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### The Marginal Effect of First-Time Homebuyer Status on Mortgage Default and Prepayment

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# The Marginal Effect of First-Time Homebuyer Status on Mortgage Default and Prepayment

## Abstract

This paper examines the loan performance of Fannie Mae and Freddie Mac first-time homebuyer mortgages originated from 1996 to 2012. First-time homebuyer mortgages generally perform worse than repeat homebuyer mortgages. But first-time homebuyers are younger and have lower credit scores, home equity, and income than repeat homebuyers, and therefore are comparatively less likely to withstand financial stress or take advantage of financial innovations available in the market. The distributional make-up of first-time homebuyers is different than that of repeat homebuyers in terms of many borrower, loan, and property characteristics that can be determined at the time of loan origination. Once these distributional differences are accounted for in an econometric model, there is virtually no difference between the average first-time and repeat homebuyers in their probabilities of mortgage default. Hence, the difference between the first-time and repeat homebuyer mortgage defaults can be attributed to the difference in the distributional make-up of the two groups and not to the premise that first-time homebuyers are an inherently riskier group. However, there appears to be an inherent difference in the prepayment probabilities of first-time and repeat homebuyers holding borrower, loan, and property characteristics constant. First-time homebuyers are less likely to prepay their mortgages compared to repeat homebuyers even after accounting for the distributional make-up of the two groups using information known at the time of loan origination.

**Keywords:** mortgage · loan performance · default · prepayment · first-time homebuyer · repeat homebuyer · home purchase · homeownership · Fannie Mae · Freddie Mac

**JEL Classification:** G21 · J11 · R21

# I Introduction

While there are widely-perceived benefits of homeownership and overwhelming support for homeownership in the United States,<sup>1</sup> the Great Recession also brought to the fore the perils of unsustainable homeownership. During the crisis, a record number of homeowners became unable to pay their mortgages and many lost their homes. According to a Core Logic report in October 2014, there were 7 million foreclosure completions in the United States since the second quarter of 2004 when the homeownership rate peaked (equivalent to 15 percent of all mortgages) and over 5 million of those foreclosure completions occurred since the financial crisis began in September 2008.<sup>2</sup> In addition, over 600,000 homes were still in some stage of foreclosure as of August 2014, a level nearly three times the historical norm.<sup>3</sup> To assess and understand the state of sustainable homeownership in the United States, studying mortgage loan performance in general—and that of first-time homebuyers in particular—is important.

Given that many government policies focus on incentives for first-time homebuyers, it is important to better understand whether first-time homebuyers as a group, holding all other factors constant, default on their mortgages at a higher rate than experienced homebuyers. For example, if first-time homebuyers do default on their mortgages at a higher level than experienced homebuyers, a rapid rise in first-time homebuyers could lead to increased foreclosures and negatively affect communities. On the other hand, if first-time homebuyers do not default at a higher rate than repeat homebuyers, all else equal, it would be important to demonstrate that first-time homebuyers, as a group, all else equal, are not inherently riskier than experienced homebuyers.

There have been numerous studies on various aspects of first-time homeownership and mort-

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<sup>1</sup>For example, see [Herbert et al. \(2013\)](#).

<sup>2</sup>See [Core Logic press release](#).

<sup>3</sup>Ibid.

gage loan performance and a small number that have touched on both topics. However, existing studies discuss loan performance of first-time homebuyers cursorily and only using data of loans guaranteed by the Federal Housing Administration (FHA). Furthermore, because the existing studies were not designed to study first-time homebuyers specifically, the findings regarding first-time homebuyer loan performance across the handful of papers are not always consistent with each other.

This paper aims to contribute to the current literature by developing a modeling approach specifically to discuss loan performance of first-time homebuyers using data on mortgages acquired by Fannie Mae and Freddie Mac, referred to as the “Enterprises” in this paper. It seeks to answer the following two main questions:

1. Do first-time homebuyer mortgages perform worse than repeat homebuyer mortgages?
2. Do any differences in performance of first-time and repeat homebuyer mortgages persist holding constant borrower, loan, and property characteristics known at the time of mortgage origination?

This paper will analyze mortgage default and prepayment as the two loan performance outcomes of interest. First-time homebuyer mortgages are compared to mortgages taken out by experienced homebuyers, i.e. existing homeowners who are moving to a new home. Such homebuyers are known in the literature as “move-up” or “repeat” homebuyers. This paper focuses exclusively on mortgages acquired by the Enterprises because collectively the two agencies have had more than 40 percent of the purchase-money mortgage market since 2007<sup>4</sup> and no study has analyzed first-time homebuyer loan performance of Enterprise mortgages to date. This paper uses the data on the universe of purchase-money mortgages originated from 1996 to 2012 and then acquired by the Enterprises by the end of 2013 and relies on

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<sup>4</sup>See [Patrabansh \(2013\)](#) for the relative share of Enterprise purchase-money mortgages over time, and the first-time homebuyer share and descriptions of Enterprise as well as FHA mortgages over time.

the information about first-time homebuyer status that is self-reported on the mortgage application by the borrowers along with other information captured at that time.

There are six main sections in this paper. After this short introduction, the second section presents a brief discussion of existing literature. The third section develops theoretical rationale for why first-time and repeat homebuyer mortgages could perform differently. The fourth section defines first-time and repeat homebuyers as they appear in the data and describes their key characteristics and mortgage loan performance. The fifth section describes the multinomial logit loan performance model of first-time and repeat homebuyer mortgages and presents a discussion of the empirical results. The last section concludes the paper.

## II Existing Literature

Existing literature on first-time homebuyers have covered many aspects such as the home purchase decision, residential investment volatility, mortgage choice, effects of perceptions of borrowing capacity on mortgage debt, home prices, effects of the first-time homebuyer tax credit, effects of housing counseling, and neighborhood quality. [Cooperstein \(1989\)](#) models the decision to become a first-time homebuyer and suggests the importance of reducing the transactions costs of buying. [Fisher & Gervais \(2007\)](#) show that marriages coincide with first-time homebuyership. [Dhillon et al. \(1987\)](#) show that mortgage choice between fixed and adjustable rates does not depend on most homebuyer characteristics, including first-time homebuyer status. [Moulton et al. \(2013\)](#) show that perceptions of borrowing capacity affect the level of mortgage debt for low-to-moderate income first-time homebuyers. [Turnbull & Sirmans \(1993\)](#) show that home prices paid by first-time homebuyers do not differ from prices paid by repeat buyers for homes of similar characteristics. [Smith \(2009\)](#) and [Dyan et al. \(2013\)](#) discuss the post-crisis tax credit program and [Schwinden \(2011\)](#) and [Baker \(2012\)](#) show large effect of the tax credit program on home prices. [Collins & O'Rourke \(2011\)](#) provide an extensive literature review of homeownership counseling, including that

for first-time homebuyers. [Van Zandt & Rohe \(2006\)](#) and [Van Zandt \(2007\)](#) show that the neighborhood quality of low-income first-time homebuyers is the same or poorer compared to that of their prior rentals, but conclude that this may be due to locational preference rather than discrimination.

There is an even more extensive body of literature on mortgage loan performance that dates back to the 1960s, with early contributions by [Herzog & Earley \(1970\)](#) and [von Furstenberg & Green \(1974\)](#). [Quercia & Stegman \(1992\)](#) provide an extensive literature review of mortgage loan performance literature up to the early 1990s and [GAO \(2005\)](#) extends the review to the mid-2000s including, [Pennington-Cross \(2003\)](#), one of the first studies to develop the competing risk hazard models. Recent literature have developed relationship of mortgage performance with state laws ([Pence 2006](#)), neighborhood characteristics ([Chan et al. \(2013\)](#) and [Bradley et al. \(2015\)](#)), downpayment ([Kelly \(2008\)](#) and [Lam et al. \(2013\)](#)), negative equity ([Fuster & Willen 2013](#)), second liens ([Lee et al. \(2012\)](#), [Been et al. \(2012\)](#), and [Leventis \(2014\)](#)) and servicer heterogeneity ([Reid et al. 2014](#)).

Even though there exists a healthy volume of literature on both first-time homebuyers and mortgage loan performance, very few studies have discussed loan performance of first-time homebuyers. A handful of studies of FHA mortgages have discussed loan performance of first-time homebuyers in passing while conducting research on various topics. Because these studies were not designed to analyze first-time homebuyer loan performance as their primary focus, their results do not fully or consistently answer the research questions of this paper posed in the introduction above.

In a paper examining mortgage discrimination and FHA loan performance, [Berkovec et al. \(1998\)](#) show significantly higher default likelihood for first-time homebuyers. That paper only models default in a logistic framework and does not model default and prepayment

jointly. Two papers by Ambrose and Capone jointly model default and prepayment probabilities of a sample of FHA loans with the first-time homebuyer variable as a control variable. The first paper (Ambrose & Capone 1998) employing a multinomial logit framework shows that among defaulted loans, first-time homebuyers prepay at a lower rate but do not default at a higher rate. Instead, they appear to reinstate more. Regression results of the second paper employing a competing risk hazard framework (Ambrose & Capone 2000) show that first-time homebuyers have a higher probability of prepayment but not default and a lower probability of second default. Another paper employing the competing risk framework to study risk-based pricing and mortgage credit availability in underserved and high-risk populations (Deng & Gabriel 2006) shows that first-time homebuyers have a dampened prepayment rate but not default rate. The last paper by Kelly (2008) analyzes the relationship of downpayment with mortgage default using Heckman’s continuous time model and finds that first-time homebuyers prepay at a lower rate and may also default at a lower rate.

As mentioned above, the primary goal of the aforementioned papers was not to study the loan performance of first-time homebuyers. Therefore their sample selection and modeling strategies were not designed for estimating first-time homebuyer loan performance. Moreover, because existing papers only analyze FHA mortgages, loan performance of Enterprise first-time homebuyers is not known widely. This paper builds on existing literature by focusing exclusively on the loan performance of first-time homebuyers served by the Enterprises since 1996.

### **III Theoretical Foundation**

This section does not aim to provide a complete theoretical foundation for mortgage loan performance of first-time homebuyers. However, it is worthwhile to develop even a simplistic framework to analyze different factors that might affect various mechanisms through which first-time and repeat homebuyer loan performance may differ. Even when this framework

does not constitute a well-developed theory, it can help explain what can affect first-time homebuyer loan performance and how. This framework will also help build a robust empirical model. However, this paper does not seek to estimate empirically how each factor affects first-time homebuyer loan performance. Rather, the goal of this paper is to test if the difference in loan performance of first-time and repeat homebuyer persists after accounting for factors that can affect loan performance. In the empirical model, borrower, loan, and property characteristics known at the time of mortgage origination are incorporated to account for factors affecting loan performance. It is expected that the average loan performance of first-time and repeat homebuyers, at least in terms of default, will not differ very much after accounting for borrower, loan, and property characteristics known at the time of mortgage origination if the default risk is assumed to be accurately captured in these observable variables.

Much of the literature on mortgage loan performance has used option price theory to model and value mortgage default and prepayment. The role of equity in affecting mortgage default is well established in the literature including, [Vandell \(1995\)](#) and [Avery et al. \(1996\)](#). Borrowers exercising the “put option” to default on a mortgage obligation (i.e. transfer ownership to the lender) when the market value of the house drops below the unpaid principal balance on the mortgage is often termed “ruthless” or “strategic” default. The role of trigger events in affecting mortgage default has also been developed in the literature including, [Ambrose & Capone \(1998\)](#) and [Avery et al. \(1996\)](#).

Trigger events can be at the micro level (e.g. divorce, health problems, or job loss in the household) or the macro level (e.g. economic downturn, or house price decline in the city, county, or state). A trigger event may not necessarily cause mortgage default by itself because the borrower can sell the property instead and may even earn a profit. Moreover, mortgage default is not costless: moving can be costly and any damage to the borrower credit

score can be devastating. Rather, the combination of a trigger event with an “underwater” mortgage may provide the toxic recipe for mortgage default where the trigger event could act as the catalyst. Nevertheless, trigger events are not expected to strike first-time and repeat homebuyers differently. To the extent trigger events affect the loan performance of first-time and repeat homebuyers differently, the framework identifying the factors affecting loan performance should incorporate the triggers.

In contrast to mortgage default, mortgage prepayment has been modeled as the exercise of the “call option” by the borrower in the literature including, [Dunsky & Ho \(2007\)](#) and [Goodstein \(2014\)](#). Borrowers refinance their mortgages when the benefit of doing so exceeds cost, i.e. when refinancing is “in the money.” The benefits are mainly influenced by the borrower’s mortgage rate relative to the market rate, future interest rate changes, and the expected length of stay in the home. Costs of refinancing a loan can be quite large and sometimes prohibitive. Just as a trigger event can act as a catalyst in mortgage default, a refinance can be hampered by borrower, loan, or property constraints such as an “underwater” mortgage or insufficient funds for closing costs. The second cause of prepayment—home sales—can be driven by macroeconomic and local conditions as well as borrower, loan, or property specifics.

Therefore, the overall loan performance of first-time and repeat homebuyers could differ due to various mechanisms driven by borrower, loan or property factors. A logic model could be developed to illustrate a framework of such mechanisms and it can be integrated with the existing option price theory. This section aims to make a preliminary contribution towards such a logic model by outlining three main factors. The borrower factor can be further classified into three subfactors: sophistication, endurance, and intentions. The loan factor can be further divided into product and institution subfactors. Finally, the property factor can be separated into quality and location subfactors.

- A1. **Borrower Sophistication:** Whether mortgage defaults are due to trigger events, “underwater” mortgages, or some combination, borrower sophistication or experience can influence the outcome. Sophisticated or experienced borrowers may find ways to keep mortgages current when faced with trigger events while less sophisticated or less experienced borrowers may not have the same ability. At the same time, sophisticated or experienced borrowers may default strategically or refinance their loans when rates fall sufficiently while less sophisticated or less experienced borrowers may not. Borrower sophistication or experience is hard to measure but may be demonstrated by borrower age, education, profession, and credit history. Presence of housing counseling may also indicate borrower sophistication or experience. Borrower sophistication can also be a result of external factors such as the presence of formal (e.g. accountants) or informal (e.g. parents) financial advisors.

To the extent first-time homebuyers are less-experienced or less-sophisticated than repeat homebuyers, the former group can be expected to default at a higher rate and prepay at a lower rate.

- A2. **Borrower Endurance:** Borrower financial endurance or strength can also determine whether a borrower defaults when faced with a trigger event, “underwater” mortgage, or some combination, and whether the borrower is able to refinance when it is financially optimal to do so. Credit scores, home equity, debt leverage, employment, income, and non-residential wealth or reserves can indicate financial endurance or strength of borrowers. However, like borrower sophistication, borrower endurance is also difficult to measure.

First-time homebuyers may have less financial endurance or strength compared to repeat homebuyers and thus may default at a higher rate and refinance at a lower rate.

They may not be able to weather “underwater” mortgages or afford refinancing costs as much as repeat homebuyers. Even when they could afford refinancing costs, their credit scores, debt or employment circumstances may not enable them to qualify for attractive refinancing rates and thus make refinancing less appealing.

- A3. **Borrower Intentions:** Borrower intentions can heavily influence default and prepayment behaviors. But they are even harder to measure than borrower sophistication and endurance. Some borrowers who choose to default strategically without presence of trigger events may be acting on existing intentions. Some borrowers may not choose to refinance even when interest rates fall because they may be planning to only live in their home for a few years. Even though borrower intentions are hard to measure, information about housing tenure and marital status may indicate some borrower intentions.

First-time homebuyers may purchase a home with the intention of only living in the home for a short period of time and may therefore not refinance as readily as repeat homebuyers even when interest rates fall. They may also want to use their savings to purchase a new home in the future rather than pay for refinancing costs.

- B1. **Loan Product:** In addition to borrower factors, loan performance can also depend on loan factors. Subprime and non-traditional mortgages could default at a higher rate. Mortgages with pre-payment penalties may be less likely to refinance.

If first-time homebuyers obtain such types of mortgages at a disproportionately higher level, they may default at a higher rate or prepay at a lower rate than repeat homebuyers.

B2. **Loan Institution:** Institutions such as guarantors, lenders, and servicers also affect mortgage loan performance by their programs and policies.

Some institutions such as the FHA or non-traditional lenders may exclusively or overwhelmingly serve first-time homebuyers. These guarantors, lenders, and servicers may affect mortgage loan performance of first-time homebuyers disproportionately through their programs and policies such as loan modification and refinance incentives.

C1. **Property Quality:** Because the underlying property provides the collateral for a mortgage, property factors also affect mortgage loan performance. Properties in poorer condition may tax borrower financial strength more and as a result, they may be more likely to default on their mortgage and less likely prepay their mortgage.

It is possible that the less experienced first-time homebuyers may buy poorer quality properties more than repeat homebuyers and as a result may have higher likelihood of default and lower likelihood of prepayment than repeat homebuyers.

C2. **Property Location:** Loan performance may differ from location to location as house prices or other economic conditions may affect one area more than another. These areas could be as small as neighborhoods or as large as states.

To the extent that first-time homebuyers prefer some neighborhoods or locations over others, or are only able to afford some neighborhoods or locations but not others, they may default at a higher rate and refinance at a lower rate than repeat homebuyers who may live in different neighborhoods or locations.

Once the factors listed above are controlled for in a model using information on borrower,

loan, and property characteristics known at the time of mortgage origination, the difference in the relative performance of first-time and repeat homebuyer mortgages should disappear if variables used in the model sufficiently capture all the factors that can affect loan performance well except those conveyed only by whether or not a mortgage is of a first-time homebuyer.

This section provided a preliminary exploration of the theoretical framework for assessing the loan performance of first-time homebuyer mortgages. While the empirical model in Section V will not be able to fully account for all the factors identified in this section, this theoretical exploration will help build an empirical model that takes into account the most important factors affecting first-time homebuyer loan performance. In the next section, borrower, loan and mortgage characteristics at loan origination that quantify the factors identified in this section are described further and mortgage loan performance outcome categories are defined and discussed.

## **IV Key Characteristics and Loan Performance**

This section will briefly describe the data used in this paper, provide a definition of the first-time homebuyer variable in the data, summarize key characteristics of first-time and repeat homebuyers, and discuss the actual (or unadjusted) mortgage loan performance outcomes of first-time and repeat homebuyer mortgages.

### **IV.A Data**

Loan performance of Enterprise first-time homebuyer mortgages has not been studied previously. The primary reason for this gap in the literature is the lack of the first-time homebuyer information in most databases. Fortunately, the Federal Housing Finance Agency (FHFA) has started to maintain a comprehensive mortgage loan performance database of mortgages acquired by the Enterprises that includes this information. This database not only contains variables describing monthly mortgage outcomes but also many data elements on borrower,

loan and property characteristics captured by the loan originator during the mortgage loan application and processing. Many of these data elements were self-reported by the borrower in the Uniform Residential Loan Application (URLA) form. This paper uses the universe of mortgages acquired by Fannie Mae and Freddie Mac by the end of 2013 that were originated from 1996 to 2012. Therefore, the loan performance of each origination cohort by origination year has been observed for at least one calendar year after mortgage origination.

## IV.B Definition

Ideally, first-time homebuyers could be defined as homebuyers who had never before owned a home and are now purchasing a home where they will live. In contrast, repeat homebuyers could be defined as homebuyers who owned a home before and are now purchasing a new home they will live in. Unfortunately, mortgage databases do not define first-time and repeat homebuyers in such a way. The Enterprise mortgage databases define first-time homebuyers primarily as homebuyers who intend to live in the purchased home and who had not owned a home in the past three years. This information is collected in the loan application and self-reported by the borrowers.<sup>5</sup> <sup>6</sup> Homebuyers who intend to live in the purchased home but are not first-time homebuyers are considered to be repeat homebuyers.

Figure 1 shows the number of mortgage loans acquired by the Enterprises by the end of 2013 by origination year. The blue bars show the count of first-time homebuyer loans and

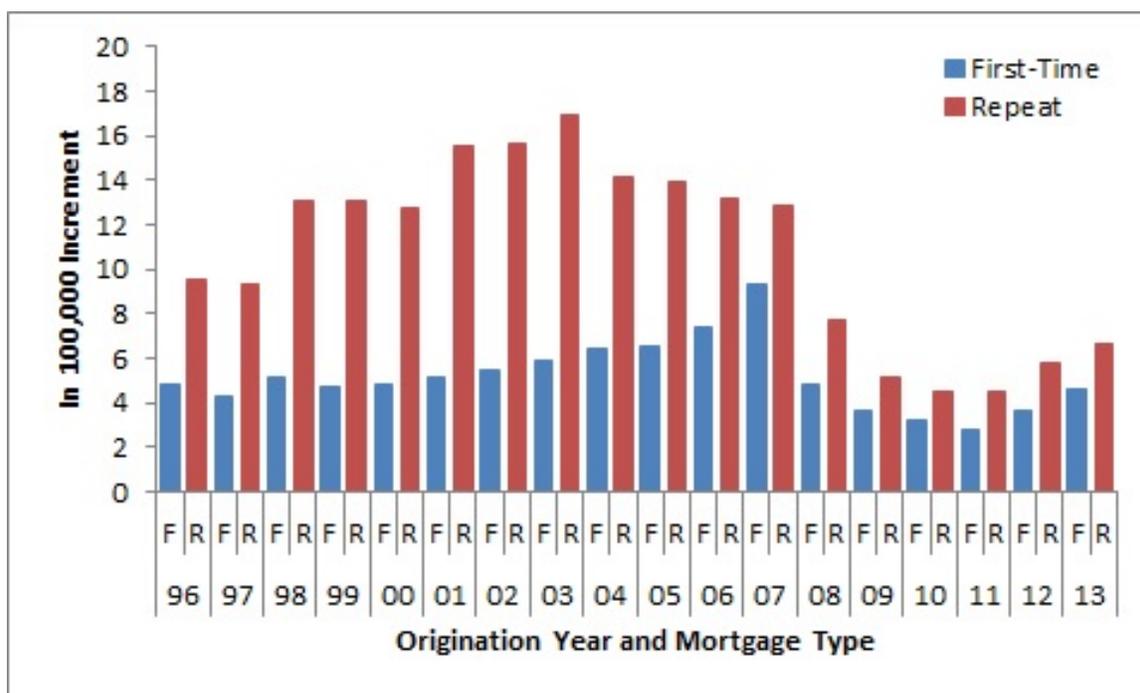
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<sup>5</sup>The two screener questions in the URLA form are as follows: “1. Do you intend to occupy the property as your primary residence? 2. If yes, have you had an ownership interest in a property in the last three years?” Fannie Mae defines a first-time homebuyer as follows: “An individual is to be considered a first-time home buyer who (1) is purchasing the security property; (2) will reside in the security property as a principal residence; and (3) had no ownership interest (sole or joint) in a residential property during the three-year period preceding the date of the purchase of the security property. In addition, an individual who is a displaced homemaker or single parent also will be considered a first-time home buyer if he or she had no ownership interest in a principal residence (other than a joint ownership interest with a spouse) during the preceding three-year time period. For additional information about making this determination, see the instructions for the Uniform Residential Loan Application (Form 1003).” Freddie Mac also defines as a first-time homebuyer similarly.

<sup>6</sup>It is very likely that this definition results in overcounting of first-time homebuyers (Patrabansh 2013); however, it is currently the only method of consistently identifying first-time homebuyers in the data.

the red bars show the count of repeat homebuyer loans. During the 1996-2012 period, the count of first-time homebuyers was the largest in 2007 at over 900,000 loans but the count of repeat homebuyer loans was the largest in 2003 at nearly 1.7 million loans. Loan originations decreased after 2007 and the count of first-time (just over 280,000) and repeat homebuyer (about 455,000) loans were the smallest in 2011. The share of first-time homebuyers ranged from the low of 25 percent in 2001 to the high of 42 percent in 2007 and 2010.

**Figure 1:** Enterprise First-Time and Repeat Homebuyer Loan Originations



**Source:** FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

### IV.C Key Characteristics

A prior FHFA publication, [Patrabansh \(2013\)](#), describes the characteristics of first-time and repeat homebuyers in detail. Instead of reiterating that analysis in this paper, this subsection summarizes key characteristics of first-time and repeat homebuyers based on Enterprise origination cohorts from 1996 to 2012. The goal of this subsection is to inform the discussion of loan performance in the remainder of the paper. Nevertheless, Appendix A also updates and enhances the figures for Enterprise first-time and repeat homebuyers from

Patrabansh (2013) using data on the universe of Enterprise purchase-money mortgages for owner-occupied residential properties originated from 1996 to 2013.

By definition, first-time homebuyers are expected to be younger than repeat homebuyers and they are indeed a younger group. The difference in median age between the two groups steadily increased from 6 years in 1996 to 10 years in 2012. The age difference also translates into differences in other borrower characteristics of first-time and repeat homebuyers. First-time homebuyers are more likely to borrow as individuals and less likely to borrow with a co-borrower than repeat homebuyers. This could indicate that fewer first-time homebuyers are married; however, the FHFA Enterprise data does not contain information about marital status. The difference in the share of single borrowers increased from 6 percentage points in 1996 to 17 percentage points in 2012. First-time homebuyers earn less money than repeat homeowners. The difference in median monthly income increased from little over \$700 in 1996 to little over \$2,000 in 2012. First-time homebuyers also have lower credit scores than repeat homebuyers. The difference in median credit score were 13 to 19 points for most cohorts but 25 and 33 points respectively for the 2006 and 2007 cohorts.

In terms of loan characteristics, first-time homebuyer loans have higher loan-to-value (LTV) ratios than repeat homebuyer loans. The difference in average LTV is 4 to 8 percentage points. First-time homebuyer loans also have higher payment-to-income (PTI)<sup>7</sup> ratios than repeat homebuyer loans. The difference in average PTI is 2 to 4 percentage points. The difference in PTI, however, does not translate into a difference in the debt-to-income (DTI)<sup>8</sup> ratio. DTI of first-time and repeat homebuyers are comparable. First-time homebuyers take out smaller loans than repeat homebuyers. The difference in median loan size ranged

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<sup>7</sup>PTI is also known as the front-end ratio. It is the ratio of the monthly payments required for ownership of a property (mortgage, tax and insurance) and the monthly income of the borrowers.

<sup>8</sup>DTI is also known as the back-end ratio. It is the ratio of the total monthly fixed payment obligations of the borrowers (payments for the property as well as other fixed obligations such as credit card payments) and their monthly income.

from about \$11,000 in 1996 to about \$30,000 in 2012. First-time homebuyer note rates are also somewhat higher than that of repeat homebuyers. The difference in average note rate ranged from 6 to 16 basis points. First-time homebuyer loans also have slightly longer loan terms than repeat homebuyer loans. The difference in average loan term ranged from 3 to 15 months. More first-time homebuyer loans were fixed rate mortgages (FRMs) and fewer were adjustable rate mortgages (ARMs) compared to repeat homebuyer loans for most origination cohorts. The difference in the FRM share ranged from 1 to 4 percentage points. However, fewer first-time homebuyer loans were FRMs and more were ARMs compared to repeat homebuyers for the 2002, 2003, 2004, 2005 origination cohorts. The share of FRMs were much smaller in those years for both first-time and repeat homebuyers than in earlier or later years, except 1996 and 1997 when balloon loans were as prevalent as ARMs.

In terms of property characteristics, first-time homebuyer properties are worth less than repeat homebuyer properties. The difference in median property value increased from slightly over \$22,000 in 1996 to little over \$50,000 in 2012. First-time homebuyer properties are also more likely to be condominiums and less likely to be single-family homes or in Planned Unit Developments (PUDs). The difference in condominium share rose from 3 percentage points in 1996 to 8 percentage points in 2012. In terms of the number of units in the property, first-time homebuyer properties are equally likely to have one-unit properties or two-to-four unit properties as repeat homebuyers.

The expectation is that these differences in borrower, loan, and property characteristics of first-time and repeat homebuyers could affect the loan performance of the two groups via various factors described in Section III. While the empirical model in Section V will account for these borrower, loan, and property characteristics, the next subsection presents the actual (or unadjusted) loan performance outcomes of first-time and repeat homebuyers.

## IV.D Loan Performance

To evaluate the relative performance of first-time and repeat homebuyer mortgages, this paper first presents statistics on loan outcomes at different time intervals after origination. Loan outcomes are broadly categorized into four groups based on how mortgages transition from one stage to another:

1. **Performing:** Following standard practice, this paper considers a loan to be “seriously delinquent” if the borrower has missed three consecutive payments.<sup>9</sup> Using that definition, a “performing” loan may have had up to two consecutive missed payments, but never three consecutive missed payments. This is an interim status for a loan because a performing loan could become a delinquent loan in the future.
2. **Seriously Delinquent:** Once the borrower has missed three consecutive payments one time, the loan will be considered “seriously delinquent” even if the borrower subsequently catches up and becomes “current.” Once a loan is seriously delinquent, it is generally considered to be a troubled mortgage, and its subsequent performance tends to be poor. Thus, for this analysis, loans that have missed three consecutive payments will be considered seriously delinquent until they are foreclosed. This is also an interim status for a loan because a seriously delinquent loan will likely become a foreclosure in the future or sometimes even become “current.”<sup>10</sup>
3. **Foreclosed:** Seriously delinquent loans that have not been made “current” in payment will undergo a process in which the borrower loses the property and the loan is terminated. This may involve lender’s repossession of the property due to formal fore-

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<sup>9</sup>However, there is no clear definition in the mortgage literature of what constitute mortgage default. Some consider three consecutive missed payments to be only a delinquency and define serious delinquency as four or even six consecutive missed payments.

<sup>10</sup>However, for this paper, a loan will never again be classified as performing once it has been designated as seriously delinquent.

closure (also known as real-estate owned or REO) or other type of loan termination such as a short sale prior to foreclosure, third-party sale at a foreclosure auction, a deed-in-lieu of foreclosure, or charge-off in lieu of foreclosure. All of these outcomes are included in the “foreclosed” category. Sometimes this category is also described as “involuntary termination,” “termination with claim,” “termination with loss,” or “termination without home retention” because the borrower loses a property involuntarily, often resulting in a loss to the lender and a claim to the guarantor. This is a final status for a loan.

4. ***Paid off:*** A healthy and performing loan can be terminated voluntarily when the borrower pays off the remaining balance of the loan and has no further obligation to the lender. A borrower can pay off the loan at a time specified in the mortgage contract, and such a loan is said to have matured.<sup>11</sup> More often, borrowers pay off the loan because they have sold the home or refinanced the home with a new mortgage.<sup>12</sup> “Voluntary termination” is sometimes also described as “paid in full,” “termination without claim,” “termination without loss,” or “termination with home retention.” This is also a final status for a loan.

Using the four broad categories described above, this section describes loan outcomes of mortgages acquired by the Enterprises. The analysis was performed separately for first-time and repeat homebuyers, for every loan origination year from 1996 to 2012. For the first-time and repeat homebuyer mortgages in each origination-year cohort, the performing rate, serious delinquency rate, foreclosure rate, and pay-off rate were calculated every year after

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<sup>11</sup>A vast majority of mortgages mature after 15 or more years. Therefore, the incidence of mortgage maturity during the study observation period (less than 15 years for most origination cohorts) is very low. Mortgage maturity is often ignored because most study observation periods are not nearly as long.

<sup>12</sup>A very small number of borrowers also pay off their mortgages before the end of the mortgage term by paying more than the monthly payment due for some period of time. Early payment of such mortgages is also classified as prepayment in the data.

mortgage origination, and also at the end of calendar year 2013.<sup>13</sup>

The performing rate in a given year was calculated as the share of loans with the performing outcome in that year. This rate could not increase over time as the analysis does not consider seriously delinquent loans that re-perform as “performing.” The seriously delinquent rate was calculated as the share of loans that were seriously delinquent but had not foreclosed in the denoted year, and this rate could increase or decrease over time. When outcomes of loans in a cohort changed from seriously delinquent to foreclosure at a rate higher than that at which they changed from performing to seriously delinquent, the seriously delinquent rate would decrease. The foreclosure rate in a denoted year was calculated as the share of loans with foreclosure as their outcome. The foreclosure rate could increase over time. The pay-off rate in a given year was calculated as the share of loans with the paid-off outcome, and this rate could also increase over time. The pay-off rate is essentially the rate of prepayment for the observation periods used in this study. For example, the share of matured loans five or even ten years from loan origination for the Enterprise mortgages is extremely small because an overwhelming majority of the mortgages have loan term of 30 years and nearly all mortgages have loan term of 15 years or longer.

Appendix B presents the complete tables. In this section, selected results are shown in two formats. For first-time and repeat homebuyer mortgages in each origination cohort, the serious delinquency, foreclosure and pay-off rates (in percent) are presented at five years after origination so that cohorts can be observed at a uniform time period after origination,

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<sup>13</sup>See Appendix B for complete tables. Loan performance was computed at annual intervals from the date of first payment. Loans originated in later years have only been observed for a few years (for example, the 2011 cohort was only observed for 2 years) while loans originated in earlier years have been observed for longer than a decade (for example, the 2002 cohort was observed for 10 years). In addition, complete performance of a cohort will not be known for a long time and eventually all mortgages of a cohort will either be paid off or foreclosed. Therefore, the performance tracking period in any snapshot analysis, such as this paper, is not only uneven across origination cohorts, but also necessarily incomplete. This issue of incomplete information is known as “censoring” in statistics and statistical techniques to overcome this issue are available but not used in this paper.

and also at the end of 2013 as the most recent snapshot.<sup>14</sup> For two of the cohorts originated during two different stages of the most recent housing cycle (2004 and 2007), annual rates are also shown up to the period loan performance data is available (for example, the 2007 cohort was only observed for six years after origination until 2013).

Figure 2 presents separate panels for two of the four points in time during which mortgage performance was evaluated (five years after origination, and at the end of 2013, from left to right vertical panels as described by the top axis),<sup>15</sup> and each of the three categories of mortgage outcome (seriously delinquent, foreclosed, and paid off, from top to bottom horizontal panels as described by the left axis). The exhibit tracks serious delinquency, foreclosure, and pay-off rates (shown in percentages in the vertical axis) of first-time (blue bars) and repeat (red bars) homebuyer mortgages for each origination year cohort (shown in the top axis). For example, the upper left panel presents the serious delinquency rate of first-time and repeat homebuyer mortgages five years after origination for each origination year cohort from 1996 to 2009. The upper-right panel presents the serious delinquency rate of first-time and repeat homebuyer mortgages at the end of 2013 for each origination year cohort.

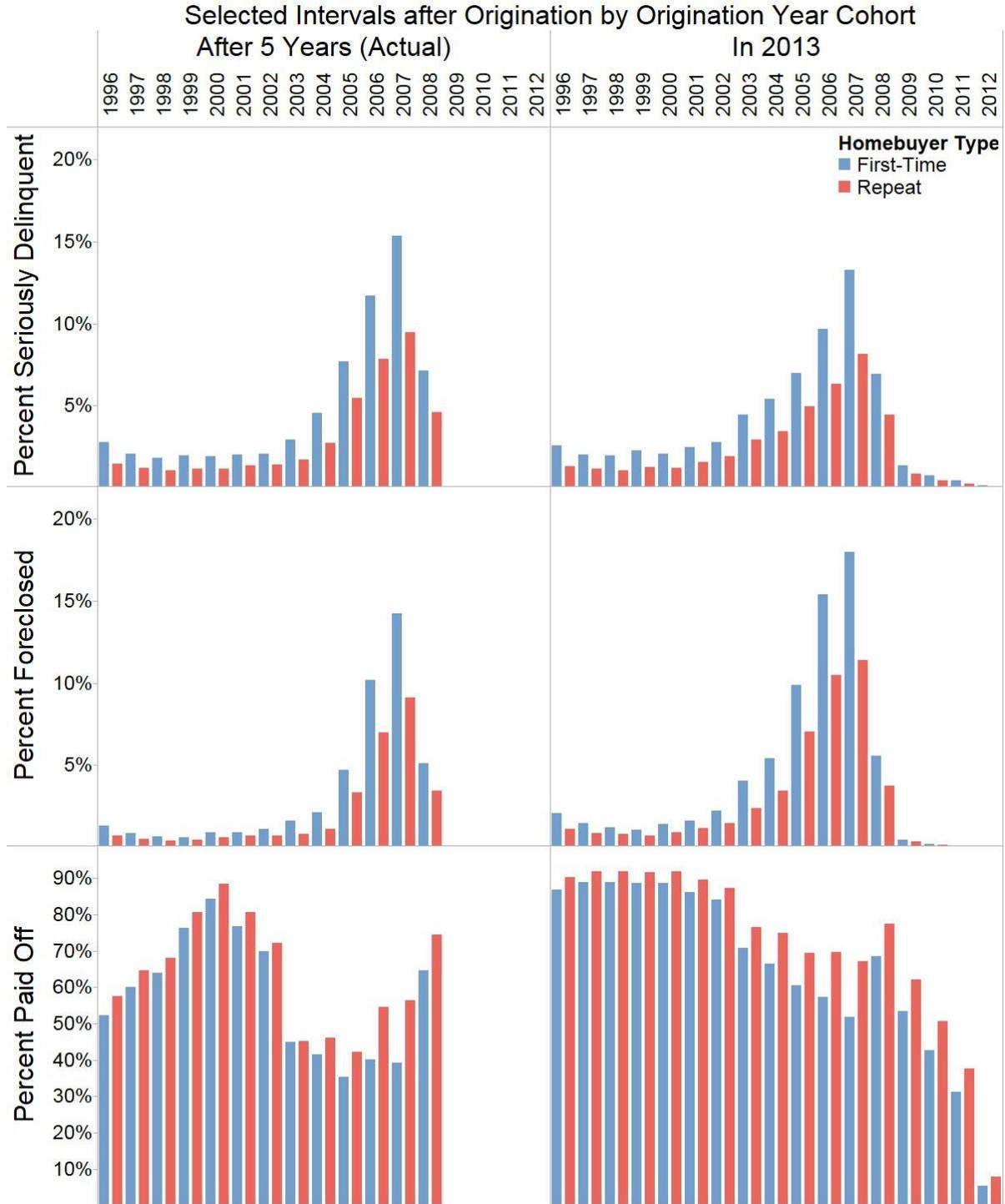
Serious mortgage delinquency and foreclosure generally depend on borrower, loan and property factors as described in Section III as well as the overall state of the economy. For both the first-time and repeat buyer mortgages originated from 1996 through 2002 (the 1996 to 2002 origination cohorts), the serious delinquency and foreclosure rates were low and ranged within a tight band of about 1 to 2 percent throughout all periods. For origination cohorts 2003 to 2008, both the serious delinquency rate and the foreclosure rate were higher. They were the highest for the 2007 cohort originated towards the end of the housing market boom.

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<sup>14</sup>Performing mortgages are not shown because they simply reflect the remainder of loans.

<sup>15</sup>Mortgage performance at two and ten years after origination was also analyzed but they are not presented in Figure 2. The performance difference between first-time and repeat homebuyer mortgages was also evident at those time periods.

**Figure 2:** Enterprise First-Time and Repeat Homebuyer Loan Performance



**Source:** FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

**Note:** The scale for the top two horizontal panels is five times that of the bottom panel.

By 2013, five years after the financial crisis, 13.3 percent of first-time homebuyer mortgages and 8.2 percent of repeat buyer mortgages from the 2007 cohort were seriously delinquent, and 18.0 percent of first-time homebuyer mortgages and 11.4 percent of repeat homebuyer mortgages had foreclosed. For cohorts originated after the financial crisis (2009 to 2012), the serious delinquency and foreclosure rates to date were again back to a lower level of 1 percent or less.<sup>16</sup>

Regardless of the point in time, the serious delinquency and foreclosure rates of first-time homebuyer mortgages of any origination cohort were higher than those of repeat homebuyer mortgages for the same origination cohort. In percentage point terms, the serious delinquency rate and the foreclosure rate of first-time homebuyer mortgages were on average 1.1 percentage points higher than those of repeat homebuyer mortgages. The differences between first-time and repeat homebuyer mortgages were somewhat larger in terms of the serious delinquency rate (an average of 1.3 percentage points) than the foreclosure rate (an average of 0.9 percentage points). The differences were also generally larger for the 2003-2008 originations (up to 6.6 percentage points higher) than earlier or later originations. Clearly, as shown by the height difference of the blue and red bars in the top and middle panels of Figure 2, first-time homebuyer mortgages were seriously delinquent or foreclosed at a higher rate than repeat homebuyer mortgages.

In contrast to serious delinquency and foreclosure, mortgage pay-off is generally more volatile because it depends on the extent to which borrowers refinance their mortgages or purchase new homes, which in turn depends greatly on how mortgage interest rates and housing markets change over time. As described in Section III, borrower, loan, and property characteristics also affect mortgage pay-off to some extent. As shown by the bottom horizontal panel of Figure 2, first-time homebuyer mortgages paid off at a lower rate than repeat home-

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<sup>16</sup>Note that the 2009-2012 cohorts have only been observed for short period of time in contrast to earlier cohorts.

buyer mortgages. In percentage point terms, the pay-off rate (the share of loans that had paid off) of first-time homebuyer mortgages was on average 5.6 percentage points lower than that of repeat homebuyer mortgages.

An alternative way to analyze mortgage loan performance is to track the outcome of each origination cohort over time. Figure 3 presents the serious delinquency, foreclosure, and pay-off rates of mortgages originated in years representative of the two of the four distinct periods of the most recent housing market cycle: 2004 and 2007.<sup>17</sup>

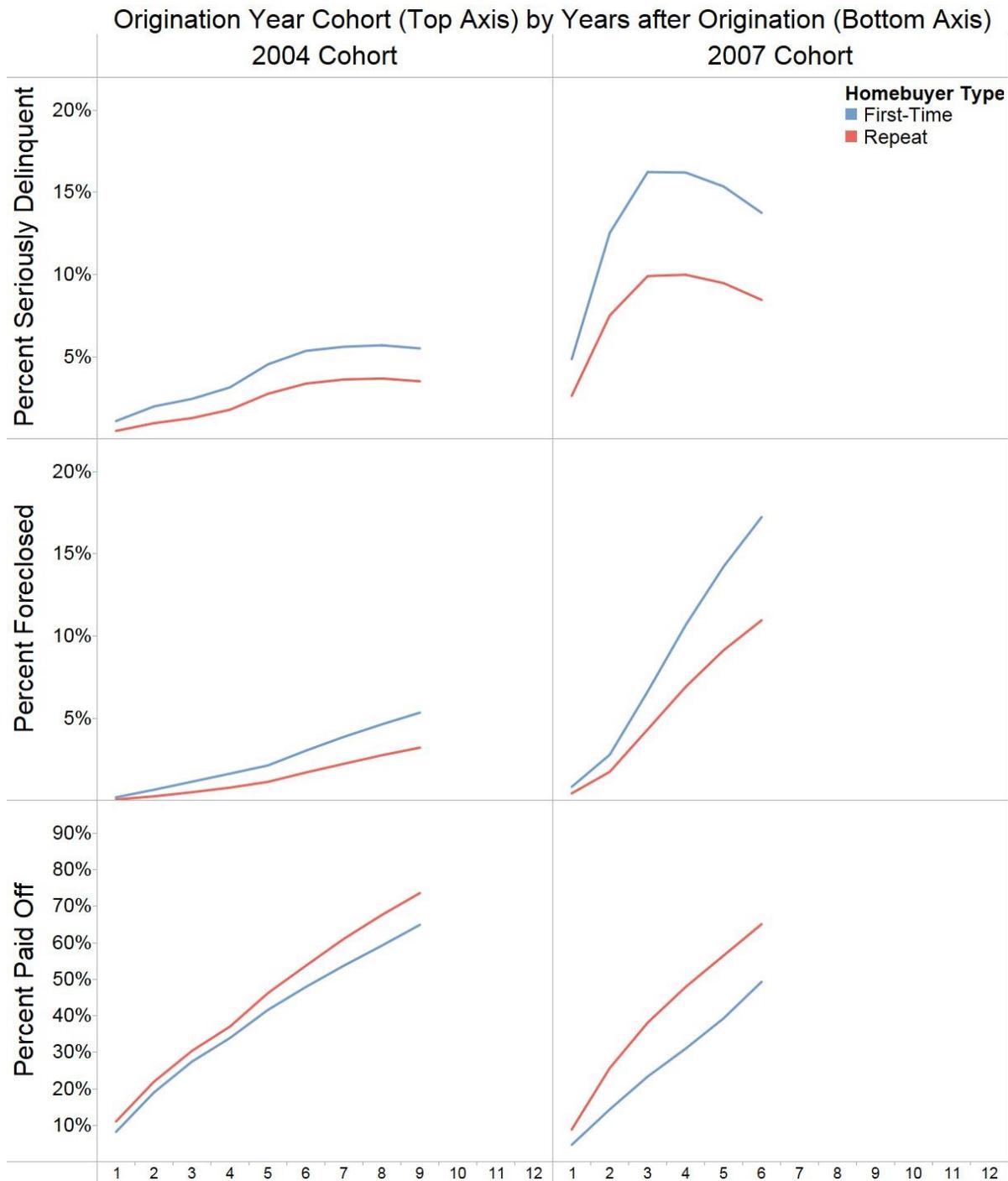
The left vertical panel of Figure 3 presents the mortgage performance of the 2004 cohort, which was largely representative of the 2003 to 2006 cohorts. The serious delinquency and foreclosure rates for the 2004 cohort were higher than those for the pre-2004 cohorts but the pay-off rate was lower. By the ninth year after origination (approximately 2013), 5.5 percent of first-time homebuyer mortgages were seriously delinquent compared to 3.5 percent of repeat homebuyer mortgages, and 5.3 percent of first-time homebuyer mortgages had foreclosed compared to 3.2 percent of repeat homebuyer mortgages. The pay-off rates by the ninth year after origination were 64.9 percent and 73.6 percent respectively for the first-time and repeat homebuyer mortgages.

The right vertical panel presents the mortgage performance of the 2007 cohort. While the performance of the 2007 cohort was the worst of all cohorts, it was still generally representative of the 2008 cohort. The serious delinquency rate for this cohort rose to 16.2 percent for first-time homebuyer mortgages and 9.9 percent for repeat homebuyer mortgages by the third year after origination (approximately 2010) and then dropped to 13.8 percent for first-time homebuyer mortgages and 8.5 percent for repeat homebuyer mortgages by the sixth year

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<sup>17</sup>Mortgage performance of other cohorts was also analyzed but is not shown in Figure 3. The performance difference between first-time and repeat homebuyer mortgages were also evident for those cohorts, but the magnitude of the difference was smaller for the pre-2004 and post-2007 cohorts than the 2004 and 2007 cohorts.

**Figure 3:** Enterprise First-Time and Repeat Homebuyer Loan Performance



**Source:** FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

**Note:** The scale for the top two horizontal panels is five times that of the bottom panel.

after origination (approximately 2013) as loans moved to foreclosure. By the sixth year, the foreclosure rates for first-time and repeat homebuyer mortgages were 17.2 percent and 11.0 percent respectively, and the pay-off rates were 49.3 percent and 65.1 percent respectively.

While there were differences between origination cohorts (the 2004 and 2007 cohorts shown in Figure 3 as well as other cohorts, which are not shown), the difference in performance of first-time and repeat homebuyer mortgages was evident for every cohort, whether cohorts were analyzed at distinct intervals as shown in Figure 2 or over time as in Figure 3. In other words, first-time homebuyer mortgages have performed worse than repeat homebuyer mortgages in all time periods analyzed. The next section presents an empirical model of how the differences in borrower, loan, and property characteristics of first-time and repeat homebuyer mortgages could explain the difference in the loan performance between the two groups.

## **V Empirical Approach**

Section III above provided an exploration of how various factors can influence mortgage loan performance and Section IV described borrower, loan, and property characteristics and the loan performance outcomes of first-time and repeat homebuyers. This section develops a multinomial logit model of loan performance based the loan performance outcomes and borrower, loan, and property characteristics presented in Section IV following the theoretical exploration of Section III as a loose framework.

### **V.A Model**

While the four mortgage outcome categories presented in Section IV were useful in describing and explaining loan performance, loan outcomes have to be grouped differently for modeling purposes. Foreclosure is clearly contingent on serious delinquency but pay-off is not. Therefore jointly modeling the four outcomes presented in Section IV violates the independence of

irrelevant alternatives (IIA) assumption required for tractable models such as multinomial logit. Moreover, the current convention in the literature is to jointly model three outcomes: default, prepayment, and current.

This paper defines mortgage default and prepayment similarly to [Lam et al. \(2013\)](#). Mortgage default is defined in two ways. Using the loan outcome descriptions in Section [IV](#), mortgage default is first defined as foreclosure completion and then as seriously delinquent or a worse state. The two definitions effectively provide a lower and an upper bound on the estimates of default. Under the first (more restrictive) definition, a loan is considered to be foreclosed if it is terminated in a foreclosure, short sale, third-party sale, deed-in-lieu sale, or charge-off in lieu of foreclosure. Therefore, this definition excludes loans that are seriously delinquent but have not been terminated, including those that are still in the foreclosure process. In effect, this provides a lower bound estimate of default. Under the second (more inclusive) definition, a loan is considered to be seriously delinquent if it ever misses three consecutive payments and becomes 90 days overdue. Therefore, this definition also includes loans that start performing after three missed payments as well as loans that are in the foreclosure process or have terminated in a foreclosure, short sale, third-party sale, deed-in-lieu sale, or charge-off in lieu of foreclosure. Effectively, this provides an upper bound estimate of default. For ease of exposition, foreclosure completion is termed simply **mortgage foreclosure** and seriously delinquent or a worse state is termed **mortgage distress** henceforth in this paper.

Mortgage prepayment is defined as pay-off of a mortgage described in Section [IV](#), whether the mortgage matured or prepaid for refinancing or after a property sale. As described in Section [IV](#), the rationale for including matured mortgages in this category is that they represent a very small share of outcomes five or even ten years after origination. What constitutes the last category of “current” loans depends on the definition of default used. If default is defined as foreclosure, then the “current” category consists of loans that are still

active, including serious delinquencies, some of which may be in the foreclosure process and other may have cured after the delinquency episode. However, if mortgage default is defined as mortgage distress, then the “current” category consists only of performing loans, which are loans that never missed more than two consecutive payments.

[Lam et al. \(2013\)](#) estimates a competing risk hazard model where loan outcome is measured every month and some of the explanatory variable such as the mark-to-market LTV change every month. In contrast, the goal of this paper is to model default-prepayment based on information known at the time of origination. Therefore, a standard default-prepayment model is used instead. The standard model in a multinomial logit framework can be formalized as follows:

$$Pr(y_i = 1|\mathbf{X}_i) = e^{\mathbf{X}_i\beta_1} / \sum_{j=1}^3 e^{\mathbf{X}_i\beta_j} = 1 / (1 + \sum_{j=2}^3 e^{\mathbf{X}_i\beta_j}) \quad (1)$$

$$Pr(y_i = 2|\mathbf{X}_i) = e^{\mathbf{X}_i\beta_2} / \sum_{j=1}^3 e^{\mathbf{X}_i\beta_j} = e^{\mathbf{X}_i\beta_2} / (1 + \sum_{j=2}^3 e^{\mathbf{X}_i\beta_j}) \quad (2)$$

$$Pr(y_i = 3|\mathbf{X}_i) = e^{\mathbf{X}_i\beta_3} / \sum_{j=1}^3 e^{\mathbf{X}_i\beta_j} = e^{\mathbf{X}_i\beta_3} / (1 + \sum_{j=2}^3 e^{\mathbf{X}_i\beta_j}) \quad (3)$$

In the model, variable  $y$  for mortgage  $i$  denotes its loan performance outcome, which can be designated as 1 to describe the performing or active category, 2 to describe the prepaid category, and 3 to describe the defaulted category. The matrix  $\mathbf{X}$  for mortgage  $i$  denotes the right-hand side explanatory variables and  $\beta$  denotes the coefficients of the explanatory variables. This paper estimates the above model under two specifications of default and “current” outcomes as described above. The first specification, Model A, models the foreclosure, pay-off, and active outcomes jointly and the second specification, Model B, models the distress, pay-off, and performing outcomes jointly.

Both specification of the model can be estimated separately for each origination year  $l$  from 1996 to 2012 at different annual observation periods  $k$ . This approach is similar to [Leventis](#)

(2014):

$$Pr(y_{k,l,i} = 1 | \mathbf{X}_i) \tag{4}$$

$$Pr(y_{k,l,i} = 2 | \mathbf{X}_i) \tag{5}$$

$$Pr(y_{k,l,i} = 3 | \mathbf{X}_i) \tag{6}$$

Estimating separate model for each origination year has multiple advantages. First, this framework allows regression coefficients to vary for each origination cohort. Second, it allows for sensitivity testing of the results across all origination cohorts as well as many observation time periods. Finally, it allows for the use of the entire universe of mortgage loans in model estimation and lets the study avoid complications related to sampling. Therefore, data from the entire universe of Enterprise purchase-money mortgages for owner-occupied properties is utilized here. The models are estimated in Stata using the *mlogit* command and the Newton-Raphson maximum likelihood function.

The first-time homebuyer indicator is the key independent variable. In addition, the model includes independent variables on borrower, loan, and property characteristics known at the time of mortgage origination. These variables were selected to capture various borrower, loan, and property factors that influence the default and prepayment of mortgages as described in Section III. To capture non-linearity, independent variables were converted to sensible categorical variables.

**Borrower Characteristics:**<sup>18</sup> In addition to the first-time homebuyer indicator, the model

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<sup>18</sup>Some characteristics are uniquely associated with first-time homebuyers. In other words, some characteristics have higher correlations with first-time status. Specifically, the youngest age groups are all or mostly first-time homebuyers. Therefore, the regression model was tested for inclusion and exclusion of the age indicator variables as well as interaction of the age variables with credit score and LTV categories for the 2004 and 2007 cohorts. Results under various specifications for different age groups, credit score groups, and LTV groups are consistent with the findings reported in the paper. This indicates that for all age groups, credit score groups, and LTV groups, the marginal effect of first-time homebuyer status for default and prepayment are substantively similar throughout. While first-time and repeat homebuyers do not overlap completely on their characteristics, the marginal effect of the first-time status is computed for the average

includes indicator variables for primary borrower's age (below 25, 25-34, 35-44, 45-54, 55-64, and 65 or higher), an indicator variable for the presence of multiple borrowers, several indicator variables for borrower's inflation-adjusted monthly income (less than \$2,500, \$2,500-\$4,999, \$5,000-\$7,499, and \$7,500 or more), and several indicator variables for borrower's credit score (below 620, 620-639, 640-659, 660-679, 680-699, 700-719, 720-739, and 740 or higher). These variables are intended to capture borrower sophistication, endurance, and intentions. Specifically, the first-time homebuyer indicator variable may capture all three factors to some degree. Borrower marital status was not available but the number of borrowers can approximate it. In fact, the number of borrowers may be a better predictor of mortgage outcome than borrower marital status because it indicates the number of adults with income. Information about the source of the downpayment was not available and the variable on the monthly reserve was missing for a large share of borrowers.

**Loan Characteristics:** The model includes indicators for LTV categories (60% or lower, 60.1-70%, 70.1-75%, 75.1-80%, 80.1-85%, 85.1-90%, 90.1-95%, and above 95% ), thirteen loan-level pricing adjustment (LLPA) categories, PTI categories (25% or below, 25.1-30%, 30.1-35%, and over 35%), DTI categories (30% or lower, 30.1-35%, 35.1-43%, and over 43% ), loan type (FRM, ARM, and a third category for balloon, interest-only, negative amortization, and alterative A loans), loan term (15-year, 20-year, and 30-year), inflation-adjusted loan amount (below \$100,000, \$100,000-\$199,999, \$200,000-\$299,999, and \$300,000 or more), note rate spread at origination or SATO (less than 10 basis points, 10-16 basis points, and 17 basis points or higher), loan origination month, and Enterprise. These variables are intended to capture loan product and institution as well as the borrower factors. The variable identifying loan originators and servicers, while available, were not captured reliably or consistently to

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buyer similar on all characteristics except first-time status. Therefore, because the models control for many borrower, loan, and property characteristics, in aggregate, it soaks up much of the unadjusted effect of the first-time homebuyer status. The result then is robust to differences between the two groups on the margin. In fact, on the default side, nearly all the variance between first-time and repeat homebuyers are explained by borrower, loan, and property characteristics other than first-time status.

be included in the model. Information on discount points also was not available. The origination month variable was used to capture all seasonal and monthly variations, not just in terms of loans but in terms of interest rates and other economic conditions. The LLPA categories are meant to capture interaction of LTV and credit score but in such a way that loan pricing is accurately captured. An indicator for existence of junior liens was not available.

**Property Characteristics:** The model includes indicators for property type (single-family, PUD, condominium, and other), whether the property is in a metropolitan statistical area (MSA), whether the property is one-unit, and the state the property is located in. These variables are meant to capture property location and property quality to the extent it can be captured. The state indicators not only capture state differences in property and foreclosure laws but also state differences in economic conditions. Information regarding property inspection or property condition was not available and neither was information about whether the property was in center city, suburb or exurb.

## **V.B Results**

In this paper, regression results are not presented in the usual fashion because over 300 regressions were run, each with over 125 covariates. A sampling of regression output showed that the signs of regression coefficients were as expected. Adjusted R-squared ranged from 0.03 to 0.22 with mean and median of 0.12. To summarize the regression results, logit coefficients of the first-time homebuyer indicator variable are converted into two types of measure: 1) the marginal effects of first-time homebuyers on loan performance outcomes, and 2) model-predicted (or adjusted) probabilities of loan outcomes for first-time and repeat homebuyers.

Computing marginal effects is a convenient way of interpreting regression coefficients of logis-

tic regressions. Marginal effect of first-time homebuyers on default or prepayment outcome describes how the first-time homebuyer loan performance can differ from the repeat homebuyer loan performance holding everything else constant (*ceteris paribus*). Marginal effects of first-time homebuyers on default or prepayment outcomes can be computed using the multinomial logit regression coefficients in two primary ways: 1) first, by holding variables except the first-time homebuyer indicator at their averages, and 2) second, by averaging the marginal effect for every mortgage holding variables except the first-time homebuyer indicator variable at their actual values.<sup>19</sup> The first method computes the marginal effect at the mean (MEM) and the second method computes the average marginal effect (AME).

In addition to computing marginal effects, the regression results can be also be used to calculate the model-predicted (or adjusted) probabilities of default or prepayment outcomes for first-time and repeat homebuyers. These adjusted probabilities can then be compared to the actual default and prepayment rates. The adjusted probabilities can also be computed by holding variables except the first-time homebuyer indicator at their respective averages, or by averaging the model-predicted default or prepayment probabilities for each mortgage holding variables except the first-time homebuyer indicator variable at their actual values. The first method computes the adjusted probability at the mean (APM) and the second method computes the average adjusted probability (AAP). Effectively, the difference in APMs of first-time and repeat homebuyers is the MEM of first-time homebuyers and the difference in AAPs of first-time and repeat homebuyers is the AME of first-time homebuyers.

Appendices C and D present the complete tables of Model A and Model B MEMs, APMs, AMEs, and AAPs for all origination cohorts and all observation periods. This section only presents MEMs and APMs five years after origination for all origination cohorts, and every year after origination for the 2004 and 2007 origination cohorts. Cohorts can be broadly

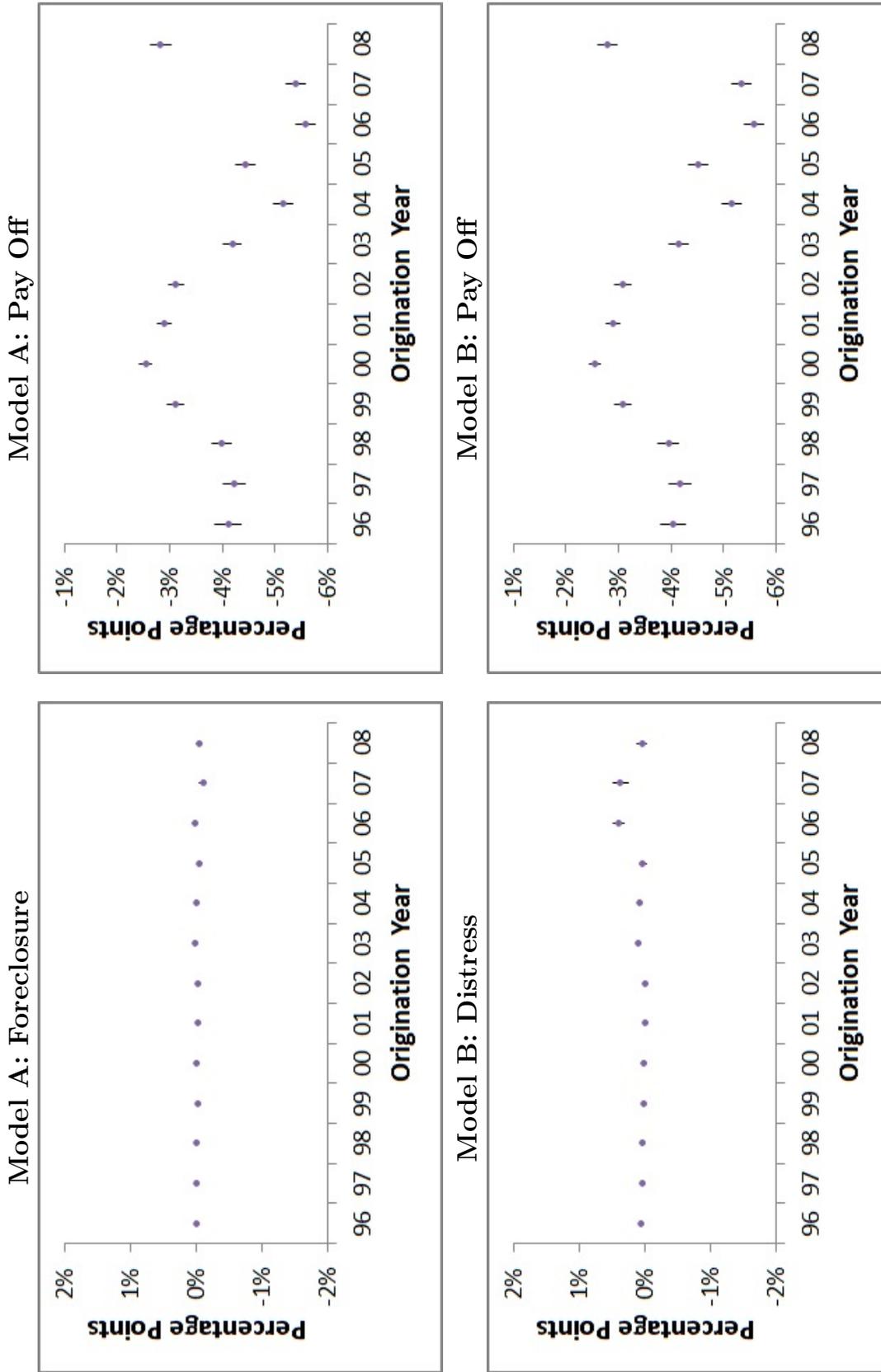
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<sup>19</sup>See [Long & Freese \(2014\)](#) and [Williams \(2012\)](#) for more description.

categorized into four groups: pre-boom (1996 to 2002), boom (2003 to 2006), bust (2007 to 2008), and post-bust (2009 to 2010). Because the pre-boom and post-bust cohorts have lower default rates, the first-time and repeat homebuyer differences can be better differentiated when the boom and the bust cohorts are analyzed in greater detail. Therefore the 2004 and 2007 cohorts were selected to represent these two distinct periods of the housing cycle and studied every year after origination until 2013. The AME results are similar to the MEM results presented below and the AAP results are also similar to the APM results in terms of the first-time and repeat homebuyer differences.

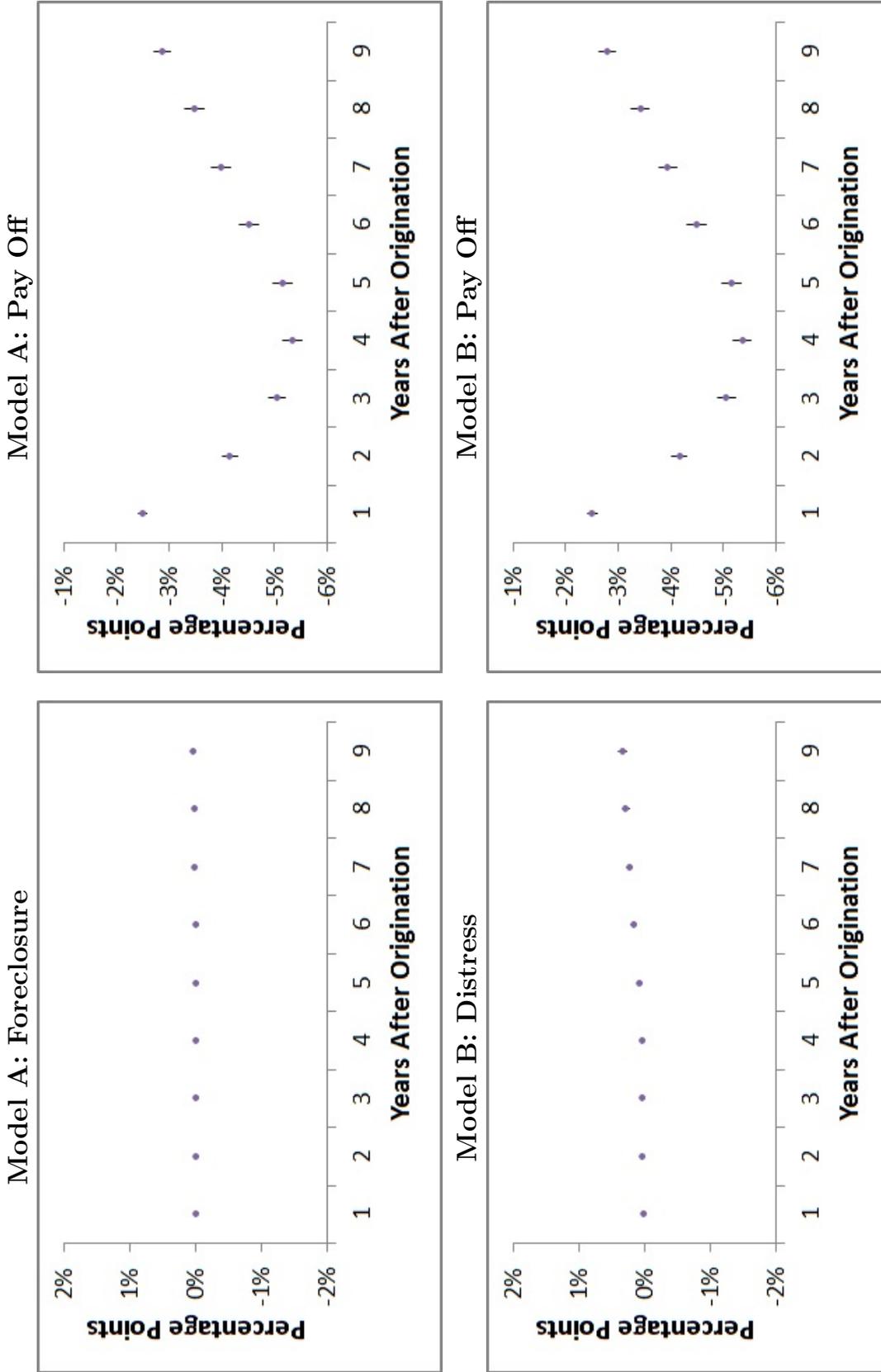
Figure 4 shows that the marginal effect at the mean (MEM) of first-time homebuyers on foreclosure and mortgage distress five years after origination is at or very close to zero for every cohort. Only the 2006 and 2007 cohorts have first-time homebuyer MEMs higher than zero when mortgage distress is analyzed in Model B, but they are only about half a percentage point, which is still a very small marginal effect. For the 2004 and 2007 origination cohorts, Figures 5 and 6 show that the first-time homebuyer MEMs for foreclosure is approximately zero no matter how long after origination loan performance is analyzed and the MEM for mortgage distress only increases to half a percentage point towards the last few observation periods. Therefore the MEMs do not change very much over time. The MEM for mortgage distress for the 2004 cohort inches up to less than half a percentage point nine years after origination as does the same MEM for the 2007 cohort after 5 or 6 years after origination. As indicated earlier, the average marginal effects (AMEs) on foreclosure or mortgage distress of first-time homebuyers is effectively the same as the MEMs. Therefore, after accounting for borrower, loan, and property characteristics known at the time of mortgage origination, there is little to no difference—on average—between the default rate of first-time and repeat homebuyers, whether default is measured as foreclosure or mortgage distress. Clearly both the upper and lower bounds of the first-time homebuyer marginal effects on default are effectively at or near zero.

Figure 4: First-Time Homebuyer Marginal Effect at Mean Five Years After Origination



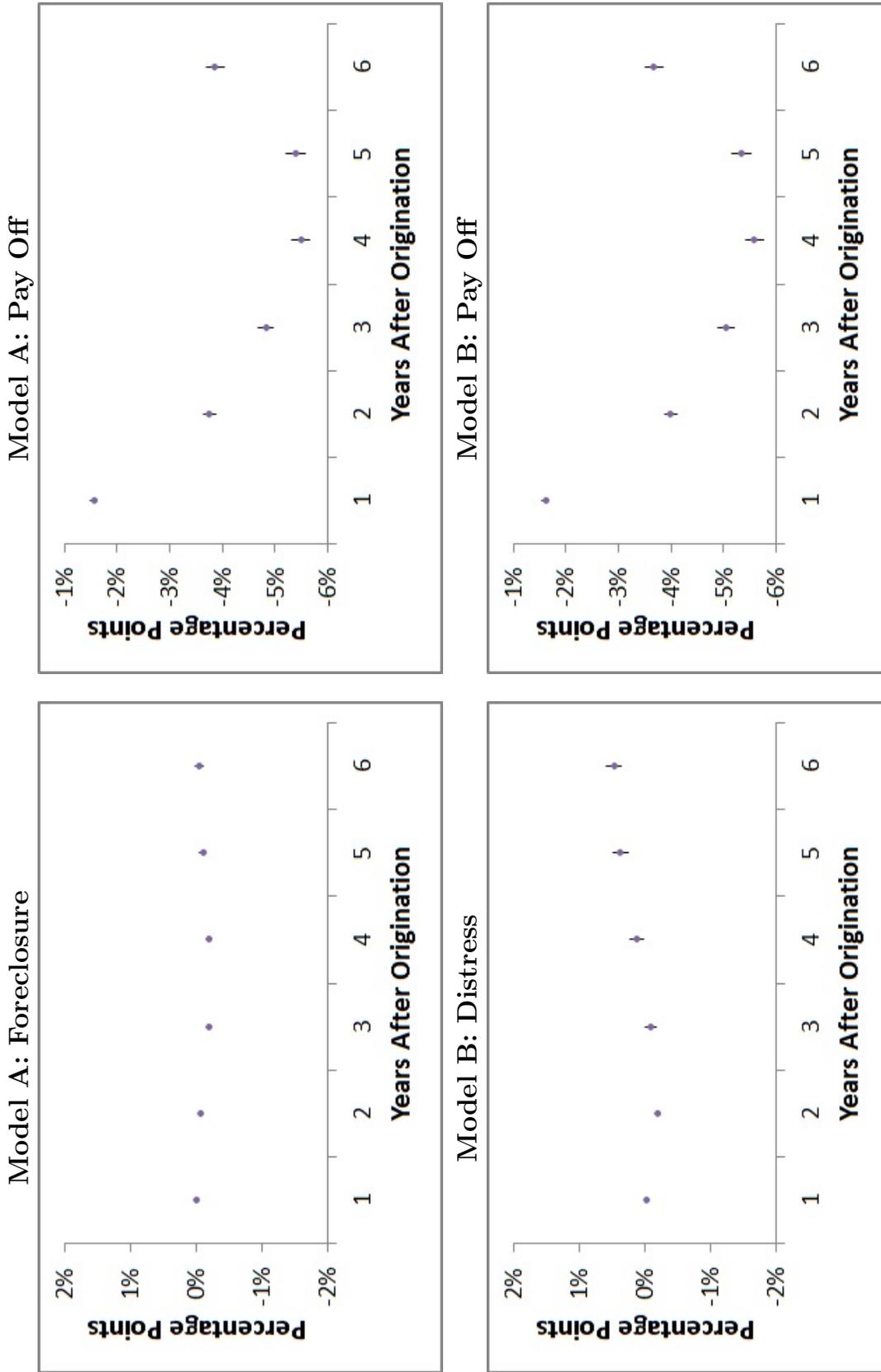
Source: Regressions based on FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

Figure 5: First-Time Homebuyer Marginal Effect at Mean of the 2004 Origination Cohort



Source: Regressions based on FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

Figure 6: First-Time Homebuyer Marginal Effect at Mean of the 2007 Origination Cohort

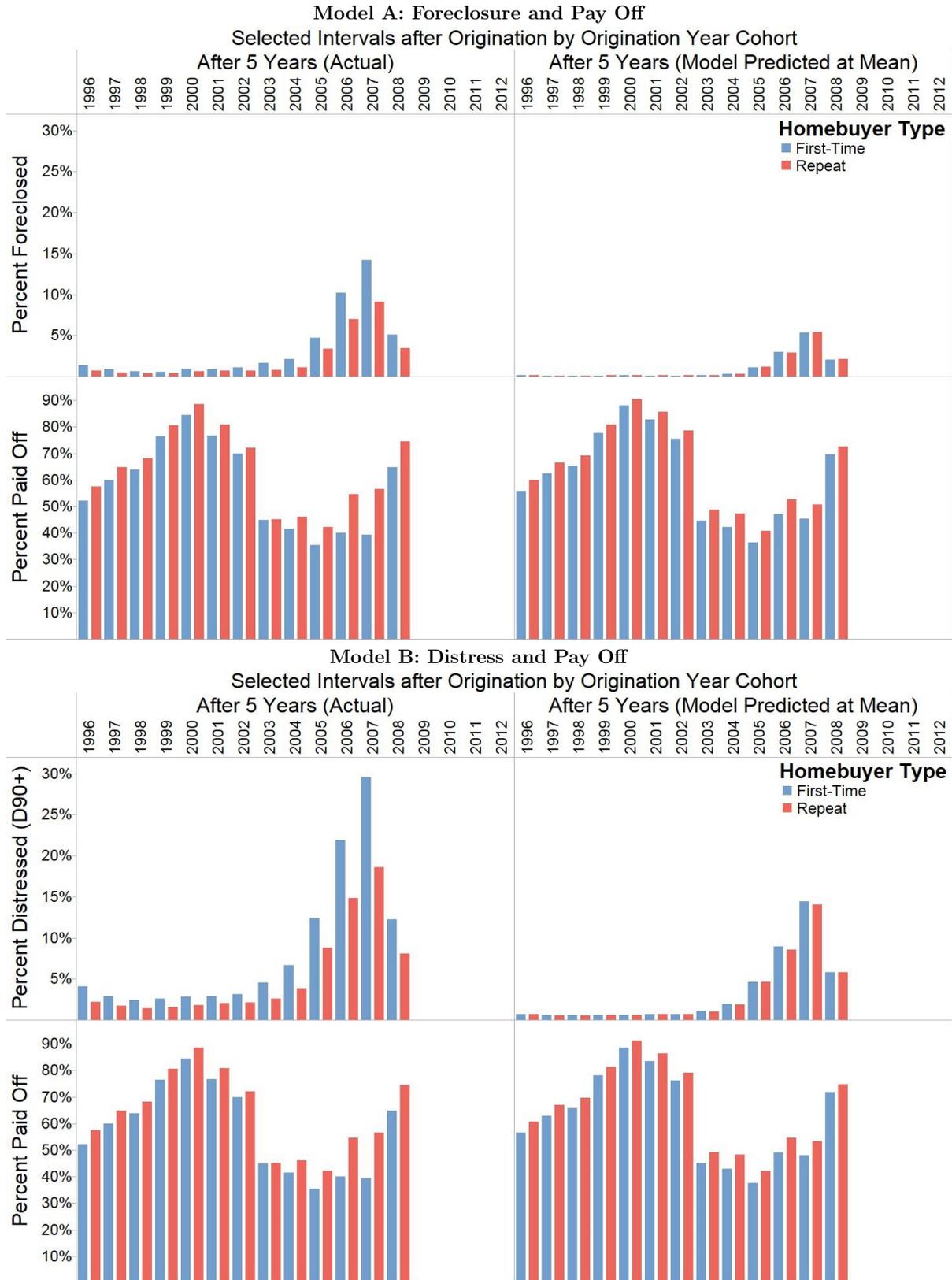


Source: Regressions based on FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

In terms of prepayment, Figure 4 shows that the marginal effect at the mean (MEM) of first-time homebuyers on pay-off five years after origination is not zero and varied by origination year and across time for each cohort. The first-time homebuyer MEM for pay-off is as low as -2.5 percentage points for the 2000 cohort and nearly -6 percentage points for the 2006 and 2007 cohorts. Moreover, Figures 5 and 6 for the 2004 and 2007 cohorts show that the first-time homebuyer MEMs for pay-off reaches a peak level three to five years after origination and then drops suggesting some degree of burnout. These results suggest that even accounting for borrower, loan, and property characteristics known at the time of origination, first-time homebuyers are 2 to 6 percentage points less likely to prepay their mortgages than repeat homebuyers. It is possible that first-time and repeat homebuyer pay-off rates are fundamentally different. Many repeat buyers, having already purchased their “move-up” houses, are likely to refinance their mortgages when rates decrease sufficiently. In contrast, many first-time homebuyers could be planning to “move-up” and purchase a new house in the next two to five years and may choose not to refinance even when mortgage rates drop because the upfront costs of refinancing may not be sufficiently offset by the reduction in mortgage payments for only a short period of time.

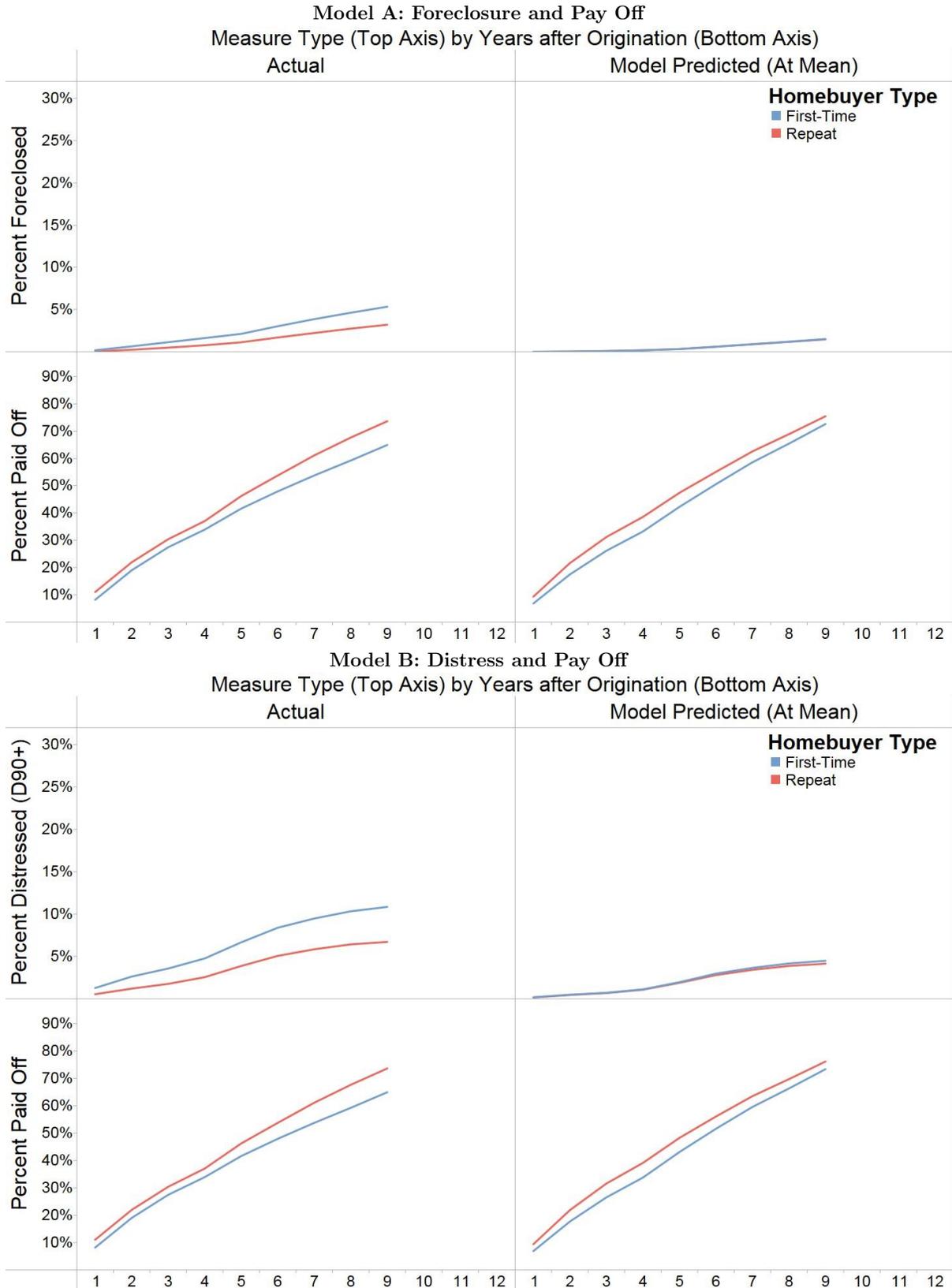
An alternate way to present the model results is to compute the model-predicted (or adjusted) probabilities of default and prepayment for first-time and repeat homebuyers side by side. Then such adjusted probabilities can be compared to the actual default and prepayment rates. Figure 7 compares the actual default and prepayment rates with the APMs for default and prepayment for five years after origination. The top panel shows the results of Model A and the bottom panel, Model B. For each model, the left side shows the actual difference in loan performance of first-time and repeat homebuyers. The right side presents the APMs. Consistent with the MEMs for default discussed above, the difference between first-time and repeat homebuyer default rates virtually disappear once borrower, loan, and property characteristics are controlled for under both models. However, the difference in the

**Figure 7:** Homebuyer Loan Performance Five Years After Origination



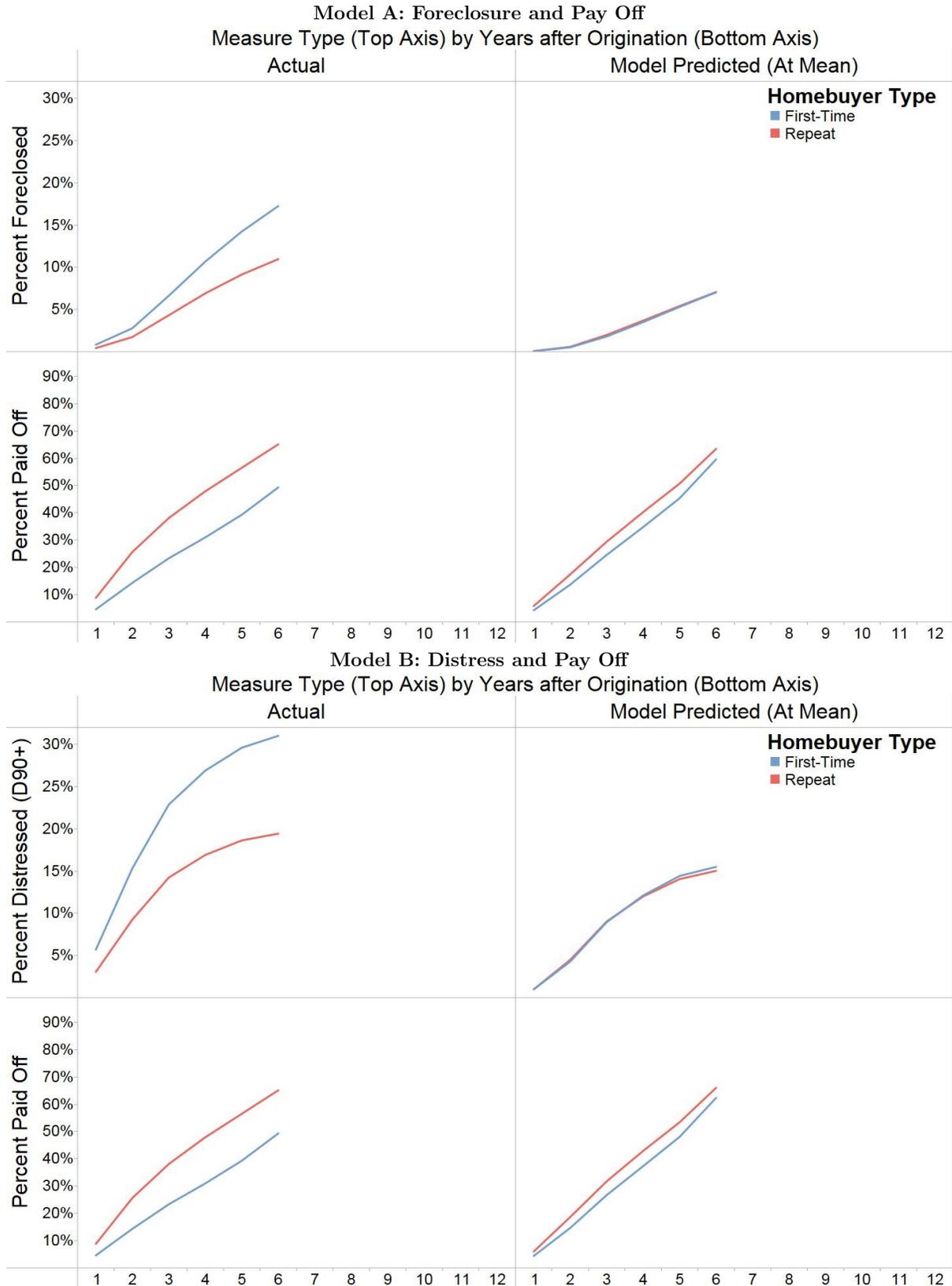
Source: Regressions based on FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

**Figure 8:** Homebuyer Loan Performance of the 2004 Cohort



Source: Regressions based on FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

**Figure 9:** Homebuyer Loan Performance of the 2007 Cohort



Source: Regressions based on FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

prepayment rates of first-time and repeat homebuyers changes very little from the actual rates to the APMs as indicated above by the MEMs for prepayment. Figures 8 and 9 show the actual loan performance outcomes and APMs for the 2004 and 2007 cohorts over time. The AAPs also convey the same conclusions.<sup>20</sup>

## **V.C Discussion**

Based on the results presented above, this subsection will provide a discussion of model sensitivity, implications, and limitations of this study and suggest a line future research on this topic.

One concern for this study may be that first-time homebuyers and repeat homebuyers may be selected differently into the mortgage pool and hence this study. For example, a homebuyer can only appear as a first-time homebuyer (assuming the ideal definition) only once but it can appear more than once as a repeat homebuyer, especially if he or she has already been successful as a previous first-time homebuyer. This means that the same repeat homebuyer may be in the comparison group of more than one cohort of first-time homebuyers and some first-time homebuyers may be classified as a repeat homebuyer for comparison to a later cohort of first-time homebuyers. From a policy point of view, this is not an important concern because whether first-time homebuyer loan performance is studied from the perspective of risk and pricing or public policy intervention of some kind, comparing first-time homebuyers to the general population of repeat homebuyers is of interest.

However, it is possible that being a first-time homebuyer in conjunction with having certain characteristics such as high or low credit score or high or low LTV affects loan performance disproportionately. To the extent that is true, it can be tested in at least two ways. In addi-

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<sup>20</sup>However, as expected, the AAP levels differ from the APM levels because the AAPs are calculated using actual values of explanatory variables and averaged while APMs are calculated at the average values of the explanatory variables.

tion to Model A and Model B presented above, alternate models that included interactions of the first-time homebuyer with LTV and credit score categories were also run for selected cohorts. The results were not substantively different from results presented above. In addition to the MEMs, AMEs, APMs, and AAPs presented above and in Appendices C and D, adjusted probabilities of loan performance were also computed at several representative values of LTV and credit score for selected cohorts. Those results were also not substantively different. Moreover, because Models A and B were run separately for 17 cohorts over time periods ranging from one year to 17 years after origination, it is safe to conclude that the results are fairly robust to many types of variations.

Another concern for the study is that several important variables such as marital status, source of income, education level, and household wealth are missing from the list of explanatory variables used in this study. There is also no control for housing counseling. All these variables can affect loan performance. Therefore, omitted variable bias is likely and the interpretation of the coefficients of other explanatory variables should be carefully considered. It is worth noting that despite omitted variables, the model is able to capture the difference in the default rate of first-time and repeat homebuyer mortgages. While inclusion of such variables will no doubt improve the model, such improvements are likely to be minimal because the extensive list of explanatory variables included in the model such as number of borrowers, monthly income, credit score, and borrower age appear to be able to proxy for much of the missing elements well enough to virtually eliminate any first-time homebuyer effects. If the first-time homebuyer indicator and other variables in the model are proxying for missing elements, the model coefficient estimates are likely biased upwards. If it were possible to include the omitted variables in the model, the coefficients, including that of the first-time homebuyer indicator variable, are likely to diminish in size. This in turn will result in even smaller first-time homebuyer marginal effects. Therefore, the inference that the first-time homebuyer marginal effect on mortgage default is expected to be stable under

improvements to the model is reasonable.

Yet another concern for the study is that the lack of competing risk hazard framework may not control for the time-variant factors that undoubtedly affect loan performance. First, the goal of the study was not to estimate the best model of default and prepayment but to estimate a model based on information known at the time of loan origination. And by definition, much of the time-variant factors are unknown at the time of origination. Second, despite the lack of time-variant factors, the model results suggest that first-time homebuyers do not default at a higher level than repeat homebuyer controlling for information known at origination. It is clear that the multinomial logit framework that does not account for time-variant hazard is not as good at predicting prepayment. Prepayment can be very sensitive to interest-rate changes over time as well as the burnout phenomenon and the model used in this study is not able to capture such dynamic changes. Therefore, the adjusted first-time and repeat homebuyer difference in prepayment does not change much from the actual difference. However, the model results in this paper suggest that including the first-time homebuyer indicator in a default-prepayment model, even in a dynamic hazard model, may be important for estimating prepayment probabilities.

There are several things that this paper does not do and can be avenues for future research on this topic.

- First, the definition of first-time homebuyers<sup>21</sup> used in this paper is not ideal. This paper does not test the sensitivity of possible overcounting of first-time homebuyers on loan performance or model results. It is possible to identify true first-time homebuyers from credit bureau data and re-estimate the default-prepayment model for a small sample to test whether the result holds.

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<sup>21</sup>The Enterprise mortgage databases define first-time homebuyers primarily as homebuyers who intend to live in the purchased home and who had not owned a home in the past three years.

- Second, this paper only studies Enterprise mortgages. The question of whether the results are generalizable to the wider population is an important one. At this time, the study can only be extended to FHA loans because a nationally representative database that identifies first-time homebuyers does not yet exist. However, that exercise will also prove valuable in extending the analysis to a wider population than just Enterprise loans.
- Third, the variable on household reserves can be scrutinized further for non-response bias. If such bias does not appear to be an issue, the model can be extended for the sample with that information. Inclusion of this variable will improve the model.
- Last, the results of this paper should be tested using a competing risk hazard framework, particularly to test more conclusively whether or not first-time homebuyers prepay at a lower rate than repeat homebuyers, all else equal.

## **VI Conclusion**

First-time homebuyer mortgages acquired by the Enterprises generally performed worse than repeat homebuyer mortgages. But first-time homebuyers are also inherently different from repeat homebuyers. For example, they are younger, and have lower credit scores, lower home equity, and less income and therefore are less likely to withstand financial stress or take advantage of financial innovations available in the market than repeat homebuyers. In other words, in terms of many borrower, loan, and property characteristics that can be determined at the time of loan origination, the distributional make-up of first-time homebuyers is somewhat weaker than that of repeat homebuyers.

Once these distributional differences are accounted for in an econometric model, however, there appears to be virtually no difference between the “average” first-time and repeat homebuyers in their probabilities of default. Therefore the difference in the first-time and repeat homebuyer loan performance is due to the difference in distributional make-up of the two

groups in terms of borrower, loan, and property characteristics and not because first-time homebuyers are an inherently riskier group. As long as the borrower, property, and loan characteristics known at the time of origination are able to determine a borrower's ability to repay well and risk is priced accordingly, there should not be a concern that the average first-time homebuyer mortgages are inherently any riskier than the average repeat homebuyer mortgages once those characteristics are taken into account. Both types of mortgages can be expected to default at a similar rate if borrowers, loans, and properties are similar in all other regards. This means that the mechanisms through which mortgage default occurs, influenced by borrower, loan and property factors, do not appear to be different for first-time homebuyers compared to repeat homebuyers. As a result, any policies targeted to mitigate mortgage default risk are equally likely to be effective for first-time and repeat homebuyers.

In contrast to default probabilities, there appears to be an inherent difference in the prepayment probabilities of first-time and repeat homebuyers holding borrower, loan, and property characteristics constant. First-time homebuyers are less likely to prepay a mortgage compared to repeat homebuyers even after accounting for the distributional make-up of the two groups at loan origination. Even in a competing risk hazard framework that accounts for refinance incentive and burnout factor over time, this difference is likely to persist, however, presumably at a reduced level. At the very least, this result suggests that a loan-month level mortgage default-prepayment model should test controlling for whether or not borrowers are first-time buyers. The result that first-time homebuyers refinance at a lower rate than repeat homebuyers, once it is also corroborated by a competing risk default-prepayment model, could also have policy implications for targeting refinance programs.

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## **Appendix A: Characteristics**

This appendix describes the characteristics of first-time and repeat homebuyers for each origination year from 1996 to 2013.

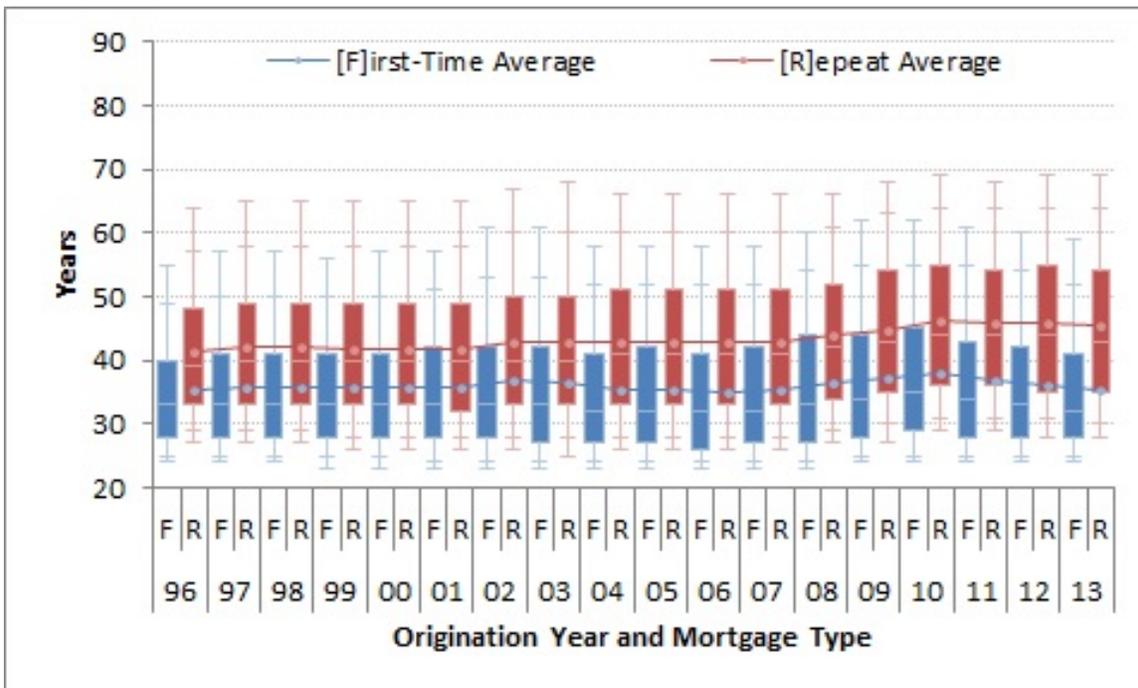
Distributions of continuous variables such as borrower age or income are shown as modified box plots. The modified box plots show the inter-quartile range (third and first quartiles) as the top and the bottom of the boxes and the median as a line somewhere in the middle (and sometimes coinciding with either the top or the bottom, or both). The whiskers on the top show the 95th and 90th percentiles and those on the bottom show the 10th and the 5th percentiles.

In addition to the distribution, averages (population means) are shown as dots. The dots are connected with a line from one origination cohort to another.

Distributions of categorical variables such as loan type or property type are shown as bar charts. Major categories are shown and minor categories are left out. Therefore, the gap between the top bar and 100 percent is the remainder or “other” category.

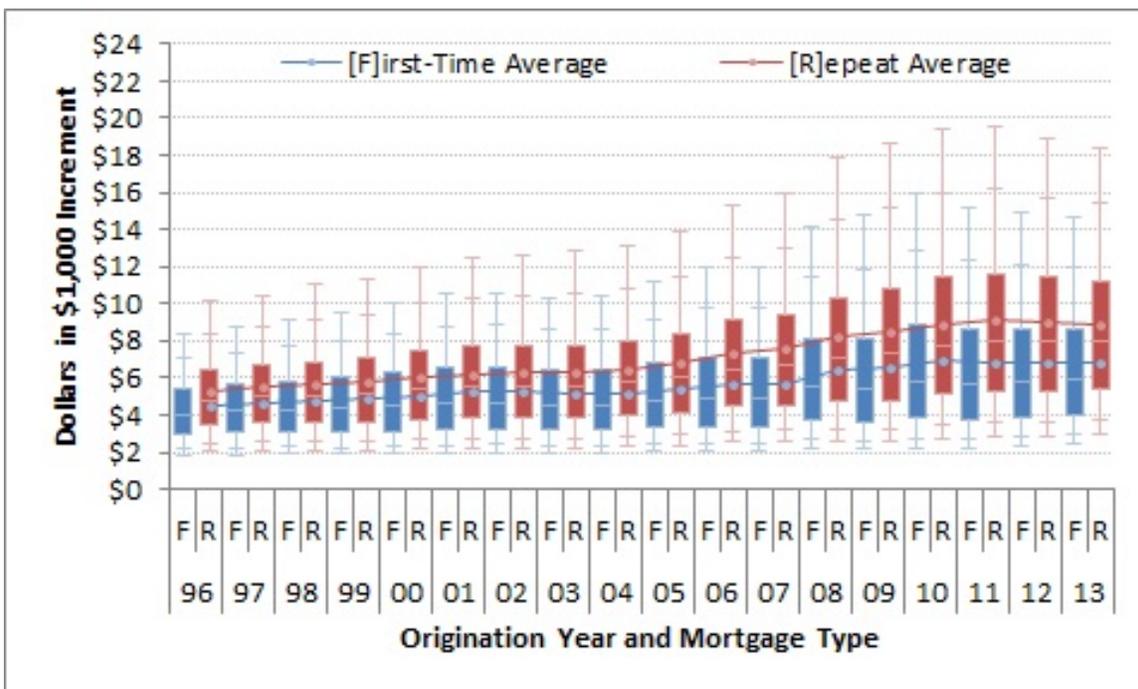
First-time homebuyer distributions and averages are shown in blue and repeat homebuyer distributions and averages are shown in red.

Figure A1: Distribution of Borrower Age



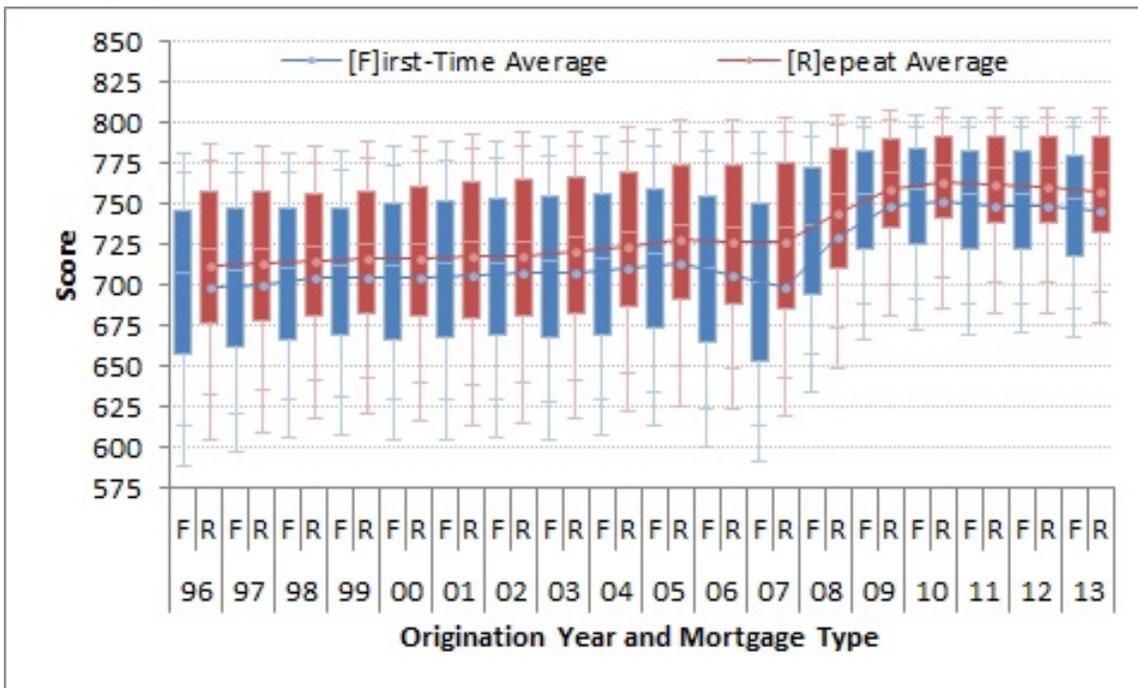
Source: FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

Figure A2: Distribution of Borrower Monthly Income



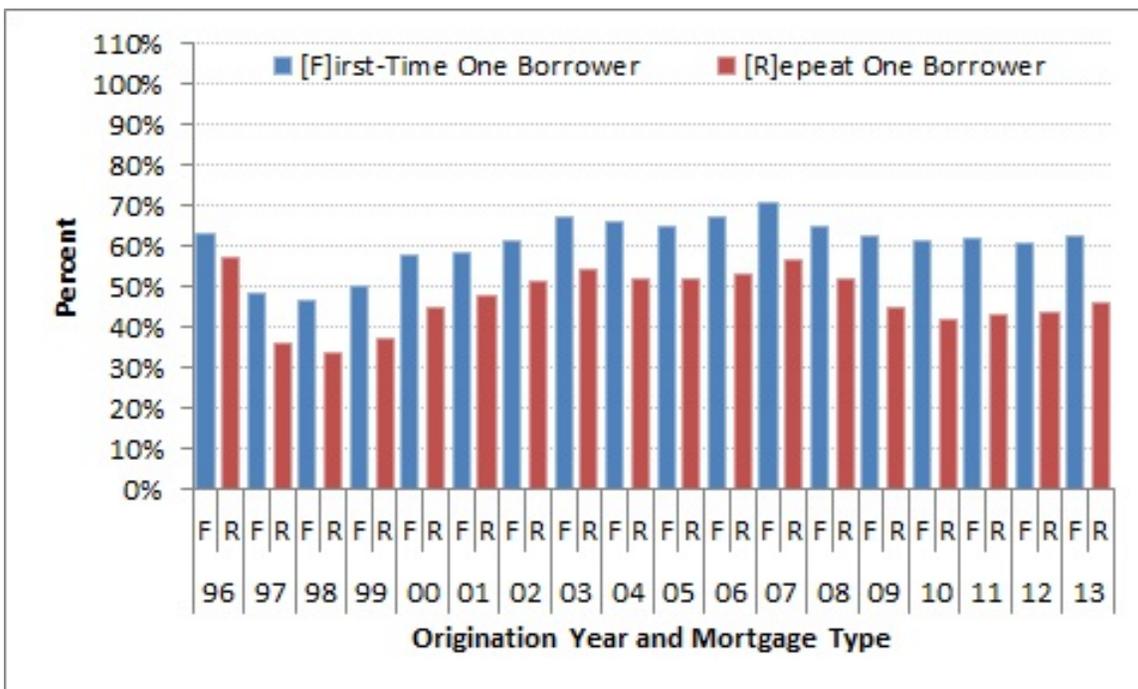
Source: FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

Figure A3: Distribution of Borrower FICO Credit Score



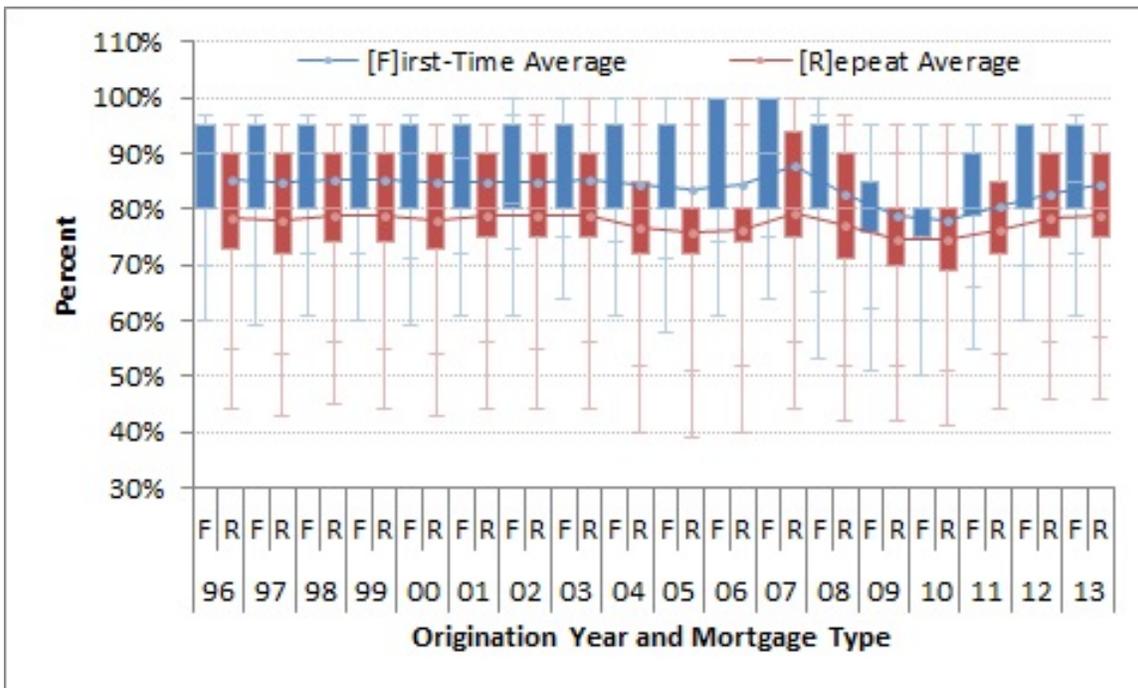
Source: FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

Figure A4: Percentage of One Borrower Mortgages



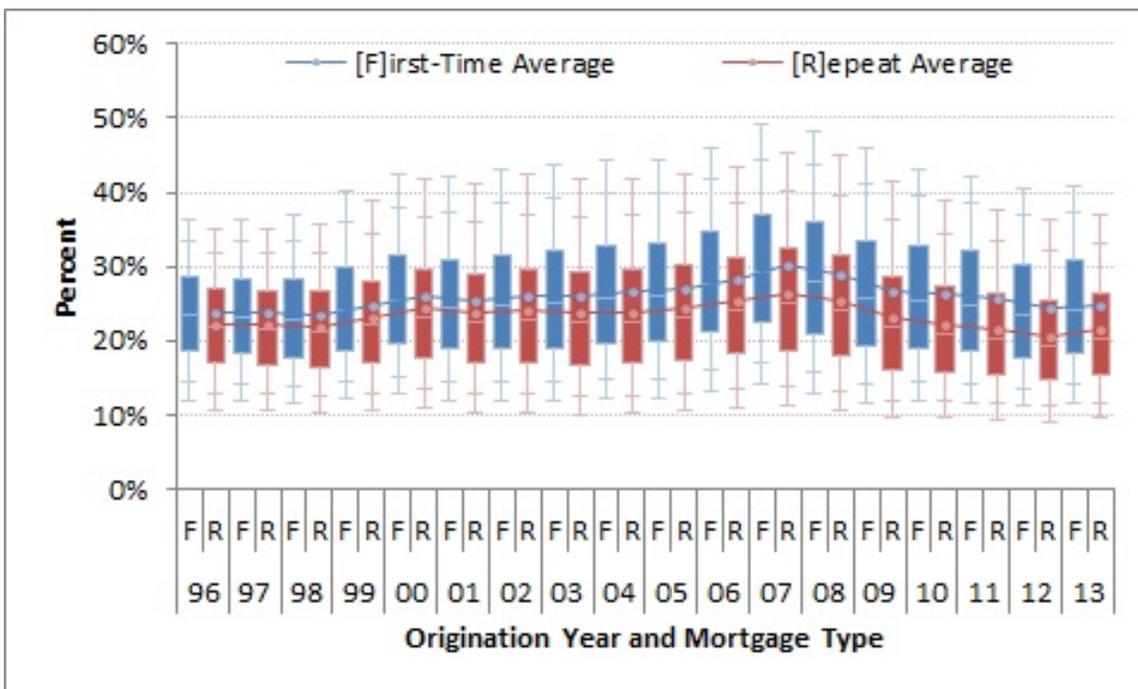
Source: FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

**Figure A5:** Distribution of Loan-to-Value (LTV) Ratio



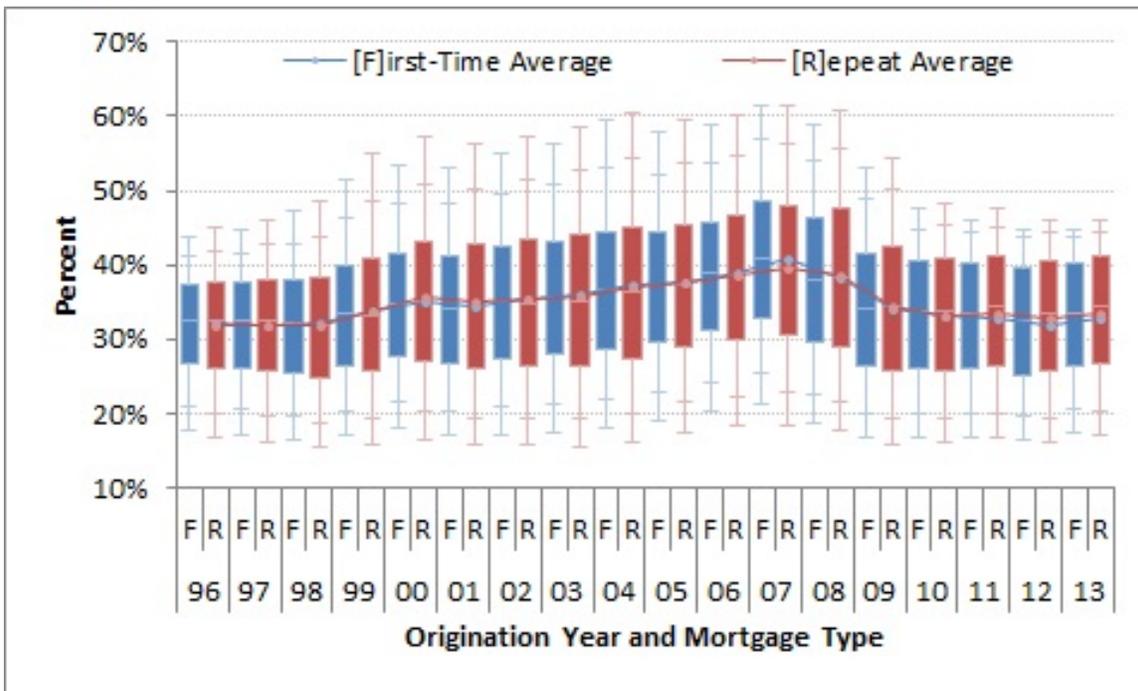
Source: FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

**Figure A6:** Distribution of Payment-to-Income (PTI) Ratio



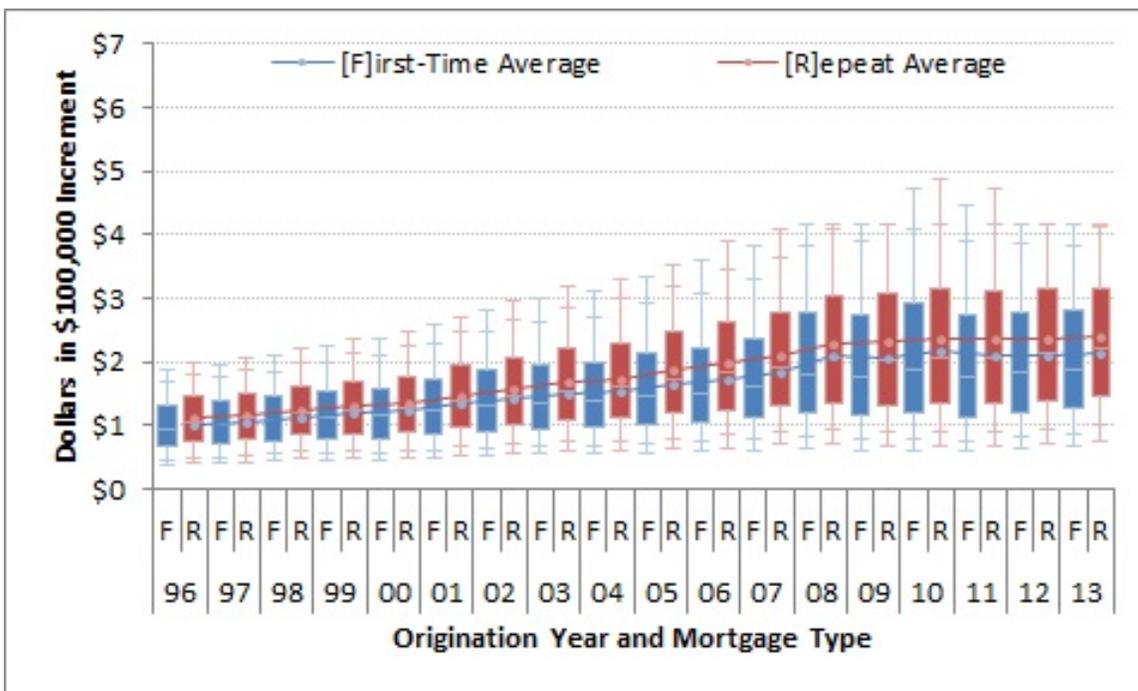
Source: FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

Figure A7: Distribution of Debt-to-Income (DTI) Ratio



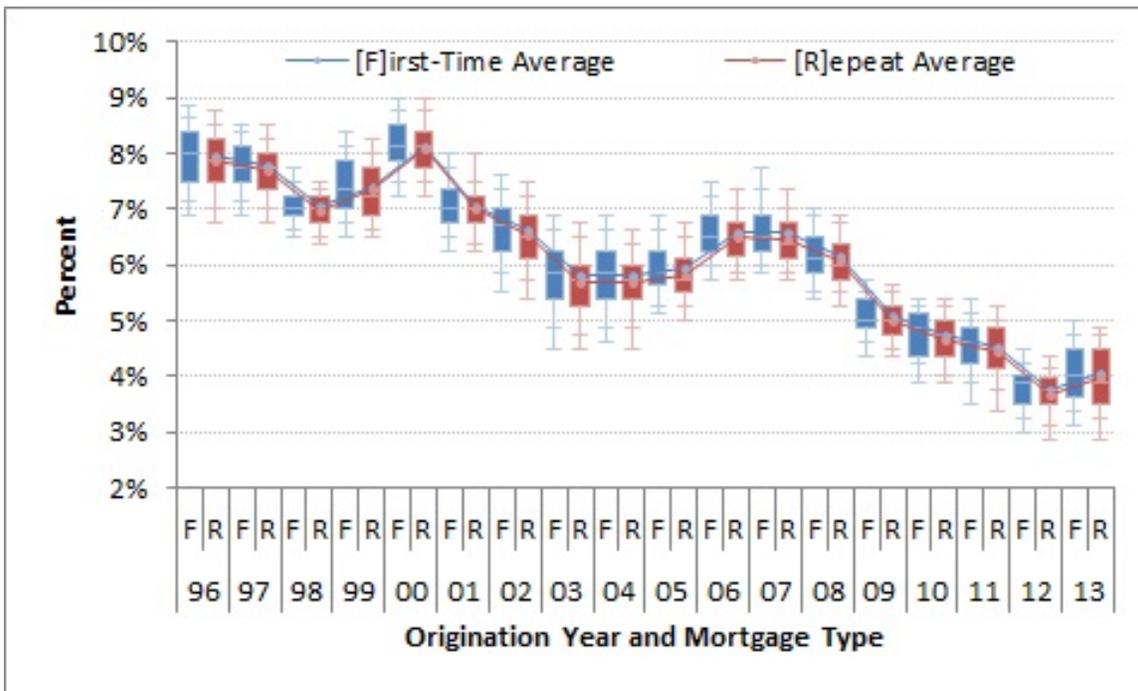
Source: FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

Figure A8: Distribution of Loan Amount



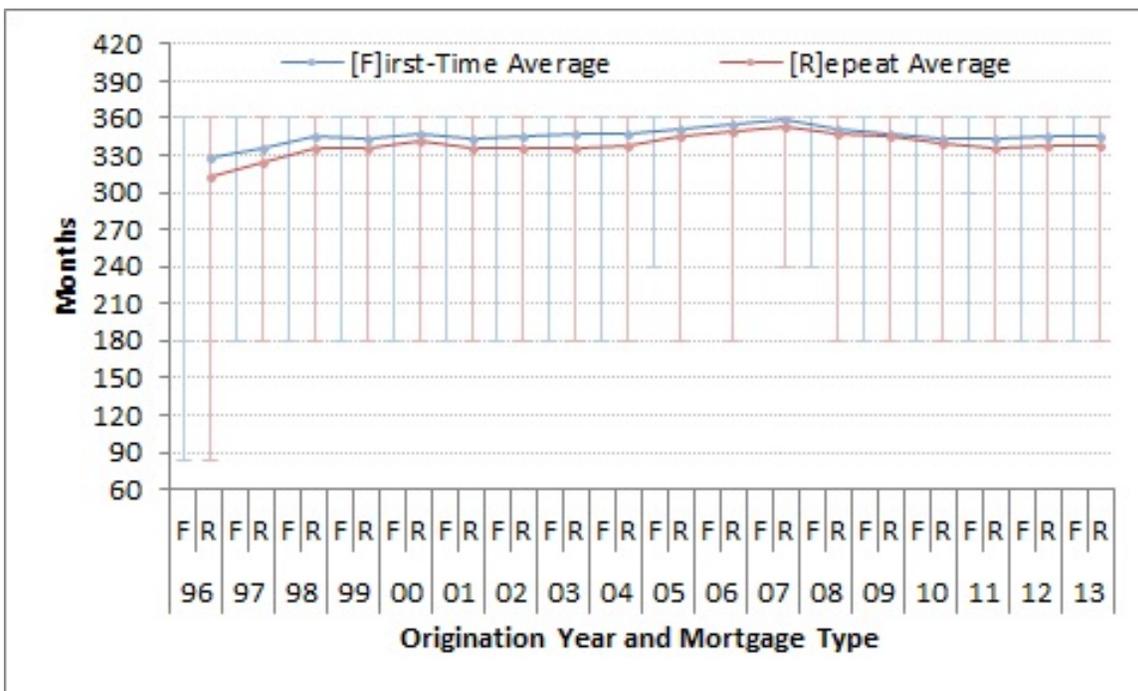
Source: FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

Figure A9: Distribution of Loan Note Rate



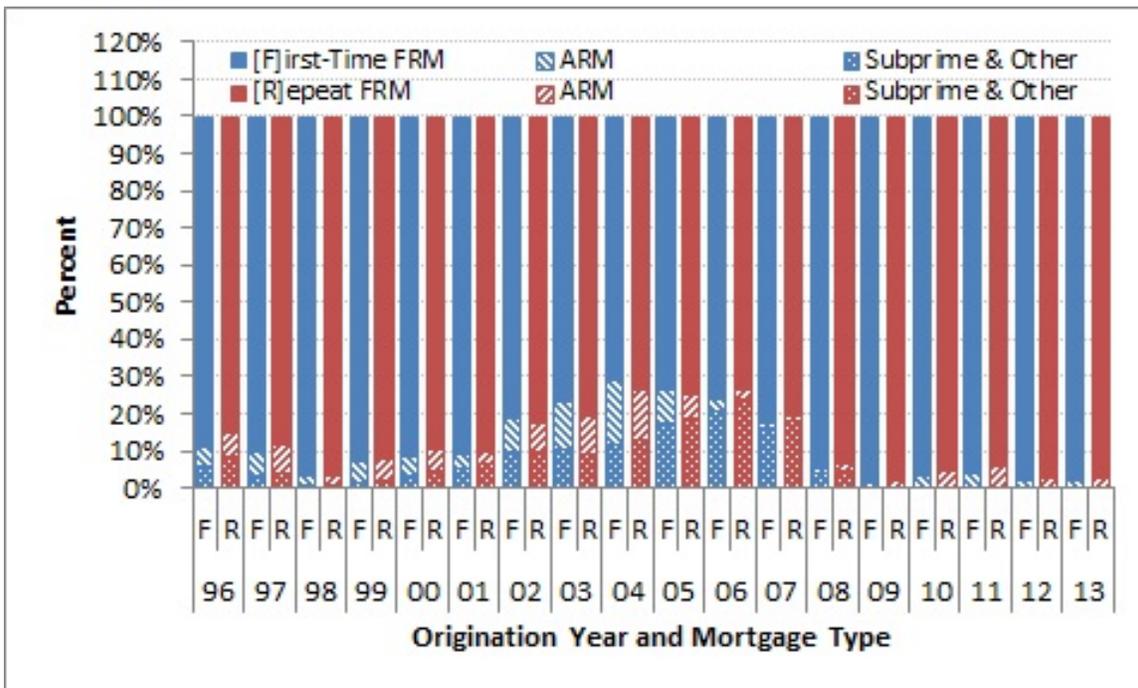
Source: FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

Figure A10: Distribution of Loan Term



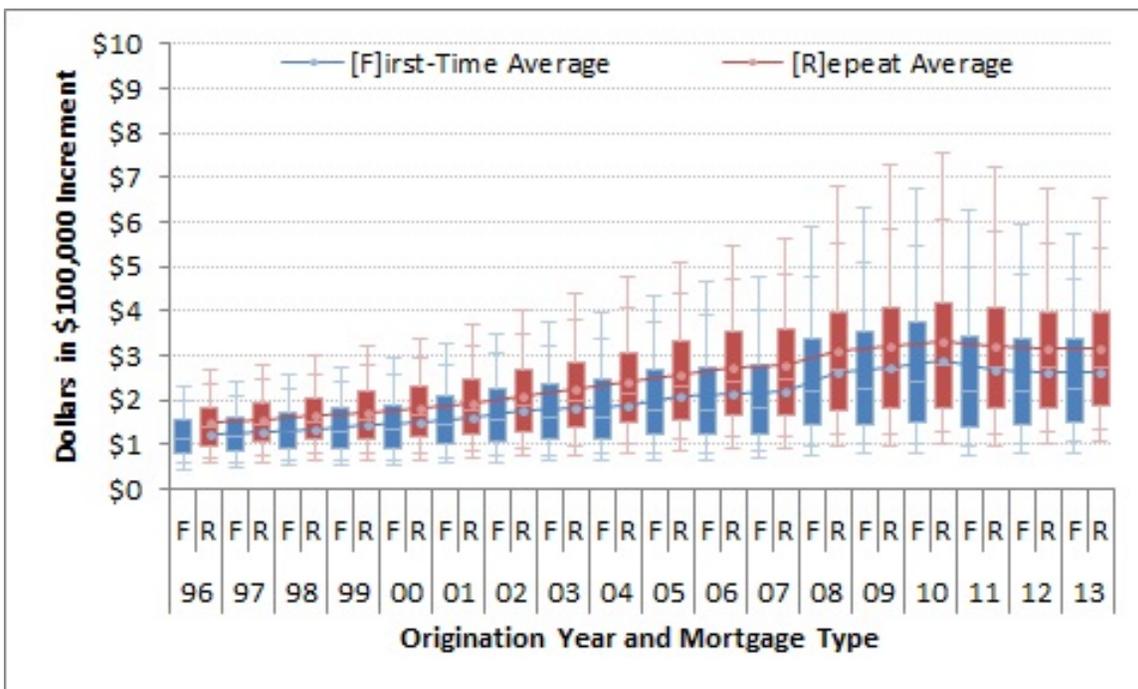
Source: FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

Figure A11: Distribution of Loan Type



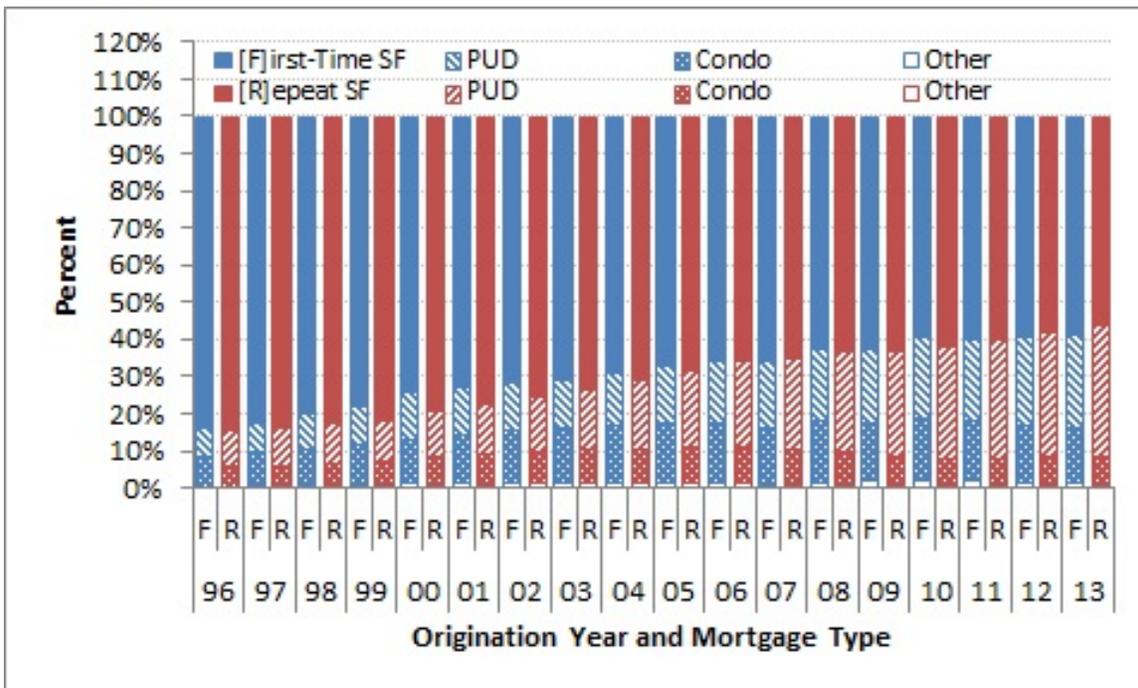
Source: FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

Figure A12: Distribution of Property Value



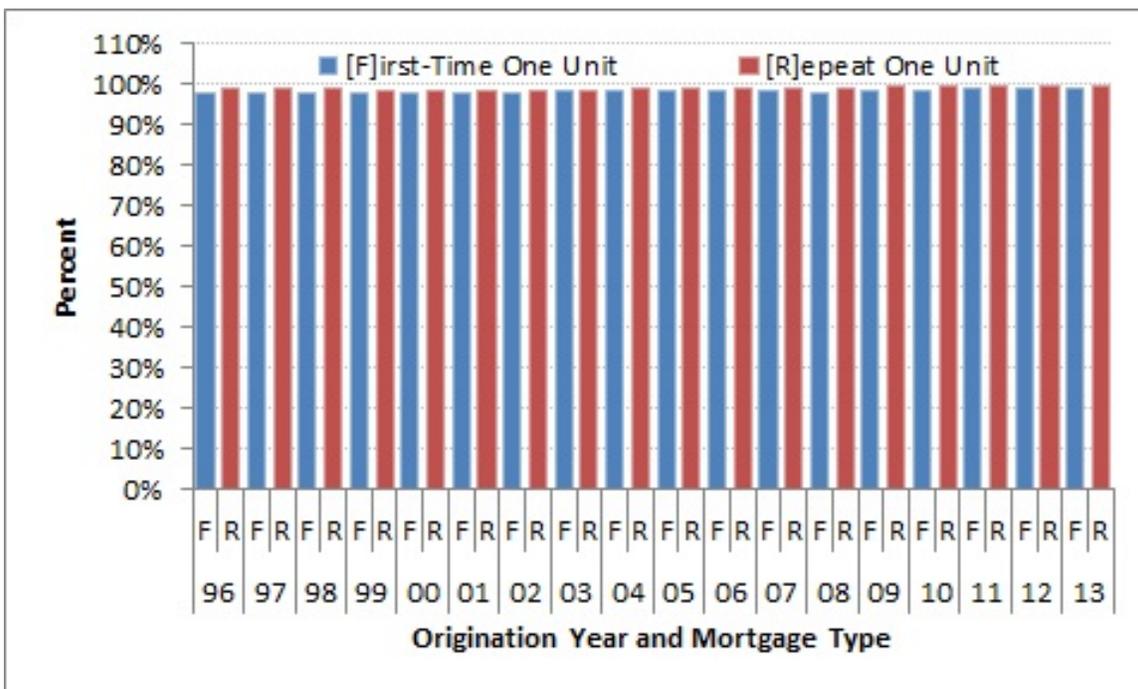
Source: FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

Figure A13: Distribution of Property Type



Source: FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

Figure A14: Percentage of One Unit Properties



Source: FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

## **Appendix B: Loan Performance Outcomes**

This appendix presents the actual loan performance of first-time (FTHB) and repeat (RHB) homebuyers for each origination year from 1996 to 2013 every year after origination until the end of 2013.

Figure B1: First-Time and Repeat Homebuyer Loan Performance: Percent Seriously Delinquent

Years After Origination	Origination Cohorts																							
	1996		1997		1998		1999		2000		2001		2002		2003		2004							
	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB						
1	0.8%	0.4%	0.6%	0.3%	0.4%	0.2%	0.3%	0.7%	0.5%	0.7%	0.6%	0.7%	0.7%	0.8%	1.0%	0.6%	1.1%	1.1%	0.5%					
2	1.7%	0.9%	1.2%	0.7%	0.9%	0.5%	1.1%	1.4%	1.0%	1.4%	1.1%	1.4%	1.4%	1.4%	1.0%	0.6%	1.8%	1.0%	2.0%					
3	2.3%	1.2%	1.5%	0.9%	1.3%	0.8%	1.6%	1.8%	1.2%	1.8%	1.3%	1.8%	1.8%	1.3%	1.3%	2.3%	2.3%	2.4%	1.3%					
4	2.6%	1.4%	1.9%	1.1%	1.7%	1.0%	1.9%	1.9%	1.2%	1.9%	1.3%	2.0%	2.0%	1.4%	1.4%	2.5%	1.4%	3.1%	1.8%					
5	2.8%	1.5%	2.1%	1.2%	1.8%	1.0%	2.0%	2.0%	1.2%	1.9%	1.4%	2.0%	2.0%	1.4%	1.7%	2.9%	1.7%	4.5%	2.8%					
6	2.9%	1.5%	2.1%	1.2%	1.9%	1.0%	2.0%	2.0%	1.2%	1.9%	1.4%	2.1%	2.1%	1.4%	1.5%	3.8%	2.3%	5.4%	3.4%					
7	2.8%	1.5%	2.0%	1.2%	1.9%	1.0%	2.1%	2.1%	1.2%	1.9%	1.2%	2.2%	2.2%	1.4%	1.8%	4.3%	2.8%	5.6%	3.6%					
8	2.7%	1.4%	2.0%	1.2%	1.8%	1.0%	2.1%	2.1%	1.2%	2.0%	1.2%	2.3%	2.3%	1.5%	1.9%	4.5%	3.0%	5.7%	3.7%					
9	2.6%	1.4%	2.0%	1.2%	1.8%	1.0%	2.1%	2.1%	1.2%	2.1%	1.2%	2.5%	2.5%	1.6%	2.0%	4.6%	3.1%	5.5%	3.5%					
10	2.6%	1.3%	2.0%	1.2%	1.9%	1.0%	2.2%	2.2%	1.2%	2.1%	1.2%	2.5%	2.5%	1.6%	2.0%	4.5%	3.0%							
11	2.6%	1.3%	2.0%	1.2%	1.9%	1.1%	2.3%	2.3%	1.2%	2.1%	1.2%	2.6%	2.6%	1.6%	2.0%									
12	2.6%	1.3%	2.0%	1.2%	2.0%	1.1%	2.3%	2.3%	1.2%	2.1%	1.2%	2.5%	2.5%	1.6%										
13	2.6%	1.3%	2.1%	1.2%	2.0%	1.1%	2.3%	2.3%	1.2%	2.1%	1.2%													
14	2.6%	1.3%	2.1%	1.2%	2.0%	1.1%	2.3%	2.3%	1.3%	1.3%														
15	2.6%	1.3%	2.1%	1.2%	2.0%	1.1%																		
16	2.6%	1.3%	2.1%	1.2%																				
17	2.6%	1.3%																						
In 2013	2.6%	1.3%	2.0%	1.2%	2.0%	1.1%	2.3%	2.3%	1.3%	2.1%	1.2%	2.5%	2.5%	1.6%	2.0%	4.5%	2.9%	5.4%	3.5%					

Years After Origination	Origination Cohorts																							
	2005		2006		2007		2008		2009		2010		2011		2012									
	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB								
1	1.2%	0.6%	2.2%	1.1%	4.9%	2.6%	2.6%	2.6%	0.3%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%									
2	2.2%	1.3%	5.3%	3.2%	12.5%	7.5%	5.8%	3.8%	0.7%	0.5%	0.4%	0.4%	0.2%	0.2%										
3	3.7%	2.4%	9.9%	6.5%	16.2%	9.9%	7.1%	4.7%	1.1%	0.7%	0.7%	0.4%												
4	6.3%	4.4%	11.8%	7.8%	16.2%	10.0%	7.5%	4.9%	1.3%	0.9%														
5	7.7%	5.5%	11.7%	7.9%	15.4%	9.5%	7.2%	4.6%																
6	7.9%	5.6%	11.1%	7.4%	13.8%	8.5%																		
7	7.7%	5.6%	10.0%	6.6%																				
8	7.2%	5.1%																						
In 2013	7.0%	5.0%	9.7%	6.4%	13.3%	8.2%	7.0%	4.4%	1.4%	0.9%	0.8%	0.4%	0.4%	0.2%	0.1%									

Source: FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

Figure B2: First-Time and Repeat Homebuyer Loan Performance: Percent Foreclosed

Years After Origination	Origination Cohorts																	
	1996		1997		1998		1999		2000		2001		2002		2003		2004	
	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB
1	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.1%
2	0.4%	0.2%	0.3%	0.1%	0.2%	0.1%	0.2%	0.3%	0.2%	0.3%	0.2%	0.3%	0.4%	0.3%	0.4%	0.3%	0.7%	0.3%
3	0.8%	0.4%	0.5%	0.3%	0.3%	0.2%	0.3%	0.5%	0.4%	0.6%	0.5%	0.7%	0.5%	0.7%	0.5%	1.0%	0.5%	0.5%
4	1.1%	0.6%	0.7%	0.4%	0.5%	0.3%	0.5%	0.8%	0.5%	0.8%	0.6%	0.9%	0.6%	0.9%	0.6%	1.3%	0.7%	0.8%
5	1.3%	0.7%	0.9%	0.5%	0.6%	0.4%	0.6%	0.9%	0.6%	0.9%	0.7%	1.1%	0.7%	1.1%	0.7%	1.6%	0.8%	1.1%
6	1.5%	0.8%	1.0%	0.6%	0.8%	0.5%	0.7%	1.0%	0.7%	1.0%	0.8%	1.2%	0.8%	1.2%	0.8%	1.9%	1.0%	1.7%
7	1.7%	0.9%	1.1%	0.6%	0.9%	0.5%	0.7%	1.1%	0.7%	1.1%	0.8%	1.4%	0.9%	1.4%	0.9%	2.5%	1.4%	2.2%
8	1.8%	0.9%	1.2%	0.7%	1.0%	0.6%	0.8%	1.1%	0.8%	1.1%	0.8%	1.6%	1.1%	1.6%	1.1%	3.0%	1.7%	2.8%
9	1.8%	1.0%	1.2%	0.7%	1.0%	0.6%	0.8%	1.2%	0.8%	1.3%	1.0%	1.8%	1.2%	1.8%	1.1%	3.5%	2.0%	3.2%
10	1.9%	1.0%	1.3%	0.7%	1.0%	0.6%	0.8%	1.2%	0.8%	1.4%	1.0%	2.0%	1.3%	2.0%	1.3%	4.0%	2.3%	
11	1.9%	1.0%	1.3%	0.8%	1.0%	0.7%	0.9%	1.3%	0.9%	1.5%	1.1%	2.2%	1.4%					
12	2.0%	1.0%	1.3%	0.8%	1.1%	0.7%	0.9%	1.4%	0.9%	1.6%	1.2%							
13	2.0%	1.0%	1.4%	0.8%	1.1%	0.7%	1.0%	1.4%	0.9%	1.6%	1.2%							
14	2.0%	1.1%	1.4%	0.8%	1.2%	0.8%	1.0%	1.4%	0.9%	1.6%	1.2%							
15	2.0%	1.1%	1.4%	0.8%	1.2%	0.8%	1.0%	1.4%	0.9%	1.6%	1.2%							
16	2.1%	1.1%	1.5%	0.9%														
17	2.1%	1.1%																
In 2013	2.1%	1.1%	1.5%	0.9%	1.2%	0.8%	1.0%	1.4%	0.9%	1.6%	1.2%	2.2%	1.5%	4.1%	2.4%	5.4%	3.5%	

Years After Origination	Origination Cohorts																	
	2005		2006		2007		2008		2009		2010		2011		2012			
	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB
1	0.2%	0.1%	0.5%	0.3%	0.8%	0.4%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2	0.8%	0.4%	2.0%	1.2%	2.8%	1.7%	1.1%	0.7%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
3	1.7%	1.0%	3.9%	2.6%	6.6%	4.3%	2.4%	1.6%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
4	2.8%	1.9%	7.2%	4.9%	10.7%	6.9%	3.8%	2.6%	0.4%	0.3%								
5	4.7%	3.4%	10.2%	7.0%	14.2%	9.1%	5.1%	3.5%										
6	6.6%	4.7%	12.8%	8.7%	17.2%	11.0%												
7	8.2%	5.8%	14.9%	10.1%														
8	9.6%	6.8%																
In 2013	9.9%	7.1%	15.4%	10.5%	18.0%	11.4%	5.6%	3.8%	0.5%	0.4%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%

Source: FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.



## **Appendix C: Marginal Effects on Loan Outcomes**

This appendix presents the model-calculated marginal effects of first-time homebuyer mortgages on various loan performance outcomes for each origination year from 1996 to 2013 every year after origination until the end of 2013. Model A estimates the marginal effects of first-time homebuyers on foreclosure and pay-off, and Model B estimates the marginal effects of first-time homebuyers on distress and pay-off. The marginal effects are first computed at the mean (MEM) and then computed as average marginal effects (AME).









## **Appendix D: Adjusted Loan Performance Outcomes**

This appendix presents the model-calculated or adjusted probabilities of various loan performance outcomes for first-time (FTHB) and repeat (RHB) homebuyers for each origination year from 1996 to 2013 every year after origination until the end of 2013. Model A estimates the adjusted probabilities of foreclosure, pay-off, and active outcomes jointly and Model B estimates the adjusted probabilities of distress, pay-off, and performing outcomes jointly. The adjusted probabilities are first computed at the mean (APM) and then computed as average adjusted probabilities (AAP).

Figure D1: First-Time and Repeat Homebuyer Adjusted Probability at the Mean: Percent Foreclosed (Model A)

Years After Origination	Origination Cohorts																	
	1996		1997		1998		1999		2000		2001		2002		2003		2004	
	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB
1																		
2	0.0%	0.0%	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
3	0.1%	0.1%	0.0%	0.1%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
4	0.1%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%
5	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.3%	0.3%
6	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.1%	0.2%	0.2%	0.3%	0.3%	0.6%	0.6%
7	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.4%	0.9%	0.9%
8	0.3%	0.3%	0.2%	0.2%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.7%	1.2%	1.2%
9	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%	0.8%	1.5%	1.5%
10	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%	0.9%		
11	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.4%			
12	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%				
13	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%				
14	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%				
15	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%				
16	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%				
17	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%				

Years After Origination	Origination Cohorts																	
	2005		2006		2007		2008		2009		2010		2011		2012			
	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB		
1																		
2	0.1%	0.1%	0.2%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		
3	0.2%	0.2%	0.7%	0.7%	1.8%	1.8%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%				
4	0.5%	0.5%	1.7%	1.8%	3.5%	3.7%	0.8%	0.8%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%				
5	1.1%	1.2%	3.0%	2.9%	5.3%	5.4%	1.4%	1.4%	0.2%	0.2%								
6	1.8%	1.8%	4.2%	4.0%	7.0%	7.1%	2.1%	2.1%										
7	2.5%	2.5%	5.3%	5.1%														
8	3.2%	3.1%																

Source: Regressions based on FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

Figure D2: First-Time and Repeat Homebuyer Adjusted Probability at the Mean: Percent Paid Off (Model A)

Years After Origination	Origination Cohorts																	
	1996		1997		1998		1999		2000		2001		2002		2003		2004	
	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB
1																		
2	17.5%	20.2%	25.0%	28.5%			2.0%	3.0%	53.5%	58.1%	51.4%	55.2%	52.7%	56.0%	20.4%	23.8%	6.9%	9.4%
3	39.0%	43.0%	33.6%	38.0%	16.6%	20.8%	29.4%	33.8%	77.4%	80.9%	73.3%	76.8%	65.4%	68.9%	31.4%	35.5%	26.2%	31.2%
4	46.5%	50.6%	43.7%	48.5%	33.3%	38.4%	60.6%	64.7%	88.5%	88.3%	79.7%	82.9%	71.6%	74.9%	38.6%	42.8%	33.2%	38.5%
5	55.8%	59.9%	62.3%	66.5%	65.2%	69.2%	77.6%	80.7%	85.1%	90.6%	82.8%	85.7%	75.4%	78.5%	44.5%	48.7%	42.2%	47.4%
6	69.6%	72.9%	79.7%	82.4%	79.4%	82.2%	82.8%	85.4%	89.3%	84.5%	84.5%	87.2%	78.2%	81.1%	50.9%	55.0%	50.5%	55.0%
7	82.0%	84.3%	86.7%	88.5%	84.0%	86.2%	85.4%	87.7%	90.1%	92.4%	85.8%	88.4%	81.2%	83.7%	57.7%	61.4%	58.5%	62.5%
8	87.6%	89.2%	89.1%	90.6%	86.2%	88.2%	86.7%	88.9%	90.6%	92.8%	87.2%	89.5%	83.6%	85.9%	64.1%	67.6%	65.4%	68.8%
9	89.8%	91.1%	90.4%	91.7%	87.6%	89.4%	87.8%	89.8%	90.9%	93.1%	88.3%	90.4%	85.7%	87.7%	70.1%	73.3%	72.5%	75.4%
10	91.0%	92.1%	91.2%	92.4%	88.6%	90.3%	88.8%	90.7%	91.3%	93.4%	89.3%	91.3%	87.5%	89.3%	76.2%	79.1%		
11	91.8%	92.8%	91.8%	92.9%	89.7%	91.2%	89.8%	91.5%	91.6%	93.6%	90.2%	92.0%	89.2%	90.8%				
12	92.4%	93.3%	92.3%	93.4%	90.6%	92.0%	90.6%	92.3%	91.8%	93.8%	91.1%	92.7%						
13	92.9%	93.7%	92.8%	93.8%	91.5%	92.8%	91.4%	92.9%	92.1%	94.0%								
14	93.4%	94.1%	93.2%	94.1%	92.3%	93.4%	92.2%	93.6%										
15	94.2%	94.8%	93.9%	94.6%	93.3%	94.3%												
16	94.5%	95.0%	94.2%	94.9%														
17	94.8%	95.3%																

Years After Origination	Origination Cohorts																	
	2005		2006		2007		2008		2009		2010		2011		2012			
	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB		
1																		
2	11.5%	14.5%	13.8%	17.7%	4.3%	5.8%	7.8%	9.2%										
3	18.4%	22.4%	25.5%	30.9%	24.6%	29.4%	39.0%	43.2%	15.9%	17.8%	40.9%	44.9%	27.3%	29.9%				
4	26.9%	31.6%	37.2%	42.8%	34.8%	40.2%	52.9%	57.4%	34.5%	37.9%								
5	36.5%	40.9%	47.1%	52.7%	45.3%	50.7%	69.7%	72.5%	56.4%	59.7%								
6	46.1%	50.3%	56.2%	61.2%	59.5%	63.4%												
7	55.6%	59.3%	66.9%	70.4%														
8	65.9%	68.8%																

Source: Regressions based on FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

Figure D3: First-Time and Repeat Homebuyer Adjusted Probability at the Mean: Percent Distressed (D90+) (Model B)

Years After Origination	Origination Cohorts																	
	1996		1997		1998		1999		2000		2001		2002		2003		2004	
	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB
1	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
2	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.5%
3	0.5%	0.5%	0.4%	0.4%	0.4%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.6%	0.6%	0.6%	0.6%	0.7%	0.7%
4	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%	0.6%	0.6%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%
5	0.8%	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%
6	0.8%	0.8%	0.7%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%
7	0.8%	0.8%	0.7%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%
8	0.8%	0.8%	0.7%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%
9	0.8%	0.8%	0.7%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%
10	0.9%	0.8%	0.7%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%
11	0.9%	0.8%	0.7%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%
12	0.9%	0.8%	0.7%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%
13	0.9%	0.8%	0.7%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%
14	0.9%	0.8%	0.7%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%
15	0.9%	0.8%	0.7%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%
16	0.9%	0.8%	0.7%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%
17	0.9%	0.8%	0.7%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%

Years After Origination	Origination Cohorts																	
	2005		2006		2007		2008		2009		2010		2011		2012			
	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB		
1	0.3%	0.2%	0.3%	0.3%	1.0%	1.0%	0.7%	0.7%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%		
2	0.6%	0.6%	1.3%	1.3%	4.3%	4.3%	2.6%	2.7%	0.3%	0.3%	0.2%	0.2%	0.1%	0.1%				
3	1.3%	1.3%	3.7%	3.7%	8.9%	9.0%	4.2%	4.2%	0.5%	0.5%	0.3%	0.3%						
4	2.8%	2.8%	6.8%	6.6%	12.1%	12.0%	5.3%	5.3%	0.7%	0.7%								
5	4.6%	4.6%	8.9%	8.5%	14.4%	14.0%	5.8%	5.8%										
6	5.9%	5.8%	10.4%	9.8%	15.5%	15.0%												
7	6.9%	6.7%	11.2%	10.5%														
8	7.5%	7.2%																

Source: Regressions based on FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

Figure D4: First-Time and Repeat Homebuyer Adjusted Probability at the Mean: Percent Paid Off (Model B)

Years After Origination	Origination Cohorts																							
	1996		1997		1998		1999		2000		2001		2002		2003		2004							
	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB						
1	2.4%	3.4%	5.5%	6.9%	3.1%	4.5%	2.0%	3.0%	13.8%	16.5%	10.4%	8.2%	20.4%	23.0%	7.1%	9.1%	6.9%	9.4%						
2	17.6%	20.4%	25.1%	28.6%	8.4%	11.3%	10.4%	13.3%	53.8%	58.5%	51.7%	51.7%	53.1%	56.4%	20.6%	24.0%	17.7%	21.8%						
3	39.4%	43.4%	33.8%	38.3%	16.7%	20.9%	29.6%	34.1%	77.9%	81.5%	73.8%	73.8%	65.9%	69.5%	31.9%	35.9%	26.5%	31.6%						
4	47.1%	51.1%	44.1%	48.9%	33.6%	38.7%	61.2%	65.3%	88.0%	88.8%	80.3%	80.3%	72.2%	75.5%	39.1%	43.3%	33.7%	39.1%						
5	56.5%	60.6%	62.9%	67.1%	65.7%	69.7%	78.3%	81.3%	86.0%	91.1%	83.4%	86.3%	76.1%	79.2%	45.2%	49.4%	43.1%	48.2%						
6	70.5%	73.7%	80.3%	83.0%	80.0%	82.7%	83.4%	86.0%	89.8%	92.2%	85.1%	87.8%	79.0%	81.8%	51.8%	55.8%	51.5%	56.0%						
7	82.9%	85.0%	87.3%	89.1%	84.5%	86.7%	86.1%	88.3%	90.6%	92.9%	86.5%	89.0%	81.9%	84.4%	58.7%	62.3%	59.5%	63.5%						
8	88.4%	89.9%	89.7%	91.1%	86.8%	88.7%	87.4%	89.5%	91.1%	93.3%	87.8%	90.1%	84.4%	86.5%	65.0%	68.5%	66.3%	69.7%						
9	90.5%	91.7%	90.9%	92.2%	88.1%	89.9%	88.5%	90.4%	91.5%	93.6%	89.0%	91.0%	86.4%	88.3%	70.9%	74.0%	73.3%	76.1%						
10	91.7%	92.7%	91.8%	92.9%	89.2%	90.8%	89.5%	91.3%	91.9%	93.9%	90.0%	90.9%	88.1%	89.8%	76.8%	79.6%								
11	92.5%	93.3%	92.4%	93.4%	90.2%	91.7%	90.5%	92.1%	92.2%	94.2%	90.9%	92.6%	89.8%	91.3%										
12	93.1%	93.8%	92.9%	93.8%	91.2%	92.5%	91.4%	92.9%	92.5%	94.4%	91.8%	91.8%												
13	93.6%	94.3%	93.4%	94.2%	92.0%	93.2%	92.1%	93.5%	92.8%															
14	94.1%	94.7%	93.8%	94.6%	92.8%	93.9%	92.9%	94.2%																
15	94.9%	95.3%	94.5%	95.1%	93.9%	94.8%																		
16	95.2%	95.6%	94.8%	95.4%																				
17	95.5%	95.8%																						

Years After Origination	Origination Cohorts															
	2005		2006		2007		2008		2009		2010		2011		2012	
	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB
1	4.5%	6.1%	4.8%	6.7%	4.4%	6.0%	8.0%	9.4%	4.3%	5.0%	4.7%	5.3%			3.5%	4.3%
2	11.6%	14.7%	14.2%	18.1%	14.7%	18.7%	23.9%	27.3%	16.0%	17.9%	19.4%	21.5%	27.3%	29.9%		
3	18.7%	22.8%	26.8%	32.3%	26.7%	31.7%	40.8%	45.1%	34.7%	38.2%	41.0%	45.0%				
4	27.7%	32.5%	39.1%	44.7%	37.3%	42.9%	55.0%	59.6%	56.9%	60.2%						
5	37.6%	42.1%	49.0%	54.6%	48.0%	53.4%	71.9%	74.7%								
6	47.3%	51.6%	58.0%	62.9%	62.3%	66.0%										
7	56.8%	60.5%	68.6%	71.9%												
8	67.0%	69.8%														

Source: Regressions based on FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

Figure D5: First-Time and Repeat Homebuyer Average Adjusted Probability: Percent Foreclosed (Model A)

Years After Origination	Origination Cohorts																	
	1996		1997		1998		1999		2000		2001		2002		2003		2004	
	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB
1																		
2	0.2%	0.2%	0.1%	0.2%			0.0%	0.0%	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%	0.1%	0.1%
3	0.4%	0.4%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.4%	0.4%	0.4%	0.4%	0.5%	0.5%	0.5%	0.6%	0.4%	0.4%
4	0.6%	0.6%	0.4%	0.5%	0.3%	0.4%	0.3%	0.4%	0.5%	0.6%	0.6%	0.6%	0.7%	0.7%	0.8%	0.8%	0.7%	0.7%
5	0.7%	0.8%	0.6%	0.6%	0.4%	0.5%	0.4%	0.5%	0.6%	0.7%	0.7%	0.7%	0.8%	0.8%	1.0%	1.0%	1.3%	1.0%
6	0.8%	0.9%	0.7%	0.7%	0.5%	0.6%	0.4%	0.5%	0.7%	0.7%	0.7%	0.8%	0.8%	0.9%	1.2%	1.2%	1.9%	1.9%
7	0.9%	1.0%	0.7%	0.8%	0.6%	0.6%	0.5%	0.6%	0.8%	0.8%	0.8%	0.9%	1.0%	1.0%	1.6%	1.5%	2.5%	2.5%
8	1.0%	1.0%	0.8%	0.8%	0.6%	0.7%	0.5%	0.6%	0.8%	0.8%	0.8%	0.9%	1.0%	1.1%	2.0%	1.9%	3.0%	3.0%
9	1.1%	1.1%	0.8%	0.9%	0.7%	0.7%	0.5%	0.6%	0.8%	0.8%	0.8%	0.9%	1.0%	1.2%	2.3%	2.2%	3.5%	3.5%
10	1.1%	1.1%	0.8%	0.9%	0.7%	0.7%	0.6%	0.7%	0.9%	0.9%	0.9%	1.0%	1.3%	1.4%	2.7%	2.5%		
11	1.1%	1.1%	0.9%	0.9%	0.7%	0.8%	0.6%	0.7%	0.9%	0.9%	1.0%	1.1%	1.5%	1.5%				
12	1.1%	1.1%	0.9%	0.9%	0.7%	0.8%	0.6%	0.7%	1.0%	1.0%	1.1%	1.1%						
13	1.1%	1.2%	0.9%	0.9%	0.8%	0.8%	0.7%	0.7%	1.0%	1.0%								
14	1.2%	1.2%	0.9%	1.0%	0.8%	0.8%	0.7%	0.8%										
15	1.2%	1.2%	0.9%	1.0%	0.9%	0.9%												
16	1.2%	1.2%	1.0%	1.0%														
17	1.2%	1.2%																

Years After Origination	Origination Cohorts																	
	2005		2006		2007		2008		2009		2010		2011		2012			
	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB		
1																		
2	0.5%	0.5%	1.3%	1.3%	0.6%	0.6%	0.3%	0.2%										
3	1.1%	1.1%	2.6%	2.7%	5.0%	5.5%	2.7%	2.9%	0.3%	0.1%	0.1%							
4	1.8%	1.9%	4.9%	5.2%	8.3%	8.9%	4.2%	4.4%	0.5%	0.5%								
5	3.2%	3.3%	7.3%	7.5%	11.2%	11.7%	5.8%	6.0%										
6	4.6%	4.6%	9.3%	9.3%	13.8%	14.1%												
7	5.8%	5.8%	11.0%	11.0%														
8	6.9%	6.9%																

Source: Regressions based on FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.

Figure D6: First-Time and Repeat Homebuyer Average Adjusted Probability: Percent Paid Off (Model A)

Years After Origination	Origination Cohorts																	
	1996		1997		1998		1999		2000		2001		2002		2003		2004	
	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB
1																		
2	21.0%	23.7%	27.7%	30.9%			2.2%	3.3%	53.1%	57.0%	51.4%	54.6%	52.4%	55.2%	22.9%	26.2%	8.5%	11.3%
3	40.7%	44.1%	35.2%	39.2%	17.4%	21.6%	31.8%	35.7%	74.0%	77.4%	70.3%	73.5%	63.1%	66.2%	33.1%	36.8%	19.4%	23.6%
4	46.9%	50.5%	44.2%	48.6%	34.1%	39.0%	58.8%	62.3%	82.1%	85.0%	76.2%	79.3%	68.6%	71.6%	39.3%	43.1%	27.6%	32.4%
5	55.0%	58.5%	60.9%	64.7%	63.8%	67.4%	74.6%	77.6%	84.7%	87.5%	79.2%	82.1%	72.0%	74.9%	44.6%	48.3%	34.1%	39.1%
6	67.0%	70.0%	76.8%	79.5%	76.7%	79.5%	79.6%	82.3%	86.0%	88.7%	80.9%	83.6%	74.6%	77.3%	50.2%	53.8%	42.4%	47.1%
7	78.4%	80.7%	83.5%	85.5%	81.1%	83.4%	82.3%	84.7%	86.7%	89.4%	82.2%	84.8%	77.5%	80.0%	56.2%	59.6%	49.9%	54.0%
8	84.3%	86.0%	86.0%	87.6%	83.4%	85.5%	83.7%	86.1%	87.2%	89.8%	83.5%	86.0%	80.0%	82.2%	62.1%	65.4%	57.2%	60.9%
9	86.5%	88.0%	87.3%	88.8%	84.7%	86.7%	84.9%	87.0%	87.6%	90.1%	84.7%	86.9%	82.1%	84.2%	67.6%	70.7%	63.4%	66.6%
10	87.8%	89.1%	88.2%	89.6%	85.8%	87.7%	85.9%	88.0%	87.9%	90.4%	85.7%	87.8%	83.9%	85.9%	73.2%	75.9%	69.8%	72.5%
11	88.7%	89.8%	88.8%	90.1%	86.9%	88.6%	86.9%	88.9%	88.2%	90.6%	86.5%	88.5%	85.7%	87.5%				
12	89.3%	90.3%	89.3%	90.5%	87.8%	89.4%	87.8%	89.6%	88.4%	90.8%	87.4%	89.3%						
13	89.8%	90.8%	89.7%	90.9%	88.7%	90.2%	88.5%	90.3%	88.7%	91.0%								
14	90.3%	91.2%	90.1%	91.2%	89.5%	90.8%	89.3%	90.9%										
15	91.1%	91.8%	90.8%	91.7%	90.5%	91.7%												
16	91.3%	92.0%	91.0%	91.9%														
17	91.5%	92.2%																

Years After Origination	Origination Cohorts																	
	2005		2006		2007		2008		2009		2010		2011		2012			
	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB
1																		
2	12.7%	15.9%	14.9%	18.8%	5.6%	7.5%	12.6%	14.4%										
3	19.4%	23.4%	27.1%	32.1%	16.9%	20.7%	27.3%	30.2%	19.8%	21.7%				30.6%	32.9%			
4	27.4%	31.9%	38.1%	42.9%	27.9%	32.2%	41.1%	44.4%	36.6%	39.6%	42.3%	45.7%						
5	36.5%	40.5%	46.6%	51.1%	37.1%	41.4%	51.8%	55.2%	55.6%	58.4%								
6	45.4%	49.2%	53.8%	57.7%	45.2%	49.1%	64.8%	67.1%										
7	53.9%	57.2%	62.0%	64.8%	55.5%	58.2%												
8	62.8%	65.3%																

Source: Regressions based on FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.



Figure D8: First-Time and Repeat Homebuyer Average Adjusted Probability: Percent Paid Off (Model B)

Years After Origination	Origination Cohorts																							
	1996		1997		1998		1999		2000		2001		2002		2003		2004							
	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB						
1	3.1%	4.3%	7.7%	9.4%	3.7%	5.3%	2.2%	3.3%	18.8%	21.7%	10.7%	13.1%	24.5%	26.9%	9.1%	11.4%	8.5%	11.3%						
2	21.0%	23.7%	27.7%	30.9%	9.1%	12.2%	12.3%	15.4%	53.1%	57.0%	51.3%	54.6%	52.4%	55.2%	22.9%	26.2%	19.4%	23.6%						
3	40.7%	44.1%	35.2%	39.2%	17.4%	21.6%	31.8%	35.7%	74.0%	77.4%	70.3%	73.5%	63.1%	66.2%	33.1%	36.8%	27.6%	32.4%						
4	46.9%	50.5%	44.2%	48.5%	34.1%	39.0%	58.8%	62.3%	82.0%	85.0%	76.2%	79.3%	68.6%	71.6%	39.4%	43.1%	34.1%	39.1%						
5	55.0%	58.5%	60.9%	64.7%	63.8%	67.4%	74.6%	77.6%	84.6%	87.5%	79.2%	82.1%	72.0%	74.9%	44.6%	48.3%	42.4%	47.1%						
6	67.0%	70.0%	76.8%	79.5%	76.7%	79.5%	79.6%	82.3%	85.9%	88.7%	80.8%	83.6%	74.6%	77.3%	50.2%	53.8%	49.9%	54.0%						
7	78.5%	80.7%	83.5%	85.5%	81.1%	83.4%	82.3%	84.7%	86.7%	89.4%	82.2%	84.8%	77.5%	80.0%	56.2%	59.6%	57.2%	60.9%						
8	84.3%	86.0%	86.0%	87.6%	83.4%	85.5%	83.7%	86.1%	87.2%	89.8%	83.5%	86.0%	80.0%	82.2%	62.1%	65.3%	63.4%	66.6%						
9	86.5%	88.0%	87.3%	88.8%	84.7%	86.7%	84.9%	87.0%	87.5%	90.1%	84.7%	86.9%	82.1%	84.2%	67.6%	70.7%	69.8%	72.5%						
10	87.9%	89.1%	88.2%	89.6%	85.8%	87.7%	85.9%	88.0%	87.9%	90.4%	85.6%	87.8%	83.9%	85.9%	73.2%	75.9%								
11	88.7%	89.8%	88.8%	90.1%	86.9%	88.6%	86.9%	88.9%	88.1%	90.6%	86.5%	88.5%	85.7%	87.5%										
12	89.3%	90.4%	89.3%	90.5%	87.8%	89.4%	87.8%	89.6%	88.4%	90.8%	87.3%	89.3%												
13	89.9%	90.8%	89.7%	90.9%	88.7%	90.2%	88.5%	90.3%	88.6%	91.0%														
14	90.3%	91.2%	90.1%	91.2%	89.5%	90.8%	89.3%	90.9%																
15	91.1%	91.8%	90.8%	91.7%	90.5%	91.7%																		
16	91.3%	92.0%	91.1%	91.9%																				
17	91.6%	92.2%																						

Years After Origination	Origination Cohorts																							
	2005		2006		2007		2008		2009		2010		2011		2012									
	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB	FTHB	RHB								
1	5.4%	7.3%	5.6%	7.7%	5.6%	7.5%	12.6%	14.4%	7.2%	8.2%	7.3%	8.2%			4.9%	5.9%								
2	12.7%	15.8%	14.9%	18.8%	16.9%	20.7%	27.3%	30.2%	19.8%	21.7%	22.8%	24.7%	30.6%	32.9%										
3	19.4%	23.4%	27.1%	32.1%	27.9%	32.1%	41.0%	44.4%	36.6%	39.6%	42.3%	45.7%												
4	27.4%	31.9%	38.1%	42.9%	37.1%	41.4%	51.8%	55.2%	55.5%	58.4%														
5	36.4%	40.5%	46.6%	51.1%	45.2%	49.1%	64.8%	67.1%																
6	45.4%	49.2%	53.8%	57.7%	55.4%	58.2%																		
7	53.9%	57.2%	62.0%	64.8%																				
8	62.8%	65.3%																						

Source: Regressions based on FHFA data of Fannie Mae and Freddie Mac purchase-money mortgages for single-family owner-occupied homes.