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

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[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]).

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[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.

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[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:

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[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 of credit"* to *"warehouse*

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[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.

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

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

of credit. Wet funding is implicitly unsecured funding. It takes place when the IMC has not yet originated the mortgages posted as collateral and therefore transfers no loan documents prior to receiving the line of credit. 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.

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[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 $1 + 0 + 0 + ... = 1$.

A.5   Dealer List

This paper studies the 29 dealers identified as warehouse lenders to 12 Independent Mortgage Companies (IMCs) in the IMCs' quarterly reports between 2004Q3 and 2007Q3. 16 of these dealers were registered as primary dealers in both 2004 and 2005. Countrywide became a primary dealer on January 4, 2004. The list of primary dealers in 2004 and 2005 are largely identical.[40] [41]

Although I observe 29 dealers (16 primary dealers) lending to the IMCs between 2004Q3 and 2007Q3, I run the within IMC across dealer specification for 2004Q3 to 2006Q3 as this is the last quarter that all IMCs remain in the sample. Nomura (a primary dealer) and SocGen are included in my analysis of dealer reported repledgeable collateral. However, they are not included in my within IMC across dealer analysis as they are only lending to New York Mortgage Trust between 2006Q3-2007Q3 and 2006Q4-2007Q3 respectively, after my analysis time period ends in 2006Q3. Nomura only has one singleton observation in 2006Q3 that must be dropped. This limits the number of dealers in my within mortgage company, across dealer analysis to 27 dealers and 15 primary dealers.

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

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

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

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

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

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

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

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

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

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

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

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

4. Bear Stearns - The data collected consist of annual and quarterly data on Bear Stearns's securities received that it was permitted to repledge as well as the fair value of securities sold or repledged. The data are reported annually in the 10-K filings and quarterly in

the 10-Q filings beginning in the fiscal year end of 2002. The data were pulled through fiscal year end 2008.

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

5. Calyon Financial (Credit Agricole) - Calyon was created in May 2004 by the transfer of assets from Crédit Lyonnais' Corporate and Investment Banking division to Crédit Agricole Indosuez (CAI). Credit Agricole is a French bank that is not registered with the SEC and does not publish reports 10-K, 10-Q, 6-K or 20-F. The French equivalent of the 10-K and 10-Q does not report data on repo collateral repurchased or repledged.

6. Citizens - Repledgeable collateral data for Citizens Bank of Woodville Texas was not collected.

7. Colonial BancGroup, Inc. - Repledgeable collateral data was not reported in Colonial BancGroup, Inc.'s financial statements.

8. Countrywide - The data collected consist of annual and quarterly data on Countrywide's securities received that it was permitted to repledge, the fair value of securities sold or repledged, assets pledged as collateral, assets pledged as collateral where the counterparty has the right to repledge, securities purchased under agreement to resell, as well as securities sold under agreement to repurchase. The data are reported annually in the 10-K filings and quarterly in the 10-Q filings beginning in September of 2002. The data were pulled through June of 2008.

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

9. Credit Suisse - The data collected consist of annual data on Credit Suisse's assets pledged as collateral, assets pledged as collateral where the coutnerparty has the right to repledge, securities received that it was permitted to repledge as well as the fair value of securities sold or repledged. The data are reported annually in the 20-F filings beginning in the fiscal year end of 2000. The data were pulled through fiscal year end 2008.

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

S&P Global database.

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

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

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

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

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

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

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

    Values for book assets and book net worth were collected from the Factset Database. No minority interest is included in book net worth, so that minority interest is treated

as a liability. All data are reported in USD.

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

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

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

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

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

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

18. JP Morgan - The data collected consist of annual data and quarterly on JP Morgan's securities received that it was permitted to repledge, the fair value of securities sold or repledged, securities purchased under resale agreements, securities borrowed, securities sold under repurchase agreements, and securities received and not repledged. The data are reported annually in the 10-K filings and quarterly in the 10-Q filings beginning in the fiscal year end of 2002. The data were pulled through fiscal year end 2008.

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

19. Lehman Brothers - The data collected consist of annual data and quarterly on Lehman's securities received and not repledged, securities permitted to be repledged, fair value

of portion sold or repledged, assets pledged as collateral where counterparty has the right to repledge as well as assets pledged as collateral where the counterparty cannot repledge. The data are reported annually in the 10-K filings and quarterly in the 10-Q filings beginning in the fiscal year end of 2003. The data were pulled through May 2008.

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

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

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

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

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

22. Nomura - Nomura annual 20-F filings report securities received as collateral that are permitted to be repledged and the fair value that has been sold or repledged but not yet repurchased. The data are collected annually from March 2001 through March

2010. March 2003 data is utilized for year end 2002 and so on. The data was reported in USD.

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

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

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

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

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

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

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

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

by Wells Fargo was completed in December 2008.

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

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

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

A.5.1   Exchange Rate Data

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

A.5.2   Mortgage Backed Securities (MBS) Yields

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

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

A.6 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.[42] 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.

In Figure 20, I plot dealers' securities out (borrowing) collateralized by agency[43] and by private-label[44] 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

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[42]Copeland, Martin and Walker [2014] p. 2350.

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

[44]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.

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.[45] 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.

> [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.

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[45]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).

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

$Y_{i,t}$ 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.

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.7 Money multiplier created by reusing Treasury securities

In comparison, Treasury securities purchased in the bilateral market could also be re-hypothecated 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]).[46] This yields the following common ratio for the multiplier created by Treasuries in the same way

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

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

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[46]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.

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

A.8 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.9 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.10 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."[47] 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 22 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 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

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[47]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.

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:

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

Table 9 reports that a 10% increase in treated IMC market share results in a 8.7% increase in mortgage originations on average in the post period.[48] 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.]

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.[49] 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%

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[48]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.

[49]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.

increase in the market share of all IMCs leads to a statistically significant 2.26% increase in purchase mortgage originations post shock.[50]

[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.[51]

[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 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.[52]

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

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

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

[52]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

mortgages originated in counties with higher total IMC market share was not statistically different from other counties. Post shock a 10% increase in total IMC market share leads to a significant 0.57 percentage point increase on average in the post period. The result for the six treated IMCs is positive and significant in the specification with county only FE however not in the specification with $state \times month$ FE as well as $county$ FE. 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 $state \times month$ 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.[53] 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 $state \times month$ 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 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

---

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

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

$$\text{Market share} \times \beta^{orig} = \qquad\qquad \text{Increase in Originations (\%)} \qquad (19)$$
$$0.027 \times 0.87 = \qquad\qquad 0.024 \qquad (20)$$
$$= \qquad\qquad 2.4\% \qquad (21)$$

$\beta^{HzdRt} = 1.1$

Increase in average hazard rate in response to BAPCPA

$$\text{Market share} \times \qquad \beta^{HzdRt} = \qquad \text{Increase in Avg. Hazard Rate} \qquad (22)$$
$$0.027 \times \qquad 1.1 = \qquad 0.0297 \qquad (23)$$

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:

$$\frac{100}{102.4} \times 0.13 + \frac{2.4}{102.4} \times X = .1597 \qquad (24)$$
$$X = 1.4 \qquad (25)$$

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

$$\text{Market share} \times \beta^{orig} = \qquad \text{Increase in Originations (\%)} \qquad (26)$$
$$0.034 \times 0.268 = \qquad 0.091 \qquad (27)$$
$$= \qquad 9.1\% \qquad (28)$$

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

$$\text{Market share} \times \qquad \beta^{HzdRt} = \qquad \text{Increase in Avg. Hazard Rate} \qquad (29)$$
$$0.34 \times \qquad 0.141 = \qquad 0.0479 \qquad (30)$$

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

Household utility U_t is given by:

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

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

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

where

$$
\Lambda_{t,t+1} = \beta \frac{C_t^h}{C_{t+1}^h} \tag{37}
$$

$$
\Lambda_{t,t+1}^* = \beta \frac{C_t^h}{C_{t+1}^{h*}} \tag{38}
$$

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.

$$
x_{t+1} = \min \left[1, \frac{(Q_{t+1}^* + Z_{t+1})k_t^b}{R_{t+1}d_t} \right] \tag{39}
$$

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.

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

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

$$W^b \equiv (1 - \sigma)w^b \qquad (49)$$

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

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:

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

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

$$Y_t = Z + ZW^h + W^b \qquad (52)$$

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

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

The household marginal utility of consumption can be defined

$$\Pi_t = \frac{1}{C_t^h} \qquad (54)$$

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. [54]

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

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.

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

89

FIGURE 13: AVERAGE NUMBER OF CREDIT LINES TO MORTGAGE COMPANIES
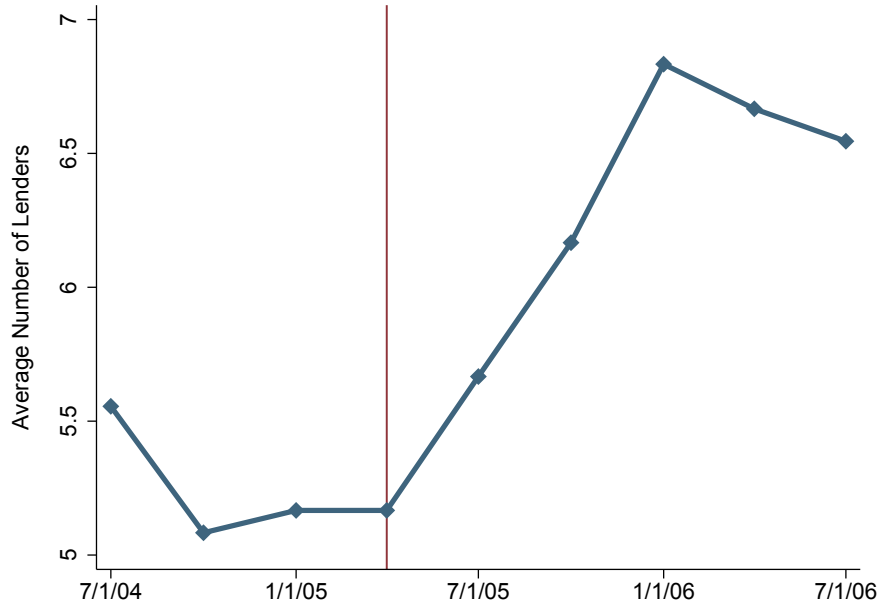
Notes: Figure plots the average number of dealers lending to the independent mortgage companies (IMCs) in my sample pre and post BAPCPA. Post BAPCPA, the average number of dealers lending to an IMC began to increase. This data is compiled from IMC quarterly filings. Figure includes all twelve IMCs in my regression analysis.

FIGURE 14: INTEREST RATE DIFFERENTIAL BETWEEN SECURED AND UNSECURED CREDIT
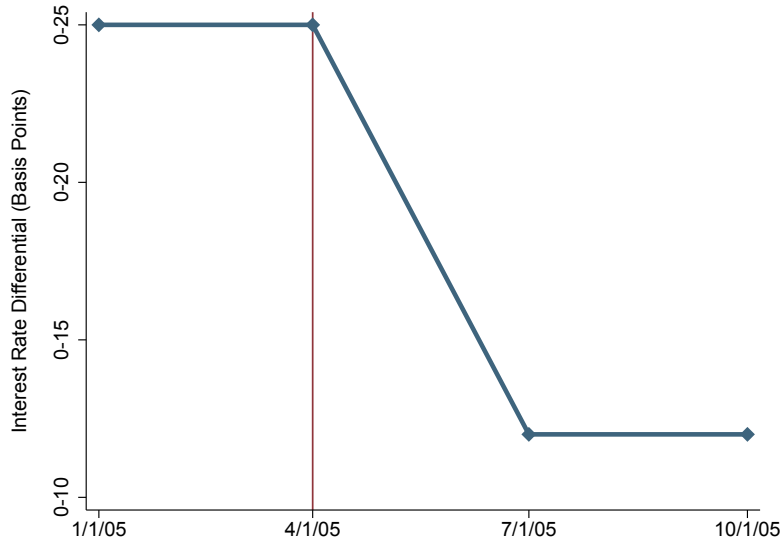
Notes: Figure plots the interest rate differential between credit lines backed by "wet" vs. "dry" collateral for an example mortgage company. Dry funding is secured by collateral that has already been created by the IMC, and requires that the loan documents be transferred to the dealer. Conversely, wet 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
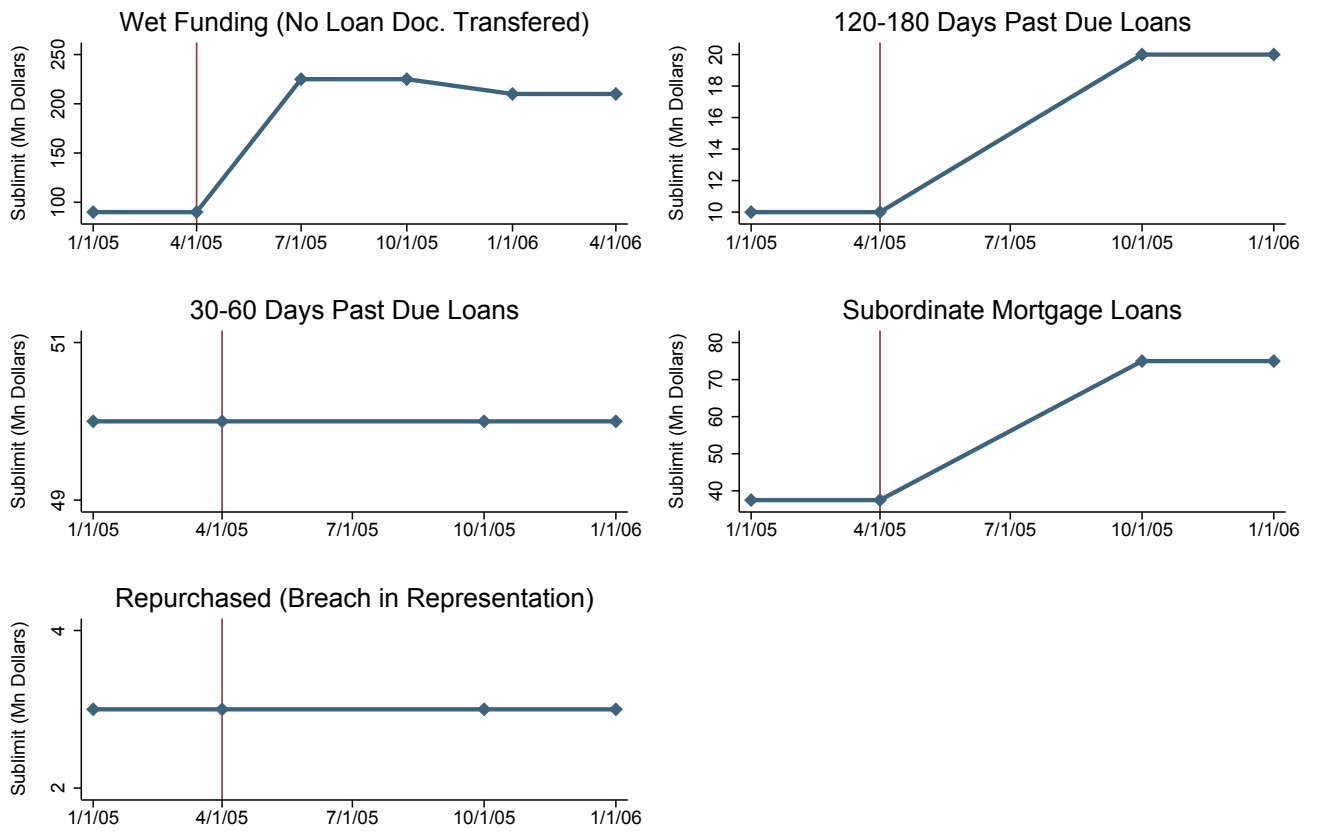
Notes: Figure provides suggestive evidence that the covenants were loosened post BAPCPA.

FIGURE 16: DEALER 2 COVENANTS ON CREDIT LINE TO EXAMPLE MORTGAGE COMPANY
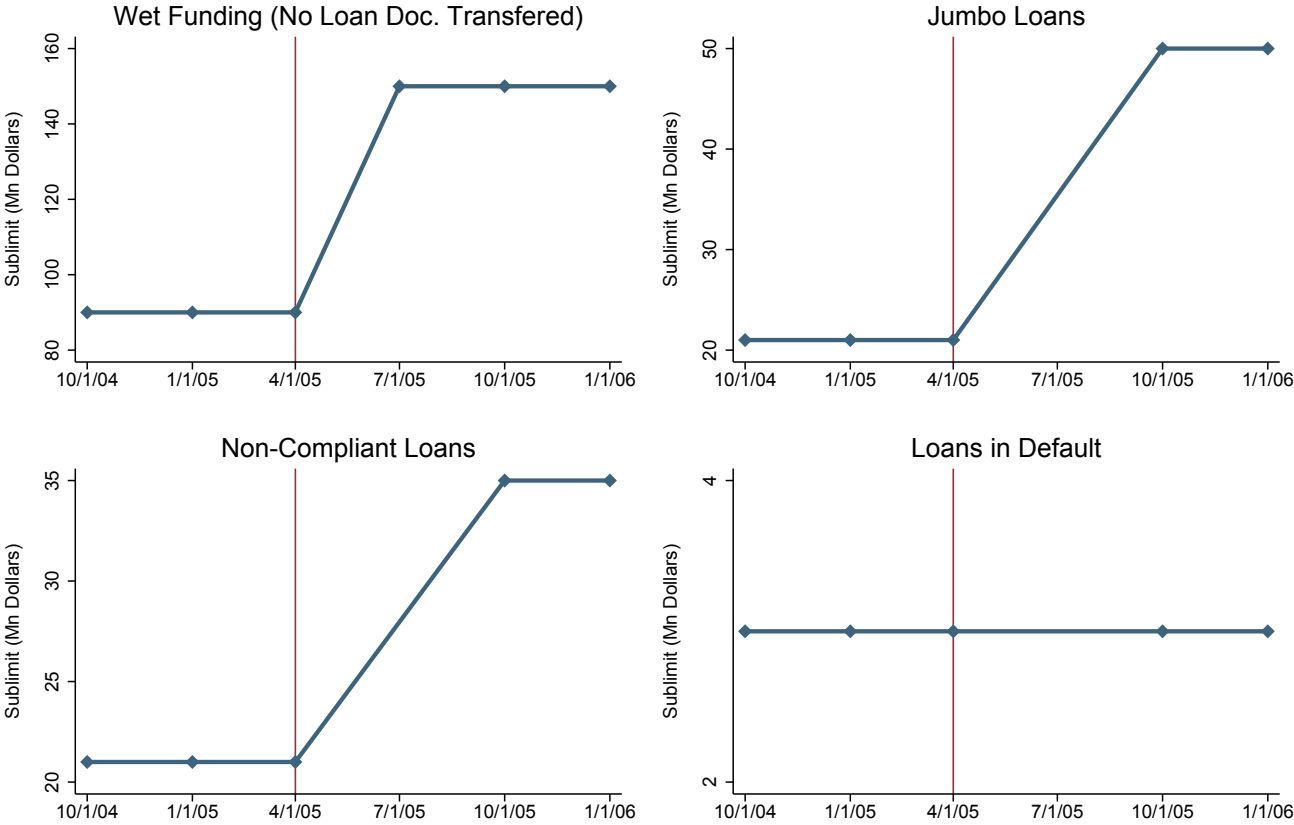
Notes: Figure provides suggestive evidence that the covenants were loosened post BAPCPA.

FIGURE 17: DEALER 3 COVENANTS ON CREDIT LINE TO EXAMPLE MORTGAGE COMPANY
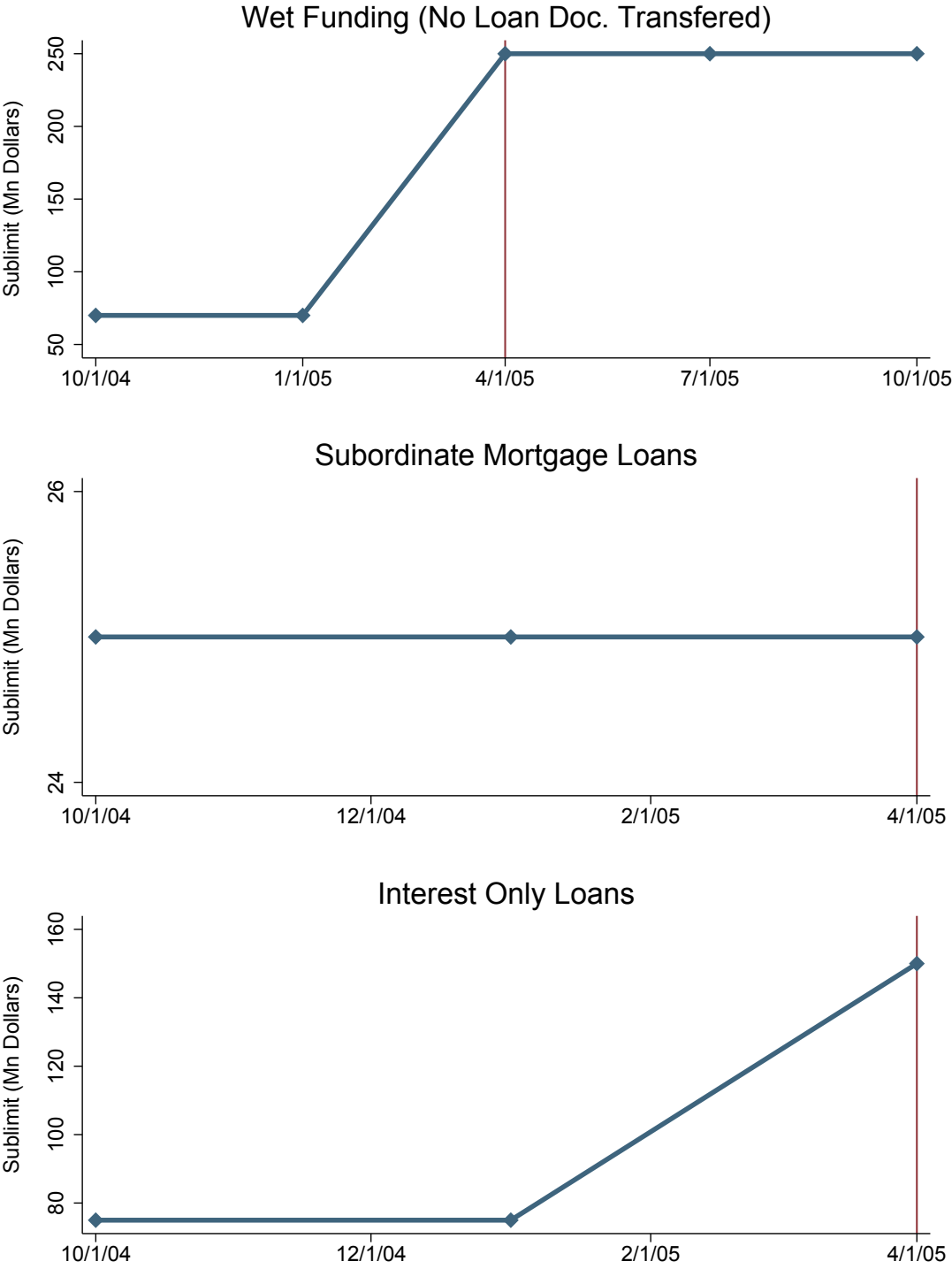
Notes: Figure provides suggestive evidence that the covenants were loosened post
BAPCPA.
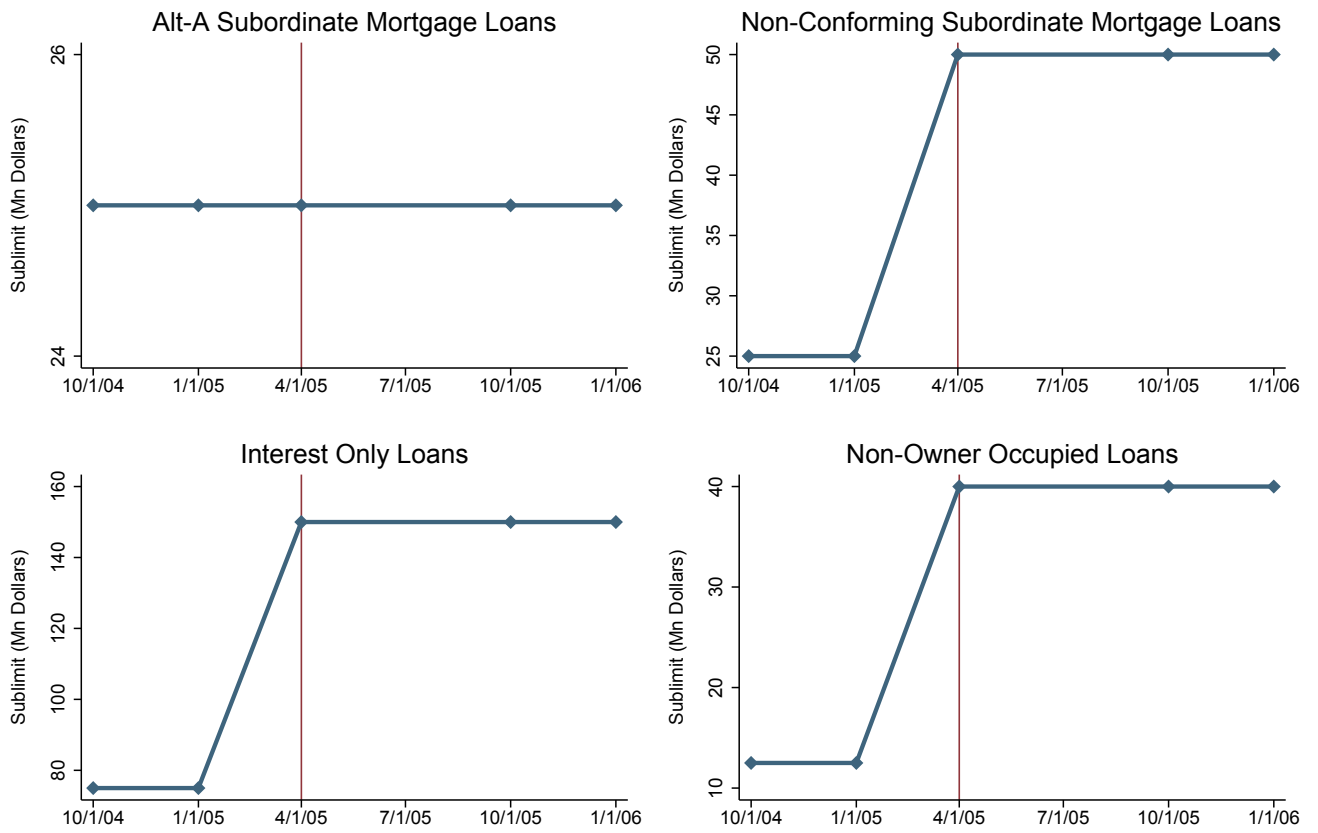
Notes: Figure provides suggestive evidence that the covenants were loosened post BAPCPA.

FIGURE 19: DEALER 5 COVENANTS ON CREDIT LINE TO EXAMPLE MORTGAGE COMPANY
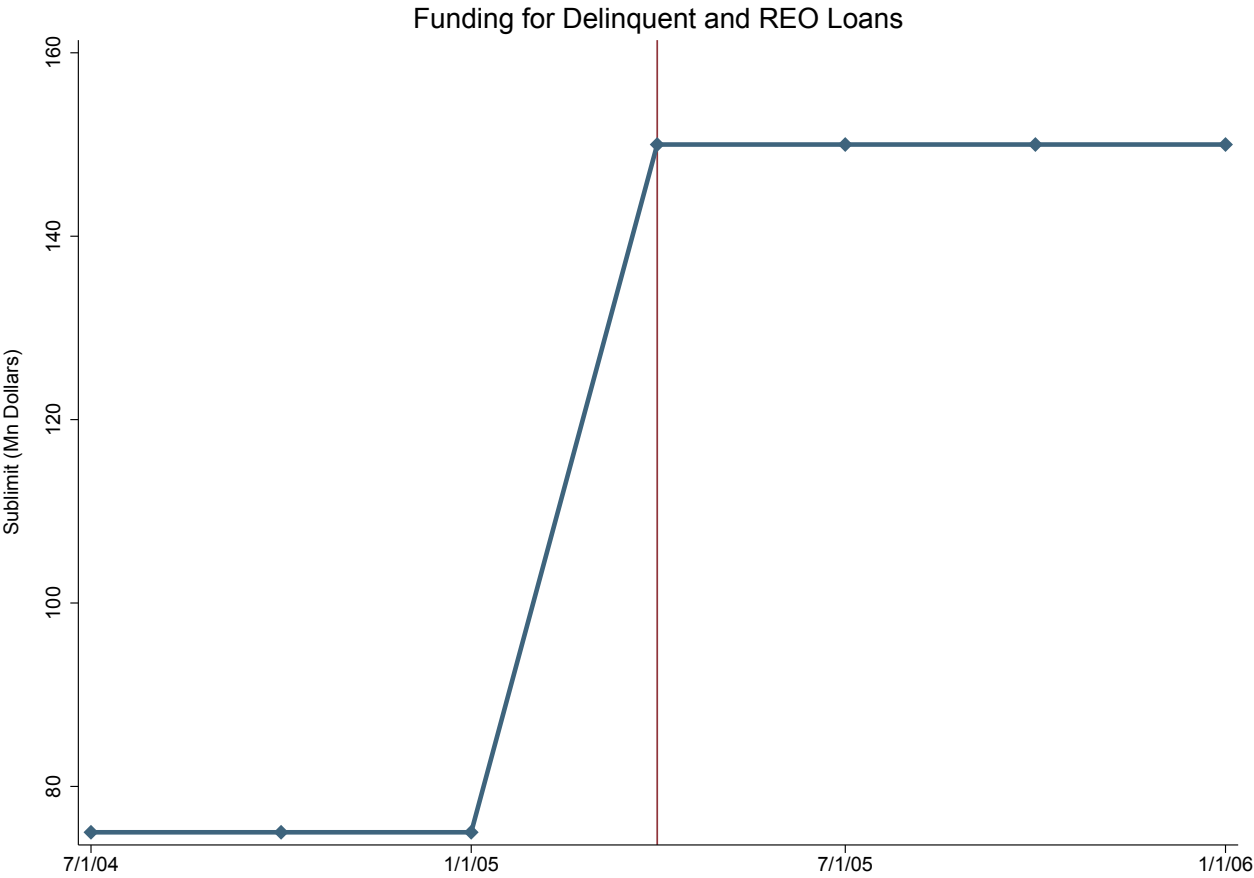
Notes: Figure provides suggestive evidence that the covenants were loosened post BAPCPA. REO stands for Real Estate Owned, which indicates that a property has been seized by the lender from borrowers who are unable to pay their mortgages.

FIGURE 20: DEALER BORROWING BACKED BY PRIVATE-LABEL VS. AGENCY MORTGAGE COLLATERAL
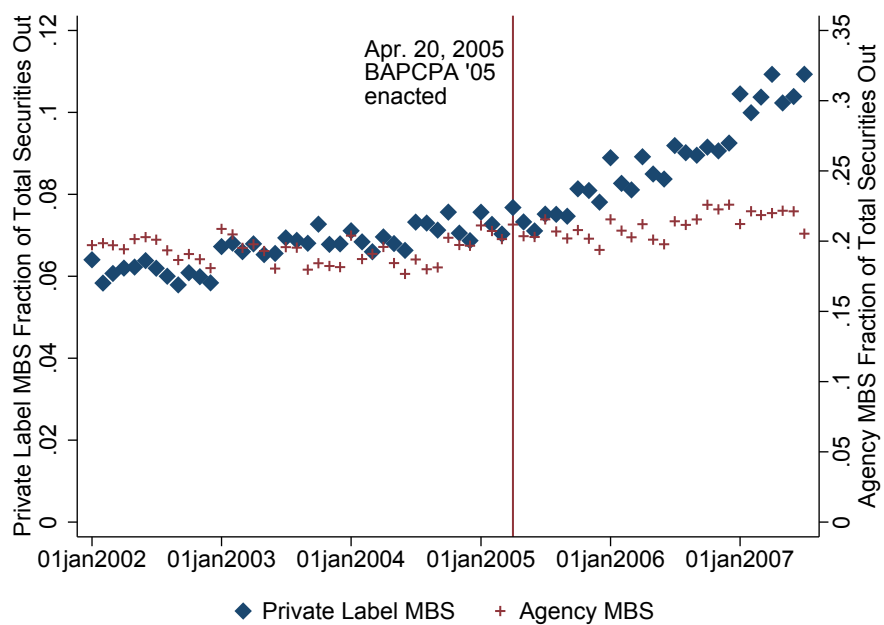
Notes: Figure plots the fraction of total primary dealer securities out that was made up of private-label MBS versus agency MBS pre and post BAPCPA. The variable corporate securities in the FR 2004 proxies for private-label MBS. Agency MBS is comprised of Federal Agency and GSE MBS in the FR 2004 data. 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
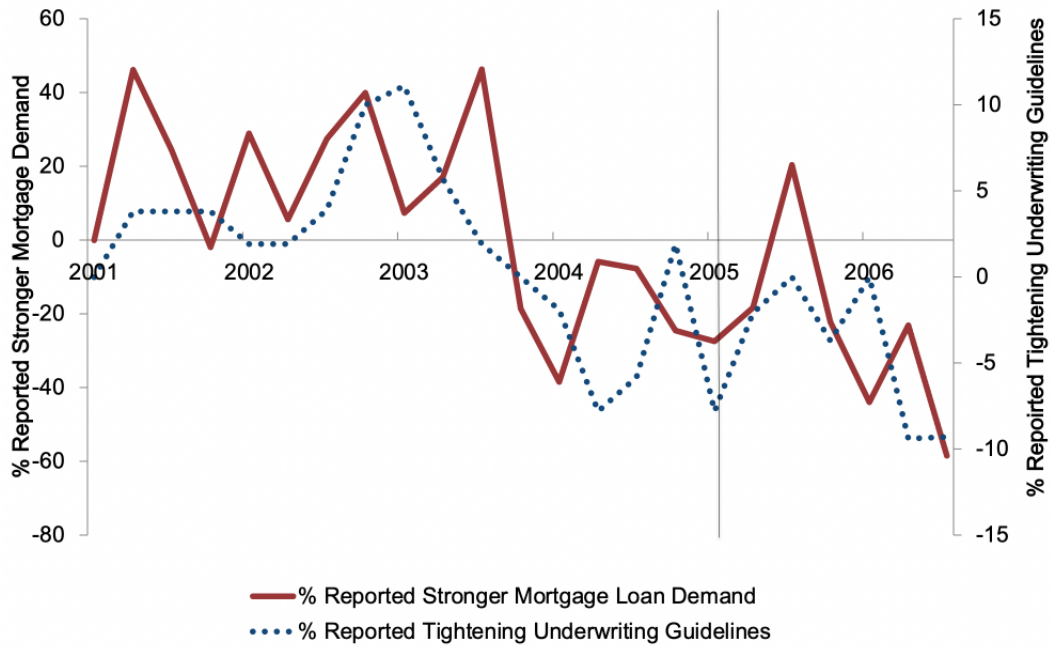

Notes: The plot reports data from the Federal Reserve's Senior Loan Officer Opinion Survey on Bank Lending Practices which surveys of up to eighty large domestic banks about mortgage demand and underwriting guidelines for all mortgage loans. Data available at: https://www.federalreserve.gov/data/sloos/sloos-201807-chart-data.htm

FIGURE 23: CONTINUOUS DID WEIGHTS
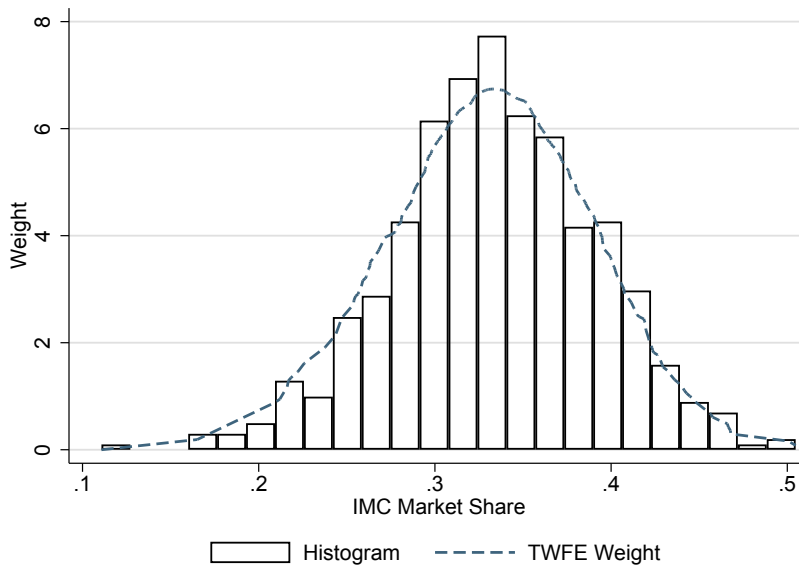
Notes: The figure plots the distribution of treatment, $IMCMarketShare_{c,2004}$ against the weights applied in the continuous difference-in-differences or two-way fixed effects specification.

FIGURE 24: SIX TREATED INDEPENDENT MORTGAGE COMPANY (IMC) MARKET SHARE
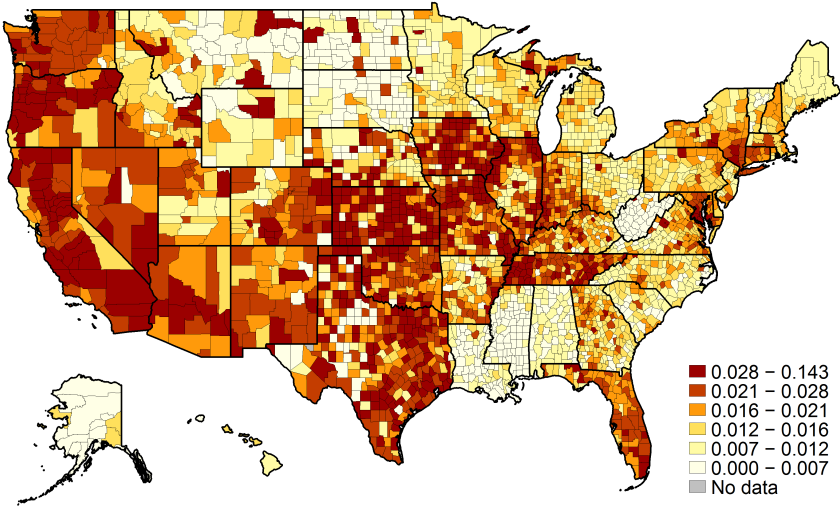
Notes: The figure depicts the county level market share of the six treated independent mortgage companies (IMCs) reported in 2004. The market shares are calculated using the 2004 HMDA data.

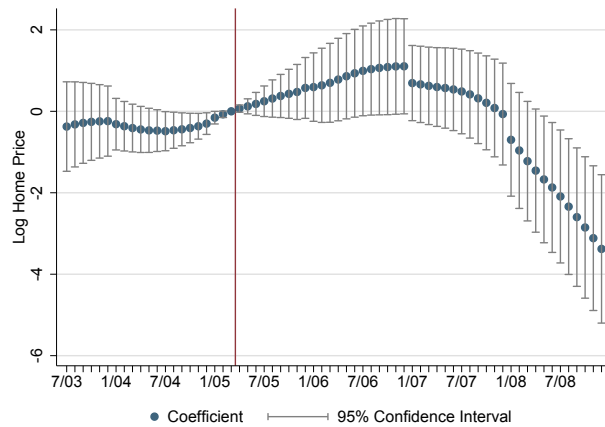FIGURE 25: TREATED IMC COUNTY MKT SHARE EFFECT ON MTG CHARACTERISTICS
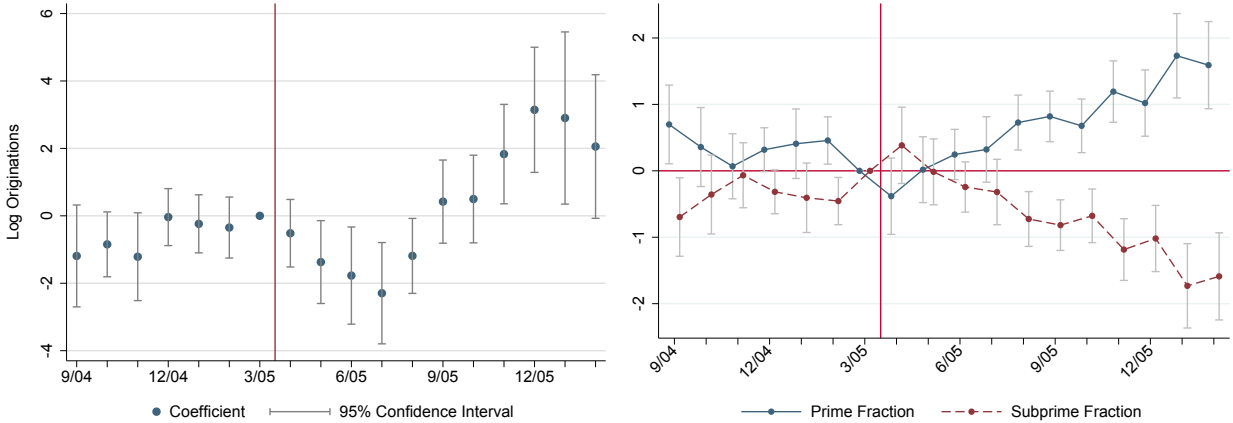
(a) Originations
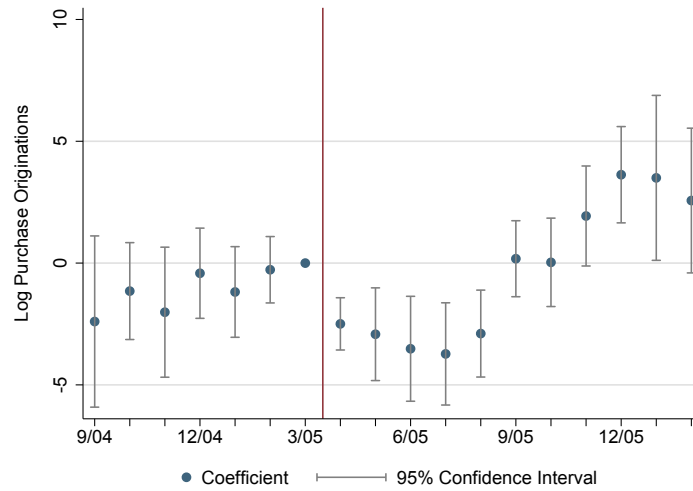
(b) Fraction Prime/Subprime
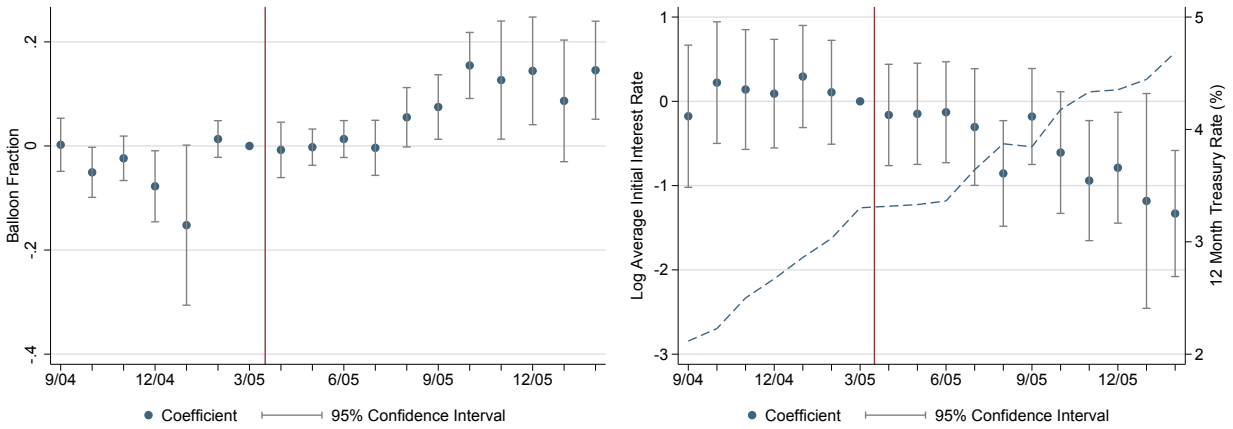
(c) Fraction Balloon

(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.
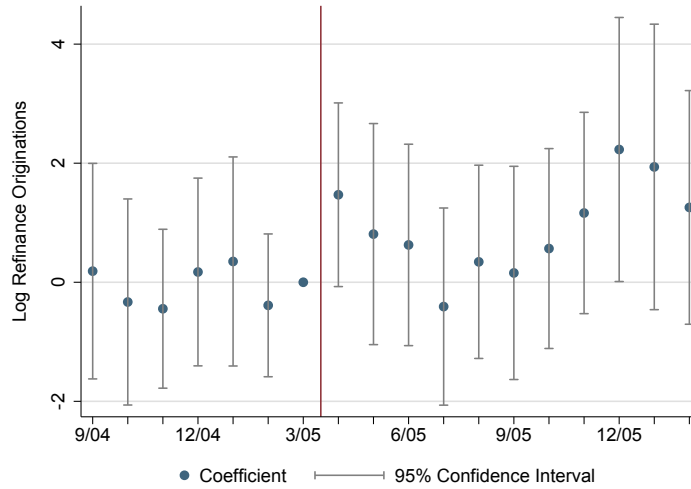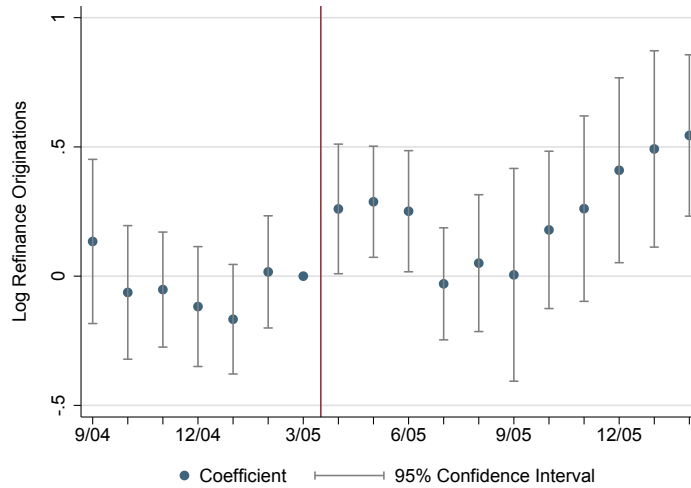
(a) Six Treated IMCs
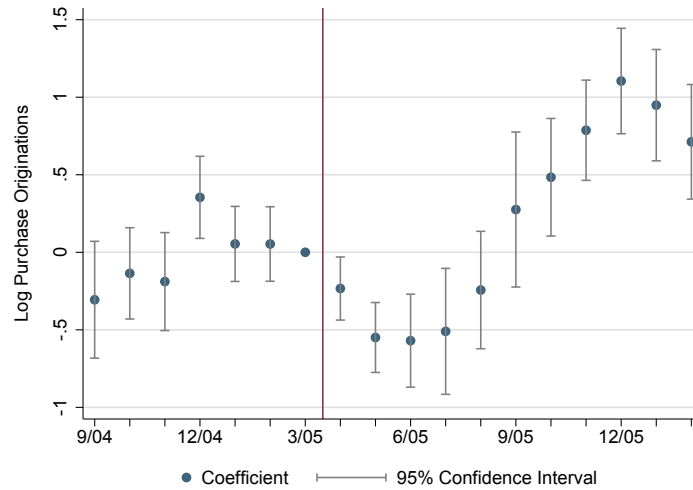
(b) All IMCs

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.

(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.

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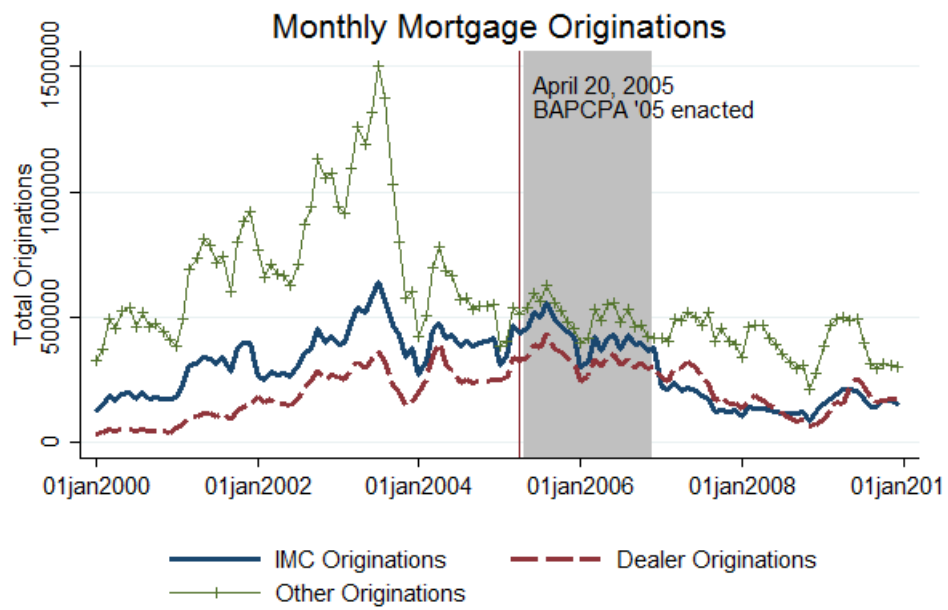
Source: Confidential HMDA Data.

Notes: Figure plots mortgage originations by dealers, IMCs, other originators. Other originators includes commercial banks and mainly represents agency mortgage originations. IMC originations mainly represents private-label originations. The steep fall in agency mortgage originations coincides with the regulations placed debt limits for Fannie Mae and Freddie Mac in response to their accounting fraud cases.
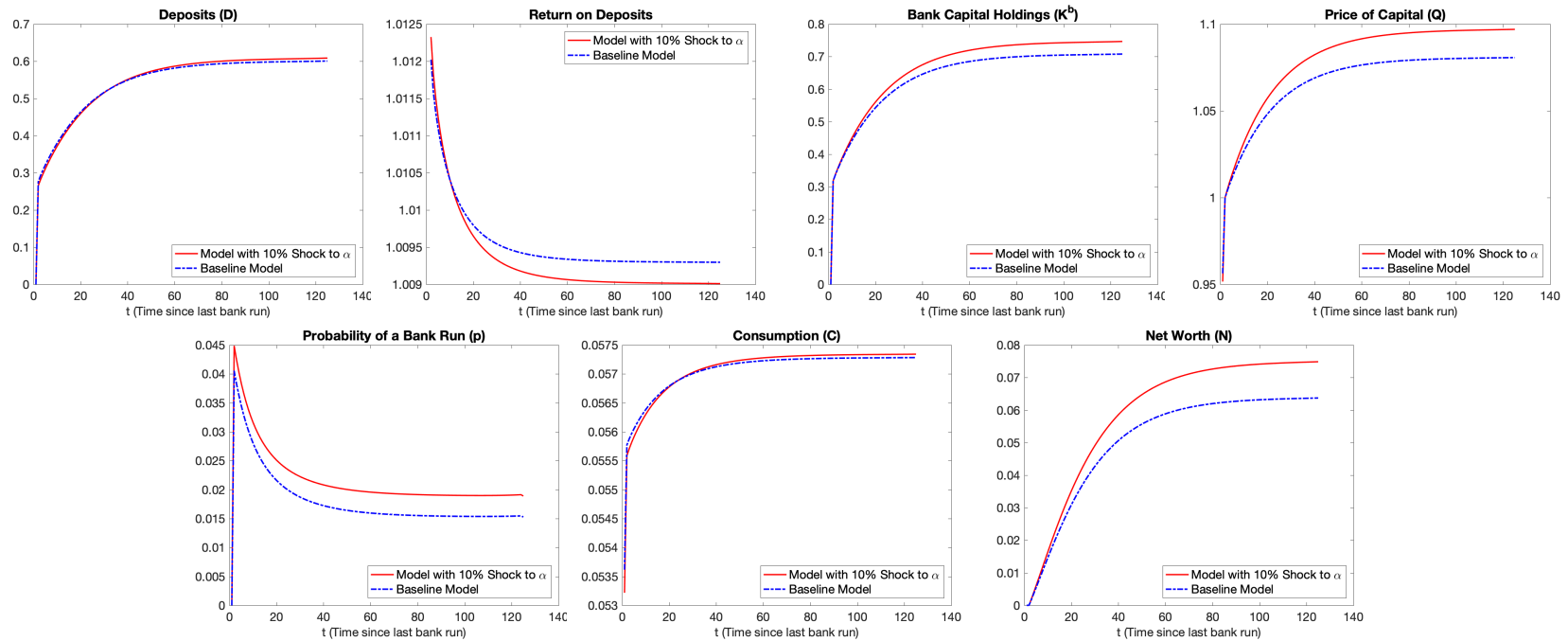
FIGURE 29: EVOLUTION OF VARIABLES IF NO BANK RUN OCCURS

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.

	(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.

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[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

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Post \times TreatedIMCMarketShare_{c,2004}$	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

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Post \times IMCMarketShare_{c,2004}$	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.