DOI:
https://doi.org/10.1007/s11146-022-09906-z

Link:
https://link.springer.com/article/10.1007/s11146-022-09906-z

The Effect of Regulatory Oversight on Nonbank Mortgage Subsidiaries*

Eliana Balla
Quantitative Supervision and Research
Federal Reserve Bank of Richmond
502 S Sharpe St.
Baltimore, MD 21201

Raymond Brastow**
Quantitative Supervision and Research
Federal Reserve Bank of Richmond
701 E Byrd St.
Richmond, VA 23219

Daniel Edgel
Department of Economics
University of Wisconsin-Madison
7481 William H. Sewell Social Sciences Building
1180 Observatory Drive
Madison, WI 53706

Morgan J. Rose
Department of Economics
University of Maryland, Baltimore County
1000 Hilltop Circle
Baltimore, MD 21250

March 2020

Abstract

In 2009, the Federal Reserve subjected nonbank mortgage-originating subsidiaries of bank holding companies, but not independent nonbank (INB) mortgage originators, to consumer compliance supervision. We examine the effects of this regulatory change on the pricing and performance of nonbank originations using a sample of conventional, fixed-rate, amortizing mortgages originated between 2000 and 2015. We find that subsidiary nonbank (SNB) loans, which had a higher probability of default than INB mortgages prior to the policy change, had a lower probability of default following the change. The findings are robust to several potential confounding effects, including those due to firm entries and exits. In addition, we identify small but statistically significant decreases in loan interest rates and loan-to-value ratios for SNB loans relative to INB loans. Our findings are consistent with BHCs reducing risk shifting in mortgage lending within BHC structures, and with SNB lending practices becoming more favorable to borrowers following their heightened regulatory scrutiny.

* We would like to thank Jung-Eun Kim, Lauren Lambie-Hanson, participants in the QSR Brown Bag at the Federal Reserve Bank of Richmond, and an anonymous referee for helpful suggestions and comments. Any and all errors are, of course, our own. *The views expressed belong to the authors and do not represent the views of the Federal Reserve Bank of Richmond, the Federal Reserve System, the University of Wisconsin-Madison, the UWM Department of Economics, the University of Maryland, Baltimore County, or the UMBC Department of Economics.*
** Contact author.

Section 1 – Introduction

In the wake of the 2007-09 financial crisis, legislatures and regulators enacted a raft of new regulations and supervisory practices designed to improve the safety and soundness of the financial system. Given the role that mortgage markets played in the crisis, one emphasis of regulatory developments was the tightening of the supervision of mortgage originators, including non-depository institutions ("nonbanks") that generally face less regulatory scrutiny than depository institution originators (Kim *et al.*, 2018). This naturally coincided with an expansion of the literature examining the lending behavior of nonbank originators and how they may respond to regulation (Keys *et al.*, 2009; Rose, 2012; Dagher and Fu, 2017; Kim *et al.*, 2018), a literature to which this paper contributes.

Using a sample of one hundred and thirty thousand mortgages originated in 2000-2015 by independent nonbanks (INBs) and by nonbank subsidiaries of depository institutions and bank holding companies (subsidiary nonbanks, or SNBs), we examine how the pricing and performance of nonbank originations changed following the financial crisis. We find a decrease in the probability of default for SNB originations relative to INB originations after the crisis, and the decrease is both statistically and economically significant. The results for prepayments are mixed, with the preponderance showing an increase in the probability of prepayment for SNB originations relative to INB originations after the crisis. SNB mortgage interest rates and LTV ratios at origination exhibit statistically significant drops relative to those for INB mortgages, but the economic significance of those decreases is limited.

Although we do not claim to identify these changes causally with any one of the web of post-crisis regulatory developments, the timing and directions of our results are consistent with a 2009 decision by the Federal Reserve to subject all mortgage-originating nonbank subsidiaries of bank holding companies (BHCs) to consumer compliance oversight similar to that faced by depository originators.[1]

[1] Federal Reserve Board Consumer Affairs Letter CA 09-8 (September 14, 2009). Consumer compliance is the adherence to all applicable laws that regulate the treatment of consumers in lending, collections, disclosures, and reporting. Regulators examine institutions for compliance with consumer protection provisions in several laws,

That policy did not apply to independent nonbanks. Under this interpretation, our results represent an extension of findings by Demyanyk and Loutskina (2016), who present pre-crisis evidence (discussed below) that SNBs originated significantly riskier loans than depository subsidiaries within the same BHCs. Our finding of a decreasing probability of default for SNB mortgages post-crisis is consistent with BHCs moving away from such risk shifting following the policy change, which brought SNBs under stricter consumer compliance oversight.

Following the general decline in mortgage originations during the financial crisis, the subsequent growth in mortgages by nonbanks has been rapid. Nonbank originations rose from approximately a quarter of all US conventional mortgage originations in 2009 to over forty percent in 2016, based on HMDA data. Ganduri (2018) and Gete and Reher (2018) attribute this growth to lower origination costs due to increased liquidity of mortgage-backed securities. Figure 1 shows the number of SNB and INB originations in our sample by vintage year (we address the dearth of sample originations in 2000-2002 in Section 3).

Multiple previous papers examine the effects of the regulatory environment on nonbank mortgage originators, without distinguishing between SNBs and INBs. Keys *et al.* (2009) emphasize regulatory structure in identifying lower default probabilities for nonbank originations relative to bank originations in the same securitization pool. Huszar and Yu (2019) and Dagher and Fu (2017) find that state anti-predatory lending laws prevent nonbanks from originating riskier mortgages with less favorable terms for borrowers. Rose (2012) finds that state laws restricting the use of prepayment penalties eliminate the elevated default risk of subprime nonbank originations relative to subprime bank originations. Shi and Zhang (2018) find that stricter state-level mortgage broker licensing regulations are

including the Fair Housing Act, the Equal Credit Opportunity Act, the Home Mortgage Disclosure Act (HMDA), and the Community Reinvestment Act. Additionally, consumer compliance examinations monitor banks for unfair or deceptive practices and any practices that have the potential to harm consumers. We provide details about the 2009 consumer compliance policy change and the history of subsidiary nonbank supervision in the following section.

associated with less risky borrower and loan characteristics, in both applications and originations. Berndt *et al.* (2010) find that the per-loan profits of nonbank originators are dependent on state regulatory regimes.

Our paper is most closely related to Demyanyk and Loutskina (2016) and Downs and Shi (2015), both of which use HMDA data to study SNB mortgage lending within BHC structures. Demyanyk and Loutskina (2016) examine mortgages originated in 2005-2006 by both bank and nonbank subsidiary originators within BHCs and find that the nonbank originations were associated with lower credit scores, lower incomes, higher loan-to-income ratios, and higher default rates than bank originations. They also find that BHCs with nonbank subsidiaries performed worse during the financial crisis in proportion to the size of their nonbank operations. They argue that BHCs shifted riskier lending practices from more strictly regulated depository subsidiaries to more loosely regulated SNBs, shielding the extent of the BHCs' riskier behaviors from compulsory loss reporting and consumer compliance oversight.

Our pre-policy findings are consistent with those of Demyanyk and Loutskina (2016), as a higher probability of default for SNB loans relative to INB loans could reflect the riskiest mortgage applicants within BHCs being shifted away from depository subsidiaries and concentrated into SNBs. Our paper differs from theirs in that our sample period extends through 2015, enabling us to capture changes in lending practices of SNBs that accompanied the subsequent market and regulatory environment. Another key difference is that Demyanyk and Loutskina (2016) contrast SNBs with depository subsidiaries of BHCs, while our focus is the contrast between subsidiary and independent nonbank originators, and specifically how differences in ownership status between SNBs and INBs relate to mortgage performance and pricing. In addition, Demyanyk and Loutskina (2016) pool fixed-rate and adjustable-rate, prime and subprime, first- and junior-lien, amortizing and interest-only mortgages in their sample. Pooling various types of loans into the same specification may be inappropriate as their

different characteristics have different implications for their probabilities of default and prepayment. [2] To avoid potential misspecification, we narrow our sample to fixed-rate, first lien, conventional, amortizing (non-balloon, non-interest only) mortgages for purchases (not refinancing) of single-family residences or condominiums only. These loan characteristics are also the ones least associated with the subprime market, so the restrictions help isolate our sample from the effects of the collapse of the subprime market during the crisis.[3]

Downs and Shi (2015) study a 2007 interagency pilot program in which a small number of both SNBs and INBs with large subprime mortgage portfolios were selected for consumer compliance examination.[4] Based on a sample of 2003-2010 originations, they find that following that pilot program, loan volumes of BHC SNBs fell relative to both INBs and BHC depository subsidiaries. They also observe that BHC SNB application denial rates increased and loan-to-income ratios decreased after 2007, consistent with tighter lending standards among SNBs.

Our analysis is complementary to Downs and Shi (2015) in that we examine mortgage performance and pricing, while they examine lending volumes, application denial rates, and other loan

[2] For example, specifications of performance regressions of adjustable-rate mortgages should account for changes in mortgage payment amounts as well as the specific timings of those changes (e.g., 2/28 versus 3/27, six month versus twelve month adjustments), none of which are relevant for fixed-rate mortgages. Similarly, subprime mortgages frequently exhibit features like prepayment penalties that cause punctuated changes in the relative probabilities of default and prepayment at specific times. Such features are far less common among prime mortgages. See Ambrose *et al.* (2005), Pennington-Cross and Ho (2008, 2010), and Rose (2013).

[3] Controlling for loan characteristics may resolve the seeming contradiction between Demyanyk and Loutskina (2016), who find that bank originations have lower probabilities of default than nonbank originations, and Keys *et al.* (2009), who find that bank originations have higher probabilities of default than nonbank originations among mortgages in the same securitization pool. Mortgages within a securitization pool tend to have similar characteristics in order to appeal to investors seeking particular risk, return, and maturity profiles, such that Keys *et al.* (2009) may in effect for control for loan characteristics in an way that Demyanyk and Loutskina (2016) do not. In unreported regressions in which we include bank originations with our reported sample, we find that bank originations have higher probabilities of default than either SNB or INB originations both before and after the financial crisis. A detailed examination of changes in the mixes of mortgage types among SNBs, INBs, and depository institutions following the financial crisis would be a worthwhile addition to this literature, but is beyond the scope of our paper.

[4] Federal Reserve Board Joint Press Release, July 17, 2007: "Federal and State Agencies Announce Pilot Project the Improve Supervision of Subprime Mortgage Lenders"

characteristics presented in HMDA data. We employ a longer post-crisis sample period, in particular allowing more time to determine whether the effects observed following the crisis persisted or were temporary blips. As we discuss below, our findings and the details of the relevant regulatory changes indicate that 2009 is a better timing for the treatment effect than 2007.[5] Finally, like Demyanyk and Loutskina (2016), Downs and Shi (2015) pool a wide variety of loan types, including conventional and non-conventional, single family and multifamily properties, first liens and other liens. As noted above, we examine a specific type of typically high-quality mortgages in order to avert potential misspecifications that might obscure the effects of the supervisory regime change.

Our paper makes multiple noteworthy contributions to the literature on nonbank mortgage lending and financial regulation. To our knowledge, ours is the first paper to identify differences in mortgage performance and pricing across types of nonbank originators following discrete changes to the regulatory environment, expanding our understanding of lender behavior under different structures within the shadow banking system. We provide an important extension to Demyanyk and Loutskina (2016) in that while we show evidence consistent with theirs that SNB originations had relatively high default rates prior to the financial crisis, we also show that SNBs had relatively low default rates subsequently. To the extent that a major aim of the post-crisis regulatory changes was to reduce the riskiness of mortgages originated by SNBs, our evidence suggests that the regulatory changes were quite effective. More subtly, we identify a reduction in the probability of default among SNB originations relative to INB originations, while not identifying economically significant changes in loan pricing terms within the same set of mortgages. Our results indicate that SNBs improved the performance of their mortgages in ways other than pricing terms or the explicit underwriting factors captured by our explanatory variables. Our paper therefore points toward a significant challenge for future work on the

[5] Downs and Shi (2015) state that they derive similar results using either 2008 or 2009 as the year of the policy change.

design of efficacious regulatory policies, namely establishing the means by which SNBs improved mortgage performance.

We should reiterate an important point mentioned above. The years during and immediately following the financial crisis saw an immense array of developments in regulation and market conditions in the financial system in general and in mortgage lending in particular. Tying our results to any single policy change, to the definitive exclusion of the many other changes occurring around that time, is a tall order. We compare the timing of changes in mortgage outcomes with multiple potentially explanatory regulatory events and control for other potential causal factors. While we conclude that our results are consistent with the 2009 decision by the Federal Reserve, we do not claim to establish empirically a firm causal relationship. The overall direction of regulatory changes in mortgage lending during those years was toward tightened lending standards, so at a minimum our results are indicative of differing reactions of SNB and INB originators to stricter regulation based on their ownership structure.

The rest of our paper proceeds as follows. Section 2 provides details about the regulatory environment for SNBs and INBs before and after the financial crisis. Section 3 describes our data and methodology. We present empirical findings in Section 4. Section 5 concludes.

Section 2 – Regulatory Background

In the decades prior to the financial crisis, nonbank mortgage originators faced little regulatory oversight. As non-deposit-taking institutions, they were not under the direct supervision of any of the federal depository regulatory agencies.[6] The Federal Trade Commission (FTC) and state attorneys general could bring legal actions against a nonbank originator, but only if consumer complaints cited

[6] The Federal Reserve is the primary supervisor for BHCs and for state-chartered banks that are members of the Federal Reserve System. The Office of the Comptroller of the Currency (OCC) is the primary supervisor for nationally chartered banks. The Office of Thrift Supervision (OTS) was the primary supervisor for thrifts until the OTS merged into the OCC in 2011. The Federal Deposit Insurance Corporation (FDIC) is the primary supervisor of state-chartered banks that are not members of the Federal Reserve System.

unfair and deceptive practices by that originator (see Engel and McCoy, 2011). The Bank Holding Company Act of 1956 gave the Federal Reserve the authority, but not the mandate, to oversee subsidiaries of BHCs, stating that "the [Federal Reserve] Board *may* make examinations of each bank holding company and each subsidiary thereof," (emphasis added).[7] The Federal Reserve did not routinely do so, and in 1998 formalized this practice by directing all consumer compliance cases involving SNBs to the Federal Trade Commission (FTC).[8] The other depository regulatory agencies did not closely supervise SNBs under their authority either, leading to a regulatory environment in which "compared with banks, [nonbank mortgage originators] were subject to a smaller set of regulations that were rarely, if ever, enforced."[9]

The Graham-Leach-Bliley Act of 1999 removed restrictions on nonbank activities of BHCs, and created an explicit division in the supervision of BHCs' SNBs and depository subsidiaries. The depository subsidiaries of BHCs remained subject to strict and routine supervisory oversight, loss disclosure, and consumer compliance regulations. The primary supervisor of an SNB's parent company was permitted to examine the SNB only when deemed necessary for the financial soundness of the depository parent company. Because there was no agency with the primary responsibility of supervising nonbank mortgage originators, there was no agency that could make the risk determination necessary to enable the primary depository supervisor to examine the SNB. The regulatory environment for SNBs therefore remained similar to that for INBs in that they faced primarily market discipline rather than supervisory oversight from depository regulators. As a result, BHCs had the potential to exploit regulatory arbitrage

[7] Public Law 84-511, Section 5(c). Title 12 of the US Code, section 1813(q)(F) designates the Federal Reserve Board as the "appropriate federal banking agency" of "any bank holding company and any subsidiary (other than a depository institution) of a bank holding company;" Section 1844(c)(2)(A)(ii) states that "the Board *may* make examinations of a bank holding company and each subsidiary of a bank holding company in order to… monitor the compliance of the bank holding company and the subsidiary with" federal laws under the Federal Reserve's jurisdiction (emphasis added).

[8] Federal Reserve Board Consumer Affairs Letter CA 98-1.

[9] Demyanyk and Loutskina (2016), page 334.

by differentiating lending practices between their depository and nonbank subsidiaries, as argued by Demyanyk and Loutskina (2016).

In July of 2007, the Federal Reserve, in coordination with OCC, FDIC, OTS, and state regulatory agencies, introduced a pilot program that exposed select subsidiary and independent nonbanks to examinations. As described above, this pilot program did not alter the relative regulatory structure faced across the two types of nonbank originators, because both SNBs and INBs were included. The pilot program was also limited in reach, as only a few nonbank originators with especially large subprime mortgage portfolios were subject to examinations.

On September 14, 2009, the Federal Reserve published Consumer Affairs Letter CA 09-8, establishing "a policy for conducting risk-focused consumer compliance supervision of, and the investigation of consumer complaints against, nonbank subsidiaries of bank holding companies… with activities covered by the consumer protection laws and regulations the Federal Reserve has the authority to enforce." This policy removed SNBs from the type of consumer compliance environment experienced by INBs, which were unaffected by the policy, and brought SNBs into the Federal Reserve's consumer compliance supervision framework. Examiners were instructed to assess each SNB's risk management at the end of the calendar year, with compliance risk (which includes legal, reputational, and operational risks) contributing to the SNB's overall risk management rating.[10]

Section 605 of the Dodd-Frank Act, which became effective in July of 2011, required the Federal Reserve to examine those activities of BHC SNBs that are permissible for depository subsidiaries, including mortgage lending. Those examinations must be conducted "in the same manner, subject to

[10] Despite examinations of the relevant statutes and regulations, and inquiries with OCC staff, we were unable to ascertain with certainty whether the OCC increased its consumer compliance scrutiny of the SNBs of nationally chartered banks (most of which operate within BHC structures) concurrently with the Federal Reserve in September 2009. If the OCC did not, and if the 2009 Federal Reserve policy change is a driver of our results, then our results are conservatively biased against finding differences between how SNB versus INB originations changed following the financial crisis.

the same standards, and with the same frequency" as they would if the lead depository institution in the BHC performed the activities.[11] That section also grants the OCC and other federal banking agencies the authority to conduct those examinations if the Federal Reserve does not. Section 605 thus further removed SNBs from the relatively loose supervisory environment of INBs, bringing SNBs closer to the environment of BHC depository subsidiaries.

Summarizing, prior to the financial crisis SNBs and INBs faced similar regulatory environments. The 2007 pilot program affected only a small number of both SNBs and INBs, and so did not alter the relative regulatory environment between to two types of nonbank originators. The 2009 Federal Reserve letter placed SNBs, but not INBs, under stricter consumer compliance supervision, tightening the regulatory environment for SNBs relative to INBs. Section 605 of the 2011 Dodd-Frank Act then further tightened the regulatory environment of SNBs relative to INBs.

Section 3 – Data and Methodology

Our dataset consists of over five million monthly observations from over one hundred and thirty thousand fixed-rate, first lien, conventional purchase mortgages originated by nonbank originators in between 2000 and 2015. All mortgages are for single-family residences, condominiums, or townhomes. Jumbo loans, balloon loans, and interest-only loans are excluded. The two primary data sources are Black Knight McDash, which collects mortgage characteristics and performance data, and CoreLogic Solutions, which collects property transaction data, including lender information, from county registries of deeds. The Black Knight McDash data compile information from the servicing portfolios of the largest mortgage servicers in the United States. The coverage of the servicing portfolios was smaller in 2000-2002 than in subsequent years, resulting in our sample having relatively few loans from those years (see

[11] Public Law 111-203, Section 605(a).

Figure 1).[12] The CoreLogic Solutions data cover all recorded residential mortgage transactions in Maryland and Virginia (unlike HMDA data, which only covers transactions involving lenders that meet a certain size threshold for a given year). We matched observations in the Black Knight McDash and CoreLogic Solutions data based on property ZIP code, origination date, loan term, and loan amount. To reduce the effect of outliers, we drop observations beyond the 0.1 and 99.9 percentiles in terms of loan amount, borrower FICO score, loan-to-value (LTV) ratio, loan interest rate at origination, and the difference between loan interest rate and the Freddie Mac Primary Mortgage Market Survey (PMMS) interest rate at origination. About 2,700 loans, overwhelmingly originated by INBs, record a one month or greater gap in the Black Knight McDash performance history. We drop these loans to ensure that every loan in the sample has a complete performance history.

Identifying a given lender as a depository, subsidiary nonbank, or independent nonbank institution involved a time- and labor-intensive matching and verification process, leading us to narrow our sample from a nationwide dataset to mortgages originated in Maryland and Virginia, the two states to which we had easiest access to local information sources, and which include a mix of high- and low-income, urban and rural, shrinking and growing mortgage markets. With these restrictions, we linked lender names from our matched dataset to tables of financial attributes maintained by the Federal Reserve and retrieved through the National Information Center (NIC). The attributes table includes charter codes that enable us to classify a lender as a commercial bank, thrift, credit union, or nonbank lender affiliated with a financial institution. The topholder table enables us to identify lender parent entities.[13]

[12] In the robustness checks described in Section 4.5, we repeat our analyses after dropping 2000-2002 originations from the sample and find no substantive changes to our main results.

[13] During our sample period, banks and BHCs often purchased independent nonbanks. A nonbank therefore could switch between being an INB and a SNB. The NIC tables provide the exact dates during which a given originator was owned by another entity, allowing us to determine whether that lender was an SNB or an INB when a particular loan was originated.

Additionally, we linked lender names to tables of all mortgage lenders licensed in Maryland and Virginia during our sample period using the publicly available Nationwide Mortgage Licensing System (NMLS). NMLS maintains a nationwide database of all licensed mortgage lenders, including lists of all alternative names used by a given lender. (The lists of alternative names were vital for identifying INBs, which frequently rebrand themselves and operate under different names in different locations.) We classified any lender that we could verify through the NMLS but not through the NIC as an independent nonbank.

Approximately half of the lenders in our matched dataset could not be confidently verified as described above, either because their names were too common to be definitively linked to a particular institution or because they were only active prior to the establishment of the NMLS in 2009. We verified and classified those lenders through a variety of public sources, including the NIC query page of the Federal Financial Institutions Examination Council website, the NMLS Consumer Access website, the annual reports of the Virginia State Corporation Commission's Bureau of Financial Institutions (BFI), a list of all licensed mortgage lenders in Maryland obtained through a Freedom of Information Act request, the West Virginia Secretary of State website, and the US Department of Housing and Urban Development Neighborhood Watch database of mortgage lenders. In the event that a lender could not be verified and classified based on those sources, we conducted broad searches for official documents (SEC filings, court cases, filings by other states' regulatory agencies) and a given lender's present and archived websites as final attempts at verification. In all, we verified and classified the lenders of over

ninety-nine percent of the loans in the restricted matched dataset.[14,15] We omitted loans by non-verified lenders from the sample.

Our sample is restricted to mortgages originated by nonbanks only. Depository institutions (such as banks, thrifts, and credit unions) are strictly regulated relative to nonbank lenders. Here we compare only SNB and INB mortgages in an attempt to isolate a policy response among originators that that shared a relatively loose regulatory environment at the start of our sample period, but whose regulatory environments later diverged. In unreported analyses, we include loans by commercial banks as an alternative control group, and the results are consistent with our primary findings.

The mortgage performance analyses employ a multinomial logit model (MNL) with the data structured in event history format with monthly observations. In each month, a loan remains current, is prepaid, or defaults. Using the loan status codes provided by Black Knight McDash, we define a loan as *Current* in a given month if it is coded as current or less than ninety days delinquent. We define a loan as *Prepaid* in the first month that it is coded as paid off, and remove it from the sample in subsequent months. We define a loan as in *Default* in the first month that it is coded as being more than ninety days delinquent, in foreclosure, in REO status, or involuntarily liquidated, and remove it from the sample in subsequent months. We consider a loan that was transferred from one servicer to another to be current in the month of transfer, and we remove it from the sample in subsequent months.[16] The MNL

[14] An alternative to our matching and verification process for identifying SNBs and INBs is to use data fields available in HMDA. Due to requirements from the proprietary data vendors, we are unable to merge HMDA data with our other data sources. In addition, given that institutions must meet a specified size threshold to be captured by HMDA, we would lose mortgages originated by the smallest institutions, which comprise a large share of our INB sample.

[15] To honor the requirements from the proprietary data vendors, after the lender classification process, the lenders were anonymized so that we cannot link sample loans to individual originators. We only know whether the originator of a given loan is an INB, a SNB whose direct parent company is a depository institution (which may or may not be within a BHC structure), or a SNB whose direct parent company is a BHC. We thank Ross Podbielski and Cooper Killen for assistance assembling and anonymizing the sample.

[16] In the robustness checks described in Section 4.5, we repeat our analyses after dropping the approximately six percent of sample loans that were transferred. We also repeat our analyses with control variables for the owner of each loan in a given month, and on just loans owned by a government-sponsored enterprise. In each case, the results were consistent with our main results.

model directly controls for the competing risks of default and prepayment by requiring that the probabilities of all three outcomes sum to one. Clapp *et al.* (2006) and Rose (2013) use an MNL that incorporates unobserved heterogeneity by modeling borrowers as coming from a finite number of discrete groups with unobserved characteristics. That model is econometrically preferable to the standard model, which assumes no unobserved heterogeneity across observations, but the model incorporating unobserved heterogeneity is far more time intensive and prone to convergence problems. Both Clapp *et al.* (2006) and Rose (2013) compare mortgage performance results derived from a standard MNL model and a MNL model with unobserved heterogeneity, and find similar results across the models.

The key explanatory variables in the performance model are *Subsidiary*, an indicator variable equaling one if the originator is a SNB and equaling zero if it is an INB, *Post*, an indicator variable equaling one if the loan was originated after September 14, 2009 and equaling 0 otherwise, and the interaction of those two variables.[17] Our control variables are typical to the literature on the performance of fixed-rate mortgages.[18] *FICO* is the borrower's FICO score at origination. *CLTV* is the current loan balance divided by the current home value, where current home value is estimated as (1 + house price appreciation since origination) multiplied by the loan amount at origination divided by the loan-to value (LTV) at origination. House price appreciation is estimated using county-level price indices from CoreLogic. *Age* is the number of months since origination. *Age* and its square are included in the analyses. *RefiPenalty*, defined as the change in the PMMS rate since origination, captures the disincentive to prepay a mortgage through a refinance when interest rates rise (or the incentive to do so when they fall). *InterestGap* equals the difference between the loan interest rate at origination and the PMMS rate for the origination month, and is associated with the riskiness of the borrower as perceived

[17] In Section 4.1, we discuss the rationale for using this date to represent our policy date.
[18] For examples, see Clapp *et al.*, 2006, Pennington-Cross and Ho (2010), Rose (2012 and 2013).

by the lender. *RelLoanSize*, defined as the loan amount at origination divided by the average loan amount for originations in the same county and vintage year, is included on the premise that greater relative loan size may be correlated to borrower income or wealth, and so can indicate protection against financial distress. *Unemployment* is the monthly percentage change in the state-level unemployment rate, and *HPI* is the percent change since origination in the quarterly Federal Housing Finance Agency (FHFA) state house price index for Maryland or Virginia, as appropriate.[19] *Condo* is an indicator variable equaling one if the property is a condominium or townhouse and equaling zero if the property is a single family residence. The performance models also include state fixed effects and vintage year fixed effects. Consistent with Rose (2013), we cluster standard errors by loan to address unobserved loan or borrower characteristics. Table 1 describes the frequency with which loans defaulted, were prepaid, or remained current throughout the dataset (Panel A) and provides summary statistics for the variables used in the mortgage performance analyses (Panel B).

The model and variables chosen for the mortgage pricing analyses are similar to those employed by Elliehausen *et al.* (2008), LaCour-Little and Holmes (2008), and Rose (2012). Specifically, we use loan-level data in a two-stage least squares (2SLS) model to account for the endogeneity of loan interest rates and LTV ratios at origination. In deciding the terms of a loan, borrowers are frequently offered a variety of interest rate and LTV combinations (higher rates associated with higher LTV ratios). For this reason, single-equation regressions of loan interest rates on determinants including LTV may produce biased coefficient estimates. We address this by employing an equation-by-equation 2SLS model for estimating interest rates and LTV ratios. An alternative approach to equation-by-equation 2SLS is a simultaneous equation model, which is more efficient if all equations are specified correctly. However, misspecification in one equation of a simultaneous equation system can cause inconsistent coefficient

[19] We use state-level house price indices for *HPI* to avoid correlation with *CLTV*, which uses county-level indices as described above.

estimates in the entire system, while an equation-by-equation approach confines this problem to the misspecified equation only. Given the paucity of data available on borrower characteristics that may be relevant to determining loan interest rates, misspecification concerns argue for the more robust equation-by-equation approach.

The dependent variables in the 2SLS models are *InitialRate* and *LTV*, the loan interest rate and LTV ratio at origination, respectively. Each one appears as an explanatory variable in the other's equation. The key explanatory variables are, again, *Subsidiary*, *Post*, and their interaction. Other explanatory variables appearing in both equations include *FICO* and *RelLoanSize* (defined above), *OwnerOcc*, an indicator variable equaling one if the mortgage is associated with an owner-occupied property and equaling zero otherwise, and *Term30*, an indicator variable equaling one if the mortgage has a thirty-year maturity and equaling zero otherwise. The instrument in the *InitialRate* equation is *Prime*, the monthly average bank prime lending rate from the Federal Reserve. This rate is used mainly to price business loans, and may be taken as a measure of the opportunity cost of mortgage lending. The prime rate does not frequently change in response to other market rates, and so should not have a direct bearing on borrowers' choices regarding mortgage pricing terms. The instruments in the LTV equation are a series of variables that capture the age distribution and house value distribution in the census tract associated with a given mortgage's property.[20] *Age15-34*, *Age35-54*, *Age55-69*, and *Age70plus* indicate the percent of residents in the borrower's census tract in a given age range. Age distributions may instrument for *LTV* because older borrowers tend to have more wealth than younger ones, and wealthier borrowers may prefer loans with lower LTV ratios. *Value$1-$2*, *Value$2-$3*,

[20] Each mortgage property's 2010 census tract is identified using the geographic coordinates provided in the CoreLogic Solutions data. For originations from 2007 to 2015, age and house value distribution data are taken from the five-year American Community Survey (ACS), based on the midpoint of the five-year range. For example, a 2009 origination is assigned census tract data based on the 2007-2011 ACS. The earliest ACS five-year data range is 2005-2009. For 2000 originations, we used data from the 2000 decennial census. For 2001-2006 originations, we used an interpolation between the 2000 decennial census data and the 2005-2009 ACS data.

Value$3-$5, and *Value$5plus* indicate the percent of owner-occupied residences in the borrower's census tract valued between $100,000 and $200,000, between $200,000 and $300,000, and so on. The distribution of house values may instrument for LTV for a similar premise, namely that borrowers with greater wealth are likely to reside in areas with higher-value properties. Table 2 provides summary statistics for the variables used in the mortgage pricing analyses.

Section 4 – Empirical Analysis

Section 4.1 – Determination of treatment date

Given that the Federal Reserve policy change, announced and enacted on September 14, 2009, subjected BHC SNBs, but not INBs, to consumer compliance supervision, we considered this a promising treatment date for examining changes in SNB versus INB originations. To determine whether that timing appears consistent with the data, we performed MNL analyses (untabulated for brevity) similar to those described below in Table 4, except that instead of including *Post* and its interaction with *Subsidiary*, we interact *Subsidiary* with vintage year indicators (2000 is the omitted category).[21] Figures 2 and 3 plot the coefficient estimates of those interaction terms, which indicate the year-by-year difference in the probability of default (Figure 2) and prepayment (Figure 3) for SNB originations relative to INB originations.

Figure 2 shows that the difference in the probability of default was positive in most years through 2009, although never significantly different from zero at the five percent level. Immediately after 2009, the difference turned negative and remained negative through the rest of the sample period, and was often statistically significant. Figure 3 indicates no such clear change in the difference in the

[21] For Figures 2 and 3, we map the vintage year indicators such that all vintage years end on September 14. For example, we assign a loan originated on October 1, 2015 to vintage year 2016. Our sample includes loans originated through the end of calendar year 2015, so our vintage year 2016 only contains three months of originations. This explains the wide confidence intervals for vintage year 2016 in Figures 2 and 3.

probability of prepayment. Before 2009, the difference was positive in some years, negative in others, but not significantly different from zero for the majority of the pre-2009 period. The coefficient estimates for the difference were generally higher after 2009, but they were not significantly different from zero in any year.

The results in Figures 2 and 3 are consistent with some change (or changes) in regulatory or market conditions in 2009 that is associated with differential effects on defaults of SNB originations relative to INB originations. As described above, the 2009 Federal Reserve policy change quite plausibly fits this bill. In the analyses that follow, we continue to use September 14, 2009, as our policy treatment date. We reiterate, though, that we do not claim to identify empirically that the Federal Reserve policy change is the causal driver of the effects we report. In particular, we cannot rule out that anticipation of Section 605 of the Dodd-Frank Act, which first passed in the US Senate in May of 2010 and went into effect in July of 2011, contributed to the changes in SNB originations relative to INB originations documented in Figures 2 and 3 and the analyses below. In either case, given our controlling for observable loan characteristics, these results indicate a change in mortgage performance that is consistent with changing relative originator discretion among SNBs and INBs with respect to unobserved borrower characteristics or other soft information.

Section 4.2 – Univariate Analysis

Table 3 presents the results of difference in means tests of the loan-level mortgage characteristics of SNB originations and INB originations, before and after the 2009 policy change. Although the magnitudes of many of the differences are quite small, they are almost all significant at the 0.1 percent level. Before the policy change, SNB originations feature higher initial interest rates and greater differences between interest rates and the PMMS rate in the origination month. SNB originations are also associated with slightly lower FICO scores than INB originations in the pre-policy

period. Post-policy, all three of those relationships flip, consistent with SNB lending practices becoming stricter relative to INBs in terms of borrower creditworthiness, and with SNBs offering borrowers relatively more attractive interest rates compared to INBs.

Section 4.3 – Multinomial Analysis

Table 4 presents results from multinomial regressions of the probabilities of default (models 1-3) and prepayment (models 4-6). The coefficient estimate for *Subsidiary* in model 3 indicates that, prior to the policy treatment, the probability of default was significantly greater for SNB originations than for INB originations.[22] Following the policy change, the probability of default fell for both SNB and INB originations as indicated by *Post*, consistent with the recovery from the financial crisis. The probability of default for SNB originations fell significantly farther than the probability of default for INB originations. Specifically, the joint effect of a post-policy SNB mortgage (0.0703 – 0.487 – 0.506 = –0.9227) is lower than the effect of a post-policy INB mortgage (–0.487), and that difference (–0.4357) is statistically significant at the one percent level. This indicates that although SNB originations had a higher probability of default than INB originations prior to the policy change, following the policy change, SNB originations had a lower probability of default than INB originations, consistent with subsidiary nonbanks tightening their mortgage lending practices relatively more than INBs. It is worth noting that in model 2, which lacks the interaction between *Subsidiary* and *Post*, *Subsidiary* is not statistically significant, implying that the difference between SNB and INB originations is masked when changes across the sample period are not considered.

[22] The percentage change in the probability of default or prepayment, relative to the probability of remaining current, associated with a one-unit change in a given variable, is calculated as e^(coefficient estimate) – 1. For example, the coefficient estimate of 0.0703 for *Subsidiary* in model 3 of Table 4 indicates an increase in the probability of default, relative to the probability of remaining current, of e^(0.0703) – 1 = 0.0728 or 7.28 percent.

The results for the other explanatory variables are largely as expected, and highly consistent across models 1-3. Borrowers with higher FICO scores are less likely to default, while borrowers with less equity in their homes (higher *CLTV*) are more likely to default. Riskier borrowers, as indicated by higher values for *InterestGap*, have a higher probability of default. Rising unemployment rates and falling house prices are both associated with a higher probability of default, as expected.

Turning to the prepayment results, the coefficient estimates in model 6 indicate that SNB originations and INB originations had similar probabilities of prepayment pre-policy. The probability of prepayment increased for both types of originations after the policy change, and that increase was not significantly different for SNB originations relative to INB originations.

Predicted signs for the other explanatory variables are not as clear-cut for prepayments as they are for defaults. A default almost always reflects a negative outcome from the borrower's perspective. A prepayment, on the other hand, may be the result of a borrower selling a home because they are unable to afford the mortgage payments, refinancing to take advantage of more favorable interest rates or improved credit quality, cashing out equity, or moving to a new neighborhood as incomes or job opportunities change. Nevertheless, the coefficient estimates in models 4-6 are sensible and highly consistent across models. Borrowers with higher FICO scores are more likely to qualify for refinancing into mortgages with better terms, while borrowers with less equity in their homes are less likely to prepay. *RefiPenalty* is negatively associated with prepayments as fewer borrowers seek to refinance after mortgage interest rates rise. Borrowers with a greater *InterestGap* have greater incentive to refinance if their financial condition improves, and higher *RelLoanSize* may capture either greater ability to qualify for a refinance due to greater borrower income or wealth, or greater need to refinance or sell

a home due to the borrower being less able to afford the present property. Borrowers are less likely to prepay mortgages during rising unemployment, and less likely to prepay when house prices rise.[23]

The evidence in Table 4 is consistent with subsidiary nonbanks improving their lending practices after becoming subject to Federal Reserve consumer compliance supervision, from the standpoint of originating loans leading to fewer borrower defaults. This is particularly striking given that the probability of defaults fell for SNB originations relative to INB originations, even beyond the observed drop in INB origination defaults. The Table 4 evidence is also consistent with the patterns shown in Figures 2 and 3.

Due to the substantial amount of churn in the nonbank origination market, we performed several additional analyses to confirm that our results were not due to the appearance or disappearance of a given type of nonbank originator either before or after the policy change. In particular, we are interested in whether the Table 4 results reflect changes in the lending behavior of nonbank originators that were active both before and after the financial crisis, as opposed to changes in the populations of SNBs and INBs before and after the crisis. In other words, we want to determine whether the observed effect is due to changes in lender behavior rather than changes to the composition of lenders in the market. To do this, we employed a series of additional models that progressively restrict our sample based on how active each nonbank originator was both before and after 2009.

Table 5 shows the results for identical models as Table 4 with the sample restricted to only those nonbank originators that originated at least one loan in the pre-policy period and in the post-policy period. This reduced our sample by nearly 30 percent in terms of both loans and monthly observations. For defaults, *Subsidiary* is no longer statistically significant, implying that among those

[23] The negative effect of house price appreciation on the probability of prepayment may be due to the dramatic and simultaneous movement of both house prices and unemployment rates during the financial crisis. There may also be asymmetric effects from negative versus positive changes to these variables on the probability of prepayment, with heterogeneous impacts on different borrowers.

SNBs and INBs that were active mortgage lenders before and after the policy change, there was no significant difference in probability of default prior to 2009. However, our main result of the probability of default falling for SNB originations relative to INB originations holds, with similar coefficient estimates for the interaction of *Subsidiary* and *Post* across tables. For prepayments, *Post* retains its sign and significance, but *Subsidiary* becomes negative and statistically significant at the five percent level, while the interaction term becomes positive and significant at the ten percent level. This indicates the SNB originations had a lower probability of prepayment prior to the policy change. After the policy change, the probability of prepayment rose for both types of originations, but rose significantly more for SNB originations than for INB originations, such that in the post-policy period there was no significant difference in the probability of prepayment across originators.[24]

In Table 6, we restrict the sample further by including only lenders that originated at least one loan in each year of progressively larger ranges before and after the policy treatment. (For brevity, we omit specifications that do not include the interaction of *Subsidiary* and *Post*.) In the default results, the results are substantively unchanged from Table 5. As in Tables 4 and 5, the difference between the joint effect on the probability of default of a post-policy SNB mortgage is lower than the effect of a post-policy INB mortgage. Those differences are statistically significant at the one percent level in every model in Table 6, implying that even in our most restricted sample, the probability of default for SNB originations fell relative to the probability of default for INB originations after the policy change.[25] This is consistent with subsidiary nonbanks tightening their lending practices relatively more than INBs after the SNBs fell under Federal Reserve consumer compliance supervision.

[24] The joint effect of a post-policy SNB mortgage (–0.0282 + 0.0733 + 0.0255 = 0.0706) is slightly lower than the effect of a post-policy INB mortgage (0.0733), but the difference is not statistically significant.

[25] In Table 4, the difference between the joint effect on the probability of default of a post-policy SNB mortgage (–0.9227) and the effect of a post-policy INB mortgage (–0.487) is –0.4357. In Table 5, the difference is –0.4465. In Table 6, the difference ranges from –0.4363 to –0.35258.

The Table 6 prepayment results are also similar to those in Table 5, with similar signs and significances for *Subsidiary*, *Post*, and their interaction in all models except the first one. The probability of prepayment was significantly lower for SNB originations than INB originations in the pre-policy period. In the post-policy period, the probability of prepayment rose faster for SNB originations than INB originations, such that there was no significant difference in the probability of prepayment across originators in any of the models in Table 6.[26]

To correct for potential bias resulting from our having more months of performance data for mortgages originated earlier in our sample period, we performed additional specifications in which we restrict the number of monthly observations for each mortgage. Table 7 presents the results from regressions using only the first one, two, three, and four years of each mortgage's performance data, respectively. The coefficient estimate for *Subsidiary* is not significantly associated with the probability of default in any of the models, but that for *Post* is, indicating a post-policy decrease in the probability of default. The interaction term is significant at least at the five percent level in all models, and the magnitudes (in absolute value) of the interaction term coefficient estimates are greater than in most of the previous tables' models. The prepayment results in Table 7 are mixed, with *Subsidiary*, *Post*, and their interaction showing inconsistent signs and significance levels across the models. Capping the number of months of performance data analyzed therefore magnifies the reduction in the probability of default among SNB originations relative to INB originations after the policy treatment, but yields ambiguous results for the probability of prepayment.[27]

[26] In Table 4, the difference between the joint effect on the probability of prepayment of a post-policy SNB mortgage (0.087277) and the effect of a post-policy INB mortgage (0.0828) is 0.004477. In Table 5, the difference is –0.0027. In Table 6, the difference ranges from –0.0035 to 0.016.

[27] In Table 7, the difference between the joint effect on the probability of default of a post-policy SNB mortgage and the effect of a post-policy INB mortgage ranges from –0.6288 to –0.49192. The difference for the probability of prepayment ranges from –0.02615 to 0.0726.

Section 4.4 – 2SLS Analysis

Table 8 presents results from 2SLS regression of mortgage interest rate at origination (models 1-3) and LTV at origination (models 4-6). The coefficient estimate for *Subsidiary* in model 3 indicates that in the pre-policy period, SNB mortgage interest rates were on average 2.1 basis points higher than INB mortgage interest rates.[28] Following the policy change, interest rates rose for both SNB and INB originations, but INB rates rose significantly farther, such that there was no significant difference between the two in the post-policy period. Specifically, INB rates rose 5.2 basis points while SNB rates rose 3.3 basis points, resulting in SNB rates on average being higher than INB rates by only 0.2 basis points. Turning to the *LTV* results, model 6 indicates that LTV ratios were on average 1.3 percentage points lower for SNB originations than for INB originations before the policy change. LTV ratios fell by more than 1.1 percentage points for INB originations and by about 1.7 percentage points for SNB originations, resulting in average LTV ratios that were 1.9 percentage points lower for SNB originations than INB originations. This difference is significant at the one percent level, but as with the *InitialRate* results, the economic significance is likely small. The narrow differences in interest rates and downpayments between SNB originations and INB originations, both before and after the policy change, suggests that the pools of borrowers served by SNBs and INBs are not drastically different.[29]

The results for the other explanatory variables are largely as expected and are quite consistent across the models for each dependent variable. The coefficient estimates for *LTV* are positive in models 1-3, consistent with borrowers being able to reduce their offered interest rates by paying higher down

[28] This result is potentially consistent with Agarwal *et al.* (2016), who present evidence from mortgages originated in 1998-2006 that lenders within a BHC structure steered certain mortgage applicants to affiliated lenders within the same BHC that offered the applicants mortgages with less favorable terms for the applicants, including higher interest rates. Agarwal *et al.* (2016) do not distinguish between bank and nonbank lenders, but it plausible that some banks steered borrowers to affiliated, less-regulated nonbank lenders, at least prior to the Federal Reserve subjecting the SNBs to closer consumer compliance supervision.

[29] This is consistent with the first two sets of columns in Table 3, which show statistically significant but economically small differences in loan characteristics between SNB and INB originations, both before and after the policy change.

payments (reducing their LTV ratios). *InitialRate* is negatively related to *LTV* in models 4-6, implying that borrowers borrow smaller amounts, and make larger down payments, when interest rates are higher. *FICO* is negatively related to both *InitialRate* and *LTV*, consistent with more creditworthy borrowers (as measured by FICO scores) receiving lower mortgage rates and generally having more financial resources available for down payments. Borrowers capable of borrowing relatively larger loan amounts also receive lower interest rates, and all else equal, larger loan amounts mechanically increase LTV ratios. Interest rates and LTV ratios are lower on average for mortgages on owner-occupied properties. *Prime* is positively associated with *InitialRate*, and census tracts with relatively older populations and homes that are more expensive are associated with lower LTV ratios.

Table 9 shows results for the same 2SLS models with the sample restricted to mortgages originated by nonbank originators that originated at least one loan in the pre-policy period and in the post-policy period, similar to Table 5. The results for *InitialRate* change markedly, with neither *Subsidiary* nor its interaction with *Post* being statistically significant. In Table 9, there was no significant difference in the initial interest rates of SNB originations and INB originations, either before or after the policy change. The results for LTV in Table 9 are substantively identical to the results in Table 8.

Table 10 further restricts the sample to nonbank originators that were active in each year of a variety of ranges, similar to Table 6. In contrast to both Table 8 and Table 9, Table 10 indicates that the interest rates on SNB originations were statistically significantly lower than INB origination interest rates before the policy change, but rose farther than INB origination interest rates after the policy change. Table 10 is consistent with Tables 8 and 9 in indicating that following the policy change there was no significant difference between the interest rates of SNB and INB originations.[30] The *LTV* results in Table 10 also show substantial changes from those in Tables 8 and 9. The magnitudes of the *Subsidiary* and

[30] Across Tables 8-10, the difference in *InitialRate* between SNB originations and INB originations in the post-policy period range from –0.4 basis points to 0.1 basis points, and the difference is not statistically significant in any of the models in those tables.

Post coefficient estimates more than double, and the sign on the interaction terms switches to positive. Tallying the effects from Table 10 indicates that SNB origination LTV ratios on average were 2.5-3.1 percentage points below INB origination LTV ratios before the policy change, and the gap narrowed to 1.6-1.9 percentage points after the policy change. The post-policy LTV ratio differences are significant at the one percent level in all models. While the pre-policy differences in *InitialRate* and the pre- and post-policy differences in *LTV* are generally statistically significant, we should reiterate that the magnitudes of the effects are such that their economic significances are likely not substantial.[31]

Section 4.5 – Robustness Checks

Table 11 presents the results from multiple robustness checks we performed related to our specification and sample design. (For brevity, we show only the coefficient estimates for the key variables *Subsidiary*, *Post*, and their interaction term.) Panels A and B display MNL model results for the probabilities of default and prepayment, respectively. Panels C and D do the same for 2SLS models for origination interest rate and LTV ratio, respectively. In all panels, model 1 shows our main results from Tables 4 (Panel A and B) and 8 (Panel C and D).

In model 2 in all four panels, we redefine *Post* to equal one for mortgages originated after July 17, 2007, zero otherwise. That was the announcement date of the interagency pilot program described in Section 2, which selected a number of both SNBs and INBs for examinations. Not surprisingly, this redefinition led to substantial changes in the coefficient estimates for *Post* across the panels. In Panel A, the coefficient estimate for *Post* shifts from negative to positive. Despite that, the probability of default for SNB originations still decreases post-policy in this specification. The difference in the probability of default between SNB originations and INB originations is negative and statistically significant but closer

[31] For perspective on the magnitudes of the results in Tables 8-10, note that Table 2 indicates that the sample standard deviations of *InitialRate* and *LTV* are 109 basis points and 18.17 percentage points, respectively.

to zero in model 2 (-.1603 versus -.4357 in model 1). SNBs appear to have reduced defaults in their mortgages relative to INBs using the 2007 or 2009 *Post* definition. However, the fact that the magnitude (in absolute value) of the effect is smaller using 2007 than 2009 suggests that our main results, which use the 2009 treatment date, better capture the timing of the divergence in nonbank originator behavior based on ownership type. In model 2 in Panels B-D, the coefficient estimate for *Post* increases substantially, but the other results are substantively unchanged.

Models 3 and 4 in Table 11 each redefine *Post* with respect to Section 605 of the Dodd-Frank Act, described in Section 2. In model 3, *Post* equals 1 for mortgages originated after May 20, 2010, the day the Senate passed its version of the Act (an earlier version passed by the House of Representatives on December 11, 2009, did not include the provisions that ultimately became Section 605). In model 4, *Post* equals 1 for mortgages originated after July 21, 2011, the day that Section 605 went into effect. In both models, the coefficient estimates for *Post* change substantially compared to our main results in model 1. In all four panels, the post-policy difference between SNB originations and INB originations are similar in sign and magnitude in models 3 and 4 to the post-policy difference in model 1, with one exception. In Panel C, the interest rates on SNB originations are lower than the interest rates on INB originations by a statistically (but not economically) significant 2.3 basis points.

The similarity of results from defining *Post* using the different treatment dates makes it difficult to distinguish between the 2009 Federal Reserve decision and Section 605 of the Dodd-Frank Act as drivers of our results. Both the Federal Reserve decision and Section 605 tightened the regulatory environment of SNBs relative to that of INBs, and it is quite plausible that our findings reflect a cumulative effect of both events. That stated, the evidence in Figure 2 suggests a change in SNB originations versus INB originations beginning around 2009, which is more consistent with the timing of the Federal Reserve decision.

As noted in Section 3, the Black Knight McDash dataset does not have extensive coverage of servicing portfolios prior to 2003, causing our sample to have few loans for those years (see Figure 1). To determine whether this skews our results, we repeated the analyses after dropping 2000-2002 originations. As can be seen in model 5 in each panel of Table 11, the results for the probability of default and origination interest rate are quite similar to our main results. The results for the probability of prepayment and origination LTV ratio show some movement from our main results, but the patterns of results are substantively unchanged.

As Figure 1 shows, our sample is well-balanced between SNB and INB mortgages early in our sample period, but during and after the financial crisis INB mortgages considerably outweigh SNB ones. To ensure that our results are not affected by this imbalance, we use a propensity score to create a balanced subsample with equal numbers of SNB and INB mortgages in each vintage year. The results are presented in model 6 in each panel of Table 11. The default results in Panel A closely resemble our main results, except that *Subsidiary* slips below statistical significance at conventional levels. In Panel B, the signs and significance levels of *Subsidiary* and the interaction term change compared to model 1, but the difference in the post-crisis probability of prepayment across SNB and INB originations is similar in model 6 and model 1. There are some drops in coefficient significance levels in model 6 of Panels C and D as well, but the patterns of our main results hold. We also generated a separate balanced subsample by dropping randomly selected observations in each vintage year. The results from this subsample, displayed in model 7 across panels, show drops in the significance of *Post*, but are otherwise substantively unchanged from our main results.

Approximately six percent of our sample loans had a transfer of ownership during our sample period. To determine whether unobserved characteristics associated with those transferred loans could be driving our results, we performed our main analyses after dropping transferred loans from our sample. The results, presented in model 8, are substantively unchanged for the probability of default

and origination interest rate. In the probability of prepayment results, SNB originations have lower probabilities of prepayment both before and after the policy change, and the difference is statistically significant in both periods. In the LTV ratio results, the interaction term loses statistical significance, but the difference between LTV ratios for SNB originations and INB originations is similar in model 8 (–1.63 percentage points) to that in our main results (–1.86 percentage points), and remains statistically significant at the one percent level.

Over eighty percent of our sample loans were owned by government-sponsored enterprises during all or part of our sample period. To determine whether our results are driven by the minority of loans never owned by GSEs, we performed our main analyses only on those loans owned by GSEs. The results, shown in model 9, are substantively unchanged in Panels A and D. Panels B and C show some changes in significance levels, but the differences in probability of prepayment and in origination interest rate across originator types in the post-policy period are consistent with those in our main results. In a related but untabulated robustness check, we performed our main performance regressions as in Table 4, but accounted for ownership transfers by including indicator variables in the specification controlling for whether, in a given month, the loan was held by a GSE, in a private mortgage-backed security, or in a lender's portfolio. The results for the probabilities of both default and prepayment are substantively unchanged for our results in Table 4.

V. Conclusion

Using a sample of fixed-rate, first lien, conventional purchase mortgages originated by nonbank originators in Maryland and Virginia between 2000 and 2015, we present evidence that SNB originations had higher probabilities of default than INB originations in the years prior our treatment date, which coincides with the Federal Reserve's 2009 Consumer Affairs Letter CA 09-8 tightening the supervisory environment of BHC SNBs from one similar to that of INBs to direct consumer compliance supervision by

the Federal Reserve. This is consistent with Demyanyk and Loutskina (2016) and potentially consistent with Agarwal et al. (2016).[32]

In the years following the policy treatment, which are outside of the sample periods of the just-cited papers, we find that the probability of default for SNB originations significantly decreased relative to that for INB originations. The magnitudes of these decreases are remarkably similar across a wide variety of sample restrictions and specification changes. We also document statistically significant but economically small decreases in origination interest rates and LTV ratios for SNB originations relative to INB originations. Although many studies have identified differences in mortgages originated by nonbanks versus banks, to our knowledge, this is the first evidence of changes in the relative performance and pricing of nonbank mortgages associated with regulatory regime differences across nonbank originators under different ownership structures. We run several alternative specifications to ensure that our results are not due to firm closures or entries following the policy treatment, to post-treatment loans having shorter performance histories, to panel imbalances, or to differences in mortgage ownership. Our default results are robust to all of those alternatives, while the interest rate and LTV ratio results hold against all except firm entries and exits.

Our findings are consistent with the Federal Reserve policy change significantly reducing the within-BHC regulatory arbitrage described by Demyanyk and Loutskina (2016), and potentially consistent with Agarwal et al. (2016). We must note again the caveat that we do not claim to definitively identify a direct causal relationship, given the array of regulatory and market changes that occurred in the wake of the financial crisis. However, given the narrow focus of the policy change, the nature of our sample, and the timing of our results, we assert that the change marked by Consumer Affairs Letter CA 09-8 was plausibly the key policy event – broad changes in the mortgage market

[32] See footnote 28.

affected originators generally, while CA 09-8 tightened the regulatory environment specifically of SNBs relative to INBs.

Our findings point toward several avenues of future research. We document significant decreases in the probability of default for SNB originations relative to INB originations, but find only quite small changes in origination interest rates and LTV ratios across institutions. This leaves open the question of how SNBs improved the performance of their mortgages, perhaps based on unobserved (to us) borrower characteristics or other forms of soft information. If our findings are driven at least partially by the Federal Reserve policy change, this implies that consumer compliance oversight is an effective tool for reducing the default probabilities of nonbank originations. The effect of such oversight on nonbank credit allocation is a related and worthwhile question, but is beyond the scope of this paper. Additionally, the expansion of nonbanks in the VA and FHA mortgage markets, examined in the context of our findings, provide fertile ground for future research.

References

Agarwal, Sumit, Gene Amromin, Itzhak Ben-David, and Douglas D. Evanoff. "Loan Product Steering in Mortgage Markets," NBER Working Paper No. 22696 (September 2016).

Ambrose, Brent W., Michael LaCour-Little, and Zsuzsa R. Huszar. "A Note on Hybrid Mortgages." *Real Estate Economics* 33, No. 4 (November 2005): 765-782.

Berndt, Antje, Burton Hollifield, and Patrik Sandas. "The Role of Mortgage Brokers in the Subprime Crisis." NBER Working Paper No. 16175 (July 2010).

Clapp, John M., Yongheng Deng, and Xudong An. "Unobserved Heterogeneity in Models of Competing Mortgage Termination Risks." *Real Estate Economics* 34, No. 2 (May 2006): 243-273.

Dagher, Jihad, and Ning Fu. "What Fuels the Boom Drives the Bust: Regulation and the Mortgage Crisis." *The Economic Journal* 127, No. 602 (June 2017): 996-1024.

Demyanyk, Yuliya, and Elena Loutskina. "Mortgage Companies and Regulatory Arbitrage." *Journal of Financial Economics* 122, no. 2 (November 2016): 328-351.

Downs, David H. and Lan Shi. "The Impact of Reversing Regulatory Arbitrage on Loan Originations: Evidence from Bank Holding Companies." *Journal of Real Estate Finance and Economics* 50, No. 3 (April 2015): 307-338.

Engel, Kathleen C., and Patricia A. McCoy. “The Subprime Virus: Reckless Credit, Regulatory Failure, and Next Steps.” Oxford University Press, 2011.

Elliehausen, Gregory, Michael E. Staten, and Jevgenijs Steinbuks. "The Effect of Prepayment Penalties on the Pricing of Subprime Mortgages." *Journal of Economics and Business* 60, No. 1-2 (January-February 2008): 33-46.

Ganduri, Rohan. “Repo Regret?” Working Paper (2018).

Gete, Pedro and Michael Reher. Nonbanks and Lending Standards in Mortgage Markets. The Spillovers from Liquidity Regulation. Working Paper (July 2018).

Huszár, Zsuzsa R. and Wei Yu. “Mortgage Lending Regulatory Arbitrage: A Cross-Sectional Analysis of Nonbank Lenders.” J*ournal of Real Estate Research* 41, No. 2 (April-June 2019) pp. 219-48.

Keys, Benjamin J., Tanmoy Mukherjee, Amit Seru, and Vikrant Vig. "Financial Regulation and Securitization: Evidence from Subprime Loans." *Journal of Monetary Economics* 56, No. 5 (July 2009): 700-720.

Kim, You, Steven Laufer, Karen M. Pence, Richard Stanton, and Nancy Wallace. "Liquidity Crises in the Mortgage Market," Brookings Papers on Economic Activity (Spring 2018): 347-413.

LaCour-Little, Michael, and Cynthia Holmes. "Prepayment Penalties in Residential Mortgage Contracts: A Cost-Benefit Analysis." *Housing Policy Debate* 19, No. 4 (2008): 631-673.

Pennington-Cross, Anthony, and Giang Ho, “The Termination of Subprime Hybrid and Fixed-Rate Mortgages,” *Real Estate Economics* 38, No. 3 (June 2010): 399-426.

Pennington-Cross, Anthony, and Giang Ho, “Predatory Lending Laws and the Cost of Credit,” *Real Estate Economics* 36, No. 2 (May2008): 175-211.

Rose, Morgan J. "Origination Channel, Prepayment Penalties and Default." *Real Estate Economics* 40, No. 4 (January 2012): 663-708.

Rose, Morgan J. "Geographic Variation in Subprime Loan Features, Foreclosures, and Prepayments." *Review of Economics and Statistics* 95, No. 2 (May 2013): 563-590.

Shi, Lan, and Yan Zhang. “The Effect of Mortgage Broker Licensing under the Originate-to-Distribute Model: Evidence from the U.S. Mortgage Market.” *Journal of Financial Intermediation* 35A, (July 2018): 70-85.

Figure 1
Number of subsidiary nonbank (SNB) and independent nonbank (INB) mortgages in our sample by vintage year. The sample is conventional, amortizing (non-balloon, non-interest only) fixed-rate mortgages for purchases of single-family residences or condominiums in Maryland and Virginia originated by nonbank originators between 2000 and 2015.

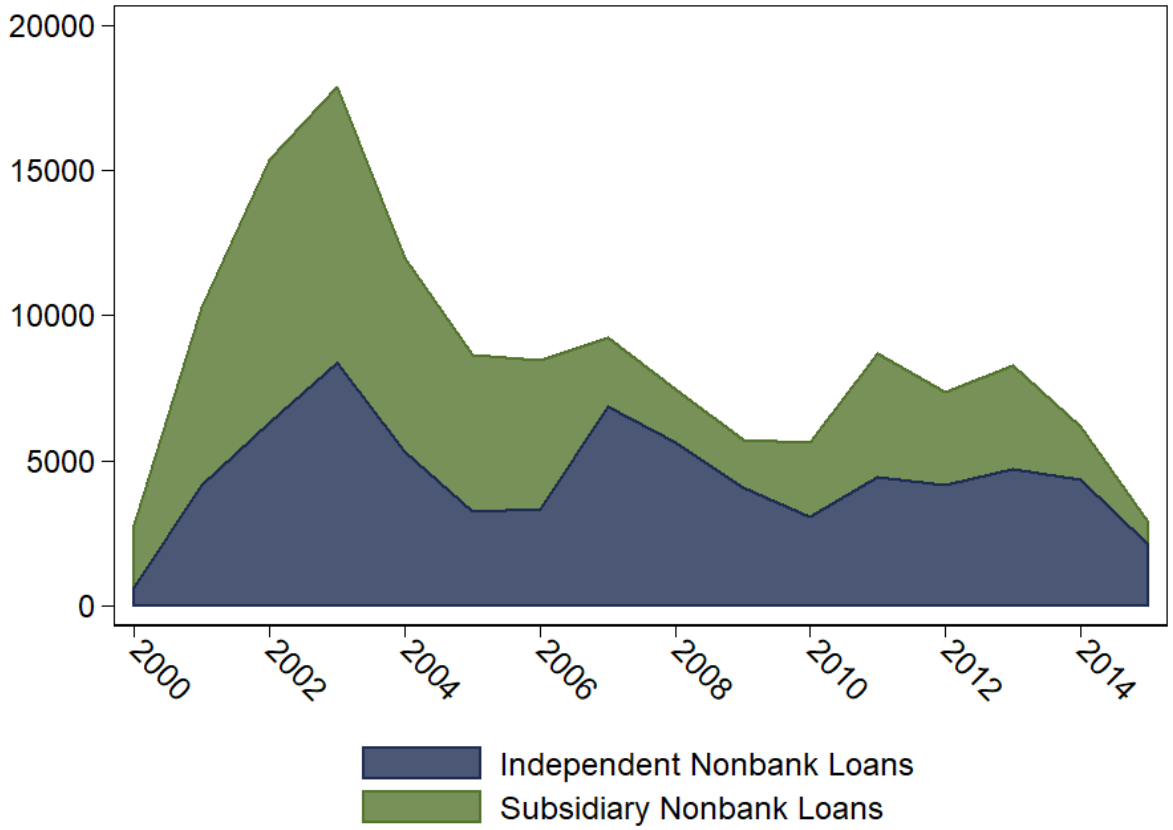

Figure 2

Estimates by vintage year of the difference between the probability of default of subsidiary nonbank (SNB) originations relative to independent nonbank (INB) originations. Estimates are derived from multinomial logit regressions similar to those in Table 4, except *Post* and its interaction with *Subsidiary* are replaced by interactions of *Subsidiary* with vintage year indicator variables. See footnote 21 for how we define vintage year indicator variables for Figures 2 and 3. The dotted line at 2009 coincides with the Federal Reserve policy change subjecting SNBs, but not INBs, to consumer compliance supervision. The bars indicate the 95 percent confidence interval for each *Subsidiary* * vintage year interaction term coefficient estimate.

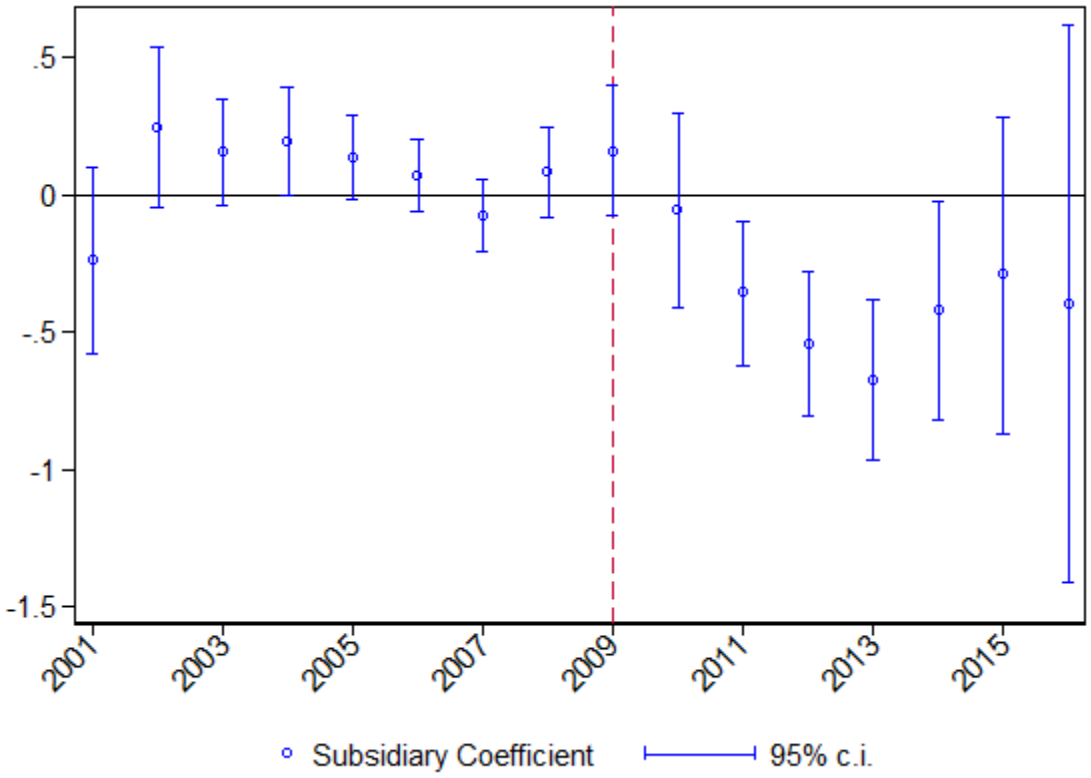

Figure 3

Estimates by vintage year of the difference between the probability of prepayment of subsidiary nonbank (SNB) originations relative to independent nonbank (INB) originations. Estimates are derived from multinomial logit regressions similar to those in Table 4, except *Post* and its interaction with *Subsidiary* are replaced by interactions of *Subsidiary* with vintage year indicator variables. See footnote 21 for how we define vintage year indicator variables for Figures 2 and 3. The dotted line at 2009 coincides with the Federal Reserve policy change subjecting SNBs, but not INBs, to consumer compliance supervision. The bars indicate the 95 percent confidence interval for each *Subsidiary* * vintage year interaction term coefficient estimate.

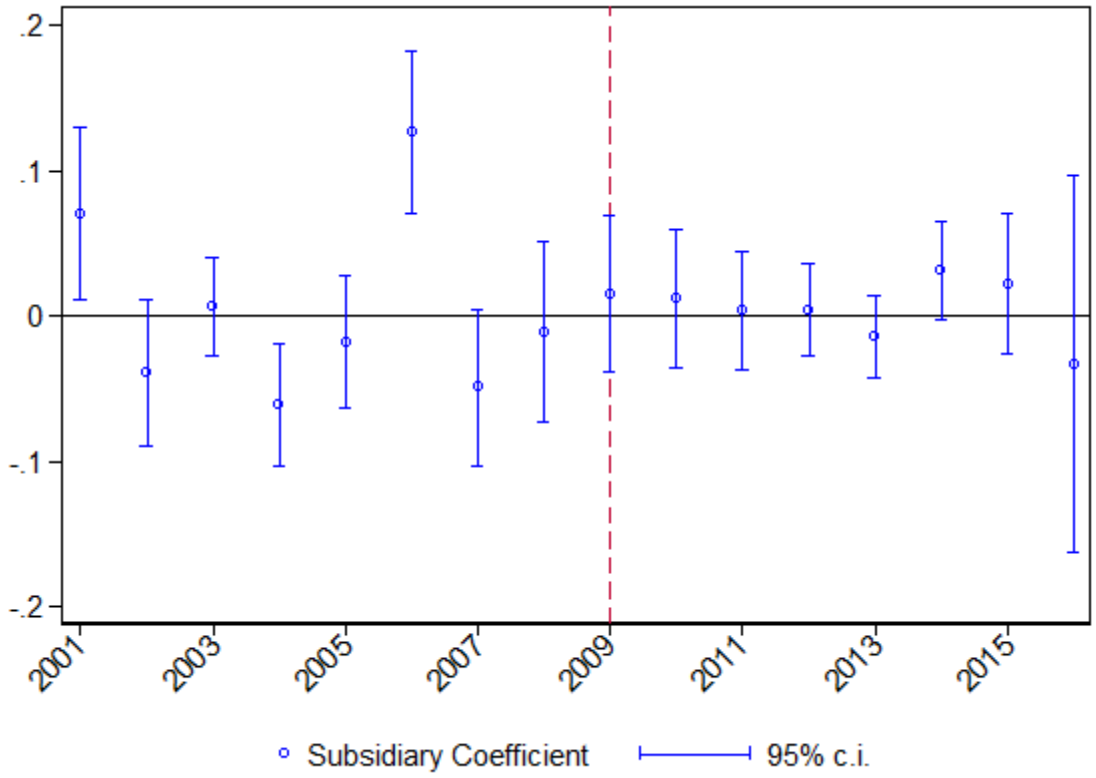

Table 1

Final loan performance status and summary statistics for variables used in mortgage performance regressions. The sample is conventional, amortizing (non-balloon, non-interest only) fixed-rate mortgages for purchases of single-family residences or condominiums in Maryland and Virginia originated by nonbank originators between 2000 and 2015. Panel A shows the loan performance status of each loan in its final monthly observation, taken from Black Knight McDash. *Current* equals 1 if the mortgage was current in the given month, 0 otherwise. *Default* equals 1 if the mortgage entered default in the given month, 0 otherwise. *Prepaid* equals 1 if the mortgage was paid off in the given month, 0 otherwise. Panel B shows summary statistics for the explanatory variables used in the mortgage performance regressions. *Subsidiary* equals 1 if the originator is a subsidiary nonbank, 0 if the originator is an independent nonbank. *Post* equals 1 if the mortgage was originated after the September 14, 2009 Federal Reserve policy change, 0 otherwise. *FICO* is the borrower's FICO score at origination. *CLTV* is the current loan balance divided by the current home value, where current home value is estimated as (1 + house price appreciation since origination) multiplied by the loan amount at origination divided by LTV at origination. House price appreciation is measured by the quarterly Federal Housing Finance Agency (FHFA) state house price index for Maryland or Virginia, as appropriate. *Age* is the number of months since origination. *RefiPenalty* is the change in the PMMS rate since origination. *InterestGap* is the difference between the mortgage interest rate at origination and the PMMS rate for the origination month. *RelLoanSize* is the loan amount at origination divided by the average loan amount for originations in the same vintage year and county. *Unemployment* is the monthly percentage change in the state-level unemployment rate. *HPI* is the quarterly change in FHFA state-level house price index. *Condo* is an indicator variable equaling one if the property is a condominium or townhouse and equaling zero if the property is a single family residence.

Panel A: Final loan performance status (loan-level observations)

	Number of loans			Percent of loans		
Variable	SNBs	INBs	Full sample	SNBs	INBs	Full sample
Current	3,084	7,542	10,608	4.7%	10.7%	7.7%
Default	3,249	4,052	7,301	4.9%	5.7%	5.3%
Prepaid	59,904	59,073	118,977	90.4%	83.6%	86.9%
Total	66,237	70,649	136,886	100.0%	100.0%	100.0%

Panel B: Explanatory variable summary statistics (monthly observations)

Variable	Observations	Mean	St.Dev.	25th percentile	Median	75th percentile	Source
Subsidiary	5,482,274	0.50	0.50	0	1	1	Multiple sources (see Section 3)
Post	5,482,274	0.27	0.44	0	0	1	McDash, CoreLogic
FICO	5,482,274	741.8	51.64	709	754	783	McDash
CLTV	5,482,274	68.41	22.74	55.43	70.23	81.12	McDash
Age	5,482,274	31.75	28.74	10	23	46	McDash

RefiPenalty	5,482,274	-0.07	0.15	-0.17	-0.06	0.02	Freddie Mac
InterestGap	5,482,274	0.12	0.49	-0.16	0.11	0.37	McDash, Freddie Mac
RelLoanSize	5,482,274	0.92	0.38	0.65	0.88	1.14	McDash
Unemployment	5,482,274	0.17	2.23	-1.43	0.00	0.00	Bureau of Labor Statistics
HPI	5,482,274	11.11	21.15	-0.92	4.32	19.80	FHFA
Condo	5,482,274	0.34	0.47	0.00	0.00	1.00	McDash

Table 2

Summary statistics for variables used in mortgage pricing regressions. The sample is loan-level observations of conventional, amortizing (non-balloon, non-interest only) fixed-rate mortgages for purchases of single-family residences or condominiums in Maryland and Virginia originated by nonbank originators between 2000 and 2015. *Subsidiary*, *Post*, *FICO*, and *RelLoanSize* are defined as in Table 1. *InitialRate* is the mortgage interest rate at origination. *LTV* is the mortgage loan-to-value ratio at origination. *OwnerOcc* equals 1 if the mortgage is associated with an owner-occupied property, 0 otherwise. *Term30* equals 1 if the mortgage has a thirty-year maturity, 0 otherwise. *Prime* is the monthly average bank prime lending rate at the time of origination from the Federal Reserve. *Age15-34* is the percentage of residents in the borrower's census tract between the ages of 15 and 34 years old. *Age35-54*, *Age55-69*, and *Age70plus* are defined similarly for other age ranges. Value$1-$2 is the percentage of owner-occupied residences in the borrower's census tract valued between $100,000 and $200,000. *Value$2-$3*, *Value$3-$5*, and *Value$5plus* are defined similarly for other price ranges.

Variable	Observations	Mean	Std.Dev.	25th percentile	Median	75th percentile	Source
Subsidiary	129,316	0.49	0.50	0	0	1	Multiple sources (see Section 3)
Post	129,316	0.26	0.44	0	0	1	McDash, CoreLogic
InitialRate	129,316	5.87	1.09	5.0	6.0	6.625	McDash
LTV	129,316	78.07	18.17	74.03	79.74	88.32	McDash
FICO	129,316	738	55	703	751	781	McDash
RelLoanSize	129,316	0.94	0.38	0.67	0.90	1.16	McDash
OwnerOcc	129,316	0.66	0.47	0	1	1	McDash
Term30	129,316	0.95	0.22	1	1	1	McDash
Prime	129,316	4.99	1.79	3.25	4.25	6.25	Federal Reserve Board
Age15-34	129,316	26.2	7.9	21.1	25.0	29.9	American Community Survey
Age35-54	129,316	31.3	4.6	28.6	31.7	34.3	American Community Survey
Age55-69	129,316	14.5	5.1	10.9	13.9	17.3	American Community Survey
Age70plus	129,316	7.9	5.6	4.2	6.8	10.2	American Community Survey
Value$1-$2	129,316	21.8	17.4	6.2	19.1	33.9	American Community Survey
Value$2-$3	129,316	24.5	13.7	15.0	24.7	32.8	American Community Survey
Value$3-$5	129,316	26.9	16.3	14.7	25.9	37.1	American Community Survey
Value$5plus	129,316	18.6	21.9	2.9	10.2	26.2	American Community Survey

Table 3

Loan-level variable means of subsidiary nonbank (SNB) originations and independent nonbank (INB) originations of conventional, amortizing (non-balloon, non-interest only) fixed-rate mortgages for purchases of single-family residences or condominiums in Maryland and Virginia between 2000 and 2015. The policy change by the Federal Reserve occurred on September 14, 2009. Variables are defined as in Tables 1 and 2. Levels of significance in t-tests for differences in means are indicated by *, **, and *** for 5%, 1%, and 0.1%, respectively.

	Pre-policy		Post-policy		Subsidiary Nonbanks		Independent Nonbanks	
Variable	SNBs	INBs	SNBs	INBs	Pre-policy	Post-policy	Pre-policy	Post-policy
InitialRate	6.42***	6.292	4.346***	4.374	6.42***	4.346	6.292***	4.374
LTV	77.47***	78.51	77.16***	79.47	77.47	77.16	78.51***	79.47
FICO	729.6***	731.1	762.7***	757.2	729.6***	762.7	731.1***	757.2
InterestGap	.194***	.167	.171***	.234	.194***	.171	.167***	.234
RelLoanSize	.924***	.937	.991***	.967	.924***	.991	.937***	.967
Condo	.311***	.355	.235***	.306	.311***	.235	.355***	.306
OwnerOcc	.55***	.605	.883***	.9	.55***	.883	.605***	.9
Term30	.949***	.954	.934***	.949	.949***	.934	.954*	.949
Observations	49,602	46,781	16,635	23,868	49,602	16,635	46,781	23,868

Table 4

Multinomial logit regressions based on monthly observations of conventional, amortizing (non-balloon, non-interest only) fixed-rate mortgages for purchases of single-family residences or condominiums in Maryland and Virginia originated by nonbank originators between 2000 and 2015. Variables are defined as in Table 1. Each coefficient estimate represents the effect on the probability of default or prepayment, relative to the probability of the mortgage remaining current, of a one-unit change in the corresponding variable. Vintage year indicators and a constant term are included in each specification. Standard errors clustered by loan appear in brackets. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively.

	Probability of default			Probability of prepayment		
	(1)	(2)	(3)	(4)	(5)	(6)
Subsidiary		-.00347	.0703**		.00133	-.000203
		(.0273)	(.0303)		(.00625)	(.00843)
Post		-.618***	-.487***		.0842***	.0828***
		(.173)	(.173)		(.0245)	(.0247)
*Subsidiary * Post*			-.506***			.00468
			(.0731)			(.0115)
FICO	-.015***	-.0149***	-.0149***	.000422***	.00042***	.00042***
	(.000245)	(.000245)	(.000244)	(.0000691)	(.0000691)	(.0000691)
CLTV	.00186***	.00185***	.00187***	-.00962***	-.00962***	-.00962***
	(.000521)	(.000521)	(.000519)	(.00024)	(.00024)	(.00024)
Age	.0371***	.0371***	.037***	.0283***	.0283***	.0283***
	(.00158)	(.00158)	(.00158)	(.00033)	(.000331)	(.000331)
Age^2	-.000186***	-.000187***	-.000186***	-.000192***	-.000192***	-.000192***
	(.0000133)	(.0000133)	(.0000133)	(2.45e-06)	(2.45e-06)	(2.45e-06)
RefiPenalty	-.0257	-.032	-.0445	-1.873***	-1.872***	-1.872***
	(.157)	(.157)	(.157)	(.0358)	(.0358)	(.0358)
InterestGap	.505***	.507***	.511***	.409***	.408***	.408***
	(.0295)	(.0295)	(.0294)	(.00806)	(.00807)	(.00807)
RelLoanSize	.0392	.0397	.0443	.406***	.406***	.406***
	(.0403)	(.0403)	(.0403)	(.00849)	(.00849)	(.00849)
Unemployment	.0586***	.0584***	.0584***	-.0526***	-.0526***	-.0526***
	(.00507)	(.00507)	(.00507)	(.0016)	(.0016)	(.0016)
HPI	-.00861***	-.00849***	-.0085***	-.00923***	-.00925***	-.00925***
	(.00129)	(.00129)	(.00129)	(.000291)	(.000291)	(.000291)
Condo	-.141***	-.141***	-.138***	-.0466***	-.0466***	-.0466***
	(.029)	(.0291)	(.029)	(.00673)	(.00675)	(.00675)
Observations	5,482,274	5,482,274	5,482,274	5,482,274	5,482,274	5,482,274
Clusters	136,886	136,886	136,886	136,886	136,886	136,886
Pseudo R^2	0.045	0.045	0.045	0.045	0.045	0.045

Table 5

Multinomial logit regressions based on monthly observations of conventional, amortizing (non-balloon, non-interest only) fixed-rate mortgages for purchases of single-family residences or condominiums in Maryland and Virginia originated by nonbank originators between 2000 and 2015. The sample is restricted to only mortgages originated by lenders that originated at least one mortgage before the policy change and at least one mortgage after the policy change. Variables are defined as in Table 1. Each coefficient estimate represents the effect on the probability of default or prepayment, relative to the probability of the mortgage remaining current, of a one-unit change in the corresponding variable. Vintage year indicators and a constant term are included in each specification. Standard errors clustered by loan appear in brackets. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively.

	Probability of default			Probability of prepayment		
	(1)	(2)	(3)	(4)	(5)	(6)
Subsidiary		-.051	.0405		-.0171**	-.0282**
		(.0323)	(.0371)		(.00745)	(.0114)
Post		-.639***	-.517***		.0808***	.0733***
		(.173)	(.174)		(.0259)	(.0262)
*Subsidiary * Post*			-.487***			.0255*
			(.0778)			(.0142)
FICO	-.0153***	-.0153***	-.0152***	.000831***	.000828***	.000825***
	(.000292)	(.000292)	(.000291)	(.0000845)	(.0000845)	(.0000845)
CLTV	.00171***	.0017***	.00171***	-.0102***	-.0103***	-.0103***
	(.000459)	(.000457)	(.000456)	(.000285)	(.000285)	(.000285)
Age	.0405***	.0406***	.0405***	.0339***	.0339***	.0339***
	(.00193)	(.00194)	(.00194)	(.000379)	(.000379)	(.000379)
Age^2	-.000206***	-.000207***	-.000207***	-.000215***	-.000215***	-.000215***
	(.0000174)	(.0000174)	(.0000174)	(2.95e-06)	(2.95e-06)	(2.95e-06)
RefiPenalty	.341*	.339*	.319*	-1.502***	-1.5***	-1.5***
	(.182)	(.182)	(.182)	(.04)	(.04)	(.04)
InterestGap	.516***	.515***	.523***	.408***	.407***	.407***
	(.0422)	(.0423)	(.0422)	(.01)	(.01)	(.01)
RelLoanSize	.082*	.0807*	.0865*	.396***	.395***	.395***
	(.0468)	(.0468)	(.0469)	(.00995)	(.00995)	(.00995)
Unemployment	.0579***	.0578***	.0577***	-.0407***	-.0406***	-.0406***
	(.00603)	(.00602)	(.00602)	(.002)	(.002)	(.002)
HPI	-.011***	-.0108***	-.0107***	-.00984***	-.00987***	-.00986***
	(.00176)	(.00175)	(.00175)	(.000393)	(.000393)	(.000393)
Condo	-.107***	-.109***	-.107***	-.0778***	-.0788***	-.0784***
	(.0331)	(.0332)	(.0331)	(.008)	(.00801)	(.00802)
Observations	3,853,328	3,853,328	3,853,328	3,853,328	3,853,328	3,853,328
Loans	96,657	96,657	96,657	96,657	96,657	96,657
Pseudo R^2	0.049	0.049	0.049	0.049	0.049	0.049

Table 6

Multinomial logit regressions based on monthly observations of conventional, amortizing (non-balloon, non-interest only) fixed-rate mortgages for purchases of single-family residences or condominiums in Maryland and Virginia originated by nonbank originators between 2000 and 2015. The sample is restricted to only mortgages originated by lenders that originated at least one mortgage in each of the ranges of years listed. Variables are defined as in Table 1. Each coefficient estimate represents the effect on the probability of default or prepayment, relative to the probability of the mortgage remaining current, of a one-unit change in the corresponding variable. Vintage year indicators and a constant term are included in each specification. Standard errors clustered by loan appear in brackets. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively.

	Probability of default				
	2008-2010	2007-2011	2006-2012	2005-2013	2004-2014
	(1)	(2)	(3)	(4)	(5)
Subsidiary	.0509	.0597	.0418	.00942	.0444
	(.0528)	(.0535)	(.0698)	(.0723)	(.0773)
Post	-.503***	-.652***	-.62**	-.591**	-.673**
	(.18)	(.234)	(.243)	(.244)	(.271)
*Subsidiary * Post*	-.486***	-.496***	-.446***	-.362***	-.431***
	(.0898)	(.0962)	(.107)	(.11)	(.115)
FICO	-.0166***	-.0161***	-.0177***	-.0178***	-.0179***
	(.000401)	(.000411)	(.000518)	(.00054)	(.000565)
CLTV	.00151***	.00147***	.00134***	.00129***	.00127***
	(.000396)	(.000388)	(.000367)	(.000365)	(.00036)
Age	.0444***	.0439***	.0482***	.0478***	.0468***
	(.00253)	(.00265)	(.00304)	(.00313)	(.00321)
Age^2	-.000233***	-.000229***	-.000255***	-.000254***	-.000249***
	(.0000246)	(.0000255)	(.0000291)	(.0000299)	(.0000305)
RefiPenalty	.872***	.897***	.982***	.885***	.751***
	(.22)	(.231)	(.258)	(.266)	(.273)
InterestGap	.377***	.394***	.317***	.297***	.295***
	(.0476)	(.0484)	(.0607)	(.0612)	(.0646)
RelLoanSize	.0274	.0407	-.0149	-.00576	-.0388
	(.0576)	(.0603)	(.0725)	(.0746)	(.0786)
Unemployment	.0527***	.0577***	.0416***	.0439***	.0444***
	(.00816)	(.00837)	(.0104)	(.0106)	(.011)
HPI	-.0107***	-.0117***	-.0109***	-.00981***	-.00932***
	(.00236)	(.00243)	(.00266)	(.00267)	(.0027)
Condo	-.119***	-.0999**	-.171***	-.139***	-.146***
	(.0425)	(.0446)	(.0521)	(.0536)	(.0556)
Observations	2,552,630	2,275,157	1,981,369	1,893,996	1,794,135
Clusters	64,896	58,192	50,915	48,870	46,203
Pseudo R^2	0.056	0.055	0.055	0.055	0.054
	Probability of prepayment				
	2008-2010	2007-2011	2006-2012	2005-2013	2004-2014
	(1)	(2)	(3)	(4)	(5)
Subsidiary	-.0238	-.0287*	-.0807***	-.0853***	-.105***
	(.0167)	(.0172)	(.0202)	(.0205)	(.0215)

Post	.103***	.0955***	.0817**	.0806**	.114***
	(.0291)	(.0332)	(.0355)	(.0365)	(.0387)
*Subsidiary * Post*	.0203	.0447**	.0922***	.0907***	.11***
	(.0193)	(.02)	(.0227)	(.0231)	(.0241)
FICO	.00131***	.00124***	.00125***	.00122***	.00115***
	(.000107)	(.000112)	(.00012)	(.000123)	(.000126)
CLTV	-.0102***	-.0104***	-.0102***	-.0102***	-.0101***
	(.000358)	(.000385)	(.00043)	(.000433)	(.000457)
Age	.0432***	.0431***	.0466***	.0467***	.0462***
	(.0005)	(.000533)	(.000594)	(.000612)	(.000628)
Age^2	-.000276***	-.00028***	-.000304***	-.000307***	-.000304***
	(4.20e-06)	(4.47e-06)	(5.02e-06)	(5.19e-06)	(5.31e-06)
RefiPenalty	-1.61***	-1.62***	-1.532***	-1.549***	-1.553***
	(.0472)	(.0501)	(.0528)	(.0539)	(.0556)
InterestGap	.373***	.369***	.373***	.377***	.381***
	(.0124)	(.0129)	(.014)	(.0143)	(.0146)
RelLoanSize	.389***	.386***	.385***	.382***	.381***
	(.0118)	(.0126)	(.0134)	(.0136)	(.0139)
Unemployment	-.0333***	-.035***	-.0376***	-.0385***	-.0422***
	(.00261)	(.00272)	(.00297)	(.00302)	(.0031)
HPI	-.011***	-.0111***	-.0126***	-.0128***	-.013***
	(.000554)	(.000573)	(.000605)	(.000612)	(.000616)
Condo	-.102***	-.09***	-.0933***	-.0939***	-.0949***
	(.00981)	(.0105)	(.0111)	(.0114)	(.0117)
Observations	2,552,630	2,275,157	1,981,369	1,893,996	1,794,135
Clusters	64,896	58,192	50,915	48,870	46,203
Pseudo R^2	0.056	0.055	0.055	0.055	0.054

Table 7

Multinomial logit regressions based on monthly observations of conventional, amortizing (non-balloon, non-interest only) fixed-rate mortgages for purchases of single-family residences or condominiums in Maryland and Virginia originated by nonbank originators between 2000 and 2015. The sample is restricted to only the first one, two, three, or four years of each mortgage's performance. Variables are defined as in Table 1. Each coefficient estimate represents the effect on the probability of default or prepayment, relative to the probability of the mortgage remaining current, of a one-unit change in the corresponding variable. Vintage year indicators and a constant term are included in each specification. Standard errors clustered by loan appear in brackets. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively.

	Probability of default			
	One year	Two years	Three years	Four years
	(1)	(2)	(3)	(3)
Subsidiary	-.00292	.0112	.00278	.00472
	(.0775)	(.0505)	(.0421)	(.0378)
Post	-.955	-.87**	-.82***	-.583***
	(.749)	(.346)	(.277)	(.221)
*Subsidiary * Post*	-.489**	-.64***	-.499***	-.535***
	(.224)	(.131)	(.101)	(.0887)
FICO	-.018***	-.0175***	-.0167***	-.0162***
	(.000568)	(.00038)	(.000321)	(.000299)
CLTV	.0025***	.00277***	.00271***	.00254***
	(.000445)	(.000526)	(.000532)	(.000541)
Age	.68***	.264***	.171***	.117***
	(.0405)	(.0126)	(.00686)	(.00442)
Age^2	-.0354***	-.0069***	-.00324***	-.00168***
	(.00299)	(.000469)	(.000179)	(.0000902)
RefiPenalty	-.883*	-1.061***	-.774***	-.646***
	(.52)	(.286)	(.23)	(.205)
InterestGap	.658***	.595***	.563***	.554***
	(.0422)	(.0338)	(.0306)	(.0297)
RelLoanSize	.223**	.135**	.104**	.0814*
	(.0971)	(.0599)	(.0503)	(.046)
Unemployment	-.00964	-.000526	.0205***	.0369***
	(.0167)	(.00938)	(.00711)	(.00601)
HPI	-.0244**	-.00709*	-.0112***	-.0105***
	(.0115)	(.00403)	(.00254)	(.00196)
Condo	-.0425	-.18***	-.166***	-.178***
	(.0763)	(.0482)	(.0393)	(.0352)
Observations	1,672,450	2,830,755	3,647,314	4,232,335
Clusters	136,886	136,886	136,886	136,886
Pseudo R^2	0.107	0.097	0.082	0.071
	Probability of prepayment			
	One year	Two years	Three years	Four years
	(1)	(2)	(3)	(3)
Subsidiary	-.0384**	-.0258**	.00655	.0124
	(.0178)	(.0114)	(.0101)	(.00962)

Post	-.00388	.0232	.171***	.091**
	(.157)	(.0863)	(.0476)	(.0357)
*Subsidiary * Post*	.111***	.0102	-.0327*	-.0299**
	(.0354)	(.0214)	(.017)	(.0149)
FICO	.00236***	.00108***	.000774***	.000628***
	(.000162)	(.000101)	(.000086)	(.0000793)
CLTV	-.00909***	-.00729***	-.00776***	-.00869***
	(.000641)	(.00041)	(.000324)	(.000282)
Age	.453***	.249***	.16***	.116***
	(.0104)	(.00331)	(.00176)	(.00119)
Age^2	-.0205***	-.00706***	-.00331***	-.00189***
	(.000711)	(.000117)	(.0000443)	(.0000233)
RefiPenalty	-5.033***	-5.461***	-4.657***	-3.894***
	(.141)	(.0732)	(.0547)	(.046)
InterestGap	.875***	.708***	.618***	.573***
	(.0182)	(.0134)	(.0117)	(.0103)
RelLoanSize	.605***	.54***	.485***	.459***
	(.0186)	(.0122)	(.0105)	(.00963)
Unemployment	.00435	.00409	-.00216	-.0105***
	(.00504)	(.00307)	(.00245)	(.00213)
HPI	.0236***	.00658***	-.00387***	-.00903***
	(.0027)	(.00099)	(.000567)	(.000414)
Condo	-.0196	-.0448***	-.056***	-.0601***
	(.0169)	(.0106)	(.00895)	(.00814)
Observations	1,672,450	2,830,755	3,647,314	4,232,335
Clusters	136,886	136,886	136,886	136,886
Pseudo R^2	0.107	0.097	0.082	0.071

Table 8

Two-stage least squares regressions based on loan-level observations of conventional, amortizing (non-balloon, non-interest only) fixed-rate mortgages for purchases of single-family residences or condominiums in Maryland and Virginia originated by nonbank originators between 2000 and 2015. Variables are defined as in Table 2. Vintage year indicators and a constant term are included in each specification. Standard errors appear in brackets. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively.

	Dependent variable: *InitialRate*			Dependent variable: *LTV*		
	(1)	(2)	(3)	(4)	(5)	(6)
Subsidiary		.0161***	.0211***		-1.442***	-1.297***
		(.00294)	(.0034)		(.0987)	(.115)
Post		.0462***	.0521***		-1.309**	-1.138**
		(.0151)	(.0152)		(.51)	(.515)
*Subsidiary * Post*			-.0193***			-.559**
			(.00667)			(.226)
LTV	.0148***	.0147***	.0147***			
	(.000344)	(.000343)	(.000343)			
InitialRate				-4.665***	-4.211***	-4.255***
				(.871)	(.866)	(.868)
FICO	-.00134***	-.00134***	-.00134***	-.0775***	-.076***	-.0761***
	(.0000386)	(.0000385)	(.0000384)	(.00219)	(.00217)	(.00218)
RelLoanSize	-.251***	-.25***	-.25***	7.619***	7.685***	7.686***
	(.00415)	(.00415)	(.00415)	(.171)	(.17)	(.17)
OwnerOcc	-.273***	-.274***	-.274***	-1.041***	-.851***	-.874***
	(.00375)	(.00375)	(.00376)	(.264)	(.263)	(.264)
Term30	.473***	.473***	.473***	15.53***	15.21***	15.23***
	(.00785)	(.00783)	(.00783)	(.619)	(.616)	(.617)
Prime	.134***	.133***	.133***			
	(.00322)	(.00322)	(.00322)			
Age15-34				.118***	.116***	.116***
				(.0116)	(.0115)	(.0115)
Age35-54				.0907***	.0911***	.0907***
				(.0203)	(.0202)	(.0202)
Age55-69				-.13***	-.129***	-.13***
				(.0149)	(.0149)	(.0149)
Age70plus				-.0734***	-.0728***	-.073***
				(.0145)	(.0145)	(.0145)
Value$1-$2				-.0423***	-.0414***	-.0414***
				(.00686)	(.00683)	(.00683)
Value$2-$3				-.139***	-.138***	-.138***
				(.00677)	(.00674)	(.00674)
Value$3-$5				-.119***	-.118***	-.118***
				(.00699)	(.00696)	(.00697)
Value$5plus				-.25***	-.25***	-.25***
				(.00685)	(.00682)	(.00682)
Observations	129,316	129,316	129,316	129,316	129,316	129,316
R^2	0.787	0.788	0.788	0.115	0.122	0.122

Table 9

Two-stage least squares regressions based on loan-level observations of conventional, amortizing (non-balloon, non-interest only) fixed-rate mortgages for purchases of single-family residences or condominiums in Maryland and Virginia originated by nonbank originators between 2000 and 2015. The sample is restricted to only mortgages originated by lenders that originated at least one mortgage before the policy change and at least one mortgage after the policy change. Variables are defined as in Table 2. Vintage year indicators and a constant term are included in each specification. Standard errors appear in brackets. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively.

	Dependent variable: *InitialRate*			Dependent variable: *LTV*		
	(1)	(2)	(3)	(4)	(5)	(6)
Subsidiary		-.00208	-.000906		-1.565***	-1.354***
		(.00342)	(.00423)		(.13)	(.16)
Post		.0457***	.0467***		-1.287**	-1.107**
		(.0146)	(.0148)		(.55)	(.556)
*Subsidiary * Post*			-.00333			-.595**
			(.00707)			(.266)
LTV	.0133***	.0134***	.0134***			
	(.000396)	(.000394)	(.000395)			
InitialRate				-5.642***	-5.296***	-5.341***
				(1.231)	(1.222)	(1.223)
FICO	-.00128***	-.00127***	-.00127***	-.0757***	-.0748***	-.0748***
	(.0000446)	(.0000445)	(.0000445)	(.00283)	(.00281)	(.00281)
RelLoanSize	-.21***	-.21***	-.21***	8.154***	8.184***	8.191***
	(.00482)	(.00481)	(.00482)	(.204)	(.203)	(.203)
OwnerOcc	-.274***	-.274***	-.274***	-.29	-.235	-.247
	(.00452)	(.00452)	(.00452)	(.355)	(.353)	(.353)
Term30	.516***	.516***	.516***	16.75***	16.47***	16.49***
	(.00931)	(.00929)	(.00929)	(.901)	(.894)	(.895)
Prime	.139***	.139***	.139***			
	(.00425)	(.00425)	(.00425)			
Age15-34				.106***	.105***	.105***
				(.0144)	(.0143)	(.0143)
Age35-54				.105***	.105***	.105***
				(.025)	(.0249)	(.025)
Age55-69				-.129***	-.129***	-.129***
				(.0187)	(.0187)	(.0187)
Age70plus				-.0676***	-.0677***	-.0678***
				(.018)	(.018)	(.018)
Value$1-$2				-.0704***	-.0679***	-.068***
				(.00946)	(.00941)	(.00942)
Value$2-$3				-.153***	-.153***	-.153***
				(.00889)	(.00887)	(.00887)
Value$3-$5				-.132***	-.131***	-.131***
				(.00935)	(.00931)	(.00931)
Value$5plus				-.267***	-.266***	-.266***
				(.00909)	(.00905)	(.00906)

Observations	89,493	89,493	89,493	89,493	89,493	89,493
R^2	0.802	0.802	0.802	0.094	0.099	0.099

Table 10

Two-stage least squares regressions based on loan-level observations of conventional, amortizing (non-balloon, non-interest only) fixed-rate mortgages for purchases of single-family residences or condominiums in Maryland and Virginia originated by nonbank originators between 2000 and 2015. The sample is restricted to only mortgages originated by lenders that originated at least one mortgage in each of the ranges of years listed. Variables are defined as in Table 2. Vintage year indicators and a constant term are included in each specification. Standard errors appear in brackets. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively.

	Dependent variable: *InitialRate*				
	2008-2010	2007-2011	2006-2012	2005-2013	2004-2014
	(1)	(2)	(3)	(4)	(5)
Subsidiary	-.073***	-.0646***	-.067***	-.0735***	-.101***
	(.00656)	(.0064)	(.00772)	(.00792)	(.00833)
Post	.0239	.0404**	.0592***	.0561***	.0558***
	(.0153)	(.0166)	(.0176)	(.0182)	(.0194)
*Subsidiary * Post*	.0763***	.0742***	.0724***	.0793***	.106***
	(.00876)	(.00865)	(.00972)	(.00996)	(.0104)
LTV	.0123***	.0133***	.0137***	.0135***	.0135***
	(.000483)	(.000476)	(.000525)	(.000533)	(.00055)
FICO	-.00154***	-.00153***	-.00131***	-.00139***	-.00139***
	(.0000548)	(.0000544)	(.0000592)	(.0000598)	(.0000618)
RelLoanSize	-.184***	-.196***	-.188***	-.186***	-.189***
	(.00574)	(.00577)	(.00617)	(.00627)	(.00651)
OwnerOcc	-.258***	-.262***	-.253***	-.252***	-.249***
	(.00571)	(.00567)	(.00611)	(.00621)	(.00636)
Term30	.539***	.528***	.54***	.549***	.548***
	(.0111)	(.0109)	(.0119)	(.0121)	(.0125)
Prime	.151***	.151***	.163***	.163***	.17***
	(.00574)	(.00559)	(.00621)	(.00633)	(.00653)
Observations	59,291	53,241	46,076	44,262	41,788
R^2	0.803	0.831	0.837	0.84	0.842
	Dependent variable: *LTV*				
	2008-2010	2007-2011	2006-2012	2005-2013	2004-2014
	(1)	(2)	(3)	(4)	(5)
Subsidiary	-2.502***	-3.138***	-3.121***	-3.045***	-2.851***
	(.303)	(.22)	(.264)	(.274)	(.296)
Post	-1.867***	-2.666***	-2.636***	-2.332***	-2.587***
	(.64)	(.515)	(.553)	(.574)	(.606)
*Subsidiary * Post*	.562	1.336***	1.351***	1.465***	1.16***
	(.381)	(.281)	(.319)	(.329)	(.349)
InitialRate	-3.859**	-4.207***	-5.313***	-5.302***	-5.053***
	(1.652)	(1.202)	(1.269)	(1.291)	(1.261)
FICO	-.0715***	-.0737***	-.0751***	-.0738***	-.0741***
	(.00405)	(.00302)	(.00299)	(.0031)	(.00306)
RelLoanSize	8.398***	8.674***	8.481***	8.478***	8.601***
	(.257)	(.19)	(.201)	(.205)	(.21)
OwnerOcc	.583	.685**	.657*	.582*	.514

	(.45)	(.33)	(.342)	(.348)	(.344)
Term30	15.76***	15.84***	17.03***	16.91***	16.67***
	(1.226)	(.893)	(.972)	(.995)	(.977)
Age15-34	.0978***	.0973***	.0949***	.0947***	.0988***
	(.0188)	(.0139)	(.0151)	(.0154)	(.0158)
Age35-54	.132***	.0971***	.095***	.0965***	.0897***
	(.0333)	(.0245)	(.0269)	(.0275)	(.0283)
Age55-69	-.12***	-.116***	-.117***	-.117***	-.124***
	(.0244)	(.0179)	(.0193)	(.0197)	(.0202)
Age70plus	-.0617**	-.072***	-.065***	-.066***	-.0627***
	(.0241)	(.0178)	(.0195)	(.0199)	(.0204)
Value$1-$2	-.0663***	-.0626***	-.0739***	-.0765***	-.0769***
	(.0149)	(.0108)	(.0122)	(.0124)	(.0125)
Value$2-$3	-.154***	-.151***	-.157***	-.16***	-.161***
	(.0145)	(.0106)	(.0117)	(.0119)	(.012)
Value$3-$5	-.119***	-.125***	-.137***	-.14***	-.138***
	(.0152)	(.0111)	(.0124)	(.0127)	(.0127)
Value$5plus	-.261***	-.26***	-.266***	-.269***	-.267***
	(.0145)	(.0106)	(.0119)	(.0122)	(.0121)
Observations	59,291	53,241	46,076	44,262	41,788
R^2	0.096	0.18	0.154	0.149	0.155

Table 11

Robustness checks of the main results from Tables 4 and 8. Panels A and B present results for key variables from multinomial logit regressions similar to those in Table 4. Panels C and D present results for key variables from two-stage least squares regressions similar to those in Table 8. Variables are defined as in Tables 1 and 2. Vintage year indicators and a constant term are included in each specification. Standard errors (clustered by loan in Panels A and B) appear in brackets. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively. Model 1 in Panels A and B and in Panels C and D show results from Tables 4 and 8, respectively. Models 2 through 4 redefine *Post* to represent alternative policy treatment dates. Model 5 restricts the sample to loans originated after 2002. Models 6 and 7 use balanced subsamples created through propensity score matching and through omitting randomly selected observations in each vintage year, respectively. Model 8 omits loans that exhibited a change in ownership during the sample period. Model 9 restricts the sample to loans owned by a government-sponsored enterprise at any point during the sample period.

Panel A

	Probability of default								
	Table 4, model 3	2007 policy treatment	2010 policy treatment	2011 policy treatment	2000-02 omitted	Propensity score	Random	Transfers omitted	GSE-owned
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Subsidiary	.0703**	.0807**	.0702**	.0554*	.0708**	-.0509	.0879***	.0511*	.0999***
	(.0303)	(.0341)	(.0301)	(.0293)	(.0315)	(.0356)	(.0328)	(.0307)	(.0329)
Post	-.487***	.258***	.535***	.551***	-.473***	-.628**	-.283	-.589***	-.569***
	(.173)	(.068)	(.196)	(.12)	(.173)	(.249)	(.22)	(.173)	(.183)
*Subsidiary * Post*	-.506***	-.241***	-.541***	-.58***	-.509***	-.479***	-.525***	-.578***	-.53***
	(.0731)	(.0588)	(.0756)	(.0865)	(.0736)	(.0834)	(.0766)	(.0729)	(.0759)

Panel B

	Probability of prepayment								
	Table 4, model 3	2007 policy treatment	2010 policy treatment	2011 policy treatment	2000-02 omitted	Propensity score	Random	Transfers omitted	GSE-owned
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Subsidiary	-.000203	.00248	-.000371	-.000872	-.0202**	.139***	.00266	-.0217**	.0453***
	(.00843)	(.00921)	(.0082)	(.00766)	(.01)	(.00932)	(.00861)	(.00848)	(.00914)
Post	.0828***	.15***	-.0205	-.0507**	.0303	.143***	.0686**	.0559**	.109***
	(.0247)	(.0274)	(.0259)	(.0207)	(.0273)	(.0323)	(.032)	(.0241)	(.0257)
*Subsidiary * Post*	.00468	-.000717	.00597	.0089	.021	-.125***	.00795	-.009	-.0363***
	(.0115)	(.0119)	(.0115)	(.0114)	(.0131)	(.0132)	(.012)	(.0114)	(.0123)

Panel C

	Dependent variable: *InitialRate*								
	Table 8, model 3	2007 policy treatment	2010 policy treatment	2011 policy treatment	2000-02 omitted	Propensity score	Random	Transfers omitted	GSE-owned
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Subsidiary	.0211***	.0269***	.0207***	.0213***	.0195***	.0115***	.0232***	.0243***	.00658*
	(.0034)	(.00365)	(.00333)	(.00319)	(.00414)	(.00379)	(.00357)	(.00352)	(.00345)
Post	.0521***	.293***	-.417***	-.477***	.0536***	.0441**	.0312	.0529***	.0438***
	(.0152)	(.0107)	(.0148)	(.0119)	(.0155)	(.0196)	(.0202)	(.0153)	(.0142)
*Subsidiary * Post*	-.0193***	-.0238***	-.02***	-.0448***	-.0174**	-.00827	-.0178**	-.033***	-.00157
	(.00667)	(.00609)	(.00687)	(.0079)	(.00715)	(.00713)	(.00723)	(.00679)	(.00644)

Panel D

	Dependent variable: *LTV*								
	Table 8, model 3	2007 policy treatment	2010 policy treatment	2011 policy treatment	2000-02 omitted	Propensity score	Random	Transfers omitted	GSE-owned
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Subsidiary	-1.297***	-1.221***	-1.315***	-1.5***	-1.495***	-1.269***	-1.246***	-1.41***	-1.385***
	(.115)	(.123)	(.113)	(.108)	(.151)	(.132)	(.121)	(.119)	(.126)
Post	-1.138**	2.9***	-.354	-1.041*	-.92	-.851	-.0615	-1.009*	-1.184**
	(.515)	(.409)	(.612)	(.568)	(.566)	(.694)	(.687)	(.519)	(.523)
*Subsidiary * Post*	-.559**	-.537***	-.548**	.332	-.478*	-.856***	-.816***	-.216	-.846***
	(.226)	(.206)	(.234)	(.271)	(.261)	(.255)	(.247)	(.232)	(.236)