The Impact of Collateral Value on Mortgage Originations

Brittany Almquist Lewis*

February 25, 2025

Abstract

Exploiting the 2005 BAPCPA policy change, which granted mortgage collateral preferred bankruptcy treatment, I find that strengthening creditor rights on mortgage securities shifts mortgage contract types from conforming to alternative mortgages. Minority-dominant, low-income-growth zip codes receive less overall credit supply in response to the shock, yet are more exposed to the alternative products with low documentation and negative amortizing structures, leading to correlated mortgage payment resets and higher default rates. A model of mortgage lending illustrates that strengthening creditor rights, which decreases lenders' cost of capital, drives the change in contract type observed in the economy.

Keywords: collateral, contract types, repo safe harbor, bapcpa, mortgage backed securities, race
JEL Classification: G01, G10, G20, G21, G23, G33, G50

*Olin Business School, Washington University - St. Louis. E-mail: **b.almquist.lewis@gmail.com**, website: **www.brittanylewis.org**. I thank Xiyu Wang for excellent research assistance. I thank Chris Clayton and Candace Miller for influential discussions. I thank Phil Dybvig, Margarita Tsoutsoura, Viral Acharya, Anjan Thakor, Antoinette Schoar, Manuel Adelino, Stijn Van Nieuwerburgh, John Barrios, David Martinez-Miera, Andreas Neuhierl, Amir Kermani, Kosali Simon, the seminar participants at Northwestern Macroeconomics, The NY Federal Reserve, Washington University in St. Louis, UNSW, University of Sydney, University of Melbourne, Goethe & SAFE, and the conference participants at the Junior Household Finance Seminar, IU Summer Health Policy Workshop, AEA, Olin-St. Louis Federal Reserve Mini-Conference, Census Bureau Workshop on Race, Ethnicity, and Inequality, Berkeley Law Scholars Conference, UW Fostering Inclusion, ECWFC, and ANU Banking and Financial Stability Meeting. I gratefully acknowledge the Guthrie Center for Real Estate Research and Indiana University's Racial Justice Research Fund for their support. Any errors in this manuscript are my own.

Expanding homeownership rates among low income and high income volatility borrowers has long been a policy goal of federal agencies. It is an important policy goal to increase access to mortgage lending for these borrowers, however we should not do so by developing institutions that set the borrowers up to fail. A growing body of literature and government initiatives have documented that the majority of foreclosures during the Global Financial Crisis (GFC) were clustered in minority zip codes (Haughwout et al. (2020), Kermani and Wong (2021), Rugh (2015), Down Payment Toward Equity Grant, DOJ False Claims Act lawsuits against mortgage originators). However, it remains an open question as to why minority borrowers were the hardest hit by foreclosures during the GFC. In this paper, I document how granting preferred bankruptcy status in the sale and repurchase ("repo") market, a large wholesale funding market, allowed the private market to extend credit to vulnerable borrowers via alternative mortgages and an increasingly fragile internal capital market structure in the run-up to the GFC.

As background, the typical repo transaction involves the borrowing institution pledging securities as collateral to borrow a short-term loan from the lending institution. In this way, a repo agreement serves the same economic function as a collateralized loan, except it is considered an outright sale followed by a repurchase of the collateral. Certain types of repo collateral receive preferred bankruptcy status, or safe harbor, which grants the collateral an exemption from automatic stay. Exemption from automatic stay means that upon a bankruptcy event, the final creditor may take immediate control of the collateral without waiting in bankruptcy court. In a downturn, exemption from automatic stay can facilitate fire sales of collateral, since counterparties may take immediate control of collateral and sell it in the market. Typically, safe assets such as Treasuries and agency mortgage collateral, which will maintain their value in a crisis, were granted exemption from automatic stay. However, in 2005, Congress passed the Bankruptcy Abuse Prevention and Consumer Protection Act (BAPCPA) which granted exemption from automatic stay to private-label mortgage collateral, which is not backed by the US Government and therefore need not maintain its price in a crisis. Given the lack of government backing, the quality of collateral becomes very important to ensure that the collateral will maintain its value in a crisis to prevent market destabilizing fire sales.

There are opposing mechanisms that can affect collateral value. BAPCPA's exemption from automatic stay increased creditor rights and thus could potentially increase collateral value. However, Duffie and Skeel (2012) argue that exemption from automatic stay may decrease incentive to monitor repo collateral and lead to a deterioration of the underlying collateral quality. In this paper, I study whether granting repo safe harbor to private-label mortgages (PLS) weakened the quality of the underlying mortgage collateral by changing

the mortgage contracts to alternative mortgages and increasing correlation in mortgage payment resets that borrowers faced. Alternative mortgages and correlated payment resets would make the funding pipeline increasingly fragile for private-label mortgages. Making the funding pipeline for PLS fragile would be especially perilous because Davis et al. (2023) and Adelino et al. (2020) show, during 2005-2006, PLS became a substitute for Federal Housing Administration (FHA) and Veterans' Affairs (VA) mortgages – mortgages which play a key role in providing access to homeownership for households with limited financial means. By granting PLS preferred bankruptcy status, BAPCPA allowed mortgages to vulnerable borrowers to be more easily securitized in the private market with limited oversight and government backstops.

I use Congress's passage of the Bankruptcy Abuse Prevention and Consumer Protection Act (BAPCPA), in April 2005, to isolate a plausibly exogenous strengthening of creditor rights for mortgage collateral in the repo market. Centering the empirical setting around BAPCPA isolates the role that stronger creditor rights play in the expansion of alternative mortgage products and the type of borrowers exposed to those products. The mortgage funding market that I study features independent mortgage companies (IMCs), which are not deposit taking institutions and which rely on credit lines to fund themselves. Large dealer-banks fund these mortgage companies with repo warehouse lines of credit known as "Master Repurchase Agreements." I assert that when BAPCPA granted exemption from automatic stay to the repo mortgage collateral, which backed these warehouse lines, it lowered dealer-banks' cost of funding private-label mortgages. It did so by allowing dealer-banks to repledge, or reuse, collateral to fund new mortgages rather than providing their own capital to do so (Lewis (2023)). Since the IMCs rely on repo warehouse lines of credit from the large dealer-banks, they were more heavily exposed to the decrease in dealer-banks' cost of capital following BAPCPA. Importantly for my research design, the change only affected private-label, or risky, mortgage collateral since agency mortgage collateral had already been granted exemption from automatic stay by the Bankruptcy Amendments Act of 1984. Prior to the GFC, independent mortgage companies made up close to one third of the mortgage lending market. Post crisis, their market share has increased to approximately half of the market and their funding structure largely remains the same. Given that the market share and funding structure of IMCs remains very similar to the pre-GFC era, the findings in this paper have important implications for how future use of private-label mortgage collateral could be made safer while BAPCPA's repo safe harbor remains in effect.

To begin, I document new stylized facts around the policy change. First, I document that the policy change leads to an explosion of risky alternative mortgage products such as negative amortizing mortgages (which increase indebtedness over time) and interest only

mortgages, and that these mortgage products were disproportionately originated to higher-income-volatility, minority-dominant zip codes. These alternative products featured artificially low introductory payments and negative amortizing structures, suggesting that the mortgages originated in response to BAPCPA lowered near-term mortgage payments, making them more affordable for borrowers with higher income variability at the cost of decreasing borrower home equity. Next, I document that following the policy change, early payment defaults and total defaults, by month of origination, more than doubled their pre-BAPCPA levels. These defaults were disproportionately experienced by higher-income-volatility, minority-dominant zip codes.

To causally document that BAPCPA drove an expansion of alternative private-label mortgages (such as balloon, negative amortizing, and two-step mortgages) to higher-income-volatility, minority-dominant borrowers, I set up a treatment intensity difference-in-differences (DiD) research design. I define treated areas to be zip codes with a higher market share of IMCs in 2004, the year prior to the change and estimate the DiD by racial subgroup to study the differential originations of mortgage products pre- versus post-BAPCPA by racial makeup of a zip code. I define a zip code to be majority Black or Latino if it is above the 80^{th} percentile in its density of a given race. If a zip code is defined as Black, the fraction of the population identifying as Black is greater than the fraction identifying as Latino, and vice versa. I document that following the policy change, a 10% increase in the pre-period treatment measure, IMC market share, leads to a relative increase in originations for majority white and Latino zip codes, but a sharp decline in originations in majority Black zip codes.

While minority zip codes did not experience a significant increase in overall mortgage originations, their number of alternative mortgage products increased disproportionately relative to white zip codes. Specifically, a 10% increase in pre-period IMC market share increased balloon mortgages by 42% for Latino zip codes, 31% for Black zip codes, and 17% for white zip codes. The same increase in treatment exposure increased negative amortizing mortgages by 21.3% for Latino zip codes, 9.6% for Black zip codes, and 8.9% for white zip codes, and it increased two-step mortgages by 24.4% for Latino zip codes, 7.4% for Black zip codes, and 0.01% for white zip codes. For a subset of private-label mortgages, I merge novel loan level data to originator type in HMDA. This allows me to create a loan level indicator for loans originated by IMCs at the monthly frequency. Consistently, in this loan level data, IMCs disproportionately increase originations of balloon and negative amortizing mortgages in response to BAPCPA and especially so in minority zip codes.

Following BAPCPA, I find that average credit scores increased in Black, Latino, and white zip codes, with large increases in majority Black and Latino zip codes and near-zero increases

in white zip codes. Although credit scores increased, even the relatively large increases in minority zip codes were likely too modest to offset the increased risk associated with the alternative mortgages. Additionally, full documentation mortgages increased statistically significantly for majority white zip codes, showed no significant increase for Latino zip codes, and decreased significantly for majority Black zip codes. Lower documentation indicates that asset and income are not fully verified, which allows borrowers to be poorly equipped to handle future mortgage payment resets, creating implications for default.

In order to study the consequences of receiving alternative mortgage products, I study both early payment default and total default using a similar DiD research design but including controls for home equity and unemployment. I find that a 10% increase in IMC market share in the pre-period leads to a 0.53 percentage point (pp) increase in early payment default for Black zip codes. This increase is statistically significantly higher than that for white and Latino zip codes, which experienced a 0.16 and 0.22 pp increase, respectively. When I turn to total defaults, I find that majority white zip codes experience a 1.9 pp increase following BAPCPA in response to a 10% increase in pre-period treatment. For the same increase in treatment, Black zip codes experienced a 3.9 pp increase in total defaults, and Latino zip codes experience a 5.1 pp increase, which are both statistically significantly higher than the increase for white zip codes.

To study whether IMCs increase lending to borrowers with higher income volatility following BAPCPA, I proxy for income volatility with low income growth between 2001 and 2004, since income growth is highly negatively correlated with income volatility. I estimate the differential impact of high- versus low-IMC market share, pre- versus post-BAPCPA in the top and bottom income growth quartile zip codes. Following the policy change, a 10% increase in pre-period IMC market share drives up originations in high income growth zip codes and drives down originations in low income growth zip codes. However, both high and low income growth zip codes receive relatively similar increases in alternative mortgages. In response to a 10% increase in pre-period IMC market share, the highest income growth zip codes experience a 31% increase in balloon mortgages and the lowest experience a 30% increase. The same increase in pre-period treatment exposure increases negative amortizing mortgages by 17% in the highest and 11% in the lowest income growth zip codes, and it increases two-step mortgages by 21% for the highest and by 6.3% for the lowest income growth quartile zip codes. Although these results are consistent with borrowers in both groups receiving an increased amount of alternative originations, the lowest income growth zip codes receive an increasing number of alternative products despite the fact that their relative total originations decrease post-BAPCPA. This is consistent with low income growth zip codes receiving a larger fraction of alternative products.

Following the policy change, I find that average credit scores increased in both the highest and lowest income growth quartile zip codes. However, although credit scores increased, the observed increases were likely insufficient to offset the increased risk associated with the alternative mortgages. I find that the number of full documentation mortgages increased significantly in the highest income growth zip codes and decreased significantly in the lowest income growth zip codes. These documentation results are consistent with higher-income-volatility borrowers receiving mortgages with less well-documented income and assets following the policy change, which has implications for default. A 10% increase in pre-period treatment increases post-period early payment defaults by 0.32 pp in the lowest and 0.28 pp in the highest income growth zip codes, and it increases total defaults in the post period by 4 pp in the lowest and 3.7 pp in the highest income growth zip codes. I estimate a robustness test that controls for income growth in my racial subgroup regressions and find that the differential exposure to alternative mortgage products and defaults in minority-dominant zip codes persists.

The burst in alternative mortgages, which featured low introductory mortgage payments, following BAPCPA, created timing coordination on the payment reset dates. I estimate a DiD regression where I limit to mortgages that experience an interest rate reset and I create a payment shock indicator, equal to one if a mortgage payment increases by 10% or more at the time of the first reset. The probability of experiencing a payment shock disproportionately increases, beginning six months after the policy change, if the mortgage was originated in a zip code with higher IMC market share. This timing is consistent with a burst of adjustable rate mortgages immediately following BAPCPA, which led to synchronized payment shocks beginning 6 months later. Latino, Black, and white borrowers all experience an increase in the probability of experiencing a payment shock in the post-period. However, borrowers with lower full documentation rates, which disproportionately affected minority zip codes, were likely less well equipped to handle these large payment resets since their ability to repay the mortgage had not been fully verified even at the low introductory payment.

To explain the mechanism through which an increase in secondary market collateral value stimulates lending of new mortgage contract types in the primary market, I propose a stylized model. The model features a competitive lender who lends to high-income-variability and less than full documented borrowers. The high-income-variability, low-documentation borrowers borrow alternative mortgages (as in Piskorski and Tchistyi (2010)) in the private-label-mortgage market. This setup is consistent with the private-label market becoming a substitute for the FHA/VA market, which funded borrowers who often could not qualify for conforming loans. The model represents the nonbank (or IMC) funding market, where a dealer-bank funds mortgage originations by providing warehouse lines of credit, takes collat-

eral ownership of the mortgages originated, and repledges the collateral (borrows against the collateral) to lower its funding costs. As a simplification of this nonbank funding structure, I model the dealer-bank lender as originating and controlling the mortgages directly.

Lenders value a mortgage that they create both for the interest income it generates and because it serves as collateral for them to borrow against in the repo market. When BAPCPA strengthens the creditor rights on private-label mortgage collateral, it increases dealers' ability to borrow against the collateral and thus decreases dealers' cost of capital. When the dealers' cost of capital required to originate mortgages decreases, they lower the interest rate that they charge borrowers on private-label mortgages. In my framework, this implies that the price offered on the alternative private-label contract would fall. Imagine that the price in the private-label market pre-BAPCPA was above borrowers' reservation price. Post-BAPCPA, if the price falls below the borrowers' reservation price, the lender expands into the market for high-income-variability and less than fully documented borrowers using a mortgage product that had not previously been offered. Consistently, I find that following BAPCPA, IMCs differentially lower their initial interest rates. This mechanism helps to explain why, although alternative mortgage products had existed since the 1980s, we had not seen them originated at the scale they reached just prior to the GFC.

Literature Review This paper contributes to several strands of the literature. First it helps to reconcile the open debate of whether the housing boom was driven by an expansion in credit supply or expectations (at the macro level: Acharya et al. (2011); Kaplan et al. (2020), and at the micro level: Mian and Sufi (2009); Adelino et al. (2018)). Lewis (2023) documents that BAPCPA 2005 created a credit supply increase that was passed from the repo market, to mortgage companies, and ultimately to the housing market. This paper innovates by establishing that BAPCPA shifted mortgage originations toward alternative amortization products. While both high and low income growth zip codes received alternative mortgages post-BAPCPA, the low-income-growth, minority-dominant, zip codes received a disproportionately large fraction that were less than fully documented, consistent with the mortgages not adequately assessing ability to repay. Importantly, I show that although alternative products were originated in low-income growth zip codes, they were originated to borrowers with higher credit scores and were recorded as prime mortgages, likely in an attempt to offset the risk associated with the alternative products.

I also offer an explanation for the puzzle of why the 2005-2007 cohort mortgages performed much worse than the 2000-2004 cohorts controlling for borrower characteristics (Gerardi et al. (2008); Haughwout et al. (2008); Mayer et al. (2009); Demyanyk and Van Hemert (2011); Krainer and Laderman (2011); Bhardwaj and Sengupta (2012); Davis et al. (2023)).

Palmer (2024) proposes that negative equity increases borrower likelihood of default in the face of even small home price declines. I document that 2005-2007 borrowers were disproportionately likely to receive negative amortizing loans with less than fully documented assets and income post-April 2005, due to BAPCPA, in addition to these borrowers having less time to build equity before the onset of the GFC.

My paper also contributes to the debate on whether repo should receive preferred bankruptcy treatment (Lubben (2010), Roe (2010), Skeel and Jackson (2012)). Supporters argue it improves stability of the financial markets (Edwards and Morrison (2005)). However, Duffie and Skeel (2012) propose four risks associated with granting repo preferred bankruptcy status: lowering repo lenders' incentive to monitor collateral; increasing their ability to become too big or interlinked to fail; increasing inefficient substitution toward short-term repo funding; and increasing risk of fire sales. Lewis (2023) documents empirical evidence of increased interlinkages and repo financing post-BAPCPA. Acharya et al. (2024) documents that repo safe harbor can lead to an increase in leverage among the most levered counterparties and Dybvig and Hou (2023) argue that it can lead counterparties to gamble. Morrison et al. (2013) note that preferred bankruptcy treatment for repos was intended for collateral with price stability. This paper innovates by establishing that the passage of repo safe harbor to private-label MBS facilitated originating alternative mortgage products to vulnerable borrowers on a risky funding structure that was highly levered, subject to repo runs, and not backed by the typical backstops of agency mortgages. Thus the findings in my paper underscore the importance of verifying collateral's ability to retain its price in a crisis before granting it exemption from automatic stay.

This paper also relates to the literature on the private creation of safe debt. Bernanke (2005) discusses a global savings glut featuring foreign countries' increased demand for safe assets. Indeed, Diebold and Richter (2023) find that a large fraction of the total supply of US credit prior to the GFC was funded by foreigners. Gorton et al. (2012) suggest that the demand for safe debt exceeds the supply of US Treasuries and that the private sector can produce substitutes for government debt. My paper contributes to this literature by proposing that by granting safe harbor to private-label MBS, BAPCPA provided the technology that allowed dealer-banks to issue safe debt, as shadow banks do in Gennaioli et al. (2013). By receiving PLS collateral from mortgage companies in one repo market and repledging the collateral in the tri-party repo market to raise funding, as shown in Lewis (2023), BAPCPA created the technology that allowed foreign credit to enter the US housing market to fund private-label mortgages. Consistently, Srinivasan (2017) shows that post-BAPCPA, borrowing backed by PLS increased in the tri-party repo market, the market through which cash typically enters the shadow banking system (Krishnamurthy

et al. (2014)).

This paper also relates to the literature on collateral value and credit provision. The literature shows that an increase in collateral value increases credit provision by decreasing interest rates and increasing debt maturity (Cerqueiro et al. (2016); Benmelech (2009); Benmelech and Bergman (2009, 2011); Benmelech et al. (2005)). I innovate relative to this literature by establishing that by increasing collateral value in the secondary market, BAPCPA changed primary market debt contracts from conforming to alternative mortgages.

Finally, this paper contributes to a growing literature on racial disparities in housing markets: returns to housing (Kermani and Wong (2021); Drukker and Ma (2024)), home prices (Bayer et al. (2017); Ihlanfeldt and Mayock (2009); Myers (2004), housing costs through unfavorable tax assessments (Avenancio-León and Howard (2022)), interest rates and fees (Bartlett et al. (2022); Bhutta and Hizmo (2021); Fuster et al. (2022); Ambrose et al. (2021), down payment constraints Gupta et al. (2023), and refinancing behavior (Gerardi et al. (2023)). Li and Mayock (2019) show that minority loans originated during 2005-2009 were more likely to have several high-risk characteristics. I innovate both by documenting that improved secondary market collateral value explains increased alternative originations to minority dominant zip codes and by showing that Black zip codes experience a relatively lower credit expansion.

1 Data and Institutional Background

1.1 Data

Dealer Repo Financing Data. I use the Federal Reserve Bank of New York's weekly survey of primary dealers (FR 2004) to measure primary dealers' aggregate trading activity by collateral class. Due to their role making the market for US Treasuries, the primary dealers are required to report trading data to the Federal Reserve. There is no external data dictionary identifying financing positions and collateral classes for these data outside the Federal Reserve. To overcome this, I hand match the FR 2004 variables to the survey instructions given to the survey respondents in order to create a weekly time series of total dealer holdings and secured financing by collateral class. Matching the FR 2004 variables to the survey instructions allows me to establish that, prior to 2013, the data included dealers' trading in private-label mortgage collateral in the line item *corporate securities*, as discussed in Lewis (2023) online appendix A.1. In this online appendix, I decompose corporate securities into the collateral classes that comprise it.

These data allow me to study whether primary dealers' repledging of private-label collateral in the repo markets increased post BAPCPA. The key variables that I utilize are

securities out and *securities in*. Securities out reports dealers' secured borrowing (cash received) and securities in reports dealers' secured lending (cash lent).[1] The FR 2004 data is likely to be representative of trading activity in the repo markets as a whole during 2005-2007 since it reports the primary dealers' aggregate activity in both the tri-party and bilateral repo markets. Copeland, Martin and Walker (2014) states that primary dealers made up 79% of all dealer activity in the tri-party repo market in July and August 2008 and assumes that this percentage holds across both the bilateral and tri-party repo markets.

Home Mortgage Disclosure Act (HMDA) Data. To establish the effect of BAPCPA on IMCs' lending to households, I utilize the HMDA data. In order to supervise and enforce fair lending practices nationwide, the US Congress mandates that all loan applications related to home purchase, refinancing, and home improvement are reported to the federal government. The main variables that I use are mortgage status (denied, approved, originated), who the originator was, whether the originator was an IMC, the year, and region in which it was originated and the race of the borrower.

I use these data to construct the IMC zip-code-level market share in 2004, the year prior to BAPCPA. To identify the IMCs, I use the crosswalk maintained by Robert Avery to match subsidiaries to their parent company and aggregate mortgages originated by the parent company. I define a mortgage company as an IMC if it underwrites and funds a loan in its own name, following the HMDA definition of IMCs. In Appendix F, I study mortgage acceptance rates by lender type and race.

CoreLogic Data. I use the CoreLogic Loan Level Market Analytics (LLMA) data to study mortgage characteristics pre- and post-BAPCPA. Due to data restrictions, in this dataset I do not observe the originator of a mortgage, prohibiting comparison of the individual mortgages originated directly by IMCs versus non-IMCs, pre- and post-BAPCPA. To overcome this in the main analysis, I aggregate all variables to the zip code level and merge them with the 2004 IMC market share in that region to analyze the effect of exposure to IMC lending on changes in mortgage characteristics.

The LLMA data contain detailed information on mortgage characteristics at origination as well as monthly performance data for a large sample of anonymized borrowers. CoreLogic collects these data from 25 of the largest mortgage servicers in the US. The data track approximately 5.7 million mortgages each year and in a typical year during 2003-2008, include 45% of mortgages originated in the US.

I also utilize the Non-Agency Residential Mortgage Backed Securities (NARMBS) data. These data cover private-label mortgages and include originator name. I conduct a fuzzy

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

merge to HMDA data which allows me to identify originators as IMCs for a subset of the data. I describe the merge in Appendix I. I utilize these data to verify that patterns in the zip-code-level regressions remain consistent in the loan level data.

Income and Race Data. This paper merges data on income and race by zip code. Average income is estimated from the IRS's Statistics of Income (SOI) data between 2001 and 2004 using the number of tax returns filed in a given income bracket relative to the total number of tax returns filed in that zip code. Race data is from the 2000 Census data. A detailed description of the race variables used can be found in Appendix A.

1.2 Institutional Details of the Sale and Repurchase "Repo" Market

The sale and repurchase, or "repo," markets are large short-term funding markets where securities are sold and repurchased by the borrowing institution, creating short-term loans from the lending institution, which are collateralized by financial assets.[2] These repo loans serve the same economic function as collateralized loans, except that the exchange of collateral is considered an outright sale followed by a repurchase.

Large securities dealers often lend cash in the repo markets and use the securities they obtain in those transactions as collateral to borrow for their own interest, i.e., dealers repledge, rehypothecate, or reuse the collateral they receive. The dealer will typically offer a lower interest rate on the repo loan if the client allows the dealer to rehypothecate the assets that serve as collateral (Copeland et al. (2014)). This suggests both that the ability to repledge collateral is valuable for the dealer, and that dealers have a valuation for ability to repledge collateral that can be expressed as an interest rate.

In order to understand the credit supply increase that BAPCPA generated, and therefore the research design, this section describes (1) the structure of IMC repo credit lines from dealers; (2) how dealers operate in the repo market; (3) how BAPCPA affected the interactions between dealers and IMCs.

Independent Mortgage Company Warehouse Repurchase Facilities. Independent mortgage companies are not deposit taking institutions. They depend heavily on the sale of their mortgages in order to fund themselves. This sale typically takes between 30-60 days. In the meantime, mortgage companies originate mortgages, package them into a warehouse facility and use this warehouse facility to borrow against. The repayment of these warehouse credit lines varies by contract but they are often repayable either when the financed mortgages are sold or on the maturity date of the contract.[3]

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

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

Lewis (2023) carefully studies the warehouse credit lines for the 12 largest IMCs and shows that the 29 largest dealers were their main funders and that the dealers passed their credit supply increase on to the IMCs that they were funding. Stanton, Walden and Wallace (2014) finds that five of these 12 IMCs originate a minimum of 49% of all IMC mortgage lending in 2006. As a lower bound, I estimate that the 12 IMCs are responsible for 59% of all IMC originations in 2006. I estimate this by adding mortgage purchases to the origination figures for the top five IMCs in Stanton, Walden and Wallace (2014) and estimating the remaining seven IMCs' originations using HMDA market share. This number is a lower bound since I do not observe the correspondent purchases by the additional seven IMCs. Given that the 12 largest IMCs studied in Lewis (2023) make up a minimum of 59% of all IMC originations in 2006, and that they all utilize the same warehouse funding structure, in the empirical section of the paper, I assume that all IMCs are treated by BAPCPA.

Repo Market Functioning. Copeland, Martin and Walker (2014) estimate that during July-August 2008, the sum of all repos outstanding on a typical day was approximately $6.1 trillion. The sum of all reverse repos outstanding was about $4 trillion.[4] The main users of repos are large dealer banks and other financial institutions such as money market funds (MMFs), hedge funds, and IMCs.

The repo market consists of two segmented markets: the **bilateral** and the **tri-party** market. The tri-party market is the market that connects dealers with nonbank cash investors such as MMFs and securities lenders. Krishnamurthy, Nagel and Orlov (2014) state that the tri-party market is the way in which cash funding enters the shadow banking system through repo. Lower overcollateralization rates or "haircuts" are charged in the tri-party market on the same collateral, due to lower counterparty risk. This is because traditionally more creditworthy market participants – such as large dealers and cash investors – trade in the tri-party market, the collateral is held by a clearing house (the third party), and the contracts are short-term in nature. The clearing house plays several important roles, such as settling and netting transactions, and the bankruptcy treatment of collateral affects the clearing house's ability to perform these functions.

The bilateral market is where opaque, less credit-worthy agents seek short-term funding. The cash borrowers in this market are riskier and face larger haircuts to protect the dealers lending to them. The bilateral repo market is a market through which funds are reallocated between dealers and across dealers and hedge funds, or mortgage companies.

Dealers play an important role as repo intermediaries between cash lenders and cash

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

borrowers across these markets. Dealers are likely to be cash borrowers (send securities out), in the tri-party market (Infante (2019)), and to be cash lenders (receive securities in) in the bilateral market (Copeland, Martin and Walker (2014)). Dealers prefer to use borrowed capital to finance their borrowing rather than to use their own scarce capital, so they repledge collateral received in the bilateral market to borrow in the tri-party market (Tuckman (2010); Copeland, Martin and Walker (2014)). This reuse of collateral allows dealers to take advantage of the differential between haircuts in the bilateral and tri-party markets to generate a cash "windfall" (Infante (2019)).

The *automatic stay*, which places a hold on a firm's assets when the firm enters bankruptcy proceedings, would interfere with the clearing houses' timely settlement of collateral in the event of bankruptcy. This would make the tri-party market unwilling to hold collateral exposed to automatic stay and thus limit dealers' ability to reuse such collateral. Repurchase agreements that use specific collateral types defined in the bankruptcy code receive an exemption from the automatic stay. Exemption from automatic stay grants the holder of the underlying collateral super-senior bankruptcy status, or safe harbor.

However collateral types that are not explicitly defined in the bankruptcy code are also traded in the repo markets. All repurchase agreements are written with the standard contract in the hopes that the court will interpret them as receiving preferred bankruptcy status. However, the preferred bankruptcy status relies on the court's interpretation of the repo contract (Lumpkin (1993)). For example, the court decided against the safe harbor of repo collateral for Lombard Wall (1982) and Criimi Mae (2000). This shocked the market and led to a steep contraction, implying that upon the court's decision, the collateral was less valuable than previously perceived. The market response to these court cases suggests that collateral must be legally exempt from automatic stay in the bankruptcy code to unequivocally qualify for preferred bankruptcy status. I discuss these court cases further in the Lewis (2023) appendix A in the Online Appendix.

Bankruptcy Abuse Prevention and Consumer Protection Act of 2005 (BAPCPA). BAPCPA was introduced in Congress in February 2005 and signed into law in April 2005.[5] The law expanded the definition of repurchase agreements in the Bankruptcy Code to include: (1) mortgage loans; (2) mortgage-related securities; (3) interests in mortgage-related securities or mortgage loans. This granted private-label mortgage securities and whole loans exemption from the automatic stay, giving the final creditor super senior bankruptcy status

[5]The law was introduced in Congress on February 1, 2005 by Republican Senator Chuck Grassley, passed by Congress on April 14, 2005, and signed into law by the president of the US on April 20, 2005 (https://www.congress.gov/bill/109th-congress/senate-bill/256/text/enr). It applied to consumer bankruptcy cases after October 17, 2005. See: Bankruptcy Abuse Prevention and Consumer Protection Act of 2005, Pub. L. No. 109-8, §907, 119 Stat. 23, 171-172 (codified as amended at 11 U.S.C. §101(47) (2012))

or safe harbor. This expansion of the bankruptcy code only affected private-label mortgage collateral, since agency mortgage collateral had been exempted in 1984.

The evidence in Lewis (2023) is consistent with BAPCPA enabling the clearing house in the tri-party market, or other counterparties, to hold private-label mortgage collateral without worry that a counterparty's failure would trigger automatic stay. Consistent with tri-party market lenders increasing their willingness to lend against private-label mortgage collateral, Srinivasan (2017) finds that, following BAPCPA, haircuts on private-label mortgage collateral in the tri-party market fell from 20% to 3%. Suggesting that BAPCPA enabled dealers to reuse, or repledge, warehoused private-label mortgage loans or newly minted private-label MBS in the tri-party market in larger quantities than they had been able to prior to the law change. The below argument would go through if dealers were able to repledge whole mortgage loans from the mortgage warehouse, or if they were able to securitize the warehoused loans quickly and pledge the newly minted securities.[6,7]

BAPCPA's Expansion of Repo Safe Harbor. This section sets up a simple example depicting the effect that BAPCPA had on dealers' reuse of collateral and the ensuing credit supply. Figure 1 depicts the proposed change from pre-BAPCPA (panel (a)) to post-BAPCPA (panel (b)) in dealers' ability to reuse the warehoused mortgage loans posted by an IMC.[8] In (a) the collateral was held – with limited reinvestment capability – to protect dealers from the default risk of the mortgage companies. In (b), Lewis (2023) shows that that the policy change increased dealers' ability to repledge the collateral by increasing the tri-party market's willingness to accept it. This allowed dealers to take advantage of the differential between the haircuts, that they charged in the bilateral market and received in the tri-party market, to create a repo money multiplier which expanded credit supply. The steep decrease in haircuts that Srinivasan (2017) finds is consistent with this mechanism.

[Figure 1 about here.]

The literature documents, both theoretically (Gottardi, Maurin and Monnet (2019)) and empirically (Copeland, Martin and Walker (2014), Infante (2019)), that differences in haircuts between the bilateral and tri-party market are larger for riskier collateral classes.

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

[7]The drop in haircuts is consistent with the collateral being considered safer and more likely to be held in the tri-party market. Adrian et al. (2009) discusses the increased use of private-label mortgage collateral in the tri-party market saying: 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.

[8]Although Figure 1 (b) and the argument below focus on reuse of warehoused mortgage collateral in the tri-party market, the argument would go through if dealers increased reuse of collateral in the bilateral market at lower haircuts than they received prior to the policy change.

The larger haircut differentials imply larger repo money multiplier potential. To establish the size of the haircut that dealers charged the IMCs in my data, I utilize data from a subset of the IMCs that report both their utilization on credit lines and the value of mortgages they post. This information allows me to estimate the haircut that IMCs paid. In 2005Q4 an *IMC* posted a 36% haircut to insulate dealers from the IMC's risk of default. I propose that BAPCPA's improved creditor rights on private-label collateral (securities or whole mortgage loans), following BAPCPA, decreased large haircuts required on collateral posted by the *dealer* in the tri-party market to 5% (as in Copeland et al. (2014) or 3% as in Srinivasan (2017)).

Imagine that pre-BAPCPA, the dealer funded the IMC initially with \$100 of capital (the "*first round*" of lending), the 36% haircut implies that the IMC posted \$136 worth of collateral to secure the repo loan, and the dealer held the collateral. In Figure 1, I depict this as a dealer paying \$100 to buy mortgage collateral valued at \$136, from the mortgage company in the bilateral market, with an agreement to sell it back in 60 days at \$100. The above haircuts imply that post-BAPCPA, dealers could re-sell the \$136 collateral for \$130 in the tri-party market. The process would work as follows. If the dealer funded the IMC with the initial \$100 of capital, the dealer could borrow \$130 by repledging the IMC's \$136 collateral in the tri-party repo market at a haircut of 5%. If the dealer reinvested in warehouse mortgage loans by lending the \$130 back to the IMC (the "*second round*" of lending), and haircuts remained the same, the IMC would post \$176.8 of new mortgages to secure the repo loan. By repledging this \$176.8 of mortgage collateral, the dealer could borrow \$169 in the tri-party market. This cycle of lending to an IMC, receiving collateral from the IMC, repledging the collateral to a cash lender, and reinvesting the cash in the IMC could continue for many rounds.

This haircut differential would lead to a money multiplier, similar to the multiplier in the fractional reserve banking system. Moreover, the dealer has incentive to reinvest each round of cash back into private-label mortgages, because the haircut differential on this collateral means that each dollar reinvested would generate more than a dollar in the dealers' own borrowing potential, lowering the cost of capital. Additionally, although this example abstracts from an interest rate charged on the repo borrowing to simplify the exposition of overcollateralization, continuing this cycle of lending would allow the dealer to lever up the return that it received from the IMC in the form of interest rates on the warehouse repurchase facilities.[9]

[9]Each additional round of lending to the IMC would increase the interest earned by the dealer. The interest earned (r) on the dealer's lending depicted in Figure 1 (a) would be $r = \$100 \times i^{IMC}$. While in Figure 1 (b) the dealer's interest earned would be: $r = \$100 \times i^{IMC} + \$130 \times (i^{IMC} - i^{Dealer})$. Where i^{IMC} is the interest rate paid by the IMC on repo funding and i^{Dealer} is the interest rate paid by the dealer on

Consistent with the collateral becoming a valuable tool to lower their cost of capital, I see the dealers offering increasingly favorable overcollateralization terms to the IMCs in my data post-BAPCPA. The haircut dealers required was 36% in 2005Q4, 26% in 2006Q1, 11% in 2006Q2, 15% in 2006Q3, and 16% in 2006Q4. The slight increase in 2006Q3 and 2006Q4 could be driven by an increase in risk of underlying mortgages. As long as the IMC generated enough money from fees or interest on the mortgages originated, it would have enough equity to fund the haircut charged by the dealer. The haircuts that I measure in 2006 are consistent with the haircut differential measured in Copeland, Martin and Walker (2014), which measures the difference between median repo haircuts on private-label collateralized mortgage obligations across the bilateral and tri-party repo market in July 2008 to be 17%. As a reference, the haircut differential on agency MBS at the time was 2%.

The haircuts I calculate for the IMCs from 2005Q4-2006Q4 allow me to calculate an upper bound on the multiplier that dealers could generate following BAPCPA. The majority of private-label mortgage securitizations sold in 30 days (Adelino, Gerardi and Hartman-Glaser (2019)). Therefore I use one month as the interval for the rounds of lending that generate the bilateral/tri-party haircut differential.[10] Given the quarterly haircut differentials between 2005Q4-2006Q4,[11] 15 rounds of lending across 15 months would create a multiplier equal to:

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

The multiplier in Equation 1 implies that the dealer can expand its leverage secured by private-label mortgage collateral to 66.5 times its initial equity, such that the dealer can supply $6,650 of credit to the economy with its initial $100 of funding.[12] This is 4.5

repo funding.

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

[11]The earliest that IMCs report overcollateralization is 2005Q4 and the latest is 2006Q4. Dividing one plus each of these numbers by 1.05 as in Equation 16 (in the Online Appendix of Lewis (2023)), yields the haircut differential utilized.

[12]There are 15 months of lending. The haircut differential is assumed to reset every 3 months because this is how often I see the haircut charged by the dealer in the bilateral market change. The value of the haircut in the tri-party market is assumed constant. This is reasonable given the similar estimates in Copeland et al. (2014); Krishnamurthy et al. (2014); Srinivasan (2017). The value of credit supplied to the IMC each round is calculated by multiplying the previous rounds' haircut differentials by each other. The total amount of credit that the dealer can supply to the economy is equal to the sum of lending across all rounds.

times the multiplier generated by rehypothecating Treasuries in the same way, described in subsection A.7 of the Online Appendix of Lewis (2023). This framework indicates that the credit supply increase caused by BAPCPA was larger than any credit supply increase resulting from the expansion of repo safe harbors to agency collateral in 1984 because the private-label collateral was riskier collateral and thus carried larger haircut differentials.

1.3 Effect of BAPCPA on Collateral Reuse

To motivate the research design used later in this paper, I illustrate the effect of the BAPCPA policy change on dealers' collateral reuse, which is an indicator for their ability to generate the money multiplier effect discussed above. I plot dealers' securities out (borrowing) collateralized by agency mortgage collateral, comprised of Federal Agency and GSE MBS, and by private-label mortgage collateral, proxied for by corporate securities which contained Non-Agency Residential MBS, each as a fraction of total securities out (total dealer borrowing) in Figure 2, recreated from online appendix A.6 of Lewis (2023). The figure shows that prior to BAPCPA a relatively constant fraction of dealers' total borrowing was collateralized each by private-label and by agency collateral. After BAPCPA the fraction of dealer borrowing collateralized by private-label collateral nearly doubled, from about 6% to close to 12%, while the fraction backed by agency collateral remained almost constant at about 22%. The value of PLS collateral used to borrow also almost doubled, jumping from $247 billion in March 2005 to $466 billion in July 2007, before crashing in late 2007, consistent with the timing of the GFC. This is consistent with an increase in dealers' ability to borrow against private-label mortgage collateral in the tri-party market, both since Infante (2019) states that dealers are likely to be borrowers in the tri-party market and since Srinivasan (2017) finds that haircuts fell about 17% in the tri-party market post-BAPCPA.

[Figure 2 about here.]

To test the statistical significance of dealers' increased use of private-label collateral to borrow following BAPCPA, I estimate the regression in Equation 2, recreated from online appendix A.6 of Lewis (2023), from January 1, 2001 through July 31, 2007 to compare 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:

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

$Y_{i,t}$ is set equal to both the log value of securities out and the fraction of total securities out (fraction of total dealer borrowing). For collateral class i at time t, $Post_t$ is an indicator

equal to zero prior to April 15, 2005 and equal to one on this date and later. PLS_i is an indicator 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 this term measures the difference in borrowing backed by private-label and agency mortgage collateral post-BAPCPA, less the difference between the two pre-BAPCPA.

[Table 1 about here.]

Table 1 reports the regression results. The coefficient on the interaction term, $Post_t \times PLS_i$, 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. Dealer's increased borrowing collateralized by PLS indicates increased ability to generate a repo money multiplier effect discussed above, creating a credit supply increase that began in the repo market. The credit supply increase pertains to the mortgage market because BAPCPA created a repo haircut differential specific to private-label mortgage collateral. Lewis (2023) Figure 7 establishes that dealers pass this credit supply increase on to the IMCs that they fund. In this paper, I use IMC market share as a treatment measure to capture zip-code-level exposure to the policy change and study the effects on mortgage borrowers.

2 Stylized Facts

2.1 The Rise of Alternative Mortgage Products

I first begin by establishing stylized facts about mortgage originations leading up to the GFC.

Fact 1: *The expansion of alternative mortgages accelerated rapidly beginning in 2005 and crashed in 2008.*

Fact 2: *The expansion of these alternative mortgages was more prominent among borrowers with low rates of income growth and those in minority-dominant zip codes.*

In Figure 3, I plot the total number of originations of negative amortizing (panel (a)) and interest only (IO) (panel (b)) mortgages from 2001 to 2008. Negative amortizing mortgages do not pay the full amount of interest and principal to amortize or pay down the loan over time. Therefore, the interest owed and not paid is added to the balance of the mortgage and recapitalized, so that the principal owed on the loan increases and interest is owed on the deferred interest. Negative-amortizing products increase borrowers' balance and thus

their indebtedness over time, rather than decreasing it. Mayer, Pence and Sherlund (2009) state that negative amortizing mortgages made up about 20% of all alternative mortgage products. Interest-only mortgage products include option-adjustable rate mortgages (option-ARMs) which offer the option to pay the fully amortizing principal and interest, only the interest payment, or a minimum amount that is less than the interest accrued. Option-ARMs were one of the main types of negative amortizing mortgage products originated in the lead up to the GFC.

Figure 3 panels (a) and (b) illuminate two interesting trends. First, they show that alternative mortgages increased suddenly in 2005 and remained at elevated levels before falling dramatically in 2008, with the onset of the GFC. Second, they show that zip codes in which borrowers experienced low rates of income growth (those in the first quartile of income growth), received disproportionately more of these alternative mortgages than borrowers in areas with high income growth (those in the fourth quartile of income growth). I measure income growth as the 2004 minus 2001 average estimated income in a zip code, divided by the average estimated income in 2001. I use income growth to proxy for income volatility because income volatility and growth are highly negatively correlated, i.e. households with low rates of income growth also have more volatile incomes,[13] and individual level income data are difficult to access.

Piskorski and Tchistyi (2010) finds that mortgage contracts which simplify the terms of the option-ARM contract have little loss in efficiency. Thus, later in this paper, I study balloon, negative amortizing (which includes option-ARMs), and two-step mortgages. These alternative mortgage products offered an artificially low mortgage payment for an initial time period, which deferred interest payments to later periods, when the payment reset to the fully amortizing price at the market rate. As I discuss later in the paper, close to 40% of the loans at this time had the first reset clustered 6 months, 1, and 2 years after origination. Alternative mortgage products may appeal to borrowers with high income volatility because they offer the ability to postpone the full interest and principal payment at times when borrowers' incomes may be low, and to repay the amount owed at a later time when their income may be higher. These products likely appeared affordable in 2005 near the height of the housing boom when the Federal Reserve was raising interest rates and home prices were near peak. However, borrowers in these mortgages would experience payment shock if the monthly payment that they reset to was higher than their artificially low initial payments.

Additionally, the annual reports of mortgage companies state that mortgage origina-

[13]See for example: the January 9, 2025 Brookings article "Low-income workers experience-by far-the most earnings and work hours instability." I also test the correlation between income growth and income volatility both at the zip code level and find that they are statistically significantly positively correlated.

tors determined the mortgage affordability based on the initial scheduled monthly payment rather than on future monthly payments after the interest rate reset date. This would allow borrowers to qualify for larger mortgages than they may otherwise qualify. To illustrate this, in Appendix B, I provide an example excerpt from independent mortgage company, HomeBanc.

[FIGURE 3 about here.]

In Figure 3 panels (c) and (d), I plot the fraction of alternative mortgage products originated, relative to all originations, in majority Black, Latino, and white zip codes.[14] Zip codes are defined as majority Black (BLK) or Latino (LTN) if they have above 16% of inhabitants identifying as a given race and less than 84% of the zip code identifying as white.[15] If a zip code is defined as Black, the fraction of the population identifying as Black is greater than the fraction of the population identifying as Latino, and vice versa. Zip codes with 16% of inhabitants identifying as either Black or Latino are close to the 80^{th} percentile of the minority distribution of zip codes in 2000. Zip codes with above 84% of inhabitants identifying as white (WHT) are defined as majority white zip codes. 84% of inhabitants identifying as white is close to the median of the distribution of white inhabitants by zip code in 2000. For the remainder of the paper, I refer to zip codes as Black, Latino, and white respectively. This measure is motivated by the theory of place-based clustering which establishes that people choose to live near other people like them (Logan and Molotch (2007); Charles (2003)).

I find that the zip codes defined as having a high minority population received a disproportionately high fraction of alternative mortgages. After 2005, the fraction of alternative mortgages increased the most in Latino zip codes, the second most in Black zip codes, and the third most in white zip codes. I also find that the fraction of other alternative mortgage products, shown later in the paper, which feature initial low monthly payments that reset to higher payments, also increased the most for minority zip codes compared to white zip codes. This pattern is consistent with Rugh (2015)'s observation that Latino borrowers continued to receive alternative mortgages at high home prices until just before the GFC, whereas white borrowers seemed to know that it was time to retreat from the mortgage market. Additionally, Davis et al. (2023) and Adelino et al. (2020) show that during 2005-2006, PLS became a substitute for Federal Housing Administration (FHA) and Veterans' Affairs (VA)

[14] I plot negative amortizing and interest only mortgages as a fraction of all originations in a zip code rather than the total number of these originations. Black and Latino households have lower homeownership rates than white households, thus for these descriptive plots, plotting the fraction of alternative mortgages better captures the disproportionate exposure that minority zip codes had to alternative mortgage products.

[15] Results are robust to varying the cutoff for high minority zip codes and to excluding the Sand States.

mortgages, which play a key role in providing access to homeownership for households with limited financial means.[16]

2.2 The Rise of Default Rates

Fact 3: *Early payment defaults and total defaults increased following 2005, and more than doubled their pre-2005 levels leading up to the Global Financial Crisis.*

Fact 4: *The increase in default rates was more prominent among borrowers with low rates of income growth and those in minority-dominant zip codes.*

In Figure 4 panel (a), I plot early payment defaults (EPD) from 2000 to 2008. Early payment defaults are reported using the Government Sponsored Entity (GSE) methodology, which flags whether a loan enters 90 day delinquency within the first 12 months since origination.[17] Historically, mortgages that are underwritten well are unlikely to default in the first year of origination (Mayer, Pence and Sherlund (2009)). Figure 4 shows that approximately 0.7% of loans in both the lowest and highest quartile of income growth experienced early payment default during 2000 to 2004. Following 2005, the early payment defaults increased at a faster rate for borrowers in the lowest quartile of income growth. By 2007, this number more than tripled such that nearly 3.0% of loans originated entered early payment default.

In panel (b), I plot the fraction of total defaults by income growth quartile. Total defaults also increased dramatically following 2005. The fraction of mortgages that defaulted by year of origination hovered around 6% of mortgages from 2000 to 2004. By 2007, this number almost quadrupled, such that nearly 30% of mortgages that originated in 2007 defaulted. Both the highest and lowest income growth quartiles experienced growth in total defaults by origination year, however the lowest income growth quartile experienced the highest fraction of defaults.

In panel (c), I explore the fraction of early payment defaults experienced by majority Black, Latino, and white zip codes. Majority Black zip codes endured the largest growth in the fraction of loans that experienced early payment default post 2005. EPDs in Black zip codes hovered around 1% during 2000 to 2004. EPDs in Black zip codes outpaced Latino

[16]The Department of Justice (DOJ) brought unprecedented law suits against FHA lenders under the False Claims Act. Several billion dollars of claims were also brought against IMCs for their lending in the PLS market. These lawsuits in the PLS market are consistent with the PLS mortgages targeting a similar demographic as FHA mortgages and regulators enacting penalties on the PLS market similar to the FHA market as a warning to lenders operating in these markets.

[17]Early payment defaults reported using the Federal Housing Administration (FHA) methodology flags whether a loan enters 60 day delinquency within the first six months since origination. The FHA measure is consistent with the GSE measure.

and white zip codes in all years post-2005 and peaked in 2007 at 3% of originated loans experiencing early payment default in majority Black zip codes. In majority Latino zip codes, the percent of EPDs remained close to 0.6% of originations during 2000 to 2004 and peaked in 2007 at almost 2% of originations. White zip codes experienced an average EPD rate of about 0.4% during 2000 to 2004 and their EPD rate peaked in 2008 at 1.8% of mortgages originated in 2007 experiencing early payment default.

In panel (d), I explore the fraction of total defaults experienced by majority Black, Latino, and white zip codes. Similar to panel (b), this measure looks at the number of originations that ever experience a default by origination year.[18] Following 2005, growth in total defaults in majority Black and Latino zip codes outpaced defaults in majority white zip codes. Prior to 2005, majority Black zip codes experienced default rates near 10%. Following 2005, the default rate for these zip codes averaged around 20% and peaked at about 26% in 2007. Prior to 2005, majority Latino zip codes experienced default rates near 7%, while following 2005, the default rate in these zip codes averaged around 17% and peaked in 2007 at close to 23%. Prior to 2005, majority white zip codes experienced a default rate close to 5%, while following 2005 the default rate in these zip codes averaged around 14% and peaked in 2007 at 17%. The large increase in total default rate in majority Black and Latino zip codes relative to majority white zip codes is consistent with the increase in risky alternative products that these zip codes received, as shown in Figure 3.

[FIGURE 4 about here.]

3 Effect of BAPCPA on Mortgage Lending

3.1 Effects by Racial Subgroups

In this section, I empirically test whether dealer-banks originate more mortgages via IMCs, consistent with an expansion of their lending on the left hand side of Figure 1, and whether they increased alternative mortgages to minority-dominant zip codes. I use a treatment intensity DiD research design. The market share of IMCs in 2004, or $IMCMktShr_{z,04}$, is the treatment variable. It captures the exposure of a zip code to IMCs in 2004, the year prior to BAPCPA. Since IMCs were directly linked to the dealers who were affected by the BAPCPA credit supply increase, the underlying assumption is that $IMCMktShr_{z,04}$ captures exposure to the credit supply shock. This variable is calculated using the number

[18] The final year in the performance data sample that I have is 2016. Therefore my measure indicates the fraction of loans that experience default in or before 2016.

of IMC mortgage originations relative to all mortgage originations in the HMDA data:[19]

$$IMCMktShr_{z,04} = \frac{Number\ of\ originations\ by\ IMCs_{z,2004}}{Total\ number\ of\ all\ originations_{z,2004}}. \tag{3}$$

This research design captures the idea that IMCs will pass on increased funding to borrowers at a faster rate than other lenders because they were linked to the dealers who received a credit supply increase from BAPCPA (Lewis (2023)). Figure 1 illustrates how dealers experience a credit supply shock by being able to repledge their collateral more easily. Figure 2 shows that indeed dealers increased their repledging out of collateral following BAPCPA. I study whether the IMCs differentially increase alternative product types following the policy change, and whether they do so disproportionately in high minority zip codes.

Figure 5 panel (a) depicts IMC market share by zip code in 2004. The spatial variation in IMC market share is likely due to the Fannie Mae and Freddie Mac scandals in 2003 and 2004 which decreased barriers to entry for IMCs to enter the mortgage market in 2003. The market share of IMCs was relatively stable throughout 2004, the year that I define treatment. The insight of the research design however is that BAPCPA was a national policy change so to the extent that it directly affected borrower behavior, this would have been internalized by both IMC and non-IMC lenders. Therefore, the way non-IMCs lend to minority versus non-minority or high- versus low-income growth areas pre- versus post-BAPCPA is an economic barometer for trends in lending. The effect associated with IMCs over and above that associated with non-IMCs captures the effect of BAPCPA increasing secondary market collateral value on primary market lending.

[Figure 5 about here.]

In Table 2, I report summary statistics for above versus below median $IMCMktShr_{z,04}$ zip codes. The higher IMC zip codes have a slightly higher fraction of BLK and LTN inhabitants. However, later in the paper, I create subgroups for majority BLK, WHT, and LTN zip codes and I find that all three groups demonstrate pre-period parallel trends. This suggests that high and low IMC zip codes move in parallel within each of these racial groups, mitigating the concern, discussed in Roberts and Whited (2013), that race or other covariates are correlated with differences in pre-period trends of treated and control zip codes.

[Table 2 about here.]

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

To study how $IMCMktShr_{z,04}$ affects zip-code-level mortgage characteristics, I estimate the following DiD specification in Equation 4, which measures the differential effect of moving from 0% to 100% IMC market share, pre- versus post-policy change. This regression estimates the differential effect that a high IMC market share has on mortgage originations and characteristics post-BAPCPA. The intuition behind this regression is that zip codes that are more exposed to IMC market share are more likely to be affected by the BAPCPA shock. The granular monthly data, around the month when BAPCPA was passed, strengthens the identification of the effects of BAPCPA. I estimate the regression separately for each racial subgroup:

$$Y_{z,t} \quad = \quad \gamma_z + \eta_{s,t} + \sum_T \beta_T IMCMktShr_{z,04} \times \mathbb{1}_{t=T} + \epsilon_{z,t}. \tag{4}$$

Where $Y_{z,t}$ is $\log(Originations_{z,t})$, $\log(Balloon_{z,t})$, $\log(NegAm_{z,t})$, $\log(TwoStep_{z,t})$, $\log(FullDoc_{z,t})$, and $\log(CreditScore_{z,t})$ in zip code z, at month t, and log is the natural logarithm. γ_z denotes Zip level fixed effects, and $\eta_{s,t}$ denotes $State \times Month$ fixed effects. $IMCMktShr_{z,04} \times \mathbb{1}_{t=T}$ is the interaction term between the market share variable and an indicator variable for month of origination.[20] β_T is the coefficient on the interaction term that measures the effect of a one unit increase in IMC market share on the dependent variable in each month relative to March 2005, the month prior to the passage of BAPCPA. Standard errors are clustered at the zip code level.

I exploit a narrow window pre- and post-BAPCPA from August 1, 2004 to October 31, 2006 to help ensure that the pre-period is a valid counterfactual for the post-period. I report the regression results with Zip fixed effects alone and with both Zip and $State \times Month$ fixed effects. The regression with both Zip and $State \times Month$ fixed effects is the preferred specification since it compares mortgage characteristics in zip codes with high versus low IMC market shares within the same state and month, absorbing state-month housing market effects. The narrow window, fixed effects, and stable pre-period IMC market share help to ensure that the pre-period is a valid counterfactual for the post-period. Callaway, Goodman-Bacon and Sant'Anna (2021) note that continuous treatment in a DiD setting can introduce bias if the estimator's weighting of treatment doses differs from the population-weighted treatment doses. Lewis (2023) develops a method to test this, which I follow in Appendix C and show that the population-weighted doses are close to normally distributed and the

[20] I also estimate the following static version of this regression with a single pre and post period:

$$Y_{z,t} = \gamma_z + \eta_{s,t} + \beta IMCMktShr_{z,04} \times Post_t + \epsilon_{z,t}. \tag{5}$$

estimator closely approximates the population weights, indicating that the estimator can be interpretted as the average treatment effect of the treated (ATT).

To study whether minorities were disproportionately impacted by IMCs' expansion of credit following BAPCPA, I estimate Equation 4 separately for subgroups of zip codes categorized by race. $\%RACE_z$ is defined as the total number of inhabitants of a certain race in a zip code divided by the total population of the zip code. I define the percent race of a zip code to be:

$$\%RACE_z = \frac{Number\ of\ RACE\ inhabitants_z}{Total\ number\ of\ inhabitants_z}. \tag{6}$$

Figure 5 contains a US heat map that documents, for each zip code, the proportion of Black inhabitants in panel (b), the proportion of Latino inhabitants in panel (c), and the proportion of white inhabitants in panel (d). I define zip codes to be a given race as defined in subsection 2.1. I estimate the same DiD specification on each of these separate subgroups, using an empirical design similar to that in Curtis, Garrett, Ohrn, Roberts and Serrato (2021).

The econometric design studies mortgage originations pre- versus post-BAPCPA as the first difference and across zip codes with high- versus low-IMC market share as the second difference. Estimating the regression separately in Black, Latino, and white zip codes allows me to study how originations responded to BAPCPA in high-IMC areas relative to low-IMC areas while comparing the effect in Black and Latino areas each relative to white areas. If BAPCPA increased lending, zip codes with a higher proportion of IMCs should increase their mortgage originations relative to zip codes with a lower proportion of IMCs. This regression specification tests whether IMCs have a larger origination response post-BAPCPA in minority zip codes relative to white zip codes. Taking Latino relative to white zip codes as an example, holding fixed the market share of IMCs in a zip code, if Latino zip codes experience a larger increase in originations relative to white zip codes in response to BAPCPA it implies that Latino zip codes received a disproportionately large effect of the credit supply increase.

Estimating the difference-in-differences specification by subgroup controls for pre-existing differences in lending in high-IMC relative to low-IMC areas separately in Black, Latino, and white zip codes. The regression coefficients for Black and Latino zip codes are each plotted relative to those for white zip codes. Comparing Black and Latino coefficients to those for white zip codes is similar in nature to a triple difference regression specification that interacts $\%RACE_z \times IMCMktShr_{z,04} \times Post_t$ (where $Post_t$ is an indicator variable equal to

1 on April 2005 and later). For each racial subgroup, the regression controls for pre-existing trends and estimates the differential effect of treatment in the post-period relative to the pre-period. The null hypothesis is that zip codes with different racial makeups were all affected by BAPCPA in the same way. If the null holds, I would expect to see no differential increase (decrease) in mortgage lending by the IMCs in areas with different racial makeup. Post policy change, if I observe a differential increase in originations for minority zip codes relative to white zip codes, it indicates that one subgroup was disproportionately affected by treatment relative to another subgroup.

3.2 Effects by Racial Subgroups - Results

Table 3 and Figure 6 panel (a) report the coefficient that measures the effect of the pre-period IMC market share on $\log(Originations_{z,t})$ each month relative to March 2005. $Originations_{z,t}$ is the total number of originations including both purchase and refinance mortgages. In the pre-period there was no differential change in lending between treated and control zip codes for any racial subgroup. Following the policy change, a 10% increase in pre-period IMC market share leads to a 0.7% and 0.6% increase in originations for white and Latino zip codes respectively post BAPCPA, with the increase in originations for white zip codes being statistically significant. However, a 10% increase in pre-period IMC market share leads to a statistically significant 2.6% decrease in mortgage originations in majority Black zip codes. This evidence is consistent with BAPCPA leading to a credit supply increase in white zip codes, while it led to a decrease in Black zip codes. In other words, Black zip codes with high-IMC market share receive fewer mortgages relative to Black low-IMC zip codes post-BAPCPA relative to pre-BAPCPA.

[Figure 6 about here.]

[Table 3 about here.]

To understand whether the increase in originations in white and Latino zip codes was driven by alternative mortgage products and whether these products played a role in the disproportionate effect of BAPCPA by racial subgroup, in Table 3 and Figure 6, I report balloon (panel (b)), negative amortizing (panel (c)), and two-step mortgages (panel (d)) as outcome variables. Negative amortizing, balloon, and two-step mortgages constitute products that are similar to the option ARM in key ways that allow borrowers to shift payments when their income is low into future periods when their income may be higher. The main benefit of these products was that their initial mortgage payments were typically lower than

those on fully amortizing mortgages. However, this introductory mortgage payment would reset, usually to a much higher payment.

Following BAPCPA, the results document a disproportionate increase in originations of alternative mortgages in minority zip codes. Figure 6 panel (b) shows that a 10% increase in pre-period IMC market share leads to a 17% increase in balloon mortgages in white zip codes, a 30.1% increase in Black zip codes, and a 41.7% increase in Latino zip codes. I report a t-test of whether the average effect of treatment in the post period is statistically significantly different for white zip codes relative to Black zip codes and for white zip codes relative to Latino zip codes. The increases in balloon mortgages for Black and Latino zip codes were both statistically significantly higher than the increase for white zip codes. The panels in Figure 6 establish that all subgroups' mortgage originations had pre-period parallel trends and they all responded at the same time to BAPCPA. Thus, this research design establishes that pre-period distributional shifts in a subgroup's mortgage originations are not driving the results following BAPCPA.

Similarly Figure 6 panel (c) shows that relative to the pre-period, a 10% increase in pre-period IMC market share leads to statistically significant increases in negative amortizing mortgages of 8.9% for white zip codes, 9.6% for Black zip codes, and 21.3% for Latino zip codes. Relative to white zip codes, the increase in negative amortizing mortgages in Latino zip codes is significantly higher while the increase in Black zip codes is not statistically different. In panel (d), I study two-step mortgages which increased by 24.4% for Latino zip codes and this number is statistically larger than the 0.01% increase that white zip codes experienced. I find a 7.4% increase for Black zip codes, though the increase is not statistically significant.

In Appendix H, I estimate these specifications using a Poisson model and find that the results remain consistent. In Appendix I, I utilize loan level data to estimate the increase in probability of originating alternative mortgage products in the post-period relative to the pre-period. For a subset of private-label mortgages, I am able to merge originator type to the originator name using a fuzzy name merge. Using these loan level data, I find that post-BAPCPA, IMCs were more likely to originate negative amortizing and balloon mortgages than they were pre-BAPCPA.[21] These results are also more prevalent in Black and Latino zip codes, consistent with minority zip codes receiving disproportionately more alternative mortgages post-BAPCPA.

To study borrower characteristics pre- and post-BAPCPA, I estimate the specification in Equation 4 with $\log(FullDoc_{z,t})$ as an outcome variable, separately by racial group. Full

[21] I am not able to estimate the effect for two-step mortgages due to lack of two-step originations in this merged subsample.

documentation mortgages are mortgages originated with fully documented income and assets. I report the results in Table 4 and Figure 7 panel (a). Prior to the policy change, there was no statistically significant change in full documentation mortgages between more- versus less-treated zip codes for any subgroup. I find that post policy change, a 10% increase in pre-period IMC market share led to a 1.0% and 0.5% increase in full documentation mortgages for white and Latino zip codes respectively and to a 3.8% decrease in full documentation mortgages for Black zip codes. The results for Black zip codes are statistically significantly different from white zip codes, while there is no statistically significant difference between white and Latino zip codes in the post-period.

[Figure 7 about here.]

[Table 4 about here.]

I also estimate Equation 4 with $\log(CreditScore_{z,t})$ as an outcome variable, separately by racial group. I report the results in Table 4 and Figure 7 panel (b). Prior to the policy change, there was no statistically significant increase in credit scores between more- versus less-treated zip codes for any subgroup. Post policy change, credit scores for each racial subgroup increase statistically significantly. A 10% increase in IMC market share in the pre-period leads to a significant increase of 0.16% for white zip codes, 0.37% for Black zip codes, and 0.22% for Latino zip codes. Following BAPCPA, the credit score increase in Black zip codes is statistically significantly higher than the increase in white zip codes.[22] This effect is consistent with lenders attempting to compensate for the increased risk of alternative amortization structures and lack of full documentation by requiring higher credit scores. However, this increase in credit scores was likely too modest to sustain the increased risk of these alternative mortgage products. For example, a 0.22% increase in credit score for Latino borrowers equates to about a one point increase from 690 to 691.

The increase in credit score and alternative mortgages for minority zip codes is consistent with the result in Appendix G which shows that the fraction of prime mortgages increased following BAPCPA and the fraction of subprime mortgages decreased. The alternative mortgages were defined as prime in CoreLogic data since they had higher credit scores than typical subprime mortgages. Alternative mortgages were typically called alt-A for "alternate A paper" meaning that the mortgage backed securities that they formed were treated as similar to A rated securities.

[22]Second home purchases are decreasing during this time period (Lewis (2023) appendix B.4) and taking on additional debt via a second mortgage would decrease credit scores rather than increase them. Thus the increased credit score result is consistent with new borrowers entering the housing market with disproportionately higher credit scores in areas with higher IMC market share post-BAPCPA.

This evidence suggests that rather than a single wave of the 2000s housing boom, there were two waves. The first wave, during 2000-2004, involved originations of subprime mortgages with below 660 (Adelino et al. (2016)) or 620 (Keys et al. (2010)) credit score but fully amortizing mortgage payment schedules.[23] The second wave featured borrowers with "near prime" credit scores who received mortgages with alternative amortization schedules and less than full documentation. Although from a credit risk perspective, the increase in credit scores was mild, I show in Appendix F that from the perspective of mortgage acceptance rates it had an effect. The IMC acceptance rate for Black and Latino applicants decreases statistically significantly in the post period, while it increases for white applicants.

To study the consequences of these alternative mortgage products to borrowers, I study early payment default (EPD_i) and total loan default following the policy change. I utilize the Government Sponsored Entity's definition of early payment default, which calculates if a borrower becomes 90 or more days delinquent within the first twelve months after the loan origination. Early payment default is typically an indicator of potential risk management issues such as lax underwriting standards. It signals that the borrower's ability to repay a mortgage may not have been accurately assessed at the time of the mortgage origination. I also create an indicator variable, $Defaulted\ Loan_i$, that is equal to one if the loan ever enters 90 day delinquency, foreclosure, or REO property in its lifetime and zero if the loan remains active. I estimate the following regression which is the loan level version of Equation 4:

$$Y_i = \gamma_z + \eta_{s,t} + \sum_T \beta_T IMCMktShr_{z,04} \times \mathbb{1}_{t=T} + \Gamma_{z,t} + \epsilon_i. \tag{7}$$

Where Y_i is EPD_i and $Defaulted\ Loan_i$ and $\Gamma_{z,t}$ includes a control for the unemployment of a zip code in 2001 interacted with $Post_t$ (an indicator equal to one in and after April 2005, and zero before), and the equity value of the home at the time of default.[24] All other variables are defined the same as in Equation 4.[25] I estimate this regression separately by racial subgroup and standard errors are clustered at zip code level.

I report the results in Figure 7 and Table 4. Figure 7 panel (c) shows that a 10% increase in pre-period IMC market share leads to a 0.53 percentage point (pp) increase in

[23] Adelino et al. (2016) states that 660 corresponds to a widely used FICO cutoff for subprime borrowers and Keys et al. (2010) use 620 FICO as the cutoff below which subprime loans were less easily securitized.

[24] To calculate negative equity, I first calculate $HomePrice = \frac{CurrentHomePriceIndex}{OriginationHomePriceIndex} \times OriginalPriceOfLoan$. I then calculate $HomeEquity = \frac{HomePrice - Balance}{HomePrice}$.

[25] I also estimate the following static version of this regression with a single pre and post period:

$$Y_i = \gamma_z + \eta_{s,t} + \beta IMCMktShr_{z,04} \times Post_t + \Gamma_{z,t} + \epsilon_i. \tag{8}$$

early payment default (EPD_i) for Black zip codes. This increase is statistically significantly higher than that for white and Latino zip codes, which experienced a 0.16 and 0.22 pp increase, respectively, for an equivalent increase in pre-period IMC market share. Panel (d) shows a 10% increase in pre-period IMC market share leads to a 5.1 pp increase in total default for Latino and 3.9 pp increase in total default for Black zip codes. This increase in both Latino and Black zip codes is statistically significantly larger than the 1.9 pp increase for white zip codes.

Combined with the results for full documentation originations, the increased defaults in minority-dominant zip codes are consistent with these zip codes receiving disproportionately more alternative mortgages with risky amortization schedules, and lower income documentation. These results also provide a potential explanation for the question posed in Rugh (2015) of why white borrowers were backing out of the housing market during the late 2000s while Latinos kept borrowing. The mortgage products likely made these mortgages more affordable for borrowers without proper assessment of the borrowers' ability to repay the mortgages over the longer term.

3.3 Effects by Income Growth (Income Volatility)

In this section, I test whether the mortgage originations following BAPCPA were concentrated among borrowers with relatively lower income growth, or higher income volatility. I estimate Equation 4 separately for zip codes in the top (Quartile 4) versus bottom (Quartile 1) quartile of income growth, where $IncGrowth_z$ is the income growth in a zip code from 2001 to 2004. I study whether areas with higher exposure to BAPCPA ($IMCMktShr_{z,04}$) began originating differentially more alternative mortgages to high income variability borrowers post BAPCPA. All variables are defined the same and standard errors are clustered as in Equation 4. Where $Y_{z,t}$ is $\log(Originations_{z,t})$, $\log(Balloon_{z,t})$, $\log(NegAm_{z,t})$, $\log(TwoStep_{z,t})$, $\log(FullDoc_{z,t})$, and $\log(CreditScore_{z,t})$ in zip code z, at month t, and log is the natural logarithm.

If high income volatility borrowers valued alternative products, these mortgages would be disproportionately originated among higher- relative to lower-income-volatility zip codes and the β_T coefficient on the interaction term would be larger in lower-income-growth zip codes.

3.4 Effects by Income Growth (Income Volatility) - Results

Table 5 and Figure 8 panel (a) report the coefficient that measures the effect of the pre-period IMC market share on $\log(Originations_{z,t})$ each month relative to March 2005. In the pre-

period, there was no differential change in lending between more and less treated zip codes for either subgroup. Following the policy change, a 10% increase in pre-period IMC market share leads to a statistically significant 1.3% decrease in originations in the lowest income growth quartile and a 2.0% increase in originations in the highest income growth quartile. The relative increase in originations in the highest income growth zip codes and the relative decrease in the lowest income growth zip codes are statistically significantly different from eachother.

To understand the role that BAPCPA played in the disproportionate expansion of alternative mortgage products in these subgroups, in Table 5 and Figure 8, I report balloon (panel (b)), negative amortizing (panel (c)), and two-step mortgages (panel (d)) as outcome variables. In panel (b), a 10% increase in pre-period IMC market share leads to a 31% increase in balloon mortgages in the lowest income growth quartile and a 30% increase in the highest income growth quartile. In panel (c), a 10% increase in pre-period IMC market share leads to an 11% increase in negative amortizing mortgages in the lowest income growth quartile and a 17% increase in the highest income growth quartile. In panel (d), a 10% increase in pre-period IMC market share leads to a 6% increase in two-step mortgages in the lowest income growth quartile and a 21% increase in the highest income growth quartile. All but the increase in two-step originations in the lowest income growth quartile are highly statistically significant.

The results in Table 5 and Figure 8 show that although low income growth, high income variability, borrowers receive a decrease in overall mortgage originations, they receive an increase, comparable to high income growth zip codes, in alternative mortgages. This indicates that low income growth borrowers receive a higher fraction of alternative mortgage products following the passage of BAPCPA. In the appendix, Table 7 shows that for a zip code with 100% market share of IMCs, post policy change, a 10% decrease in income growth statistically significantly increases the fraction of negative amortizing originations by 1.1 pp, the fraction of balloon originations by 0.48 pp, and the fraction of interest only originations by 1.7 pp. The fraction of two-step originations also increased 0.13 pp more in zip codes with lower income growth, however not statistically significantly at the 95% level. These results indicate that in low income growth, or high income volatility, areas IMCs were originating a disproportionately high fraction of alternative mortgages, which gave borrowers artificially low initial mortgage payments.

[Figure 8 about here.]

[Table 5 about here.]

In Figure 9 panel (a), I plot the results for $\log(FullDoc_{z,t})$ and report the static coefficients in Table 6. Prior to the policy change, both subgroups move in parallel to each other. Post policy change, a 10% increase in pre-period IMC market share leads to a 2.0% increase in full documentation mortgages for the highest and a 2.9% decrease for the lowest income growth zip codes. These results are both statistically significantly different from zero and from each other, consistent with low income growth zip codes receiving disproportionately fewer full documentation mortgages.

In Figure 9 panel (b) I plot the results for $\log(CreditScore_{z,t})$ and report the static coefficients in Table 6. Prior to the policy change, there was no statistically significant increase in credit scores between more- versus less-treated zip codes for either subgroup. I find that post policy change, a 10% increase in pre-period IMC market share leads to a significant 0.22% increase in credit score for low and 0.29% for high income growth zip codes. These results are statistically significantly different from zero, however not from each other. As in the previous section, the increase in credit score is consistent with lenders attempting to compensate for increased risk of alternative amortization structures and lack of full documentation by requiring higher credit scores, however, this increase in credit score was likely too modest to sustain the increased risk of these mortgage products.

To study the consequences of these alternative products on borrowers, I use Equation 7 to study early payment default (EPD_i) and total loan default by subgroups for the top and bottom income growth quartile, utilizing the same variable definitions as in the previous section. Standard errors are clustered at the zip code level. I plot the results in Figure 9 panels (c) and (d) and report the static coefficients in Table 6. Studying early payment default in Figure 9 panel (c), I find that a 10% increase in pre-period IMC market share leads to statistically significant increases in early payment default of 0.32 pp for the lowest income growth quartile zip codes and 0.28 pp for the highest income growth quartile zip codes. Studying total loan default in panel (d), a 10% increase in pre-period IMC market share leads to statistically significant increases in total default of 4.0 pp for the lowest income growth quartile and 3.7 pp for the highest income growth quartile.

[Figure 9 about here.]

[Table 6 about here.]

Morduch et al. (2018) document that minority income volatility is significantly higher than that of white earners. In the Appendix J, I test whether controlling for income growth quartile in the regressions by racial subgroup eliminates the effect of race on the increase in alternative mortgage originations, credit score, and defaults, and the decrease in loan

documentation. I find that significance and magnitude by racial makeup of each zip code remains the same as in the regressions in subsection 3.2.

4 Payment Shocks

To establish the effect of alternative mortgages on borrower outcomes, I study mortgage payment shocks. I define a payment shock to be a mortgage payment reset that is $\geq 10\%$ above the initial mortgage payment, at the time of first reset. I estimate the following regression specification separately in BLK, LTN, and WHT zip codes:

$$PayShock_{z,t} = \gamma_z + \eta_{s,t} + \sum_T \beta_T IMCMktShr_{z,04} \times \mathbb{1}_{t=T} + \Phi_{z,t} + \epsilon_{z,t}. \tag{9}$$

Where $PayShock_{z,t}$ is the average fraction of loans that experience a payshock in a given zip code out of all loans that experience a reset in that month, where the month indicates the month of the payment reset. The dataset is limited to all loans that experience a mortgage reset. $\Phi_{z,t}$ represents control variables comprising of $Post_t \times avgLTV_{z,04}$, $Post_t \times avgCreditScore_{z,04}$, $Post_t \times avgDTI_{z,04}$. All other variables are defined the same as in Equation 4.[26] This regression specification controls for similar borrower and mortgage characteristics, allowing a differential trend in the post period. It studies the remaining effect that being originated in a high versus low IMC market share zip code has on whether a mortgage experiences payment shock.

The regression results shown in Table 12 and Figure 10 indicate that, in the post period, mortgages originated in zip codes with high IMC market share are statistically significantly more likely to experience pay shocks relative to mortgages originated in low IMC zip codes. Comparing the response in BLK and LTN zip codes to WHT zip codes, I find that, on average in the post-period, a 10% increase in pre-period treatment leads majority WHT zip codes to experience a statistically significant 4.3 pp increase in likelihood of experiencing a payment shock when their mortgage payment resets. The average increase in payment shock likelihood for the majority LTN zip codes in the post period is a significant 3.6 pp, which is not statistically different from the 4.3 pp increase in WHT zip codes. The average increase in payment shock likelihood for the majority Black zip codes in the post period for a 10% increase in pre-period treatment is a significant 2.3 pp. In Figure 13 in the appendix, I also

[26] I also estimate the following static version of this regression with a single pre and post period:

$$PayShock_{z,t} = \gamma_z + \eta_{s,t} + \beta IMCMktShr_{z,04} \times Post_t + \Phi_{z,t} + \epsilon_{z,t}. \tag{10}$$

document that the initial interest rate decreases disproportionately in zip codes with high IMC market share, which is consistent with high IMC zip codes experiencing larger payment shocks when interest rates reset.

The pay shock results are also economically significant in magnitude. For example, Fuster and Willen (2017) find that changes in payment size have a large effect on default rates - reducing the payment size by 50% decreases the default rate by 55%. If the response is symmetric, increasing payment size by 10% should increase default rates by 11%. Argyle et al. (2020) find that borrowers target payment size at origination when making debt decisions, and Fulford and Low (2024) find that expense shocks significantly affect households' financial fragility. Thus in high income variability and minority-dominant zip codes, correlated mortgage payment shocks are poised to have a large effect on borrower default. Additionally, while the increase in payment shock likelihood is slightly lower in majority Black zip codes, these zip codes may have more difficulty enduring payment shocks, due to higher income volatility (Morduch et al. (2018)) and wealth (Derenoncourt et al. (Forthcoming)) gaps between white and Black zip codes.

[FIGURE 10 about here.]

The timing of the payshock-likelihood increase is also important. It begins to increase in high IMC market share zip codes about eight months after the policy change and becomes increasingly common through October 2006. These results are consistent with BAPCPA creating a coordination device for IMCs to originate alternative mortgages, and an ensuing burst of IMC alternative mortgage originations, with artificially lower mortgage payments beginning in April of 2005, directly following BAPCPA. Since alternative mortgage products have reset dates that cluster around 6 months, 12 months, and 24 months[27] the reset dates on these mortgage products are clustered in time, demographics, and geographic regions.

5 Model

5.1 Model Set-up

In this section, I develop a model of mortgage lending for private-label (PL) mortgage borrowers. The borrowers in this market do not consider mortgages of the other types (i.e. conforming mortgages); they are not mobile across markets. This setup is consistent with

[27] Close to 4% of loans with a payment reset have the first reset within 6 months, 16% within one year, and 20% within two years.

the private-label market becoming a substitute for the FHA/VA market, which funded borrowers who often could not qualify for conforming loans.[28]

I shut down frictions between the dealer and the IMC. The IMCs can be thought of as originating mortgages on behalf of the dealers. Thus I call the dealers "dealer-banks" to denote that they function both as dealers operating in the repo market and as mortgage originators.[29] The model investigates how the shock to dealer cost of capital caused by BAPCPA is passed on to households and assumes that the shock is frictionlessly passed from the dealers to the IMCs that they fund.

The market for private-label (PL) mortgages indicates alternative, or alternate-A mortgage products, to study the increase in alt-A mortgage products following BAPCPA. The borrowers in the alt-A market can be thought of as borrowers who fulfill lower documentation requirements to verify income and assets, have more volatile income, and a higher cost of repaying their mortgage payment (θ). I utilize the insight from Piskorski and Tchistyi (2010) that the optimal mortgage product for borrowers with more volatile income and pricier mortgage to income ratios is the option-arm, or similar, mortgage product. In the theory, alt-A mortgages are optimal for high income volatility borrowers because they allow borrowers to delay mortgage payments when their income may be low and repay them at a later date when their income may be higher.

I use the model to study the impact of increasing the value that dealers receive by repledging private-label mortgage collateral (c^{PL}) and the effect on the interest rate dealers charge to the private-label borrowers, r^{PL}. The value that the dealer-bank receives from repledging collateral (c^{PL}) is exogenous. I consider a one-period model of a mortgage lender and a borrower. The borrower, of type θ, receives utility from housing ($h_\theta \in \{0, 1\}$), where the choice $h_\theta = 1$ means the purchase of a home, whereas $h_\theta = 0$ means no purchase. θ reflects creditworthiness, in the sense that higher θ indicates borrowers for whom it is less costly to repay the mortgage payment. The borrower has quasi-linear utility. He derives utility from owning a home $v(1)$. The purchase of the home requires a mortgage at dollar value M and requires no down payment. The borrower dislikes paying the mortgage payment required on the mortgage at interest rate (r^{PL} where $r^{PL} \geq 0$),

$$u = v(h_\theta) - \frac{1}{\theta}(1 + r^{PL})M \times h_\theta, \quad h_\theta \in \{0, 1\}. \tag{11}$$

[28] As of April 2005, FHA/VA loans, which were fully amortizing, were likely prohibitively expensive because home prices were near peak and the Federal Reserve was raising interest rates.

[29] Mortgages are funded via a repo warehouse line of credit from the dealer to the IMC. Dealers can repledge the collateral. The interest that the dealer receives on the line of credit is the interest rate that it charges the IMC on a repo loan. The IMC passes this rate to the borrower as the interest rate. However, to simplify the model, dealers lend directly to the mortgage borrowers and then pledge mortgage collateral created from the mortgages.

Since $v(0)$ and $v(1)$ are constant, the household maximizes utility by choosing between $v(0)$ and $v(1)-(1+r^{PL})M$, therefore he chooses between housing $h_\theta = \{0,1\}$. Given h_θ, the value of $v(1)$ and $v(0)$ and M are fixed. Choosing $h_\theta = 1$ requires that the borrower take out a fixed mortgage amount, M, at interest rate, r^{PL}. In other words, the borrower takes out a mortgage if the utility he derives from purchasing a home minus the mortgage payment is greater than his utility from not purchasing a home. I assume that $v(0)$ is the utility that the borrower receives from renting a home. $v(1) - v(0)$ is the incremental value that the borrower receives from owning a home relative to renting a home. There is a distribution over how costly mortgage repayment is, θ. The cost of borrowing is captured by $\frac{1}{\theta}$,

$$\theta \sim F \quad \text{on} \quad [\underline{\theta}, \overline{\theta}]. \tag{12}$$

Borrowers choose $h = 1$ if

$$v(1) - \frac{1}{\theta}(1 + r^{PL})M > v(0). \tag{13}$$

For every mortgage originated, the lender gains utility from the mortgage payment received, inflated by the shadow value of collateral, c^{PL}, generated by repledging the mortgage as collateral. A feature of the model is the choice to model the value of repledging collateral as analogous to the interest earned on the collateral. This construct is motivated by the fact that securities dealers offer their debtors a lower interest rate if the dealer has permission to repledge the collateral, consistent with dealers having an interest rate valuation for the repledgeability of collateral. p is the dealer-bank's fixed, exogenous, funding cost to provide the money necessary for the mortgage. Thus the dealer-bank's total cost of originating a mortgage varies linearly with the value of M. The risk profile of borrowers is subsumed in the interest rate, r^{PL}. The lender is competitive and therefore chooses to originate the value of mortgages that sets marginal cost equal to marginal revenue. The lender sets the price of the mortgage accordingly and meets demand based on that interest rate:

$$u = (1 + r^{PL})(1 + c^{PL})M - pM = 0. \tag{14}$$

5.2 Model Results

The lender's break even condition gives:

$$r^{PL} = \frac{p}{1 + c^{PL}} - 1. \tag{15}$$

The main result follows from this break even condition:

Proposition 1 *The interest rate decreases when the shadow value of collateral increases:*

$$\frac{\partial r^{PL}}{\partial c^{PL}} < 0. \tag{16}$$

Ceteris paribus, taking a comparative static of r^{PL} with respect to c^{PL}, as c^{PL} increases, r^{PL} falls. From the borrower's problem, there is a threshold borrower type – everyone with $\theta > \theta^*(r^{PL*})$ will borrow:

$$\theta^*(r^{PL*}) = \frac{(1 + r^{PL*})M}{v(1) - v(0)}. \tag{17}$$

θ^* gives a break even point such that $v(1) - \frac{1}{\theta^*}(1 + r^{PL})M = v(0)$. Types with higher θ will always choose to buy a home. This yields an interest rate threshold value, which I denote by r^{PL*},

$$r^{PL*} \quad := \quad \frac{\theta^* \times (v(1) - v(0))}{M} - 1. \tag{18}$$

This yields the following comparative statistics:

Lemma 2 *The threshold interest rate at which a borrower is willing to take out a mortgage, r^{PL*}, is*

1. *increasing in $v(1) - v(0)$*
2. *increasing in θ*
3. *decreasing in M*

The interest rate threshold at which the borrower is willing to borrow is equal to the borrower's relative utility from buying a home, over and above renting, per unit of mortgage value M, and scaled up by a measure reflecting the borrower's creditworthiness θ. Ceteris paribus, Lemma 2 indicates the following: the threshold interest rate is increasing when the relative benefit of owning a home is higher, when the cost of borrowing $\frac{1}{\theta}$ is lower, and when the value of the mortgage M is lower.

When the interest rate (r^{PL}) set by the lender requires a θ^* that is higher than $\overline{\theta}$, the upper bound of the support, the interest rate charged is higher than any interest rate that borrowers are willing to pay. This can be seen from Equation 18, holding fixed $v(1)$, $v(0)$, and

M. This can occur when the collateral c^{PL} is low, as can be seen by combining Equation 15 and Equation 18:

$$\theta^*(r^{PL*}) = \frac{(1+r^{PL})M}{v(1)-v(0)} = \frac{p}{1+c^{PL}} \times \frac{M}{v(1)-v(0)}. \tag{19}$$

When the value of c^{PL} increases[30], the value of the interest rate set by the lender will fall. If the new interest rate, $r^{PL'}$ falls, then the threshold type θ^* will fall. If θ^* falls lower than $\overline{\theta}$, it will open up a new market of borrowers. This is because now, the interest rate that lenders are willing to charge on alt-A mortgage products, such as option ARMs and balloon mortgages, will be low enough that some borrowers in this market choose to take out a mortgage at this price. The treated zip codes' increase in credit score and decrease in the introductory interest rate offered on mortgages with adjustable rate structures (balloon ARM, negative amortizing (option ARM), two-step, etc.), shown in (Figure 13) in the appendix, are consistent with the model's prediction.

6 Discussion & Conclusion

θ reflects the borrower's creditworthiness. The interest rate that the lender is willing to charge the borrower for alternate-A products with low documentation is based on the lender's break even condition. The interest rate determines the threshold value of borrowers who would take on the mortgage, which implicitly sets the average credit risk of borrowers who receive private-label mortgages (i.e. borrowers with $\theta \in [\theta^*, \overline{\theta}]$), given the distribution of θ in the economy. The p in the model can be thought of as capturing credit risk in the economy. Since the market is competitive, other dealer-banks will have priced in the cost of originating mortgages given the distribution of θ and credit risk in the economy.

The lender's cost of capital (or value of rehypothecating collateral) offsets the borrowers' creditworthiness in pricing the mortgage. To see this, consider that Equation 15 shows that once BAPCPA exogenously increases the value from repledging the collateral (c^{PL}), the interest rate that the dealer levies on a borrower decreases, while the average creditworthiness of the borrowers and the cost (p) associated with originating the mortgage do not change. Feeding the interest rate back into Equation 17 shows that the decrease in interest rate decreases the threshold value θ^*, at which borrowers will take out an alt-A mortgage.

Imagine for example, prior to BAPCPA, p and c^{PL} were such that the dealer-bank would charge a 6% interest rate, and only borrowers with a 750 credit score and above would take

[30]The collateral value increases following BAPCPA because the policy change increases the recovery value of the collateral to a repo lender if a counterparty defaults, increasing its ability to be repledged.

out the mortgage, such that $h_{750} = 1$. Note, here credit score indicates willingness to pay which reflects borrowers' ability to make mortgage payments. Post-BAPCPA, p does not change[31], however c^{PL} increases, which lowers the interest rate that dealer-banks charge to 4%. At 4%, both the 750 and 690 credit score borrowers are willing to take out the mortgage ($h_\theta = 1$).

Mortgage Price and Demand by Credit Score

	750	h_{750}	690	h_{690}
$BeforeBAPCPA$	6%	1	6%	0
$AfterBAPCPA$	4%	1	4%	1

If, in the economy, $\overline{\theta} = 700$, then prior to BAPCPA, no borrowers would demand this product. Following the policy change, when the interest rate drops to 4%, all borrowers with a 690 to 700 credit score will demand the mortgage. This creates a demand stimulating mechanism that appears as if the dealer-bank is lending a new product (alt-A) mortgages to high income volatility, low documentation borrowers. However, according to the model, these alternative products always existed, however the price at which dealer-banks were willing to originate them was above borrowers' reservation price.

As borrowers enter the alt-A market, the fraction of borrowers with an alt-A mortgage increases relative to borrowers with a conforming mortgage. As a result, the average credit score in the economy increases, consistent with panel b in Figure 7 and Figure 9. However, the credit score required post-BAPCPA would have been even higher if p adjusted to account for increased credit risk from the new support of θ, which entered the market after the increase in c^{PL} decreased the interest rate. This is the sense in which the observed increase in credit scores was likely too modest to account for the increased risk in alternative products, which were originated to borrowers with low documentation in minority-dominant low-income-growth zip codes.

[31] p does not adjust because dealers do not have time to learn about the default rate at a lower threshold $\theta^{*'}$, which brings new borrowers into the market. The dealer-banks do not have time to learn due to the speed of credit supply increase caused by the explosiveness of the repo money multiplier in Lewis (2023).

References

Acharya, V. V., Anshuman, V. R. and Viswanathan, S. V. (2024), Bankruptcy exemption of repo markets: Too much today for too little tomorrow?, Technical report, National Bureau of Economic Research.

Acharya, V. V., Richardson, M., Van Nieuwerburgh, S. and White, L. J. (2011), *Guaranteed to fail: Fannie Mae, Freddie Mac, and the debacle of mortgage finance*, Princeton University Press.

Adelino, M., Gerardi, K. and Hartman-Glaser, B. (2019), 'Are lemons sold first? dynamic signaling in the mortgage market', *Journal of Financial Economics* **132**(1), 1–25.

Adelino, M., McCartney, W. B. and Schoar, A. (2020), The role of government and private institutions in credit cycles in the us mortgage market, Technical report, National Bureau of Economic Research.

Adelino, M., Schoar, A. and Severino, F. (2016), 'Loan originations and defaults in the mortgage crisis: The role of the middle class', *The Review of Financial Studies* **29**(7), 1635–1670.

Adelino, M., Schoar, A. and Severino, F. (2018), 'Dynamics of housing debt in the recent boom and great recession', *NBER Macroeconomics Annual* **32**(1), 265–311.

Adrian, T., Burke, C. R. and McAndrews, J. (2009), 'The federal reserve's primary dealer credit facility', *Current Issues in Economics and Finance* **15**(4).

Agarwal, S., Chomsisengphet, S., Mahoney, N. and Stroebel, J. (2018), 'Do banks pass through credit expansions to consumers who want to borrow?', *The Quarterly Journal of Economics* **133**(1), 129–190.

Ambrose, B. W., Conklin, J. N. and Lopez, L. A. (2021), 'Does borrower and broker race affect the cost of mortgage credit?', *The Review of Financial Studies* **34**(2), 790–826.

Argyle, B. S., Nadauld, T. D. and Palmer, C. J. (2020), 'Monthly payment targeting and the demand for maturity', *The Review of Financial Studies* **33**(11), 5416–5462.

Avenancio-León, C. F. and Howard, T. (2022), 'The assessment gap: Racial inequalities in property taxation', *The Quarterly Journal of Economics* **137**(3), 1383–1434.

Bartlett, R., Morse, A., Stanton, R. and Wallace, N. (2022), 'Consumer-lending discrimination in the fintech era', *Journal of Financial Economics* **143**(1), 30–56.

Bayer, P., Casey, M., Ferreira, F. and McMillan, R. (2017), 'Racial and ethnic price differentials in the housing market', *Journal of Urban Economics* **102**, 91–105.

Benmelech, E. (2009), 'Asset salability and debt maturity: Evidence from nineteenth-century american railroads', *The Review of Financial Studies* **22**(4), 1545–1584.

Benmelech, E. and Bergman, N. K. (2009), 'Collateral pricing', *Journal of financial Economics* **91**(3), 339–360.

Benmelech, E. and Bergman, N. K. (2011), 'Bankruptcy and the collateral channel', *The Journal of Finance* **66**(2), 337–378.

Benmelech, E., Garmaise, M. J. and Moskowitz, T. J. (2005), 'Do liquidation values affect financial contracts? evidence from commercial loan contracts and zoning regulation', *The Quarterly Journal of Economics* **120**(3), 1121–1154.

Bernanke, B. S. (2005), 'The global saving glut and the us current account deficit', *Speech delivered at the Sandridge Lecture, Virginia Association of Economists, Richmond* .

Bevill, Bresler & Schulman Asset Management Corp. v. Spencer Sav. & Loan Ass'n (1989).

Bhardwaj, G. and Sengupta, R. (2012), 'Subprime mortgage design', *Journal of Banking & Finance* **36**(5), 1503–1519.

Bhutta, N. and Hizmo, A. (2021), 'Do minorities pay more for mortgages?', *The Review of Financial Studies* **34**(2), 763–789.

Bricker, J., Dettling, L. J., Henriques, A., Hsu, J. W., Jacobs, L., Moore, K. B., Pack, S., Sabelhaus, J., Thompson, J. and Windle, R. A. (2017), 'Changes in us family finances from 2013 to 2016: Evidence from the survey of consumer finances', *Fed. Res. Bull.* **103**, 1.

Callaway, B., Goodman-Bacon, A. and Sant'Anna, P. H. (2021), 'Difference-in-differences with a continuous treatment', *arXiv preprint arXiv:2107.02637* .

Cerqueiro, G., Ongena, S. and Roszbach, K. (2016), 'Collateralization, bank loan rates, and monitoring', *The Journal of Finance* **71**(3), 1295–1322.

Charles, C. Z. (2003), 'The dynamics of racial residential segregation', *Annual review of sociology* **29**(1), 167–207.

Copeland, A., Martin, A. and Walker, M. (2014), 'Repo runs: Evidence from the tri-party repo market', *The Journal of Finance* **69**(6), 2343–2380.

Curtis, E. M., Garrett, D. G., Ohrn, E. C., Roberts, K. A. and Serrato, J. C. S. (2021), Capital investment and labor demand, Technical report, National Bureau of Economic Research.

Davis, M. A., Larson, W. D., Oliner, S. D. and Smith, B. R. (2023), 'A quarter century of mortgage risk', *Review of Finance* **27**(2), 581–618.

Demyanyk, Y. and Van Hemert, O. (2011), 'Understanding the subprime mortgage crisis', *The Review of Financial Studies* **24**(6), 1848–1880.

Derenoncourt, E., Kim, C. H., Kuhn, M. and Schularick, M. (Forthcoming), Wealth of two nations: The us racial wealth gap, 1860-2020, Technical report, Quarterly Journal of Economics.

Diebold, L. and Richter, B. (2023), 'When two become one: foreign capital and household credit expansion', *Available at SSRN 3817595* .

Drukker, L. D. and Ma, L. (2024), 'Racial disparities in home selling', *Available at SSRN 4736956* .

Duffie, D. and Skeel, D. A. (2012), 'A dialogue on the costs and benefits of automatic stays for derivatives and repurchase agreements', *U of Penn, Inst for Law & Econ Research Paper* (12-02).

Dybvig, P. and Hou, C. X. (2023), 'Gambling for redemption or ripoff, and the impact of superpriority', *Available at SSRN 4444093* .

Edwards, F. R. and Morrison, E. R. (2005), 'Derivatives and the bankruptcy code: Why the special treatment', *Yale J. on Reg.* **22**, 91.

Fulford, S. and Low, D. (2024), 'Expense shocks matter', *Consumer Financial Protection Bureau Office of Research Working Paper* (2024-08).

Fuster, A., Goldsmith-Pinkham, P., Ramadorai, T. and Walther, A. (2022), 'Predictably unequal? the effects of machine learning on credit markets', *The Journal of Finance* **77**(1), 5–47.

Fuster, A. and Willen, P. S. (2017), 'Payment size, negative equity, and mortgage default', *American Economic Journal: Economic Policy* **9**(4), 167–191.

Gennaioli, N., Shleifer, A. and Vishny, R. W. (2013), 'A model of shadow banking', *The Journal of Finance* **68**(4), 1331–1363.

Gerardi, K., Lehnert, A., Sherlund, S. M. and Willen, P. (2008), 'Making sense of the subprime crisis', *Brookings Papers on Economic Activity* pp. 69–145.

Gerardi, K., Willen, P. S. and Zhang, D. H. (2023), 'Mortgage prepayment, race, and monetary policy', *Journal of Financial Economics* **147**(3), 498–524.

Gorton, G., Lewellen, S. and Metrick, A. (2012), 'The safe-asset share', *American Economic Review* **102**(3), 101–106.

Gottardi, P., Maurin, V. and Monnet, C. (2019), 'A theory of repurchase agreements, collateral re-use, and repo intermediation', *Review of Economic Dynamics* **33**, 30–56.

Gupta, A., Hansman, C. and Mabille, P. (2023), 'Financial constraints and the racial housing gap'.

Haughwout, A. F., Lee, D., Scally, J., Van der Klaauw, W. et al. (2020), Inequality in us homeownership rates by race and ethnicity, Technical report, Federal Reserve Bank of New York.

Haughwout, A., Peach, R. and Tracy, J. (2008), 'Juvenile delinquent mortgages: Bad credit or bad economy?', *Journal of Urban Economics* **64**(2), 246–257.

Ihlanfeldt, K. and Mayock, T. (2009), 'Price discrimination in the housing market', *Journal of Urban Economics* **66**(2), 125–140.

Infante, S. (2019), 'Liquidity windfalls: The consequences of repo rehypothecation', *Journal of Financial Economics* **133**(1), 42–63.

Kaplan, G., Mitman, K. and Violante, G. L. (2020), 'The housing boom and bust: Model meets evidence', *Journal of Political Economy* **128**(9), 3285–3345.

Kermani, A. and Wong, F. (2021), Racial disparities in housing returns, Technical report, National Bureau of Economic Research.

Keys, B. J., Mukherjee, T., Seru, A. and Vig, V. (2010), 'Did securitization lead to lax screening? evidence from subprime loans', *The Quarterly journal of economics* **125**(1), 307–362.

Krainer, J. and Laderman, E. (2011), Prepayment and delinquency in the mortgage crisis period, Federal Reserve Bank of San Francisco.

Krishnamurthy, A., Nagel, S. and Orlov, D. (2014), 'Sizing up repo', *The Journal of Finance* **69**(6), 2381–2417.

Lewis, B. A. (2023), 'Creditor rights, collateral reuse, and credit supply', *Journal of Financial Economics* **149**(3), 451–472.

Li, P. and Mayock, T. (2019), 'Mortgage characteristics and the racial incidence of default', *Journal of Housing Economics* **46**, 101655.

Logan, J. R. and Molotch, H. (2007), *Urban fortunes: The political economy of place, with a new preface*, Univ of California Press.

Lubben, S. J. (2010), 'The bankruptcy code without safe harbors', *Am. Bankr. LJ* **84**, 123.

Lumpkin, S. A. (1993), 'Repurchase and reverse repurchase agreements', *Instruments of the money market* pp. 59–74.

Mayer, C., Pence, K. and Sherlund, S. M. (2009), 'The rise in mortgage defaults', *Journal of Economic perspectives* **23**(1), 27–50.

Mian, A. and Sufi, A. (2009), 'The consequences of mortgage credit expansion: Evidence from the us mortgage default crisis', *The Quarterly journal of economics* **124**(4), 1449–1496.

Morduch, J., Hardy, B., Darity, W. and Hamilton, D. (2018), 'Wealth inequality, income volatility, and race', *Working Paper* .

Morrison, E. R., Roe, M. J. and Sontchi, C. S. (2013), 'Rolling back the repo safe harbors', *Bus. Law.* **69**, 1015.

Myers, C. K. (2004), 'Discrimination and neighborhood effects: Understanding racial differentials in us housing prices', *Journal of urban economics* **56**(2), 279–302.

Palmer, C. (2024), An iv hazard model of loan default with an application to subprime mortgage cohorts, Technical report, National Bureau of Economic Research.

Piskorski, T. and Tchistyi, A. (2010), 'Optimal mortgage design', *The Review of Financial Studies* **23**(8), 3098–3140.

Roberts, M. R. and Whited, T. M. (2013), Endogeneity in empirical corporate finance1, *in* 'Handbook of the Economics of Finance', Vol. 2, Elsevier, pp. 493–572.

Roe, M. J. (2010), 'The derivatives market's payment priorities as financial crisis accelerator', *Stan. L. Rev.* **63**, 539.

Rugh, J. S. (2015), 'Double jeopardy: Why latinos were hit hardest by the us foreclosure crisis', *Social Forces* **93**(3), 1139–1184.

Skeel, D. A. J. and Jackson, T. H. (2012), 'Transaction consistency and the new finance in bankruptcy', *Colum. L. Rev.* **112**, 152.

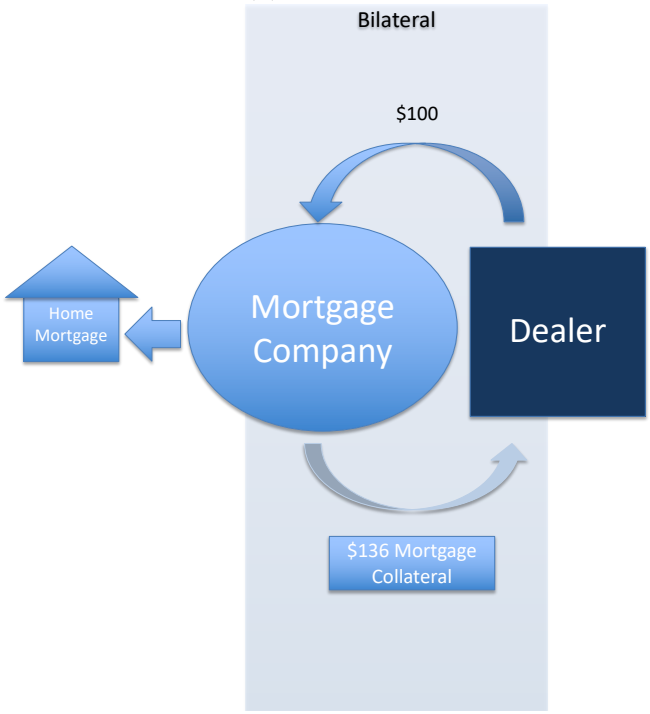
Srinivasan, K. (2017), 'The securitization flash flood', *Available at SSRN 2814717* .

Stanton, R., Walden, J. and Wallace, N. (2014), 'The industrial organization of the us residential mortgage market', *Annu. Rev. Financ. Econ.* **6**(1), 259–288.

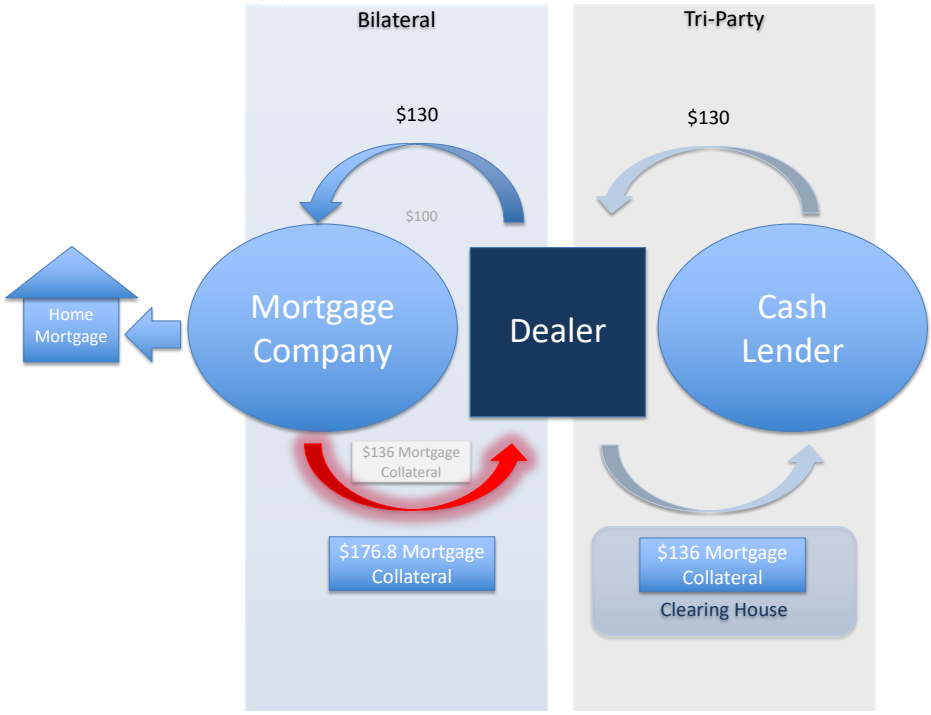
Tuckman, B. (2010), 'Systemic risk and the tri-party repo clearing banks', *CFS Policy Paper* p. 4.

FIGURE 1: REPO MARKETS BEFORE AND AFTER BAPCPA 2005

(a) Repo markets before BAPCPA

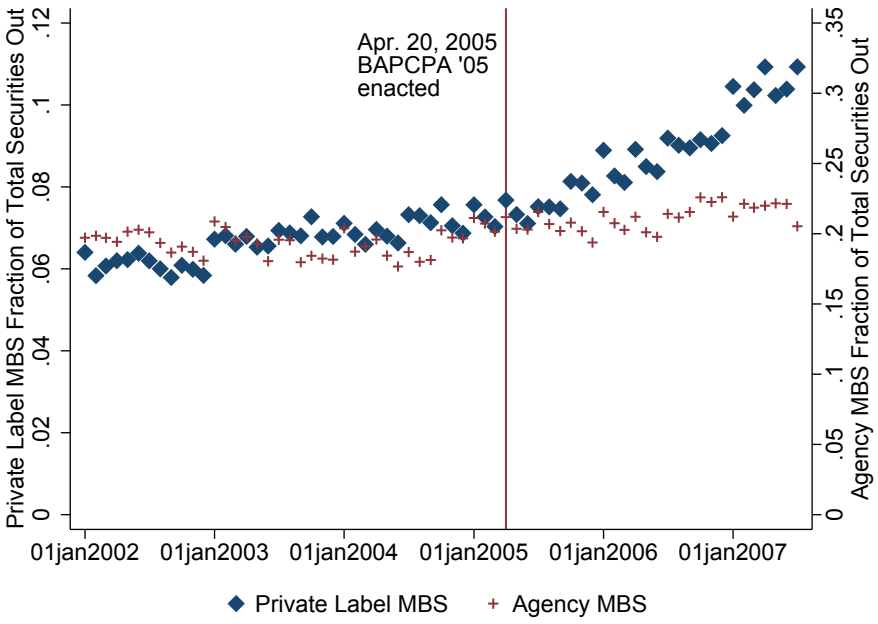


(b) Repo markets after BAPCPA



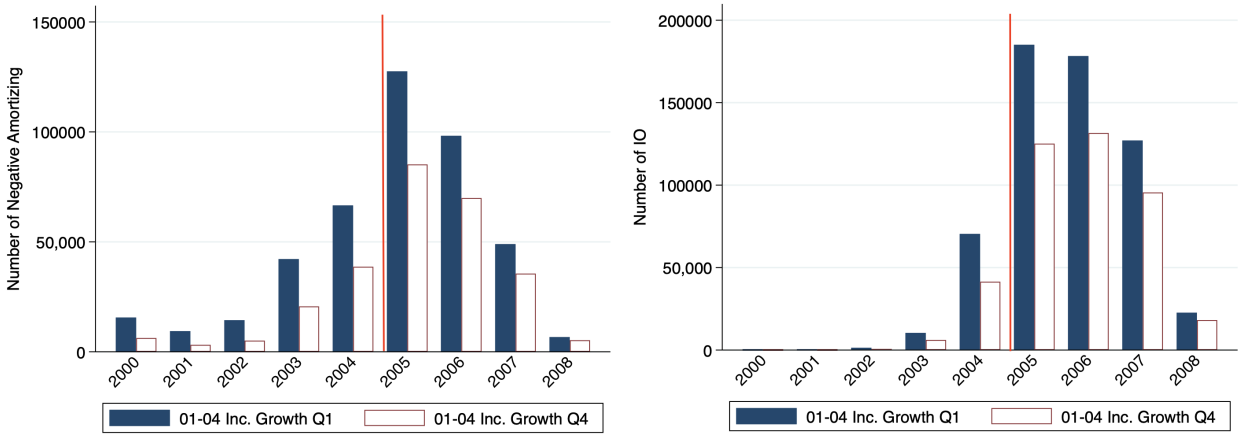
Notes: Figures depict the process by which a dealer can borrow and lend funds via the tri-party and bilateral repurchase market respectively, using the same underlying private-label mortgage collateral provided by the cash borrower for both contracts. Figure (a) depicts the "first round" of lending from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

FIGURE 2: DEALER BORROWING BACKED BY PRIVATE-LABEL VS. AGENCY MORTGAGE COLLATERAL

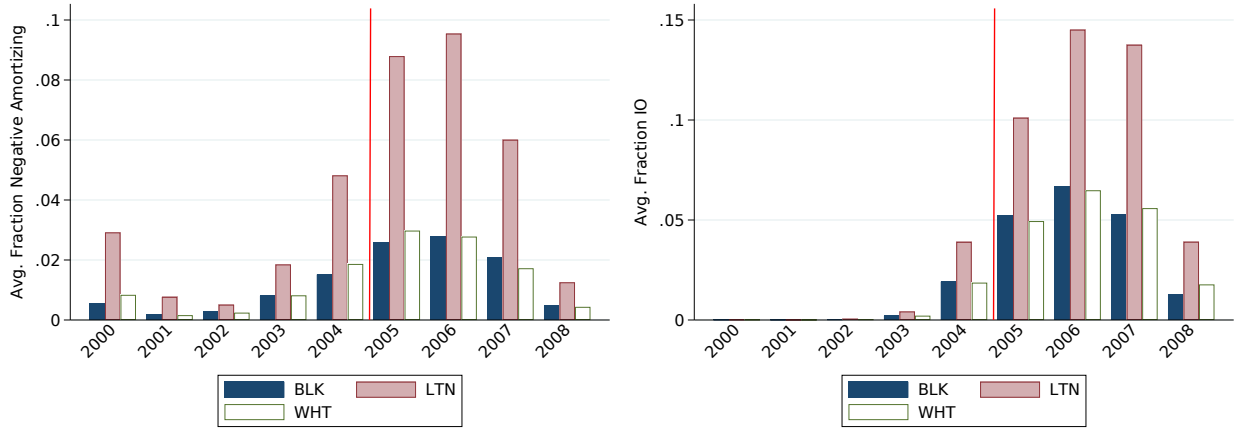


Notes: Figure plots the fraction of total primary dealer securities out that was made up of private-label MBS versus agency MBS pre and post BAPCPA. The variable corporate securities in the FR 2004 proxies for private-label MBS. Agency MBS is comprised of Federal Agency and GSE MBS in the FR 2004 data. 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 3: MORTGAGE PRODUCTS BY ZIP CODE INCOME QUARTILE AND RACE



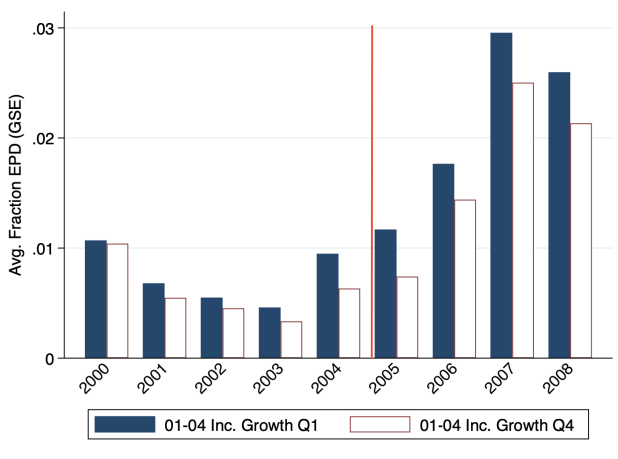
(a) Num. Negative Amortizing – Income Quartile (b) Num. Interest Only (IO) – Income Quartile



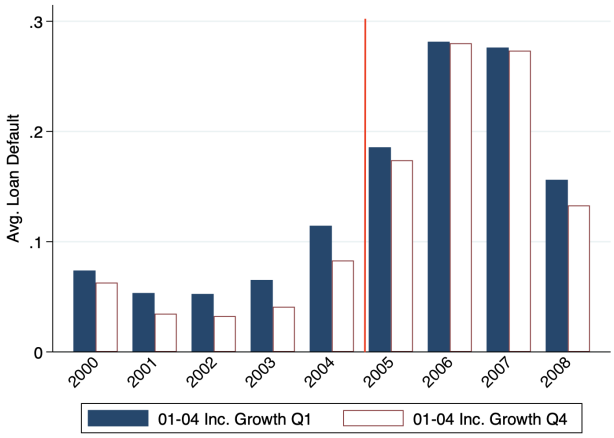
(c) Frac. Negative Amortizing – Race (d) Frac. Interest Only (IO) – Race

Notes: The figure depicts mortgage originations by product type. Panels (a) and (b) depict the total number of mortgages originated each year for a given product type in zip codes that are in the lowest quartile (Q1) and the highest quartile (Q4) of 2001 to 2004 income growth. Panels (c) and (d) depict the fraction of mortgages originated each year for a given product type in zip codes that are defined as Black (BLK), Latino (LTN), and white (WHT).

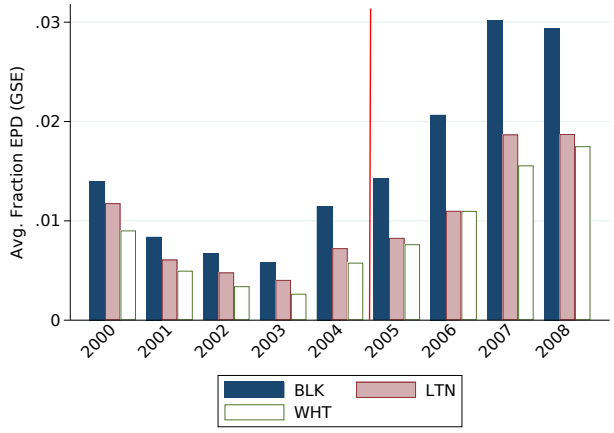
FIGURE 4: MORTGAGE DEFAULTS BY ZIP CODE INCOME QUARTILE AND RACE



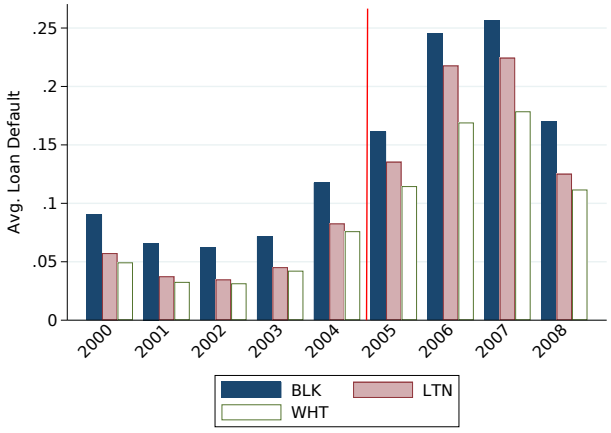
(a) EPD (GSE Measure) – By Income Quartile



(b) Total Defaults – By Income Quartile



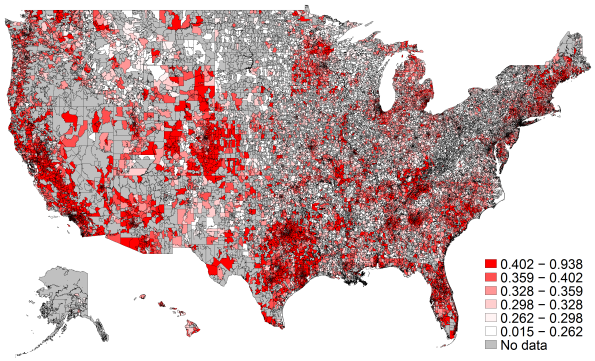
(c) EPD (GSE Measure) – By Race



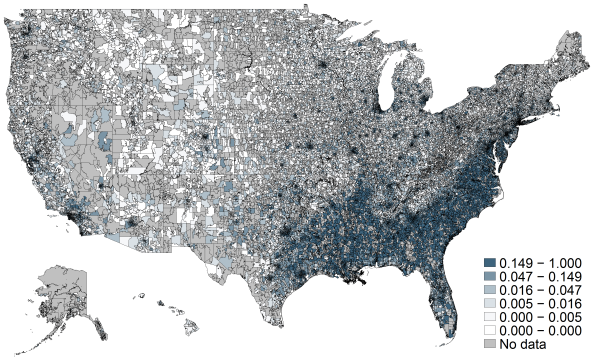
(d) Total Defaults – By Race

Notes: The figure depicts the fraction of Early Payment Defaults (EPD) and total defaults by year of mortgage origination. The figure depicts the fraction of defaults for the lowest quartile (Q1) and the highest quartile (Q4) of income growth between 2001 to 2004 in panels (a) and (b). In panels (c) and (d) the figure depicts the fraction of defaults in zip codes that are defined as Black (BLK), Latino (LTN), and white (WHT).

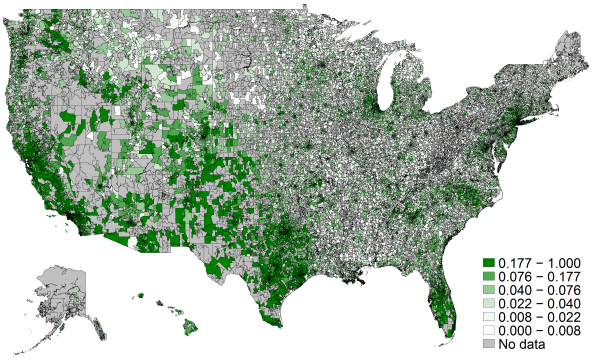
FIGURE 5: HEATMAPS



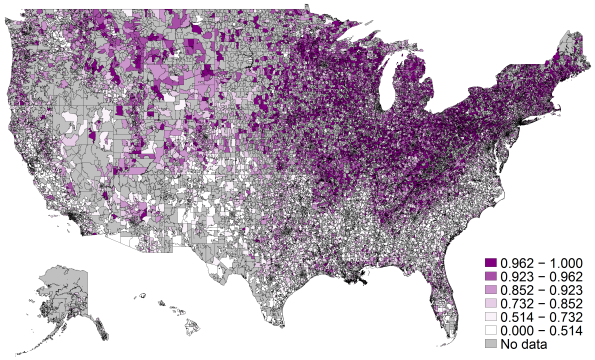
(a) Independent Mortgage Company (IMC) Market Share



(b) Population of Black Inhabitants



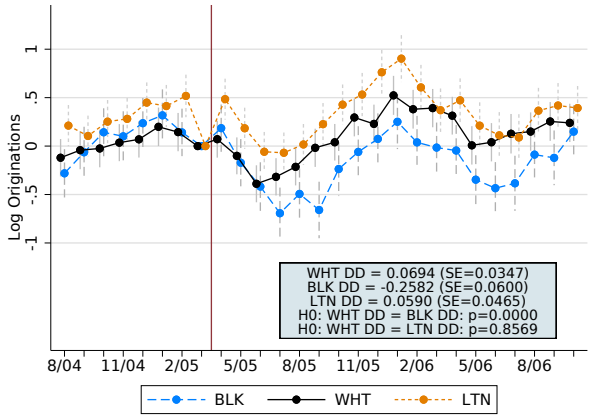
(c) Population of Latino Inhabitants



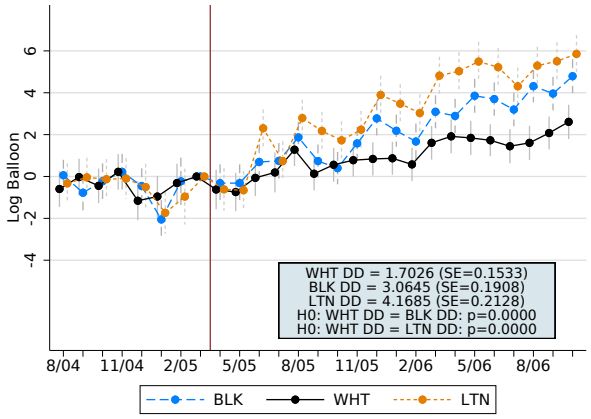
(d) Population of White Inhabitants

Notes: Panel (a) The figure depicts the zip-code-level market share of all IMCs reported in 2004. The market shares are calculated using the 2004 HMDA data. Panels (b)-(d) depict the zip-code-level population of inhabitants by race. The calculation utilizes the American Community Survey (ACS) 5-year estimates for race from IPUMS National Historical Geographic Information System NHGIS.

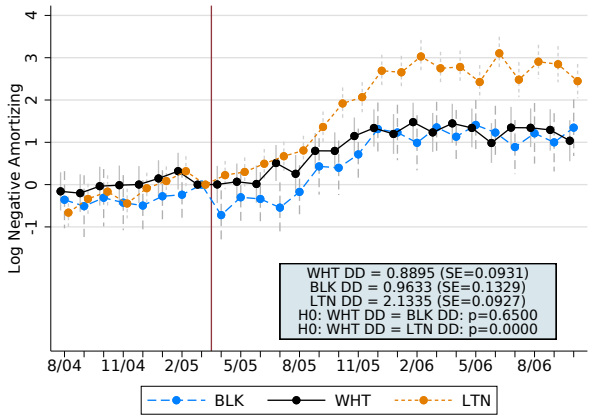
FIGURE 6: DIFFERENCE-IN-DIFFERENCES (DID) BY RACE SUBCATEGORIES - ORIGINATIONS & MORTGAGE PRODUCTS



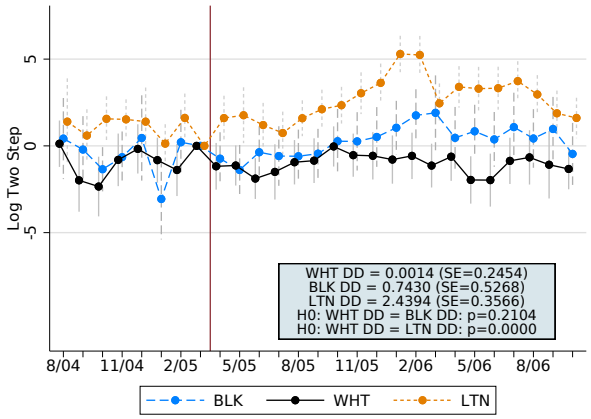
(a) Originations



(b) Balloon



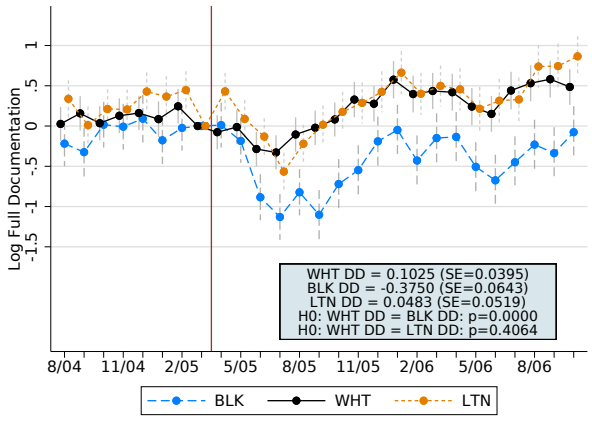
(c) Negative Amortizing



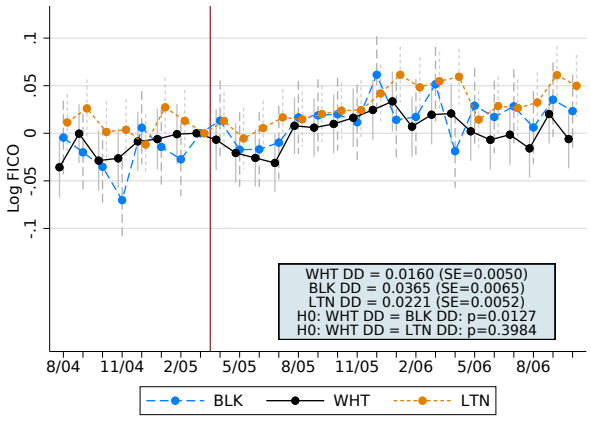
(d) Two-Step

Notes: Figure plots the dynamic response of the coefficient of interest β_T from the Equation 4 by subcategory.

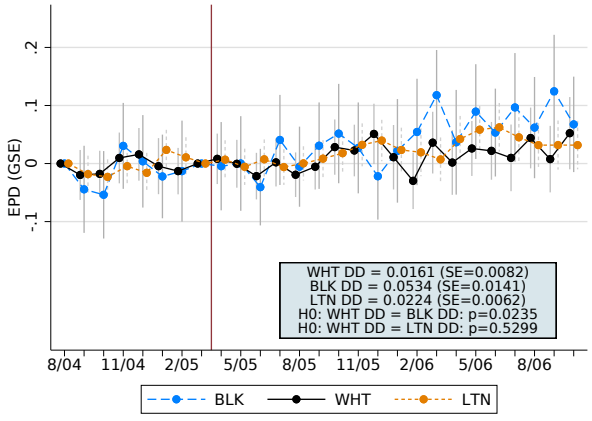
FIGURE 7: DIFFERENCE-IN-DIFFERENCES (DID) BY RACE SUBCATEGORIES - BORROWER CHARACTERISTICS



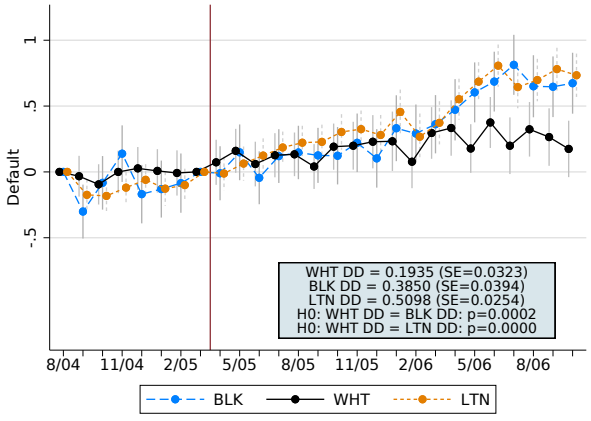
(a) Full Documentation



(b) Credit Score



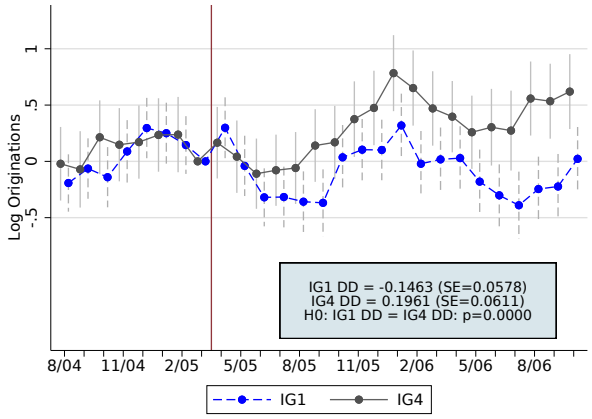
(c) Early Payment Default



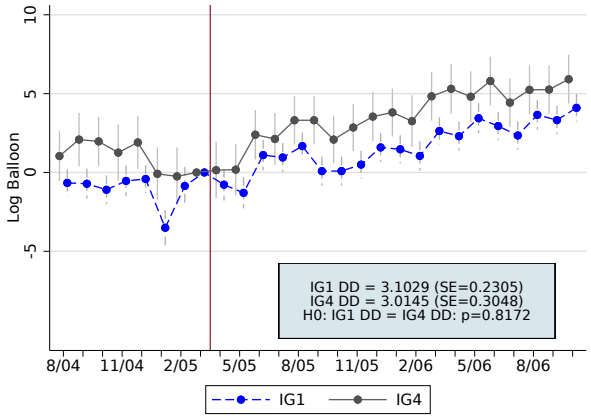
(d) Total Default

Notes: Panels a and b plot the dynamic response of the coefficient of interest β_T from Equation 4 by subcategory. Panels c and d plot the dynamic response of the coefficient of interest β_T from Equation 7 by subcategory.

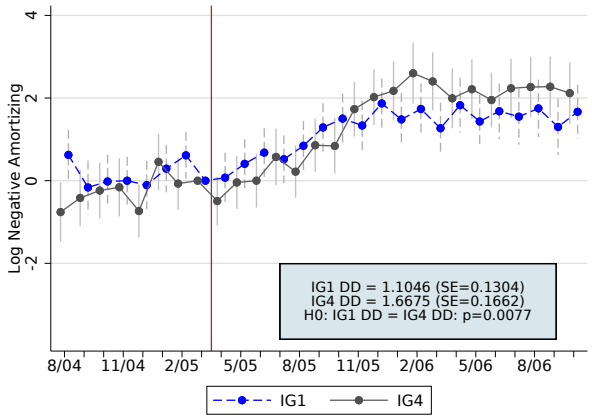
FIGURE 8: DIFFERENCE-IN-DIFFERENCES (DID) BY INCOME GROWTH SUBCATEGORIES - ORIGINATIONS & MORTGAGE PRODUCTS



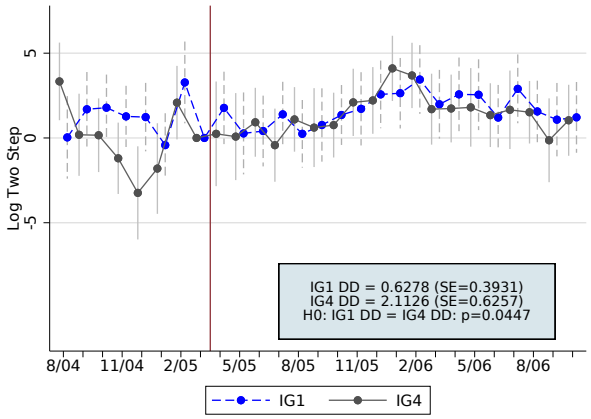
(a) Originations



(b) Balloon



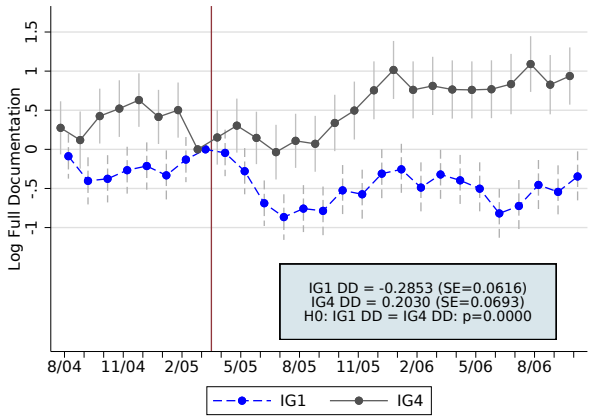
(c) Negative Amortizing



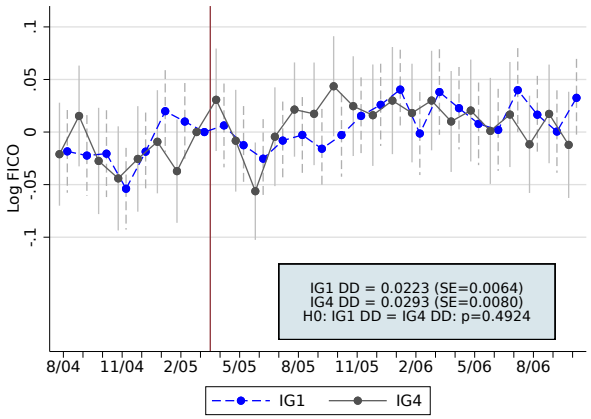
(d) Two-Step

Notes: Figure plots the dynamic response of the coefficient of interest β_T from the Equation 4 by subcategory.

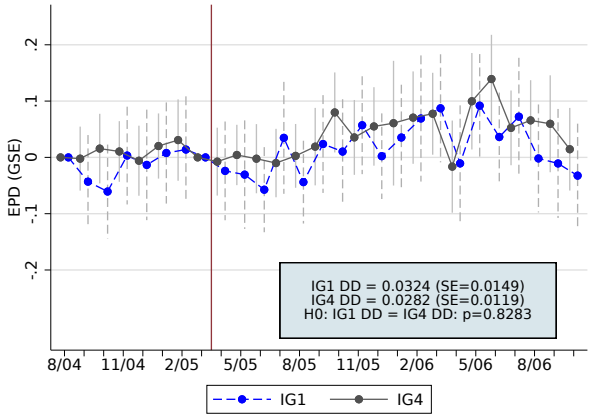
FIGURE 9: DIFFERENCE-IN-DIFFERENCES (DID) BY INCOME GROWTH SUBCATEGORIES - BORROWER CHARACTERISTICS



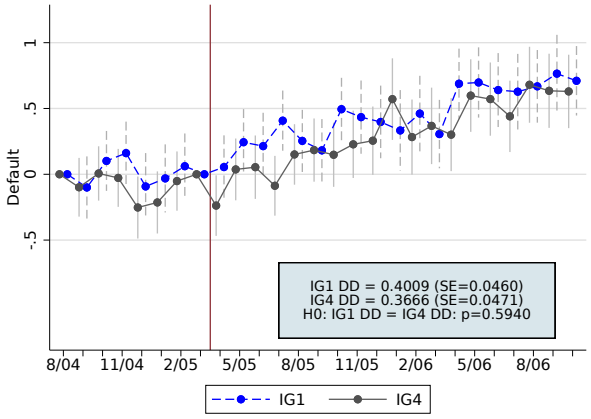
(a) Full Documentation



(b) Credit Score



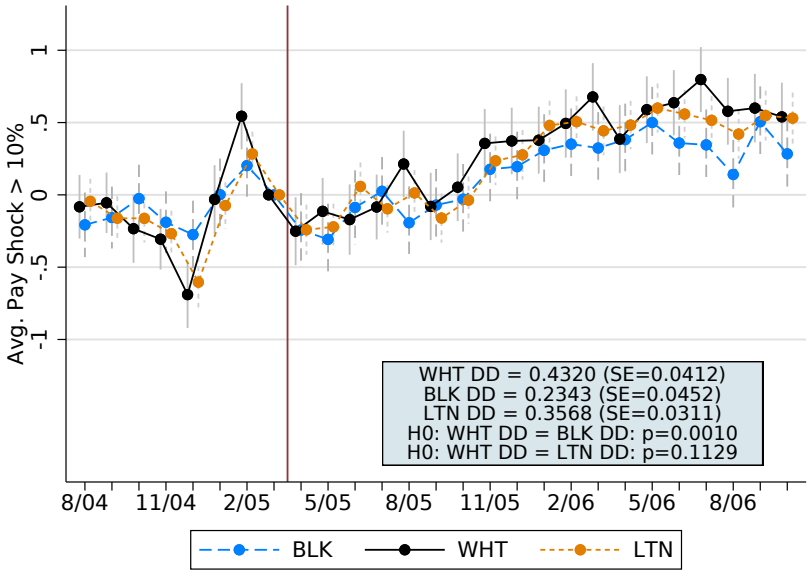
(c) Early Payment Default



(d) Total Default

Notes: Panels a and b plot the dynamic response of the coefficient of interest β_T from Equation 4 by subcategory. Panels c and d plot the dynamic response of the coefficient of interest β_T from Equation 7 by subcategory.

FIGURE 10: 10% PAY SHOCK



Notes: The figure depicts the likelihood of pay shocks for mortgages originated in zip codes with higher IMC market share pre- versus post-BAPCPA in each subgroup.

Table 1: Dealer Secured Borrowing using PLS Collateral

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

Notes: Table reports the results from Equation 2. Regression is run on the FR 2004 data data from January 1, 2002 through July 31, 2007, where April 15, 2005 and after is considered the post period.

Table 2: Summary Statistics

	All	Above Median IMCMktShr	Below Median IMCMktShr
	(1)	(2)	(3)
Numbers of ZIP codes	36,092	18,046	18,046
Income	37,690	36,351	39,079
	(16,852)	(14,710)	(18,720)
%IncomeGrowth(01-04)	7.79	7.41	8.20
	(8.43)	(8.53)	(8.30)
AverageHousingPrice	193,942	171,506	220,487
	(162,749)	(96,960)	(213,088)
%HousingPriceGrowth(01-04)	25.99	28.51	22.99
	(19.73)	(20.87)	(17.80)
%CollegeEducated	7.91	7.18	8.63
	(6.00)	(5.01)	(6.78)
%Unemployed	2.71	2.86	2.55
	(2.51)	(2.48)	(2.54)
%Black	7.23	10.00	4.46
	(15.76)	(18.83)	(11.28)
%Hispanic	6.69	9.37	4.02
	(14.56)	(16.47)	(11.76)
%White	81.54	75.72	87.35
	(23.85)	(26.36)	(19.37)

Notes: Table reports the results using data from the IRS Statistics of Income (income), Zillow (house prices), and the US Census (education, employment, and demographics). ZIP codes with higher IMC market share have slightly more Black and Hispanic residents. However, subgroup analysis shows pre-period parallel trends across majority Black, White, and Hispanic ZIP codes, suggesting racial composition does not drive trend differences.

TABLE 3: Originations by Race

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	log(Orig)		log(Balloon)		log(NegAm)		log(TwoStep)	
WHT								
Post × IMCMktShr$_{z,04}$	0.004	0.069**	2.587***	1.703***	1.220***	0.889***	1.168***	0.001
	(0.026)	(0.035)	(0.134)	(0.153)	(0.070)	(0.093)	(0.223)	(0.245)
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes
ZipFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
r2$_a$	0.92	0.93	0.34	0.47	0.81	0.83	0.12	0.29
N	502127	502058	66304	66055	150434	150245	12990	12460
BLK								
Post × IMCMktShr$_{z,04}$	0.062**	-0.258***	2.096***	3.065***	0.817***	0.963***	0.481**	0.743
	(0.026)	(0.060)	(0.116)	(0.191)	(0.076)	(0.133)	(0.208)	(0.527)
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes
ZipFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
r2$_a$	0.91	0.92	0.23	0.35	0.68	0.70	0.03	0.11
N	505314	505267	56352	56186	123375	123278	7661	7019
LTN								
Post × IMCMktShr$_{z,04}$	0.021	0.059	3.264***	4.169***	1.580***	2.133***	1.566***	2.439***
	(0.023)	(0.047)	(0.128)	(0.213)	(0.063)	(0.093)	(0.201)	(0.357)
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes
ZipFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
r2$_a$	0.92	0.93	0.34	0.47	0.81	0.83	0.12	0.29
N	502127	502058	66304	66055	150434	150245	12990	12460

Notes: Table reports the coefficient of interest in each subgroup for Equation 5.

TABLE 4: Characteristics and Performance by Race

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	log(FullDoc)		log(FICO)		loanEPDgse		loanDefault	
WHT								
Post × IMCMktShr$_{z,04}$	-0.072**	0.102***	0.024***	0.016***	0.025***	0.016**	0.383***	0.194***
	(0.031)	(0.040)	(0.003)	(0.005)	(0.005)	(0.008)	(0.021)	(0.032)
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes
ZipFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
r2$_a$	0.88	0.89	0.22	0.22	0.01	0.02	0.09	0.11
N	430578	430492	484723	484655	736633	736584	736633	736584
BLK								
Post × IMCMktShr$_{z,04}$	-0.085***	-0.375***	0.029***	0.036***	0.026***	0.053***	0.400***	0.385***
	(0.029)	(0.064)	(0.003)	(0.007)	(0.005)	(0.014)	(0.020)	(0.039)
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes
ZipFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
r2$_a$	0.87	0.88	0.23	0.23	0.01	0.02	0.09	0.11
N	431083	431051	486377	486336	736633	736584	736633	736584
LTN								
Post × IMCMktShr$_{z,04}$	-0.251***	0.048	0.024***	0.022***	0.025***	0.022***	0.504***	0.510***
	(0.027)	(0.052)	(0.003)	(0.005)	(0.004)	(0.006)	(0.018)	(0.025)
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes
ZipFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
r2$_a$	0.88	0.89	0.22	0.22	0.01	0.02	0.09	0.11
N	430578	430492	484723	484655	736633	736584	736633	736584

Notes: Table columns 1 through 4 report the coefficient of interest in each subgroup for Equation 5. Columns 5 through 8 report the coefficient of interest in each subgroup for Equation 8.

TABLE 5: Originations by Income Growth Subcategories

	Income Quartile 1							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	log(Orig)		log(Balloon)		log(NegAm)		log(TwoStep)	
Post × IMCMktShr$_{z,04}$	-0.036	-0.146**	2.710***	3.103***	1.244***	1.105***	1.138***	0.628
	(0.034)	(0.058)	(0.173)	(0.231)	(0.101)	(0.130)	(0.264)	(0.393)
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes
ZipFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
r2$_a$	0.92	0.93	0.30	0.44	0.77	0.79	0.10	0.24
N	246182	246182	38624	38253	80326	80078	6869	6180
	Income Quartile 4							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	log(Orig)		log(Balloon)		log(NegAm)		log(TwoStep)	
Post × IMCMktShr$_{z,04}$	0.125***	0.196***	3.058***	3.015***	1.600***	1.667***	1.398***	2.113***
	(0.036)	(0.061)	(0.188)	(0.305)	(0.104)	(0.166)	(0.278)	(0.626)
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes
ZipFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
r2$_a$	0.92	0.93	0.30	0.44	0.77	0.79	0.10	0.24
N	246182	246182	38624	38253	80326	80078	6869	6180

Notes: Table reports the coefficient of interest in each subgroup for Equation 5.

TABLE 6: Characteristics and Performance by Income Growth Subcategories

	Income Quartile 1							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	log(FullDoc)		log(FICO)		loanEPDgse		loanDefault	
Post × IMCMktShr$_{z,04}$	-0.275***	-0.285***	0.030***	0.022***	0.021***	0.032**	0.464***	0.401***
	(0.039)	(0.062)	(0.004)	(0.006)	(0.007)	(0.015)	(0.031)	(0.046)
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes
ZipFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
r2$_a$	0.88	0.90	0.25	0.26	0.01	0.02	0.09	0.11
N	217937	217935	239706	239706	306645	306595	306645	306595
	Income Quartile 4							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	log(FullDoc)		log(FICO)		loanEPDgse		loanDefault	
Post × IMCMktShr$_{z,04}$	-0.142***	0.203***	0.032***	0.029***	0.029***	0.028**	0.557***	0.367***
	(0.042)	(0.069)	(0.004)	(0.008)	(0.007)	(0.012)	(0.032)	(0.047)
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes
ZipFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
r2$_a$	0.88	0.90	0.25	0.26	0.01	0.02	0.09	0.11
N	217937	217935	239706	239706	306645	306595	306645	306595

Notes: Table columns 1 through 4 report the coefficient of interest in each subgroup for Equation 5. Columns 5 through 8 report the coefficient of interest in each subgroup for Equation 8.

Appendix

A Census Data Collection and Variables

Data Collection Method: The population data was downloaded from the 2000 Census of Population using the Census Data API (website: https://www.census.gov/data/developers/data-sets/decennial-census.2000.html) with the R programming language. The Census dataset was selected because it contains data specifically from the year 2000, while the NHGIS database only provides data from the 2012-2016 period.

Variables Used: The data used in this analysis is from the year 2000, corresponding to ZIP Code Tabulation Areas (ZCTAs). The following variables were used:

From '/data/2000/dec/sf1/variables':

- Total population (P004001)
- Hispanic or Latino population (P004002)
- White population (P004005)
- Black or African American population (P004006)

From '/data/2000/dec/sf3/variables':

- Population with a Bachelor's degree, male (P037015) and female (P037032)
- Unemployed population, male (P043007) and female (P043014)

B HomeBanc Discussion of Alternative Mortgages

Independent mortgage company, HomeBanc, states in its 2005 annual report that the primary attraction of alternative mortgage products is that they have initial monthly payments that are significantly lower than those on traditional mortgages. This feature allows borrowers to be approved for larger mortgages because many originators determine the amount that a borrower can afford based on the initial scheduled monthly payment, not on the payment once the mortgage resets to its market rate. See excerpt below:

> "Mortgage loans that are referred to generally as ARMs may include any of the following types of loans: ... hybrid, interest-only, negative amortization, option ARMs."

"The primary attraction to borrowers of these adjustable-rate mortgage loan products is that **initial monthly mortgage loan payments** can be **significantly lower** than fixed-rate or level-pay mortgage loans under which the borrower pays both principal and interest at an interest rate fixed for the life of the mortgage loan. As a result, many borrowers are able to incur substantially **greater mortgage debt** using one of these adjustable-rate mortgage loan products"

"When evaluating a mortgage loan application from a prospective borrower, ... many mortgage originators determine the amount of loan that the **borrower can afford** based on the borrower's **initial scheduled monthly payments** ... rather than based on the adjusted monthly payments as of future mortgage interest reset dates"

"Borrowers who intend to avoid increased monthly payments by refinancing their mortgage loans may find that lenders may not in the future be willing or able to offer these adjustable-rate mortgage loan products... . A decline in housing prices generally or in certain regions of the United States could also leave borrowers with insufficient equity in their homes to permit them to refinance. In addition, if the recent rapid increase in house prices ceases or housing prices decline, borrowers who intend to sell their properties on or before the expiration of the fixed-rate periods or interest-only periods on their mortgage loans 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. 55-56.

C Continuous Difference-in-Differences

IMC Market Share 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 3.4 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, the natural target parameter (population average treatment effect on the

treated (ATT)). 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 $IMCMktShr_{z,04}$ for the counties used in the regression analysis. I find that $IMCMktShr_{z,04}$ 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 on the treated (ATT).

[FIGURE 11 about here.]

If strong parallel trends does not hold and "selection bias" was likely to be higher at higher treatment levels, even having the population weights that are similar to the TWFE will not eliminate bias. This is because there still may be bias in the treatment response at each dose. In this 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 zip codes, driving variation in the IMC market share. This growth in IMCs was concentrated in 2003 and stabilized by 2004. I calculate the 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 conduct the regression 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.

2001-2004 Income Growth I also include the income growth distribution plotted against the two way fixed effects weights used in the estimation command. The distribution of income

growth is relatively similar to the weights used in the twfe command, which demonstrates that the interpretation of the beta coefficient calculated is the average treatment effect of the treated (ATT).

[FIGURE 12 about here.]

D Difference-in-Differences Results for All Zip Codes

I estimate the treatment intensity research design in Equation 4 for all mortgages in the Corelogic LLMA data in a single regression. This analysis acts as foundation for the analyses that study distributional differences in the impact of these mortgages on different borrowers.

I estimate the regression for the following $Y_{z,t}$ variables: $\log(PurchaseOriginations_{z,t})$, $\log(Balloon_{z,t})$, $\log(NegAm_{z,t})$, $\log(TwoStep_{z,t})$, $\log(Initial\ Interest\ Rate_{z,t})$, and $\log(AvgFICO_{z,t})$ in zip code z, at month t, log is the natural logarithm. [32] γ_z denotes Zip level fixed effects, and $\eta_{s,t}$ denotes $State \times Month$ fixed effects. $IMCMktShr_{z,04} \times \mathbb{1}_{t=T}$ is the interaction term between the market share variable and an indicator variable for month of origination. β_T is the coefficient on the interaction term that measures the effect of a one unit increase in IMC market share on the dependent variable in each month relative to March 2005, the month prior to the passage of BAPCPA. Standard errors are clustered at the zip code level.

Figure 13 reports the regression results. As shown in Figure 13 panel (a), the total number of purchase mortgage originations increased statistically significantly following BAPCPA for zip codes with high IMC exposure. These purchase originations first decrease and then begin to increase following the shock. This initial decrease is likely due to lenders transitioning into alternative products, which had not been originated as prolifically prior to BAPCPA. Figure 13 panel (b) shows that a 10% increase in pre-period IMC market share leads balloon originations to increase by 22%, panel (c) shows that the same increase in IMC market share leads negative amortizing originations to increase by 10.6%, and panel (d) shows that it leads two-step originations to increase by 16.6%. Two-step mortgages offered a fixed initial interest rate for an agreed-upon introductory period, typically for 5-7 years, and then reset once to a fixed rate at the prevailing market rate. Option ARM products are included in negative amortizing products since CoreLogic does not report Option ARMs separately.

Figure 13 panel (e) shows that a 10% increase in IMC market share in 2004 in a given zip code leads to a statistically significant 0.8% average decrease in the introductory interest

[32] This is the zip-code-level equivalent of the county level regression in Lewis (2023). While county level $\log(PurchaseOriginations)$, $FracBalloon$, $FracNegAm$, and $\log(Initial\ Interest\ Rate)$ were touched on in Lewis (2023), they are explored at the more granular zip code level here and $TwoStep_{z,t}$ and $AvgFICO_{z,t}$ are new to this analysis. I study these variables to establish that there is an overall increase in alternative mortgages at the zip code level and study differences in demographic groups in the body of the paper.

rate directly following BAPCPA. The actual interest rate that adjustable rate mortgages were pegged to was the twelve month Treasury rate. The Treasury rate was monotonically increasing during this time period, as the Federal Reserve was in a monetary tightening regime. The decrease in the initial interest rate is consistent with an increase in alternative products, which allow the borrower to pay an initial introductory payment that is less than the fully amortizing interest and principal payment accruing on the mortgage.

In Figure 13 panel (f), I plot the credit score at the zip code level pre- versus post-BAPCPA. I find that the credit score increased following the policy change in areas that were more exposed to the IMCs. Prior to the policy change, there was no statistically significant increase in the credit score between more- versus less-treated zip codes. Following the policy change, a 10% increase in pre-period IMC market share led to a persistent 0.17% increase in credit score of new mortgage originations in the zip code. This increase in credit scores is consistent with an increase in mortgage originations from the extensive margin, as the model suggests, rather than the intensive margin.[33] This is because, if IMCs were increasing the number of mortgages that they originated but lending to their existing stock of borrowers, the credit score associated with these mortgages would begin to fall. Originating multiple new purchase mortgages to the same borrower would increase the borrowers' leverage ratio and lower their credit score. Additionally, I find that refinance mortgages were falling over this time period, as were second home purchases. The increasing credit score is also consistent with the increase in alternative mortgage products with riskier amortization structures; lenders likely compensated for increased income volatility and low down-payments by increasing borrower credit scores on these products.

[Figure 13 about here.]

E Triple Difference by IMC Market Share and Income Growth (Income Volatility)

By setting up a triple difference regression specification, I test for evidence consistent with BAPCPA driving an expansion of originations among borrowers with higher income volatility. I study whether areas with higher exposure to BAPCPA began originating differentially more alternative mortgages to high income variability borrowers post BAPCPA. I estimate the following specification:

[33] For IMCs, this could have been canabalizing FHA originations, and not be completely new borrowers who otherwise would not have received mortgages.

$$
\begin{aligned}
Y_{z,t} &= \mu\ IMCMktShr_{z,04} \times Post_t \\
&+ \nu\ IMCMktShr_{z,04} \times IncGrowth_z + \tau\ IncGrowth_z \times Post_t \\
&+ \beta\ IMCMktShr_{z,04} \times IncGrowth_z \times Post_t \\
&+ \gamma_z + \eta_{s,t} + \epsilon_{z,t}. \qquad (20)
\end{aligned}
$$

Where $Y_{z,t}$ is $\log(Originations_{z,t})$, $FracBalloon_{z,t}$, $FracNegAm_{z,t}$, $FracTwoStep_{z,t}$, $FracInterestOnly_{z,t}$. log is the natural logarithm of a number and $Frac$ represents the fraction that a given mortgage product makes up of all mortgage originations in a region. For each zip code z in month t, $Originations_{z,t}$ is the total number of originations. The continuous treatment variable, $IMCMktShr_{z,04}$ is the market share of IMCs in a zip code z in 2004. $Post_t$ is an indicator variable that equals one for April 2005 and later and zero otherwise. $IncGrowth_z$ is the income growth in a zip code from 2001 to 2004. β is the coefficient on the interaction term, $Post_t \times IMCMktShr_{z,04} \times IncGrowth_z$. β measures how lower values of $IncomeGrowth_z$ affect mortgage originations in the post-period relative to the pre-period, holding constant the IMC market share in 2004 in each zip code. The triple difference measures the differential effect on mortgage originations of moving from 0% to 100% IMC market share, post- versus pre-shock, for zip codes with high versus low levels of income growth. γ_z represents Zip level fixed effects and $\eta_{s,t}$ represents $State \times Month$ fixed effects. Standard errors are clustered at the zip code level.

The insight behind this regression specification is that zip codes that have a higher market share of IMCs should increase their alternative mortgage originations at a faster rate following BAPCPA relative to zip codes that have a higher market share of banks. Moreover, borrowers may value products that offer the ability to delay principal and interest payments at a time when their income is low and repay the amount owed at a time when their income may be higher. Alternative mortgage products achieved this payment flexibility by lowering introductory monthly payments and delaying the fully amortizing principal and interest payments to a later point in the life of the loan. This made these products appear affordable at the peak of the housing boom when the Federal Reserve was raising interest rates and home prices were near peak. If high income volatility borrowers valued alternative products, these mortgages would be disproportionately originated among higher- relative to lower-income-volatility zip codes and the β coefficient on the triple interaction term would be negative since high income volatility is proxied for by low income growth. BAPCPA should drive a larger increase in mortgage originations in zip codes that have both a high IMC market share and low income growth.

The IMC market share variable is a continuous measure. However, to understand the insight of the regression, imagine that zip codes were made up of either 100% banks or 100% IMCs. The regression calculates the difference between IMC lending in high versus low income growth zip codes between the pre-period as well as in the post-period. It then calculates the difference between the pre-period versus the post-period and compares it to the analogous difference for bank lending. In Appendix C, I show that the population weighted doses of income growth are close to normally distributed and thus the TWFE estimator closely approximates the population weights, making any bias in the regression small.

E.1 Effects by Income Growth (Income Volatility) - Results

The results in Table 7 show that low-income growth, high-income variability, borrowers are statistically significantly more likely to receive alternative mortgage products following the passage of BAPCPA. These results are consistent with the following mechanism: BAPCPA lowered dealer-banks' cost of capital in the secondary market for private-label mortgages and in response, dealer-banks decreased the primary market interest rate on these mortgages. The decreased mortgage payments in this market created a demand stimulation mechanism and led to more originations of option ARM, or similar mortgages, in areas with low-income growth (high-income volatility).

Table 7 shows that for a zip code with 100% market share of IMCs, post policy change, a 10% decrease in income growth would increase the fraction of negative amortizing originations by 1.1 pp, the fraction of balloon originations by 0.48 pp, and the fraction of interest only (IO) originations by 1.7 pp. The fraction of two-step originations also increased 0.13 pp more in zip codes with lower income growth, however not statistically significantly at the 95% level. The results also show that total mortgage originations increased as income growth increased, indicating that IMCs were also increasing mortgage originations in high-income growth areas. However, in low-income growth, or high-income volatility, areas IMCs were disproportionately originating alternative mortgages, which gave borrowers artificially low initial mortgage payments.

[Table 7 about here.]

F Mortgage Acceptance Rates

To test whether the trends in origination of mortgage products are reflected in mortgage acceptance rates, I use loan-level HMDA data to identify the differential effect of BAPCPA on mortgage approval rates by race. I utilize a triple difference empirical specification. The first difference is the pre- versus post- BAPCPA period. The second difference is IMC lender

versus non-IMC (i.e. banks, affiliated mortgage companies, and other traditional lenders). The third difference is the race of a borrower.

Since the IMCs were funded heavily by warehouse repurchase agreements from dealers, the empirical design utilizes IMC lenders to causally identify the effect of BAPCPA's strengthening of repo creditor rights. The applicant race reported in the data allow the research design to identify whether a borrower received a differential increase (decrease) in mortgage approval rate from IMC lenders versus non-IMCs lenders post policy change by race. I estimate the following regression:

$$\begin{aligned} Accepted_b = \alpha post_t + \delta IMC_b + \lambda RACE_b \\ +\rho IMC_b \times post_t + \zeta IMC_b \times RACE_b + \xi post_b \times RACE_b \\ +\beta IMC_b \times \%Race_b \times Post_t \\ +\gamma_c + \eta_{s,t} + \epsilon_b. \end{aligned} \tag{21}$$

Where $Accepted_b$ is an indicator variable, for borrower b, equal to one if the mortgage application is approved. The public HMDA data is only available at the annual frequency. $Post_b$ is an indicator variable set equal to one for 2005 and later. IMC_b is an indicator variable set equal to one if an application is received by an IMC lender. $RACE_b$ is an indicator for whether an applicant identifies as Black, Latino, or white. I iterate through specifying one race and including the other two in the control group. γ_c represents county level fixed effects and $\eta_{s,t}$ represents the $state \times year$ fixed effects. β represents the change in the application acceptance rate post-BAPCPA relative to pre-BAPCPA when the application is received by an IMC lender and the borrower identifies as a given race.

Table 8 presents the results of Equation 21. Relative to other racial groups, Black and Latino borrowers experienced significant declines in mortgage acceptance rates by 5.5% and 6.6% respectively. White borrowers experienced a significant relative increase in mortgage acceptance rate by 3%. This is consistent with white borrowers receiving more subprime mortgages, which were fully amortizing but required lower credit scores, and therefore slackened the credit score constraint. While minority borrowers received more alt-A products, which required higher credit scores but had riskier amortization structures, and therefore slackened the wealth/income constraint.

The acceptance rates are consistent with IMCs originating relatively more alternate-A paper products in minority zip codes and relatively more subprime products in white zip codes. The alt-A products required modestly higher credit standards, consistent with the relatively lower approval rates in minority zip codes in the post-period. The Survey of

Consumer Finances indicates that by 2016, the median net worth of white families was $171,000, while the median for Black families was $17,600, almost ten times lower (Bricker et al. (2017)). Given the stark wealth gap (Derenoncourt et al. (Forthcoming)) and income volatility gaps (Morduch et al. (2018)), the down payment and documentation requirements were likely much more binding for minority households than for white households, conistent with the higher originations of alt-A products depicted in Figure 6.

[Table 8 about here.]

G Discussion of Prime and Subprime Originations by Racial Subgroup

I estimate the same regression in Equation 4, where $Y_{z,t}$ is the fraction of prime and subprime mortgages originated in a zip code pre- versus post-BAPCPA, by racial subgroup.

Figure 14 plots the results. Following the policy change, relative to white zip codes, a larger fraction of prime mortgages were originated in majority Latino zip codes. This is consistent with a the larger fraction of alternative originations in Latino zip codes, since these alternative mortgages were recorded as prime in CoreLogic. Consistently, the fraction of subprime originations decreased post-BAPCPA, however it decreased less steeply for white zip codes relative to Latino zip codes. Combined with the relatively larger increase in total originations in white zip codes, this indicates that white zip codes were receiving a larger fraction of subprime mortgages, which were below 660 credit score but fully amortizing "vanilla" mortgages.

Relative to white zip codes Black zip codes received an increase in fraction of subprime mortgages for about five months following the policy change. After five months following BAPCPA, the fraction of subprime "vanilla" mortgages began to fall and the fraction of prime alternative mortgages began to rise in Black zip codes. Due to the initial drop in fraction of prime mortgages, it took about 8 months for Black zip codes to catch up to the fraction of prime mortgages originated in white zip codes.

[Figure 14 about here.]

H Poisson Regressions

In this section, I estimate the Poisson regressions of the form:

$$Y_{z,t} = \gamma_z + \eta_{s,t} + IMCMktShr_{z,04} \times Post_t + \epsilon_{z,t} \tag{22}$$

Where $Y_{z,t}$ is the number of balloon, negative amortizing, two-step, and interest only mortgages originated in a given zip code in a given month. γ_z are zip code fixed effects

and $\eta_{s,t}$ are state $\times$ origination month fixed effects. $IMCMktShr_{z,04}$ is the market share of independent mortgage companies operating in a given zip code in 2004 and $Post_t$ is an indicator equal to 1 in April 2005 and after, and equal to zero otherwise.

I estimate each of these regressions separately by racial subgroup. I am estimating a difference-in-differences research design within each racial subgroup. This means that the coefficient of interest is capturing the differential increase in mortgage originations of a given product type in the post-period, over and above the pre-period level within zip codes of a different racial subgroup. In the following figures, I find that in all of the specifications, the number of these alternative products originated in Latino zip codes outpaced the number of originations in majority white or Black zip codes.

[Table 9 about here.]

I Matching the CoreLogic NARMBS Originators to HMDA

Independent mortgage companies are identified in the CoreLogic NARMBS data by merging the NARMBS data with the HMDA data using a name match. The name match is broadly designed to do two things. First, it keeps the top five ranked matches, second it matches origination year to the year an originator is seen active in the Avery crosswalk. The data then use HMDA's definition of an IMC. A detailed description of the matching process is below.

The matching process for originators in CoreLogic NARMBS and HMDA used an algorithm that generated best matches based on name similarity and the years in which each entity operated. The matching utilized the crosswalk maintained by Robert Avery, which matches subsidiaries operating in the HMDA data to their parent. Year an entity operated was determined using the year the mortgage was originated in CoreLogic and matching it to the year an entity operated in the Avery file. Matching was performed in several rounds: first on the originator name in CoreLogic to the HMDA NAME column in the Avery file, then the HMDA NAMES column for any unmatched CoreLogic orignators, and then using the HMDA NAMEOR column etc. After all rounds were completed, a manual check was conducted.

The matching algorithm for each round proceeds as follows. First, all originator names from both NARMBS and HMDA were capitalized. Then the `matchit` command in Stata was used to compile a list of possible matches between each originator name in NARMBS and the corresponding column in HMDA (either NAME, NAMES, NAMEOR or PARENT). For these possible matches (multiple HMDA originators could be matched to a single NARMBS originator), matches were dropped if the first word of the NARMBS originator name did

not match the first word of the HMDA originator name, if the years in which the matched originators operated differed more than 3 years, and if the second words for the originator names did not match for cases where there were over 200 HMDA orginators matched to one NARMBS originator. Matches were marked for later manual checks at this round if there was only 1 word in the NARMBS originator name and there were more than 99 HMDA matches. Then, matches were further filtered through if the name was an exact match, if the second word matched, or if the match was one of the top 5 matches based on the metric produced by `matchit`, similscore. Finally, if there was an exact name match available, the exact name closest to the NARMBS origination year was used. If there was no exact name match available, the match closest to the NARMBS origination year with the highest similscore was used.

After all the rounds of matching were completed, the matches generated by the algorithm were inspected by hand. Matches were dropped if the names differed significantly (for example "Associated Mortgage Center, Inc" and "Associated Mortgage, Inc") or if the NARMBS originator name was too ambiguous or common to link it to another entity in HMDA (for example "First Bank"). After this final manual inspection, 2,148 originators in NARMBS were matched to an originator in HMDA. This represents 10.3% of the originators in NARMBS.

Using the NAMRBS data, I estimate the following regression by racial subgroups:

$$Y_l = \gamma_z + \eta_{s,t} + \mu IMCoriginator_l + \sum_T \beta_T IMCoriginator_l \times \mathbb{1}_{t=T} + \epsilon_l \tag{23}$$

Where Y_l represents an indicator variable equal to one if the mortgage is a balloon mortgage or a negative amortizing mortgage. I find that both balloon and negative amortizing mortgage originations increase disproportionately post BAPCPA if the mortgage was originated by an IMC. The effects are strongest in minority-dominant zip codes.

[FIGURE 15 about here.]

J Controlling for Income Growth Quartile in the Racial Subgroup Regressions

As a robustness to Equation 4, I estimate the following DiD specification comparing zip codes with high- versus low-2004 market share of IMCs pre- versus post-policy change including a control for income growth of a zip code from 2001 to 2004 interacted with the post period.

I estimate the regression separately for each racial subgroup:

$$Y_{z,t} = \gamma_z + \eta_{s,t} + \beta Post_t \times IMCMktShr_{z,04} + \delta Post_t \times IncGrowth_z + \epsilon_{z,t}. \quad (24)$$

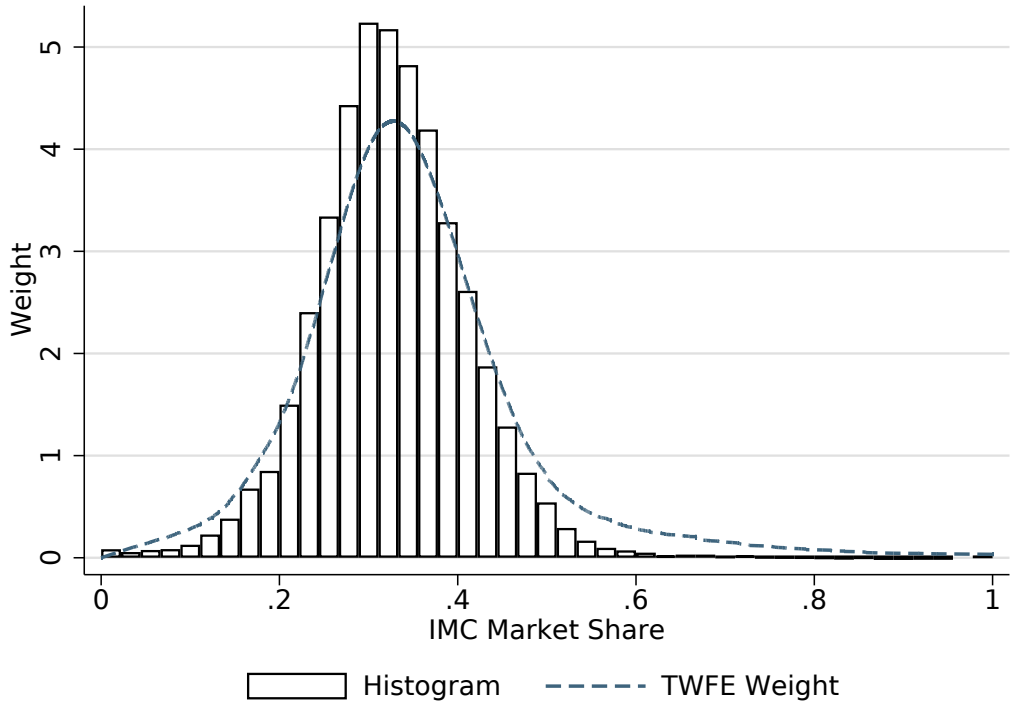
Where all variables are defined as in the main draft. I interact $Post_t$ with $IncGrowth_z$ to allow areas with high- versus low-income-growth to behave differently following the policy change. I estimate that regression separately in the majority WHT, BLK, and LTN zip codes and report the results in Table 10 and Table 11. I find that majority BLK and LTN zip codes still disproportionately experience a statistically significant increase in alternative mortgages, credit score, and default rates, and a decrease in full documentation, even controlling for income growth (proxying for income volatility). These results are consistent with racial makeup of a zip code differentially affecting the types of mortgages originated post BAPCPA, which cannot be explained by income volatility alone.

[Table 10 about here.]

[Table 11 about here.]

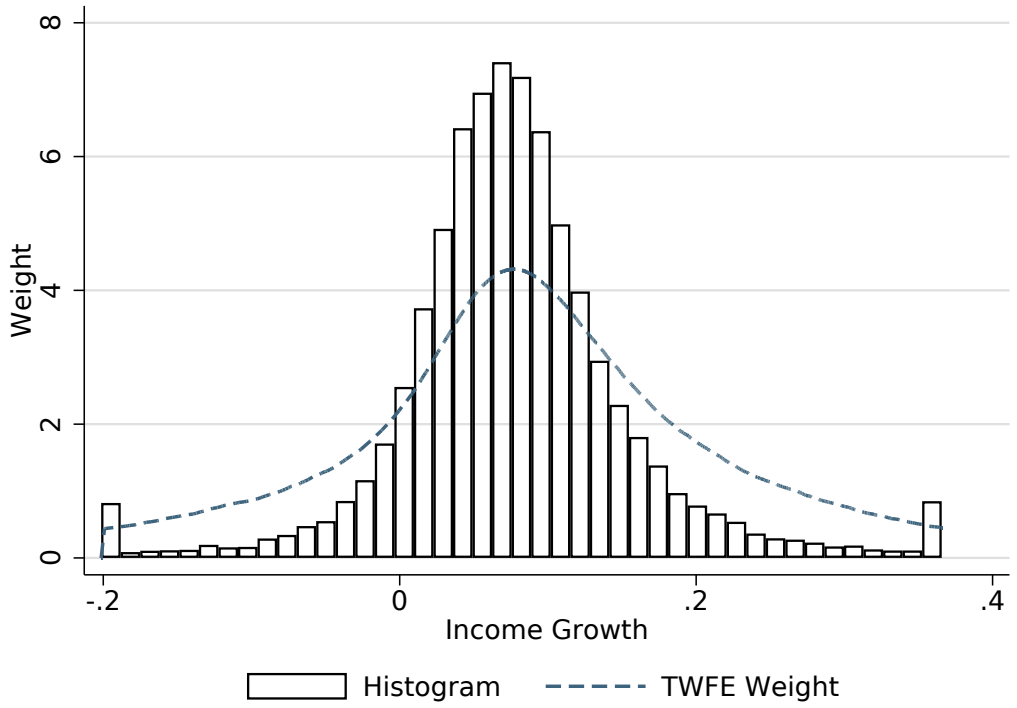
[Table 12 about here.]

Figure 11: Continuous DID Weights - IMC Market Share



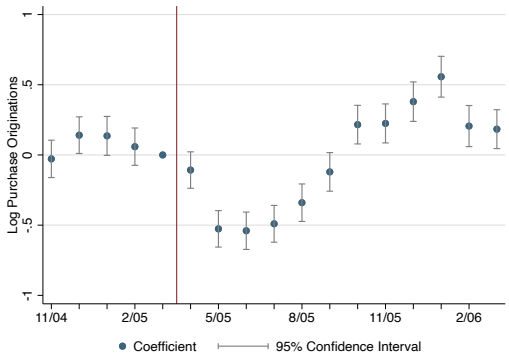
Notes: The figure plots the distribution of the actual treatment variable, $IMCMktShr_{z,04}$ against the weights applied in the continuous difference-in-differences or two-way fixed effects specification.

FIGURE 12: CONTINUOUS DID WEIGHTS - INCOME GROWTH

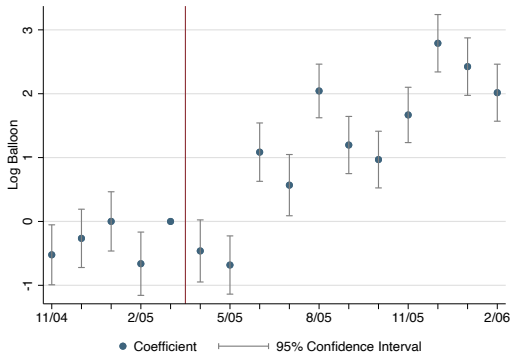


Notes: The figure plots the distribution of the actual treatment variable, income growth in a zip code from 2001 to 2004 ($IncGrowth_z$) against the weights applied in the continuous difference-in-differences or two-way fixed effects specification.

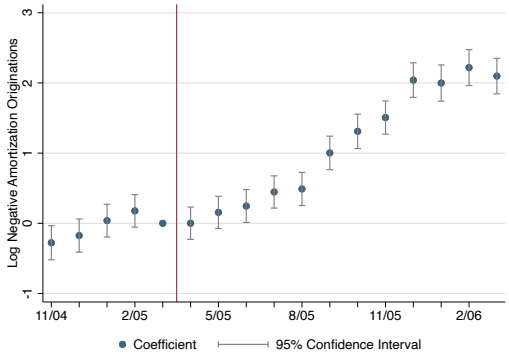
FIGURE 13: ZIP IMC MARKET SHARE EFFECT ON MORTGAGE ORIGINATIONS



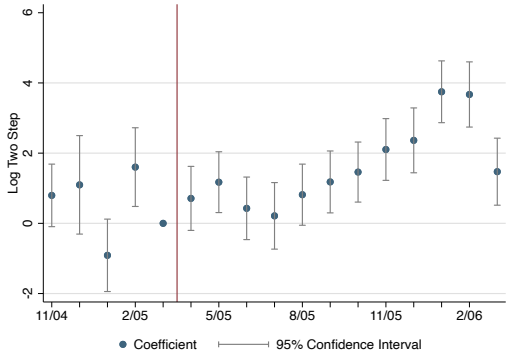
(a) Total Purchase Originations



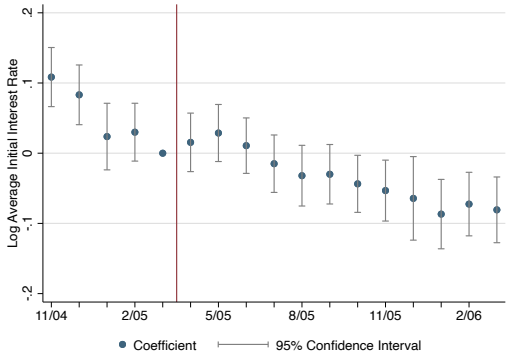
(b) Balloon Originations



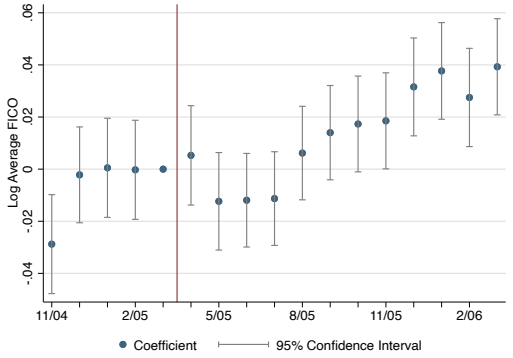
(c) Negative Amortizing Originations



(d) Two-Step Originations



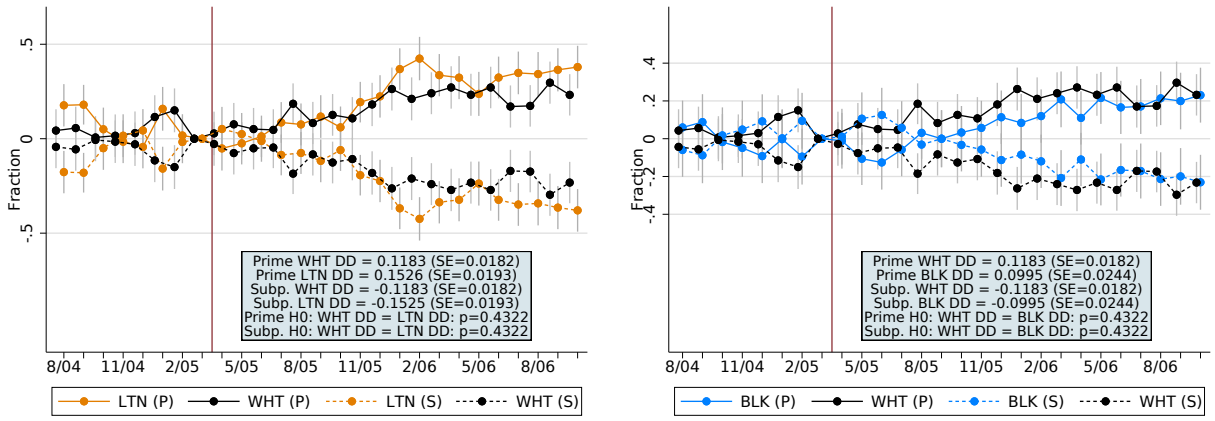
(e) Initial Interest Rate



(f) Average Credit Score

Notes: Figure plots the dynamic response of the dependent variable to the 2004 market share of independent mortgage companies (IMCs) in a zip code. I estimate Equation 4 on the entire sample, not by racial or income growth subgroup. β_T is the coefficient on the indicator variable that interacts $IMCMktShr_{z,04}$ with an indicator for each month pre and post the shock. I use the public HMDA data to compute the 2004 zip-code-level IMC market share and CoreLogic data to study originations. The figure indicates that following BAPCPA, regions more exposed to the policy change significantly increased the number of mortgages that they originated and shifted toward alternative mortgage products with higher credit score and lower initial interest rate, relative to less exposed regions.

Figure 14: Difference-in-Differences (DiD) by Race Subcategories - Prime vs Subprime

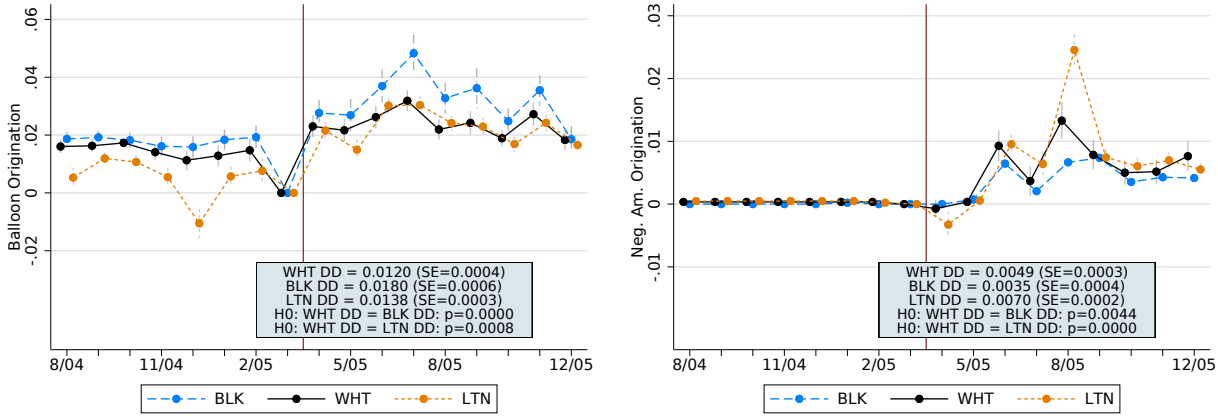


(a) Latino vs white zip codes

(b) Black vs white zip codes

Notes: Panels a and b plot the dynamic response of the coefficient of interest β_T from Equation 4 by race subcategory.

Figure 15: Loan Level DiD by Race Subcategories - Borrower Characteristics



(a) Balloon

(b) Negative Amortizing

Notes: Figure plots the dynamic response of the coefficient of interest β_T from the following equation by race subcategory.

$$Y_l = \gamma_z + \eta_{s,t} + \mu IMCoriginator_l + \sum_T \beta_T IMCoriginator_l \times \mathbb{1}_{t=T} + \epsilon_l. \tag{25}$$

TABLE 7: Differential Effect of Treatment on Low Income Growth Zip Codes

	Product Types				
	(1) logorig	(2) fracballoon	(3) fracnegam	(4) fractwostep	(5) fracio
Post × $\text{IMCMktShare}_{z,04}$	-0.1596***	0.0450***	0.0467***	0.0031***	0.0270***
	(0.0377)	(0.0023)	(0.0061)	(0.0011)	(0.0064)
Post × IncGrowth_z	-0.5505***	0.0093	0.0374*	0.0045	0.0600***
	(0.1110)	(0.0062)	(0.0216)	(0.0036)	(0.0212)
Post × $\text{IMCMktShare}_{z,04}$ × IncGrowth_z	1.8982***	-0.0481**	-0.1109*	-0.0130	-0.1738***
	(0.3276)	(0.0192)	(0.0649)	(0.0115)	(0.0641)
cons	2.4852***	-0.0027***	0.0168***	0.0002	0.0407***
	(0.0091)	(0.0006)	(0.0015)	(0.0002)	(0.0015)
ZipFE	Yes	Yes	Yes	Yes	Yes
StatexMonthFE	Yes	Yes	Yes	Yes	Yes
r2	0.9274	0.0968	0.3896	0.0742	0.3227
N	491717	491717	491717	491717	491717

Notes: Table reports the response of housing market characteristics in a given zip as a function of the interaction term between 2004 market share of independent mortgage companies (IMCs) × income growth between 2001 and 2004 in that zip × the post period. I estimate the triple difference regression in Equation 20. I use the Public HMDA data to compute the 2004 zip level IMC market share. I use CoreLogic LLMA data to study mortgage product types and characteristics.

TABLE 8: HMDA Mortgage Acceptance Rates by Race

	Acceptance Rate		
	(1)	(2)	(3)
	BLK	LTN	WHT
Race	-0.066***	-0.010*	0.250***
	(0.005)	(0.005)	(0.005)
$IMC_{z,04}$	-0.129***	-0.135***	-0.070***
	(0.006)	(0.005)	(0.004)
$IMC_{z,04}$ × Race	0.079***	0.128***	-0.049***
	(0.006)	(0.005)	(0.004)
Post × Race	0.021***	0.022***	-0.018***
	(0.002)	(0.002)	(0.002)
$IMC_{z,04}$ × Post	0.111***	0.111***	0.073***
	(0.003)	(0.003)	(0.003)
Race × $IMC_{z,04}$ × Post	-0.055***	-0.066***	0.030***
	(0.004)	(0.004)	(0.003)
Constant	0.471***	0.466***	0.315***
	(0.002)	(0.001)	(0.002)
StatexYearFE	Yes	Yes	Yes
CountyFE	Yes	Yes	Yes
$r2_a$	0.02	0.02	0.07
N	185792947	185792947	185792947

Notes: Table reports the response of HMDA loan acceptance rates in a given zip as a function of the interaction term between 2004 market share of independent mortgage companies (IMCs) × an indicator for majority race in that zip × the post period. I estimate the triple difference regression in Equation 21. The coefficients measure the change in the dependent variable if $IMCMktShr_{c,04}$ increased from 0% to 100% in the post period if a zip is considered majority Black (Latino, White). HMDA acceptance rates come from the HDMA Loan Application Register. I also use the Public HMDA data to compute the 2004 zip level IMC market share. Zip-level racial demographics come from the Census.

TABLE 9: Originations by Race (Poisson)

	(1) Negative Amortizing	(2) Balloon	(3) Two Step	(4) Interest Only
		WHT		
Post × IMCMktShr$_{z,04}$	2.355***	8.644***	-2.341***	1.780***
	(0.145)	(0.214)	(0.480)	(0.160)
StatexMonthFE	Yes	Yes	Yes	Yes
ZipFE	Yes	Yes	Yes	Yes
r2$_p$	0.62	0.42	0.18	0.73
N	1352431	1645281	418095	1457832
		BLK		
Post × IMCMktShr$_{z,04}$	2.086***	6.773***	-3.086***	1.486***
	(0.202)	(0.303)	(0.478)	(0.174)
StatexMonthFE	Yes	Yes	Yes	Yes
ZipFE	Yes	Yes	Yes	Yes
r2$_p$	0.64	0.42	0.24	0.76
N	429004	536114	187644	432426
		LTN		
Post × IMCMktShr$_{z,04}$	4.665***	14.122***	1.193**	2.172***
	(0.098)	(0.244)	(0.468)	(0.100)
StatexMonthFE	Yes	Yes	Yes	Yes
ZipFE	Yes	Yes	Yes	Yes
r2$_p$	0.75	0.47	0.39	0.83
N	470190	539949	242151	501909

Notes: Table reports the coefficient of interest in each subgroup for Equation 22.

TABLE 10: Originations by Race (Robustness)

	WHT							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	log(Orig)		log(Balloon)		log(NegAm)		log(TwoStep)	
Post × IMCMktShr$_{z,04}$	-0.036	0.039	2.710***	1.541***	1.127***	0.653***	1.251***	-0.262
	(0.031)	(0.042)	(0.156)	(0.175)	(0.086)	(0.123)	(0.245)	(0.327)
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes
ZipFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$r2_a$	0.91	0.92	0.36	0.49	0.81	0.83	0.12	0.30
N	389530	389461	55925	55673	117263	117084	10769	10225
	BLK							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	log(Orig)		log(Balloon)		log(NegAm)		log(TwoStep)	
Post × IMCMktShr$_{z,04}$	0.043	-0.276***	2.197***	2.860***	0.797***	0.974***	0.619***	0.733
	(0.029)	(0.063)	(0.128)	(0.204)	(0.086)	(0.144)	(0.238)	(0.555)
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes
ZipFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$r2_a$	0.90	0.91	0.24	0.36	0.65	0.68	0.04	0.11
N	407411	407365	49816	49625	101110	101011	6581	5913
	LTN							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	log(Orig)		log(Balloon)		log(NegAm)		log(TwoStep)	
Post × IMCMktShr$_{z,04}$	-0.011	-0.030	3.414***	4.377***	1.550***	2.246***	1.638***	2.515***
	(0.026)	(0.057)	(0.146)	(0.267)	(0.076)	(0.119)	(0.223)	(0.390)
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes
ZipFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$r2_a$	0.91	0.92	0.36	0.49	0.81	0.83	0.12	0.30
N	389530	389461	55925	55673	117263	117084	10769	10225

Notes: Table reports the coefficient of interest in each subgroup for Equation 22.

TABLE 11: Characteristics and Performance by Race (Robustness)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	log(FullDoc)		log(FICO)		loanEPDgse		loanDefault	
WHT								
$\text{IncGrowth}_z \times \text{Post}$	0.117***	0.066**	0.003	0.005	0.014***	0.004	0.182***	-0.041**
	(0.031)	(0.030)	(0.003)	(0.003)	(0.005)	(0.005)	(0.022)	(0.019)
$\text{Post} \times \text{IMCMktShr}_{z,04}$	-0.177***	0.000	0.026***	0.018***	0.029***	0.017	0.415***	0.142***
	(0.036)	(0.048)	(0.004)	(0.006)	(0.006)	(0.012)	(0.024)	(0.042)
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes
ZipFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$r2_a$	0.87	0.88	0.21	0.21	0.01	0.02	0.09	0.11
N	345595	345515	379557	379486	613405	613350	613405	613350
BLK								
$\text{IncGrowth}_z \times \text{Post}$	0.146***	0.001	0.001	0.004	0.014***	0.004	0.182***	-0.041**
	(0.031)	(0.031)	(0.003)	(0.003)	(0.005)	(0.005)	(0.022)	(0.019)
$\text{Post} \times \text{IMCMktShr}_{z,04}$	-0.133***	-0.430***	0.030***	0.032***	0.031***	0.060***	0.450***	0.343***
	(0.032)	(0.069)	(0.003)	(0.007)	(0.006)	(0.016)	(0.023)	(0.043)
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes
ZipFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$r2_a$	0.86	0.87	0.22	0.23	0.01	0.02	0.09	0.11
N	359643	359604	395930	395889	613405	613350	613405	613350
LTN								
$\text{IncGrowth}_z \times \text{Post}$	0.117***	0.066**	0.003	0.005	0.014***	0.004	0.182***	-0.041**
	(0.031)	(0.030)	(0.003)	(0.003)	(0.005)	(0.005)	(0.022)	(0.019)
$\text{Post} \times \text{IMCMktShr}_{z,04}$	-0.326***	-0.071	0.025***	0.021***	0.029***	0.019**	0.547***	0.467***
	(0.031)	(0.066)	(0.003)	(0.007)	(0.005)	(0.008)	(0.021)	(0.033)
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes
ZipFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$r2_a$	0.87	0.88	0.21	0.21	0.01	0.02	0.09	0.11
N	345595	345515	379557	379486	613405	613350	613405	613350

Notes: Table reports the coefficient of interest in each subgroup for Equation 24.

TABLE 12: Pay Shock $\geq 10\%$ by Race

	(1)	(2)	(3)	(4)	(5)	(6)
	WHT		BLK		LTN	
Post $\times$ IMCMktShr$_{z,04}$	0.216***	0.432***	0.236***	0.234***	0.053**	0.357***
	(0.028)	(0.041)	(0.026)	(0.045)	(0.024)	(0.031)
StatexMonthFE	No	Yes	No	Yes	No	Yes
ZipFE	Yes	Yes	Yes	Yes	Yes	Yes
r2$_a$	0.16	0.24	0.15	0.23	0.16	0.24
N	235027	234938	223741	223693	235027	234938

Notes: Table reports the coefficient of interest in each subgroup for Equation 10.