

# Racial Discrepancy in Mortgage Interest Rates

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**Abstract** Existing research on racial discrimination in mortgage lending has overwhelmingly focused on whether black applicants are more likely to be denied for credit than comparable white applicants. This study investigates whether the approved black applicants are likely charged higher interest rates than their white counterparts. Using data from three waves of the U.S. Survey of Consumer Finance, our results suggest that black borrowers on average pay about 29 basis points more than comparable white borrowers. We also find that rate disparity mainly occurs to young borrowers with low education as well as those borrowers whose income and credit disqualify them for prime lending rates. Furthermore, among borrowers in the higher rate groups, black women seem to receive much more disparate treatment than black men. We conclude that, while the racial disparity in mortgage rates is widespread between black and white borrowers, it is the more financially vulnerable black women who suffer the most.

**Keywords** Racial discrimination · Gender discrimination · Mortgage interest rate

## Introduction

Racial discrimination in mortgage lending is a sensitive social issue and the subject of frequent policy debate and academic research. Since the publication of the influential 1992 Boston Federal Reserve Study, which concludes that “race does play a role as lenders consider whether to deny or approve a mortgage loan application” (page 43), the subject has motivated a great number of academic studies to examine various aspects of mortgage lending process. Overall, though, the voluminous literature has largely

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focused on disparate treatment in the mortgage approval process, that is, whether minority borrowers are more likely to be rejected than white borrowers for mortgage loans. The current study investigates a different racial disparate treatment in the outcome of the lending process – whether minority applicants are likely to be charged higher interest rate than white borrowers after they have been approved for a mortgage.

Compared to the extensive literature on application rejection rates, racial discrepancy on mortgage rates has attracted less attention from researchers in the past perhaps for two reasons. One is that there seems to be a common perception that the U.S. mortgage market is highly competitive in the sense that long-term loans are made at very thin spread over the lenders' cost of funds. (Holmes and Horvitz (1994) This implies that lenders have little room for differential rate manipulations, and that all successful mortgage applicants are likely to receive similar interest rates. Another reason has to do with the rise of electronic loan application, whether by telephone or Internet, since the 1990s. Electronic lending eliminates the need for personal contact between the applicant and the loan originator and underwriters. Since race is excluded from the standard information used in underwriting, electronic application is often perceived as racially and ethnically blind. (Yazer (2006))

However, the slew of law suits against mortgage lenders for discriminatory lending practices in the wake of the recent financial crisis suggest disparate treatment of minority mortgage borrowers is more widespread than many had realized before. The well-publicized case against Countrywide Financial Corporation, which was settled for \$355 million in December 2011, was the largest discriminatory lending case in history. It revealed that over 200,000 black and Hispanic borrowers who qualified for regular loans were charged higher fees or subprime interest rates.<sup>1</sup> The Wells Fargo case, which was settled for \$175 million in July 2012, revealed that the nation's largest home mortgage lender and its mortgage brokers had charged higher fees for minority borrowers across the country, or steered them into subprime loans when white borrowers with similar risk profiles would receive prime lending rates. It was reported that Wells Fargo was facing some 30 other similar law suits from various consumer groups and government entities. These and many legal cases had prompted the Obama administration to set up a new unit in the civil rights division to focus on lending bias amid the fallout from the waves of foreclosures that set off the recent financial crisis.<sup>2</sup>

These unveiled legal cases suggest that the current lending system is perhaps not racial and ethnically blind after all. But how widespread is such practice among all lenders? Is it only a phenomenon during the recent bubble years when the lending standards had deteriorated to extent that practically anything went, or does it happen in normal times as well? Given the social and economic heterogeneity among minority borrowers, are some groups of minority borrowers more vulnerable than others in receiving disparate treatment from the lenders? For example, what are the role of gender, age, and education in the lending outcomes of minority borrowers?

Answers to these questions have important social and economic ramifications. But detecting such disparity in empirical analysis can be challenging. After all, it can be argued that, racial disparity in mortgage rates, if indeed exists, may not have much to do with race per se but have more to do with borrowers' credit risks and their mortgage

<sup>1</sup> See report at: <http://www.justice.gov/usao/cac/countrywide.html>

<sup>2</sup> See "Wells Fargo Will Settle Mortgage Bias Charges" by Charlie Savage, The New York Times, July 12, .

preferences. For example, if blacks on average tend to have less education and earn less income than whites, or if blacks are more likely to buy houses with less down payment, or if blacks simply prefer to borrower 30-year fixed rate mortgages (which tend to have the highest interest rate among all common mortgage products), then it is entirely reasonable to expect that the average mortgage rates for blacks to be higher than that for whites. However, if this indeed is the case, one would expect that, once all the objective measures (mortgage features, borrower characteristics, and market conditions, etc.) are controlled for, the racial disparity should disappear in a properly conducted analysis. The challenge, therefore, is to overcome the limits often facing previous efforts, such as using data only from selected lenders or missing critical variables (such as borrowers' credit history). The current study conducts a comprehensive analysis using three consecutive waves of U.S. Survey of Consumer Finances conducted in 2001, 2004, and 2007 to build a data base with national coverage, which enables us to dissect the sample in various ways to investigate the interest rate discrepancy between black and white borrowers from different angles.

Compared with proprietary loan level data that most previous studies obtain from lending institutions, the Survey of Consumer Finance (SCF) data provides some unique advantages for studying this issue: First, the samples contain detailed information on wealth and debts of the borrowers, which allows us to see how much of racial discrepancies are explained by the differences in borrowers' wealth. Second, the samples contain a unique variable of shopping behavior to indicate how borrowers go about obtaining their loans – whether they primarily relied on recommendations by people they trust, or made effort in searching and comparing among multiple loan offers. Given that the research in psychology and consumer behavior area has generally concluded that search is beneficial for consumers shopping for more expensive and complex products, it would be interesting to see how effective shopping behavior is in explaining the racial discrepancies. Third, the samples contain information on demographics such as age and education that are usually not available but might explain the vulnerability of minorities to being offered unusually high interest rates. Last but not least, the SCF has a formal sampling procedure that ensures the national representativeness of the samples coverage. Such sample representativeness is challenging to achieve with loan level data, as most lenders tend to operate in concentrated geographic areas.

We conduct a series of regression analysis that control for mortgage features, type of lenders, time of the loan issuance, plus an array of borrower characteristics including age, education, income, wealth, credit quality, shopping behaviors, etc. We find persistent racial differences in mortgage rates that are both statistically and economically significant. While individual risk factors can explain a lot of the differences, shopping behavior appears to explain little of the racial differences. Closer examination with residual analysis and quantile regressions reveals that racial discrepancies are concentrated among younger black borrowers with low education. In addition, black borrowers, particularly black women who fail to qualify for lower interest rates due to their risk profiles are likely to be charged 57.36 basis points more than their white counterparts.

The rest of the paper is organized as follows. After a brief literature review in Section 2, we discuss the SCF data and our sample in Section 3. Section 4 presents the summary statistics and a preliminary analysis that indicate large unconditional rate differences between black and white borrowers, which lead to formal analyses in Section 5 and the presentation of main empirical findings. Section 6 concludes.

## Related Studies

Attempts to analyze mortgage discrimination date back to the late 1970s. (See Black et al. (1978), Yinger (1979)), King (1980), Schafer and Ladd (1981), among others) But the issue really caught on public attentions and academic debates after the 1992 Boston Federal Reserve study, which was later published in *The American Economic Review* (Munnell et al. (1996)). Examining the HMDA data, the Boston study finds that “minorities are more than twice as likely to be denied a mortgage than whites.” A large body of literature quickly emerged as the result of this study. The majority of these studies focus on investigation of two issues – mortgage rejection rates and, to a lesser degree, the default rates of minority borrowers. The logic is that, on the one hand, higher rejection rates for minority borrowers may suggest possible discrimination. On the other hand, lower default rates by minorities (if detected) may suggest a higher underwriting standard was applied to these borrowers to begin with, which would imply disparate treatment at the approval stage. While the body of literature is too large to be discussed here in detail, excellent reviews of this literature can be found in LaCour-Little (1999), Turner and Skidmore (1999), and Ross and Yinger (2002). Some of the more frequently cited papers in this area include Yinger (1996), Ross and Yinger (1999) Ladd (1998) and Becker (1993). Data and methodological limitations of these studies are discussed in Ferguson and Peters (1995) and Clarke et al. (2009)

Compared to the large number of studies on mortgage rejection and default rates, fewer studies have analyzed racial disparities on interest rates. Courchane and Nickerson (1997) conducted a case study using data from the Office of the Comptroller of the Currency. They find some evidence of minorities paying an average of interest more frequently than white borrowers. Crawford and Rosenblatt (1999) examined two-year worth of data from one large lending institution and find no differential pricing treatment among conventional loan borrowers. Because of small samples, neither study’s findings can be generalized to the broader market. Black et al. (2003) analyze a sample of purchase and refinancing loans by a single mortgage lender in 1996 and conclude that the differences in interest rate premium (overage) has more to do with market power and differential bargaining skill and less to do with the race of borrowers. Susin (2003) analyzes the 2001 American Housing Survey data and finds that blacks pay an average of 44 basis points more than whites, but he suggests that most of the black-white differential is more pronounced in refinancing than purchase mortgages. The study by Boehm et al. (2006) analyze an expanded AHS data set and find that significant racial disparity in mortgage rates are more likely to occur in the conventional mortgage market where black borrowers tend to pay a much higher annual percentage rate (APR) than whites for both purchases and refinancing. However, the validity of the finding is limited because their regression analysis does not control for borrower credit history. This information is arguably the most important factor in determining the interest rate a borrower is to receive.

More recent studies on racial discrepancies in mortgage rates have overwhelmingly concentrated in the area of subprime lending. Bocian et al. (2006) use a large proprietary data set to examine the pricing discrepancies between minority borrowers and their white counterparts for subprime mortgages issued around 2004, and they found that black and Latino borrowers are more likely to receive higher rates than white borrowers with similar risk profiles. On the other hand, Haughwout et al. (2009) use a

different proprietary data with subprime loans issued during the 2004 – 2006 period and found no evidence of adverse pricing against minority borrowers. Ghent, Hernández-Murillo, and Owyang (2011) investigated the subprime mortgage pricing discrepancy in California and Florida during 2005 (the peak year of the subprime expansion) and documented evidence of redlining and adverse pricing for Blacks and Hispanics. Bayer et al. (2013) combined HMDA data with a proprietary data set to examine racial discrepancies in subprime mortgage pricing during the 2004 – 2008 period and found significant unexplained racial, ethnic and age differences in the incidence of high cost or subprime mortgage credit with minority groups and older borrowers having a higher incidence of high cost loans.

The current study expands this line of investigation beyond subprime lending, and attempts to detect racial discrepancies in mortgage rates for both prime and subprime loans using data from the Survey of Consumer Finance (SCF). The rich information contained in the SCF data on borrower characteristics (income, wealth, credit, shopping behavior, etc.) presents an opportunity to examine racial discrepancy in mortgage rates in relation to consumer preferences and shopping behavior.

## Data

This study uses data from the U.S. Survey of Consumer Finances in 2001, 2004, and 2007 with national coverage. The SCF data is a [triennial](#) survey of the balance sheet, pension, income, and other demographic characteristics of U.S. families. The study is sponsored by the U.S. [Federal Reserve Board](#) in cooperation with the U.S. [Department of the Treasury](#). Since 1992, data have been collected by the [National Organization for Research](#) at the University of Chicago (NORC). Data from the SCF are widely used in academic research, as well as in economic analysis at the Federal Reserve and other branches of government.

The SCF survey is conducted among a representative sample of the U.S. households. It contains information on mortgages as well as on broader household finances and demographics. The data contains a large random sample of borrowers who obtained various types of mortgages with various terms from a variety of different lending establishments. This allows us to extend the examination of racial disparity in mortgage rates to all types of mortgage loans rather than just subprime loans. Each survey collects detailed loan information including type of mortgage, loan amount, term, interest rate, time of origination, etc. Other variables include detailed household income and demographic information, such as the borrower's age, race, highest level of education, as well as whether they own any banking accounts. The borrower's credit worthiness is measured in part by whether they filed bankruptcy or their credit applications were rejected in the past five years. In addition, the survey also contains explicit questions on how the borrowers selected their lenders—whether the decision was based on a search for the lowest rates or recommendations by other people. Response to this question provides an explicit measure of how much search effort the borrower had committed before he or she accepted the

mortgage offer from the lender. This variable was found to be critical in explaining the gender disparity of mortgage rates in Cheng et al. (2011)

Our initial data sample contains about 3,653 observations, each of which represents a surveyed household who obtained a mortgage during the period of 1997 – 2007. All the mortgages are either for purchase or refinancing purposes. Home equity loans are excluded. We apply three screenings to the sample. First, we eliminate observations with missing variables or irregular values (negative income); second, we eliminate observations in the top and bottom one percent of the mortgage rate distribution (a few households reported paying a 0% interest rate on the mortgages, while some households reported paying a 33% interest rate on their mortgages); third, we eliminate observations with either extremely small loan amounts or extremely low loan-to-income ratios. The final sample contains a total of 3,505 observations, of which 228 mortgages are identified as blacks (single black or black-headed household), and the remaining 3,277 are white borrowers. Table 1 displays the list of variables in the sample.

**Table 1** The variables description

Variables	Descriptions
Rate	Interest rate (in basis points) on mortgage
Race	Indicator for whether the borrower is White or Black
Year	Indicator for which year the mortgage was originated
Mortgage Info	
ARM	Indicator for whether the mortgage is adjusted rate mortgage or fixed rate mortgage (FRM)
Term	The maturity of the mortgage whether the loan is 15-year, 30-year or other mortgage
LTV	Indicator for whether the loan-to-value ratio for purchase is bigger than 95%, not bigger than 80% or others
Refi	Indicator for whether the mortgage is refinancing or purchase
Borrower Info	
Debt service-to-income ratio	Total monthly debt obligation divided by borrower's monthly gross income
Net wealth	Borrower's networth at the time of survey
Liquid worth	Borrower's cash and cash-equivalent asset
Rejection	Indicator for whether the borrower has ever been rejected any credit application in the past five years prior to the survey, or no application at all
Bkrupt	Indicator for whether the borrower filed for bankruptcy before
Age	The age of the household head at the time of mortgage insurance.
Edu	Indicator for whether the borrower is college educated, high school educated, or others
"Shopping" Behavior	
shopARMrefi	Categorical variable that is the product of three variables - Shopping, ARM and loan purpose (refi or purchase), which indicates 12 scenarios: search-ARM-purchase, recommend-ARM-purchase, other-ARM-purchase, search-ARM-refi, recommend-ARM-refi, other-ARM-refi, search-FRM-purchase, recommend-FRM-purchase, other-FRM-purchase, search-FRM-refi, recommend-FRM-refi, other-FRM-refi

## Preliminary Analysis

The summary statistics of the data suggest clear differences between black and white borrowers in almost every aspect. As displayed in Table 2, the median mortgage amount for black is \$105,000 vs. \$120,000, suggesting blacks tend to purchase lower-priced houses. Median household income for black is \$57,000, which is less than that of white (\$72,000). As a result, the debt service-to-income ratio for black is higher (32.8%) than that of white (26.3%). To most lenders, these higher ratios suggest higher default risk on the borrower if holding other things equal. It is also noticeable that the median net worth of black borrowers is much less than that of white (\$88,000 vs. \$189,000, respectively), and so is their liquid wealth compared to white borrowers (\$3,300 vs. \$6,500, respectively). It is necessary to note that the mortgages in our sample are originated during the period of 1997-2007, but the SCF data only reports the income and wealth at the time of survey, which may not match the time when the loans were originated. However, since most of the mortgages were originated or refinanced within 3 years of the survey, and the average household income may not change much during this period, we believe the income and wealth information are reasonable proxies for data prior to the borrowing.

In terms of mortgage preference, blacks are less likely to borrow adjustable-rate mortgages (ARM) than whites (11.0% versus 17.1%), and they seem to prefer long-term mortgages (30-year loans) than white (71.0% versus 57.8%). In addition, blacks tend to purchase home with less down-payment. 54% black borrowers finance their home with loan-to-value ratio above 95%, compared to only 30.3% whites in the same category. Note that loan-to-value ratios for refinancing are not available because there is no transaction price or reliable appraisal value of the property.

In terms of borrowers characteristics, fewer black borrowers tend to have college degrees than white borrowers (46.1% versus 62.1%), their bankruptcy rate is almost twice as high as white borrowers (16.6% versus 8.6%), and more of blacks were declined for credit than whites during the five years before the survey was taken (33.1% versus 15.2%).

On average black borrowers tends to shop around less than white borrowers (27.4% versus 41.2%) in looking for mortgages. 31.8% of blacks choose lenders recommended by friends and families, compared to 25.1% of white borrowers doing the same. Such borrowers' shopping behavior was found to be a powerful control variable that is able to explain away the gender discrepancy in mortgage rates by Cheng et al. (2011). Since similar behavioral difference is also found between black and white borrowers, we are interested in seeing whether shopping behavior can explain away the racial discrepancy as well.

Now we focus on examining the interest rate difference between black and white borrowers. As preliminary analysis, we apply a simple t-test to examine the unconditional rate differences between blacks and whites for the full sample, as well as various subsamples. The results are displayed in Table 3.

The full sample of data shows that, unconditionally, black borrowers on average pay 67 basis points higher than white borrowers during the 10-year survey period. The differences remain rather consistent and statistically significant when the three waves of surveys are analyzed separately. We then split



**Table 2** Summary statistics

Variable		Full Sample (3,505 obs)	Black (228 obs)	White (3,277 obs)
Median (mean) mortgage rate	basis points	600 (622)	650 (684.7)	600 (617.7)
Median loan amount	\$1,000	120	105	120
Median borrower income	\$1,000	70	57	72
Median Debt service-to-income ratio (%)		27.0	32.8	26.3
Median net wealth	\$1,000	172.0	88.0	189.9
Median liquid wealth	\$1,000	6.1	3.3	6.5
Sample proportions (Percent)				
ARM	Yes	16.7	11.0	17.1
	No	83.3	89.0	82.9
Loan Term	30 years	58.7	71.0	57.8
	15years	21.5	12.6	22.2
	Others	19.8	16.4	20.0
Loan-to-value ratios (purchase)	LTV<=80	45.1	20.6	47.3
	80<LTV<=95	22.6	25.4	22.4
	LTV>95	32.3	54.0	30.3
Refinance		63.3	52.0	64.1
Education	College educated	61.0	46.1	62.1
	High School educated	19.5	28.4	18.8
	Others	19.5	25.5	19.1
Credit Applications rejected in last 5 years	No	77.1	50.1	79.0
	Yes	16.4	33.1	15.2
	No credit record	6.5	16.8	5.8
Bankruptcy	Yes	9.1	16.6	8.6
	No	90.9	83.4	91.4
Shopping Behavior	By recommendation	25.5	31.8	25.1
	By search lowest rate	40.3	27.4	41.2
	Other reasons	34.2	40.8	33.7
Sample components				
2001 Survey of Consumer Finance		27.9	31.0	27.7
2004 Survey of Consumer Finance		38.7	35.1	39.0
2007 Survey of Consumer Finance		33.3	33.9	33.3

Data source: Survey of Consumer Finance.



**Table 3** Rates and the differences between black and white borrowers (basis points)

Data	All	black	White	Difference	P-value of the Difference
Full sample (3,505 obs)	622.0	684.7	617.7	67.0	0.0001
2001 SCF (979 obs)	728.2	774.6	724.6	50.0	0.0001
2004 SCF (1,357 obs)	561.0	633.4	556.5	76.9	0.0001
2007 SCF (1,169 obs)	604.0	655.4	600.4	55.0	0.0001
All borrowers					
"High Rate" Group	716.9	762.2	712.8	49.4	0.0001
"Low Rate" Group	527.2	549.6	526.1	23.5	0.0001
All Women					
"High Rate" Group	751.7	794.5	739.2	55.3	0.0001
"Low Rate" Group	527.2	559.0	547.9	11.1	0.0670
All Men					
"High Rate" Group	711.7	750.6	709.1	41.5	0.0001
"Low Rate" Group	524.6	549.3	523.6	25.7	0.0001

the sample into two halves – a High Rate group and a Low Rate group separating at the median rate. On average, blacks pay 49.4 and 23.5 basis points more than whites, respectively for the High and Low Rate groups, which remain statistically significant. Lastly, we divide the sample into Men versus Woman, and repeat the High vs. Low Rate group analysis. Among women borrowers, blacks pay on average 55.3 basis points higher than whites in the High Rate group. But in the Low Rate group the difference is much smaller (11.1 basis points) and also less significant (p-value 0.067 vs. 0.0001). Among men borrowers, blacks pay significant higher rates regardless whether they are in the Low or High Rate group.

Overall, interest rate disparity between black and white appears to be rather persistent, and is only slightly impacted by gender difference. These significant racial differences warrant further examination in which a multitude of borrower and mortgage characteristics are being properly controlled.

### Regression Analysis

In this section we estimate three regression models to which the groups of independent variables are to be gradually added to control various aspects of borrower characteristics, mortgage features, shopping behaviors, gender, year of origination, lending institutions, etc. In addition to the full sample analysis, we also use quantile regression and analyzes men and women separately. The

dependent variable for all regressions is the mortgage interest rate, and race is the independent variable of primary interest.

## Model Specifications

### *Model 1 Control for Race and Mortgage Features*

We begin with the basic set of controls that are standard to include in many mortgage pricing models. More specifically, we estimate the following regression

$$\text{Rate} = \alpha + \beta_1 \text{Race} + \beta_2 \text{refi} + \beta_3 \text{ARM} + \beta_4 \text{Term} + \beta_5 \text{LTV} + \beta_6 \text{DtoIncm} + \beta_7 \text{LtoIncm} + \beta_8 \text{rejection} + \beta_9 \text{Bkrupt} + \beta_{10} \text{Lender} + \beta_{11} \text{Year} + \varepsilon \quad (1)$$

where Rate is the interest rate (in basis points) on mortgage originated by a certain household. Race is a dummy variable to indicate white or black borrowers. Refi is a dummy variable to indicate whether the loan is for purchase or refinance. ARM is a dummy variable which equals to 1 if the loan is an adjustable rate mortgage and zero otherwise. Term refers to the maturity of the loan, which indicates whether the term of the loan is 15-year, 30-year, or others. LTV indicates whether the loan-to-value ratio of the mortgage is less than 80%, 80 – 95%, or higher than 95%. DtoIncm denotes the debt service-to-income ratio, and LtoIncm is the loan-to-income ratio. Because of these two variables, the income level is not included. Rejection indicates if the borrower has ever been rejected any credit application in the past five years prior to the survey or has no previous application record. Bkrupt is another dummy variable which indicates if the borrower ever filed bankruptcy before. These two variables indicate the borrower's credit quality in the absence of a more direct measure of credit history. Similar measures are used by Charles et al. (2008) to capture borrowers' credit worthiness in a study on racial disparity in automobile financing rates. In addition, the type of lending institution (Lender) is included to control for the source of financing. Charles et al. (2008) finds black borrowers exhibit strong tendency in using certain type of financing companies for automobile purchase, and they suggest such tendency is strongly correlated to the observed racial disparity in car loan interest rates. Finally, since interest rates change over time, the year of loan origination (Year) should also be controlled for.

### *Model 2 Control for Borrower Characteristics*

The second model expands the controlling variables to include borrower's wealth, age and education. Specifically, we estimate

$$\text{Rate} = \alpha + \beta_1 \text{Race} + \beta_2 \text{refi} + \beta_3 \text{ARM} + \beta_4 \text{Term} + \beta_5 \text{LTV} + \beta_6 \text{DtoIncm} + \beta_7 \text{LtoIncm} + \beta_8 \text{rejection} + \beta_9 \text{Bkrupt} + \beta_{10} \text{Lender} + \beta_{11} \text{Year} + \beta_{12} \text{NetWrth} + \beta_{13} \text{LiqWrth} + \beta_{14} \text{Age} + \beta_{15} \text{Age}^2 + \beta_{16} \text{Edu} + \varepsilon \quad (2)$$

where NetWrth and LiqWrth indicate borrower's wealth level. These variables are typically not available from loan level data of lending institutions, but are reported in the SCF data. In addition, we include borrower's age as it is an important demographic variable. Since age is often found to have non-linear impact on mortgage pricing, we

also include the age square. Finally, Edu indicates the borrower's highest education level, which are college, high school, or below high school. Education level is used to proximate the financial literacy of the borrower, as Lusardi and Mitchell (2006, 2008) suggests that financial literacy has strong impact on individual's financial decisions.

### *Model 3 Examine the Effect of "Shopping Behavior"*

The third model attempts to control for the impact of borrowers' shopping behavior on mortgage rates. Research in behavioral finance and consumer psychology has shown that the effort in search for complex products (such as mortgage) is rewarded by the market – the more complex the products, the more rewarding to search. Given that the mortgage market is inefficient due to the heterogeneity of people and products, it stands to reason that good search effort may be more beneficial for some mortgage products than for others. In fact, a recent study on gender disparity in mortgage rates by Cheng et al. (2011) find that men and women differ significantly in how they choose loans and lenders. Whereas most men select their lenders based on who offers the lowest rates, a large portion of the women simply deal with lenders recommended to them by other people. They find such behavioral difference can effectively explain the gender disparity in mortgage rates, where the traditional variables had failed. Hinged on the notion that the effect of search depends on the complexity of the product, we include a cross-effect variable, shopARMrefi, to capture the interaction among search behavior, mortgage type (ARM or Fixed-rate), and purpose of loan (Purchase or refinance). Specifically, we estimate:

$$\begin{aligned} \text{Rate} = & \alpha + \beta_1 \text{Race} + \beta_2 \text{refi} + \beta_3 \text{ARM} + \beta_4 \text{Term} + \beta_5 \text{LTV} + \beta_6 \text{DtoIncm} + \\ & \beta_7 \text{LtoIncm} + \beta_8 \text{rejection} + \beta_9 \text{Bkrupt} + \beta_{10} \text{Lender} + \beta_{11} \text{Year} + \\ & \beta_{12} \text{NetWrth} + \beta_{13} \text{LiqWrth} + \beta_{14} \text{Age} + \beta_{15} \text{Age}^2 + \beta_{16} \text{Edu} + \\ & \beta_{17} \text{shopARMrefi} + \varepsilon \end{aligned} \quad (3)$$

For the new cross-effect variable, Shop has three categories to indicate if the borrower's lender choice is based on search for the lowest rate, or based on recommendation by others, or based on other reasons. These other reasons may include convenient lending office location, multiple services under-one-roof, previous business relationship, low service fees, perception of easy-to-qualify, or no-choice (assumption of existing mortgage or financing through builders who have contracted lenders), etc. Since ARM and refi each has two categories, the variable shopARMrefi thus captures 12 ( $3 \times 2 \times 2$ ) interactive effects. Because of the cross-effect variable, the individual variable ARM and refi in Model 2 are removed.

### Full Sample Regression Results

Table 4 displays the full sample regression results. Race is the primary variable of interest. As indicated in Model 1, for mortgages of comparable features, black borrowers on average pay 31.13 basis points more than white borrowers when debt ratios and credit quality are controlled. This difference is both statistically and economically significant. Not surprisingly, bankruptcy and prior credit rejection exhibit pronounced effects on mortgage rates. The signs of all other variables are as expected. For instance,

**Table 4** Full-sample regression results

Variables	Category/value	Model 1		Model 2		Model 3	
		Coefficient	t-Stat.	Coefficient	t-Stat.	Coefficient	t-Stat.
Intercept		744.85	19.56	762.10	19.65	762.73	20.25
Race	Black	31.13	11.76	30.75	11.66	28.94	11.02
ARM	Yes	-19.36	-8.30	-17.93	-7.69		
Term	15 years	-20.17	-7.75	-17.82	-6.86	-17.68	-6.85
	30 years	10.51	4.84	11.46	5.25	11.64	5.35
Refi.	Yes	7.73	3.38	10.58	4.45		
LTV	<=80%	-7.44	-2.52	-2.22	-0.74	-1.03	-3.24
	80 - 95%	3.87	1.23	6.13	1.96	7.30	1.50
Debt-service-to-income ratio		69.12	15.24	65.25	14.41	65.01	14.41
Bkruptcy	Yes	20.19	7.95	18.10	7.01	18.85	7.34
Rejection	No	-25.52	-8.09	-25.57	-8.09	-24.26	-7.72
	Yes	17.07	4.88	15.41	4.35	14.45	4.10
Net wealth	\$100,000			-0.08	-2.13	-0.08	-1.98
Liquid wealth	\$10,000			-0.15	-2.31	-0.13	-2.05
Borrower Age				-1.47	-3.69	-1.39	-3.51
Borrower Age <sup>2</sup>				0.014	3.57	0.013	3.28
Edu	Below high School			22.14	11.43	20.63	10.69
	High School			11.32	5.76	9.65	4.94
shopARMrefi	Recommend-FRM-purchase					9.39	1.62
	Search-FRM-purchase					-12.04	-2.09
	Other-FRM-purchase					14.91	2.56
	Recommend-FRM-refi					-9.26	-1.89
	Search-FRM-refi					-13.40	-2.80
	Other-FRM-refi					-3.71	-0.77
	Recommend-ARM-purchase					17.56	2.17
	Search-ARM-purchase					-58.42	-7.54
	Recommend-ARM-refi					-13.03	-1.86
Search-ARM-refi					-67.28	-10.37	
Year (of loan origination)	Yes				Yes	Yes	
Lending Institution	Yes				Yes	Yes	
R <sup>2</sup>		34.8%			35.5%	36.6%	
Number of Observations		3,505			3,505	3,505	

Data Source: Survey of Consumer Finances. The base (omitted) class of some of the multi-class categorical variables are: "White" in Race, "others" in Term, "LTV>95%" in LTV, "never applied" in Rejection, "college" in Edu . There are two base categories in variable shopARMrefi, which are "Other-ARM-purchase" and "Other-ARM-refi"

ARM has a negative coefficient of -19.36, suggesting ARMs' tends to have lower interest rates than comparable fixed-rate mortgages. Similarly, 30-year mortgages tend to have higher interest rates than 15-year loans. Interest rates on loans with LTV below 80% tend to have lower interest rate than those with LTV higher than 80% or above.

Model 2 adds borrower wealth, age and education into the regression, in addition to all the variables in Model 1. It can be seen that the coefficient of Race is reduced slightly from 31.13 to 30.75, suggesting the racial discrepancy in rates to be rather persistent and statistically significant. Both the borrower's net worth and liquid wealth exhibit rather significant coefficients with the correct (negative) signs. The Age variable also appears to have a significant impact on mortgage rates. Other things being equal, higher age is correlated to lower rates. The level of education is also significant. Compare to those with college educations, borrowers with only high school education tend to pay 11.32 basis points more in interest rates, and those with less than high school degree pays even higher – 22.14 basis points more. The effect is even bigger than having a prior bankruptcy. The coefficients of all other independent variables remain stable with similar magnitudes and correct expected signs.

Model 3 adds the cross-effect variable of *shopARMrefi* to the control variables. The coefficients of this cross-effect variable do seem to illuminate the impact of shopping behavior on mortgage rates. For example, for borrowers who seek ARM for purchase, those who search for the best rates are likely to pay 58.42 basis points less than the base category borrower. On the other hand, those who select ARM based on recommendation are likely to pay 17.56 basis points more than the base category borrowers. The difference between the two behaviors is an astonishing 75.98 basis points! This is a huge interest rate gap by any measure of the mortgage market. Virtually identical gap exists for refinance as well. In comparison, for fixed-rate mortgages (FRM), borrowers who search for the lowest rates still pay less than those rely on recommendation. But the difference is only 21.44 basis points, much smaller than the gap for ARMs. These results suggest that searching for the lowest rates is much more beneficial for borrowers who choose adjustable rate mortgages, regardless of whether it is for purchase or refinance. Given that ARMs are inherently more complex with a lot more customizable features than the conventional fixed-rate mortgages, this finding makes sense as it is consistent with the notion that search is more valuable for complex products.

But despite the cross-effect shopping behavior being significant at most levels of interactions with ARM and refi, it does little to explain away the racial disparity of interest rates. The coefficient of Race is only slightly lowered from 30.75 in Model 2 to 28.94 in Model 3, and remains statistically significant. That is, after all variables are controlled for, racial discrepancy in mortgage rates remain remarkably stable and persistent at around 29 – 31 basis points in favor of white borrowers.

An interesting inquiry at this point would be to see where the racial discrepancies are concentrated among black borrowers. That is, do all the black borrowers pay higher rates or only certain groups of borrowers are vulnerable? To answer this question, we conduct a three-step residual analysis: First, we use the full sample data to re-run Model 3 with the Race variable being excluded. As a result, the effect of Race will be captured in the residual. We then filter out the white borrowers and keep only the estimated residuals of black borrowers. Next, we divide these black borrowers by three age groups (below 30, 30-49, and above 50) and two education levels (college and no-college). In addition, we also split the sample into two halves – a High Rate group and a Low Rate group separating at the median rate. Finally, we regress the residual on two cross-effect variables – Gender(rate group) and Age(education) and obtain the results in Table 4A.

**Table 4A** Impact of gender, age, and education on racial discrepancy

Variables	Coefficient	T-Stat.
Intercept	-69.34	-6.72
Gender(rate group)		
Female, high rate group	169.86	16.25
Female, low rate group	7.74	0.67
Male, high rate group	108.41	11.72
Age(Education)		
<30year, no college	37.97	2.75
30-49yrs, no college	-5.23	-0.54
50+, no college	8.62	0.79
<30yrs, college	7.92	0.48
30-49yrs, college	-3.22	-0.32
R <sup>2</sup>	26.2%	
Number of Obs.	228	

Note: The sample include only black borrowers. The dependent variable is the residual from Model 3 without the Race variable. The base category for Age (Education) is 50+yrs of age with college degree. The base category for Gender(rate group) is Male-low rate group

The cross effect of gender and rate group indicates both male and female borrowers in the high rate group are overwhelmingly subject to disparate rate treatment, with female borrowers suffer even more than male borrowers. This is consistent with alleged lender behavior in the afore-mentioned Wells Fargo case where minority borrowers are deliberately steered into subprime loans with higher interest rates. Charles et al. (2008)) also reported a similar finding that automobile shoppers who fail to qualify for lower interest car loans are more likely to receive disparate treatment from lenders. The cross-effects of age and education suggest that racial discrepancies in mortgage rates are most concentrated among younger black households without a college education. This result also confirms a recent finding in Bayer et al. (2013)) that young borrowers with low levels of education face a higher incidence of high cost loans relative to young borrowers who have completed college.

### Diagnosis of Multi-collinearity

When a regressor is nearly a linear combination of other regressors in the model, the estimates for a regression model may not be uniquely computed. This problem is called co-linearity or multicollinearity. The primary concern is that as the degree of multicollinearity increases, the regression estimates of the coefficients become less accurate and the standard errors for the coefficients can be inflated. If this problem is present in our analysis, the model may fit the data, but the coefficients cannot be interpreted. Therefore, to demonstrate a lack of collinearity or remove it is important when interpreting the coefficient on the “Race” variable.

There are many ways to detect multicollinearity. We use the most common approach to calculate the variance inflation factor (VIF) by following Belsley et al. (1980). Table 5 is the summary of multicollinearity diagnostics. Belsley et al. (1980) suggest

**Table 5** Diagnosis of multi-collinearity

Variables	Category/value	Model 1		Model 2		Model 3		
		Tolerance	VIF	Tolerance	VIF	Tolerance	VIF	
Race	Black	0.95	1.06	0.95	1.06	0.94	1.06	
ARM	Yes	0.97	1.04	0.95	1.05			
Term	15 years	0.59	1.69	0.58	1.71	0.58	1.72	
	30 years	0.58	1.73	0.56	1.77	0.56	1.79	
Refi.	Yes	0.39	2.59	0.35	2.84			
LTV	<=80%	0.47	2.13	0.44	2.27	0.37	2.70	
	80 - 95%	0.63	1.58	0.63	1.59	0.51	1.96	
Debt-income-ratio		0.99	1.01	0.88	1.14	0.88	1.14	
Bkruptcy	Yes	0.93	1.08	0.89	1.12	0.89	1.12	
Rejection	No	0.33	3.02	0.33	3.07	0.32	3.08	
	Yes	0.33	3.06	0.32	3.16	0.31	3.18	
Net wealth	\$100,000			0.83	1.21	0.83	1.21	
Liquid wealth	\$10,000			0.93	1.08	0.92	1.08	
Borrower Age				0.22	4.61	0.22	4.64	
Borrower Age <sup>2</sup>				0.22	4.47	0.22	4.52	
Edu	Below high School			0.88	1.14	0.87	1.15	
	High School			0.89	1.12	0.89	1.13	
shopARMrefi	Recommend-FRM-purchase					0.57	1.74	
	Search-FRM-purchase					0.48	2.07	
	Other-FRM-purchase					0.64	1.57	
	Recommend-FRM-refi					0.47	2.11	
	Search-FRM-refi					0.21	4.84	
	Other-FRM-refi					0.18	5.57	
	Recommend-ARM-purchase					0.20	0.20	
	Search-ARM-purchase					0.26	3.90	
	Recommend-ARM-refi					0.18	5.46	
	Search-ARM-refi					0.21	4.84	
	Year of loan origination		Yes		Yes		Yes	
	LendingInstitution		Yes		Yes		Yes	
	R <sup>2</sup>			34.8%		35.5%		36.6%
	Number of Observations			3,505		3,505		3,505

that if the VIF is around 10 or less (or Tolerance is around 0.10 or higher), the multicollinearity issue should not be of great concerns. However, if the VIF is larger than 100 (or Tolerance is lower than 0.01), the estimates should have a fair amount of numerical error and the multicollinearity issue must be addressed. Since VIF numbers in our regression models are all within the range of 1- 10, and the VIF numbers for the race variable "Black" for all models is around 1, we conclude that there should be no multicollinearity issue in our regression models.



## Quantile Regressions

Given the persistent racial disparity in mortgage rates found in the full-sample analysis, we want to take a closer examination of the issue at subsample levels to see if the disparity is more significant for certain group of borrowers. Charles et al. (2008)) finds that most of the racial disparity in interest rates in the automobile market occurs in quantiles above the median. Similar to their approach, we estimate Model 3 for quantile regressions at the median, twenty-fifth percentile, and seventy-fifth percentile. The results are shown in Table 6. For brevity, we only report the Race coefficients without listing the detailed coefficients of all other variables.

Table 6 indicates that racial disparity of mortgage rates is significant in all percentiles, but it is much more pronounced in the median and seventy-fifth percentile. On the one hand, these results suggest the racial disparity is perhaps widespread and not limited to certain groups of borrowers. On the other hand, black borrowers who presumably cannot qualify for interest rates in the lower percentile are likely to pay a much higher premium than white borrowers in the same group. The higher the percentile, the larger the rate disparity. At seventy-fifth percentile, for example, blacks on average pays nearly 36.7 basis points more than white borrowers in the same group. For a typical \$200,000, 30-year fixed-rate mortgage issued at 4.5% for white borrowers, the additional 0.367% interest rate charge means \$44.07 extra payment per month and \$15,867 additional interest costs over the life of the loan for the black borrowers. To put this finding in context with previous research on the mortgage application stage, if black applicants face a higher rejection rate, they are positively selected with respect to the population of their race. It is plausible to believe that black borrowers tend to have better credit worthiness than white borrowers who are charged the same interest rate (or in the same percentile). In other words, the rate disparity could have been bigger than what is shown in Table 6 if the black and white borrowers were equally credit-worthy.

**Table 6** Quantile regression results – full sample

Race	25th Percentile		Median		75th Percentile	
	Coefficient	T-Stat.	Coefficient	T-Stat.	Coefficient	T-Stat.
Black	5.57**	2.04	13.82***	5.58	36.69***	10.54
Controls						
Mortgage features	Yes		Yes		Yes	
Borrower characteristics	Yes		Yes		Yes	
Shopping behavior (shopARMrefi)	Yes		Yes		Yes	
Year of origination	Yes		Yes		Yes	
Lending institution	Yes		Yes		Yes	

\*\*significant at the 0.05 percent level; \*\*\* significant at the 0.01 percent level

## Racial Disparity by Genders

Next we conduct the same quantile regressions (using Model 3) for men and women borrowers separately. The results are displayed in Tables 7 and 8. For male borrowers, we see that the racial disparity is significant across all percentiles, and the largest disparity is again in the seventy-fifth percentile. For female borrowers, the results are more noteworthy. As Table 8 shows, in the low rate group (twenty-fifth percentile), the rate disparity for black women is small and insignificant. However, the disparities in the other two groups (the median and seventy-fifth percentiles) are much higher for black women than for black men. In the seventy-fifth percentile, for example, black women on average are charged 57.36 basis points than their white counterparts, which is much higher than the 19.30 extra basis points that black men are charged over white men (Table 7). This result is interesting in light of the findings of Cheng et al. (2011), which finds no gender disparity in mortgage rates. So if it is plausible to assume there is no rate disparity between white men and white women, then the results in Tables 7 and 8 could suggest that disparity may exist between black men and women in the higher rate groups (i.e. the median and seventy-fifth percentiles). This is a finer point (i.e. disparate gender treatment in certain groups of borrowers) that was not revealed by the earlier study. In summary, our analysis thus far indicates that, other things being equal, black borrowers pay higher interest rate than their white counterparts. Quantile regression further reveals that the rate disparity is significant across all rate groups, but the magnitudes of the rate disparity vary – it is much higher in the high rate group (e.g. the seventy-fifth percentile) than it is in the low rate group (the twenty-fifth percentile). This suggests that black borrowers whose credit and other characteristics disqualify them for lower interest rates tend to receive much bigger disparate treatment. Such disparate treatment, however, seems to be disproportionately borne by black women. As Tables 7 and 8 indicate, unless they qualify for the lowest rate group (twenty-fifth percentile), black women are likely to be charged rate premiums that are 2 to 3 times that of what black men would be charged. Such high rate premium is likely to put the black women at significantly disadvantageous positions in the long run.

**Table 7** Quantile regression for men

Race	25th Percentile		Median		75th Percentile	
	Coefficient	T-Stat.	Coefficient	T-Stat.	Coefficient	T-Stat.
Black	8.05**	2.52	8.90***	4.20	19.30***	4.40
Controls						
Mortgage features	Yes		Yes		Yes	
Borrower characteristics	Yes		Yes		Yes	
Shopping behavior (shopARMrefi)	Yes		Yes		Yes	
Year of origination	Yes		Yes		Yes	
Lending institution	Yes		Yes		Yes	

\*\*significant at the 0.05 percent level; \*\*\* significant at the 0.01 percent level

**Table 8** Quantile regression for women

Race	25th Percentile		Median		75th Percentile	
	Coefficient	T-Stat.	Coefficient	T-Stat	Coefficient	T-Stat
Black	1.90	0.34	26.47***	5.05	57.36***	11.78
Controls						
Mortgage features	Yes		Yes		Yes	
Borrower characteristics	Yes		Yes		Yes	
Shopping behavior (shopARMrefi)	Yes		Yes		Yes	
Year of origination	Yes		Yes		Yes	
Lending institution	Yes		Yes		Yes	

\*\*\* significant at the 0.01 percent level

## Conclusions

Existing literature on racial discrimination in mortgage lending has overwhelmingly focused on whether black loan applicants are more likely to be denied for credit than comparable white loan applicants. This study investigates whether the successfully approved black applicants are likely to be charged higher interest rates than their white counterparts. Using data from three waves of the U.S. Consumer Finance Survey, our results indicate that, after careful control of the observed mortgage features, borrower characteristics, consumer shopping behaviors, and types of lending institutions, black borrowers on average pay about 29 basis points more than comparable white borrowers. But closer examination reveals significant disparity among black borrowers. Specifically, much of such racial discrepancy is concentrated among younger black borrowers without college education. Quantile regression further reveals that the discrepancy is significantly higher for those borrowers who fail to qualify for the best interest rate (the twenty-fifth percentile) perhaps due to age, education, and other characteristics. But for those who make into the low rate percentile, the racial disparity is somewhat more modest in economic sense, though remain statistically significant. Separate analysis of male and female borrowers reveals more interesting insights. On the one hand, we find significant racial disparity between black and white borrowers across all rate groups regardless their genders. On the other hand, black women seem to receive more severe disparate treatment than black men relative to their white counterparts, especially those black women who fail to qualify for the lowest interest (the twenty-fifth percentile). The results suggest that, while the racial disparity in mortgage rates is widespread between black and white borrowers, it is the more financially vulnerable black women who suffer the most. The excessive premium this group of women must pay for long term credit is almost certainly going to put them into even more vulnerable financial conditions in the long run.

Our finding also provides additional insight into the issue of gender discrimination in mortgage lending that was studied in Cheng et al. (2011). Although that study has concluded that there is no significant gender disparity in mortgage rates, the current finding suggests that such gender disparity may still exist among certain groups of black borrowers, namely those borrowers whose income and credit disqualify them from receiving the best interest rates. To these borrowers, it is possible that the lending system is neither race- nor gender-blind. This, of course, would be a worthy topic for future and more nuanced investigations.

Finally we should point out that the SCF data only reports interest rates on mortgages but contains no information about discount points. It is well known that there is a trade-off between interest rates and discount points in the mortgage market. Other things being equal, lower interest rates are associated with higher discount points. Therefore, interest comparisons among different borrowers should control for the discount points. That being said, given the fact that there has been no empirical evidence suggesting that black and white exhibit different preferences with regard to choosing discount points, the inclusion of discount points would not likely to have altered the findings of this paper.

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