated in response to BAPCPA

$$\text{Market share} \times \beta^{orig} = \text{Increase in Originations (\%)} \tag{26}$$

$$0.034 \times 0.268 = 0.091 \tag{27}$$

$$= 9.1\% \tag{28}$$

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%.

$\beta^{HzdRt} = 0.141$
Increase in average hazard rate in response to BAPCPA

$$\text{Market share} \times \beta^{HzdRt} = \text{Increase in Avg. Hazard Rate} \tag{29}$$

$$0.34 \times 0.141 = 0.0479 \tag{30}$$

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.

C 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.

C.1 Setup

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

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

$$K_t^b + K_t^h = 1 \tag{31}$$

Each banker has an i.i.d. probability $\sigma \in (0, 1)$ of surviving until the next period and a probability $1 - \sigma$ of exiting at the end of the current period. Each period, a measure $1 - \sigma$

of bankers are born and endowed with $w^b > 0$ units of the consumption good.

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

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

$$f^B(K_t^b) = ZK_t^b \tag{32}$$

Households produce the consumption good according to the production function

$$f^H(K_t^h) = ZK_t^h - \frac{\alpha}{2}(K_t^h)^2 \tag{33}$$

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

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

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

C.2 Households

The model shuts down any frictions between actual households and the IMCs so that the households in the model correspond to the IMCs. The households both consume and save. The households can save either by lending funds to the competitive financial institutions,

the banks, or by holding the capital directly. Every period, households receive a return on their asset holdings as well as an endowment of the consumption good equal to ZW^h.

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

$$R_t = \begin{cases} \bar{R}_t & \text{if no bank run,} \\ x_{t+1}\bar{R}_t & \text{if bank run occurs} \end{cases} \tag{34}$$

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:

$$U_t = E_t \left(\sum_{i=0}^{\infty} \beta^i \ln C^h_{t+i} \right) \tag{35}$$

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

$$1 = \bar{R}_{t+1} E_t \left[(1-p_t)\Lambda_{t,t+1} + p_t \Lambda^*_{t,t+1} x_{t+1} \right] \tag{36}$$

where

$$\Lambda_{t,t+1} = \beta \frac{C^h_t}{C^h_{t+1}} \tag{37}$$

$$\Lambda^*_{t,t+1} = \beta \frac{C^h_t}{C^{h^*}_{t+1}} \tag{38}$$

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.

$$x_{t+1} = \min\left[1, \frac{(Q^*_{t+1} + Z_{t+1})k^b_t}{R_{t+1}d_t}\right] \tag{39}$$

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

$$p_t = 1 - E_t(x_{t+1}) \tag{40}$$

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

C.3 Banks

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

Bankers in the model may be constrained in their ability to borrow deposits and will attempt to save their way out of the financial constraints by accumulating their retained

earnings. To limit this possibility that bankers will try to move towards one hundred percent equity financing, bankers have a finite expected lifetime and each banker has an i.i.d. probability σ of surviving until the next period and a probability $1-\sigma$ of exiting at the end of the current period. The expected lifetime of a banker is then $\frac{1}{1-\sigma}$.

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

$$V_t = E_t \left[\sum_{i=1}^{\infty} \beta^i (1-\sigma) \sigma^{i-1} \Pi_{t+i} n_{t+i} \right] \tag{41}$$

where $(1-\sigma)\sigma^{i-1}$ is the probability that a banker exits at date $t+i$, n_{t+i} is the banker's terminal net worth upon exiting in period $t+i$, and Π_{t+i} is the household's marginal utility of consumption in period $t+i$. The bankers take the household's marginal utility of consumption a given. I will discuss the household's marginal utility of consumption in the aggregation section.

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

$$n_{t+1} = (Z + Q_{t+1}) \, k_t^b - R_{t+1} d_t \tag{42}$$

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

$$Q_t k_t^b = n_t + d_t \tag{43}$$

There is a limit to the amount of deposits that bankers can borrow in a given period. This constraint can be motivated by assuming that a moral hazard problem exists. In time t, after accepting the deposits, but still during the same period, the banker chooses whether to operate "honestly" or to divert the assets for personal use. Operating honestly requires the banker to invest the deposits, wait until the next period, realize the returns on deposits

and meet all deposit obligations. If the banker chooses to divert the assets, it will only be able to liquidate up to the fraction θ of the assets and will only be able to do so slowly, in order to remain undetected. Therefore the banker must decide whether to divert at time t, before the resolution of uncertainty at time $t+1$. The cost of diverting assets is that the depositors are able to force the banker into bankruptcy in the next period. Therefore at time t, the bankers decide whether or not to divert the assets by comparing the franchise value of the financial intermediaries that they operate to the potential gains from diverting funds. The value of diverting funds is determined by the fraction of funds diverted, times the household's marginal utility of consumption, times the value of the capital diverted, $\theta_t \Pi_t Q_t k_t^b$.

The franchise value of the financial intermediaries that bankers operate is denoted V_t. V_t is calculated as the present discounted value of the future payouts from operating the bank honestly every period. Given that bankers consume their net worth in the period that they exit, their franchise value can be stated recursively as the expected discounted value of the sum of their net worth conditional on exiting in the following period plus their franchise value conditional on continuing in the following period.

$$V_t = E_t \left[\beta(1-\sigma) \Pi_{t+1} n_{t+1} + \beta \sigma V_{t+1} \right] \tag{44}$$

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

$$\theta_t \Pi_t Q_t k_t^b \leq V_t \tag{45}$$

Since both the banker objective function and constraints are constant returns to scale, the optimization problem can be reduced to choosing the leverage multiple, ϕ_t to maximize

the bank's "Tobin's q ratio," ψ_t, where

$$\psi_t = \frac{V_t}{n_t} \tag{46}$$

$$\phi_t = \frac{\psi_t}{\Pi_t \theta} \tag{47}$$

C.4 Aggregation

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

$$\theta_t \Pi_t Q_t K_t^b = V_t. \tag{48}$$

Denote by N_t the sum of accumulated net worth of surviving and entering bankers that were operating at period t and survived until period $t+1$ and the endowment of bankers. Let Q_t denote the market price of capital and D_t aggregate households' bank deposits. The evolution of N_t is given, as follows with the total endowment across all entering bankers, W^b, given by

$$W^b \equiv (1-\sigma) w^b \tag{49}$$

$$N_{t+1} = \sigma \left[(Z + Q_{t+1}) K_t^b - R_{t+1} D_t \right] + W^b \tag{50}$$

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

$$C_t^h + D_t + Q_t K_t^h + \frac{\alpha}{2}(K_t^h)^2 = Z_t W^h + R_t D_{t-1} + (Z_t + Q_t) K_{t-1}^h + (1-\sigma) N_t \tag{51}$$

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

$$Y_t = Z + ZW^h + W^b \tag{52}$$

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

$$Y_t = \frac{\alpha}{2}(K_t^h)^2 + C_t^h. \tag{53}$$

The household marginal utility of consumption can be defined

$$\Pi_t = \frac{1}{C_t^h} \tag{54}$$

C.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 29, 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 29 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 **?**. 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. [52]

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

Figure 11: 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 12: EFFECT OF REPO ACCOUNTING ON DEALER LEVERAGE RATIO

Accounting Treatment of Secured Loan vs Repo as an Outright Sale

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

No Relationship with IMC

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

Dealer lends to IMC in form of a Vanilla Secured Loan

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

IMC pays off loan

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

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

No Relationship with IMC

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

Dealer purchases securities from IMC as a Reverse-Repo

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

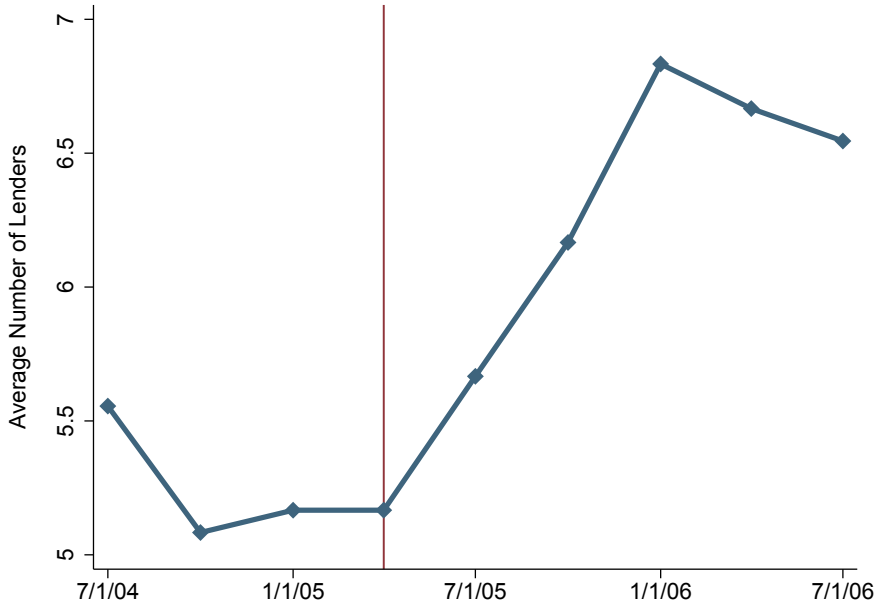
Dealer sells securities back to IMC

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

Dealer Leverage Ratio (Assets/Equity)

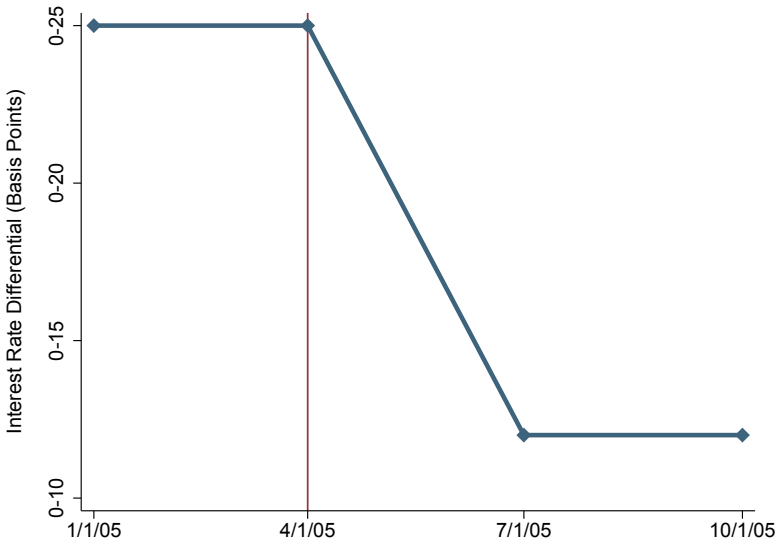
	Day 0	Day 1	Day 2
Secured Loan (A)	2.25	2.5	2.25
Reverse-Repo (B)	2.25	2.25	2.25

Figure 13: Average Number of Credit Lines to Mortgage Companies



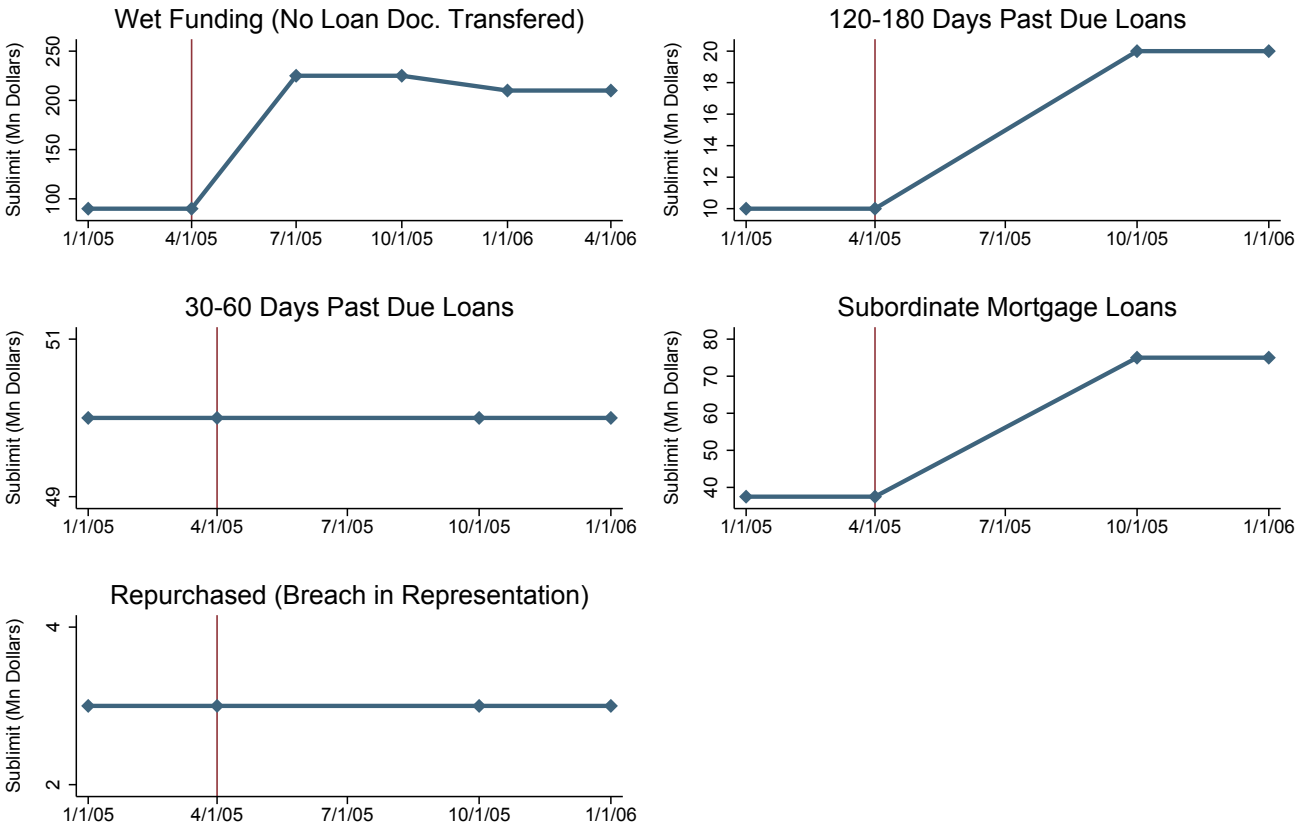
Notes: Figure plots the average number of dealers lending to the independent mortgage companies (IMCs) in my sample pre and post BAPCPA. Post BAPCPA, the average number of dealers lending to an IMC began to increase. This data is compiled from IMC quarterly filings. Figure includes all twelve IMCs in my regression analysis.

FIGURE 14: INTEREST RATE DIFFERENTIAL BETWEEN SECURED AND UNSECURED CREDIT



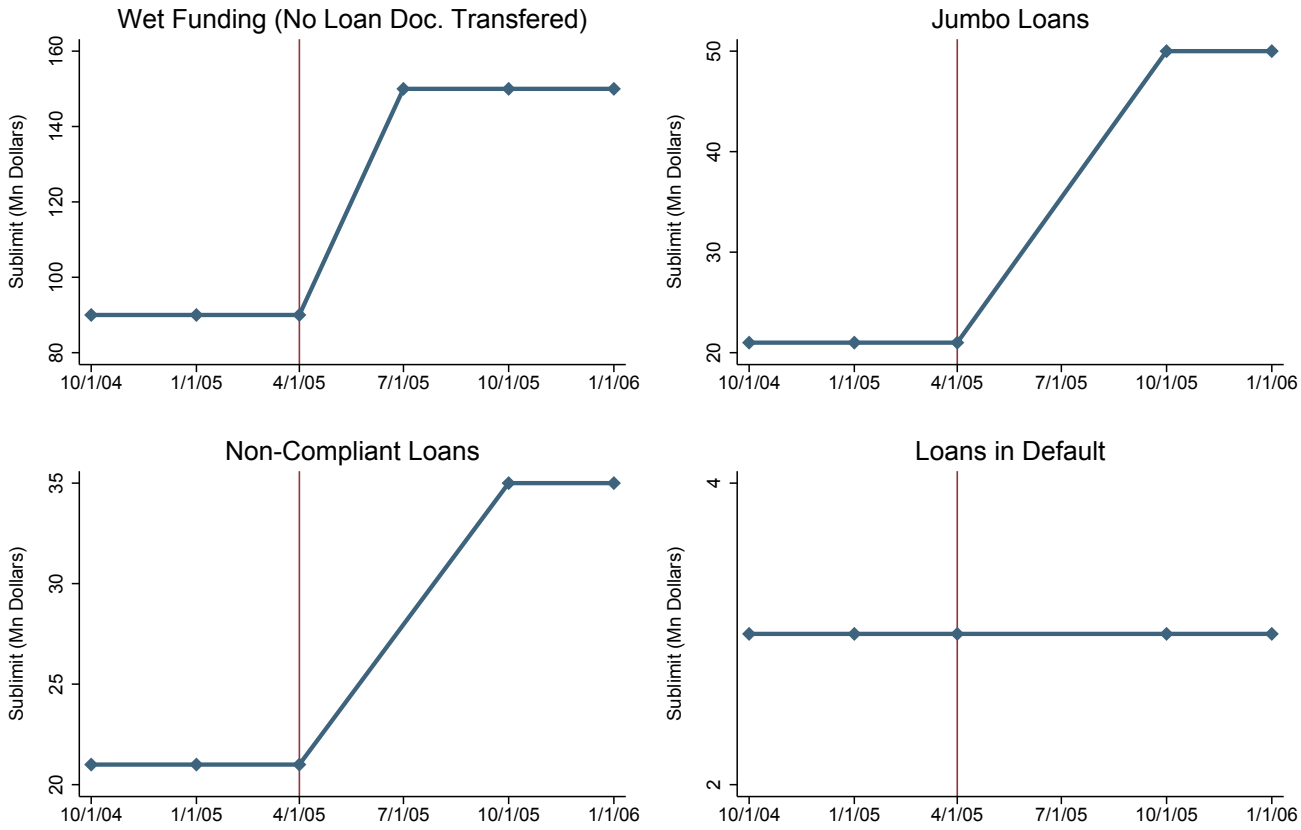
Notes: Figure plots the interest rate differential between credit lines backed by "wet" vs. "dry" collateral for an example mortgage company. Dry funding is secured by collateral that has already been created by the IMC, and requires that the loan documents be transferred to the dealer. Conversely, wet 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 15: DEALER 1 COVENANTS ON CREDIT LINE TO EXAMPLE MORTGAGE COMPANY



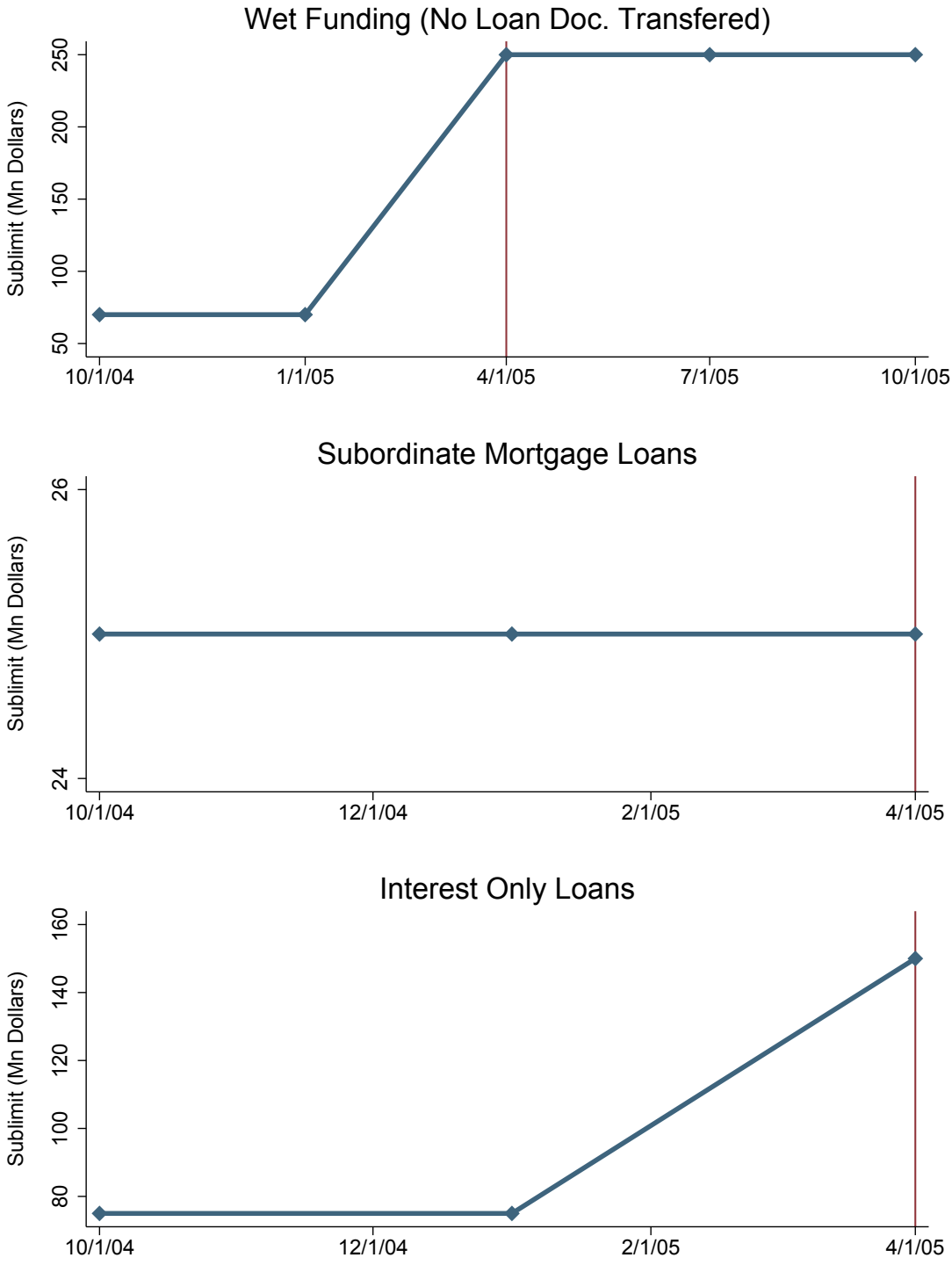
Notes: Figure provides suggestive evidence that the covenants were loosened post BAPCPA.

FIGURE 16: DEALER 2 COVENANTS ON CREDIT LINE TO EXAMPLE MORTGAGE COMPANY



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

Figure 17: Dealer 3 Covenants on Credit Line to Example Mortgage Company

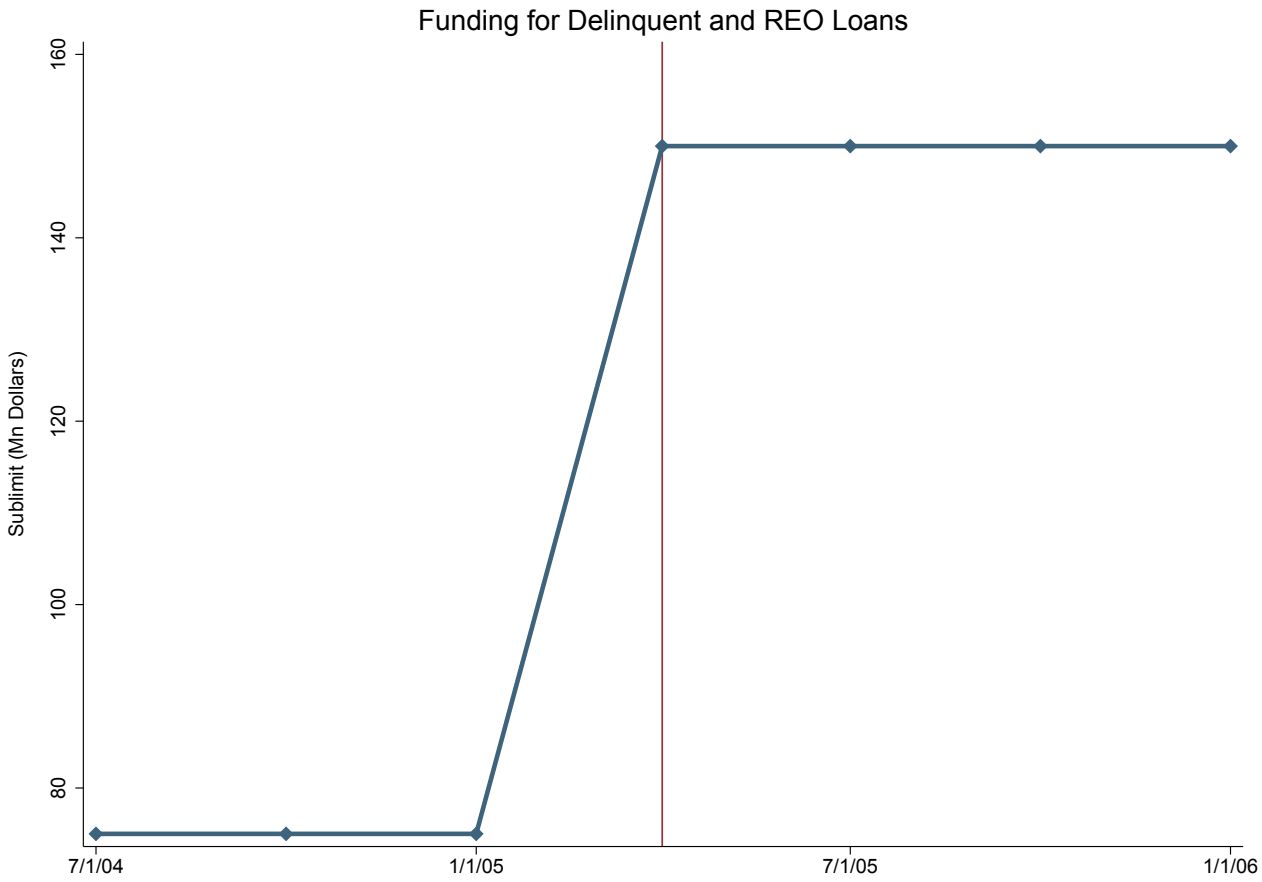


Notes: Figure provides suggestive evidence that the covenants were loosened post BAPCPA.

FIGURE 18: DEALER 4 COVENANTS ON CREDIT LINE TO EXAMPLE MORTGAGE COMPANY

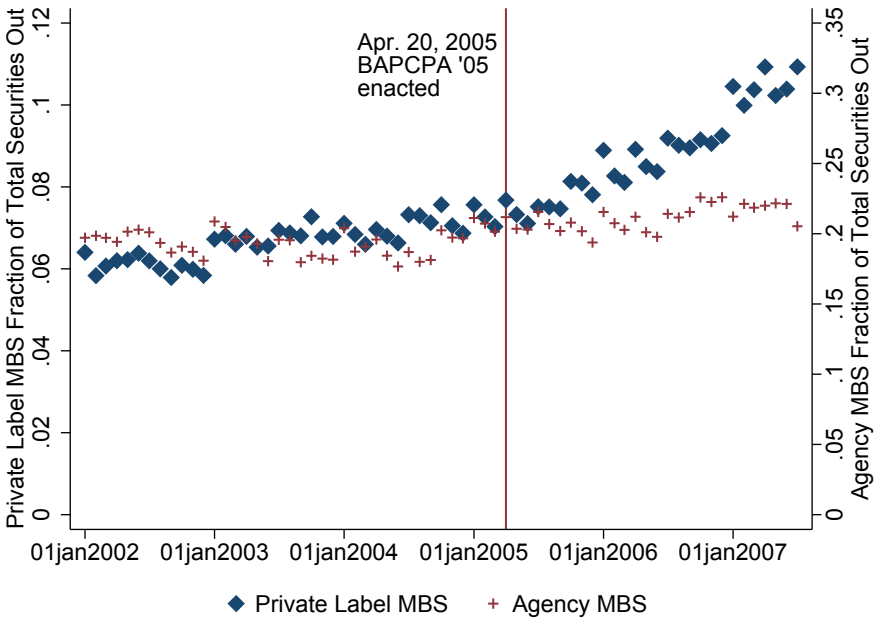
Notes: Figure provides suggestive evidence that the covenants were loosened post BAPCPA.

Figure 19: 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 20: 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 21: 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:

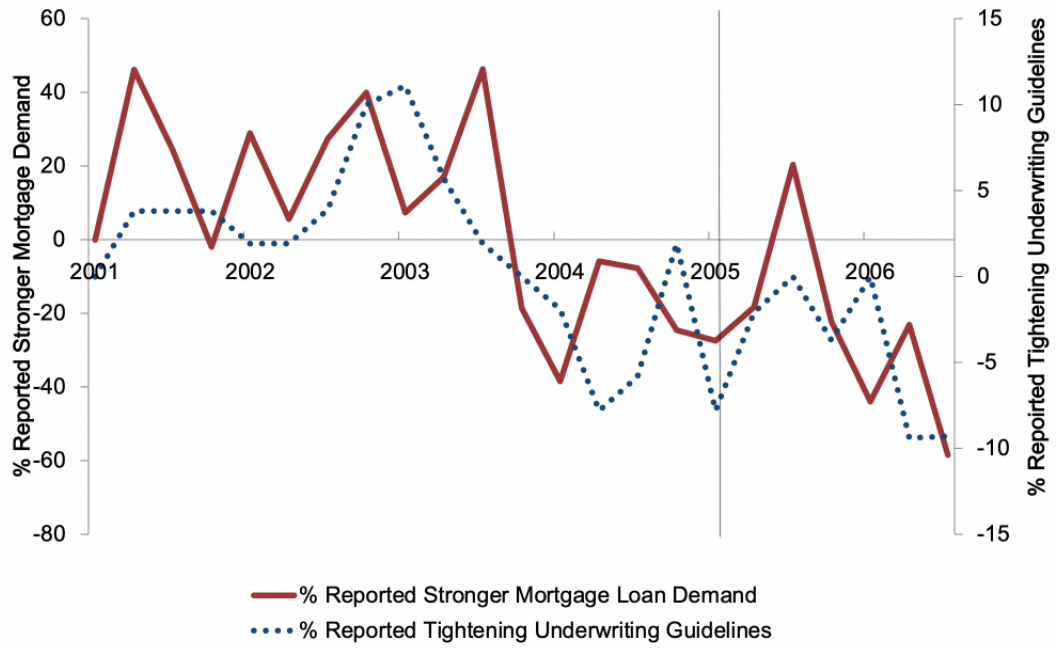
2.63%, dated 2/3/05 due 3/23/05 (Collateralized by Corporate Obligations with principal amounts of $642,653,500, 1.63% - 11%, 5/23/05 - 5/1/34)

(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

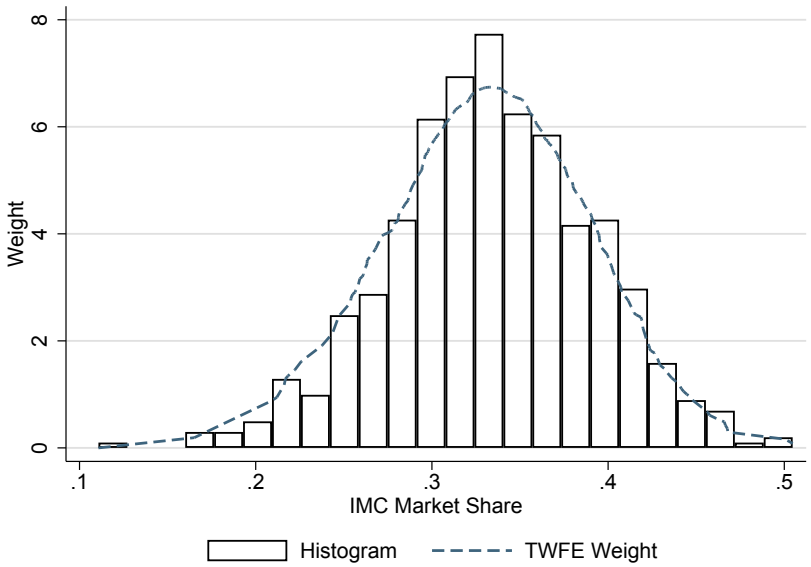
Notes: Figure (a) depicts reverse repurchase agreements from Fidelity Phillips Street Trust to Countrywide, Credit Suisse, and Goldman Sachs backed by "Mortgage Loan Obligations" (b) depicts reverse repurchase agreements from JPMorgan Trust II to Bear Stearns and Goldman Sachs backed by "Mortgage Backed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

FIGURE 22: MORTGAGE DEMAND & UNDERWRITING GUIDELINE TIGHTENING



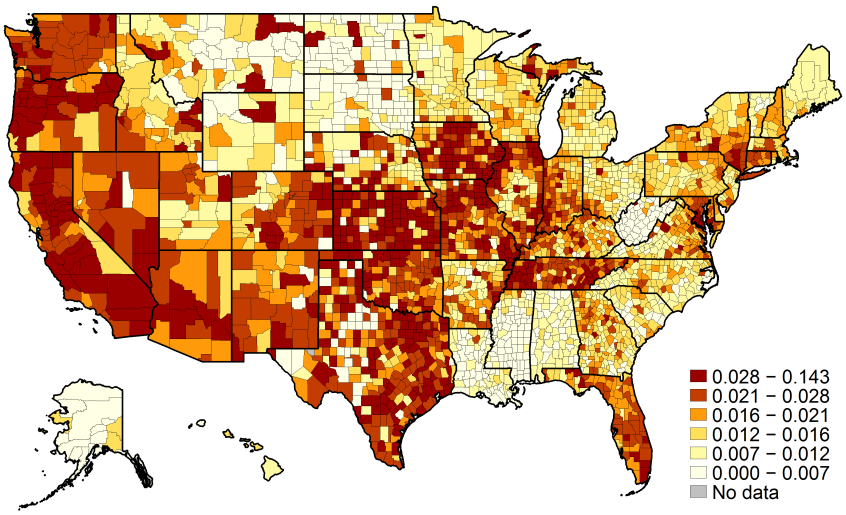
Notes: The plot reports data from the Federal Reserve's Senior Loan Officer Opinion Survey on Bank Lending Practices which surveys of up to eighty large domestic banks about mortgage demand and underwriting guidelines for all mortgage loans. Data available at: https://www.federalreserve.gov/data/sloos/sloos-201807-chart-data.htm

Figure 23: Continuous DID Weights



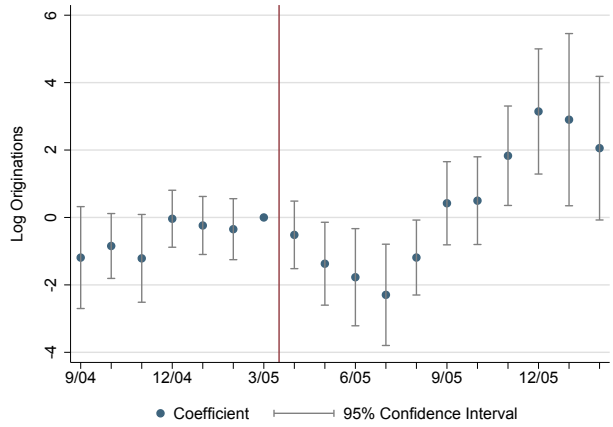
Notes: The figure plots the distribution of treatment, $IMCMarketShare_{c,2004}$ against the weights applied in the continuous difference-in-differences or two-way fixed effects specification.

Figure 24: Six Treated Independent Mortgage Company (IMC) Market Share

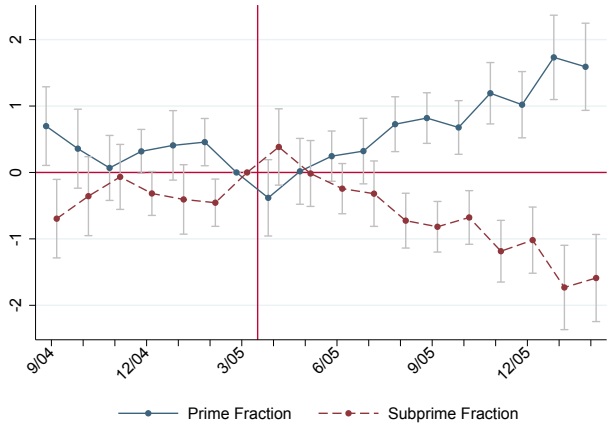


Notes: The figure depicts the county level market share of the six treated independent mortgage companies (IMCs) reported in 2004. The market shares are calculated using the 2004 HMDA data.

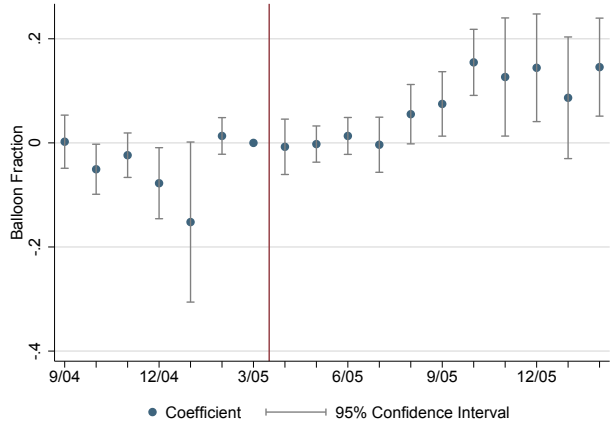
FIGURE 25: TREATED IMC COUNTY MKT SHARE EFFECT ON MTG CHARACTERISTICS



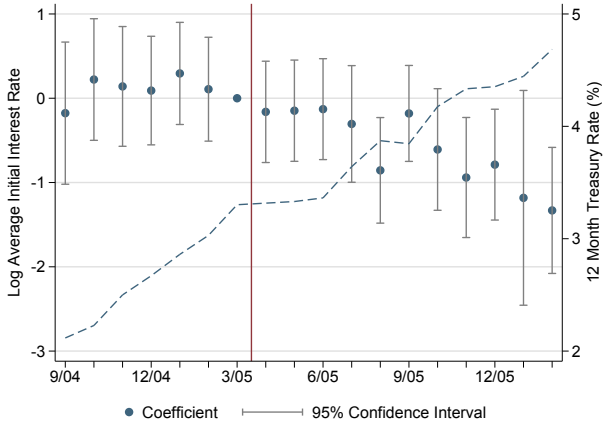
(a) Originations



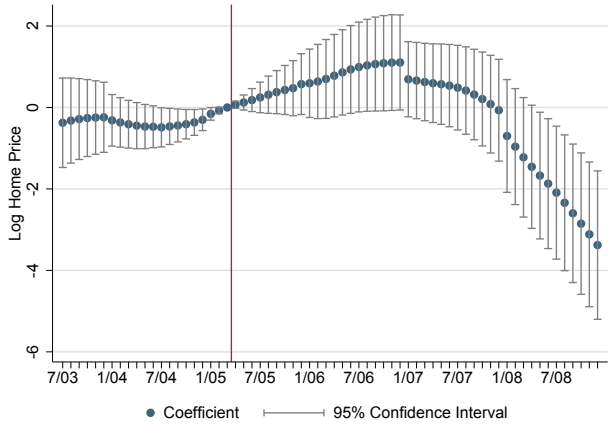
(b) Fraction Prime/Subprime



(c) Fraction Balloon



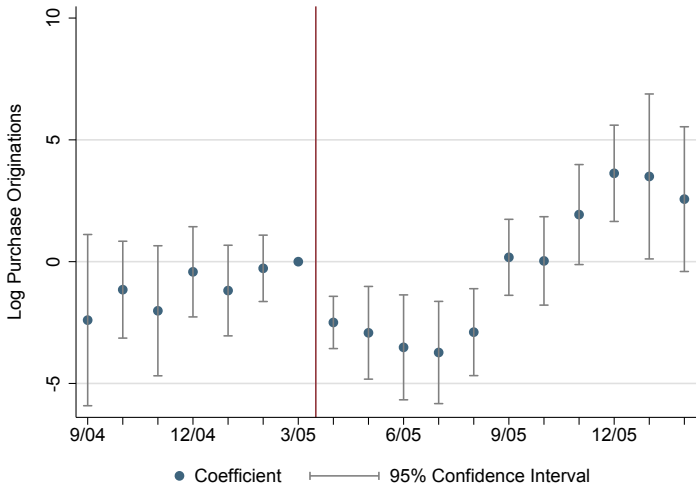
(d) Initial Interest Rates on ARMs



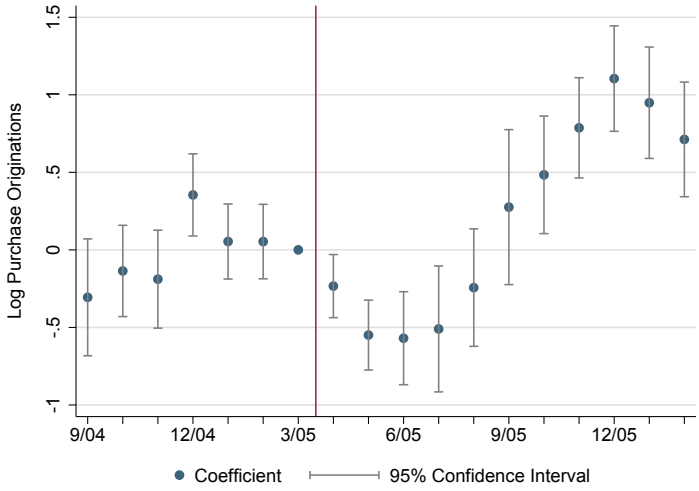
(e) Home Prices

Notes: Figures plot the dynamic response of mortgage characteristics in a given county to the 2004 IMC market share of the six most treated IMCs in that county in Equation 10. β_T is the coefficient of interest. It is the coefficient on the indicator variable that interacts $TrtIMCMktShr_{c,2004}$ with month. I use the public HMDA data to compute the 2004 county level IMC market share and CoreLogic and the county month HMDA data to study originations.

Figure 26: IMC County Market Share Effect on Purchase Mortgage Originations



(a) Six Treated IMCs

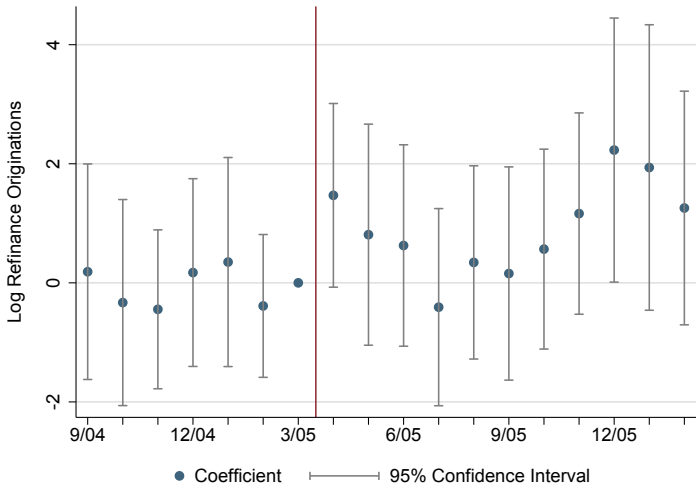


(b) All IMCs

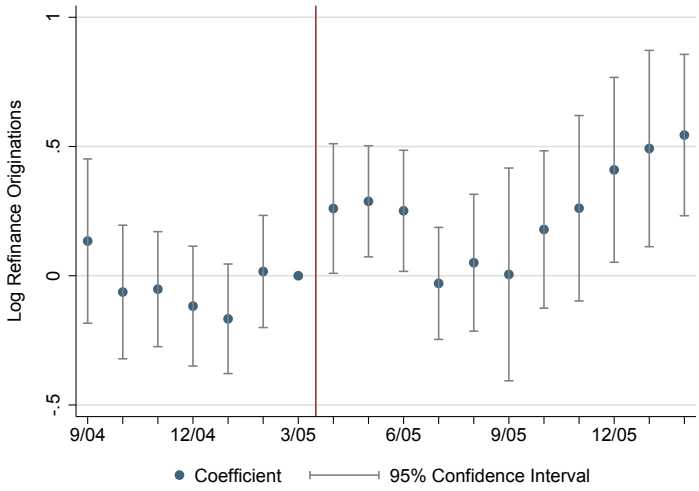
Notes: Figure plots the dynamic response of purchase mortgage originations in a given county to the 2004 market share of independent mortgage companies (IMCs) in that county. I estimate Equation 10. β_T is the coefficient of interest. It is the coefficient on the variable that interacts $(Treated)IMCMarketShare_{c,2004}$ with an indicator for each month pre and post the shock. I use the public HMDA data to compute the 2004 county level IMC market share and the county month HMDA data to study originations.[a] The figure indicates that following BAPCPA counties more exposed to policy change significantly increased the number of purchase mortgages that they originated relative to less exposed counties.

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

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



(a) Six Treated IMCs

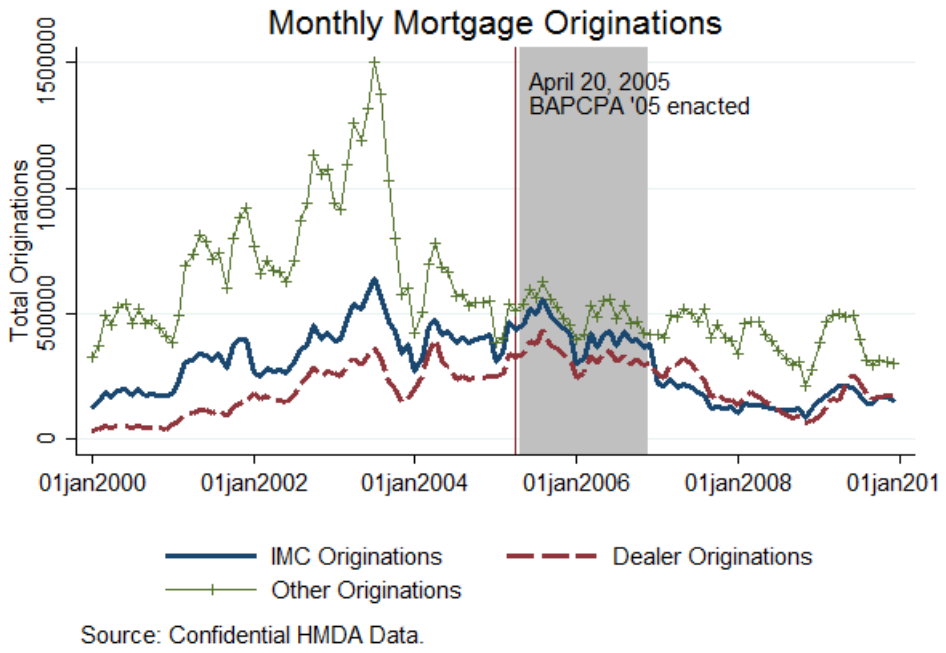


(b) All IMCs

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 10. β_T is the coefficient of interest. It is the coefficient on the variable that interacts $(Treated)IMCMarketShare_{c,2004}$ with an indicator for each month pre and post the shock. I use the public HMDA data to compute the 2004 county level IMC market share and the county month HMDA data to study originations.[a] The figure indicates that following BAPCPA counties more exposed to policy change significantly increased the number of refinance mortgages that they originated relative to less exposed counties. Though much of the effect is driven by purchase originations.

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

FIGURE 28:



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.

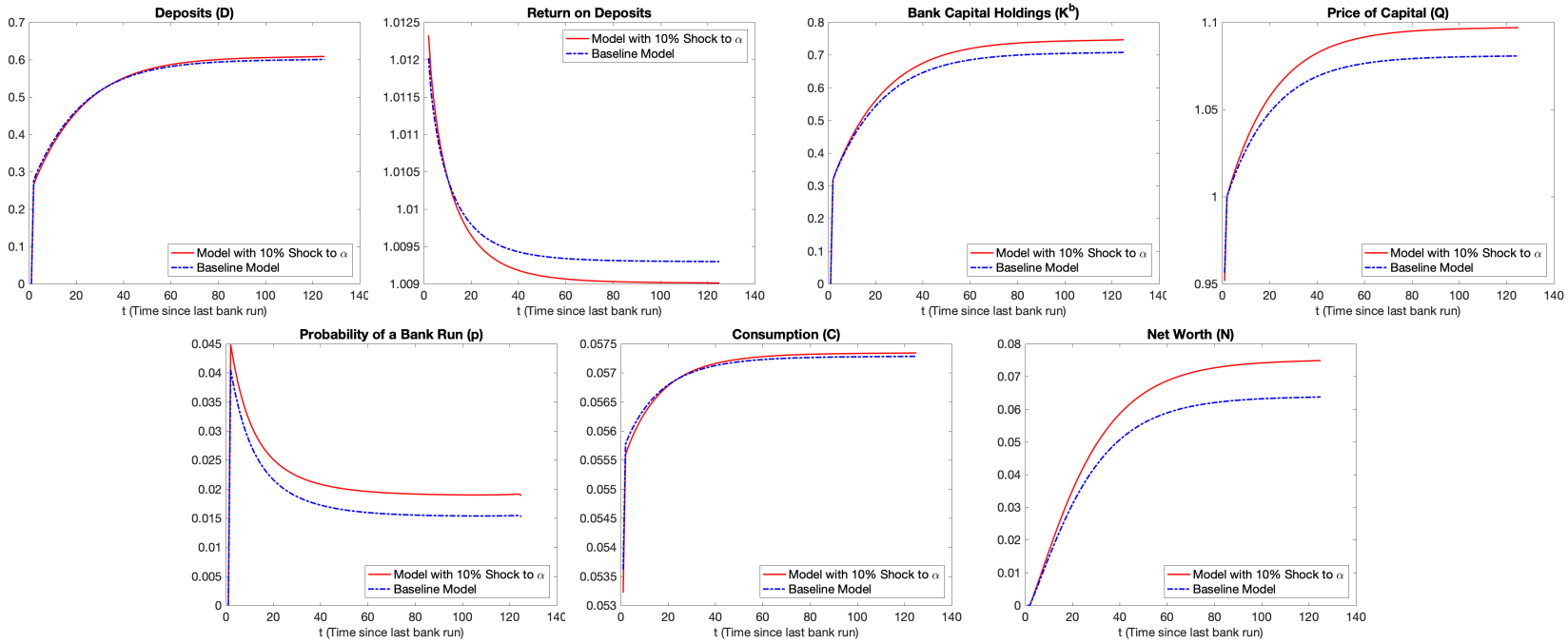


FIGURE 29: EVOLUTION OF VARIABLES IF NO BANK RUN OCCURS

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.

Table 8: Increase in Dealer Secured Borrowing using Private-Label Mortgage Collateral

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

Notes: Table reports the results from Equation 12. 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 9: Treated 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)	
	Treated IMCs Affected											
$Post \times TrtIMCMktShr_{c,04}$	5.533***	0.870	0.095***	0.113***	2.497***	-0.698***	1.887***	1.117***	3.591***	0.953**	0.689	-1.589**
	(0.291)	(0.694)	(0.009)	(0.027)	(0.154)	(0.268)	(0.383)	(0.275)	(0.527)	(0.478)	(0.799)	(0.712)
CountyFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
r2	0.9635	0.9946	0.1555	0.5191	0.8456	0.9473	0.0401	0.0448	0.9771	0.9956	0.9699	0.9918
N	8728	8572	9000	8874	9000	8874	355154	355134	19232	18929	15831	15628

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

$$Y_{c,t\{l\}} = \gamma_c + \eta_{s,t} + \beta\ Post_t \times TrtIMCMktShr_{c,04} + \epsilon_{c,t\{l\}}$$

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. At the county level, the specification measures the fraction of loans originated 5 months prior to April 2005, that ever defaulted, and compares it to the fraction originated just post April 2005 that ever defaulted as a function of treated IMC market share. γ_c represents county level fixed effects, $\eta_{s,t}$ represents $state \times month$ fixed effects, $IMCMarketShare_{c,2004}$ is the IMC county level market share in a given county in 2004, the year before the shock occurs. β is the coefficient of interest. It is the coefficient on the interaction between $TrtIMCMarketShare_{c,2004}$ and the post period. This coefficient measures the change in the dependent variable if $TrtIMCMarketShare_{c,2004}$ increased from 0% to 100%. I use the Public HMDA data to compute the 2004 county level IMC market share and the county month HMDA data to study originations.[a] I use CoreLogic LLMA data to study mortgage characteristics and Zillow's ZHVI to study home prices.

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

Table 10: IMC County Market Share Effect on Additional Mortgage Characteristics

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

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

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

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

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