Borrowers from a different shore: Asian mortgage market outcomes

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Abstract: Even though Asians are the largest minority group participating in United States mortgage markets, research on differences in underwriting and pricing outcomes in mortgages typically focuses on the outcomes of African American/Black or Latino/Hispanic borrowers. One explanation for this lack of attention on Asian outcomes follows from the relative economic prosperity of this minority group, which may lead to the belief that they are not in need of consumer protection. While simple group averages support this belief, many researchers claim that the heterogeneity of Asian experiences dictates the use of other measures to account for the varied outcomes of Asian Americans. Using public and private sources of lender data, we examine these issues in U.S. mortgage markets. We find that Asians face challenges in mortgage markets in ways that may be unique as compared to other minority groups. While an examination of unadjusted average denial rates indicates favorable outcomes for Asians compared to other minority groups, we find that after accounting for loan and borrower characteristics, Asians have the highest denial rates among minority groups.

Keywords:
Mortgage markets, Asians, minority borrowers, discrimination

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1. Introduction

A robust housing finance literature focuses on whether minority borrowers have experienced differential outcomes in mortgage markets as compared to non-Hispanic white ("NHW") borrowers. Historically observed disparities motivated policy initiatives to protect minority borrowers, highlighted differences in the resources and constraints across borrowers with different races and ethnicities, and impelled litigious and regulatory responses. The minority groups examined in research studies or in regulatory supervisory reviews generally include African American/Black ("African American or AA") or Hispanic/Latino borrowers ("Hispanic").[1] The experiences of Asian American borrowers receive less attention, even though this group of borrowers represents a substantial share in mortgage markets.

Asians applied for and obtained a larger share of purchase money mortgages than either African American or Hispanic borrowers in recent years, measured in both number and dollars.[2] This pattern has existed for some time, particularly in heavily Asian geographies.[3] In a recent study released by the Federal Reserve Board ("FRB"), economists found that "across racial or ethnic groups, the largest increase in home-purchase loan activity was experienced by Asians and non-Hispanic whites; the number of home-purchase loans extended to borrowers in each of these groups increased about 15 percent, while lending to blacks and Hispanic whites increased at a rate of less than half this value."[4] Asians, moreover, already have relatively high homeownership rates (see Table 1), and, while now only about 5 percent of the U.S.

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[1] Throughout we refer to African American/Black as African American and Hispanic/Latino as Hispanic. The Home Mortgage Disclosure data on which we rely for our analyses includes African American or Black in the same category and Hispanic or Latino in the same category.

[2] This is based on conventional, 1-4 family and manufactured home dwellings from Home Mortgage Disclosure Act ("HMDA") data, available at: http://www.ffiec.gov/hmda/hmdaproducts.htm.

[3] See Dymski and Mohanty, 1999

[4] See Canner and Bhutta, 2013.

population, Asians were the fastest-growing racial or ethnic group in the country in 2012 (Census, 2013).[5]

Table 1. Homeownership Rates by Race and Ethnicity of Householder[6]

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
U.S. total	65.4%	65.7%	66.3%	66.8%	67.4%	67.8%	67.9%	68.3%	69.0%	68.9%	68.8%	68.1%	67.8%	67.4%	66.9%
White	69.1	69.3	70.0	70.5	71.1	71.6	71.8	72.1	72.8	72.7	72.6	72.0	71.7	71.4	71.0
NHW	71.7	72.0	72.6	73.2	73.8	74.3	74.5	75.4	76.0	75.8	75.8	75.2	75.0	74.8	74.4
Black	44.1	44.8	45.6	46.3	47.2	47.4	47.3	48.1	49.1	48.2	47.9	47.2	47.4	46.2	45.4
Other race	51.0	52.5	53.0	53.7	53.5	54.2	54.7	56.0	58.6	59.2	59.9	59.2	58.5	57.8	57.0
Am. Ind. Aleut, Esk.	51.6	51.7	54.3	56.1	56.2	55.4	54.6	54.3	55.6	58.2	58.2	56.9	56.5	56.2	52.3
Asian or Pacific Islander	**50.8**	**52.8**	**52.6**	**53.1**	**52.8**	**53.9**	**54.7**	**56.3**	**59.8**	**60.1**	**60.8**	**60.0**	**59.5**	**59.3**	**58.9**
Hispanic	42.8	43.3	44.7	45.5	46.3	47.3	48.2	46.7	48.1	49.5	49.7	49.7	49.1	48.4	47.5
Non-Hispanic	67.4	67.8	68.3	68.9	69.5	69.9	70.0	70.8	71.5	71.2	71.2	70.5	70.3	69.8	69.4

The lack of research and regulatory attention for Asian borrowers may mean the unique challenges faced by Asian borrowers are not well understood, leading to less targeted support for Asians in the housing market. While consumer protection laws include Asians as a protected class, the lack of attention may result in Asians receiving less consumer protection

[5] See http://www.census.gov/newsroom/releases/archives/population/cb13-112.html, last accessed October 17, 2013.

[6] The homeownership rate is the percentage of homeowning households among all households in the given demographic group. Source: U.S. Census Bureau. Web: www.census.gov.

than other groups.[7] A likely hypothesis for the diminished focus on Asian American borrowers follows from their perceived relative economic success compared to other minority groups in the U.S. Empirical support exists for this hypothesis, with average household incomes and education levels typically found to be higher for Asians in the US than for other groups.

Table 2. U.S. Education and Income, by Race/Ethnicity[8]

Educational Attainment: % with Bachelor's Degree or More, ages 25 and older, 2010	
U.S. Population	28
Asians	49
Whites	31
Blacks	18
Hispanics	13
Median Household Income, 2010	
U.S. Population	$49,800
Asians	$66,000
Whites	$54,000
Blacks	$33,000
Hispanics	$40,000

Earlier studies of discrimination in lending have rarely found evidence that Asian Americans would be denied mortgage loans more often than non-Hispanic whites.[9] Researchers have also found that Asian borrowers are less likely to have subprime loans as compared to African

[7] For example, the Equal Credit Opportunity Act ("ECOA") of 1974 prohibits discrimination in credit markets on the basis of race, color, or national origin, among other factors. See 15 USC 1691.

[8] See Pew Research Center, 2012, at 2.

[9] See Turner and Ross, 2002.

Americans or Hispanic borrowers.[10] As credit distributions for Asian Americans mirror those of non-Hispanic whites, not much evidence of pricing differentials has been found historically.[11]

Further examination of Asian American experiences in the mortgage market is merited, however. Earlier studies using experimental methods provide evidence of challenges Asians face in the housing market.[12] For example, using a matched paired testing strategy, Turner and Ross (2003) find that Asian homebuyers faced discrimination in areas such as housing availability and assistance with financing that exceeded that faced by Hispanic homebuyers and at a level comparable to that faced by African American homebuyers.

Most discrimination studies rely on a research methodology that compares the average outcomes among minority and NHW groups, but these methods may not well capture the heterogeneity of Asian American experiences. Because of differences across key factors such as time since immigration and country of origin, many believe that the successful socioeconomic outcomes of Asian Americans reflect only selected groups, producing a bi-modal economic distribution.[13] In this way, the positive experiences of a relatively small number of elite Asians bias average statistics upwards, whereas the bottom of the distribution suffers disadvantages comparable to the similarly situated members of other minority groups. Some advocates have claimed that the focus on mean outcomes, as well as social constructions such as the "model minority myth," have led to Asians having an overstated perception of success and a resultant lack of social service targeting.

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[10] See Courchane, Surette and Zorn, 2004.

[11] See Canner and Bhutta, 2013 for a discussion of credit bureau information by race.

[12] See Freddie Mac, 2005, for differences among groups of Asian borrowers and challenges facing potential homebuyers.

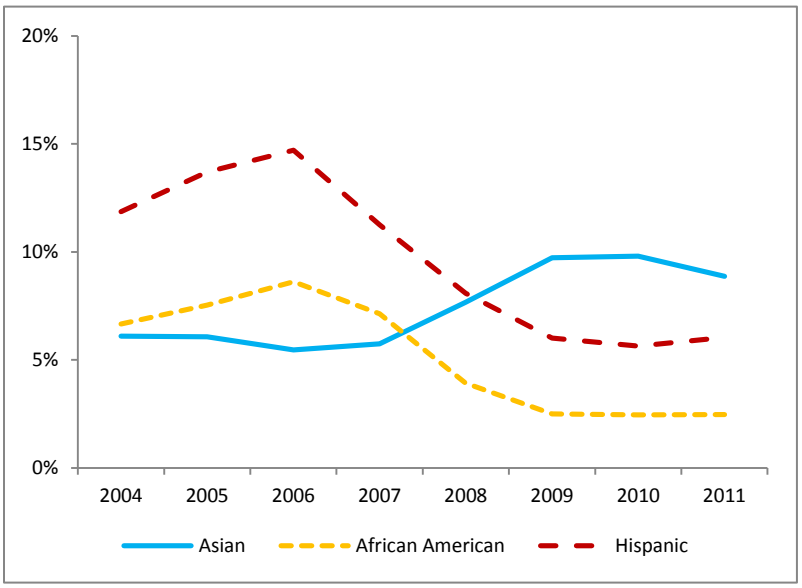
[13] See Fong, 2008, Ishimatsu, 2013 and National CAPACD, 2013.

In this paper, we examine the experiences of Asians in U.S. mortgage markets. Using public data and unique private lender data, we test for differences in the price level (as measured by mortgage annual percentage rates) and approval rates compared with other racial and ethnic groups, while controlling for key economic factors such as credit worthiness or type of loan product. As well, we analyze differences based on the racial composition of borrowers' neighborhoods. We pay particular attention to the question of whether outcomes differ at different points in the distribution of various economic measures.

2. Asian Borrowers in the Mortgage Market

Asian borrowers are the largest minority group participating in the mortgage market in recent years. In Figure 1, we display the share of origination volume (based on the count of loans) for borrowers in the mortgage market who identify themselves as Asian, African American or Hispanic borrowers from 2004-2011. Trends for origination dollars, application volumes, and application dollars are quite similar. From 2004 until 2007, Asians had the lowest number of originations among the displayed minority groups. The share for African Americans and Hispanics grew as house prices grew and the development of the subprime market offered more options for home mortgages. However, as housing prices declined, leading to a collapse of subprime lending and tightening of credit standards, Asians have grown to comprise the largest minority group share of application and origination dollars (since 2008) and application and origination loan counts (since 2009).

Figure 1: Share of HMDA Originations for Minority Borrowers[14]



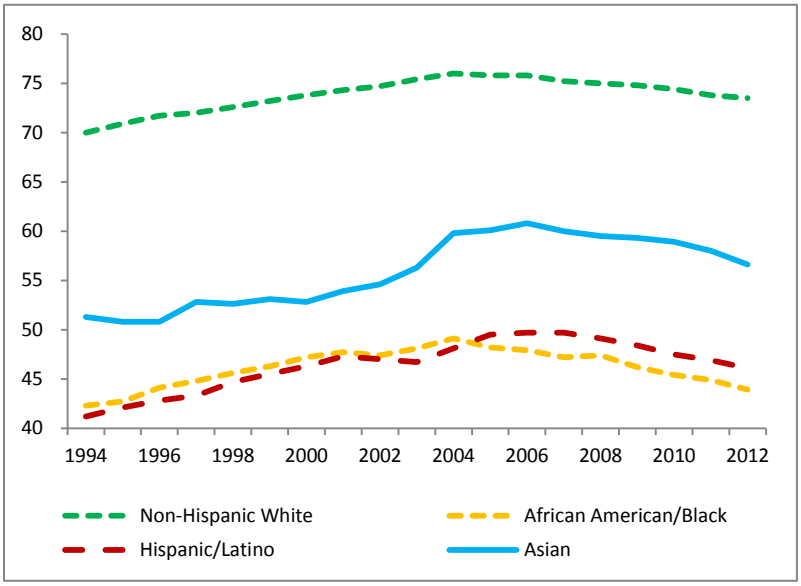
We focus on mortgage market outcomes in this study, but note that participation rates in the mortgage market reflect preferences for both homeownership and debt. In addition, differences in mortgage market participation may also reflect disparities in wealth, education, and financial literacy or market experiences such as discouragement to apply for a mortgage. Based on findings from focus groups, Freddie Mac (2005) found that Asians generally expressed an aversion to debt, with a need to feel financially stable, and a preference for fully understanding the home buying and financing process before buying homes. These observations suggest that Asians may be relatively cautious before entering the mortgage market. The Freddie Mac report also revealed distinct preferences among respondents from different countries of origin.

We display home ownership rates by race/ethnicity in Figure 2 form 1994-2012. Here, we observe that even though Asian borrowers may be relatively cautious when considering

[14] This is based on data from HMDA, for 1-4 family, owner-occupied, purchase money loans.

borrowing, this group nonetheless had the highest home ownership rates among minority groups, with this gap growing in the recent decade.

Figure 2: Home Ownership Rates 1994-2012[15]



Asian Americans clearly have a large share of the housing market, and an increasing share of the mortgage market. Given this, the lack of focus on Asians as a group may reflect several competing explanations. For example, it is possible that Asian Americans are less likely to report any overt discrimination than other minority groups. [16] Under-reporting of potentially discriminatory behavior makes it less likely that action will be taken to correct any abuse and limits the attention drawn to the issue. Other research describes the lack of nationally

[15] Data from U.S. Census.

[16] See AAPIPRC, 2012 at 1 and Kim, 2011. Kim reviews discrimination in the employment context.

recognized Asian issue advocates or Asians in prominent leadership positions that can raise awareness about struggles and campaign for targeted Asian issues.[17]

In Asian studies literature, a much maligned explanation for the lack of attention is the "model minority myth," which suggests that Asian Americans are "too successful" to be regarded as disadvantaged. The characterization of Asians as a "model minority" is frequently traced back to media stories highlighting how Asians were able to experience relative vocational and economic success, due to characteristics such as a strong work ethic, frugality, and family values, as for example, in "Success Story of One Group in the US" (US News & World Report, 1966). This rhetoric extended into the public sphere as well, with President Ronald Reagan claiming that Asians espouse American "bedrock values" of America, including "community spirit and the responsibility of parents and schools to be teachers of tolerance, hard work, fiscal responsibility, cooperation, and love" (Reagan, 1984).

Research indicates that the social construction of groups can affect policy targets and design (e.g., Schneider and Ingram, 1993). Being viewed as more economically prosperous or successful than other races or ethnicities may have led to some social privilege benefits for Asians, however, these positive stereotypes can negatively impact social services provided, including the need for housing supports. Wu (2002) summarizes this concern, "although everyone claims to have no wish to compare suffering in a contest of victims, Asian-Americans are presumed to be unaffected by significant prejudice, or, at worst, deprived to a much lesser degree than African-Americans and Hispanics are…It seems almost offensive to raise Asian-American concerns except appended as a matter of last priority."

[17] See Lai et al., 2001 and Wu, 2002.

The Asian model minority stereotype has many detractors. Some of the issues reflect empirical observations such as the geographic distribution and household composition of Asians. For example, Asians tend to have more household members, and therefore more wage earners, on average, leading to higher household incomes that may not reflect higher per person outcomes. While average total household incomes are almost $12,000 higher for Asian than for non-Hispanic white households in the U.S. (Pew, 2012), Asian incomes per capita are about 93 percent of non-Hispanic whites (AAPIPRC, 2012).[18] When comparing average incomes in the ten metropolitan areas with the highest number of Asian residents, Asian incomes per capita are about 71 percent of those of non-Hispanic Whites (AAPIPRC, 2012).

Researchers in the Asian American and Pacific Islander Policy Research Consortium (AAPIPRC, 2012) voiced the need to understand the challenges facing diverse Asian American communities in response to a recent report highlighting the success of Asian Americans, claiming that the use of aggregate statistics and broad characterizations "falls short of examining tremendous and critical differences among Asian ethnic groups…[T]he study could lead policymakers, the media and the public to draw conclusions that reflect inaccurate stereotypes about Asian Americans being only a community with high levels of achievement and few challenges ."[19]

Another problem is that the sensationalized "rags-to-riches" stories of a select few Asian Americans can perpetuate a belief that all Asians experience prosperity, masking the struggles of many Asians. By only examining average outcomes, Asian Americans may appear to be relatively high achievers, while differences among groups within the Asian American population remain unrecognized. Time since immigration and country of origin are two variables which

[18] The 2012 Pew Report (at 3) states that Asians compared to all other U.S. adults have higher median annual household income ($66,000 versus $49,800) and higher median household wealth ($83,500 vs. $68,529).

[19] See AAPIPRC, 2012 at 1.

may have historically led to a bi-modal distribution, but recently there is little difference between native born and recent immigrant Asians.[20] The heterogeneity of Asian American groups has induced researchers in other contexts, such as labor markets, to call for more research on the relative outcomes of Asian ethnic subgroups.[21]

In the panels of Figure 3, we display differences across U.S. residents by Asian countries of origin for 2010 median household incomes, home values, and home ownership rates. There is substantial variation in these metrics. Residents with countries of origin of Myanmar and Thailand have median incomes of almost $20,000 less than the all Asian median, while those with origins in India have median incomes over $30,000 more than the all Asian median. The median Indian household, therefore, will be expected to face a different set of financial constraints than the median Thai household when considering housing finance options. The second panel of Figure 3 shows differences in median home values for different countries of origin. Here, surprisingly, those with origins from South Korea and Myanmar, two groups with relatively low median incomes, have among the highest median house prices. The highest median home value among Asian subgroups belongs to the Chinese.

[20] See Pew Report (2012) at 10.

[21] See Altonji and Blank, 1999.

Figure 3a: 2010 Median Household Income, Difference from All Asian Median

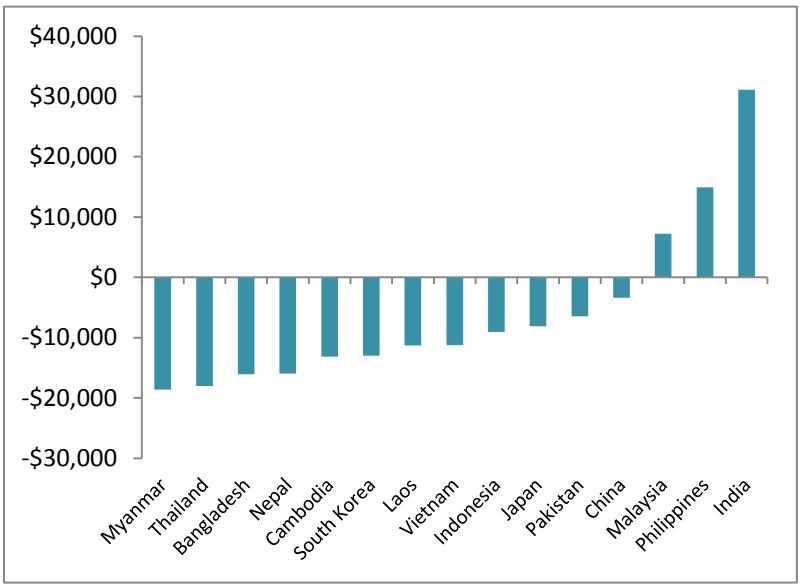
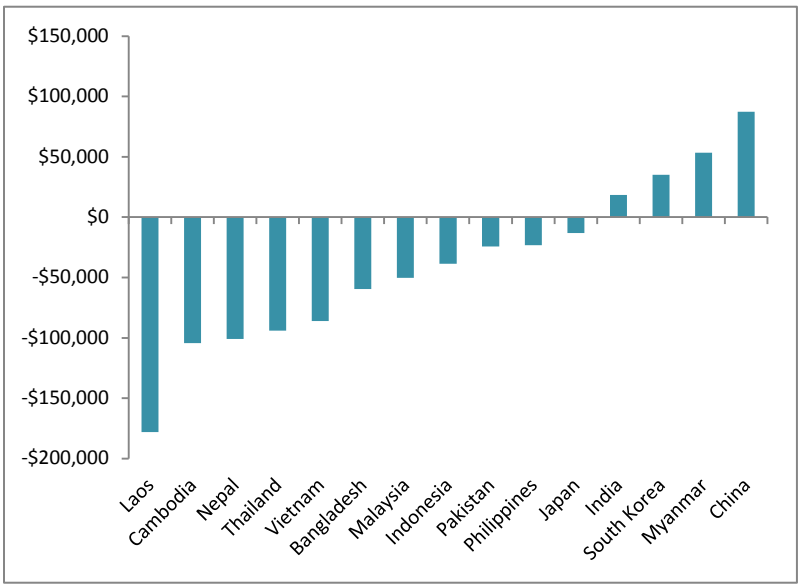
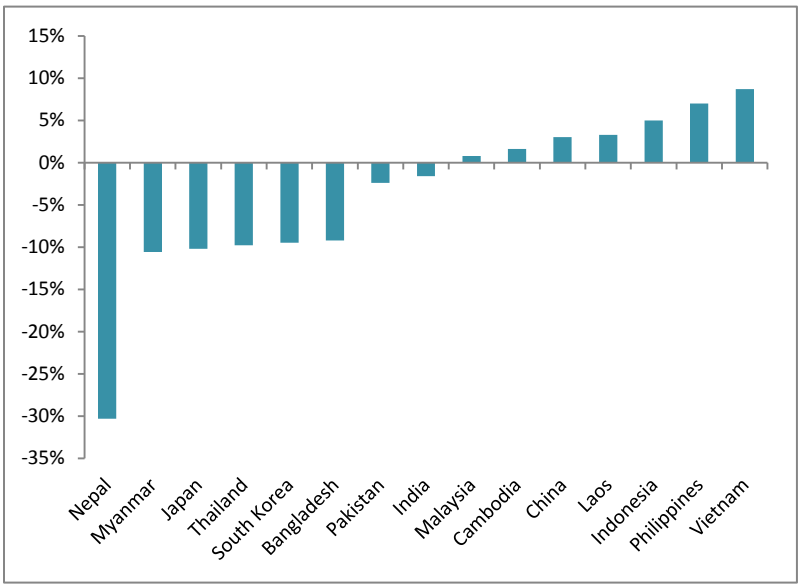


Figure 3b: 2010 Median Home Value, Difference from All Asian Median



Homeownership differences are presented in panel (c) of Figure 3, by country of origin.

Figure 3c: 2010 Home Ownership Rate, Difference from All Asian Races[22]



With high rates of immigration, a broad distribution by Asian country of origin around income, home values, and homeownership, and increasing rates of mortgage market participation, understanding whether Asians are impacted by potential discrimination in credit markets matters. The discrimination may take the form of taste-based discrimination (e.g., Becker, 1971) or it may be demonstrated by statistical discrimination (e.g., Arrow, 1972; Phelps, 1972). Positive social construction in terms of being perceived as highly educated and reflecting American values may lead to less expected taste-based discrimination against Asians compared to other minority groups. On the other hand, anti-Islamic sentiments generically held by some about all Asian groups have prompted a rise in anti-Asian sentiment in communities and other contexts.[23] This would be expected to increase taste-based discrimination for at least some Asian subgroups.

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[22] Source: US Census Bureau, 2010 American Community Survey 1-Year Estimates.

[23] See SAALT, 2010.

The relatively positive social construction of Asians may also influence the statistical discrimination behavior of creditors. Statistical discrimination is often considered "rational," since it is related to information costs rather than animus. Because acquiring information on the default risk of each prospective borrower is costly, lenders may employ forms of statistical discrimination if they rely on group-level indicators of repayment probability. If Asian repayment signals are, on average, positive because of high average incomes and economic achievement, then this would be expected to advantage Asian borrowers. Conversely, noisy signals because of the relatively heterogeneous repayment indicators of the Asian borrower group would be expected to increase default risk and therefore credit market costs.

Only a few studies have included Asians explicitly when studying discrimination in mortgage markets. Calem et al. (2004) looked at whether Asians (and other minority groups) were more likely to receive subprime mortgage products. They found mixed evidence depending on whether they defined Asian as a percent of Census tract population or as individual borrower race. Turner and Ross (2004) found evidence of discrimination in mortgage markets when engaging in matched pair testing of Asians. Specifically, they found that "Asians and Pacific Islanders face significant levels of discrimination when they search for housing in large metropolitan areas nationwide…. Asian and Pacific Islander homebuyers experience *consistent adverse treatment* 20.4 percent of the time, with systematic discrimination occurring in housing availability, inspections, financing assistance, and agent encouragement. This level of discrimination is comparable to the level experienced by African American homebuyers, and significantly higher than the level of discrimination against Hispanics."[24] Canner and Bhutta find that Asians were much less likely to receive higher priced loans or to be denied for

[24] See Turner and Ross (2004) at iii.

mortgage loans than were African Americans or Hispanics.[25] The outcomes observed from these last authors, however, were not adjusted for loan or borrowers characteristics controls.

3. Data and Methodology

Our analysis uses proprietary loan level records from a number of mortgage lenders over the 2004 to 2012 period which is aggregated to protect confidentiality. These data contain information on many fields critical for conducting analyses of pricing and underwriting decisions, but not available in public data sources, such annual percentage rate ("APR"), credit score, debt-to-income ("DTI") ratio, loan term, documentation type, amortization type, and loan-to-value ("LTV") ratio. We restrict data to 1-4 family, purchase money, conventional loans.

The race/ethnicity of borrower comes from data these lenders report as part of HMDA compliance. Borrowers are identified by all races/ethnicities they report; therefore, borrowers can be included in multiple minority groups. For example, a borrower who reports as both African American race and Hispanic ethnicity would be coded as both African American and Hispanic in the data. Non-Hispanic white borrowers have reported no other race than white and no other ethnicity except "not Hispanic or Latino."

We include in Table 3 summary statistics for the sample. Asians represent about 6% of the borrowers in our data, with African Americans comprising about 8% and Hispanics about 12%. The remaining borrowers are non-Hispanic white, comprising about 74% of our sample. Most mortgages are 30 year term, and the average LTV ratio is just above 80%. Credit scores over the period average 712, lower than typical by 2013. We include about 29% adjustable rate

[25] See Canner and Bhutta, 2013, Table 13 at 61.

mortgages ("ARM") with 65% known to be fixed term ("FRM"). The remainder have unknown term.

Table 3. Summary Statistics

Borrower/Loan Characteristic	Mean	Standard Deviation
Denial Rate	11.52%	0.32
APR	7.03	1.77
Asian	6.34%	0.24
African American	7.78%	0.27
Hispanic	12.26%	0.33
Credit Score	711.58	66.90
LTV	81.08	14.06
Loan Term	29.23	4.43
DTI	37.38	13.46
Full Documentation	39.72%	0.49
Limited/No Documentation	36.91%	0.48
Unknown Documentation	23.37%	0.42
ARM	28.79%	0.45
Balloon	0.10%	0.03
Fixed Rate	65.39%	0.48
Amortization Type Unknown	5.72%	0.23
Year	2006.79	1.71

Next, in Table 4, we examine the distributions of key factors that can affect mortgage outcomes across races/ethnicities. We find that the average and the range of values for the key characteristics of Asians closely resemble that of the NHW group. Asians have relatively higher credit scores, lower DTI ratios, and lower LTV ratios than the other minority groups. Notably, the 75th percentile of LTV for Asian borrowers was 80%, indicating that relatively fewer Asian borrowers obtained loans with LTVs greater than 80 percent. This is consistent with the focus groups studied by Freddie Mac, which indicated Asians were less comfortable with taking on debt and more interested in making larger down payments. The credit scores likely also reflect

this behavior, over time. The resulting lower average APR for Asians reflects their higher credit worthiness and more conservative mortgage behavior.

Table 4. Distributions of Key Variables

Borrower/ Loan Characteristic	Race/Ethnicity	Mean	Percentiles 10th	25th	50th	75th	90th	IQR
APR	Asian	6.62	5.24	5.94	6.48	7.09	7.84	1.15
	African American	8.38	6.08	6.76	7.69	10.05	11.77	3.29
	Hispanic	7.75	5.92	6.59	7.32	8.50	10.79	1.91
	Non-Hispanic White	6.82	5.13	6.00	6.59	7.28	8.63	1.28
DTI	Asian	37.14	22.30	31.17	38.76	44.70	49.74	13.53
	African American	40.89	26.54	34.30	41.70	47.76	52.79	13.46
	Hispanic	39.88	26.74	34.26	40.71	46.00	50.42	11.74
	Non-Hispanic White	36.59	20.45	29.00	37.61	44.78	50.63	15.78
Credit Score	Asian	729	661	698	734	770	791	72.00
	African American	661	575	610	657	710	758	100.00
	Hispanic	691	611	648	693	736	772	88.00
	Non-Hispanic White	720	627	678	729	773	795	95.00
Income	Asian	116,667	44,000	61,000	91,000	140,000	208,000	79,000
	African American	79,011	31,000	42,000	60,000	90,000	134,000	48,000
	Hispanic	92,435	36,000	50,000	74,000	109,000	157,000	59,000
	Non-Hispanic White	103,055	35,000	49,000	74,000	114,000	181,000	65,000
LTV	Asian	78.61	65.00	78.49	80.00	80.00	90.00	1.51
	African American	86.56	79.65	80.00	83.00	97.17	100.00	17.71
	Hispanic	83.37	75.00	80.00	80.00	92.49	100.00	12.49
	Non-Hispanic White	80.38	62.96	79.74	80.00	90.00	100.00	10.26

In the last column of this table, we display the interquartile range ("IQR").[26] We see mixed evidence of the dispersion of Asian economic characteristics in our sample. Asian borrowers have the relatively tightest distribution of credit scores, as well as LTV ratios. Income IQR is largest for Asians, however, with the range 20% wider than non-Hispanic whites, over 30% wider than Hispanics, and over 60% wider than African Americans. At each percentile,

[26] IQR measures the difference between the values of the 75th and 25th percentiles.

however, Asians have relatively the highest income. Therefore, while we find evidence of relative heterogeneous Asian incomes, in our sample, we observe relatively high incomes for applicants in this group at various points in the distribution.

We examine whether the probability of denial and price of credit (as measured by APR) differ for Asian borrowers, after accounting for available factors that can affect these outcomes. We begin our analysis by regressing these outcomes, y, on an indicator for identifying as Asian, *AS*, vectors of other races/ethnicities, and a vector of covariates, X, including loan and borrower characteristics that can affect the outcome.

$$y_{its} = \alpha + \beta AS_i + \gamma_1 RE_i + \gamma_2 X_i + d_t + d_s + \varepsilon_{its} \quad (1)$$

Here, *i* indexes borrower, *t* indexes year, and *s* indexes state. We include vectors of dummy variables to account for variation in the outcome common across years, d_t, and common across states over time, d_s. We estimate the model of APR using OLS and can interpret the fitted parameter on our outcome of interest, β, as the effect of being Asian on the outcome, holding other factors constant. For the binary outcome of being denied or not, we estimate a logit model based on equation (1) and report the average marginal effects of key variables.

In order to examine whether Asian borrowers at different income levels face differential experiences in mortgage markets, we add interactions of Asian or the other minority races/ethnicities with five income levels, I_τ (0 - ≤$50K, $50 - ≤$100, $100 - ≤$150k, >$150k), with estimated parameters δ_τ and θ_τ for τ equal to one to five.

$$y_{its} = \alpha + \sum_{\tau=1}^{5}\{\delta_\tau(AS_i \times I_\tau) + \theta_\tau(RE_i \times I_\tau) + I_\tau\} + \beta AS_i + \gamma_1 RE_i + \gamma_2 X_i + d_t + d_s + \varepsilon_{its} \quad (2)$$

We interpret the parameter estimates δ_τ as the marginal effect of being Asian in each income category, as compared to non-Hispanic white outcomes for that same income category.

Finally, we examine outcomes based on neighborhood level racial/ethnicity composition, rather than individual level race/ethnicity. We substitute a vector of the proportion of Asian residents in the tract from different Asian countries of origin, T_A, for the individually reported Asian indicator and include a vector of the proportion of African American and Hispanic residents in the tract, T_{RE}.

$$y_{itsg} = \alpha + \omega_1 T_{Ag} + \omega_2 T_{REg} + \gamma X_i + d_t + d_s + \varepsilon_{its} \qquad (3)$$

Here, g indexes tract and ω_1 and ω_2 are parameter estimate vectors. We interpret our outcome of interest, ω_1, as the marginal effect of being a borrower from a neighborhood with an increasing proportion of residents from that specific Asian country of origin.

4. Findings

We begin with an examination of unadjusted relationships between outcomes and race. In Figures 4 and 5, we display the denial rates and average APRs for minority borrowers from 2004 to 2011. Across all years, non-Hispanic white borrowers had the lowest denial rates, followed by Asians, then Hispanic, and African American borrowers.

Figure 4: Denial Rates 2004-2011[27]

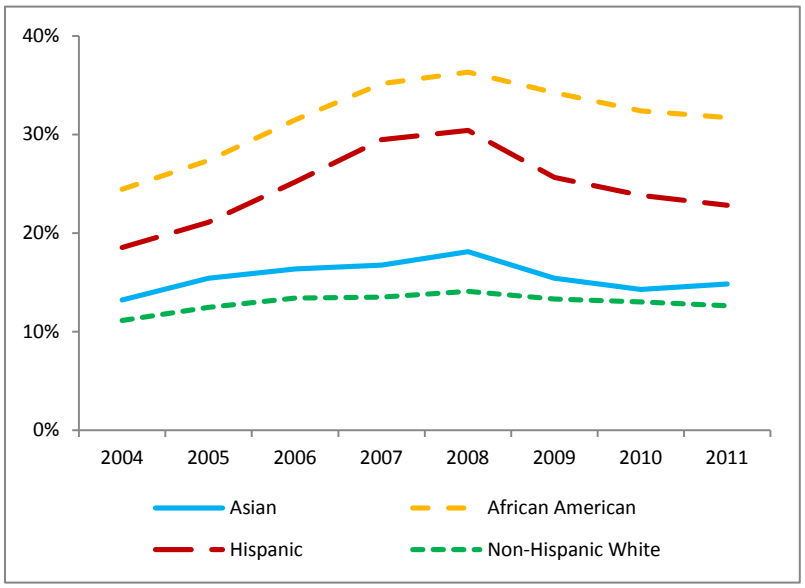


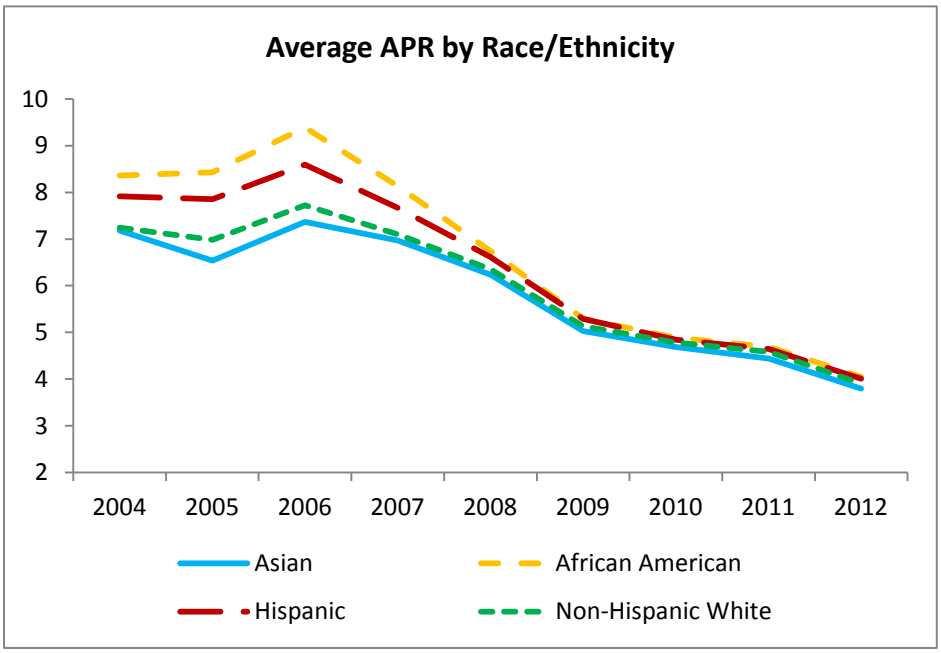
Figure 5 includes the distributions by race/ethnicity of APR over the period from 2004 – 2012. The relative position is similar in the examination of average APR. As now well known in the industry, with the tightening of credit standards, borrowers with riskier profiles and lower credit scores are simply unable to obtain mortgage loans. In earlier years, these borrowers would have received higher priced loans reflecting risk-based pricing. As the risk profiles become more similar over time, resembling the better credit worthiness, on average, of borrower as lenders prepare to meet newer standards imposed by Dodd Frank legislation, the differences become negligible across race/ethnicity categories.

These unadjusted metrics, of course, should not be interpreted as evidence of discrimination by lenders, as they do not account for the many factors that affect denial and APR. Nonetheless,

[27] Source for denial rates: HMDA data, 1-4 family, owner-occupied, purchase money loans.

they provide evidence that, when comparing overall averages, Asians appear to have more positive outcomes relative to Hispanic and African American borrowers, but disadvantageous relative to non-Hispanic Whites.

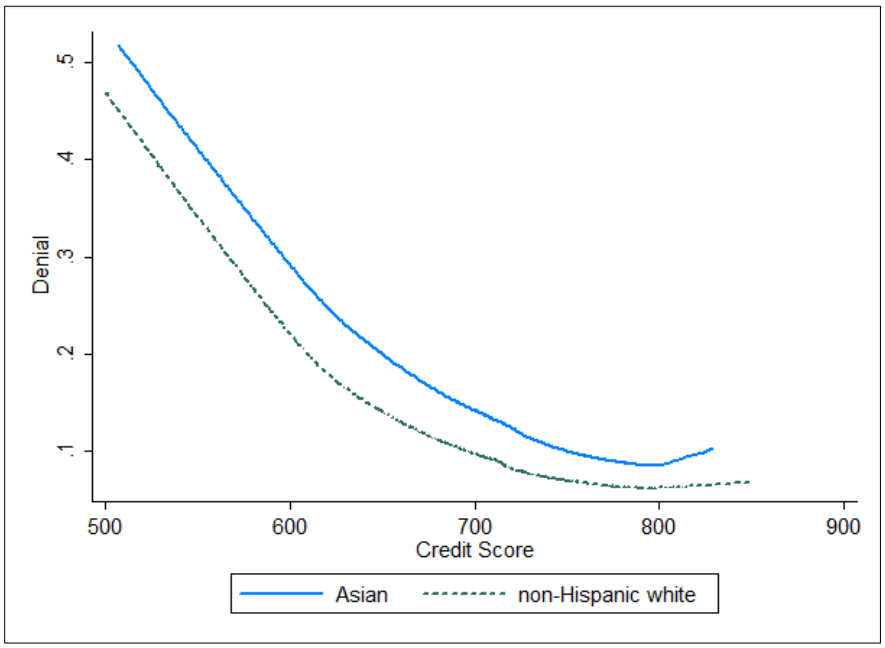
Figure 5: Average APR 2004-2012[28]



As expected, the difference between APRs and denial rates of Asians and NHW borrowers reflect, in part, differences in credit quality. In Figures 6a and 6b, we plot locally weighted (lowess) curves of the relationship between credit score (on the x-axis) and denial rate or APR (on the y-axis) respectively. We observe that over the entire distribution, for similar credit scores, Asians are more likely to be denied than non-Hispanic white borrowers, with some convergence of the lines at high credit scores near 800.

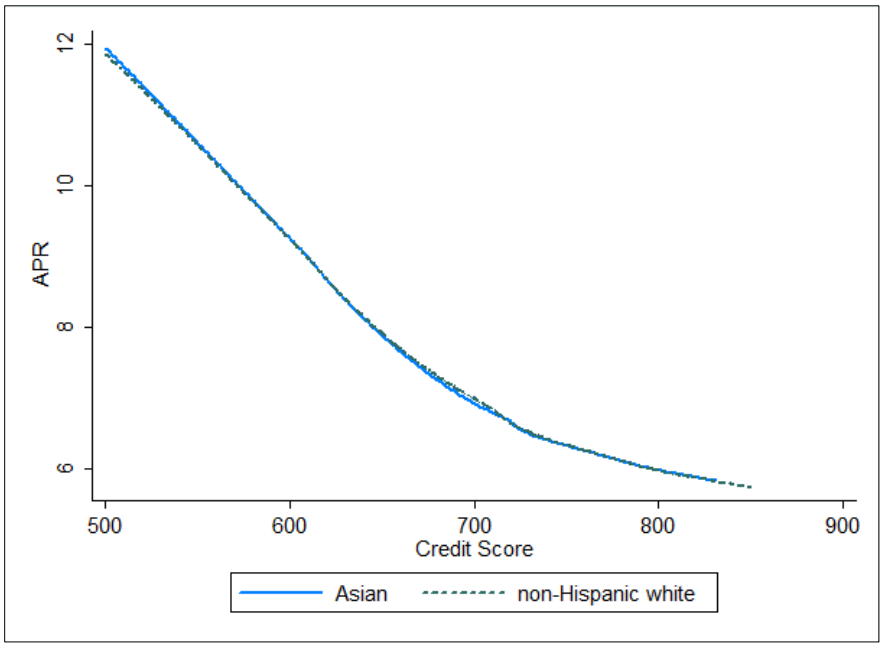
[28] Source for APR: proprietary lender database.

Figure 6a: Lowess Fits – Denial & Credit Scores



We observe no difference in the distribution of APR by credit score. For reasons that cannot be well explained when we examine only a bi-variate relationship with credit scores, we find that regardless of Asians being denied more often given similar credit scores, once Asians are approved for mortgage loans, they are priced nearly identically to those received by NHW borrowers with similar credit scores. This suggests that the denial reasons are not credit score related, alone, and may reflect other factors such as verification of income or assets, type of loan requested, among other possible factors.

Figure 6b: Lowess Fits – APR and Credit Scores



We next consider findings from our regression estimates. In Table 5, we display average marginal effects and p-values from our analysis of underwriting. Here, the dependent variable for the binary outcome equal one if the applicant is denied and zero otherwise.

Column 1 provides an estimate of the marginal effects from the model that includes race and ethnicity but no other controls. We observe that the probability of being denied is higher for each of the minority groups in the model, as compared to non-Hispanic white applicants. Though higher than the probability of denial of non-Hispanic whites, Asian applicants have a relatively lower probability of denial (2.1%) compared to Hispanic (6.6%) and African American (8.2%) applicants. This reflects the relatively advantageous average credit scores and socioeconomic characteristics we observe for this group.

After adding a robust set of controls for loan and economic factors that can affect underwriting decisions, we improve the ability of the model to correctly predict the actual underwriting

decision as the pseudo R-squared increases from 0.01 to 0.41. Lender specific models, which allow for adjustment to specific lender based underwriting standards, predict better than models with aggregation. However, most of the variables perform as one would expect in our aggregated model. We find that borrowers are more likely to be denied as LTV and DTI ratios increase. Denial probabilities are also increased when the loan product lacks full documentation (usually this means income or assets or employment were not verified at the time of approval). The shorter the loan term, the less likely the loan was to be denied. Credit score controls are included as linear splines, such that the interpretation of coefficients on these terms are the marginal effect of a one point change in credit score on underwriting denial in that range. In each range, increasing credit scores decreased the probability of denial, and coefficients suggest that a 100 point increase in credit score (about 1.5 standard deviations) decreases denial probability by about 1%.

We observe different relationships between race and denial once we add loan and borrower characteristics. While all minority groups continue to have a relatively higher probability of denial when compared to non-Hispanic whites, the conditional probabilities of denial for Hispanic and African American applicants (1.4%) become slightly lower than the probability for Asian applicants (1.7%). Thus, while average Asian underwriting outcomes at first appear advantageous compared to other minority groups, Asians fare worse when comparing similarly situated applicants.[29] This is consistent with findings from empirical analyses of Asian labor market outcomes that indicate that Asian Americans have relatively low returns to their educational investments.[30]

[29] By similarly situated, we mean that we have controlled for loan type, LTV, credit and other factors in the determination of the underwriting decision.

[30] For example, see Hirschman and Wong, 2004.

Table 5: Analysis of Underwriting by Race/Ethnicity

Loan/Borrower Characteristic	Comparison Group	Raw Model		Credit Model	
		Marginal Effect	p-value	Marginal Effect	p-value
		(1)	(2)	(3)	(4)
Asian	Non-Hispanic white	0.021	0.000	0.017	0.000
Hispanic		0.066	0.000	0.014	0.000
African American		0.082	0.000	0.014	0.000
LTV ≤ 60	60 < LTV ≤ 80			-0.012	0.000
80 < LTV ≤ 85				0.016	0.000
85 < LTV ≤ 90				0.017	0.000
90 < LTV ≤ 95				0.026	0.000
95 < LTV ≤ 100				0.007	0.000
100 < LTV				0.210	0.000
Term ≤ 10	20 < Term ≤ 30			0.244	0.000
10 < Term ≤ 15				0.026	0.000
15 < Term ≤ 20				0.023	0.000
30 < Term				0.000	0.906
Credit Score Spline to 580	NA			-0.001	0.000
Credit Score Spline 580 to 640				-0.001	0.000
Credit Score Spline 640 to 700				-0.001	0.000
Credit Score Spline Above 700				-0.001	0.000
38 ≤ DTI < 50	DTI < 38			-0.003	0.000
50 ≤ DTI				0.092	0.000
DTI Missing/Unknown				0.038	0.000
Full Documentation	Low Documentation			-0.028	0.000
Unknown Documentation				0.235	0.000
ARM	Fixed Rate Mortgage			-0.007	0.000
Balloon				0.086	0.000
Unknown Amortization Type				0.243	0.000
Pseudo R-Sq.		0.0135		0.41	
# of Observations		675,479		675,314	

Source: Private lender data from 2004-2012. Models used to estimate results in column (3) include lender, year, and state controls.

In Table 6, we provide the marginal effects from the underwriting model, by race and ethnicity at different income levels. We find that Asians are about as likely to be denied as African Americans at the lowest income level, but at the $100-$150k level, they are more likely to be

denied than any other minority group. At the highest income level, this result reverses, with Asians less likely to be denied.

Table 6: Analysis of Underwriting by Race/Ethnicity for Different Income Levels

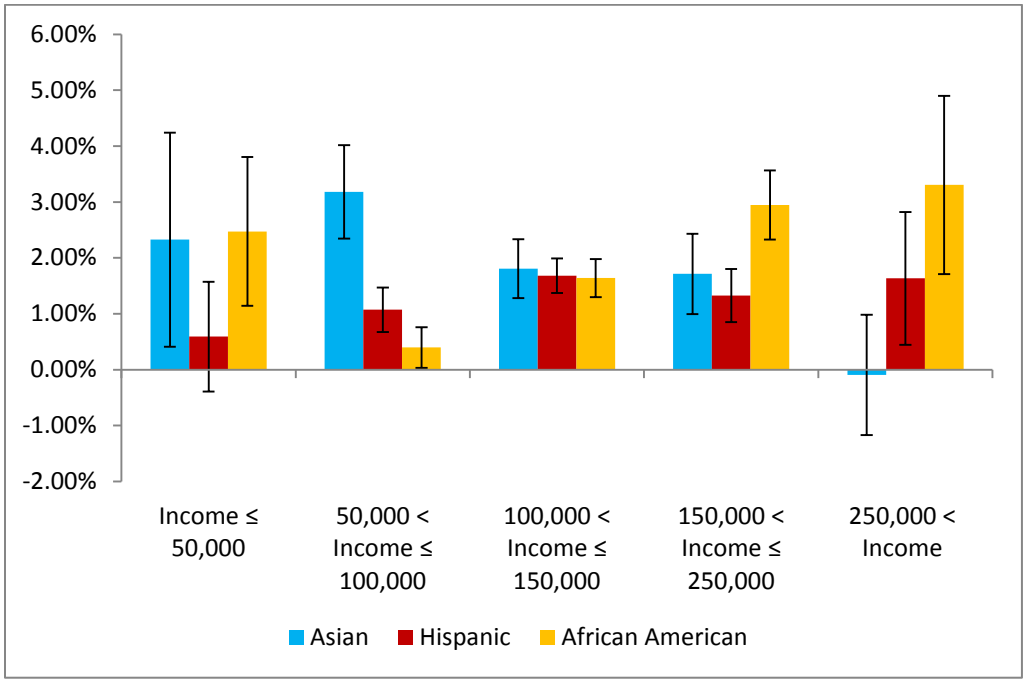
Asian	Marginal Effect (1)	p-val (2)	Min (3)	Max (4)
Income ≤ 50,000	0.023	0.017	0.004	0.042
50,000 < Income ≤ 100,000	0.032	0.000	0.023	0.040
100,000 < Income ≤ 150,000	0.018	0.000	0.013	0.023
150,000 < Income ≤ 250,000	0.017	0.000	0.010	0.024
250,000 < Income	-0.001	0.865	-0.012	0.010
Hispanic				
Income ≤ 50,000	0.006	0.238	-0.004	0.016
50,000 < Income ≤ 100,000	0.011	0.000	0.007	0.015
100,000 < Income ≤ 150,000	0.017	0.000	0.014	0.020
150,000 < Income ≤ 250,000	0.013	0.000	0.009	0.018
250,000 < Income	0.016	0.007	0.004	0.028
African American				
Income ≤ 50,000	0.025	0.000	0.011	0.038
50,000 < Income ≤ 100,000	0.004	0.033	0.000	0.008
100,000 < Income ≤ 150,000	0.016	0.000	0.013	0.020
150,000 < Income ≤ 250,000	0.029	0.000	0.023	0.036
250,000 < Income	0.033	0.000	0.017	0.049

Source: Lender data from 2004-2012. Models used to estimate results include all controls in the underwriting model in Table 5.

Figure 7 provides a graphical depiction of the information in Table 6 in which the distribution of the underwriting model results are presented once the logit regressions are adjusted for the interaction between race/ethnicity and income. The height of the bar for each category represents the average denial rate, given the income category. We find considerable variance across races, within each income category. At incomes from $50k-$100k, Asians are almost three times more likely to be denied than Hispanics or African Americans. In the middle income range, all groups are around 1.5%, but as incomes increase, we find Asians less likely to be denied than other minority groups. This may reflect credit risk or higher downpayments. These

differences across income groups, moreover, suggest that Asians, along with other groups, may face distinct challenges depending on their socioeconomic level.

Figure 7: Underwriting Model Results – with interactions for income levels



We next include the empirical outcomes from the analysis of APR (Tables 7 and 8). This sample is restricted to borrowers with loan originations, excluding any whose applications were denied. For the pricing results, the marginal effects reflect the difference, on average, in basis points between the loan and borrower characteristic and the comparison group characteristic. For race/ethnicity, it provides the average difference in APR paid by a minority group compared to that paid by non-Hispanic whites. Omitted variables that may impact this outcome include channel (retail or wholesale), loan type (conventional or government), market segment (prime or subprime) or verifiable assets, among others.

In Table 7, we find that loans with higher LTV values, longer terms, and lower credit scores result in higher APRs. DTI ratios from 38%–50% also lead to increased pricing on the loan,

relative to loans with DTI ratios less than 38%. The result from ARM is counterintuitive, as ARM pricing generally was lower than pricing on fixed rate loans during this period. As we have no control for subprime loans that were disproportionately ARM loans, however, this outcome may reflect the market segment rather than the specific loan characteristic.

We find, as expected, that African American and Hispanic borrowers paid more, on average, than non-Hispanic whites after controlling for all available factors (displayed in column 3). African Americans had the highest APRs, on average, with a 31 basis point differential when compared to non-Hispanic whites, while Hispanics paid 26 basis points more on average. Asians paid less, on average than non-Hispanic whites, after controlling for factors such as credit score and LTV. This means that either the interaction of factors, or unobservable factors, influence the APR for Asians. Unlike the underwriting results, Asians continue to have relatively favorable pricing compared to the other minority groups after including available loan and borrower characteristics. Therefore, we find evidence that though some Asian applicants may face challenges obtaining mortgages, they are able to obtain relatively low prices for credit after they have been approved.

As in Table 6, we provide the distribution of pricing outcomes, by race and ethnicity for disaggregated categories of income. This table presents effects after controlling for credit variables from Table 7, column 3. We find, as expected, each minority group has the largest share of borrowers in the middle income category ($100 - $150k) with over 40% for each group. Asians have considerably higher percentages in the highest two categories (combined 28.04%), as compared to African Americans (14.31%) or Hispanics (21.14%). The coefficient for the category (e.g. Asian) plus the marginal impact provide the total marginal effect on that group. For example, Asians with incomes no more than $50,000 pay 1.22 basis points less than similar non-Hispanic whites (-0.091 + -0.031). Asians are unusual in that the marginal benefit of being Asian, in terms of pricing, falls with income.

Table 7: Analysis of Pricing by Race/Ethnicity

Loan/Borrower Characteristic	Comparison Group	Raw Model		Credit Model	
		Coeff (1)	p-val (2)	Coeff (3)	p-val (4)
Asian	Non-Hispanic white	-0.237	0.000	-0.163	0.000
Hispanic		0.902	0.000	0.220	0.000
African American		1.534	0.000	0.267	0.000
LTV ≤ 60	60 < LTV ≤ 80			0.017	0.000
80 < LTV ≤ 85				0.308	0.000
85 < LTV ≤ 90				0.417	0.000
90 < LTV ≤ 95				0.635	0.000
95 < LTV ≤ 100				0.704	0.000
100 < LTV				0.747	0.000
Term ≤ 10	20 < Term ≤ 30			-0.397	0.000
10 < Term ≤ 15				-0.145	0.000
15 < Term ≤ 20				-0.045	0.000
30 < Term				0.212	0.000
Credit Score Spline to 580	NA			-0.008	0.000
Credit Score Spline 580 to 640				-0.027	0.000
Credit Score Spline 640 to 700				-0.015	0.000
Credit Score Spline Above 700				-0.001	0.000
38 ≤ DTI < 50	DTI < 38			0.061	0.000
50 ≤ DTI				-0.042	0.000
DTI Missing/Unknown				0.300	0.000
Full Documentation	Low Documentation			-0.013	0.000
Unknown Documentation				-0.522	0.000
ARM	Fixed Rate Mortgage			0.930	0.000
Balloon				-0.018	0.574
Unknown Amortization Type				0.040	0.000
R-Squared		0.0752		0.7269	
# of Observations		1,263,248		1,263,098	

Source: Lender data from 2004-2012. Models used to estimate results in column (3) include lender, year, and state controls. The number of observations differs as more lenders provided pricing than underwriting data.

Table 8: Analysis of Pricing by Race/Ethnicity for Different Income Levels

Loan/Borrower Characteristic	Count	Coeff (1)	p-val (2)	Lower Bound (3)	Upper Bound (4)
Asian	81,904	-0.091	0.000	-0.116	-0.065
Asian Interacted with Income					
Income ≤ 50,000	1,765	-0.031	0.190	-0.077	0.015
50,000 < Income ≤ 100,000	12,078	-0.118	0.000	-0.148	-0.089
100,000 < Income ≤ 150,000	33,253	-0.090	0.000	-0.117	-0.063
150,000 < Income ≤ 250,000	18,234	-0.053	0.000	-0.081	-0.024
250,000 < Income	4,735				
Unknown Income	11,839	-0.026	0.093	-0.056	0.004
Hispanic	152,840	0.033	0.037	0.002	0.063
Hispanic Interacted with Income					
Income ≤ 50,000	4,593	-0.021	0.317	-0.063	0.020
50,000 < Income ≤ 100,000	37,545	0.088	0.000	0.055	0.121
100,000 < Income ≤ 150,000	65,951	0.246	0.000	0.214	0.278
150,000 < Income ≤ 250,000	28,340	0.188	0.000	0.155	0.222
250,000 < Income	3,968				
Unknown Income	12,443	0.055	0.002	0.019	0.090
African American	93,069	0.089	0.001	0.037	0.141
African American Interacted with Income					
Income ≤ 50,000	2,196	-0.025	0.468	-0.092	0.042
50,000 < Income ≤ 100,000	33,458	0.164	0.000	0.110	0.217
100,000 < Income ≤ 150,000	39,389	0.194	0.000	0.140	0.247
150,000 < Income ≤ 250,000	11,505	0.153	0.000	0.097	0.209
250,000 < Income	1,810				
Unknown Income	4,711	0.125	0.000	0.064	0.186
Income ≤ 50,000	31,194	-0.025	0.468	-0.092	0.042
50,000 < Income ≤ 100,000	318,957	0.164	0.000	0.110	0.217
100,000 < Income ≤ 150,000	521,108	0.194	0.000	0.140	0.247
150,000 < Income ≤ 250,000	214,748	0.153	0.000	0.097	0.209
250,000 < Income	60,094				
Unknown Income	116,997	0.125	0.000	0.064	0.186
R-Squared					0.7302
# of Observations					1,263,098

Source: Lender data from 2004-2012. Models used to estimate results include all controls in Table 7. The number of observations differs as more lenders provided pricing than underwriting data.

Aggregating many different subgroups into a single "Asian" category obscures the effects felt by those from different cultures and different countries of origin. Similar complaints have been made by other racial and ethnic groups. For example, Hispanics have often expressed the

differences between those of Hispanic origin compared to those of Latino backgrounds (from Latin American countries of origin) (e.g., Gimenez, 1989). We can clearly see the differences in underwriting and pricing among different groups of Asians in Tables 9 and 10. The underwriting results indicate that the Taiwanese, Indian, Hmong and Korean groups face the highest marginal denial rate, after controlling for other relevant factors (as in Table 5). Nine of the Asian groups have higher estimates of denial rates than African American or Hispanic borrowers, though not all of these results are precisely estimated. Japanese, Indonesian and Malaysians are less likely to be denied than non-Hispanic whites.

Table 9: Analysis of Underwriting by Country of Origin among Asian Applicants

Country of Origin	Average % Among Asians	Marginal Effect (1)	p-val (2)	Lower Bound (3)	Upper Bound (4)
Taiwanese	1.07%	0.060	0.281	-0.049	0.168
Korean	12.12%	0.037	0.001	0.016	0.058
Indian	20.05%	0.036	0.000	0.021	0.051
Hmong	1.32%	0.032	0.072	-0.003	0.067
Bangladeshi	0.27%	0.030	0.753	-0.158	0.218
Cambodian	1.28%	0.029	0.335	-0.030	0.088
Vietnamese	10.87%	0.028	0.001	0.011	0.044
Other Asian	2.26%	0.019	0.545	-0.043	0.081
Pakistani	1.70%	0.016	0.687	-0.062	0.094
African American		0.014	0.000	0.012	0.016
Hispanic		0.014	0.000	0.012	0.016
Chinese (excl. Taiwanese)	20.22%	0.014	0.084	-0.002	0.029
Filipino	17.66%	0.010	0.122	-0.003	0.024
Thai	1.60%	0.005	0.906	-0.081	0.091
Laotian	1.70%	-0.021	0.354	-0.066	0.024
Japanese	7.14%	-0.047	0.003	-0.078	-0.016
Indonesian	0.38%	-0.089	0.476	-0.332	0.155
Malaysian	0.12%	-0.111	0.543	-0.468	0.246
Sri Lankan	0.22%	-0.124	0.460	-0.454	0.205

Source: Lender data from 2004-2011. Models used to estimate results include all controls in the underwriting model in Table 5. African American and Hispanic coefficients are presented for comparison purposes. All comparisons are to non-Hispanic white applicants.

Table 10 highlights the differences in pricing among the groups. We find that Bangladeshi, Indonesian, and Cambodians face considerable higher pricing differentials ranging from 91 basis points (Bangladeshi) to 27 basis points (Cambodian). These groups pay, on average, not only more than non-Hispanic whites, but more than or comparable levels to African American and Hispanic borrowers. In contrast, many groups pay less, on average, with the lowest pricing differentials experienced by those who originate from Malaysia, Taiwan and Pakistan, after controlling for other factors (as in Table 7).

Table 10: Analysis of Pricing by Country of Origin among Asian Applicants

Country of Origin	Average % Among Asians	Coeff (1)	p-val (2)	Lower Bound (3)	Upper Bound (4)
Bangladeshi	0.26%	0.918	0.000	0.434	1.402
Indonesian	0.39%	0.644	0.012	0.139	1.150
African American		0.269	0.000	0.260	0.277
Cambodian	1.48%	0.268	0.000	0.137	0.398
Hispanic		0.221	0.000	0.215	0.228
Thai	1.35%	0.139	0.216	-0.081	0.358
Laotian	1.63%	0.092	0.155	-0.035	0.218
Filipino	18.61%	0.079	0.000	0.047	0.110
Other Asian	1.95%	0.015	0.851	-0.144	0.174
Sri Lankan	0.20%	0.001	0.999	-0.817	0.818
Hmong	1.22%	-0.015	0.777	-0.120	0.089
Japanese	7.97%	-0.059	0.039	-0.115	-0.003
Vietnamese	12.10%	-0.145	0.000	-0.181	-0.110
Indian	18.21%	-0.243	0.000	-0.279	-0.208
Chinese (excl. Taiwanese)	19.23%	-0.343	0.000	-0.378	-0.308
Korean	12.55%	-0.360	0.000	-0.404	-0.316
Malaysian	0.10%	-0.405	0.467	-1.496	0.686
Taiwanese	1.05%	-0.456	0.002	-0.743	-0.170
Pakistani	1.70%	-0.466	0.000	-0.646	-0.286

Source: Lender data from 2004-2011. Models used to estimate results include all controls in the pricing model in Table 7. African American and Hispanic coefficients are presented for comparison purposes. All comparisons are to non-Hispanic White borrowers.

5. Conclusions

Asians are the fastest growing racial or ethnic group in the U.S., and although some research indicates relative conservatism when purchasing homes (Freddie Mac, 2005), this group has relatively high homeownership rates. While Asians comprise the largest minority group in mortgage markets in recent years, research on housing and housing finance outcomes for these borrowers has lagged behind that focused on the challenges facing African Americans and Hispanics. Using a large sample of proprietary lender data from 2004 to 2012, we provide in this study a comprehensive examination of U.S. mortgage market underwriting and pricing outcomes for Asians.

Asians in the U.S. have relatively high average household incomes (Pew Center, 2012) and credit scores, which would be expected to contribute to relatively favorable outcomes in mortgage markets.[31] When examining the average price (APR) Asians pay for mortgages, we find evidence that supports this expectation. Asians not only receive lower annual percentage rates than African and American borrowers in our sample, but also have advantageous pricing (of over 16 basis points) relative to non-Hispanic white borrowers. This result is robust to the inclusion of a number of loan and borrower characteristics expected to affect the pricing of the loan.

Examination of denial outcomes provides a contrary story. Comparing unadjusted group averages indicates that Asians are more likely to be denied than non-Hispanic white borrowers, but less likely to be denied than African American or Hispanic borrowers. Adding loan and borrower characteristics explains a portion of the denial differential for all minority groups, but relatively less for Asians than for the other two groups. In fact, controlling for other factors, our

[31] Authors' calculations based on private lender data used in this study.

results suggest that Asians are most likely to be denied among observed minority groups. Therefore, consistent with findings in other contexts such as labor markets, Asians have worse outcomes than similarly situated applicants of other minority groups or non-Hispanic whites.

Researchers of Asian American studies often highlight the heterogeneous nature of Asian American socioeconomic characteristics to emphasize the need to produced nuanced analyses beyond aggregate outcomes. Part of this concern is that the success of only a small number of elite Asians biases averages upwards, masking the challenges faced by those at the bottom of the economic distribution. Our data sample and corresponding analyses provide mixed evidence of this phenomenon for Asian borrowers. For example, while Asians have the most disperse incomes among the racial/ethnic groups we include in our analyses; Asian incomes were also the highest throughout the distribution. As a result, although we find that Asians in our sample may be quite diverse economically, they also were relatively better off, on average, according to available measures.

To analyze the outcomes of Asians at different income levels more formally, we examine mortgage market outcomes of borrowers in five categories across the income distribution. Analysis of pricing indicates that Asians at different income levels may have faced distinct experiences in mortgage markets, but nonetheless obtained favorable pricing at all income levels. On the other hand, we find evidence that Asians with relatively low incomes had comparable or worse underwriting outcomes than did non-Hispanic whites, African Americans, and Hispanics. Asian denial rates relative to other groups improve as incomes increase.

Finally, we examined differences in denial and pricing across communities with varying levels of residents from different Asian countries of origin. There are some stark differences across Asian groups. For example, borrowers from areas with relatively high Taiwanese, Korean, or Indian communities were more likely to be denied than were borrowers from Japanese or Filipino communities. Alternatively, borrowers from relatively high Bangladeshi or Cambodian

geographies had higher average prices than residents of relatively high Chinese or Vietnamese areas. In many cases, those from areas with relatively advantageous pricing outcomes had relatively disadvantageous underwriting outcomes and vice versa. These differences support concerns about the diversity of experiences faced by Asians originating from different countries of origin.

Our research provides evidence that Asians face distinct challenges in mortgage markets and that these borrowers warrant consideration in consumer protection and in the receipt of housing and financial support services. In particular, we find that Asians may face impediments when trying to obtain a mortgage, with denial rates at worse or comparable levels than relatively oft-studied African Americans and Hispanics. These difficulties appear exacerbated for Asians with low incomes, while we find less evidence of disadvantageous conditional outcomes for Asians with high incomes. Therefore, support for Asian borrowers would appear to be well-targeted if it started with those with relatively poor socioeconomic backgrounds.

Mortgage market outcomes across Asian countries of origin based on the geographic proxy are also starkly dissimilar. This is consistent with other housing research that indicates that aggregation of Asian preferences and socioeconomic characteristics is problematic when trying to understand challenges to prudent decisions. This challenge, however, is not necessarily unique to Asians. Other minority racial and ethnic groups can make similar claims about heterogeneity of experiences and communities. The lack of conformity among members of many races and ethnicities presents challenges to policymakers and researchers, where broad rules and groupings are attractive. Nevertheless, nuanced analysis and detailed understanding are needed to appropriately characterize experiences, recognize causal mechanisms, and promote an efficient mortgage market.

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