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THE VULNERABILITY OF MINORITY HOMEOWNERS IN THE HOUSING BOOM AND BUST

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Working Paper 19020
http://www.nber.org/papers/w19020

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
May 2013

We thank the Ford Foundation, Research Sponsors Program of the Zell/Lurie Real Estate Center at Wharton, and the Center for Real Estate and Urban Economic Studies at the University of Connecticut for financial support. We thank Robert Avery and Erik Hurst for providing detailed comments on the paper, as well as the participants in the 2012 January meetings of the Weimer School for Advanced Studies in Real Estate, the NBER Summer Institute and the Federal Reserve Bank of Atlanta. Gordon MacDonald, Kyle Mangum, and Yuan Wang provided outstanding research assistance. The analyses presented in this paper uses information provided by Experian Information Solutions, Inc. Experian is a service mark and registered trademark of Experian Information Solutions, Inc. However, the substantive content of the paper is the responsibility of the authors and does not reflects the specific views of any credit reporting agencies. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

At least one co-author has disclosed a financial relationship of potential relevance for this research. Further information is available online at http://www.nber.org/papers/w19020.ack

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NBER Working Paper No. 19020
May 2013, Revised February 2015
JEL No. J15,R2

ABSTRACT

This paper examines mortgage outcomes for a large, representative sample of individual home purchases and refinances linked to credit scores in seven major US markets in the recent housing boom and bust. Among those with similar credit scores and loan attributes, black and Hispanic homeowners had much higher rates of delinquency and default in the downturn. There is important heterogeneity within minorities: black and Hispanics that live in areas with lower employment rates and that have high debt to income ratios are the driving force behind the observed racial and ethnic differences in foreclosures and delinquencies. Moreover, these estimated differences are especially pronounced for loans originated near the peak of the housing boom even after controlling for the effect of origination timing on households' equity position. These findings suggest that black and Hispanic homeowners drawn into the market near the peak were especially vulnerable to adverse economic shocks and raise concerns about homeownership as a mechanism for reducing racial disparities in wealth.

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"*We're creating... an ownership society in this country, where more Americans than ever will be able to open up their door where they live and say, welcome to my house, welcome to my piece of property.*" President George W. Bush, October 2004

1. Introduction

Owning a home has long been viewed as an important mechanism for creating and storing wealth. Yet purchasing a home has traditionally required a substantial down payment, limiting access to those with a sufficient amount of initial capital (Englehart, 1996 and Brueckner, 1986). Motivated by this perspective, a number of public policy programs have had an explicit goal of expanding homeownership and many politicians have embraced it as a means of upward mobility.[1] Moreover, many commentators have argued that relaxing down payment constraints would help reduce large racial and ethnic gaps in homeownership and, ultimately, lead to a reduction in racial and ethnic inequality (Rohe, Van Zandt and MacCarthy, 2002). In fact, racial and ethnic disparities in wealth dwarf those in income. In 1998, for example, the median wealth of black and Hispanic renters was less than $3,000 dollars and the 75th percentile wealth was below $10,000 (Herbert, Haurin, Rosenthal and Duda 2005).[2]

The expansion of housing credit from the late 1990s to mid-2000s led to historically high rates of homeownership in the United States for all households, including a peak of 49.7 percent in 2004 Q2 for blacks and of 50.1 percent in 2007 Q1 for Hispanics, and this increase in homeownership was largely cheered. But as the subsequent housing and economic crises developed, however, the risks of homeownership became increasingly obvious. Delinquency and foreclosure rates rose sharply, especially in low-income neighborhoods, and many households not only lost substantial housing wealth but also faced the prospect of lower credit scores (higher borrowing costs) for years to come. A comparison of mortgage delinquencies and foreclosures between 2005 and 2009 provides a particularly stark picture of the differential

[1] Belsky, Retsinas and Duda (2005), Herbert, Haurin, Rosenthal and Duda (2005), and Quercia, McCarthy and Wachter (2003) describe efforts to reduce down payment requirements for low-income borrowers, and Di and Liu (2007) find evidence of a reduction in the importance of household wealth in the transition to homeownership in recent years.

[2] Oliver and Shapiro (1997) also estimate that the financial assets and net worth of black households nearing retirement (aged 50-64) were only 14 and 20 percent of those of white households, respectively, while the analogous figure for income was 67 percent. Also see Deng, Ross and Wachter (2003), Gyourko, Linneman, Wachter (1999), Duca and Rosenthal (1991, 1994), Wachter, S.M., Megbolugbe (1992), Linneman, Wachter, (1989) on the role of borrowing constraints in explaining the black-white homeownership gap.

impact of the downturn by race and ethnicity. Figure 1 shows that while all homeowners had negligible 90-day delinquency and foreclosure rates in 2005 for our sample of seven major markets, high rates of delinquency and foreclosure and large racial and ethnic differences had emerged by 2009. More than 1 in 10 black and Hispanic homeowners in our sample had a delinquent mortgage by 2009, compared to 1 in 25 for white households, and a similar pattern held for foreclosure rates. By 2010, homeownership rates had fallen to 45.6 percent for blacks and 47.5 percent for Hispanics.

While researchers have documented the greater exposure of minority households to employment, income and health shocks (See, for example, Smith (1995), Altonji and Blank (1999), Shapiro (2004), Shuey and Wilson (2008) and Hoynes, Miller, and Schaller (2012)), much less is known about the differential impact of credit and financial shocks, especially in housing markets. We tackle this issue by examining mortgage outcomes by race during the last housing cycle in a diverse set of U.S. housing markets. The main goal of our analysis is to properly estimate the differential delinquency and default by minority homeowners in the housing market bust, accounting for observed differences in credit worthiness, loan characteristics, other demographics, house type, neighborhood, and lender type, such as prime and subprime lending.[3]

Moreover, we test another explanation for high rates of negative credit market outcomes for minority homeowners during the crisis, i.e., the selection of high-risk households into the housing market close to the peak of the housing cycle. If we recognize that households sort into owner-occupancy in part due to both the cost/difficulty of obtaining mortgage credit and the risk of exposure to future adverse events, then, for a given cost of credit, households with low risk of adverse events will be more likely to be homeowners. As the cost of credit falls or the availability of credit expands, more households will become homeowners, and the newest homeowners will be drawn from the remaining high risk pool. To the extent that wealth and liquidity gaps leave minority households especially vulnerable to negative economic shocks, we

[3] The literature also suggests that subprime lending has been an important factor in explaining rising foreclosure rates in low income and minority neighborhoods. Gerardi and Willen (2009), Reid and Laderman (2009), Edminston (2009), and Wachter, Russo and Hershaff (2010) show that the housing market crisis and the preceding growth of subprime lending have disproportionately affected low income and minority neighborhoods. More broadly, Mian and Sufi (2009) document large increases in foreclosure rates in neighborhoods that had a large volume of subprime loans and that this growth in subprime loans occurred primarily in neighborhoods with very low income growth.

expect that those minority households drawn into homeownership following a major expansion of credit are especially likely to default in a subsequent economic downturn.[4]

There are significant empirical challenges to studying mortgage outcomes by race and ethnicity. Most directly, data sets linking home purchases and mortgage decisions by race to detailed risk factors and subsequent loan performance for a representative sample of homeowners have been essentially non-existent. Most research documenting the distribution and performance of high cost or subprime loans have used one of two sources: a) Analyses using Home Mortgage Disclosure Act (HMDA) data (Calem, Gillen and Wachter 2004; Avery, Canner and Cooke 2005; Apgar, Calder and Fauth 2004) typically find significant racial and ethnic differences in the allocation of high cost credit, but these studies can only control for the extremely limited borrower and loan attributes in HMDA; b) Proprietary data aggregated across many lenders (Mayer and Pence 2007; Mayer, Pence and Sherlund 2009; Reid and Laderman 2009; Fisher, Lambie-Hanson and Willen 2010) often capture only a select subset of the mortgage market and typically do not contain information on borrower race or ethnicity instead documenting differences at the neighborhood level.

We overcome these issues by first assembling a unique panel data set that links a representative sample of HMDA data on home purchase and refinance mortgages originated between May and August in the years between 2004 and 2008, to public records data on housing transactions and liens for approximately 270,000 homeowners in seven distinct metropolitan housing markets: Chicago IL CMSA, Cleveland OH MSA, Denver CO MSA, Los-Angeles CA CMSA, Miami-Palm Beach Corridor, San Francisco CA CMSA, and Washington DC-Baltimore MD suburban Corridor. These data contain information on all liens as well as the name and address of the individual purchasing the housing unit or refinancing their mortgage and in many cases the name of the individual's spouse, in addition to information about house prices, housing characteristics, and neighborhood or census tract of the housing unit.

We then provided this rich sample to one of the major credit rating agencies. The credit rating agency used the name and address to match borrowers to archival credit reporting data, providing in each year a Vantage credit score plus detailed credit line information from each

[4] For example, Charles and Hurst (2002) suggests that black households may have fewer family resources to draw on; particularly, they document that, conditional on credit score and income, young black adults are less likely to purchase homes due in part to the ability or willingness of parents to provide down payment assistance.

individual's report. This matched mortgage-housing unit-credit data provides detailed information on the financial circumstances of each homeowner at the time of mortgage origination, the terms of the mortgage including whether it was a high-cost loan, and the performance of the mortgage over the subsequent years.[5]

Our final panel data has three critical advantages relative to others that have been analyzed in the recent literature. First, all of the information is matched at the individual rather than neighborhood level. This allows us to examine how the pricing and performance of loans varies with the race of the homeowner separately from the racial composition of the neighborhood. Second, our data set includes a representative sample of all mortgages that were originated in these markets in the time period. Finally, our data set contains controls for all of the standard risk factors that are typically considered in mortgage underwriting and pricing models.

Our empirical results show that black and Hispanic households are more likely to become delinquent and default on their mortgages than white households with similar credit scores, loan characteristics, demographics, house type, neighborhood, and lender. Blacks are 3.0 and 1.5 percentage points more likely to enter foreclosure than whites in our home purchase and refinance samples, respectively; while Hispanics are 3.1 and 2.1 percentage points more likely to enter foreclosure in the same samples. These differences are substantial relative to the unconditional 5.2 and 3.7 percent average foreclosure rates in the home purchase and refinance samples, and represent approximately 1/3 of the unconditional racial and ethnic differences in the home purchase samples and 1/2 of the unconditional differences in the refinance sample. Most of this decline in the unconditional racial and ethnic differences arise from including general controls for observable mortgage risk factors in our econometric model, as opposed to controls associated with subprime lending.

Next, we include in our model a series of contemporaneous controls that represent information that may not have been available to the lender at the time of mortgage origination. These controls include county by credit year fixed effects, contemporaneous measures of negative equity based on county level price indices, and the interaction of the negative equity

[5] Bhutta and Canner (2013) provide the one exception in the literature that documents racial and ethnic differences in foreclosure controlling for borrower credit scores by merging HMDA data with data from a credit reporting agency, but they are only able to control for the overall amount of the primary mortgage because they do not observe either subordinate debt or the value of the home securing that debt.

variables with race and ethnicity specific measures of county employment rates. These controls decrease conditional racial differences in foreclosure by approximately 50 percent and decrease conditional ethnic differences in foreclosure by between 10 and 20 percent. The decline in racial and ethnic differences arises entirely from the use of race specific employment rates. Controlling for county level employment rates does not erode the racial and ethnic differences in foreclosure. The foreclosure and delinquency differences are explained by the lower rates of employment among blacks, and to some extent Hispanics, and the higher rates of foreclosure among all households with negative equity and in counties with low employment rates for their group.

We then attempt to identify which borrowers are responsible for the observed racial and ethnic differences in delinquency and foreclosure. For African-Americans home buyers, we find that all racial differences are concentrated among borrowers with subprime credit scores and high debt expense to income ratios. Ethnic differences are somewhat higher for high debt expense to income ratio loans, but subprime credit does not seem to matter. Furthermore, ethnic differences in foreclosure are concentrated among Hispanic borrowers in counties with low employment rates for Hispanics. While as noted earlier within county employment rate differences between Hispanic and whites does not explain ethnic differences, the effect of exposure to low employment rates has a much larger effect on Hispanic homeowners than on white homeowners. A similar, but more modest phenomenon, is observed for black homeowners. The larger impact of county level employment rates on the foreclosure risk of minority borrowers is consistent with those borrowers being less able to manage the economic distress created by economic downturns, even after controlling for differential exposure to loans with risky terms and contemporaneous levels of negative equity and employment risk.

We already noted that recent home purchases have higher foreclosure and delinquency rates than the refinance sample – which by definition are composed of homeowners that were drawn into the housing market much earlier. As a final test of our hypothesis concerning the vulnerability of recent minority homebuyers, we examine whether the timing of the selection into the housing market has an effect on delinquency and foreclosure. We find that racial and ethnic differences are largest for home purchase originations in 2006, the peak of the housing boom according to the Case-Shiller price index, even after controlling for the subsequent higher rates of negative equity for borrowers who purchased near the peak of the housing market. The

pattern is similar, but less strong, for the refinance sample. We also examine racial and ethnic differences for a subsample of refinance mortgages that were originally purchased between 1998 and 2008 and subsequently refinanced in our sample period. For this subsample, racial and ethnic differences in foreclosure are tiny for homes that were originally purchased from 1998 to 2000, but substantial for homeowners who originally purchased their homes between 2001 and 2007, i.e., those drawn into the market during the credit expansion, with the largest effects arising between 2004 and 2007. These home purchase timing effects are largest for minority borrowers with high debt to income ratios and who are exposed to low employment rates.

Taken together, our results provide strong evidence that minority households drawn into homeownership late in the recent housing market boom were especially vulnerable in the subsequent downturn in ways that are not explained by (i) borrower characteristics observed at origination, (ii) exposure to different lenders or loans, (iii) performance of local labor and housing markets. These results call into question the idea of encouraging homeownership as a general mechanism for reducing racial disparities in wealth. To the extent that increases in homeownership are driven by the entry of especially vulnerable households into the owner-occupied market, such a push may backfire, leaving vulnerable households in a difficult financial situation and adversely affecting their wealth and credit-worthiness for years.

There are important caveats to our results. First, we do not directly observe household savings or wealth, which might help to explain why some households are able to manage adverse economic shocks more easily than others. Future work could more explicitly measure whether the estimated differences in mortgage outcomes by race reported here are primarily due to differences in wealth. Another limitation of our analysis is that our study period only covers the recent housing crisis. While Hoynes, Miller, and Schaller (2012) shows similar patterns by race for negative labor market shocks in a number of recent recessions, there is a chance that the recent housing market boom and bust may be unique in history.

The remainder of this paper proceeds as follows. The next section presents the data used in the analysis. Section 3 presents the main results from our analyses of credit outcomes, and section 4 shows heterogeneity in those estimates. Section 5 presents additional analyses by the year of mortgage origination or home purchase. Section 6 concludes.

2. Data

Our data set is based on public Home Mortgage Disclosure Act (HMDA) data from between 2004 and 2008 and proprietary housing transaction/lien and assessor's databases purchased from Dataquick.[6] We begin with a convenience sample of seven major housing markets where Dataquick has information on refinance mortgages going back to at least 2004: Chicago IL CMSA, Cleveland OH MSA, Denver CO MSA, Los-Angeles CA CMSA, Miami-Palm Beach Corridor, San Francisco CA CMSA, and Washington DC-Baltimore MD suburban Corridor. We restrict our HMDA data to home purchase or refinance mortgages on owner-occupied, 1-4 family properties. In the Dataquick sample, we eliminate non-arm's length transactions, transactions where the name field contains the name of a church, trust, or where the first name is missing, and transactions where the address could not be matched to a 2000 Census tract or the zip code was missing (this last step eliminates very few records due to the high quality of the name and address records in the assessor files). The HMDA and Dataquick data are then merged based on year, loan amount, name of lender, state, county, and census tract. We obtain high quality matches for approximately 50% of our HMDA sample.[7] As we show in Table 1 below, this criteria does not impact the representativeness of our final sample.

Next, we draw a sample of mortgages to provide to a credit-reporting agency. These mortgages were sampled from May through August so that the March 31st archival credit report for the year of the mortgage provides appropriate information on the borrowers' credit quality prior to obtaining the mortgage. We oversample mortgages to minority borrowers, mortgages to white borrowers in minority or low-income neighborhoods, and high cost mortgages as designated in HMDA as high rate spread loans. In order to maximize the number of minority loans given the likelihood of sample saturation, we first draw the following oversamples based on race and ethnicity: 500 in each site, year and group (400 for 2004)[8] selected randomly from mortgages to black borrowers, mortgages to Hispanic borrowers, and mortgages to white borrowers in minority or low-income neighborhoods. We then split the remaining sample into

[6] Data provided by DataQuick Information Systems, Inc. www.dataquick.com. The property transaction data is collected by Dataquick or by intermediaries from county assessor's offices and contains a population of all sales and liens of all types including refinance mortgages, home improvement loans, and home equity lines of credit..

[7] The key factor limiting the match rate is the lender name because the lender of record in the local assessor's data often differs from the respondent in HMDA. Less restrictive match criteria can yield a match rate around 90%, but in order to be conservative we restricted ourselves only to instances where we successfully match on lender name.

[8] The smaller sample in 2004 is driven by budgetary restrictions because costs depend upon the number of records, and earlier years imply more records because we follow every borrower from the origination year until 2009.

rate spread and non-rate spread loans drawing 1000 borrowers associated with rate spread loans in each year and site (800 for 2004) and 2714 borrowers (2286 for 2004) from the non-rate spread sample in each year and site. Weights are developed based on the probability of selection,[9] and each site receives equal weight in the pooled sample.[10]

This sample is provided to Experian Information Solutions, Inc.[11] who matches the name and address of each borrower and co-borrower to archival credit report data from March 31st preceding the mortgage transaction and March 31st for every year that follows this transaction through 2009. Our match rate for the pre-mortgage archive is 81.4 and 84.5 percent in the home purchase and refinance samples, respectively. For years following the mortgage, the match rate rises by 4 to 5 percentage points. In many cases, these individuals also may not have been found by the credit reporting agencies when the lender requested a report in which case lack of a score matches the information that the lender would have had when approving and pricing the loan, but lenders can enter by hand additional information that is not available to us such as social security number or previous addresses.[12]

Table 1 illustrates the impact of our match process on the sample mean on race and ethnicity of the borrower, whether the primary mortgage is a high cost or rate spread loan, which is defined as a 3 percentage point or more spread between the mortgage Annual Percentage Rate (APR) and the interest rate on 10 year treasury notes (the APR includes both the interest or note rate on the loan and the effect of closing costs on the cost of credit.), loan amount, family income of the borrower, and census tract variables including median income, percent black, Hispanic and Asian resident, and percent of properties owner-occupied. The first column shows the mean for the entire HMDA sample for our seven sites where each site receives equal weight in the mean. The second column shows the mean for our HMDA-Dataquick match, and the third column

[9] The sampling is explicitly based on 8 strata for each site: black borrowers, Hispanic borrowers, white borrowers in minority or low-income neighborhoods, and all other borrowers divided into rate spread and non-rate spread loans. All loans from the same strata and year receive equal weight.

[10] We have a convenience sample of housing markets so it would be inappropriate to weight based on the number of mortgages. In any stratified sampling scheme, Los Angeles, which dominates our sample in terms of total number of HMDA mortgages, would be selected with certainty while housing markets like Denver and Cleveland would be assigned to a stratum with other similarly sized and located metropolitan areas and if chosen would receive a higher weight (offsetting the smaller number of mortgages) based on the probability of being selected from the stratum.

[11] Experian is a service mark and registered trademark of Experian Information Solutions, Inc.

[12] For home purchase mortgages, we only observe the address of the new housing unit, but in practice this does not present a major problem for the credit data match because the archival data can be matched based on current and several past addresses and in practice we observe only a small difference between the home purchases and refinance match rate.

restricts our sample to mortgages between May and August. The fourth column shows the weighted mean for the sample of mortgages that was provided to the credit reporting agency. The last column in Table 1 shows the weighted means on these common variables for just the subsample where the name and address was matched to the minimum amount of credit line data in order to generate a record. The sample composition is quite stable except for a moderate decline in share white and moderate increase in loan amount between columns 1 and 2 associated with the difficulty of matching lender names between HMDA and the Dataquick provided assessor files. While our HMDA-DataQuick match algorithm loses 50 percent of the HMDA mortgages, the composition of the match sample is quite similar to the composition of the population of mortgages, and the other aspects of our sample construction have virtually no impact on the composition of mortgages over key attributes.

Table 2 shows the weighted means for our final samples of post mortgage credit reports for the home purchase and refinance subsamples that were successfully merged to pre-mortgage credit report data.[13] The first two columns show the mean and standard deviation for our sample of home purchase mortgages, and the last two columns show these values for refinance mortgages. From the contemporaneous credit history data, we obtain number of 90 to 180 day mortgage delinquencies and foreclosures in the last 12 months. From the pre-mortgage data, we obtain these same outcomes prior to the mortgage and the borrowers' (or if unavailable coborrower's) Vantage score. The first credit report observation following the mortgage is used to obtain monthly mortgage payment, which when combined with HMDA income is used to calculate the mortgage payment to income ratio.[14] The monthly mortgage payment is combined with debt payments from the pre-mortgage credit data and HMDA income to calculate debt payment to income ratio. Finally, age is observed for many borrowers and coborrowers in the credit history files.

The HMDA data contains whether the loan is a high cost or exceeds a standard rate spread above treasury rates, borrower race and ethnicity, gender, loan amount, applicant income,

[13] The samples sizes in Table 2 are substantially larger than the samples size in the final column of Table 1 because each mortgage in Table 1 will have one post mortgage credit report observation for every year between the year after origination and the final year of our data in 2009.

[14] The mortgage payment for the current mortgage is only observed in the credit line data from the year following the mortgage. However, in most instances, borrowers who are matched by the credit reporting agency prior to the mortgage are also matched in the following year.

and whether a coborrower is present. We use the loan amount to calculate whether the loan is non-conforming or a jumbo loan, i.e. too large to be purchased by the Government Sponsored Enterprises, and based on census tract we observe tract racial and ethnic composition, income, poverty rate, share owner-occupied and the value of median rents to median home price, which is viewed as a proxy for anticipated housing price appreciation. From the match with transaction data, we observe the presence and size of subordinate liens, whether the liens are fixed or variable rate mortgages, the loan to value ratio based on sales price for home purchase mortgages and on an estimated value based on either previous sales price[15] or assessed value for refinance mortgages when a previous sale is unobserved,[16] and detailed property attributes including whether single family home, a condominium, and number of units on the property.

3. Delinquencies and Foreclosures by Race

In this section, we present empirical estimates for models of two housing market outcomes, delinquencies and foreclosures. Each mortgage origination contributes one or more observations based on the origination date. Specifically, the 2004 originations contribute housing market outcome observations in 2005, 2006, 2007, 2008 and 2009, while each 2008 origination contributes only a single post mortgage outcome for 2009. We write those outcomes *d* for individual *i*, of race *r*, at time of origination *s*, calendar time *t*, and MSA *m*, as:

$$(1) \qquad d_{irstm} = \beta R_{ir} + \gamma X_{is} + \delta_{st} + \theta_m + \varepsilon_{irstm}$$

where *R* includes dummies for blacks, Hispanics and Asians, so all estimates are relative to white households. X_{is} include the set of pre-mortgage origination variables reported in Table 2.[17] Our

[15] We use our extensive housing transaction data to develop both a hedonic and repeat sales quarterly price index for each county. When we observe a previous sale of the property, we simply adjust that earlier sales price to estimate current value based on the hedonic index. However, the repeat sales index yields quite similar estimates.

[16] When a previous sale is not observed, we use the county assessment and adjust that value by the average ratio of sales price to assessed value for that county and quarter, see Clapp, Nanda and Ross (2008). In California, our refinance sample is restricted to mortgages where a previous purchase is observed because property assessments are uninformative as to the value of the underlying property. This restriction is feasible because the Dataquick data in California contains transactions back to the late 1980s.

[17] The loan to value ratio is included as intervals or bins below 0.6, 0.6 to 0.8, 0.8 to 0.84, 0.85 to 0.89, 0.90 to 0.94, 0.95 to 1.00, 1.00 to 1.04, and 1.05 and above. The Vantage scores are included as a series of dummy variables based on 20 point bins. The mortgage payment and debt to income ratios are also divided into bins. The bins vary in

design relies on the fact that we are controlling for almost all characteristics of borrowers, houses, and mortgages that were observable by lenders at time of origination. Especially noteworthy is the information about credit scores, which in principle means that we will compare housing outcomes between blacks and whites, for example, with similar creditworthiness and with similar choices of house type, neighborhoods, and loan characteristics. Finally, the model also includes year of origination by year of the credit profile indicators δ_{st} to deal with common trends, as well as housing market fixed effects.

Next, we expand our set of underwriting controls X_{is} to include a variety of variables intended to capture the potential influence of the subprime mortgage market on observed racial and ethnic differences. The extended model includes a dummy for whether the loan is a high cost or rate spread loan, as defined in the data section above. Since subprime lending shares are highly concentrated in a subsample of lenders, we include lender fixed effects, and we also include neighborhood or census tract fixed effects because subprime lending is also potentially concentrated in certain cities and neighborhoods. Finally, we include additional controls to recognize that the impact of key loan terms on borrower outcomes may vary between prime and subprime borrowers. We identify borrowers with Vantage scores below 701 as subprime borrowers[18] and then interact the subprime dummy with dummy variables associated with key thresholds of loan to value ratio, debt to income ratio, mortgage payment to income ratio,[19] as well as with the presence of subordinate debt and whether the primary mortgage has a fixed or adjustable interest rate.

We also consider a model that includes contemporaneous controls in order to capture changes in the economic environment during the sample period

$$(2) \qquad d_{irstm} = \beta R_{ir} + \gamma X_{ist} + \delta_{st} + \theta_{mt} + \varepsilon_{irstm}$$

size. For mortgage payment to income ratios, the smallest bins are 0.02 are around the traditional secondary market criteria of 0.28, and for total debt payment to income ratios the smallest bins are 0.03 around the threshold of 0.36.

[18] The credit reporting agencies that developed the Vantage score algorithms describes scores below 701 as non-prime. Further, a Vantage score of 701 is comparable to a FICO score of 660 in that in both cases approximately 30% of individuals have credit scores below these thresholds.

[19] The loan to value thresholds used are 0.80, 0.90, 0.95 and 1.00, the debt to income thresholds used are 0.36 and 0.45, and the mortgage payment to income ratio thresholds used are 0.28 and 0.33

Specifically, the model is extended to include housing market by current year fixed effects, contemporaneous controls for negative equity, and controls for employment risk. The controls for negative equity are based on original loan to value ratio scaled by changes in the price level based on a county level hedonic price index that was estimated using all single family transactions in the county during the sample period. We create a dummy for whether the current loan to value ratio is between 1.0 and 1.1, 1.1 and 1.3, 1.3 and 1.5, and above 1.5. The literature on mortgage foreclosure and default suggests that the likelihood of foreclosure and the effect of negative equity on foreclosure will vary with the employment outcomes of homeowners. We do not have individual information about employment. Instead, we create measures of local employment and unemployment rates for prime age (25-54) males for each county, year and racial/ethnic group using the public use sample of the American Community Survey, where the employment rate is calculated as the fraction of males in that group who reported being employed last week. We interact this employment measure with the negative equity dummy variables. One caveat is that Gyourko and Tracy (2013) demonstrate substantial attenuation bias in credit outcome models when county level employment rates are used to proxy for actual future employment outcomes. In our case, however, we find that county employment rates (at least as a proxy for the risk of unemployment) have strong explanatory power for differential rates of mortgage delinquency and foreclosure.

The first and fifth columns of Table 3 present the unconditional racial and ethnic differences in 90-180 day mortgage delinquency and in foreclosure filing, respectively, for the samples of home purchase and refinance mortgages. The estimates for the home purchase sample are shown in panel 1 and the estimates for the refinance sample are shown in panel 2. We find massive differences for both black and Hispanic borrowers of 8.6 and 3.0 for black home purchase and refinance borrowers and of 9.1 and 4.3 for Hispanic borrowers in the probability of facing a foreclosure filing, as compared to the 5.2 and 3.7 percent average foreclosure rates in the home purchase and refinance samples, respectively. Both overall delinquency and foreclosure rates and racial and ethnic differences in those rates are larger in the home purchase sample. One possible explanation for this difference is that, on average, the homes in the refinance sample were purchased earlier. Those homeowners may have had more time to accumulated housing equity prior to the housing market downturn, or were generally less

vulnerable to housing shocks. We will explore the timing of house purchase in more detail in section 5.

The next two columns of estimates for the delinquency and foreclosure models include first the detailed underwriting variables and then in the next column those controls plus the additional controls for subprime lending including the lender and neighborhood fixed effects (see appendix Tables A1 and A2 for a complete list of parameter estimates). Blacks are 3.0 and 1.5 percentage points more likely to enter foreclosure than comparable whites in our home purchase and refinance samples, respectively; while comparable Hispanics are 3.1 and 2.1 percentage points to enter foreclosure than whites in the same samples after controlling for risk factors observable at the time of the loan. Comparing columns 1 and 5 to columns 3 and 7 indicates that these differences represent approximately 1/3 of the unconditional racial and ethnic differences in the home purchase samples and 1/2 of the unconditional differences in the refinance sample. For both samples, both outcome variables, and both groups, the main erosion of racial and ethnic differences in credit market outcomes arises from the inclusion of standard underwriting controls. The inclusion of lender and neighborhood fixed effects and additional controls for subprime lending had almost no effect on the estimated racial and ethnic differences with one exception. The control for whether the loan was high cost or a rate spread loan accounts for the entire reduction in the estimates between columns 2 and 3 and columns 6 and 7 (see appendix Table A2. Significantly, the effect associated with having a high cost loan cannot simply arise from the higher mortgage payments associated with these loans because our model contains detailed controls for the housing and total debt expense to income ratios faced by households. Estimates for Asians are also statistically significant, but substantially smaller than the differences observed for African-Americans and Hispanics and not economically meaningful.

The final pair of columns, columns 4 and 8, in Table 3 presents the estimates for models that include a series of contemporaneous controls that represent information that may not have been available to the lender at the time of mortgage origination. These controls further erode the delinquency and foreclosure differences decreasing racial differences in foreclosure by approximately 50 percent and decreasing ethnic differences in foreclosure by between 10 and 20 percent. The decline in racial and ethnic differences arises entirely from the use of race specific employment rates. Racial and ethnic differences are essentially unchanged in models that simply

control for county by year fixed effects or control for the overall county level employment rate.[20] The foreclosure and delinquency differences that were not explained by standard mortgage risk variables are in substantial part explained by the lower rates of employment among blacks during the recent crisis, and to some extent among Hispanics, and the higher rates of foreclosure among all households with negative equity and in counties with low employment rates for their group.[21]

As noted above, racial and ethnic differences in delinquency and foreclosure in the refinance are smaller than the comparable differences in the home purchase sample. Racial and ethnic differences continue to be higher in the home purchase sample even after controlling for mortgage risk factors. Further, in columns 4 and 8, the larger differences in the home purchase sample cannot be explained simply by the increased time available to homeowners in the refinance sample to accumulate housing equity prior to the crisis because these models explicitly control for current loan to value ratios. On the other hand, since foreclosure rates in general are higher in the home purchase sample, the unexplained differences are a larger share of the unconditional racial and ethnic differences in the refinance sample than in the home purchase sample. In columns 3 and 7, where we control for mortgage risk factors, racial and ethnic differences are about 1/3 of the average rate of foreclosure in the home purchase sample, and 1/2 of the average rate of foreclosure for the refinance sample. For the models that control for contemporaneous factors, the pattern is the same, but the relative magnitude of the unexplained differences are much smaller for the home purchase sample.

4. Heterogeneity in the Race Differentials

We first present the time pattern of these race differentials in Figure 2. We estimate these parameters by interacting the race dummies with calendar year indicators. The top panel of the figure shows racial and ethnic differences for the home purchase sample and the bottom panel of the figure shows these differences for the refinance sample. Each figure contains four graphs

[20] Whether race specific or overall county employment rates are used in the model, the estimates indicate that negative equity and employment rates have powerful and interactive effects. The estimates on the negative equity dummy variables are large and positive, while the estimates on the interactions with employment rate are negative and similar in magnitude suggesting that being in negative equity has little or no effect on foreclosure when employment rates are high, but becomes increasingly important as employment rates fall. See appendix Table A3.
[21] The R-squares for these models are not very high in large part because future adverse outcomes are heavily driven by events that happen after the borrower obtains their mortgage, but also because the fit of linear models tends to be lower when events are infrequent.

representing the racial differences in each year unconditionally (circle), conditional on traditional risk factors (diamond), conditional on subprime controls (square), and conditional on contemporaneous controls (triangle). While the inclusion of additional controls erodes the level of racial and ethnic differences, the pattern is the same overall for all models and both groups. Racial and ethnic differences are relatively small or non-existent beginning in 2005, and then grow rapidly as the crisis proceeds typically peaking at the end of our sample in 2009.

Next we attempt to identify which borrowers are responsible for the observed racial and ethnic differences in delinquency and foreclosure. In order to accomplish this, we re-estimate the final models in Table 3, columns 4 and 8, including interactions with key risk factors. We consider three mortgage risk factors by interacting race and ethnicity with dummy variables for whether the borrower has a subprime credit score (vantage score below 701), whether the loan is a high cost or rate spread loan, and whether the debt expense to income ratio is above levels that were required during this time to be considered for purchase by the Government Sponsored Enterprises, FreddieMac and Fannie Mae (a ratio above 0.45). We also estimate models interacting the race and ethnicity dummies with one minus the group specific, county level employment rate described above. The models use one minus the employment rate so that the estimated coefficients on the black and Hispanic dummy variables are for racial and ethnic differences where employment rates are 100 percent, as opposed to zero percent, which would be far out of the sample range.

These estimates are shown in Table 4 with the results for the home purchase sample presented in panel 1 and for the refinance sample in panel 2. Columns 1 and 4 present the baseline results from columns 4 and 8 in Table 3. Columns 2 and 5 present the results where race and ethnicity is interacted with the mortgage risk factors. For blacks, racial differences in foreclosure and delinquency are higher in the home purchase sample for borrowers with subprime credit scores and high debt to income ratios and in the refinance sample for borrowers with rate spread loans and high debt to income ratios. Significantly, no racial differences remain for black borrowers who do not have any of these risk factors. For Hispanics, ethnic differences in delinquency and foreclosure are larger among borrowers with high debt to income ratios in both samples, but these effects are smaller than the effects for blacks and most of the ethnic differences observed in Table 3 remain among Hispanic borrowers who do not have any of these risk factors.

Columns 3 and 6 present the results where race and ethnicity are both interacted with one minus the prime age male employment rate, a general unemployment rate that accounts for both unemployment and labor force participation. For both groups, racial and ethnic differences are concentrated among borrowers with higher county by group level unemployment rates. However, the ethnic differences in the impact of employment rates are significantly larger than the racial differences. In order to give a sense of the magnitude of these effects, we estimate the racial and ethnic differences for borrowers at low risk of unemployment, i.e. when the employment rate among prime age males as a share of all prime age males is 96 percent. At this high employment level, ethnic differences in foreclosure are near zero at 0.005 and 0.006 in the home purchase and refinance samples, respectively, but racial differences in foreclosure remain significantly higher at 0.029 and 0.011 for the two samples.

5. Heterogeneity in Mortgage Outcomes by Year of Origination

This section examines the pattern of delinquency and foreclosure risk based on year of origination. First, we restrict the sample to 2008 and 2009 delinquencies and foreclosures in order to focus on the crisis period and to avoid confounding the direct effect of origination year with differences that arise because earlier origination years allow for foreclosure and delinquency during the pre-crisis period. Table 5 presents the unconditional racial and ethnic differences by origination year with 2004 originations as the omitted category. For home purchase originations, there is a substantial increase in the racial and ethnic differences in foreclosure and delinquency for originations between 2005 and 2007 relative to 2004 with the largest differences arising for 2006 originations. The pattern for refinance mortgages is less clear with substantially smaller and less significant differences in the estimate racial and ethnic effects between originations from 2005 to 2007 and originations in 2004, and no differences at all in the racial foreclosures differences for refinance mortgages.

As in Figure 2, Figure 3 presents racial and ethnic differences in foreclosure for all four model specifications presented in Table 3, except Figure 2 presents racial differences by origination year. The top panel of Figure 3 shows the results for the home purchase sample. In all models, we get a peak in racial and ethnic differences 2006 at the peak of the housing market. For the final model indicated by the triangle, these differences arise even after controlling for contemporaneous housing prices, and so these results cannot simply be driven by the fact that

2006 home purchase mortgages exposed home buyers to the largest declines in housing prices relative to the purchase price. Rather, minority homebuyers in 2006 appear to be more vulnerable to the economic downturn than homebuyers in earlier years or homebuyers after the onset of the crisis, even after conditioning on detailed credit risk factors associated with the borrower and the mortgage. The bottom panel of Figure 2 shows the results for the refinance sample. As noted above, racial differences in foreclosure do not increase for originations in or near 2006. Ethnic differences in foreclosure for the refinance sample follow the same pattern as was observed in the home purchase sample, but the effects for 2006 are substantially smaller in magnitude.

We next use the refinance sample in order to examine home purchase originations over a longer timeframe. Specifically, we match refinance mortgages with the original home purchases back to 1998, which is the earliest year for which we observe home purchases in all seven of our markets. In Table 6, we present the unconditional racial and ethnic differences in foreclosure by home purchase year relative to mortgage refinancing for homes purchased prior to 2008. While the sample represents only home purchases that selected into refinance and our model must control for credit scores observed after the home purchase, our estimates demonstrate the significance of purchase year for a representative sample of refinance mortgages. Notably, the origination year coefficients are relatively flat for the first three years of the sample 1998 to 2000. After 2000, we see substantially larger racial and ethnic differences in foreclosures for homes that were originally purchased closer to the boom, and the largest differences arise between 2004 and 2006. Unexpectedly, racial and ethnic differences drop for home purchases in 2006 relative to 2005 and 2007, except for the racial differences in delinquency. We do not have any explanation for this anomaly. Figure 4 presents the racial and ethnic differences by home purchase year for all four models. As before, the basic pattern of results is robust to including controls for mortgage risk factors, contemporaneous employment risk, and levels of negative equity.

Finally, following up on the analyses in Table 4, we examine the effect of home purchase year for borrowers with key risk factors by interacting year of home purchase with either a dummy variable for whether the borrower has a high debt to income ratio or with the race and year specific unemployment rate for the county in which the borrower resides. These results are shown in Table 7 for the home purchase sample and in Table 8 for the refinance sample. In the

home purchase sample, both blacks and Hispanics have larger racial and ethnic differences in delinquency and foreclosure in 2005 and 2006 if they had high debt to income ratios with the effects being largest in 2006, and Hispanics have larger ethnic differences in delinquency and foreclosure after 2004 if they were exposed to high unemployment rates with the effects being largest in 2006 and 2007. Similarly for the refinance sample, the effect of having a high debt to income ratio on racial and ethnic differences in delinquency and foreclosure tends to be largest for homes purchased between 2001 and 2005, and the effect of exposure to high unemployment rates on racial and ethnic differences tends to be highest for home purchased between 2002 and 2007.

Overall, these results corroborate the intuition presented in introduction. As credit expanded during the housing boom, households with higher unobserved risk of defaults and delinquencies entered the housing market and, empirically, black and Hispanic borrowers were much more likely to be in this group. The selection of these especially high-risk households into the market translated into much higher rates of delinquencies and defaults once the recession started, especially among minority borrowers.

6. Summary and Conclusion

In this paper, we identify large racial and ethnic differences in the likelihood of mortgage delinquencies and foreclosures in the recent housing market bust and associated recession. Substantial differences remain after controlling for (i) the borrower, home, loan and market attributes, including the individual's credit score, that would have been observed by lenders *ex ante*, (ii) differences in lenders, neighborhoods or the significance of loan attributes that might be associated with subprime lending and (iii) *ex post* measures of exposure to local housing and labor market shocks. Collectively, these results imply that the relatively poor mortgage outcomes for minority borrowers are not simply a function of greater participation in the subprime sector or greater exposure to neighborhood housing price declines or unemployment rates.

Finally, these differences are concentrated among borrowers who may have difficulty making mortgage payments during the crisis. Blacks and Hispanics with high debt payment to income ratios have larger racial and ethnic differences in delinquencies and foreclosures, and in fact black borrowers who do not have risk factors of this type are no more likely to have a delinquency or foreclosure than white borrowers. Also, blacks and Hispanics experience much

larger increases in delinquency and foreclosure rates as county employment rates fall during the crisis than are experienced by equivalent white borrowers. These effects are largest for Hispanics, and we do not find any ethnic differences in delinquency and foreclosure in counties and years with relatively high employment rates for Hispanics.

A further decomposition of our main findings by origination year reveals that the large estimated racial and ethnic differences in mortgage outcomes are concentrated in mortgages that were originated in 2005 through 2007. That is, black and Hispanic households drawn into homeownership at the peak of the credit expansion and housing boom were especially likely to subsequently become delinquent and default on their mortgages. This finding is again robust to the inclusion of a broad set of controls for borrower, lender, loan, and neighborhood attributes, as well as controls for contemporaneous risk factors. This finding is also observed over a longer time period when examining racial differences by year of home purchase in the refinance sample. And these effects are more pronounced for borrowers with high debt to income ratios or with exposure to lower employment rates.

The simple idea discussed earlier that forward looking borrowers sort into homeownership in part based on their risk of experiencing adverse future events highlights a potential unified explanation for the full set of empirical results. African-Americans and Hispanics borrowers appear to be much more vulnerable to changes in market employment rates, declines in housing prices and having originally high debt expense to income ratios. African-American and Hispanic homebuyers near the peak of the housing market and the credit market expansion have the highest foreclosure rates during the crisis, and these high rates cannot be explained by the higher rates on negative equity experienced by borrowers who took out loans when housing prices were at their peak.

Our results complement a recent literature that aims to understand the causes and consequences of the last housing cycle. For example, while Mian and Sufi (2009) demonstrate a significant role for subprime lending in explaining overall neighborhood level foreclosure rates, our analysis implies that subprime lending can explain at most a modest fraction of observed racial and ethnic differences in credit market outcomes. In addition, tighter underwriting standards and increased financial oversight arising from recent financial reforms are unlikely to address these concerns because the observed differences arise after controlling for all traditional

underwriting variables, are based on comparisons within lenders and neighborhoods, and occur across a broad spectrum of minority borrowers.

Finally, regardless of the ultimate explanation for the observed higher rates of negative mortgage outcomes, our study raises serious concerns about homeownership as a vehicle for reducing racial wealth disparities. Our findings suggest instead that homeownership may be especially risky for households with a low initial level of wealth (savings) or fewer family resources on which to draw when hit with an adverse economic shock. Because delinquencies and default have consequences that go beyond the direct loss of housing equity/wealth, they can contribute substantially to perpetuating the wealth gap across generations. The increased cost of all subsequent borrowing (through the lower credit scores), in particular, makes future wealth accumulation much more difficult.

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Table 1: Sample Selection of HMDA Variables

Variable	HMDA full sample		DQ High quality match		DQ High quality match May-Aug		Sample, weighted		Experian Matched Sample, weighted[2]	
	Mean	Stand. Dev.	Mean	Stand. Dev.	Mean	Stand. Dev.	Mean	Stand. Dev.	Mean[1]	Stand. Dev.
Black	0.111	0.339	0.116	0.345	0.114	0.343	0.114	0.343	0.112	0.315
Hispanic	0.174	0.410	0.194	0.427	0.193	0.426	0.192	0.426	0.185	0.388
Asian	0.075	0.284	0.086	0.303	0.085	0.301	0.086	0.303	0.089	0.284
White	0.678	0.505	0.601	0.529	0.605	0.528	0.605	0.528	0.611	0.487
Loan Amount (in 1000s)	247	243	271	221	274	224	274	227	278	211
Applicant Income (in 1000s)	107	142	105	128	105	127	106	132	106	115
Tract Median Income (in 1000s)	59.1	25.6	59.6	25.2	59.7	25.2	59.7	25.2	60.4	23.5
Tract Pct Black	0.126	0.238	0.116	0.225	0.115	0.224	0.115	0.224	0.113	0.204
Tract Pct Hispanic	0.169	0.227	0.165	0.221	0.164	0.220	0.165	0.221	0.163	0.202
Tract Pct Asian	0.063	0.109	0.065	0.112	0.065	0.111	0.065	0.111	0.066	0.104
Number of Observations	9,345,709		4,002,996		1,459,468		273,589		238,785	

Notes: The first column presents the means and standard deviations for all Home Mortgage Disclosure Act (HMDA) home purchase and refinance mortgages in our seven market areas between 2004 and 2008 where each market is given equal weight in the means. The second column presents the means for the subsample where we have a high quality match between HMDA and the housing transaction file based on loan amount, type of loan, census tract and lender name, and the third column is based on further restricting the sample to mortgages originated between May and August. The fourth column presents means for the stratified sample that was merged to the credit history data weighted by the inverse of the sampling probabilities again with equal weights for each market, and the fifth column presents weighted means for the subsample that was successfully merged to an established credit history prior to mortgage origination.

Table 2: Descriptive Statistics

	Purchase Sample		Refinance Sample	
Credit Data	Mean	Std. Dev.	Mean	Std. Dev.
Mortgage Delinquency 90-180 Days	0.035	0.214	0.030	0.196
Foreclosure	0.053	0.319	0.037	0.250
Delinquency prior to Mortgage	0.001	0.025	0.002	0.046
Foreclosure prior to Mortgage	0.001	0.037	0.006	0.082
Vantage Score	781.3	104.0	775.0	109.8
Mortgage Payment to Income Ratio	0.256	0.280	0.247	1.064
Debt Payment to Income Ratio	0.321	0.336	0.348	1.191
Borrower Age	27.1	23.1	34.3	24.8
HMDA Data				
Rate Spread	0.151	0.358	0.168	0.374
American Indian	0.003	0.054	0.003	0.056
Asian	0.097	0.296	0.086	0.280
Black	0.089	0.284	0.126	0.331
Hispanic	0.195	0.397	0.182	0.386
White	0.616	0.486	0.604	0.489
Male	0.643	0.479	0.643	0.479
Female	0.355	0.478	0.355	0.478
Loan Amount (in 1000s)	105.7	106.1	100.6	108.8
Applicant Income (in 1000s)	285.9	210.1	261.6	199.2
Coborrower Present	0.354	0.478	0.476	0.499
Jumbo Loan	0.280	0.449	0.189	0.392
Tract Median Income (in 1000s)	60.04	23.43	60.44	23.54
Tract Share Black	0.100	18.340	12.273	21.652
Tract Share Hispanic	0.162	20.210	17.116	20.573
Tract Share Asian	0.065	10.252	7.107	10.756
Tract Share Owner Occupant	0.683	23.892	69.202	22.749
Tract Share in Poverty	0.077	7.273	7.962	7.491
Tract Rent/Price	0.0045	0.0019	0.0044	0.0017
Dataquick Data				
Loan to Value Ratio	0.885	0.242	0.576	0.416
Subordinate Lien	0.428	0.495	0.016	0.127
First Lien Adjustable Rate	0.515	0.500	0.478	0.500
Condo	0.218	0.413	0.139	0.346
Mobile	0.001	0.035	0.001	0.034
Single Family	0.774	0.418	0.837	0.369
Lot Size (sf in 1000s)	15.67	575.97	15.05	397.86
Unit square feet (in 1000s)	1.80	26.19	1.77	20.12
Number of Bathrooms	1.99	6.60	2.00	1.15
Number of Bedrooms	2.17	6.85	2.04	1.77
Number of Stories	1.17	1.58	1.22	1.33
Units in Building	1.41	14.83	1.49	19.88
Sample Size	327,124		306,213	

Notes: The first two columns contain means and standard deviations for our sample of post-mortgage credit reports for each home purchase mortgage borrower for which a credit score was observed prior to mortgage origination. The last two columns contain the same information for the post-mortgage reports of mortgage refinancers.

Table 3. Estimated Differences in Mortgage Outcomes - Delinquency and Foreclosure Rates

Home Purchase Sample								
	Delinquency				Foreclosure			
Race	Unconditional	Underwriting	Subprime	Contempor-aneous	Unconditional	Underwriting	Subprime	Contempor-aneous
Black	0.060***	0.030***	0.023***	0.015***	0.086***	0.042***	0.030***	0.017***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
Hispanic	0.054***	0.023***	0.019***	0.015***	0.091***	0.038***	0.031***	0.025***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Sample Size	331,608	331,608	331,608	330,912	331,608	331,608	331,608	330,912
R-Squared	0.013	0.057	0.098	0.108	0.016	0.074	0.122	0.137

Refinance Sample								
	Delinquency				Foreclosure			
Race	Unconditional	Underwriting	Subprime	Contempor-aneous	Unconditional	Underwriting	Subprime	Contempor-aneous
Black	0.030***	0.016***	0.012***	0.005**	0.030***	0.017***	0.015***	0.007**
	(0.001)	(0.002)	(0.002)	(0.002608)	(0.002)	(0.002)	(0.003)	(0.003)
Hispanic	0.031***	0.015***	0.013***	0.011***	0.043***	0.024***	0.021***	0.019***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Sample Size	309,137	309,137	309,137	308,459	309,137	309,137	309,137	308,459
R-Squared	0.005	0.046	0.090	0.096	0.005	0.045	0.095	0.102

Notes: This table presents the estimates for number of 90 to 180 day mortgage delinquencies and number of foreclosures within the last 12 months for the samples described in Table 2 based on the home purchase and refinance samples, panels 1 and 2 respectively. The first column for each outcome presents unconditional differences, the second column presents results conditional on detailed controls for pre-origination vantage credit score, loan to value ratio, mortgage and total debt payment to income ratios, whether interest rate is adjustable, presence of subordinate debt, whether a jumbo loan, borrower income, race, ethnicity, gender, age, presence of coborrower, census tract demographics and detailed unit attributes, as well as origination year by credit year fixed effects. The third column presents estimates after adding controls for rate spread loans, lender fixed effects, tract fixed effects, and additional subprime controls, and the fourth column present estimates after adding county by year fixed effects plus contemporaneous controls for negative equity and employment rates. Standard errors (in parentheses) are robust to heteroskedasticity, and clustered at tract-credit year level. *** indicates significant at 1% level, ** means significant at 5% level, and * is significant at 10% level.

Table 4A. Race and Ethnicity Interactions – Home Purchase Sample

	Delinquency			Foreclosure		
Race	**Baseline**	**Risk Factor**	**Employment**	**Baseline**	**Risk Factor**	**Employment**
Black	0.015***	-0.002	-0.005	0.017***	0.000	-0.001
	(0.002)	(0.003)	(0.005)	(0.004)	(0.005)	(0.007)
Hispanic	0.015***	0.016***	-0.032***	0.025***	0.020***	-0.056***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.005)
Black*Subprime		0.018***			0.035***	
		(0.005)			(0.008)	
Hispanic* Subprime		0.000			0.008	
		(0.004)			(0.007)	
Black*Rate Spread		0.006			-0.011	
		(0.004)			(0.007)	
Hispanic*Rate Spread		-0.006			0.002	
		(0.003)			(0.005)	
Black*High DTI		0.041***			0.058***	
		(0.006)			(0.009)	
Hispanic*High DTI		0.010**			0.021***	
		(0.004)			(0.007)	
Black*Unemp Rate			0.570***			0.754***
			(0.065)			(0.092)
Hispanic*Unemp Rate			0.908***			1.521***
			(0.066)			(0.089)
R-squared	0.102	0.108	0.109	0.137	0.137	0.138

Notes: This table presents estimates for delinquency and foreclosure based on the home purchase. The first column for each outcome presents the final column of estimates from Table 3. The second column presents estimates based on the interaction of the dummy variables for race and ethnicity with whether the borrower has a vantage credit score below 701, a loan to value ratio above 0.95, or a debt to income ratio above 0.45. The third column presents estimates using interactions of race and ethnicity with one minus the race by year county average employment rate for prime age adults. Standard errors (in parentheses) are robust to heteroskedasticity, and clustered at tract-credit year level. *** indicates significant at 1% level, ** means significant at 5% level, and * is significant at 10% level.

Table 4B. Race and Ethnicity Interactions – Refinance Sample

	Delinquency			Foreclosure		
Race	**Baseline**	**Risk Factor**	**Employment**	**Baseline**	**Risk Factor**	**Employment**
Black	0.005**	-0.004	-0.019***	0.007**	0.008**	-0.014***
	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.005)
Hispanic	0.011***	0.011***	-0.035***	0.019***	0.014***	-0.032***
	(0.001)	(0.002)	(0.003)	(0.002)	(0.002)	(0.004)
Black*Subprime		0.004			-0.013**	
		(0.004)			(0.005)	
Hispanic* Subprime		0.004			0.020***	
		(0.004)			(0.005)	
Black*Rate Spread		0.010***			0.002	
		(0.003)			(0.004)	
Hispanic*Rate Spread		-0.009***			-0.007*	
		(0.003)			(0.004)	
Black*High DTI		0.016***			0.009*	
		(0.004)			(0.005)	
Hispanic*High DTI		0.007**			0.010**	
		(0.003)			(0.005)	
Black*Unemp Rate			0.651***			0.631***
			(0.066)			(0.071)
Hispanic*Unemp Rate			0.874***			0.956***
			(0.065)			(0.073)
R-squared	0.096	0.096	0.097	0.102	0.102	0.103

Notes: This table presents estimates for delinquency and foreclosure based on the refinance purchase. The first column for each outcome presents the final column of estimates from Table 3. The second column presents estimates based on the interaction of the dummy variables for race and ethnicity with whether the borrower has a vantage credit score below 701, a loan to value ratio above 0.95, or a debt to income ratio above 0.45. The third column presents estimates using interactions of race and ethnicity with one minus the race by year county average employment rate for prime age adults. Standard errors (in parentheses) are robust to heteroskedasticity, and clustered at tract-credit year level. *** indicates significant at 1% level, ** means significant at 5% level, and * is significant at 10% level.

Table 5. Estimated Differences in Mortgage Outcomes by Origination Year

Home Purchase Sample				
Race and Ethnicity	**Delinquency**		**Foreclosure**	
Interactions	**Black**	**Hispanic**	**Black**	**Hispanic**
Level Estimate	0.061***	0.061***	0.086***	0.104***
	(0.005)	(0.005)	(0.010)	(0.009)
2008	-0.031***	-0.026***	-0.055***	-0.066***
	(0.007)	(0.006)	(0.011)	(0.010)
2007	0.017**	0.038***	0.000	0.035***
	(0.007)	(0.006)	(0.011)	(0.012)
2006	0.054***	0.051***	0.091***	0.108***
	(0.008)	(0.007)	(0.014)	(0.012)
2005	0.027***	0.034***	0.033**	0.057***
	(0.008)	(0.007)	(0.013)	(0.011)
Sample Size	0.027		0.035	
R-squared	207,723		207,723	

Refinance Sample				
Race and Ethnicity	**Delinquency**		**Foreclosure**	
Interactions	**Black**	**Hispanic**	**Black**	**Hispanic**
Level Estimate	0.038***	0.044***	0.051***	0.059***
	(0.005)	(0.005)	(0.007)	(0.006)
2008	-0.022***	-0.023***	-0.051***	-0.046***
	(0.006)	(0.006)	(0.007)	(0.007)
2007	-0.002	0.015**	-0.027***	-0.002
	(0.006)	(0.006)	(0.008)	(0.008)
2006	0.020***	0.018***	-0.009	0.035***
	(0.007)	(0.006)	(0.009)	(0.009)
2005	0.010	0.007	-0.003	0.024***
	(0.007)	(0.006)	(0.008)	(0.009)
Sample Size	0.011		0.012	
R-squared	192,953		192,953	

Notes: This table presents estimates for a model where mortgage origination year is interacted with race and ethnicity to explain delinquency and foreclosure for the home purchase and refinance samples. The first column for each outcome presents the estimates for origination year interacted with whether the borrower is black, and the second column presents the estimates for origination year interacted with whether Hispanic. The row labelled level estimate presents the estimate on the dummy variable for black or Hispanic. The omitted category is all mortgages underwritten in 2004. Standard errors (in parentheses) are robust to heteroskedasticity, and clustered at tract-credit year level. *** indicates significant at 1% level, ** means significant at 5% level, and * is significant at 10% level.

Table 6. Estimated Differences in Mortgage Outcomes by Home Purchase Year – Refinance Sample

Ethnicity	Delinquency		Foreclosure	
Interactions	Black	Hispanic	Black	Hispanic
Level	0.034***	0.037***	0.035***	0.052***
	(0.003)	(0.004)	(0.004)	(0.005)
2008	0.038	-0.034	-0.051***	-0.052***
	(0.009)	(0.003)	(0.009)	(0.019)
2007	0.037	0.041*	0.046	0.088**
	(0.003)	(0.025)	(0.036)	(0.041)
2006	0.017	0.049***	0.01	0.015
	(0.015)	(0.014)	(0.022)	(0.017)
2005	0.027**	0.038***	0.029**	0.050***
	(0.011)	(0.009)	(0.014)	(0.011)
2004	0.037***	0.028***	0.020*	0.057***
	(0.009)	(0.007)	(0.011)	(0.010)
2003	0.021**	0.023***	0.018	0.024**
	(0.009)	(0.007)	(0.011)	(0.010)
2002	0.015*	0.025***	0.015	0.019*
	(0.009)	(0.008)	(0.010)	(0.011)
2001	0.035***	0.004	0.006	0.016
	(0.012)	(0.007)	(0.010)	(0.011)
2000	0.004	-0.003	-0.004	-0.001
	(0.008)	(0.008)	(0.009)	(0.011)
1999	0.008	-0.009	0.014	-0.009
	(0.008)	(0.008)	(0.011)	(0.010)
1998	0.009	0.003	-0.008	-0.005
	(0.011)	(0.010)	(0.010)	(0.011)
Sample Size	192,953		192,953	
R-squared	0.012		0.012	

Notes: This table presents estimates based on the refinance sample for a model where home purchase year is interacted with race and ethnicity to explain delinquency and foreclosure. The first column for each outcome presents the estimates for home purchase year interacted with whether the borrower is black, and the second column presents the estimates for origination year interacted with whether Hispanic. The omitted category is all homes purchased prior to 1998. Standard errors (in parentheses) are robust to heteroskedasticity, and clustered at tract-credit year level. *** indicates significant at 1% level, ** means significant at 5% level, and * is significant at 10% level.

Table 7. Estimated Differences in Mortgage Outcomes by Origination Year and Risk Factors

Home Purchase Sample - Debt to Income Interactions				
Race and Ethnicity	**Delinquency**		**Foreclosure**	
Interactions	**Black**	**Hispanic**	**Black**	**Hispanic**
2008	-0.029	0.033**	-0.097***	-0.080***
	(0.020)	(0.015)	(0.035)	(0.023)
2007	-0.016	0.028*	-0.079**	-0.006
	(0.020)	(0.015)	(0.035)	(0.025)
2006	0.050**	0.061***	0.179***	0.158***
	(0.023)	(0.017)	(0.043)	(0.033)
2005	0.032	0.045***	0.085*	0.076***
	(0.026)	(0.018)	(0.046)	(0.028)
Sample Size	207,241		207,241	
R-squared	0.139		0.184	

Home Purchase Sample - Unemployment Rate Interactions				
Race and Ethnicity	**Delinquency**		**Foreclosure**	
Interactions	**Black**	**Hispanic**	**Black**	**Hispanic**
2008	0.011	0.213	-0.286	0.498***
	(0.113)	(0.142)	(0.182)	(0.187)
2007	-0.101	0.960***	-0.198	1.195***
	(0.114)	(0.153)	(0.184)	(0.207)
2006	-0.128	0.498***	-0.003	1.212***
	(0.126)	(0.155)	(0.213)	(0.233)
2005	-0.218*	0.291*	-0.151	0.426**
	(0.124)	(0.156)	(0.204)	(0.204)
Sample Size	207,241		207,241	
R-squared	0.139		0.182	

Notes: This table presents estimates based on the home purchase sample for a model where the interactions between home purchase year and the race and ethnicity dummy variables are interacted with mortgage risk factors, high debt to income ratio dummy (panel 1) or exposure to unemployment rates by race by current year by county (panel 2). The first column for each outcome presents the estimates for home purchase year interacted with whether the borrower is black and with the risk factor, and the second column presents the estimates for origination year interacted with whether Hispanic and the risk factor. The omitted category is homes purchased or mortgages originated in 2004. Standard errors (in parentheses) are robust to heteroskedasticity, and clustered at tract-credit year level. *** indicates significant at 1% level, ** means significant at 5% level, and * is significant at 10% level.

Table 8A. Differences by Home Purchase Year and DTI – Refinance Sample

Race and Ethnicity	Delinquency		Foreclosure	
	Black	Hispanic	Black	Hispanic
2008	-0.052	0.015	-0.084*	-0.21
	(0.088)	(0.072)	(0.045)	(0.131)
2007	0.015	0.041	-0.035	-0.143**
	(0.065)	(0.059)	(0.086)	(0.067)
2006	0.036	0.047	0.02	0.037
	(0.035)	(0.029)	(0.044)	(0.030)
2005	0.077***	0.055***	0.045	0.063***
	(0.026)	(0.018)	(0.033)	(0.024)
2004	0.049**	0.022	0.004	0.061**
	(0.020)	(0.014)	(0.023)	(0.026)
2003	0.042*	0.007	0.004	0.033
	(0.024)	(0.016)	(0.022)	(0.024)
2002	0.017	0.016	0.04	0.026
	(0.020)	(0.019)	(0.026)	(0.028)
2001	0.057*	0.019	0.018	0.047*
	(0.030)	(0.017)	(0.024)	(0.029)
2000	-0.002	-0.006	-0.033	0.020
	(0.019)	(0.019)	(0.021)	(0.023)
1999	-0.049***	-0.026*	0.009	-0.016
	(0.017)	(0.015)	(0.024)	(0.022)
1998	0.014	0.046**	-0.028	0.028
	(0.023)	(0.023)	(0.020)	(0.027)
Sample Size	192,444		192,444	
R-squared	0.131		0.144	

Notes: This table presents estimates based on the refinance sample for a model where the interactions between home purchase year and the race and ethnicity dummy variables are interacted with mortgage risk factors, high debt to income ratio dummy (panel A) or exposure to unemployment rates by race by current year by county (panel B). The first column for each outcome presents the estimates for home purchase year interacted with whether the borrower is black and with the risk factor, and the second column presents the estimates for origination year interacted with whether Hispanic and the risk factor. The omitted category is homes purchased prior to 1998. Standard errors (in parentheses) are robust to heteroskedasticity, and clustered at tract-credit year level. *** indicates significant at 1% level, ** means significant at 5% level, and * is significant at 10% level.

Table 8B. Differences by Home Purchase Year and DTI – Refinance Sample

Race and Ethnicity	Delinquency		Foreclosure	
	Black	Hispanic	Black	Hispanic
2008	0.287	0.012	0.360	0.161
	(0.425)	(0.161)	(0.464)	(0.298)
2007	0.758*	0.138	0.915	-0.447
	(0.395)	(0.833)	(0.686)	(1.081)
2006	0.165	0.751**	0.803*	0.387
	(0.241)	(0.332)	(0.418)	(0.250)
2005	0.276	0.858***	0.728***	1.061***
	(0.189)	(0.215)	(0.268)	(0.257)
2004	0.459***	0.380**	0.320*	0.570***
	(0.157)	(0.169)	(0.176)	(0.193)
2003	-0.040	0.472**	0.251	0.131
	(0.186)	(0.206)	(0.169)	(0.216)
2002	0.108	0.158	-0.103	0.609**
	(0.136)	(0.208)	(0.166)	(0.269)
2001	0.335	-0.083	-0.102	0.140
	(0.305)	(0.179)	(0.174)	(0.242)
2000	0.116	0.118	0.081	0.334
	(0.150)	(0.241)	(0.179)	(0.249)
1999	0.063	0.040	0.158	-0.124
	(0.175)	(0.188)	(0.188)	(0.228)
1998	-0.184	-0.004	-0.010	0.531*
	(0.184)	(0.252)	(0.157)	(0.293)
Sample Size	192,444		192,444	
R-squared	0.131		0.144	

Notes: This table presents estimates based on the refinance sample for a model where the interactions between home purchase year and the race and ethnicity dummy variables are interacted with mortgage risk factors, high debt to income ratio dummy (panel A) or exposure to unemployment rates by race by current year by county (panel B). The first column for each outcome presents the estimates for home purchase year interacted with whether the borrower is black and with the risk factor, and the second column presents the estimates for origination year interacted with whether Hispanic and the risk factor. The omitted category is homes purchased prior to 1998. Standard errors (in parentheses) are robust to heteroskedasticity, and clustered at tract-credit year level. *** indicates significant at 1% level, ** means significant at 5% level, and * is significant at 10% level.

Figure 1. Unconditional rates of mortgage foreclosures and delinquencies by race and year

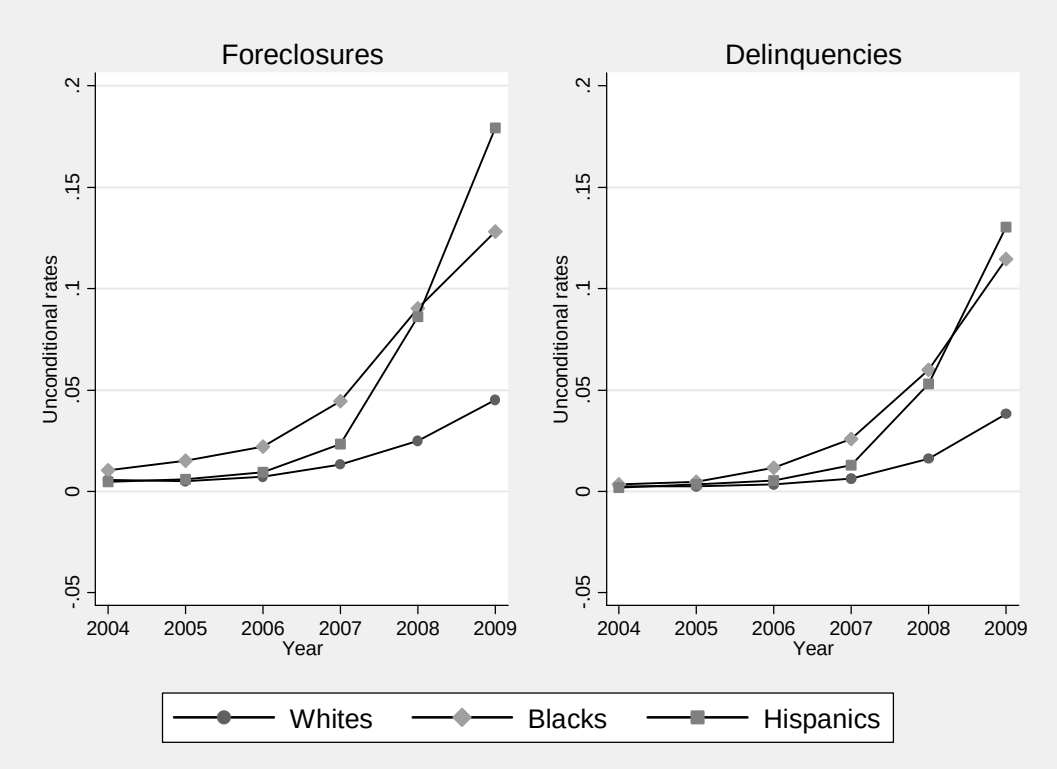

Figure 2. Black and Hispanic probability of foreclosure relative to whites by calendar year, purchase and refinance samples

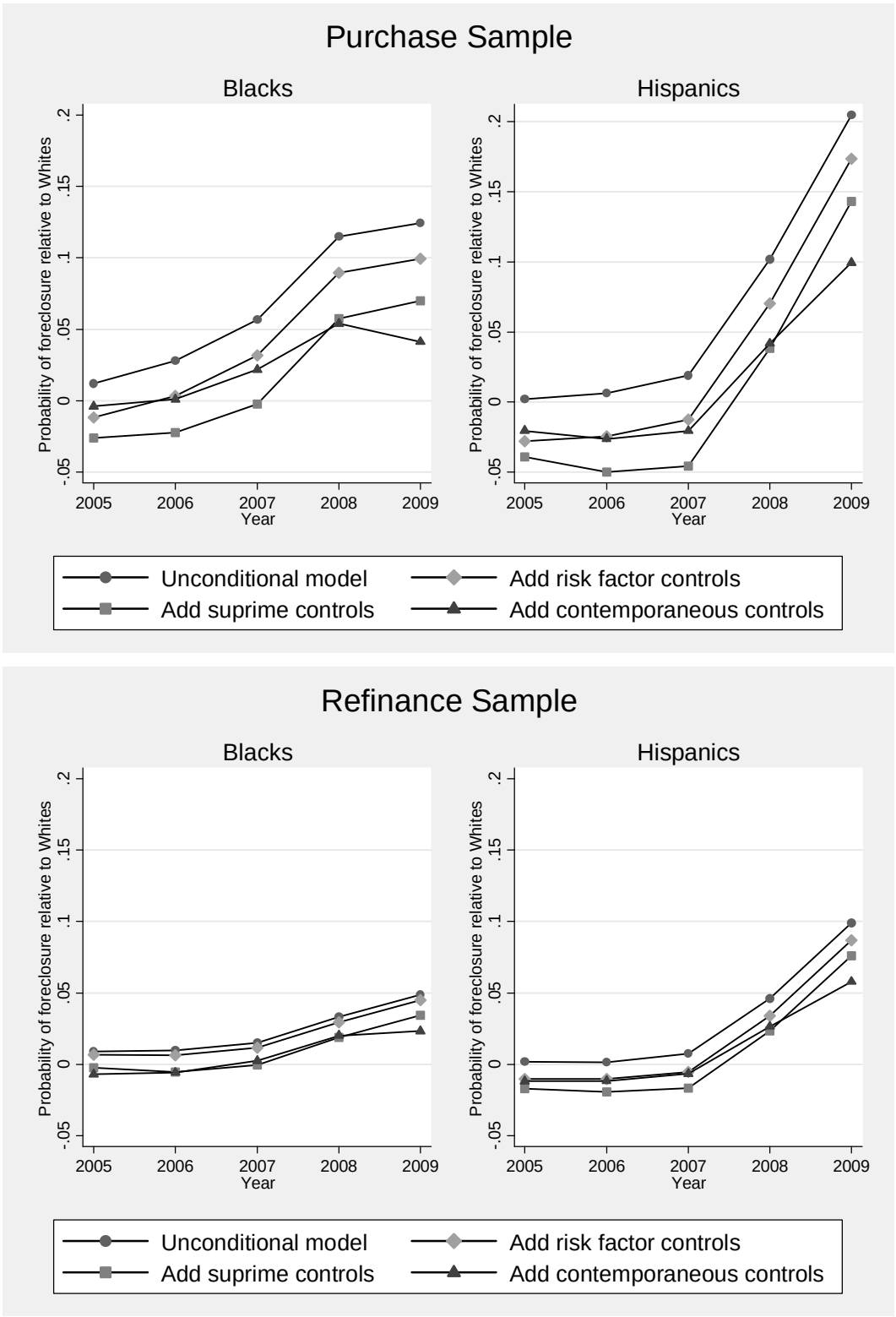

Figure 3. Black and Hispanic probability of foreclosure relative to whites by loan origination year, purchase and refinance samples

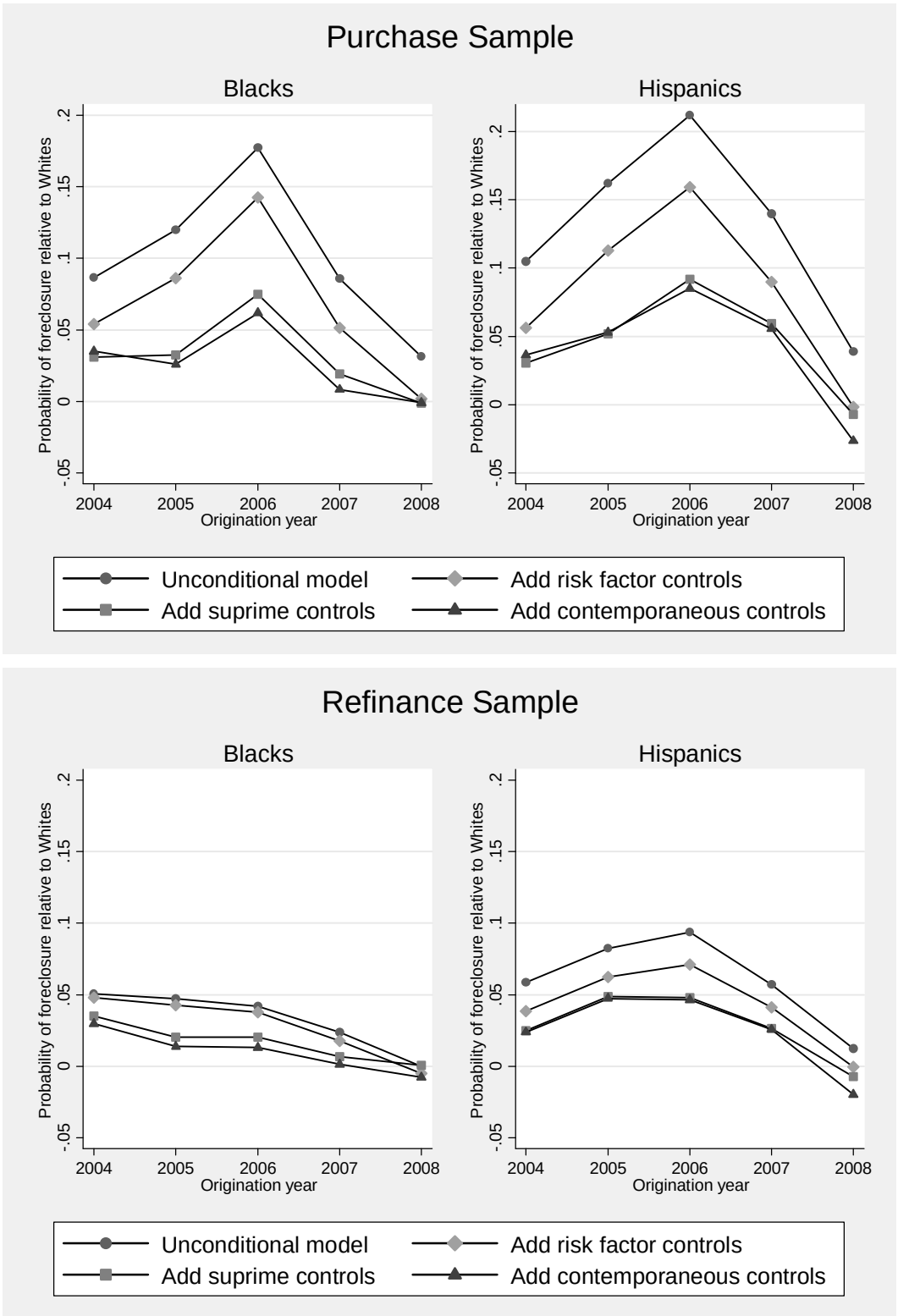

Figure 4. Black and Hispanic probability of foreclosure relative to whites by home purchase year of refinance loan