

Bank Aggregator Exit, Nonbank Entry, and Credit Supply in the Mortgage Industry

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Abstract

The pullback of banks from mortgage origination and servicing has been studied extensively, but bank pullback from mortgage aggregation business has not. Aggregators provide significant liquidity to the mortgage market: they bridge the gap between local loan originators and global capital markets by purchasing, pooling, and securitizing mortgages from smaller firms. Banks began leaving the aggregation market in the 2010s, especially for mortgages guaranteed by the Federal Housing Administration. Using plausibly exogenous variation in bank aggregators' pre-exit market shares, we show that their abrupt exits resulted in nonbank aggregators gaining market share as well as some lenders growing enough to disintermediate their aggregators altogether. Disintermediation of aggregators led to an expansion of the credit box to benefit low credit score borrowers, as originators have access to soft information in their underwriting decisions that is not available to aggregators. However, exiting banks retained a role in the market by providing short-term funding to nonbank loan originators and aggregators.

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1 Introduction

Nonbanks have replaced banks as the dominant player in the mortgage intermediation chain, with nonbanks originating 62 percent of mortgages in 2022 and servicing 54 percent.¹ The causes and consequences of this shift have been documented by many authors (Buchak et al., 2018, 2020; Fuster et al., 2019; Gete and Reher, 2018; Kim et al., 2018). However, the literature has largely omitted the pullback of banks from the mortgage *aggregator* market.

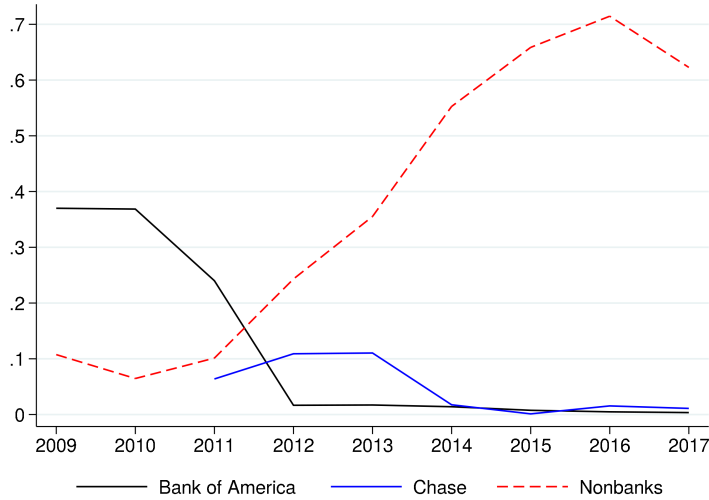
Aggregators purchase, pool, and securitize loans from smaller “correspondent” lenders, thereby connecting these originators to the global capital markets and providing substantial liquidity to the mortgage market. Correspondent lenders often have a comparative advantage in loan origination due to their connections in their local communities, but lack the scale to effectively access longer-term funding from securitization markets. To the best of our knowledge, only Stanton et al. (2014, 2018) have studied the aggregator market, and the insights in those papers are derived primarily from theoretical models and are focused on the years before the Global Financial Crisis (GFC).

We study how the pullback of bank aggregators from the market for loans guaranteed by the Federal Housing Administration (FHA) affected the roles that banks and nonbanks play in the FHA intermediation chain and how this shift affected credit supply and loan performance. The FHA market is an ideal laboratory for our purposes. First, the FHA market is large and important to the macroeconomy. It represented 28% of all owner-occupied home-purchase mortgage originations—totalling \$1.3 trillion—from 2009 to 2017 and a much larger share of mortgages originated to borrowers with lower credit scores, minority borrowers, and first-time homebuyers. Second, aggregators are particularly crucial in this market, providing liquidity for more than a half of FHA originations. FHA loans are almost always funded ultimately by mortgage-backed securities (MBS) guaranteed by Ginnie Mae. In the Ginnie Mae market, firms only have the option of receiving an MBS in exchange for their loans—which is a more valuable option for large firms than small firms—whereas in the Fannie Mae and Freddie Mac markets lenders can receive either cash or MBS. Thus, small lenders can benefit from aggregators’ economies of scale by selling loans to aggregators without having direct access to the Ginnie Mae market.

Our identification strategy rests on the exits of two very large aggregators of FHA mortgages—Bank of America (BOA) and JP Morgan Chase (Chase)—from the market in 2012 and 2014, respectively. As described in Section 2, the exits were motivated in part by the large costs associated with defaulted mortgages,

¹The nonbank share of mortgage originations is from data collected under the Home Mortgage Disclosure Act and is for closed-end first-lien purchase mortgages collateralized by owner-occupied site-built one-to-four family properties. The servicing share is from *Inside Mortgage Finance* and is for the 50 largest servicers.

Figure 1: Share of FHA Mortgages Contributed to Ginnie Mae Pools by Type of Issuer



Note: This figure shows the share of FHA purchase loans contributed to Ginnie Mae guaranteed MBS by different types of financial firms. Source: Authors’ calculations based on HMDA data.

including the U.S. government’s prosecutions under the False Claims Act to recoup losses on defaulted FHA loans. Figure 1 shows that BOA was the issuer for nearly 40% of all FHA home-purchase loans in Ginnie Mae pools in 2010. (We follow Ginnie Mae’s terminology and refer to a lender that contributes loans to a Ginnie Mae pool and receives in exchange an MBS and the obligation to service the loans as an “issuer.”) In 2012, Chase was the issuer for more than 10% of FHA home-purchase loans in Ginnie pools. Both lenders purchased more than 90% of FHA loans that they securitized from correspondent lenders. Over the same period, nonbanks expanded their share of the Ginnie Mae issuer market from less than 10% to more than 70%.

We design a difference-in-differences (DID) estimate around this exit shock, described in Section 3. We exploit two sources of empirical variation: variation across counties where BOA and Chase had large and small market shares before their exits, and variation across retail originators who sold very little, or a great deal, of their originations to BOA and Chase before their exits. Our primary specification resembles a shift-share design, with exit exposure measured by (continuous) pre-exit market shares. With this empirical strategy, we estimate the effects of exit by bank aggregators on the industrial organization (IO) of the FHA mortgage market and credit supply.

Our first set of analyses shows how dramatically the IO of the FHA market changed in response to the exits. Comparing counties with high and low exposure to BOA and Chase, we find that nonbank issuers

replaced 50-60% of BOA and Chase's pre-exit market share. Evaluated at the average pre-exit market shares, BOA and Chase's exits led to a 21 pp and 5 pp increase, respectively, in the share of FHA originations that were contributed to Ginnie Mae pools by nonbanks.

We next examine originators' response to BOA and Chase's exits, since originators that sold loans to BOA or Chase had to find alternative sources of long-term liquidity: either selling to another aggregator or securitizing their own originations directly. We find that after BOA's exit, only 40% of loans that correspondents would have sold to BOA were sold to other bank aggregators. For the remaining 60%, about 20% were instead sold to nonbank aggregators, and 40% were securitized directly by the retail originators. The latter effect is in part driven by correspondent lenders that changed their business model to issue Ginnie MBS themselves, and thus became vertically integrated lenders that originated and securitized loans within the same firm. In contrast, we find that after Chase's exit, of loans that would have been sold to Chase, 30% were sold to other banks, 50% were sold to nonbanks aggregators, and only 20% were securitized directly by the retail originators. We show that Chase's correspondent lenders were smaller than BOA's correspondents, and so becoming a vertically integrated issuer was likely less cost effective for these firms.

BOA and Chase continued to provide liquidity to the mortgage market after exiting the FHA aggregator business by providing short-term "warehouse" credit to nonbanks. Because nonbanks lack internal sources of liquidity to fund originations prior to securitization, they typically obtain warehouse lines from multiple banks. We find that almost all of the increase in nonbank market share that resulted from BOA and Chase's exit was funded, at least in part, through warehouse lines provided by BOA, Chase, and other banks that significantly pulled back from the FHA market. If nonbanks utilized their different sources of warehouse funding in proportion to the size of each credit line, then 1/3 of total nonbank entry in response to Chase and BOA's exits was indirectly funded by the exiting banks.

Our second set of analyses examines how this shift in the IO of the FHA market affected credit supply. We find that the average credit score declined by 10 points after BOA's exit if its county-level share of BOA went from 100% to 0%, and the effects of Chase's exit are also around 10 points. When scaled by the average market share, however, the average credit score on FHA loan originations dropped by 3.5 points, on average, after BOA's exit and by a smaller 0.4 points, on average, after Chase's exit. We show that the drop in the average credit score stemmed from an increase in the share of originations extended to borrowers with very low credit scores.

We consider three explanations for why the exit of bank aggregators might have led to an expansion of credit availability. First, most nonbanks, unlike banks, are monolines that focus only on mortgage-related

products. A nonbank that wants to expand its footprint is largely limited to the mortgage space and so might increase lending to lower-score borrowers, whereas a bank could choose among multiple business lines (Gissler et al., 2020). Second, nonbanks might be less concerned than banks about the reputational and financial risks associated with lending to borrowers who are more likely to default. Nonbanks have fewer business lines—and thus less franchise value—to protect than banks. Nonbanks are also regulated less comprehensively for safety-and-soundness issues than banks. Third, vertically integrated nonbanks that originate and securitize mortgages may be willing to originate mortgages to borrowers with lower credit scores because, unlike aggregators, they have access to the “soft” information collected during the loan origination process and so know that the loans are not being adversely selected by the loan originator.

To provide evidence that helps differentiate among these explanations, we compare the effects of the two banks’ exits on ex-post loan performance, conditional on the “hard” information such as credit scores that both originators and aggregators have access to. If the expansion of credit supply is due to nonbanks having a greater tolerance for risk than banks, we might expect loan performance to deteriorate even after controlling for these factors. On the other hand, if the expansion is due to vertically integrated originators being able to internalize this soft information in their underwriting, we might expect loan performance to stay constant or even improve.

We find that sixty-day delinquency rates (controlling for hard information) did not increase after the exits of BOA and Chase, which suggests that the increase in lending to borrowers with lower credit scores did not stem primarily from nonbanks having a higher taste for risk than banks. Indeed, a different measure—the share of loans that completed foreclosure within two years of origination—fell by 0.14 pp, conditional on hard information after BOA’s exit. This effect amounts to a 75% reduction relative to the average FHA two-year foreclosure rate before BOA’s exit. In contrast, Chase’s exit did not result in a statistically significant decrease in completed foreclosures within the two year window. The discrepancy between the BOA and Chase results is consistent with the fact that BOA’s exit led to a more substantial increase in the market share of integrated nonbank issuers than did Chase’s exit, and suggests that some of the expansion in credit is due to a reduction in information frictions resulting from the rise in integrated nonbank issuers.

Our findings add to three main literatures. First, as we noted earlier, although several studies have examined the pullback of banks from the originator and servicer markets after the GFC, we believe we are the first to consider the consequences of the pullback of banks from the aggregator market.

Second, our findings about the shifts in credit supply that were associated with the pullback of banks from the aggregator market complements other studies on the effects of mortgage-market intermediaries on

the cost and availability of credit. Using a calibrated model, Jiang (2023) illustrates how banks can use their upstream market power in warehouse lending to soften downstream competition with nonbanks in mortgage markets, with the result of higher mortgage costs for consumers. Bosshardt et al. (2023) find that nonbank originators charge higher interest rates than bank originators, which they interpret as compensation for nonbanks originating riskier loans. Buchak et al. (2018) finds that “fintech” nonbank originators charge higher rates than bank originators, which they attribute to borrowers being willing to pay a premium for fintech convenience. Our approach differs from these studies: we focus on aggregators in the FHA market rather than originators of loans eligible for sale to the government-sponsored enterprises (GSEs) Fannie Mae and Freddie Mac, and we provide causal empirical estimates using a quasi-experimental research design.

More broadly, our paper relates to other studies of intermediation frictions in the mortgage market, such as Fuster et al. (2021), Fuster et al. (2022), and Sharpe and Sherlund (2016), who demonstrate that originators raise mortgage interest rates and prioritize applications that are easier to process when borrower demand swamps originators’ ability to meet it. Aiello (2022), Cherry et al. (2022), and Kim et al. (2022) show that nonbank servicers’ liquidity and capital constraints affect the quality of mortgage servicing, and Cherry et al. (2021) and Degerli and Wang (2022) also suggest the borrowers’ outcomes can differ with bank and nonbank servicers. Buchak et al. (2020) highlight that banks’ option to fund mortgages either on or off balance sheet means that regulatory changes may affect the credit provision of bank originators differently from nonbanks.

Third, our result that the credit box is larger under an integrated originator model than a correspondent lender-aggregator model suggests that aggregators recognize the potential for adverse selection in the loans sold to them by correspondent lenders. Many studies have considered a similar adverse selection issue between loan originators and securitization sponsors (Jiang et al., 2014, Keys et al., 2010, Keys et al., 2012, Bubb and Kaufman, 2014, Agarwal et al., 2012), and the Dodd-Frank Act mandated risk retention in securitization in an attempt to better align the incentives of the loan originator and the securitization sponsor. However very little research has focused on similar asymmetric information dynamics in the context of loan aggregation.

2 Banks, Nonbanks, and the False Claims Act

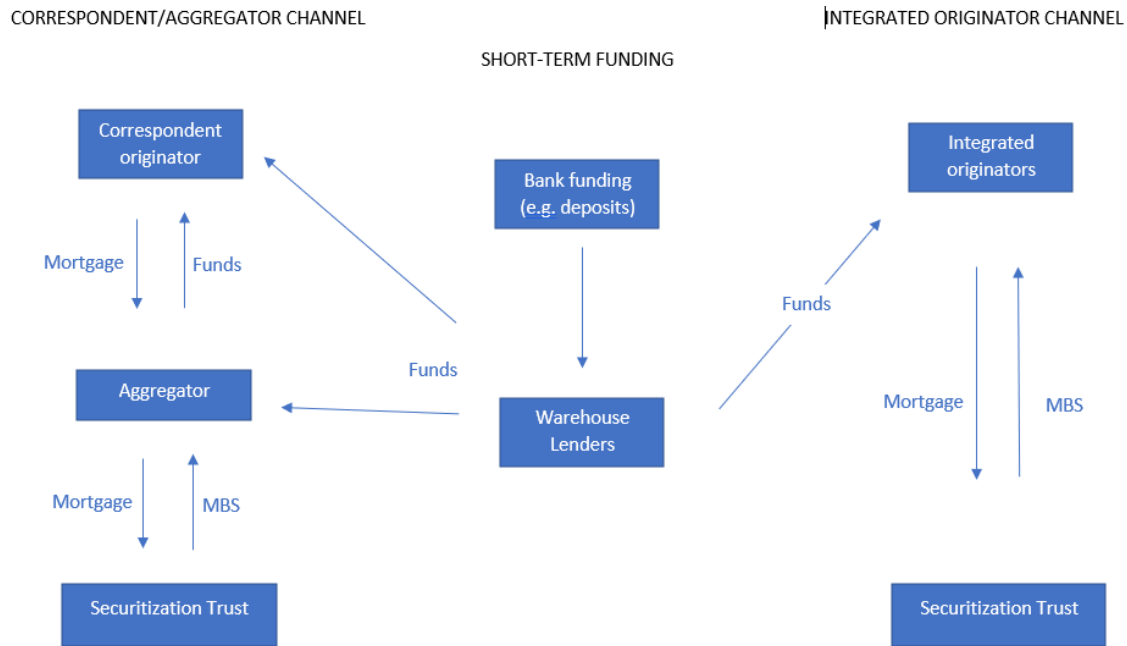
To fix ideas, we describe the different roles that banks and nonbanks may play in the origination, funding, and servicing of a mortgage, also shown in Figure 2.

- **Loan Origination.** A borrower works with a correspondent originator (top box, left side) or inte-

grated originator (top box, right side) to obtain a mortgage. Originators can be banks or nonbanks. Correspondent originators obtain long-term funding for the mortgage by selling it to an aggregator (middle box, left side), while integrated originators obtain long-term funding by securitizing the mortgage directly (right side of the flow chart). Bank originators also have the option to obtain long-term funding by funding the mortgage on balance sheet (not shown).

- **Short-term Funding for Mortgages.** Bank correspondent originators, integrated originators, or aggregators generally fund their originations with deposits provided by savers (not shown). Nonbank correspondent originators, integrated originators, or aggregators fund their originations with warehouse lines of credit provided by banks (middle of flow chart).
- **Loan Aggregation.** Large financial institutions—both bank and nonbank—purchase mortgages from small originators that lack the scale to securitize mortgages in a cost-effective manner (middle box, left side).
- **Loan Securitization.** When a bank or nonbank originator or aggregator accumulates sufficient mortgages, it sells the loans to a securitization trust (bottom box) and receives in exchange MBS guaranteed by Ginnie Mae (for loans insured or guaranteed by the Federal Housing Administration, FHA, or Department of Veterans Affairs, VA) or Fannie Mae or Freddie Mac (for “conventional” loans that meet these agencies’ guidelines), or it receives “private label” MBS without a government credit guarantee (for loans that are too large or otherwise do not meet the standards of the agencies).
- **Mortgage Servicing.** The process of selling a loan to a securitization trust bifurcates the loan from the obligation to service it. The firm that sells the loan generally retains the servicing obligation and either services the loan itself or contracts out servicing operations to a subservicer.
- **Escrow Provision.** Borrowers’ monthly contributions toward their insurance and tax obligations must be held in escrow accounts at FDIC-insured depository institutions until disbursement to the appropriate entities (not shown). In the interim, the balances in these accounts contribute to banks’ deposit base.
- **Cross-selling opportunities.** Banks use the information that they glean from originating and servicing mortgages to market other products to these borrowers (not shown). Nonbanks can only use this information to encourage borrowers to refinance their mortgages.

Figure 2: Nonbank Financial Intermediation in the FHA Market



In the immediate aftermath of the Global Financial Crisis, banks dominated all these roles. In 2010, they originated 73% of mortgages, were the aggregator for 94% of loans sold by correspondent lenders to aggregators, and were the issuers for 93% of mortgages funded by Ginnie Mae MBS and the seller/servicers for 89% of mortgages sold to Fannie Mae and Freddie Mac. In addition, they provided warehouse credit and escrow services to nonbanks and held some of their own originations on balance sheet.²

This picture changed rapidly over the next decade. In 2017, banks originated 48% of mortgages, were the aggregator for 68% of loans sold by correspondents, and were the issuers for 33% of mortgages funded by Ginnie Mae MBS and the seller/servicers for 50% of mortgages sold to Fannie Mae/Freddie Mac. Banks continued, however, to provide warehouse credit and escrow services to banks, and hold some originations on balance sheet.

Banks pulled back from the mortgage market for multiple reasons. Some reasons apply to all types of mortgages. Regulatory changes, particularly the more-stringent treatment of MSR under the U.S. implementation of the Basel III capital accord, made mortgage lending less profitable for banks (Buchak et al., 2018, Kim et al., 2018). Nonbanks also appeared to be quicker to take advantage of fintech innovations in mortgage origination (Buchak et al., 2018, Fuster et al., 2019). The secular decline in interest rates eroded banks' funding cost advantage relative to nonbanks (Sarto and Wang, 2023).

²Origination and aggregator shares are from HMDA. Issuer and seller/servicer shares are from eMBS.

Other reasons are more specific to mortgages with a higher probability of default. The cost, uncertainty, and liability associated with originating and servicing these loans rose sharply as a result of the GFC. These costs were particularly elevated for mortgages insured by the FHA, in part because these mortgages are generally extended to lower credit score borrowers with an inherently higher probability of default, and in part because lenders faced liability under the False Claims Act (FCA). Although both banks and nonbanks were sued by the Department of Justice under the FCA, the ramifications may have been more severe for banks because they faced more reputational risk, had other business lines to protect, and had deeper pockets.

The FCA liability stemmed from the fact that when originators or aggregators submit loans for FHA insurance, they perform multiple quality assurance functions on behalf of the FHA and certify that the loans meet program standards. Aggregators are liable for loans that they submit for insurance, even if the underlying fraud was primarily committed by the loan originator. Starting in 2011, the Department of Justice filed lawsuits under the FCA alleging that certain lenders had certified loans that did not meet the guidelines and thereby defrauded the government. The prosecutions came as somewhat of a surprise to lenders since before the GFC, FCA prosecutions were mostly focused on the defense and health care industries. Legislative changes in 2009 and 2010 made the FCA more effective in pursuing fraud claims against financial institutions.³

The financial penalties allowed under the FCA include triple damages for the government's loss from the fraud as well as civil penalties. As a result, the FCA prosecutions were costly: 16 lenders paid around \$5.5 billion in damages from 2012-17,⁴ and Jamie Dimon, Chase CEO, noted in a 2016 shareholder letter that "FCA settlements wiped out a decade of FHA profitability."⁵ They were also reputationally costly: the Department of Justice required most lenders to plead guilty as part of the settlements. Inasmuch as the prosecutions were seen as unfair and arbitrary, they may also have increased the perceived uncertainty associated with FHA lending. The Mortgage Bankers Association wrote in a 2020 letter that "the Federal Housing Administration (FHA) and Department of Justice over pursued lenders for minor errors on defaulted FHA insured loans that had no causal relationship to the reason for default."

The FCA lawsuits were likely a factor in BOA's departure from correspondent lending in 2012 and were explicitly a factor in Chase's exit from the FHA market in 2014. BOA inherited a large aggregator business as part of its 2008 acquisition of Countrywide Financial and in 2010 was the largest aggregator of FHA

³The Fraud Enforcement and Recovery Act of 2009 expanded the FCA's liability provisions. The Dodd-Frank Reform Act of 2010 increased the amount of financial compensation that private whistleblowers could receive if an FCA lawsuit led to a financial recovery by the government.

⁴Authors' calculation from Department of Justice press releases.

⁵<https://reports.jpmorganchase.com/investor-relations/2016/ar-ceo-letters.htm>

mortgages, accounting for 48% of FHA mortgages purchases by aggregating institutions.⁶ On October 4, 2011, BOA announced that it would shut down its aggregation activities at the end of the year as part of its effort to right-size its balance sheet and rebuild capital after it suffered enormous losses from the Countrywide acquisition. At the same time, BOA was negotiating an FCA settlement with the Department of Justice for legacy FHA loans originated by Countrywide. In early February 2012, HUD announced that BOA would pay \$500 million to settle the first of what turned out to be two major FCA settlements.⁷

Chase exited the FHA market two years later, after it settled an FCA lawsuit with the Department of Justice on February 5, 2014 for \$614 million. In 2012, Chase was the second largest FHA aggregator, accounting for 14% of FHA mortgages purchased by aggregating institutions. Chase’s CEO, Jamie Dimon, announced the bank’s pullback from the FHA market in a July 2014 conference call with investors: “*Until they come up with a safe harbor or something, we are going to be very, very cautious in that line of business... The real question for me is should we be in the FHA business at all.*”

3 Identification and Estimation

Our identification strategy leverages county-level and lender-level variation in the impact of BOA and Chase’s exits. Figure 3(a) plots the cross-county variation in pre-exit markets shares for BOA and Chase in 2010 and 2012, respectively. Both BOA and Chase had large market shares before their exits: on average, BOA’s share was 33% and Chase’s was 12%. However, their market shares varied significantly across counties, ranging from zero to 70% pre-exit for BOA and zero to 30% for Chase.

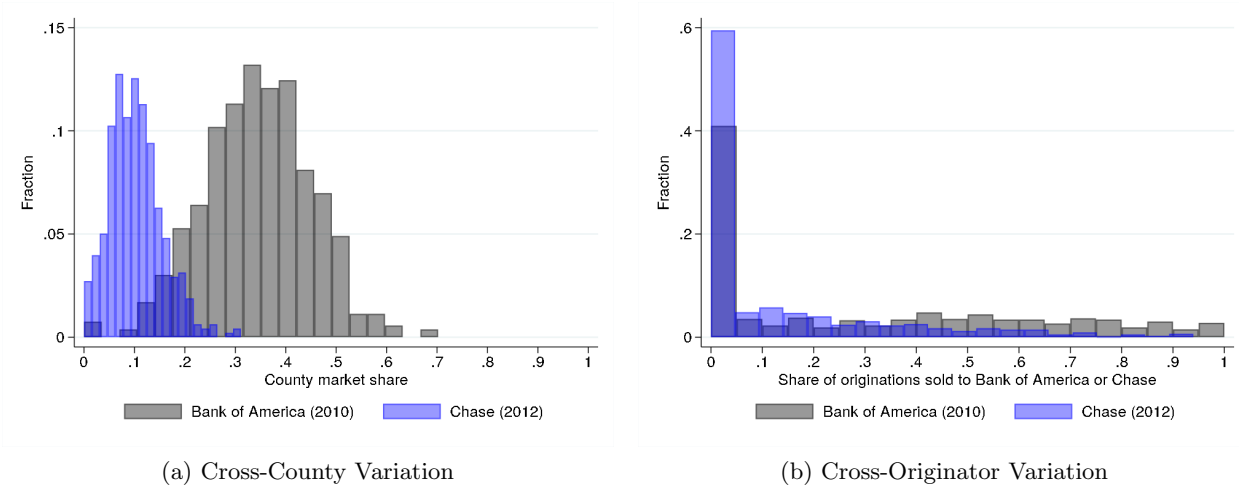
There was also significant variation across retail originators in the shares of their originations that they sold to BOA or Chase, suggesting that some retail originators were more affected by BOA or Chase’s exit. Figure 3(b) plots the cross-originator variation in pre-exit shares of originations sold to BOA and Chase in 2010 and 2012, respectively. There is a large mass close to zero: about 40% (60%) of retail originators did not sell any loans to BOA in 2010 (Chase in 2012). Among lenders with positive shares, however, there is large variation, and some sold all or almost all their originations to BOA or Chase.

This type of variation suggests a difference-in-differences (DID) identification strategy to estimate the effects of bank aggregator exit. As the bank aggregators pulled back nationally, some counties experienced the abrupt exit of a dominant aggregator, while other counties experienced insignificant changes in market structure. From the retail originators’ perspectives, some retail originators lost their primary purchaser,

⁶Authors’ calculation from data collected under the Home Mortgage Disclosure Act.

⁷<https://archives.hud.gov/news/2012/pr12-026.cfm>

Figure 3: Variation in Exposure to BOA and Chase's Exit



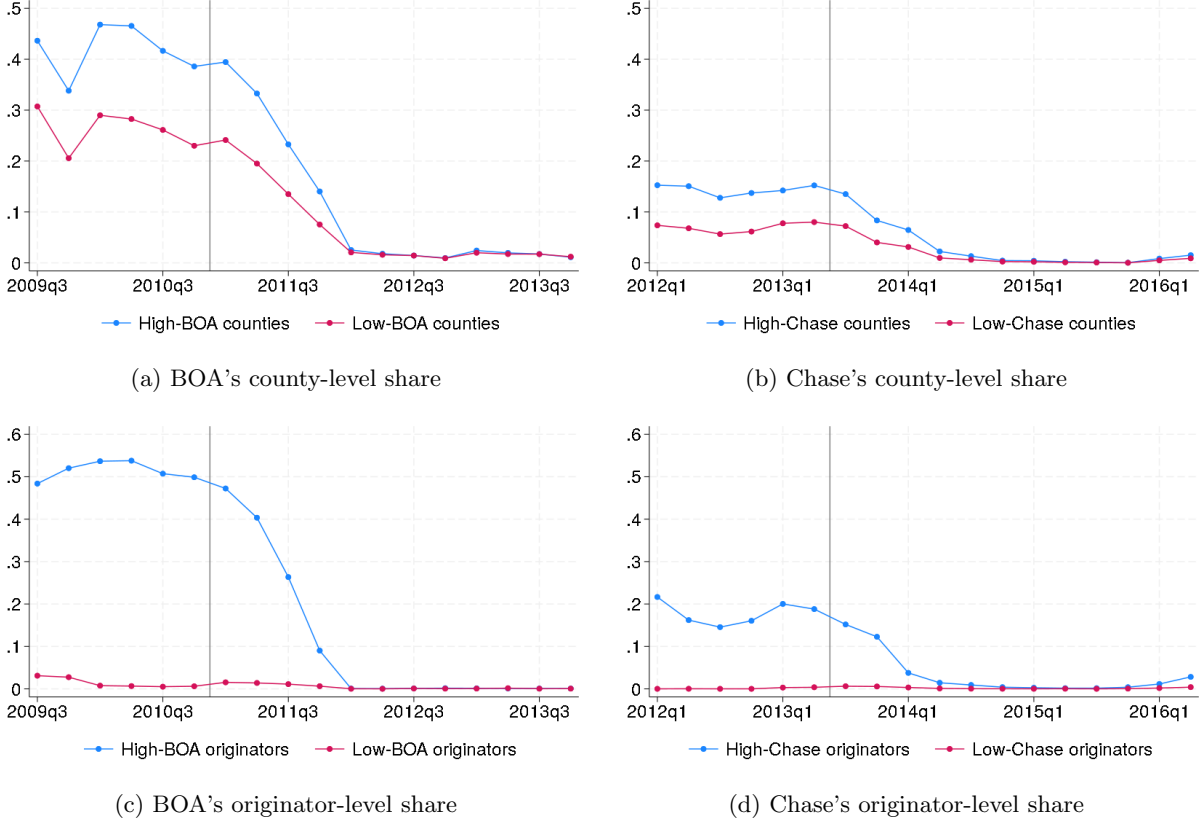
Note: Histograms for exposure to BOA and Chase at the county and the originator level. Panel (a) presents the distributions of county market shares of BOA in 2010 and Chase in 2012 for FHA home-purchase loans. We excluded small counties with fewer than 250 originations in 2010 for BOA share and in 2012 for Chase share. Panel (b) presents the distributions of shares of BOA in 2010 and Chase in 2012 as purchasers of FHA purchase originations across retail originators. We exclude small retail originators with fewer than 100 originations in 2010 for the BOA share and in 2012 for the Chase share. Source: Authors' calculations based on HMDA data.

while the aggregator counterparty relationships of other lenders were substantively unaltered. Comparing otherwise similar markets or retail originators, the effects of exit are identified off differences in outcomes over time across counties or originators with high and low pre-exit BOA or Chase market shares.

Indeed, figures 4(a) and 4(b) show that BOA's and Chase's county-level market shares as Ginnie Mae issuers evolved largely in a parallel way in counties with high and low exposure to BOA and Chase before their exits. Then their shares converged toward zero over four to five quarters in both groups of counties once BOA and Chase started their exit in 2011:Q1 and 2013:Q3, respectively. figures 4(c) and 4(d) show that shares of new originations that originators sold to BOA and Chase exhibit a similar pattern.

We implement the DID strategy in a regression framework using a rich set of controls, estimating separate regressions for each exit event. Specifications depend on whether an outcome y is measured at the county (c) \times quarter (q) level or the originator (j) \times year level. Formally,

Figure 4: Evolution of BOA's share and Chase's share before and after their exits



Note: Panels (a) and (b) display unconditional averages of BOA and Chase's market shares as Ginnie Mae issuers at the county level. High-BOA and high-Chase counties are counties with BOA shares in 2010 and Chase shares in 2012 above the median (36% for BOA and 10% for Chase). Panels (c) and (d) display unconditional averages of shares of loans sold to BOA and Chase at the originator level. High-BOA and high-Chase originators are originators with shares of their originations sold to BOA in 2010 and Chase in 2012 above the median (10% for BOA and 0.2% for Chase). Source: Authors' calculations based on HMDA data.

$$y_{ict} = \sum_{\tau=t^*-6}^{t^*+11} \alpha_{\tau} S_c 1[\tau = t] + X_{ct} \gamma + \xi_c + \xi_{g(c)t} + \epsilon_{ict} \quad (1)$$

$$y_{ijt} = \sum_{\tau=t^*-6}^{t^*+11} \beta_{\tau} H_j 1[\tau = t] + X_{jt} \zeta + \delta_j + \delta_{g(j)t} + \omega_{ijt} \quad (2)$$

The exit quarter (t^*) is 2011:q1 for BOA and 2013:q3 for Chase. For each exit, our sample includes 18 quarters, spanning from 6 quarters prior to the exit to 12 quarters after the exit: 2009:q3–2013:q4 for BOA's exit and 2012:q1–2016:q2 for Chase's exit. These event-study style regressions are flexible enough for us to

see how market outcomes evolved over time. This flexibility is important especially in our setting because the gradual exits of both BOA and Chase, as shown in figure 4, likely affected relevant market outcomes gradually.

The treatment exposures are S_c and H_j for the county- and originator-level regression, respectively. The corresponding DID estimates are α_t and β_t . For the county-level regression (equation (1)), S_c is BOA or Chase’s market share in county c in 2010 or 2012, for the respective exit event. Similarly, for the originator-level regression ((equation (2)), H_j is the share of loans originated by retail originator j that were sold to BOA in 2010 or to Chase in 2012. The treatment exposure S_c and H_j are measured as of two years prior to the exit year because both BOA and Chase began their exit processes in year $t^* - 1$ and completed their exits in year t^* . In addition to the above event study regressions, we also estimate specifications that pool α_t and β_t in pre-periods ($t < t^*$) and post-periods ($t \geq t^*$), yielding a single DID estimate for the outcome.

Each regression includes a rich set of controls X , fixed effects for county-markets ξ_m or originators δ_j , and fixed effects $\xi_{g(c)t}$ and $\delta_{g(j)t}$ that allow arbitrary trends in the outcome across treatment/control groups defined by $g()$. These controls address many potential threat to the identification of the effects of BOA or Chase exits, as discussed in detail in the following section.

We also sometimes estimate a originator-level regression, which is similar to equation (2):

$$y_{jt} = \sum_{\tau=t^*-6}^{t^*+11} \beta_\tau H_j 1[\tau = t] + X_{jt}\zeta + \delta_j + \delta_{g(j)t} + \zeta_{jt} \quad (3)$$

The only difference between equations (2) and (3) is that the unit of observation is each loan for the former, while that is each lender for the latter.

3.1 Threats to Identification

As noted in Section 2, the mortgage market experienced significant changes during our sample period besides the FCA prosecutions and BOA and Chase exits. These events could threaten identification if their impacts on borrower demand or the relative appetites of banks and nonbanks for supplying FHA loans were correlated with variation in exposure to BOA or Chase exit across locations or lenders. If this were so, we might be inappropriately attributing mortgage market outcomes to BOA and Chase’s exit when other factors were the cause. The change that presents the most direct challenge to our identification strategy is the decrease in the maximum GSE loan limit in October 2011 and in the maximum FHA loan limit on January 1, 2014,

which coincide with the BOA and Chase exits.⁸ Because the loan limit varies by county, this change poses a threat to our identification strategy if these loan limits changed in counties where BOA or Chase had large market shares.

Our control group specification addresses this by focusing on variation between counties that experienced similar changes in FHA and GSE loan limits during the period. We estimate each county’s percent-change in FHA and GSE conforming loan limits, and group observations together into 10 percent-change bins. We fully interact these bins across FHA and GSE policies (14 combinations empirically), and include group-year fixed effects $\xi_{g(c)t}$ in the regression to allow for arbitrary trends in the outcome variable for counties that experienced similar changes in conforming loan limits.

Other mortgage market developments during this period affected the relative appetite of banks and nonbanks for participating in the mortgage market. For example, in July 2013, the Federal Reserve and other U.S. banking regulators finalized a rule to implement Basel III capital rules in the United States. The phase-in period for large banking organizations began in January 2014. Gete and Reher (2018) find that the Liquidity Coverage Ratio, which became effective in 2013, also facilitated an increase in nonbank market share. Several mortgage-market rules made by the Consumer Financial Protection, such as the Ability to Repay rule, also took effect in January 2014. Throughout this period, the GSEs pursued lenders for loan putbacks. However, since these changes applied across the country, we have no reason to think their effects are correlated with BOA or Chase’s share of a particular market.

Treatment/Control Balance Our control group specification might throw out useful variation between otherwise similar counties near loan limit bin thresholds. As well, counties within the FHA and GSE loan limit groups might be dissimilar in other observable ways. To assess balance between treatment and control groups, Appendix Table A.1 compares county-level summary statistics for above and below median exit exposure markets. We find that our control group specification exhibits overall exceptional balance.⁹

⁸The maximum loan size eligible for FHA insurance or for sale to the GSEs varies by MSA and county. In 2008, the Economic Stimulus Act increased the maximum limit for FHA and GSE loans dramatically from \$362,790 to \$729,750. Various pieces of legislation kept it at that level until October 2011, when the GSE limit fell to \$625,000. The FHA loan limit stayed at the higher level until January 1, 2014, when it also fell to \$625,000. The unusual situation of the FHA loan limit exceeding the GSE loan limit meant that FHA loans were attractive for a couple years to some borrowers who would typically have chosen other products.

⁹As judged by differences in pre-exit conditional means, above/median exposure, in: mortgage interest rates, credit scores, loan-to-value ratios, the fraction of all mortgage originations that were FHA loans, the fraction of FHA loans purchased by aggregators, the pre-exit market share of nonbank aggregators, pre-GFC house price growth, and (by construction) FHA and GSE conforming loan limits. Only total FHA loan volume and nonbanks’ retail origination market share appear to be economically different between above/below median exit exposure groups.

3.2 Data and Sample Selection

Our empirical estimates are based on loan-level data collected under the Home Mortgage Disclosure Act (HMDA) for 2009-2017 and by the FHA from 2009-2015, as well as lender-level information from the Nationwide Multistate Licensing System & Registry (NMLS) maintained by the Conference of State Bank Supervisors (CSBS) and shared with the Federal Reserve under the Secure and Fair Enforcement for Mortgage Licensing Act (SAFE) of 2008. We describe these data in more detail next.

HMDA. Financial institutions that meet certain size thresholds and have one or more offices in metropolitan statistical areas are required under the Home Mortgage Disclosure Act (HMDA) to submit information on the mortgage applications that they receive and on the mortgages that they purchase from other firms. The data covered an estimated 90 to 95 percent of FHA loan originations in 2009.¹⁰ For our purposes, the key data fields are the loan characteristics, the name of the loan originator or purchaser, the census tract where the property collateralizing the loan is located, and indicators for whether the loan originator sold the loan to an aggregator or securitized the loan directly.

We limit our HMDA sample to originations or purchases of FHA-insured home-purchase loans. We focus solely on home purchase originations because of the possible confounding effects of the streamlined refinancing and modification programs in place during this period to manage the backlog of delinquent mortgages.

To infer to which institution an originator sold its loan, we link loan origination and purchase records. We match these records based on the loan amount, borrower income, and census tract, and impose the restriction that the loan purchase must occur within a two-month period after the loan origination. We are able to impose this constraint by using the confidential version of the HMDA data, which includes the origination and purchase date. We are able to match 72 percent of loan purchases to a corresponding origination in the data.

We use these HMDA data to calculate two key measures. First, we calculate the share of FHA loans in each county that were originated or purchased by BOA in 2010 or by Chase in 2012. We calculate these measures only for counties with at least 250 FHA purchase originations in that year since shares measured over small numbers of observations may be imprecise. The resulting dataset includes measures for 724 counties in the year before BOA's exit and 701 counties for the year before Chase's exit. Second, we calculate for each lender what share of its FHA-insured originations were sold to BOA in 2010 or to Chase in 2012. We calculate these measures only for lenders who originated 100 or more FHA loans in that year,

¹⁰https://www.huduser.gov/portal/periodicals/ushmc/spring11/USHMC_1q11.pdf

with a resulting dataset of xxx lenders in 2010 and yyy lenders in 2012.

FHA Administrative Data. Since the HMDA data for the years we examine do not include the interest rate on the loan, the credit score of the borrower, or the performance of the loan over time, we gauge loan-level outcomes with data on FHA loans obtained from the FHA under a memorandum of understanding with the Federal Reserve Board. Most of these variables are also available in the data on loans in Ginnie Mae pools that are publicly available on the Ginnie Mae website and in the eMBS data. The advantage of the FHA administrative data is that it includes the county for the property that collateralizes the loan, which allows us to match the loan to the market share of lenders in the relevant county.

NMLS. We obtain data on the warehouse funding relationships between banks and nonbank firms from the NMLS maintained by the CSBS. Under the SAFE Act, nonbanks that hold a state license or state registration through the NMLS are required to file a Mortgage Call Report (MCR) with state regulators that includes information on the nonbank's balance sheet and external financing facilities. The SAFE Act authorizes the sharing of these data with State and Federal regulatory officials with mortgage or financial services industry-oversight authority, such as the Federal Reserve. The MCR data start in 2012 and are available at a quarterly frequency for Ginnie Mae issuers. Most crucially for our purposes, nonbanks report information about their credit lines such as the committed and utilized amounts of each credit line and the name of the lender that extended each credit line.

4 Effects on the Industrial Organization of the Mortgage Market

This section investigates how BOA and Chase's exits affected the industrial organization of FHA mortgage lending, focusing on changes in roles filled by banks and nonbanks along the intermediation chain. We measure the start of each bank's exit as the quarter in which we observe the bank's market share start to decline in the data. These quarters – 2010:Q4 and 2013:q2 – pre-date the announced exit dates of December 31, 2011 and July 2014 by about a year. We anticipate that any effects of the exits on the market would be more gradual during this transition period when the exit was not formally announced.

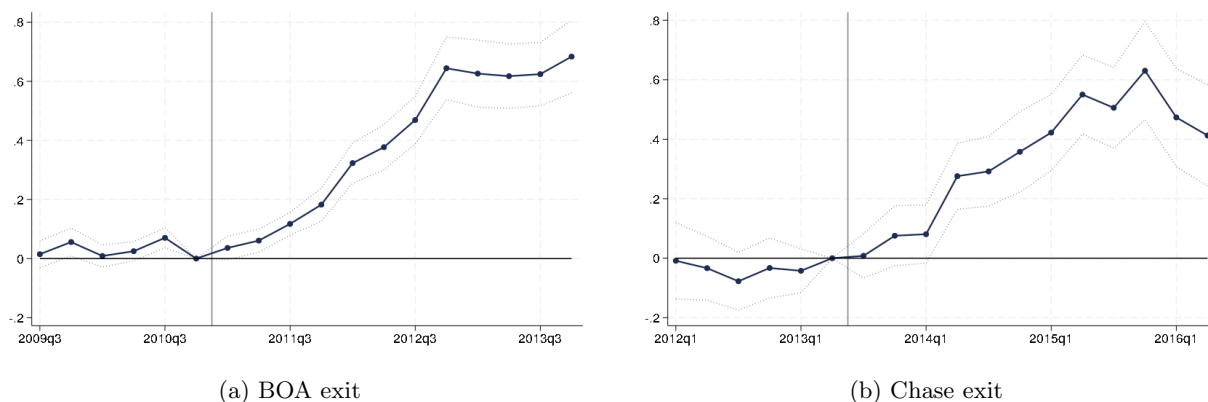
4.1 Nonbanks Expand their Presence as Ginnie Mae Issuers

We first examine whether nonbanks increased their market share as Ginnie Mae issuers for FHA home-purchase loans after the exit of BOA and Chase. We use variation across counties in BOA and Chase's

market share as Ginnie Mae issuers (equation (1)) to estimate the effects. Our figures in this section graph the coefficients α_t or β_t by quarter, depending on whether we are using county-level variation S_c or lender-level variation H_j to estimate the effects. The coefficients can be interpreted as the change in the outcome variable if a county or lender's share of loans sold to BOA or Chase went from 100% to 0%.

Our estimates indicate that the bank/nonbank replacement rate eventually reached around 50%-60% for each exit event after the transition period following the beginning of the exits. As shown in figure 5(a), every one percentage point of BOA's pre-exit market share in FHA home-purchase loans was replaced by nearly 0.6 pp of nonbank market share in the same county in 2013, on average. At the mean pre-exit share (35%), the estimate implies that BOA's exit contributed to a 21 pp increase in nonbanks' share of placing FHA loans in Ginnie Mae pools in 2013.

Figure 5: Effects of Bank Exit on Market Share of Nonbanks



Note: Estimates and 95% confidence intervals from equation (1) for the effects of a 100% decline in exiting-bank market share on whether a loan is securitized by a nonbank Ginnie Mae issuer. Standard errors clustered at the county level. Source: Authors' calculations based on HMDA data.

We find largely similar effects of Chase's exit on nonbank market shares (figure 5(b)). Every 1 percentage point of decline in Chase's market share was replaced by roughly 0.5 pp of nonbank market share in the same county in 2015 and 2016. Chase's pre-exit market share in the FHA market in 2012 was 10% on average, meaning that Chase's exit from the FHA market led to a 5 pp increase in nonbank shares as Ginnie Mae issuers. To summarize, both exits led to a significant increase in the share of FHA mortgages that nonbank issuers placed in Ginnie Mae MBS.

4.2 Responses by Retail Originators to Bank Aggregators' Exit

We now turn to how retail originators responded to BOA and Chase's exits. Both BOA and Chase relied heavily on purchases from unaffiliated correspondent lenders to source FHA loans to deliver into Ginnie Mae MBS. Thus, their exits likely had substantial effects on the retail originators that typically sold large shares of their originations to BOA or Chase.

Originators that previously sold loans to either BOA or Chase could respond to their exits in multiple ways. First, they could sell loans to another aggregator, including a nonbank aggregator such as PennyMac Loan Services. Second, they could securitize their own originations directly into Ginnie Mae MBS. Some originators might need to become Ginnie Mae issuers in order to take advantage of this option. We examine originators' responses using the originator-level variation in pre-exit shares (equation (2)) described in Section 3.

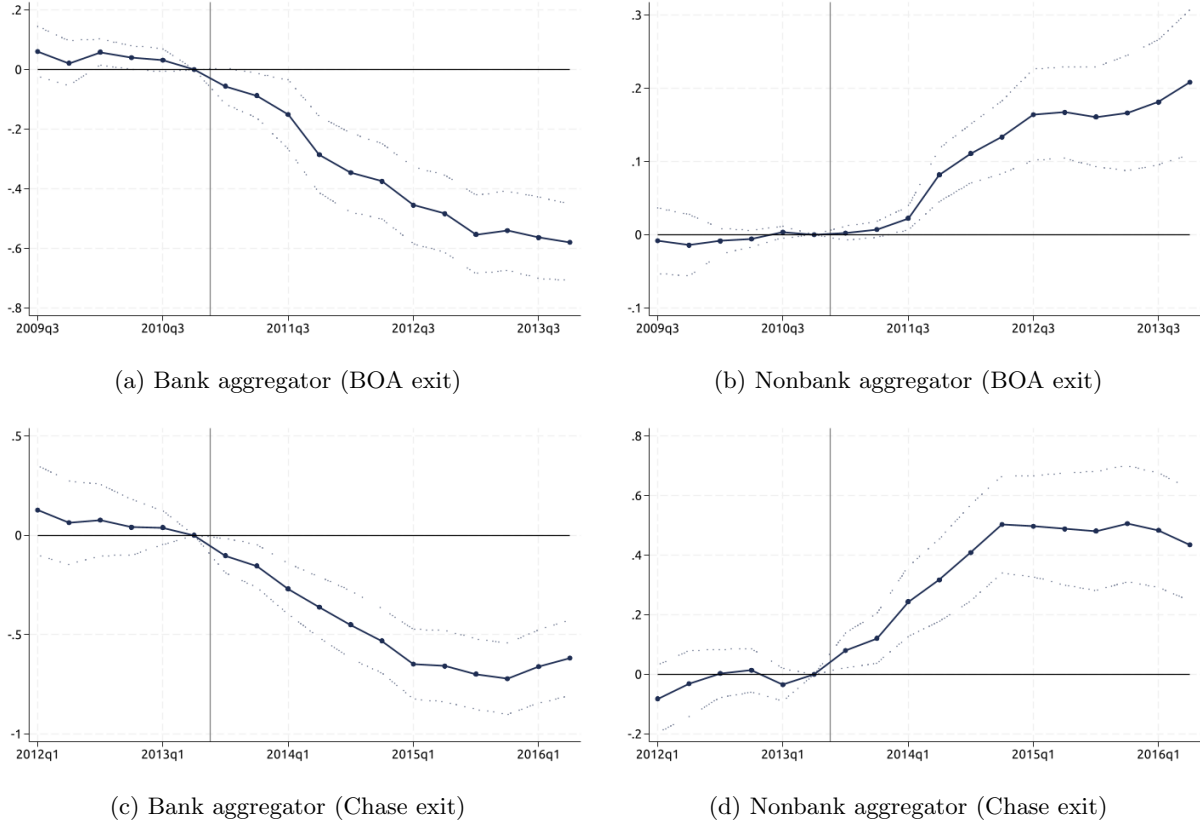
4.2.1 Response 1: Sell to a Bank or Nonbank Aggregator

We begin showing the change in originator-aggregator relationships after the BOA and Chase exits by estimating equation (2) with two different dummy variables as outcome measures: a variable that equals one if the loan is sold to a bank aggregator and a variable that equals one if the loan is sold to a nonbank aggregator. The key independent variable is the share of the originator's loans that were sold to BOA or Chase before the bank's exit (H_j).

Figure 6(a) shows that about 60% of originations that previously were sold to BOA were not sold to another bank aggregator in 2013. This decline is mainly driven by the exit of BOA, which is a bank aggregator. The fact that the estimate did not reach -100% implies that about 40% of loans that were previously sold to BOA were sold to another bank aggregator in 2013. Figure 6(b) shows that about 20% of loans that would have been sold to BOA were sold to nonbank aggregators in 2013, replacing about a third of the decline in the bank aggregator share. This imperfect replacement by nonbank aggregators suggests that some originators responded to BOA's exit in ways other than just switching to a different aggregator.

Figures 6(c) and 6(d) show qualitatively similar responses by originators to Chase's exit. About 70% of loans that would have been sold to Chase were not sold to another bank aggregator in 2016 (figure 6(c)), and about 50% of such loans were sold to nonbank aggregators in 2016 (figure 6(d)). Comparing these estimates indicates that nonbank aggregators replaced bank aggregators to a larger degree – 70% of the decline – after Chase's exit than BOA's.

Figure 6: Effects of Bank Exit on Whether a Loan Is Sold to Bank or NonBank Aggregators



Note: Estimates and 95% confidence intervals from equation (2) for the effects of a 100% decline in exiting-bank market share on whether a loan is sold to a bank aggregator (panels (a) and (c)) and whether a loan is sold to a nonbank aggregator (panels (b) and (d)). Standard errors clustered at the county level. Source: Authors' calculations based on HMDA data.

4.2.2 Response 2: Securitize own originations into Ginnie Mae MBS

Originators that sold loans to Chase and BOA may also have responded to the banks' exits by securitizing their originations directly into Ginnie Mae MBS instead of selling them to aggregators. We re-estimate equation (2), now using as the outcome variable a dummy variable that is equal to one if a loan is securitized by the originator.

We find that originators securitized more loans themselves in response to the exits, and the effects are larger after BOA's exit. Figures 7(a) and 7(b) show that about 40% of loans that would have been sold to BOA were securitized by originators in 2013 and 20% for Chase in 2016. These results are consistent with our findings that nonbank aggregators only partially replaced bank aggregators and that the nonbank aggregator share increased more after Chase's exit.

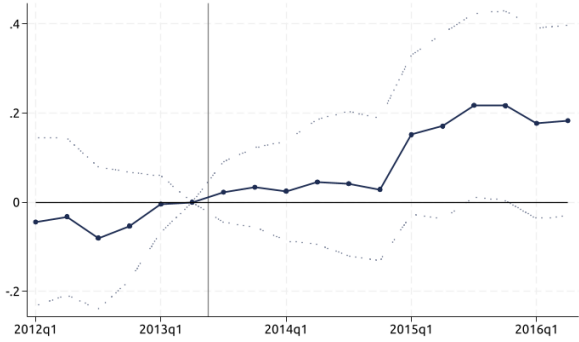
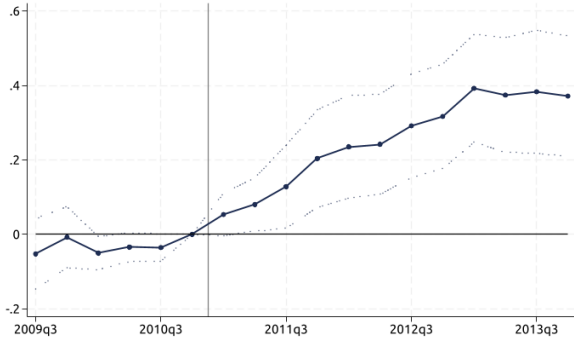
The finding that BOA’s exit led to a larger increase in the share of loans securitized by originators is in part because more originators chose to become Ginnie Mae issuers after BOA’s exit. As mentioned earlier, only originators that are Ginnie Mae issuers, which we refer to as “integrated” originators, can issue MBS guaranteed by Ginnie Mae. We estimate a lender-level DID regression (equation (3)), where the outcome variable is a dummy variable that equals to one if a retail originator is a Ginnie Mae issuer in a particular quarter.

Figures 7(c) and 7(d) show that some originators exposed to BOA’s exit indeed became Ginnie Mae issuers after the exit, whereas Chase’s exit had positive but statistically insignificant effects. Moreover, because BOA’s pre-exit share was much larger than Chase’s, the average effects are also much larger with BOA’s exit (6 pp in 2013) than with Chase’s exit (less than 1 pp). The 6 pp increase resulting from BOA’s exit is large in magnitude, given that only 15% of retail originators were Ginnie Mae issuers prior to BOA’s exit. Together with our findings in Figure 6, this result suggests that BOA’s exit led to a greater share of loans directly securitized by integrated originators. In other words, BOA’s exit resulted in some retail originators switching their business models from being correspondent lenders that sold their entire production to aggregators to becoming Ginnie Mae issuers themselves.

Why didn’t Chase’s exit have similar effects? As shown in Figure 8, the originators that relied heavily on Chase were much smaller in scale than those that sold similar shares of loans to BOA. Scale matters for the decision to become a Ginnie Mae issuer for two reasons. First, Ginnie Mae requires its issuers to meet regulatory thresholds such as the minimum net worth, which prevents very small lenders from becoming a Ginnie Mae issuer. Second, Ginnie Mae issuers only have the option of receiving an MBS in exchange for their loans after securitization. Because small MBS pools often trade at a significant discount relative to large MBS pools (Atanasov et al., 2017), small originators likely receive better pricing on their loans by selling to aggregators than by issuing MBS themselves.

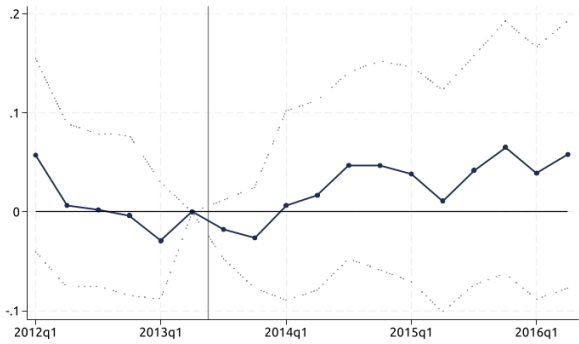
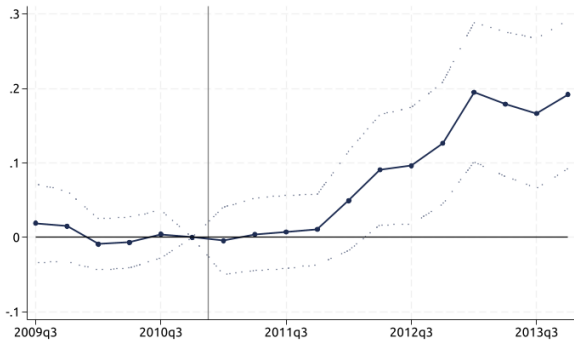
Indeed, columns (2) and (4) of Table 1 show that the average effects in columns (1) and (3) are entirely driven by large originators, which are defined as those with above-median origination volume in 2010 for BOA’s exit and in 2012 for Chase’s exit. Interestingly, the estimates for larger originators in columns (2) and (4) are comparable, suggesting that the larger overall effect with BOA’s exit in column (1) compared with Chase’s exit in column (3) is due to the difference in the size of originators most affected by the exits.

Figure 7: Effects on whether a retail originator is a Ginnie Mae issuer



(a) Share of loans securitized by originators (BOA exit)

(b) Share of loans securitized by originators (Chase exit)



(c) Share of originators that are Ginnie Mae issuers (BOA exit)

(d) Share of originators that are Ginnie Mae issuers (Chase exit)

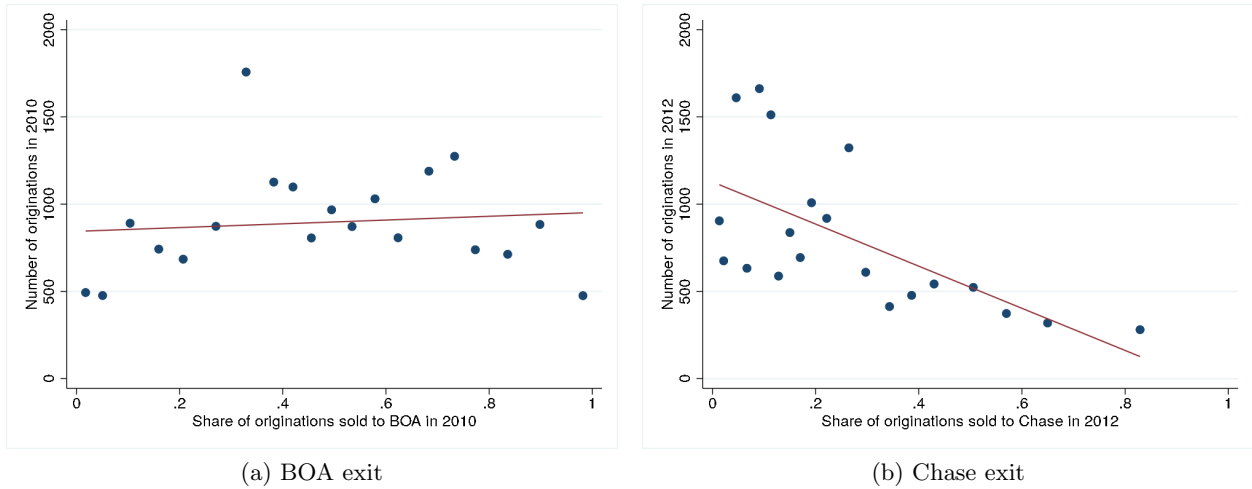
Note: Panels (a) and (b) present estimates and 95% confidence intervals from equation (2) for the effects of a 100% decline in exiting-bank market share on whether a loan is securitized directly by the originator. Panels (c) and (d) present estimates and standard errors from equation (3) for the effects of a 100% decline in exiting-bank market share on whether a lender is a Ginnie Mae issuer in a particular quarter. Standard errors clustered at the county level. Source: Authors' calculations based on HMDA data.

Table 1: Effects on whether a retail originator is a Ginnie Mae issuer

	BOA's exit		Chase's exit	
	(1)	(2)	(3)	(4)
$1[t^* \leq t \leq t^* + 5] \times$ Pre-exit Originator-level Share (H_{jt})	0.021 (0.021)	0.016 (0.022)	0.005 (0.032)	-0.015 (0.024)
$1[t^* \leq t \leq t^* + 5] \times$ Pre-exit Originator-level Share (H_{jt}) \times Large originator		-0.008 (0.041)		0.072 (0.076)
$1[t^* + 6 \leq t \leq t^* + 11] \times$ Pre-exit Originator-level Share (H_{jt})	0.154*** (0.041)	0.012 (0.038)	0.036 (0.058)	-0.064 (0.047)
$1[t^* + 6 \leq t \leq t^* + 11] \times$ Pre-exit Originator-level Share (H_{jt}) \times Large originator		0.242*** (0.078)		0.285** (0.128)
Lender FE	Y	Y	Y	Y
Quarter FE	Y	Y	Y	Y
N. Obs.	12,357	12,357	11,909	11,909
Adj. R^2	0.75	0.75	0.79	0.80

Note: Estimates and standard errors from equation (3) for estimates and standard errors from equation (3) for the effects of a 100% decline in exiting-bank market share on whether a lender is a Ginnie Mae issuer in a particular quarter. An originator is defined as large if its origination volume is above the median in 2010 for BOA's exit and in 2012 for Chase's exit. Standard errors clustered at the lender level. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: Authors' calculations based on HMDA data.

Figure 8: Relationship between Origination Volume and Exposure to BOA and Chase



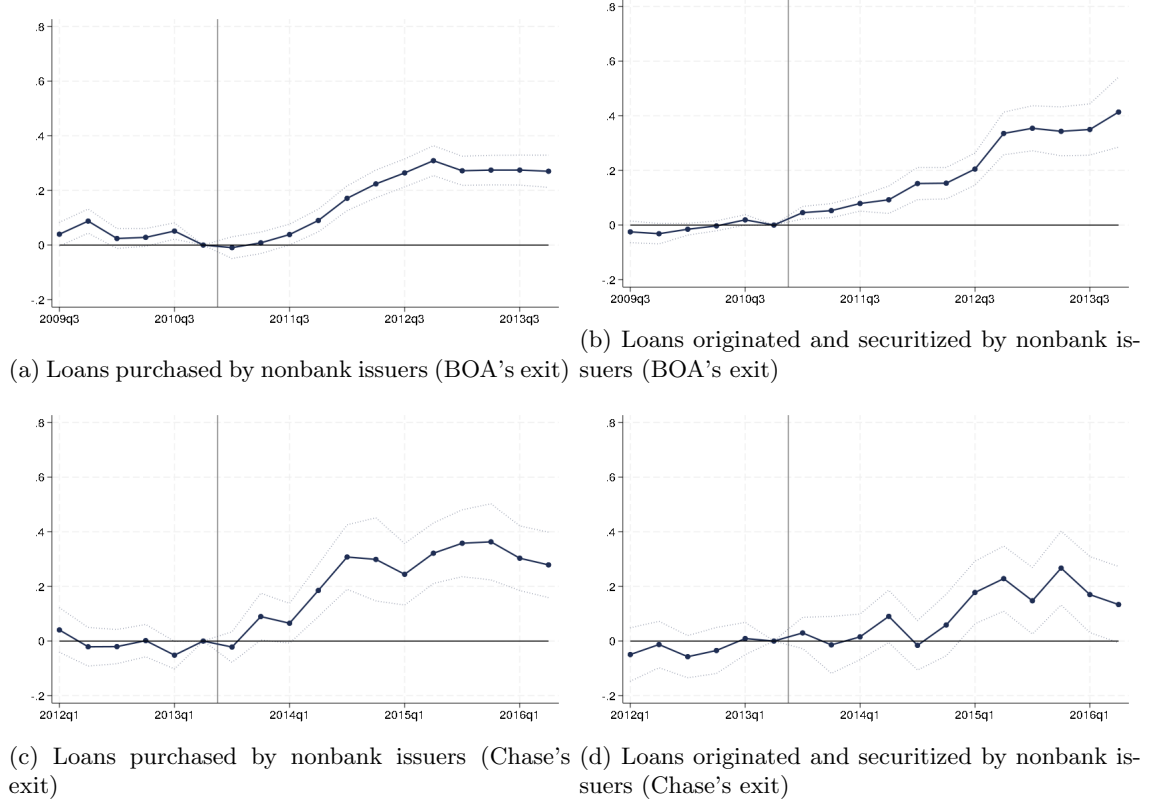
Note: Binned scatter plots that show how a retail originator's origination volume is related to the share of its originations sold to BOA in 2010 and to Chase in 2012. Source: Authors' calculations based on HMDA data.

4.3 Entry by Nonbank Types with Different Business Models

We return to our regressions using county-level variation to parse out which types of nonbanks make up the rise in Ginnie Mae nonbank issuer share after the BOA and Chase exits. Specifically, we re-estimate equation (1) with two new outcome variables: (i) whether an FHA home-purchase loan was contributed to a Ginnie Mae pool by a nonbank aggregator (that is, where a nonbank issuer purchased the loan from a correspondent originator) and (ii) whether an FHA home-purchase loans was contributed to a Ginnie Mae pool by a nonbank originator (that is, where the originator and issuer are the same entity).

Results presented in Figure 9 mirror the results from section 4.2. Both BOA's exit and Chase's exit increase county-level shares of loans purchased and originated by nonbank issuers. However, figures 9(b) and 9(d) show that nonbank issuers replaced BOA to a larger degree (around 40% in 2013) than Chase (around 20% in 2016). In other words, nonbank originators that are Ginnie Mae issuer (or integrated nonbank originators) played a larger role after BOA's exit.

Figure 9: Effects of Bank Exit on Nonbank Ginnie Mae Issuer Market Shares, by Business Model



Note: Estimates and standard errors from equation (1) for the effects of a 100% decline in exiting-bank market share on whether a loan is purchased by a nonbank aggregator (panels (a) and (c)) and whether a loan is originated and securitized by a nonbank issuers (panels (b) and (d)). Standard errors clustered at the county level. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: Authors' calculations based on HMDA data.

4.4 Increase in Bank Warehouse Lending

Although BOA and Chase exited the FHA aggregator business, they might continue to provide liquidity to the FHA market as warehouse lenders. In fact, one industry survey ranked Chase as the second largest warehouse lender in 2013.¹¹ Nonbank Ginnie Mae issuers need short-term financing to purchase loans from correspondent lenders or to originate loans themselves before the loans are sold to the MBS market. Because nonbanks lack access to the liquidity sources typically available to banks, such as deposits and FHLB advances, nonbanks typically obtain short-term financing through warehouse lines of credit from commercial banks or investment banks that are collateralized by the new originations in the pipeline (Kim et al., 2018;

¹¹ "Warehouse Commitments Tumble in 3Q13, But Some Nonbanks Get Sweet Deals From Lenders," *Inside Mortgage Finance*, Issue 2013:47, December 13, 2013.

Jiang, 2023).

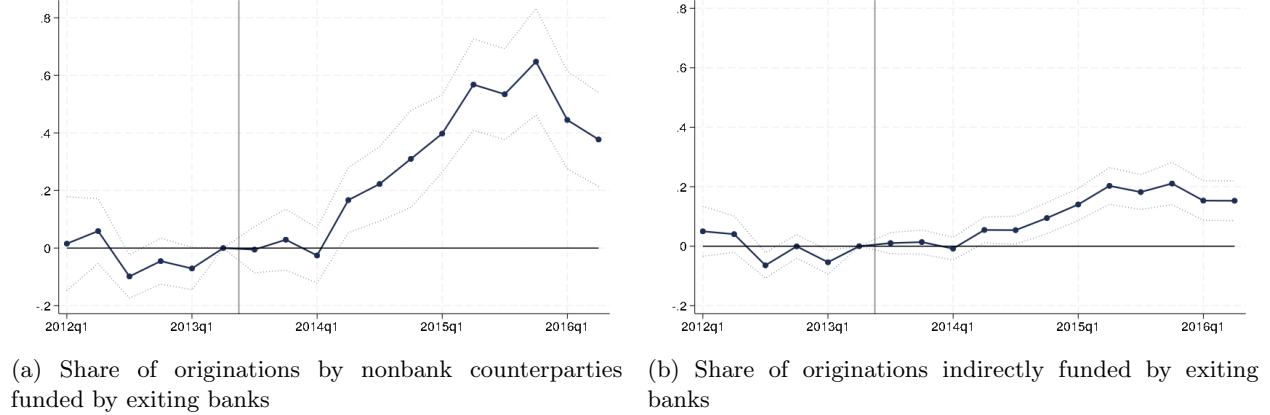
In this section, we examine whether exiting banks increased their supply of warehouse funds to the nonbanks who replaced them as issuers. For this analysis, we matched nonbank firms in the HMDA data with information on their funding relationship with banks from the MCR data. The MCR data begin in 2012, which precludes analysis of BOA’s exit.

We re-estimate our regressions using county-level variation (equation (1)) with two new outcome variables. First, figure 10(a) presents the estimates of the effect of Chase’s exit on the FHA origination market share of nonbank Ginnie Mae issuers that have at least one warehouse credit facility from the five largest banks that significantly pulled back from the FHA market (“exiting banks”), including Chase and BOA.¹² Our results are similar to those for entry by nonbank issuers reported earlier in figure 5(b): every 1 percentage point of decline in Chase’s market share was replaced by roughly 0.6 pp in the market share of nonbanks funded at least in part by the exiting banks of nonbank market share in the same county in 2015 and 2016.

Second, figure 10(b) considers the increase, after Chase’s exit, in the share of FHA originations that came from nonbank Ginnie Mae issuers and were funded by warehouse lines from the exiting banks. This outcome variable is defined as the market share of nonbank issuers multiplied by the share of warehouse lending each nonbank received from the exiting banks. Note that the estimates for this outcome are about a third of the estimates in figure 10(a), suggesting that exiting banks funded about a third of increased originations by nonbank issuers. Taken together, these results suggest that Chase and other exiting aggregators funded through warehouse credit lines a large share of the originations of the nonbanks that replaced them.

¹²Our MCR data use agreement does not allow us to show outcomes specifically related only to Chase or BOA.

Figure 10: Chase’s exit and warehouse line provision by exiting banks



Note: Estimates and standard errors from equation (1) for the effects of a 100% decline in Chase’s market share. Standard errors clustered at the market level. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: Authors’ calculations based on HMDA and MCR data.

4.5 Additional Results

4.5.1 Alternative Response by Originators

In Section 4.2, we considered two ways in which originators respond to the exits. However, originators could also respond in the extensive margin: originators that relied on BOA or Chase could reduce their FHA loan originations because the exits could make selling loans more difficult. We estimate equation (2) at the originator level using log of an originator’s total FHA origination volume as the outcome variable. Appendix figure A.1 shows that neither BOA’s exit nor Chase’s exit had large effects on originators in the extensive margin.

4.5.2 Fintech Nonbank Issuers

Some “fintech” nonbank lenders harnessed new technologies to increase their market share after the GFC (Buchak et al., 2018, Fuster et al., 2019). However, fintech lenders do not appear to be a factor in our story. As shown in Appendix figure A.2, fintech nonbank issuers’ share changed very little in the counties more exposed to the BOA and Chase exits.¹³ This result suggests that fintech lenders did not have an advantage over other firms in replacing BOA and Chase, perhaps because fintech innovations are geared toward the loan origination process rather than toward providing liquidity by purchasing loans from correspondent lenders.

¹³We classify firms as “fintech” using the classification from Buchak et al. (2018).

5 Effects on Mortgage Originations

The increase in the market share of both nonbank aggregators and nonbank originators after the exits of BOA and Chase has the potential to affect credit supply. We hypothesize that credit supply to borrowers with lower credit scores is most likely to be affected. We describe three possible reasons why.

First, nonbanks that want to expand their operations (perhaps to increase their scale so that becoming a Ginnie Mae issuer is cost effective) can only do so by broadening the types of mortgage products or mortgage borrowers that they serve. In contrast, banks that want to expand their operations can choose from multiple product lines.¹⁴ Second, nonbanks may be more willing than banks to take risks in mortgage origination. Since banks have multiple business lines to protect, they have more franchise value at stake, and may be more cautious about embarking on lending that could put these other activities at risk. Nonbanks also face a less stringent regulatory regime than banks, and so may not be required by their regulators to internalize some of the downside risks of originating risky loans.

Third, some bank aggregators were replaced by nonbank originators that grew large enough to issue MBS themselves. The disintermediation of the aggregators resolves some sources of asymmetric information that might cause aggregators to be cautious about credit risk. For example, originators have access to “soft” information on a borrower’s credit risk that is not observable to the aggregator, and originators cannot credibly commit to pass that information to the aggregator. Originators also know whether they took any shortcuts in the loan origination process that might result in legal liability for the aggregator at a later point. Vertically integrated originator-issuers may be more willing to originate riskier loans because they can more fully gauge the risk they are taking on.

We test these hypotheses with loan-level FHA administrative data and measure exit exposure by county pre-exit market shares. Our analysis is based on (1) with loan-level controls.¹⁵ As in the preceding section, the regression coefficient gives the change in the outcome attributable to a 100% exiting market share.

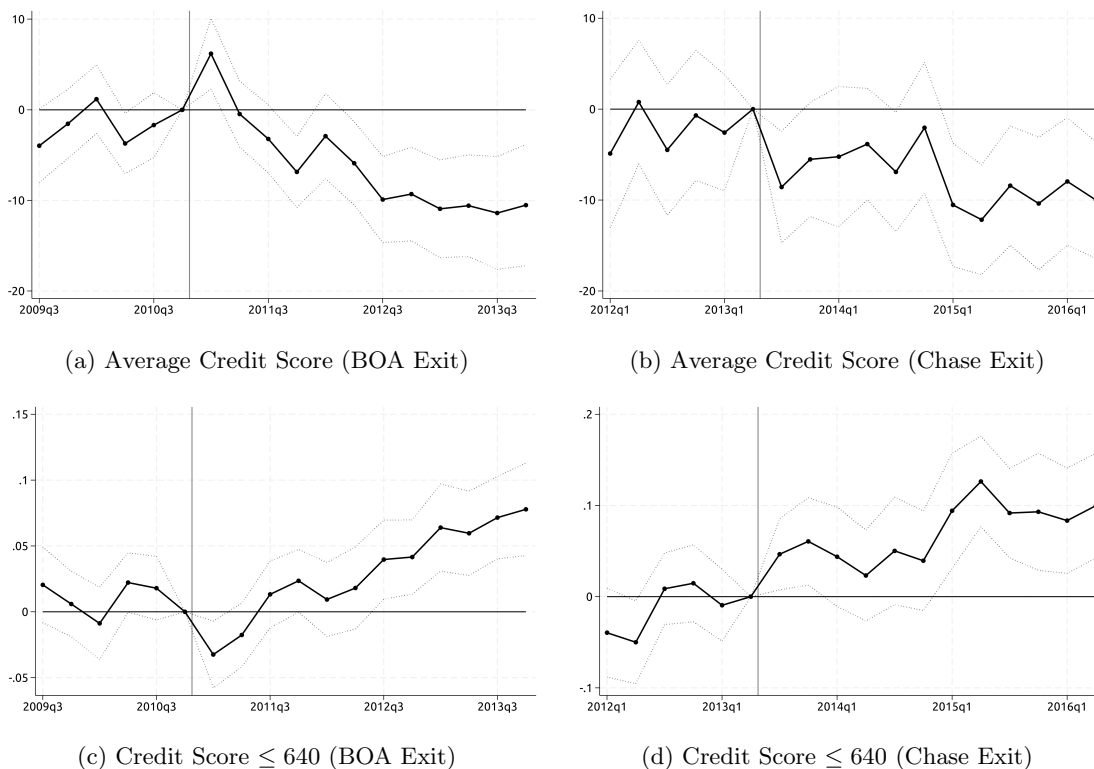
As shown in figures 11(a) and 11(b), average credit scores on FHA originations decreased after the BOA and Chase exits. Evaluated at the mean exit exposure, the credit score of the average FHA origination declined by 3.5 points after BOA’s exit and 1 point after Chase’s exit. Figures 11(c) and 11(b) show that the decrease in average credit scores was driven by an expansion of credit to borrowers with lower credit scores. Evaluated at the mean exit exposure, the share of FHA originations extended to borrowers with

¹⁴Gissler et al. (2020) shows that increased competition in the auto loan market leads nonbanks to originate loans to riskier auto loan borrowers and banks to substitute toward business lending away from auto lending.

¹⁵We include the size of the loan, and dummy-variable bins for credit scores, loan-to-value ratios, debt-to-income ratios, loan terms, and whether the borrower is a first time home buyer.

credit scores lower than 640 expanded by 2 percentage points after BOA’s exit, and by 1 percentage point after Chase’s exit.

Figure 11: Effects on Origination Credit Scores



Note: Estimates and 95% confidence intervals from equation (1) for the effects of a 100% decline in exiting-bank market share on average credit scores (panels (a) and (b)) and whether the borrower’s credit score is below 640 (panels (c) and (d)). Standard errors clustered at the county level. Source: Authors’ calculations based on administrative FHA data.

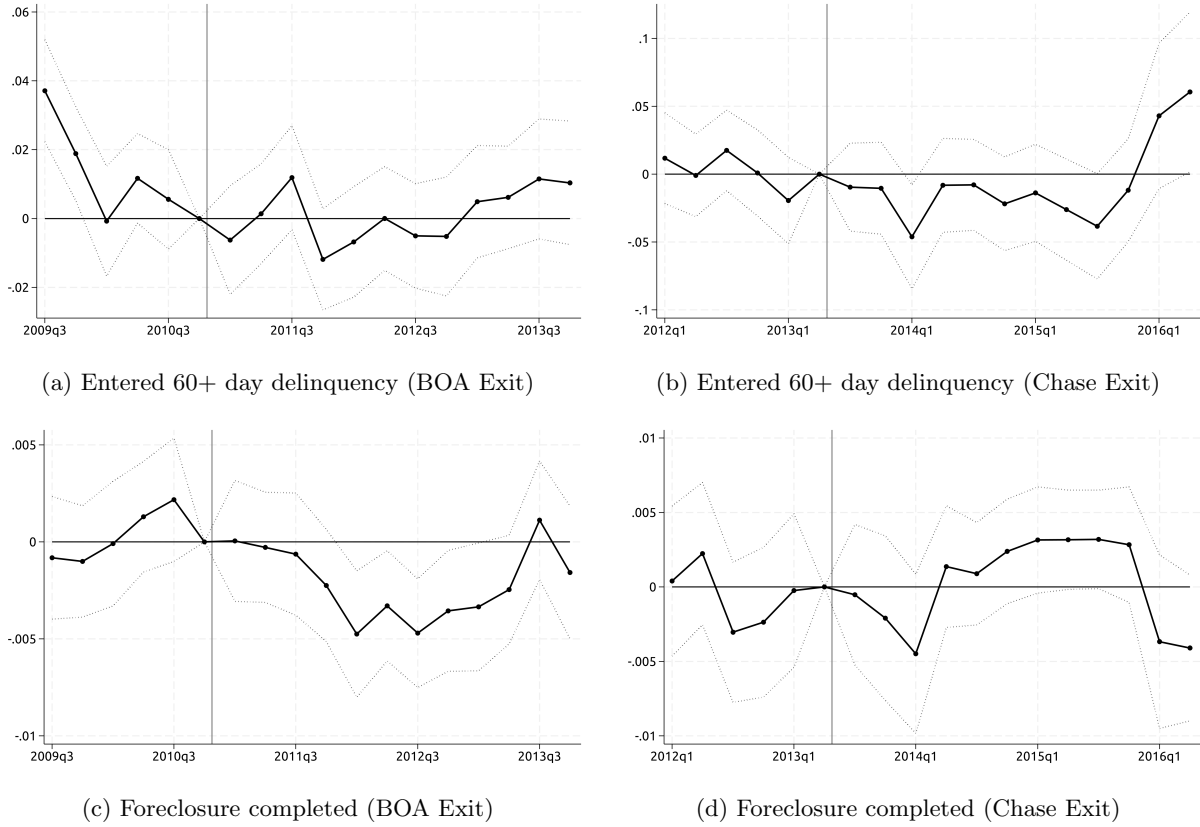
We can gain some insight as to why the exit of bank aggregators led to an expansion of credit supply by examining loan performance after origination. Conditional on ex-ante observable determinants of credit quality, such as credit scores or loan-to-value ratios, the remaining variation in ex-post credit quality outcomes captures potential soft information originators had when underwriting the loan. If the expansion of credit supply is due to nonbanks having a greater tolerance for risk than banks, we might expect loan performance to deteriorate even after controlling for these factors. On the other hand, if the expansion is due to vertically integrated originators being able to internalize this soft information in their underwriting, we might expect loan performance to stay constant or even improve.

To measure this, we estimate equation 1 using county-level variation in pre-exit shares of BOA and Chase

with measures of ex-post loan performance as outcome variables. As the outcome variable, we consider whether a loan entered 60-day delinquency within two years of origination. We also consider whether the foreclosure was completed within two years of origination. These regression include controls for observed underwriting characteristics such as credit scores, loan-to-value ratios, debt-to-income ratios, loan size, and whether a borrower is a first-time home buyer. Thus, the effects estimated in these regression likely reflect changes in collection or use of soft information about borrower's credit risk.

Estimates presented in figure 12 indicate that the credit supply expansion is not just due to nonbanks having a greater tolerance for risk than banks. Figures 12(a) and 12(b) show that the share of loans entering 60+ day delinquency did not change after either BOA's exit or Chase's exit. Moreover, figures 12(c) and 12(d) show that BOA's exit even reduced the share of loans foreclosed within two years of origination, whereas Chase's exit did not change this two-year foreclosure share. Evaluated at mean exposure, ex-post default probabilities fell by 0.14 percent after BOA's exit. Although this effect seems small in absolute terms, it is large relative to the mean default rate in exit-affected markets (0.18 percent). That is, BOA's exit decreased ex-post default rates by about 75 percent, on average. This finding is consistent with the information effects of vertically integrating originator-issuer-servicer business lines. Note that BOA's exit led to a much larger increase in the market share of vertically integrated nonbank issuers than Chase's exit, as discussed in Section 4.2.2. In light of results for credit scores, our estimates suggest that lenders expanded the credit box using formally asymmetric, soft information to mitigate ultimate loan risk.

Figure 12: Effects on Ex-post Loan Performance (within 2 years)



Note: Estimates and 95% confidence intervals from equation (1) for the effects of a 100% decline in exiting-bank market share on whether a loan enters 60+ day delinquency within two years (panels (a) and (b)) and whether the foreclosure was completed within two years (panels (c) and (d)). Standard errors clustered at the county level. Source: Authors' calculations based on administrative FHA data.

6 Conclusion

Exit by bank aggregators had dramatic effects in the U.S. mortgage industry. Nonbanks entered the space vacated by exiting banks, and some nonbank lenders grew enough to disintermediate their aggregators altogether. Disintermediation of aggregators led to an expansion of the credit box to benefit low credit score borrowers, as originators have access to soft information in their underwriting decisions that is not available to aggregators.

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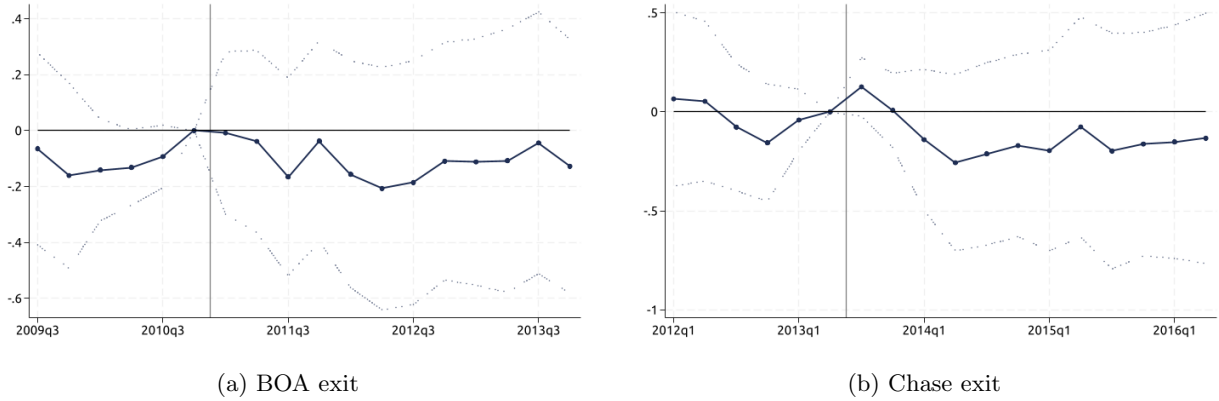
Table A.1: Summary Statistics for Treatment/Control Group Balance

	BOA Exit Exposure (2010)			Chase Exit Exposure (2012)		
	Above Median	Below Median	$\frac{m_a - m_b}{\sigma}$	Above Median	Below Median	$\frac{m_a - m_b}{\sigma}$
Total FHA Volume (\$M)	294.983	213.943	0.176	253.065	183.031	0.190
Percent FHA	0.376	0.365	0.114	0.274	0.281	-0.075
Correspondent/Total	0.545	0.574	-0.513	0.541	0.549	-0.157
Nonbank Retail Share	0.463	0.346	0.665	0.562	0.488	0.398
Nonbank Correspondent Share	0.054	0.069	-0.325	0.097	0.120	-0.405
House Price Growth 2002-2007	6.151	6.138	0.004	6.036	6.317	-0.076
CLL-FHA Change (\$1000s)	-39.773	-30.030	-0.180	-36.697	-36.680	-0.000
CLL-GSE Change (\$1000s)	15.695	16.116	-0.012	16.493	15.497	0.027
Interest Rate	4.898	4.893	0.012	3.728	3.710	0.050
Credit Score	698.194	698.578	-0.007	695.320	694.188	0.023
Percent CS \leq 640	0.159	0.158	0.001	0.105	0.111	-0.021
Loan/Value	95.173	95.167	0.001	95.305	95.496	-0.037
First Time Homebuyer	0.762	0.765	-0.008	0.785	0.778	0.016
Pre-exit Share (Exposure)	0.414	0.247	1.648	0.145	0.063	1.556

Note: Conditional means by above/below median exposure, taken in 2010 and 2012 for BOA and Chase exit, respectively. Authors' calculations based on FHA and HMDA data.

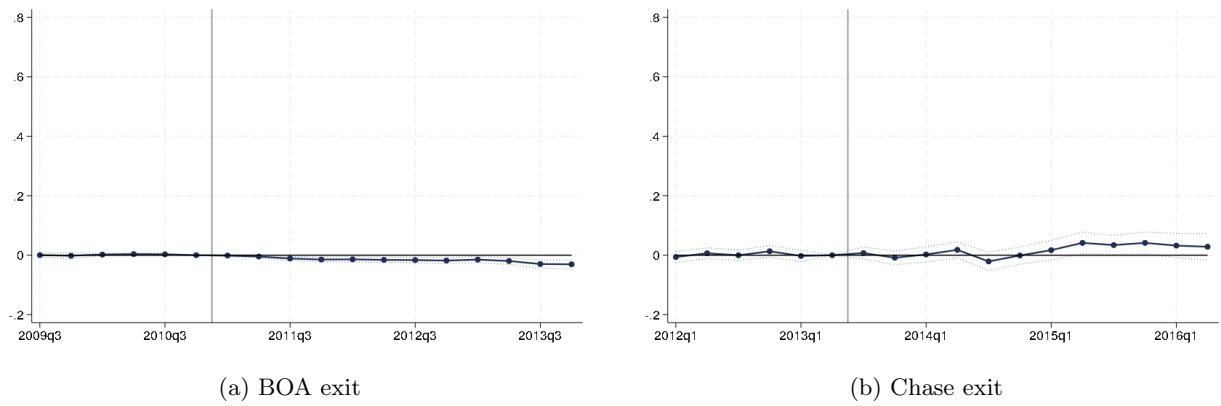
A Additional Figures

Figure A.1: Effects of Bank Exit on Lending Volume at the Originator Level



Note: Estimates and standard errors from equation (3) for the effects of a 100% decline in exiting-bank market share on log of a lender's total origination volume. Standard errors clustered at the county level. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: Authors' calculations based on HMDA data.

Figure A.2: Effects of Bank Exit on Market Share of Fintech Issuers



Note: Estimates and standard errors from equation (1) for the effects of a 100% decline in exiting-bank market share on market shares of fintech issuers. Standard errors clustered at the county level. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: Authors' calculations based on HMDA data.