



Analyzing Bank of West Lending Practices

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- Assistant Professor, Perella Department of Finance
- Instructor, Spring 2023 FinTech Capstone Project
- Scholar in the field of corporate finance
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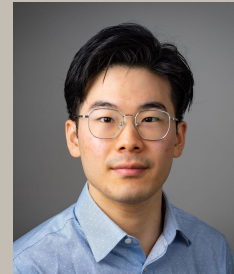
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(Finance, BIS)

Capstone Mission

Government regulations today prevent financial institutions from making lending decisions based on an applicant's demographic attributes. Historically, the practice of redlining prevented residents of certain areas from accessing credit due to race or ethnicity.

Our mission is to identify whether or not Bank of the West violates fair lending requirements by conducting a thorough analysis of its lending behaviors in areas with high minority populations.

Capstone Mission

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We will use loan-level data, demographic information, and advanced technologies like OpenAI's *ChatGPT API* to identify any potential biases and provide actionable insights on how BMO Harris can address any shortcomings and ensure equitable access to credit for all communities.

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Background

Bank of West History

- **Bank of the West (BOW)** was established in 1874 as Farmers National Gold Bank of San Jose in California. It has since evolved and expanded to become a full-service bank with **branches in 23 states across the United States.**



BANK OF THE WEST
BNP PARIBAS

Bank of West History

- Bank of the West (BOW) was established in 1874 as Farmers National Gold Bank of San Jose in California. It has since evolved and expanded to become a full-service bank with branches in 23 states across the United States.
- BOW services **individual homebuyers**, **real estate investors**, and those looking for **mortgage financing** or **refinancing**.



BANK OF THE WEST
BNP PARIBAS

BMO Harris & Bank of the West Merger

- On February 1, 2023, BMO Harris (BMO) completed its planned acquisition of Bank of the West.

WE'VE JOINED THE BMO FAMILY!



BANK OF THE WEST
BNP PARIBAS

BMO  **Harris Bank**

BMO Harris & Bank of the West Merger

- On February 1, 2023, BMO Harris (BMO) completed its planned acquisition of Bank of the West.
- **Both banks have allegations of redlining, creating opponents to the merger.**

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BANK OF THE WEST
BNP PARIBAS

BMO  **Harris Bank**

BMO & BOW Merger Controversy

- In 2018, the **National Community Reinvestment Coalition (NCRC)** filed a complaint with the US Department of Housing and Urban Development (HUD), **alleging that BMO Harris Bank engaged in illegal redlining practices.**

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BANK OF THE WEST
BNP PARIBAS

BMO  **Harris Bank**

BMO Harris & Bank of the West Merger Controversy

- In 2018, the National Community Reinvestment Coalition (NCRC) filed a complaint with the US Department of Housing and Urban Development (HUD), alleging that BMO Harris Bank engaged in illegal redlining practices.
- In 2022, the **California Reinvestment Coalition (CRC)** also raised concerns about Bank of the West's activities.
 - BOW Lending Rate to Black Borrowers = 1.2% of originations
 - Peers' Lending Rate to Black Borrowers = 2.3% of originations

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BANK OF THE WEST
BNP PARIBAS



Regulatory Background

**Equal Credit Opportunity Act
(ECOA)**

**Fair Housing Act
(FHA)**

**Community Reinvestment Act
(CRA)**

**Home Mortgage Disclosure Act
(HMDA)**

Regulatory Background

Equal Credit Opportunity Act
(ECOA)

These federal laws look to ensure equal access to credit by preventing lenders from discriminating against loan applicants on the basis of **race, color, religion, national origin, sex, marital status, or age.**

Fair Housing Act
(FHA)

Community Reinvestment Act
(CRA)

Home Mortgage Disclosure Act
(HMDA)

Data Analysis

Interpreting our findings

Final Merged Dataset

Sample:

- Arizona & California 2021
- Competitors (50% - 200% of BOW's loan origination volume)

Steps:

- Clean and merge Census & HMDA data
 - Numerical to categorical
 - Renaming
 - Omitted null, missing, and duplicate observations
- Aggregate loan-level HMDA data to bank-tract level
 - Bank: BOW or "Competitor"

Variables include:

- Loan volume, types, characteristics, and outcomes
- Borrower demographics & local demographics



Descriptive Variables of Whole Dataset

	Count	Std	Min	Max	Means		
					All Obs	Bank of the West	All Other Banks
Number of Loan Applications	13,837	54.44	1.00	964.00	44.74	3.38	64.67
Number of Approved Loans	13,837	46.54	1.00	836.00	37.49	2.39	54.40
Denial Rate	13,837	0.16	0.00	0.86	0.18	0.21	0.17
Average Approved Loan Amount (\$ M)	13,837	1.00	0.02	55.25	0.48	0.48	0.48
Total Requested Loan Amount (\$ M)	13,837	31.99	0.02	827.75	20.57	1.77	29.63
Total Approved Loans Amount (\$ M)	13,837	28.30	0.02	638.74	17.81	1.31	25.76
Avg Approved Loan Interest Rate	13,837	0.45	1.58	7.68	3.14	3.41	3.02
Avg Approved Rate Spread	13,249	0.38	-1.21	4.01	0.36	0.47	0.31
LTV (%)	13,833	19.76	2.88	1815.71	63.66	61.05	64.91

Denial Rates by Product and Purpose

		All Other Banks	Bank of the West
Loan Type	Loan Purpose		
Conventional	Cash-out refinancing	0.13	0.26
	Home improvement	0.37	0.38
	Home purchase	0.09	0.13
	Other purpose	0.36	0.45
	Refinancing	0.12	0.34
Federal Housing Administration FHA	Cash-out refinancing	0.29	0.76
	Home improvement	0.18	1
	Home purchase	0.11	0.38
	Other purpose	0.23	1
	Refinancing	0.18	0.67

Denial Rates by Product and Purpose

FHA Loan:

- Back by Federal Housing Administration
- Provide Affordability and Accessibility
- For lower income or credit scores

Federal Housing Administration
FHA

All Other Banks **Bank of the West**

Loan Purpose	All Other Banks	Bank of the West
Cash-out refinancing	0.13	0.26
Home improvement	0.37	0.38
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	Home improvement	0.18	1
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	Other purpose	0.23	1
	Refinancing	0.18	0.67

62 apps


1 app

3 apps

Median Income of Applicants by Product and Purpose

		All Other Banks	Bank of the West
Loan Type	Loan Purpose		
Conventional	Cash-out refinancing	105	135
	Home improvement	128	146
	Home purchase	131	225
	Other purpose	134	151
	Refinancing	123	183
Federal Housing Administration FHA	Cash-out refinancing	75	69
	Home improvement	51	79
	Home purchase	80	91
	Other purpose	29	36
	Refinancing	28	83

Median Income Quintiles Loan Approval Analysis

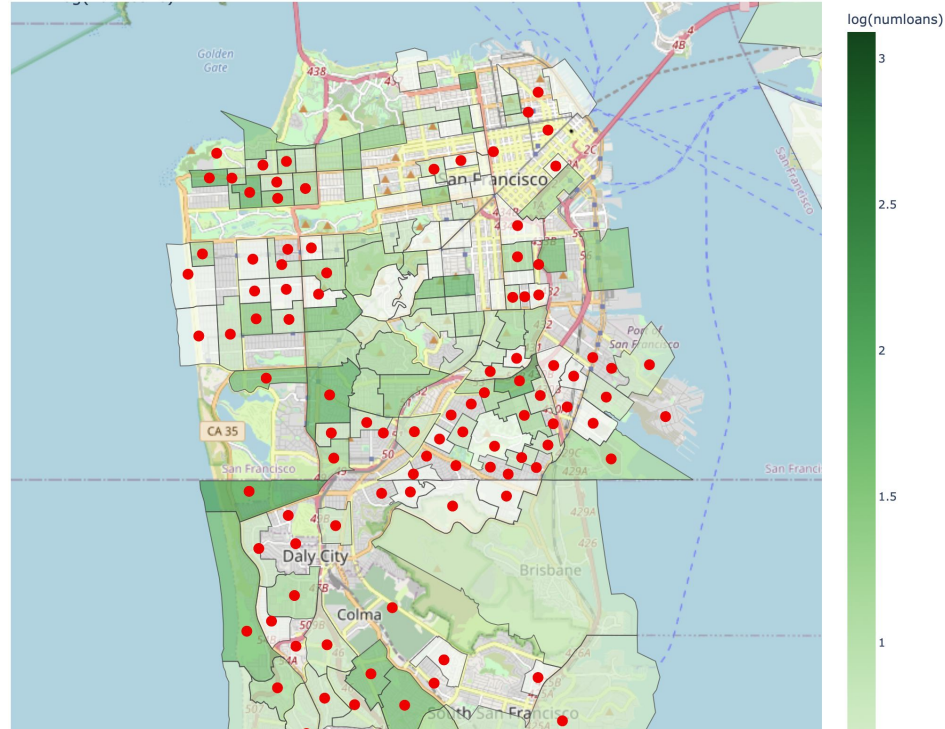
	Average Loan Portfolio (\$ Millions)		Approval Rate (%)		
	All Other Banks	Bank of the West	All Other Banks	Bank of the West	
Median Income Quintiles					
1 (Lowest)		10.13	0.39	80	65
2		16.31	0.64	82	67
3		23.99	0.65	84	68
4		33.02	1.07	87	71
5 (Highest)		65.56	2.43	89	72

Minority Quintiles Loan Analysis

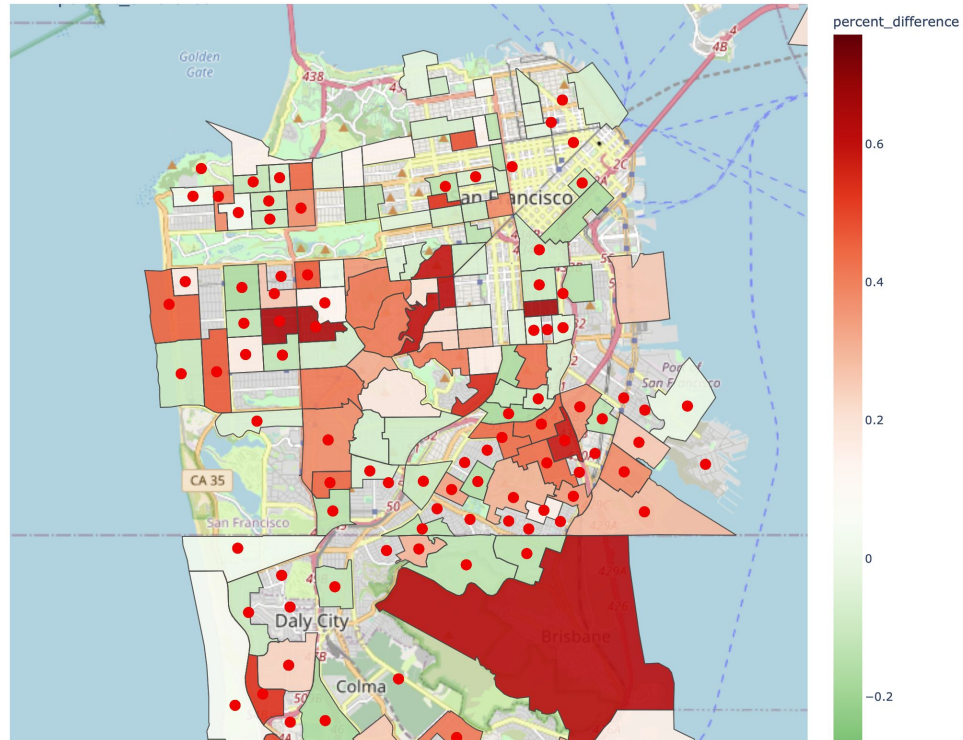
Minority Rate Quintile	% of Loans Made		% of Dollars Loaned		Approval Rate(%)	
	All Other Banks	Bank of the West	All Other Banks	Bank of the West	All Other Banks	Bank of the West
1 (Lowest)	32	29	32	33	85	71
2	37	35	36	35	84	72
3	19	18	19	16	84	71
4	10	14	10	12	84	69
5 (Highest)	3	4	3	4	86	70



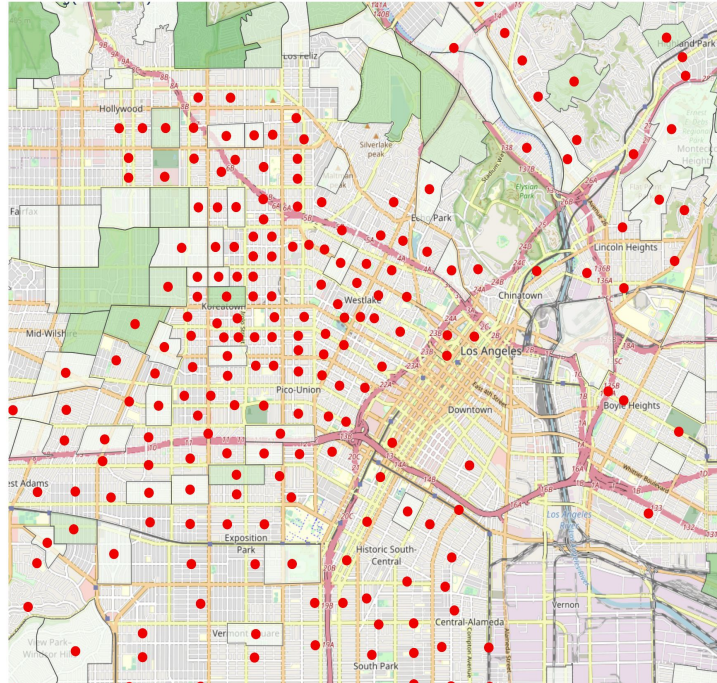
Number of Loans of BOW for San Francisco



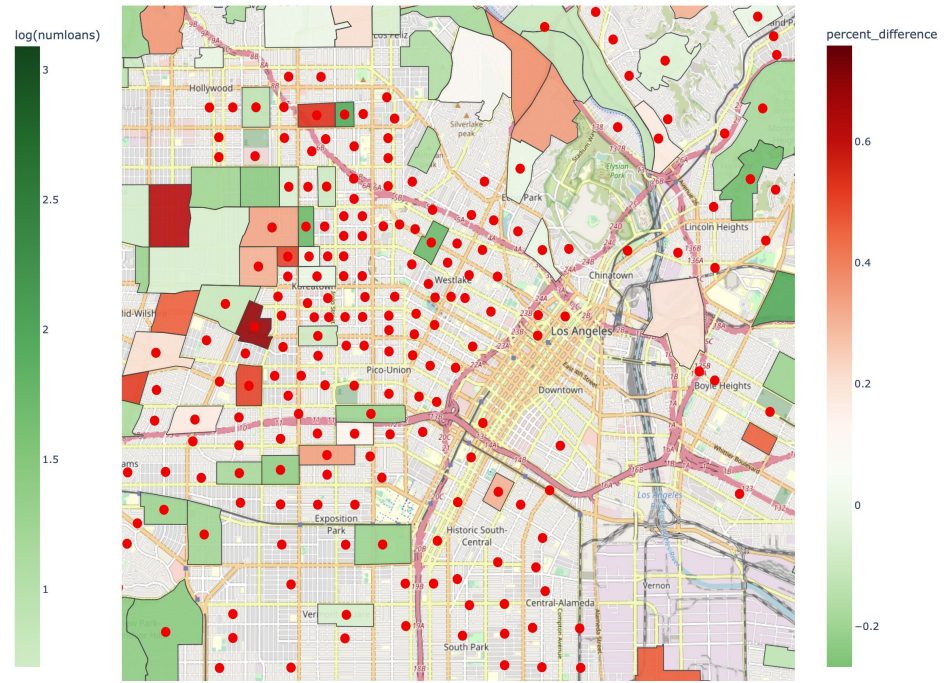
Denial Rate Percent Difference of BOW and All Competitors



Same Graphs But Now LA



Logarithmic Number of Loans



Denial Rate Percent Difference

Regressions

Application of ML

Regression

Generalized Regression Equation:

$$y = a + b*BOW + c*HighMinority + d*BOW*HighMinority + e*TractDemoVars + f*BankApplicantVars + u$$

Where:

a: Intercept

BOW: Binary variable, bank observation identifier

HighMinority: Binary variable, minority group above median minority group population

BOW*HighMinority: Interaction Term

TractDemoVars: Control variables at tract level

BankApplicantVars: Control variables at bank level

Minority Groups of Interest:

Hispanic, Black, Asian

Regression Table 1 – Probability of Receiving a Loan Application

Minority Group for Column:	Hispanic (1)	Black (2)	Asian (3)	All (4)
Intercept	-1.426*** (0.109)	-1.437*** (0.105)	-1.185*** (0.108)	-1.427*** (0.105)
BOW	-0.415*** (0.007)	-0.475*** (0.007)	-0.610*** (0.007)	-0.517*** (0.005)
High Minority	0.087*** (0.007)	0.035*** (0.007)	-0.064*** (0.007)	0.000*** (0.000)
High Minority:BOW	-0.192*** (0.010)	-0.083*** (0.010)	0.197*** (0.010)	0.000 (0.000)
log(1+Median Household Income)	0.212*** (0.009)	0.215*** (0.009)	0.198*** (0.009)	0.216*** (0.009)
Poverty Ratio	0.092** (0.041)	0.093** (0.042)	0.060 (0.041)	0.090** (0.042)
R-squared	0.407	0.397	0.409	0.395
R-squared Adj.	0.407	0.397	0.409	0.395
No. observations	18658	18658	18658	18658

Sample: All tract-bank pairs. We augment the dataset to include tracts where BOW is not active and set the number of loan applications to zero. The independent variable is a binary variable indicating whether BOW received a loan in a tract. High minority equals one in tracts where the minority in that column has an above median population share. In column (4), Minority group over median equals one in tracts where less than 50% of the population is white. Standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

High Hispanic census tracts served by BOW have low probability of receiving a loan application

Minority Group for Column:	Hispanic (1)	Black (2)	Asian (3)	All (4)
Intercept	-1.426*** (0.109)	-1.437*** (0.105)	-1.185*** (0.108)	-1.427*** (0.105)
BOW	-0.415*** (0.007)	-0.475*** (0.007)	-0.610*** (0.007)	-0.517*** (0.005)
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High Black census tracts served by BOW have low probability of receiving a loan application

Minority Group for Column:	Hispanic (1)	Black (2)	Asian (3)	All (4)
Intercept	-1.426*** (0.109)	-1.437*** (0.105)	-1.185*** (0.108)	-1.427*** (0.105)
BOW	-0.415*** (0.007)	-0.475*** (0.007)	-0.610*** (0.007)	-0.517*** (0.005)
High Minority	0.087*** (0.007)	0.035*** (0.007)	-0.064*** (0.007)	0.000*** (0.000)
High Minority:BOW	-0.192*** (0.010)	-0.083*** (0.010)	0.197*** (0.010)	0.000 (0.000)
log(1+Median Household Income)	0.212*** (0.009)	0.215*** (0.009)	0.198*** (0.009)	0.216*** (0.009)
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High Asian census tracts served by BOW have higher probability of receiving a loan application

Minority Group for Column:	Hispanic (1)	Black (2)	Asian (3)	All (4)
Intercept	-1.426*** (0.109)	-1.437*** (0.105)	-1.185*** (0.108)	-1.427*** (0.105)
BOW	-0.415*** (0.007)	-0.475*** (0.007)	-0.610*** (0.007)	-0.517*** (0.005)
High Minority	0.087*** (0.007)	0.035*** (0.007)	-0.064*** (0.007)	0.000*** (0.000)
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log(1+Median Household Income)	0.212*** (0.009)	0.215*** (0.009)	0.198*** (0.009)	0.216*** (0.009)
Poverty Ratio	0.092** (0.041)	0.093** (0.042)	0.060 (0.041)	0.090** (0.042)
R-squared	0.407	0.397	0.409	0.395
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Regression Table 2 – Logarithm of Number of Applications

Minority Group for Column:	Hispanic (1)	Black (2)	Asian (3)	All (4)
Intercept	-3.555*** (0.221)	-3.993*** (0.213)	-4.204*** (0.220)	-3.921*** (0.212)
BOW	-3.304*** (0.015)	-3.201*** (0.014)	-3.355*** (0.014)	-3.259*** (0.010)
High Minority	-0.102*** (0.015)	0.079*** (0.014)	-0.162*** (0.015)	0.000*** (0.000)
High Minority:BOW	0.085*** (0.020)	-0.114*** (0.020)	0.207*** (0.020)	0.000 (0.000)
log(1+Median Household Income)	0.680*** (0.019)	0.711*** (0.018)	0.740*** (0.019)	0.708*** (0.018)
Poverty Ratio	-0.741*** (0.084)	-0.764*** (0.084)	-0.703*** (0.084)	-0.755*** (0.084)
R-squared	0.857	0.857	0.857	0.856
R-squared Adj.	0.857	0.857	0.857	0.856
No. observations	18658	18658	18658	18658

Sample: All tract-bank pairs. We augment the `dataset` to include tracts where BOW is not active and set the number of loan applications to zero. The independent variable is the logarithm of the number of applications plus one. High minority equals one in tracts where the minority in that column has an above median population share. In column (4), Minority group over median equals one in tracts where less than 50% of the population is white. Standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Number of applications is higher in high Hispanic and BOW served tracts

Minority Group for Column:	Hispanic (1)	Black (2)	Asian (3)	All (4)
Intercept	-3.555*** (0.221)	-3.993*** (0.213)	-4.204*** (0.220)	-3.921*** (0.212)
BOW	-3.304*** (0.015)	-3.201*** (0.014)	-3.355*** (0.014)	-3.259*** (0.010)
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Number of applications is lower in high Black and BOW served tracts

Minority Group for Column:	Hispanic (1)	Black (2)	Asian (3)	All (4)
Intercept	-3.555*** (0.221)	-3.993*** (0.213)	-4.204*** (0.220)	-3.921*** (0.212)
BOW	-3.304*** (0.015)	-3.201*** (0.014)	-3.355*** (0.014)	-3.259*** (0.010)
High Minority	-0.102*** (0.015)	0.079*** (0.014)	-0.162*** (0.015)	0.000*** (0.000)
High Minority:BOW	0.085*** (0.020)	-0.114*** (0.020)	0.207*** (0.020)	0.000 (0.000)
log(1+Median Household Income)	0.680*** (0.019)	0.711*** (0.018)	0.740*** (0.019)	0.708*** (0.018)
Poverty Ratio	-0.741*** (0.084)	-0.764*** (0.084)	-0.703*** (0.084)	-0.755*** (0.084)
R-squared	0.857	0.857	0.857	0.856
R-squared Adj.	0.857	0.857	0.857	0.856
No. observations	18658	18658	18658	18658

Sample: All tract-bank pairs. We augment the dataset to include tracts where BOW is not active and set the number of loan applications to zero. The independent variable is the logarithm of the number of applications plus one. High minority equals one in tracts where the minority in that column has an above median population share. In column (4), Minority group over median equals one in tracts where less than 50% of the population is white. Standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Number of applications is higher in high Asian and BOW served tracts

Minority Group for Column:	Hispanic (1)	Black (2)	Asian (3)	All (4)
Intercept	-3.555*** (0.221)	-3.993*** (0.213)	-4.204*** (0.220)	-3.921*** (0.212)
BOW	-3.304*** (0.015)	-3.201*** (0.014)	-3.355*** (0.014)	-3.259*** (0.010)
High Minority	-0.102*** (0.015)	0.079*** (0.014)	-0.162*** (0.015)	0.000*** (0.000)
High Minority:BOW	0.085*** (0.020)	-0.114*** (0.020)	0.207*** (0.020)	0.000 (0.000)
log(1+Median Household Income)	0.680*** (0.019)	0.711*** (0.018)	0.740*** (0.019)	0.708*** (0.018)
Poverty Ratio	-0.741*** (0.084)	-0.764*** (0.084)	-0.703*** (0.084)	-0.755*** (0.084)
R-squared	0.857	0.857	0.857	0.856
R-squared Adj.	0.857	0.857	0.857	0.856
No. observations	18658	18658	18658	18658

Sample: All tract-bank pairs. We augment the dataset to include tracts where BOW is not active and set the number of loan applications to zero. The independent variable is the logarithm of the number of applications plus one. High minority equals one in tracts where the minority in that column has an above median population share. In column (4), Minority group over median equals one in tracts where less than 50% of the population is white. Standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Regression Table 3 – Denial Rate

Minority Group for Column:	Hispanic (1)	Black (2)	Asian (3)	All (4)
Intercept	0.085 (0.087)	0.128 (0.083)	0.189** (0.085)	0.134 (0.083)
BOW	0.088*** (0.005)	0.070*** (0.005)	0.002 (0.006)	0.050*** (0.004)
High Minority	0.054*** (0.006)	0.022*** (0.005)	-0.040*** (0.006)	-0.000* (0.000)
High Minority:BOW	-0.088*** (0.008)	-0.044*** (0.007)	0.084*** (0.008)	0.000 (0.000)
log(1+Median Household Income)	0.006 (0.007)	0.002 (0.007)	0.001 (0.007)	0.003 (0.007)
Poverty Ratio	0.025 (0.036)	0.031 (0.036)	0.028 (0.036)	0.031 (0.036)
Mean Loan-To-Value	-0.000*** (0.000)	-0.000* (0.000)	-0.000** (0.000)	-0.000 (0.000)
R-squared	0.035	0.024	0.033	0.020
R-squared Adj.	0.034	0.023	0.033	0.019
No. observations	8990	8990	8990	8990

Sample: Tracts where BOW approves at least one loan. The independent variable is denial rate. High minority equals one in tracts where the minority in that column has an above median population share. In column (4), Minority group over median equals one in tracts where less than 50% of the population is white. Standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Effect of being in a high Hispanic tract which is served by BOW on denial rate is less strong than in tracts for competitors

Minority Group for Column:	Hispanic (1)	Black (2)	Asian (3)	All (4)
Intercept	0.085 (0.087)	0.128 (0.083)	0.189** (0.085)	0.134 (0.083)
BOW	0.088*** (0.005)	0.070*** (0.005)	0.002 (0.006)	0.050*** (0.004)
High Minority	0.054*** (0.006)	0.022*** (0.005)	-0.040*** (0.006)	-0.000* (0.000)
High Minority:BOW	-0.088*** (0.008)	-0.044*** (0.007)	0.084*** (0.008)	0.000 (0.000)
log(1+Median Household Income)	0.006 (0.007)	0.002 (0.007)	0.001 (0.007)	0.003 (0.007)
Poverty Ratio	0.025 (0.036)	0.031 (0.036)	0.028 (0.036)	0.031 (0.036)
Mean Loan-To-Value	-0.000*** (0.000)	-0.000* (0.000)	-0.000** (0.000)	-0.000 (0.000)
R-squared	0.035	0.024	0.033	0.020
R-squared Adj.	0.034	0.023	0.033	0.019
No. observations	8990	8990	8990	8990

Sample: Tracts where BOW approves at least one loan. The independent variable is denial rate. High minority equals one in tracts where the minority in that column has an above median population share. In column (4), Minority group over median equals one in tracts where less than 50% of the population is white. Standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Effect of being in a high Black tract which is served by BOW on denial rate is less strong than in tracts for competitors

Minority Group for Column:	Hispanic (1)	Black (2)	Asian (3)	All (4)
Intercept	0.085 (0.087)	0.128 (0.083)	0.189** (0.085)	0.134 (0.083)
BOW	0.088*** (0.005)	0.070*** (0.005)	0.002 (0.006)	0.050*** (0.004)
High Minority	0.054*** (0.006)	0.022*** (0.005)	-0.040*** (0.006)	-0.000* (0.000)
High Minority:BOW	-0.088*** (0.008)	-0.044*** (0.007)	0.084*** (0.008)	0.000 (0.000)
log(1+Median Household Income)	0.006 (0.007)	0.002 (0.007)	0.001 (0.007)	0.003 (0.007)
Poverty Ratio	0.025 (0.036)	0.031 (0.036)	0.028 (0.036)	0.031 (0.036)
Mean Loan-To-Value	-0.000*** (0.000)	-0.000* (0.000)	-0.000** (0.000)	-0.000 (0.000)
R-squared	0.035	0.024	0.033	0.020
R-squared Adj.	0.034	0.023	0.033	0.019
No. observations	8990	8990	8990	8990

Sample: Tracts where BOW approves at least one loan. The independent variable is denial rate. High minority equals one in tracts where the minority in that column has an above median population share. In column (4), Minority group over median equals one in tracts where less than 50% of the population is white. Standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Effect of being in a high Asian tract which is served by BOW on denial rate is stronger than in tracts for competitors

Minority Group for Column:	Hispanic (1)	Black (2)	Asian (3)	All (4)
Intercept	0.085 (0.087)	0.128 (0.083)	0.189** (0.085)	0.134 (0.083)
BOW	0.088*** (0.005)	0.070*** (0.005)	0.002 (0.006)	0.050*** (0.004)
High Minority	0.054*** (0.006)	0.022*** (0.005)	-0.040*** (0.006)	-0.000* (0.000)
High Minority:BOW	-0.088*** (0.008)	-0.044*** (0.007)	0.084*** (0.008)	0.000 (0.000)
log(1+Median Household Income)	0.006 (0.007)	0.002 (0.007)	0.001 (0.007)	0.003 (0.007)
Poverty Ratio	0.025 (0.036)	0.031 (0.036)	0.028 (0.036)	0.031 (0.036)
Mean Loan-To-Value	-0.000*** (0.000)	-0.000* (0.000)	-0.000** (0.000)	-0.000 (0.000)
R-squared	0.035	0.024	0.033	0.020
R-squared Adj.	0.034	0.023	0.033	0.019
No. observations	8990	8990	8990	8990

Sample: Tracts where BOW approves at least one loan. The independent variable is denial rate. High minority equals one in tracts where the minority in that column has an above median population share. In column (4), Minority group over median equals one in tracts where less than 50% of the population is white. Standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Regression Table 4 – Interest Rate Spread

Minority Group for Column:	Hispanic (1)	Black (2)	Asian (3)	All (4)
Intercept	2.666*** (0.198)	3.067*** (0.190)	3.077*** (0.194)	3.115*** (0.189)
BOW	0.205*** (0.011)	0.234*** (0.012)	0.263*** (0.013)	0.241*** (0.009)
High Minority	0.028** (0.013)	0.015 (0.012)	0.014 (0.012)	-0.000*** (0.000)
High Minority:BOW	0.088*** (0.018)	0.016 (0.017)	-0.037** (0.018)	0.000 (0.0000)
log(1+Median Household Income)	-0.243*** (0.016)	-0.278*** (0.016)	-0.279*** (0.016)	-0.2814*** (0.016)
Poverty Ratio	-0.392*** (0.085)	-0.388*** (0.085)	-0.376*** (0.085)	-0.3825*** (0.085)
Mean Loan-To-Value	0.006*** (0.000)	0.006*** (0.000)	0.006*** (0.000)	0.006*** (0.000)
R-squared	0.181	0.175	0.174	0.174
R-squared Adj.	0.180	0.174	0.174	0.174
No. observations	8433	8433	8433	8433

Sample: Tracts where BOW approves at least one loan. The independent variable is approved interest rate spread. High minority equals one in tracts where the minority in that column has an above median population share. In column (4), Minority group over median equals one in tracts where less than 50% of the population is white. Standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Effect of being in a high Hispanic tract which is served by BOW on rate spread is stronger than in tracts for competitors

Minority Group for Column:	Hispanic (1)	Black (2)	Asian (3)	All (4)
Intercept	2.666*** (0.198)	3.067*** (0.190)	3.077*** (0.194)	3.115*** (0.189)
BOW	0.205*** (0.011)	0.234*** (0.012)	0.263*** (0.013)	0.241*** (0.009)
High Minority	0.028** (0.013)	0.015 (0.012)	0.014 (0.012)	-0.000*** (0.000)
High Minority:BOW	0.088*** (0.018)	0.016 (0.017)	-0.037** (0.018)	0.000 (0.000)
log(1+Median Household Income)	-0.243*** (0.016)	-0.278*** (0.016)	-0.279*** (0.016)	-0.2814*** (0.016)
Poverty Ratio	-0.392*** (0.085)	-0.388*** (0.085)	-0.376*** (0.085)	-0.3825*** (0.085)
Mean Loan-To-Value	0.006*** (0.000)	0.006*** (0.000)	0.006*** (0.000)	0.006*** (0.000)
R-squared	0.181	0.175	0.174	0.174
R-squared Adj.	0.180	0.174	0.174	0.174
No. observations	8433	8433	8433	8433

Sample: Tracts where BOW approves at least one loan. The independent variable is approved interest rate spread. High minority equals one in tracts where the minority in that column has an above median population share. In column (4), Minority group over median equals one in tracts where less than 50% of the population is white. Standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Effect of being in a high Black tract which is served by BOW on rate spread is stronger than in tracts for competitors

Minority Group for Column:	Hispanic (1)	Black (2)	Asian (3)	All (4)
Intercept	2.666*** (0.198)	3.067*** (0.190)	3.077*** (0.194)	3.115*** (0.189)
BOW	0.205*** (0.011)	0.234*** (0.012)	0.263*** (0.013)	0.241*** (0.009)
High Minority	0.028** (0.013)	0.015 (0.012)	0.014 (0.012)	-0.000*** (0.000)
High Minority:BOW	0.088*** (0.018)	0.016 (0.017)	-0.037** (0.018)	0.000 (0.0000)
log(1+Median Household Income)	-0.243*** (0.016)	-0.278*** (0.016)	-0.279*** (0.016)	-0.2814*** (0.016)
Poverty Ratio	-0.392*** (0.085)	-0.388*** (0.085)	-0.376*** (0.085)	-0.3825*** (0.085)
Mean Loan-To-Value	0.006*** (0.000)	0.006*** (0.000)	0.006*** (0.000)	0.006*** (0.000)
R-squared	0.181	0.175	0.174	0.174
R-squared Adj.	0.180	0.174	0.174	0.174
No. observations	8433	8433	8433	8433

Sample: Tracts where BOW approves at least one loan. The independent variable is approved interest rate spread. High minority equals one in tracts where the minority in that column has an above median population share. In column (4), Minority group over median equals one in tracts where less than 50% of the population is white. Standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Effect of being in a high Asian tract which is served by BOW on rate spread is less strong than in tracts for competitors

Minority Group for Column:	Hispanic (1)	Black (2)	Asian (3)	All (4)
Intercept	2.666*** (0.198)	3.067*** (0.190)	3.077*** (0.194)	3.115*** (0.189)
BOW	0.205*** (0.011)	0.234*** (0.012)	0.263*** (0.013)	0.241*** (0.009)
High Minority	0.028** (0.013)	0.015 (0.012)	0.014 (0.012)	-0.000*** (0.000)
High Minority:BOW	0.088*** (0.018)	0.016 (0.017)	-0.037** (0.016)	0.000 (0.0000)
log(1+Median Household Income)	-0.243*** (0.016)	-0.278*** (0.016)	-0.279*** (0.016)	-0.2814*** (0.016)
Poverty Ratio	-0.392*** (0.085)	-0.388*** (0.085)	-0.376*** (0.085)	-0.3825*** (0.085)
Mean Loan-To-Value	0.006*** (0.000)	0.006*** (0.000)	0.006*** (0.000)	0.006*** (0.000)
R-squared	0.181	0.175	0.174	0.174
R-squared Adj.	0.180	0.174	0.174	0.174
No. observations	8433	8433	8433	8433

Sample: Tracts where BOW approves at least one loan. The independent variable is approved interest rate spread. High minority equals one in tracts where the minority in that column has an above median population share. In column (4), Minority group over median equals one in tracts where less than 50% of the population is white. Standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Regression Findings

-	Hispanic	Black	Asian
Application Probability	Concern	Concern	Satisfactory
Number of Applications	Satisfactory	Concern	Satisfactory
Denial Rate	Satisfactory	Satisfactory	Concern
Interest Rate Spread	Concern	Concern	Satisfactory

ChatGPT Loan Officer

How AI Could Shape the Future of Lending

Overview

- Mortgage lending industry is undergoing a technological revolution, with new developments in AI technology poised to reshape the way loans are originated and underwritten
- AI has the potential to transform the lending process by improving accuracy, streamlining workflows, and enhancing the customer experience



Experiment with OpenAI's ChatGPT and API

- Experiment conducted using OpenAI's ChatGPT and API to determine whether the system could accurately assess and approve or deny loans based on specific variables
- 100 random loans from census tract-bank dataset with specific variables selected such as 'loan amount', 'loan purpose', 'property value', 'income', 'total units', and more
- Results analyzed to assess consistency, randomness, and potential bias



Results of Experiment - Panel A

Test	Evaluator	Approval Rate (%)	t-stat	Interest Rate (%)	t-stat
Original Data	Real Data	95		3.40	
No Race	ChatGPT	88		4.75	
No Race 2	ChatGPT	87	0.21	4.77	-0.21
No Race 3	ChatGPT	89	-0.22	4.78	-0.30
White	ChatGPT	90	-0.45	4.82	-0.69
Black	ChatGPT	89	-0.22	5.42	-6.94
Asian	ChatGPT	86	0.42	4.90	-1.47
Hispanic	ChatGPT	88	0.00	5.27	-5.25

Results of Experiment - Panel B - No Bias Prompt

Test	Evaluator	Approval Rate (%)	t-stat	Interest Rate (%)	t-stat
Original Data	Real Data	95		3.40	
No Race	ChatGPT	83		4.84	
White	ChatGPT	88	-1.00	4.71	1.05
Black	ChatGPT	83	0.00	5.06	-1.53
Asian	ChatGPT	92	-1.93	4.81	0.21
Hispanic	ChatGPT	87	-0.79	4.83	0.06

Bias in AI Loan Decision Making

- Our results raise some red flags about the possibility of AI tech being used in practice.
- AI is only as unbiased as the data and people training the programs.



Related Articles

- Alternative Credit Scoring models describe models that use non-traditional data.
- Models utilizing more data elements have the potential to increase credit access to historically underserved populations.
- “Credit Invisibility” affects 15% of the black and hispanic population.
- While some machine learning algorithms have been found to be highly accurate, they result in less lending to minority populations.
- Machine Learning algorithms must be trained however, to omit biases based on historical data.

Conclusion

Capstone Mission

- 1) To identify whether or not BOW **violates fair lending requirements**

- 2) To **promote fair lending practices** and **eliminate discrimination** in credit lending

Conclusion

- Bank of the West
 - Applicant's **median income** are generally **higher** than those of all other banks by product and purpose
 - Lending practices **vary depending** on **demographic makeup** of the census tract
 - Tracts with high number of **Hispanic** or **Black** people:
 - Are **Less likely** to receive loan applications
 - Experience on average **higher loan prices**
 - **Opposite** is true of **Asian** populations
- OpenAI's ChatGPT and API
 - Highlighted the importance of avoiding biases in loan decisions
 - Specifically, when using AI and machine learning technology to promote fair lending

Key Finding

Our statistical analysis of BOW concludes that protected classes are underserved
in the states of California and Arizona

Takeaways

- Our analysis presents a need for emphasis on fair and unbiased lending practices:
 - Proper data training, compliance with regulations, regular audits, and ongoing monitoring is needed to avoid biases in lending decisions
 - As the industry continuously evolves and new technology is introduced, staying current with the latest trends and best practices is crucial

Acknowledgements

Thank you to:

- Professor Bowen for the support throughout this process
- Matt for...

Thank you! Any questions?



Ellie Degeorges
(Accounting)



Victoria Genco
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Isaac Grodin
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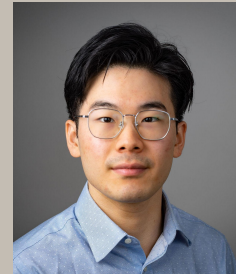
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