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Bay Area Housing Market in Relation to H1-B Visa

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1. Introduction

The Bay Area, the home of IT and Finance employees, is currently facing a housing bubble. The Bay Area has become one of the most expensive place to reside in the United States. According to Mercury News website, median sales prices in San Mateo rose 30 percent from the previous January, reaching $1.31 million. Santa Clara prices jumped nearly 24 percent to $1.05 million. Alameda rose about 14 percent to $755,000, and Contra Costa home prices went up 7 percent to $355,000 [1]. The median house prices have increased tremendously. There are two reasons why the house prices have appreciated. One of the reason can be that the supply of housing units is not increasing at the same pace as its demand. The Tech and the Finance companies are increasing employment quickly and attracting workers to work in the Bay Area but not that very many housing units are created for these workers to live in. According to Wikipedia website, from 2012 to 2017, the San Francisco metropolitan area added 400,000 new jobs, but only 60,000 new housing units[2]. The other reason can be the income earned by the employees in Technology and Finance companies. According to the State of California Employment Development Department, the highest paying job is in the Tech field[3]. Individuals in Finance field working in the San Francisco earn around $70,000 to $80,000 per year[4]. These high income earners are able to bid high for the property in the Bay Area.

Most of the employees hired in the technology companies are on employment visa (H1-B visa). H1 B visa is a non-immigrant visa granted to foreign individuals to work in the United States for three years in specialty occupations. Around 69.8% of the H1-B visa holders in the United States are hired in Technology industry and around 6.6% are hired in the Finance Industry. The table shows the Top H1-B Specialty Occupations in 2017.

Programmer Analyst	Senior Software Engineer
Software Engineer	Developer
Software Developer	Lead Technology
Systems Analyst	Technology Analyst
Computer Programmer	Assistant Professor
Business Analyst	Consultant
Computer Systems Analyst	Project Manager

As observed, most of the H1-B workers are in Technology Field. Every year, 30% of the H1-B visas issued are from the state of California. And out of that, around 50% of the H1-B visas issued is from the Bay Area, due to Silicon Valley[5]. According to Glassdoor website, the average

salary of a computer engineer in San Francisco is around $120,000 per $year^6$. Due to this, the median salary in the Bay Area has increased and so has the median housing prices.

2. Background / Literature Review

Robert Cervero's article on Jobs-Housing Balance Revisited gives a good insight job-housing balance in the Bay Area. It examines the ratios of jobs to employed residents in the Bay Area. According to the article "jobs followed the labor markets, housing capital generally did not follow jobs. A consequence is that workers in the job-surplus cities average longer duration commutes" In order to reduce traffic congestion and air pollution, commute time from place of residence to the place of work can be lessened by maintaining a job-housing balance (creating more houses near place of work). However, due to restricted house production, the house prices are increasing making workers to prefer at location to reside in farther from their office. In order to reduce the inconvenience and commute time, jobs and workers locate to another place.

The insight to be taken from Robert Cervero's paper is its conclusion that is jobs and worker can relocate to another place. The Bay Area is attracting a lot of foreign workers to work in the technology and finance companies. The housing in the Bay Area is very expensive. A lot of workers in the Bay Area have to commute for long hours either due to traffic or distance from home to office is a lot. There can be a possibility that the finance and/or technology companies might relocate in future due to this reason.

3. Data Description – Part 1

This research makes use of panel data. The panel dataset contains data on the 9 counties in the Bay Area, namely Alameda, Contra Costa, Marin, Napa, San Francisco, Santa Clara, San Mateo, Solano and Sonoma. For each these counties, there is data on Housing Price Index, Number of Housing Units, Bank Prime Rate, Median Housing Income and Number of H1-B visa petitions filled, for the years 2012 to 2016. The years 2012 to 2016 are selected because the hike in the number of H1-B visa petitions filled is seen from 2012 that is after the US economy revived from the 2008 recession.

The data for housing price index, bank prime rate and median household income for each county is collected from FRED. The data for number of housing units for each county is collected from US Census. The data for number of H1-B petitions filled is collected from h1bdata.info website. Data from FRED and US census is at county level. But data on h1bdata.info website is at the city level. Data was collected for each year (2012 to 2016) in each city in the county and merged to county level data. This was done for all the 9 counties in the Bay Area, to get number of H1-B petitions filled in the Bay Area for years 2012 to 2016.

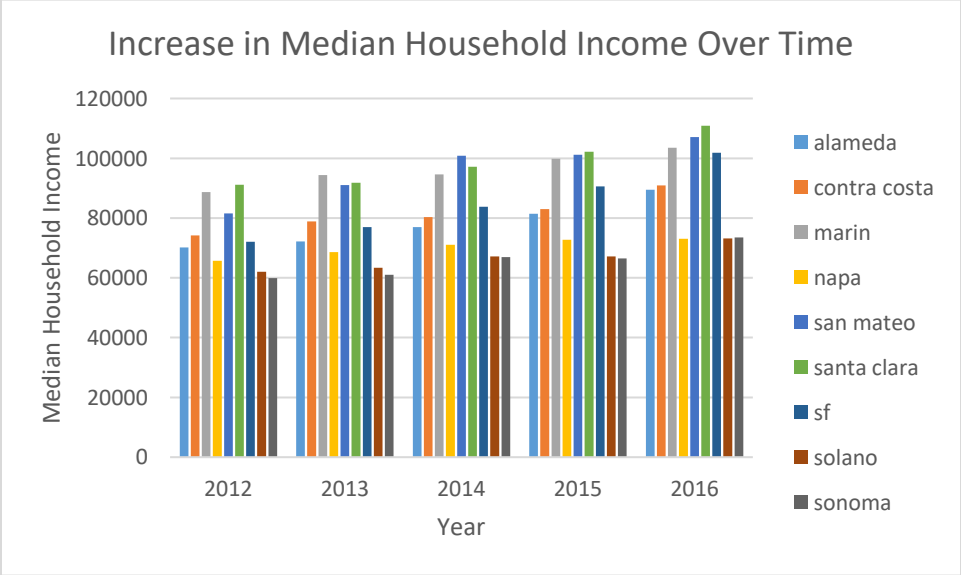
A basic analysis was conducted, using data from Bank of the West to see the average property values H1-B visa holders, Green Card holders and US Citizens buy for Dublin, Fremont, San Ramon and Union City from 2005 to 2017.

City	H1-B	Green Card	US Citizen
Dublin	847,000	906,833	773,414
Fremont	893,111	773,250	829,896
San Ramon	842,500	870,292	779,651
Union City	675,000	610,667	592,564

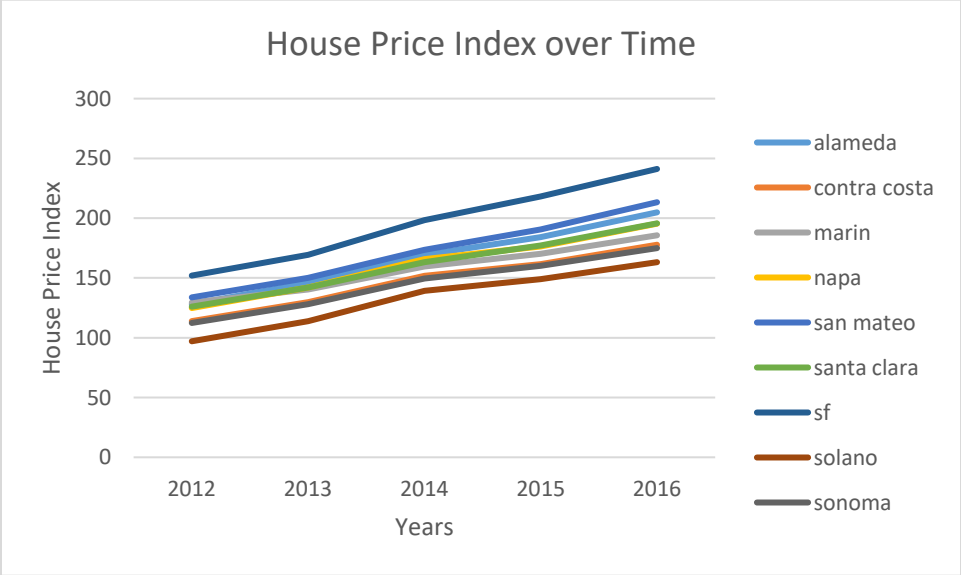
The analysis showed that the proportion of H1-B home buyers is very low as compared to a US citizen and Green Card holders. But the analysis shows that H1B home buyers, purchase a very high priced property, as seen in the table above. This means that H1-B visa holders are individuals with high income. The variables in the Bay Area panel dataset are particularly chosen to estimate the impact median household owners given that they are H1-B visa holders on the housing price index.

4. Data Description – Part 2

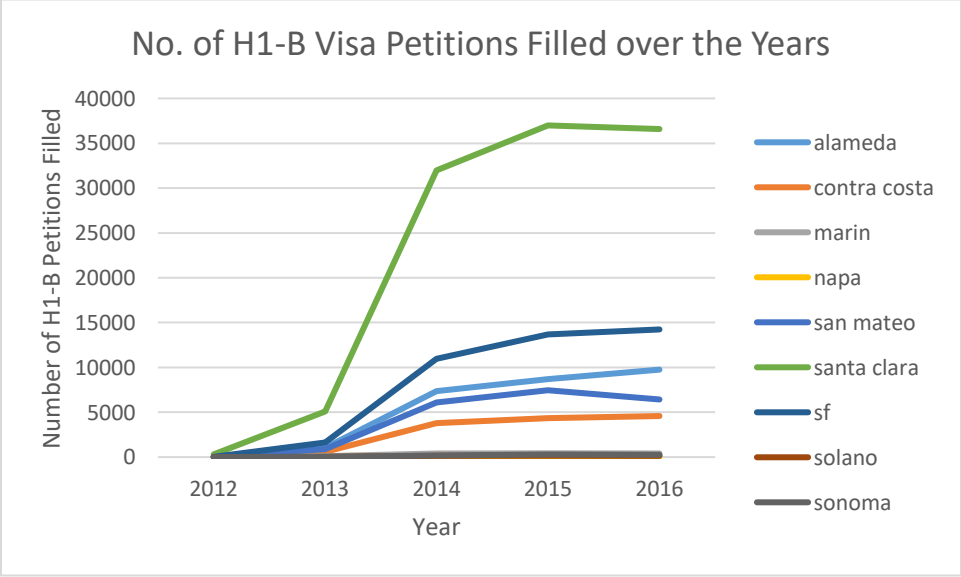
The graph below shows the increase in median household income from 2012 to 2016 in the 9 counties in the Bay Area. Santa Clara County and San Francisco County have the highest median household incomes compared to the rest of the counties. Santa Clara has the highest in almost all the years except 2014.



The graph below shows the appreciation of House Price Index in each of the counties in the Bay Area from 2012 to 2016. There is no drop in the housing price index. San Francisco County beating all other counties over the years.



The graph below shows the number of H1-B Visa Petitions filled over the years in each of the counties in the Bay Area. In the year 2012, there were some cities with very few H1-B visas filled. But from 2013, number of H1-B visas issued is increasing at alarming numbers. Santa Clara County ranks number 1 as it is the Tech Hub and most of the H1-B visa holders are employed in Tech.



Summary of the Variables in the Data

Variable	Obs	Mean	Std. Dev,	Min	Max
Year	45	2014	1.430194	2012	2016
Hpi	45	159.7424	30.9675	97.03	241.16

interest	45	3.304	0.1042375	3.25	3.51
Units	45	315799.7	199992.3	55010	665705
Income	45	82012.71	14102.62	59855	110843
H1b	45	4783.756	9113.225	0	36990
County	0				

There are a total of 45 observations in the data set as there are 9 counties and it is over a period of 5 years (2012 to 2016). The bank prime interest rate has not increased much over the years, the standard deviation is just 0.1. The standard deviation for the number of housing units, median household income and number of H1-B visa petitions is immense. By looking at the min and the max for those three variables, there is an enormous difference. This raises a question as what is going in the Bay Area housing market.

5. Estimation Procedure

$Hpi_i = \beta_0 + \beta_1 interest_i + \beta_2 units_i + \beta_3 income_i + u_i$

hpi is the housing price index
interest is the bank prime interest rate
units is the number of housing units
income is the median household income

Hypothesis to test the model
H_o: $\beta_3 = 0$
H_a: $\beta_3 \neq 0$
The null hypothesis will be tested at p value of 0.05.

Housing Price Index is an estimation of many variables but for this research bank prime rate, number of housing units and median household income is used. Due to the omission of other variables which cannot be observed and can be correlated, there can be a problem of endogeneity. Also, number of housing units is the supply factor of the housing market. Prices are fixed at an equilibrium point where supply is equal to demand. This causes the problem of simultaneity. An attempt to fix the two problems, an instrumental variable can be used.

In order to estimate this IV regression, the basic econometric assumptions needed for the number of H1-B visa petitions to be considered a good instrument in this regression are:

a. Instrument exogeneity – Cov (z_i, u_i) = 0 number of H1-B petitions filled should not be correlated with the omitted variables in the error term.
b. Instrument relevance – Cov (z_i, x_i) ≠ 0 – number of H1-B visa petitions filled should be correlated with the median household income.

   The correlation for number of H1-B petitions filled and median household income is 0.5

To estimate this model with the help of an instrument, we will assume that number of H1-B visa petitions filled only affects the house price index through its effect on median household income.

In order for number of H1-B petitions filled to be considered as a good instrument the F statistics from first stage regression should be greater than 10.

6. Results – Part 1

(OLS Model)	
VARIABLES	hpi
interest	128.4***
	(34.44)
units	3.75e-06
	(1.80e-05)
income	0.000971***
	(0.000272)
Constant	-345.2***
	(108.2)
Observations	45
R-squared	0.523

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(IV)	
VARIABLES	hpi
interest	88.82*
	(45.67)
units	-1.71e-05
	(2.39e-05)
income	0.00182***
	(0.000655)
Constant	-277.8**
	(124.0)
Observations	45
R-squared	0.409

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Estat firststage
First-stage regression summary statistics

Variable	R-sq.	Adjusted R- sq.	Partial R-sq.	F(1,41)	Prob > F
Income	0.3887	0.3440	0.1945	9.89975	0.0031

Minimum eigenvalue statistic = 9.89975

Critical Values	# of endogenous regressors: 1			
Ho: Instruments are weak	# of excluded instruments: 1			
	5%	10%	20%	30%
2SLS relative bias	(not available)			
	10%	15%	20%	25%
2SLS Size of nominal 5% Wald test	16.38	8.96	6.66	5.53
LIML Size of nominal 5% Wald test	16.38	8.96	6.66	5.53

7. Results – Part 2

The results in the above estimations reject the null hypothesis at p value lesser than 0.05. Median household income given that they are on H1-B visa status does have an impact on the house price index of the Bay Area.

The model was estimated first using OLS. The coefficient on income is 0.000971. Median household income does have an impact on the housing prices. This model is subject to omitted variable bias and also has a simultaneity issue. Bank prime interest rate is of statistically significance at 5% level. Hence, the estimates of the coefficients are not viable.

The coefficient on income using an instrumental variable is 0.00182. The value has increased from 0.000971 to 0.00182. H1-B visa holders do control for the median housing income in the Bay Area. Under this method, bank prime interest rate losses its statistical significance at 5% level.

However, the F statistics from the first stage regression is 9.89975. This makes the number of H1-B visa petitions filled to be a weak instrument. The F stats is lesser than 10 but it is very close to 10.

8. Limitations of the Research

Given the results, this model suffers a few limitations. Although to estimate the model, it is assumed that there is instrument exogeneity. But there are a lot of factors contained in the error term like years of education, number of work experience etc. that are correlated with the number of H1-B visa petitions filled. Also, there are other factors that have led to the increase in the median household income in the Bay Area like number of family members, foreign investment etc. There are many factors which have not be observed in this research and have been placed in

the error term. Another limitation of this research is that number of H1-B petitions filled is a weak instrument, the F stat is close to 10 but not greater than 10.

In order to overcome the limitations, more data can be added. More number of years can be added to the dataset to get a better estimation. A better measure than the median housing income is income of specialty workers. These specialty workers have high income and makes them capable to bid for a high price property. And a majority of the H1-B visa holders are specialty workers. More variables like average rent can also be added to the model.

9. Conclusion

The Bay Area housing bubble can be well understood with the impact of the H1-B visa holders. The housing prices and the median income are rising at a tremendous pace. H1-B visa holders have driven up the median housing income in the Bay Area. The property values have increased because people have high income in the Bay Area. This is significantly important as President Trump plans to place a ban on the H1-B visa renewal. This means that after the initial 3 years, the H1-B visa holders will not be able to extend their work permit for another 3 years. If these highly specialty workers have to move out of the Bay Area, the median housing income will fall and so will the house price index of the Bay Area.

10. Citations

[1] Bay Area homes deliver record-breaking returns. Retrieved from https://www.mercurynews.com/2018/02/28/bay-area-home-prices-continue-to-rise-in-record-breaking-streak/

[2]San Francisco Bay Area. (2018, June 06). Retrieved from https://en.wikipedia.org/wiki/San_Francisco_Bay_Area#Economy

[3]Financial Analyst Salary in San Francisco, CA (June 2018). (n.d.). Retrieved from https://www.glassdoor.com/Salaries/san-francisco-financial-analyst-salary-SRCH_IL.0,13_IM759_KO14,31.htm

[4]Bay Area homes deliver record-breaking returns. Retrieved from https://www.mercurynews.com/2018/02/28/bay-area-home-prices-continue-to-rise-in-record-breaking-streak/

[5]Did you know that USCIS receives and adjudicates approximately 6 million petitions and applications annually? (n.d.). Retrieved from https://www.uscis.gov/tools/reports-studies/immigration-forms-data

[6]Computer Engineer Salary in San Francisco, CA (June 2018). (n.d.). Retrieved from https://www.glassdoor.com/Salaries/san-francisco-computer-engineer-salary-SRCH_IL.0,13_IM759_KO14,31.htm

[7]Cervero, R. (1996). Jobs-Housing Balance Revisited: Trends and Impacts in the San Francisco Bay Area. *Journal of the American Planning Association, 62*(4), 492-511.

Data

Search Salary Now. (n.d.). Retrieved from http://h1bdata.info/index.php

US Census Bureau. (n.d.). National, State, and County Housing Unit Totals: 2010-2016. Retrieved from https://www.census.gov/data/tables/2016/demo/popest/total-housing-units.html
Board of Governors of the Federal Reserve System (US), Bank Prime Loan Rate [MPRIME], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/MPRIME, June 7, 2018.
U.S. Federal Housing Finance Agency, All-Transactions House Price Index for Alameda County, CA [ATNHPIUS06001A], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/ATNHPIUS06001A, June 7, 2018.
U.S. Federal Housing Finance Agency, All-Transactions House Price Index for Contra Costa County, CA [ATNHPIUS06013A], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/ATNHPIUS06013A, June 7, 2018.
U.S. Federal Housing Finance Agency, All-Transactions House Price Index for Marin County, CA [ATNHPIUS06041A], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/ATNHPIUS06041A, June 7, 2018.
U.S. Federal Housing Finance Agency, All-Transactions House Price Index for Napa County, CA [ATNHPIUS06055A], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/ATNHPIUS06055A, June 7, 2018.
U.S. Federal Housing Finance Agency, All-Transactions House Price Index for San Francisco County, CA [ATNHPIUS06075A], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/ATNHPIUS06075A, June 7, 2018.
U.S. Federal Housing Finance Agency, All-Transactions House Price Index for Santa Clara County, CA [ATNHPIUS06085A], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/ATNHPIUS06085A, June 7, 2018.
U.S. Federal Housing Finance Agency, All-Transactions House Price Index for San Mateo County, CA [ATNHPIUS06081A], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/ATNHPIUS06081A, June 7, 2018.
U.S. Federal Housing Finance Agency, All-Transactions House Price Index for Solano County, CA [ATNHPIUS06095A], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/ATNHPIUS06095A, June 7, 2018.
U.S. Federal Housing Finance Agency, All-Transactions House Price Index for Sonoma County, CA [ATNHPIUS06097A], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/ATNHPIUS06097A, June 7, 2018.
U.S. Bureau of the Census, Estimate of Median Household Income for Alameda County, CA [MHICA06001A052NCEN], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/MHICA06001A052NCEN, June 7, 2018.
U.S. Bureau of the Census, Estimate of Median Household Income for Contra Costa County, CA [MHICA06013A052NCEN], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/MHICA06013A052NCEN, June 7, 2018.
U.S. Bureau of the Census, Estimate of Median Household Income for Marin County, CA [MHICA06041A052NCEN], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/MHICA06041A052NCEN, June 7, 2018.
U.S. Bureau of the Census, Estimate of Median Household Income for Napa County, CA [MHICA06055A052NCEN], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/MHICA06055A052NCEN, June 7, 2018.

U.S. Bureau of the Census, Estimate of Median Household Income for San Francisco County/City, CA [MHICA06075A052NCEN], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/MHICA06075A052NCEN, June 7, 2018.
U.S. Bureau of the Census, Estimate of Median Household Income for Santa Clara County, CA [MHICA06085A052NCEN], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/MHICA06085A052NCEN, June 7, 2018.
U.S. Bureau of the Census, Estimate of Median Household Income for San Mateo County, CA [MHICA06081A052NCEN], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/MHICA06081A052NCEN, June 7, 2018.
U.S. Bureau of the Census, Estimate of Median Household Income for Solano County, CA [MHICA06095A052NCEN], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/MHICA06095A052NCEN, June 7, 2018.
U.S. Bureau of the Census, Estimate of Median Household Income for Sonoma County, CA [MHICA06097A052NCEN], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/MHICA06097A052NCEN, June 7, 2018.