

The Fundamentals of the Housing Market: A Closer Look at Los Angeles

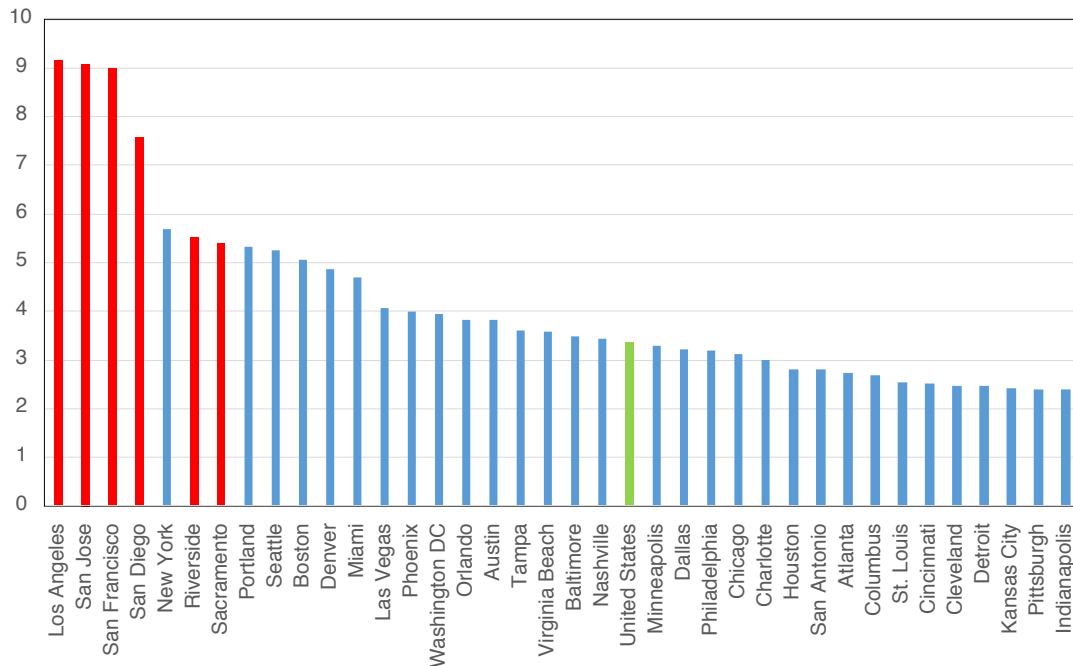
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Across California, first-time homebuyers are complaining of expensive and unaffordable home prices, especially in the Bay Area and Los Angeles regions. Of the seven least affordable metros in the country (Los Angeles, San Jose, San Francisco, San Diego, New York, Riverside, and Sacramento), six are in California. As shown in Figure 1A, affordability is measured by the ratio of the median home price to the median household income. It is also tough for California renters as shown in Figure 1B by the ratio of the

median rent to the median household income. Of the seven least affordable metros for renters in the country, five are in California. In particular, for Los Angeles residents need to pay more than half of their income on rental.

Why are California metros so unaffordable? The simple answer is the supply and demand of the housing markets. Taking a closer look at supply and demand factors illuminates the difficulties for California homebuyers.

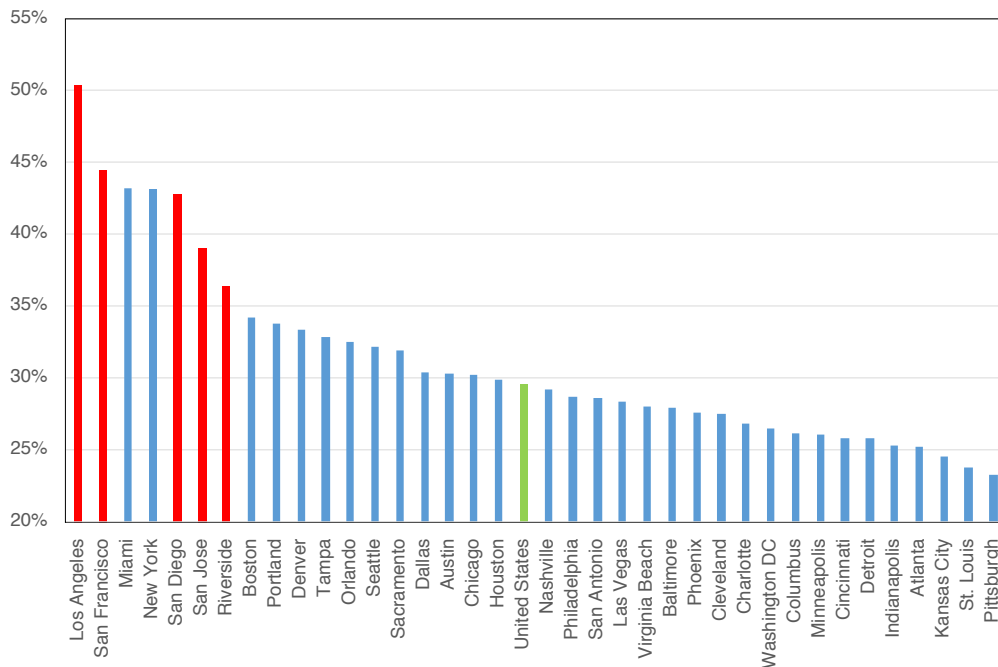
Figure 1A Ratio of Median Home Price to Median Household Income, 2016Q4



Source: Zillow

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Figure 1B Ratio of Median Rent to Median Household Income, 2016Q4

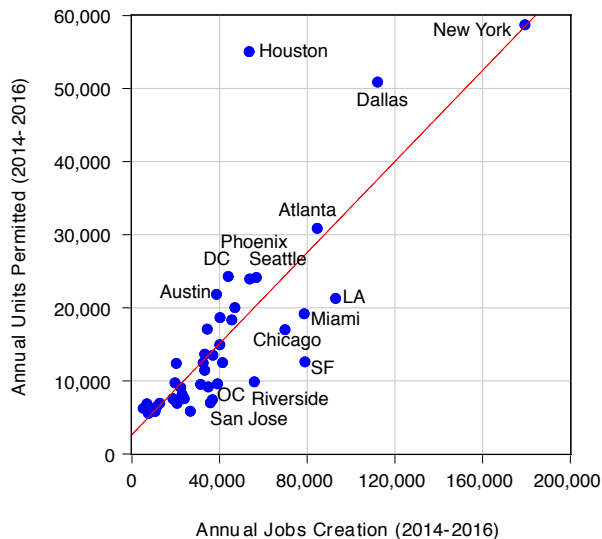


Source: Zillow

In William Yu’s Forecast article in 2013 entitled: “What Predicts the Long-term Home Price Appreciation of A City? Evidence From 1995 to 2012,” we identify two supply factors (housing supply and unavailable land) and three demand factors (economic growth, human capital and ocean dummy¹ as amenities proxy) that significantly predict long-term price appreciation for 303 metros during the period. Like some housing market research in the economics literature, we suggest that limited supply to demand is one of the major causes of high home prices in coastal California.

Can the demand and supply factors still explain and predict home prices across the country over the past three years? Figure 2 presents the correlation between the average annual payroll jobs created and average annual housing units permitted from 2014 to 2016 for 43 major metros. The red line indicates the average relationship between job creation and new housing supply of a metro. By and large, big metros, like New York, created more jobs as well as housing units than small metros, like Austin. However, we see some dispersion along the red line. For those metros (e.g. Dallas and Houston) above the red line, it means that

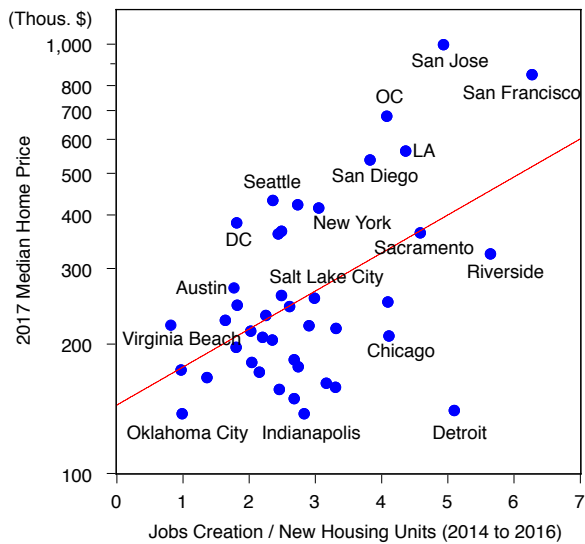
Figure 2 Correlation Between Average Annual Jobs Creation and Average Annual Housing Units Permitted, 2014 to 2016



Sources: Bureau of Labor Statistics and Census

1. If a metro is adjacent to the Pacific or Atlantic Ocean, it is assigned as one, otherwise, zero.

Figure 3 Correlation Between Jobs-to-Units Ratios (2014-2016) and Median Home Prices (2017)



Sources: Bureau of Labor Statistics, Zillow, and Census' American Community Survey 5 Year (2011 to 2015)

they supply more housing units for a new job compared to those metros below the red line. Notice that major California metros are all below the red line, meaning that California housing supply growth is less than demand growth compared to other metros.

Figure 3 displays a positive correlation between job-to-housing unit ratios from 2014 to 2016 and the median home prices in 2017. Note that the higher the ratio of jobs-to-units, the less the supply of local housing to match the demand for housing induced by economic growth. As we can see in Figure 3, San Francisco, Riverside, San Jose, L.A., and Sacramento have high ratios compared to Virginia Beach or Oklahoma City. The red line shows us the relationship we expect: low ratios (meaning more housing supply to demand) predict low home prices while high ratios (less housing supply to demand) predict high home prices.

That said, what we found in the period of 1995 to 2012 is still holding true in the period of 2014 to 2016. Even given its stronger economic recovery, California still has relatively

limited housing supply because of its stringent regulations, such as CEQA (California Environmental Quality Act) and NIMBY (Not in My Back Yard) culture. That is largely why we have less affordable housing markets here. Furthermore, we can see that metros above the red line are mostly located in coastal area with more amenities and therefore price premiums, while those below the red line are in inland regions.

A Closer Look At the Los Angeles Housing Market

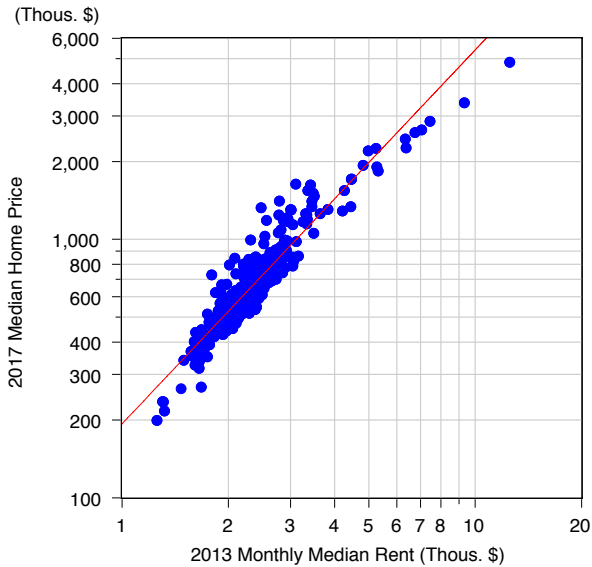
Figure 4 presents the median home prices by zip code across the larger Los Angeles metro area (including Orange County) in April 2017. What explains the home price disparity among 340 zip codes across the region, ranging from \$200,000 homes to \$4.8 million mansions?

Figure 4 The Median Home Price by Zip Code in Los Angeles Metro, April 2017



Source: Zillow

Figure 5 Correlation Between Monthly Median Rent, April 2013, and Median Home Value by Zip Code, April 2017



Source: Zillow

The first possibility to explain the wide difference of median home prices across L.A. is the rent. In general, the inherent value of a home is the net present value of all its future expected rent revenues. Indeed, Figure 5 shows a strong correlation between the rents and home prices of a zip code (A simple regression shows R-squared of 0.91).

Determinants for Housing Rents

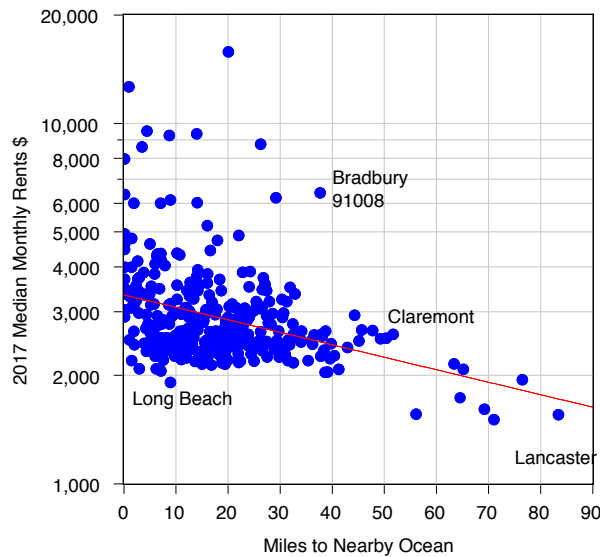
What explains the variation of the median rent of a zip code across L.A.? We run some regressions and find the following equation that can explain 69% of the variation of home prices among 340 zip codes with six significant factors as follow:

- Median household income in 2013: A higher median household income of a zip code implies the residents are more productive and have more income to afford higher rent. This is a very reasonable predictor.
- Distance (miles) to ocean: In our 2013 article, we suggested that bicoastal metros, such as L.A. and New York, have positive rent premiums due to higher demand for natural amenities (in this case, the ocean) compared to inland metros, such as Las Vegas or Kansas City. Following the same logic, here we suspect that a zip code closer to the ocean, such as Santa Monica, would have higher demand due to access to ocean/beach and the consequent mild temperature all-year long compared to a zip code farther from the ocean, such as Palmdale. The negative correlation as shown in Figure 6 confirms this common attitude.
- Human Capital Index in 2012: In addition to income, we find that more highly educated residents might bring desirable benefits to a zip code, such as a better public school and lower crime rates, which contribute to higher demand and rent.
- New housing supply from 2000 to 2014: As we mentioned before, a lower supply of housing (building permits) in a zip code will drive the rent higher given the same amount of demand.
- City of Los Angeles: After controlling all previous variables, we find that zip codes in the City of Los Angeles enjoy a higher rent than the rest of the zip codes. We suggest two reasons: (1) the City of Los Angeles is the home of major corporations located in Downtown or Century City as well as an international airport as a gateway to other major global cities. (2) Young people (ages 25 to 34), who tend to be renters, are more likely to live in the City of Los Angeles for its urban amenities.

Equation 1 Housing Rents Regression Model

Log(Rent) April 2017 =	α	$+\beta_1$	Median Household Income	$+\beta_2$	Miles to Ocean	$+\beta_3$	City Human Capital Index	$+\beta_4$	Housing Supply	$+\beta_5$	City of Los Angeles	$+\beta_6$	Orange County
(estimator)	7.1	6E-06		-0.005		0.004		-0.003		0.133		-0.08	
(t-stat)	(-97)	(10)		(-7.3)		(5.5)		(-3.8)		(5.8)		(-3)	
AdjR squared = 0.69												Observation = 338	
Equation 1													

Figure 6 Correlation Between Miles to Ocean and Monthly Median Rent by Zip Code, April 2017



Sources: Zillow and author's calculation

- Orange County: It is a bit unclear why zip codes in Orange County tend to have a lower rent than those in Los Angeles County. We suggest that one possible reason is that the distance of OC zip codes is farther from Downtown L.A. and LAX airport than L.A. County zip codes, which is the opposite side of the City of Los Angeles factor mentioned above.

Figure 6 exhibits why the distance (miles) to the ocean is a factor determining rents of a zip code. The negative correlation demonstrates that a location farther from the beach is less desirable because of decreasing natural amenities.

Determinants for Housing Prices

Now, the next question is: In addition to rent revenues, are there other factors that will explain or predict the variation of median home prices of a zip code in L.A.? We have heard that many foreign buyers, especially Chinese investors, have been buying real estate in Los Angeles over the past several years. Does it play a role in rising home prices? Does the urban revival trend among suburb-rejecting young people influence housing prices?

Here we provide our simple regression model to answer these questions.

- Median rent in April 2013²: As mentioned above, the median rent of a zip code is the single most important predictor of the home price with a very significant t-statistic of 33. We use the rent in April 2013 to make sure it is more of an exogenous variable to predict home prices.
- Human Capital Index in 2012: As mentioned above, the human capital index already explains the rent by capturing non-income local factors. Now, besides rent, the human capital index has additional predictive power on home prices for asset investors. That said, high-human capital areas produce a price premium for homebuyers with a significant t-statistic of 8.7. Figure 7 shows a positive correlation between the human capital index and median home prices.
- Distance (miles) to ocean: Besides rents, distance to the ocean has additional predictive power on home prices for investors. Figure 8 shows a negative correlation between the distance to the ocean and median home prices. Figure 9 shows a stronger negative correlation between the distance to the ocean and median home prices per square foot.

Equation 2 Housing Price Regression Model

Log(Price) April 2017	=	α	+ β_1	Log(Rent) April 2013	+ β_2	City Human Capital Index	+ β_3	Miles to Ocean	+ β_4	Housing Supply	+ β_5	Chinese Resident %	+ β_6	Young (Age 25 to 34) %
(estimator)		3	1.31	0.002		-0.002		-0.004		0.004		0.01		
(tstat)		(10)	(33)	(5)		(-3.9)		(-5.2)		(4.5)		(7.9)		
Adj.R squared = 0.92				Observation = 338										

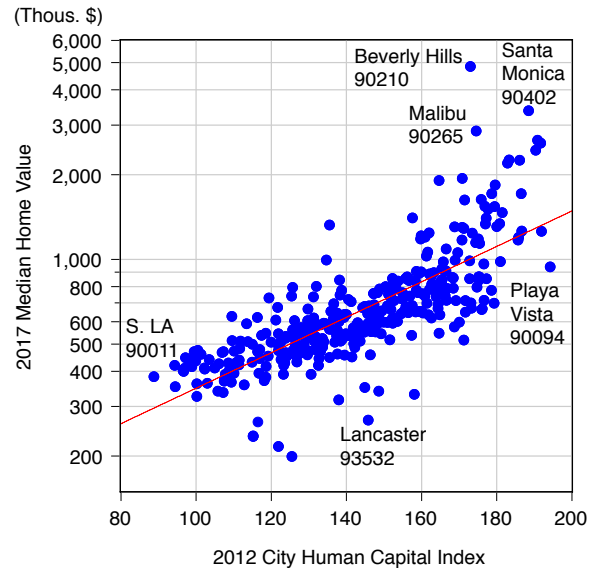
Equation 2

2. Calculated as the average rental rates of April 2012, 2013 and 2014.

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- **New housing supply 2000 to 2014:** Besides rent, housing supply provides additional predictive insight to home prices where less home supply leads to higher home prices.
- **Chinese population % in 2013:** The fraction of Chinese population in a zip code provides additional insight to home prices. As we suspect, a zip code with more Chinese or Chinese American population tends to attract more affluent Chinese investors buying its properties, presumably because of the availability of Chinese grocery stores, restaurants, services and the increased possibility of Chinese language communication. Figure 10 shows a positive correlation between the Chinese population percentage and median home prices. We found that the Asian population percentage is also a positive predictor of zip code home price as shown in Figure 11. Figure 12 displays the L.A. map colored by intensity of Chinese population by zip code.
- **Young resident %, Age 25 to 34 in 2013:** A zip code with a higher percentage of young residents, age 25 to 34, predicts higher home prices. One possible reason is that young people tend to live in areas with vibrancy and dynamism, which include cultural amenities that drive up demand and price premiums. Figure 13 displays the L.A. map colored by intensity of young residents by zip code.

Figure 7 Correlation Between Human Capital Index and Median Home Value by Zip Code, April 2017



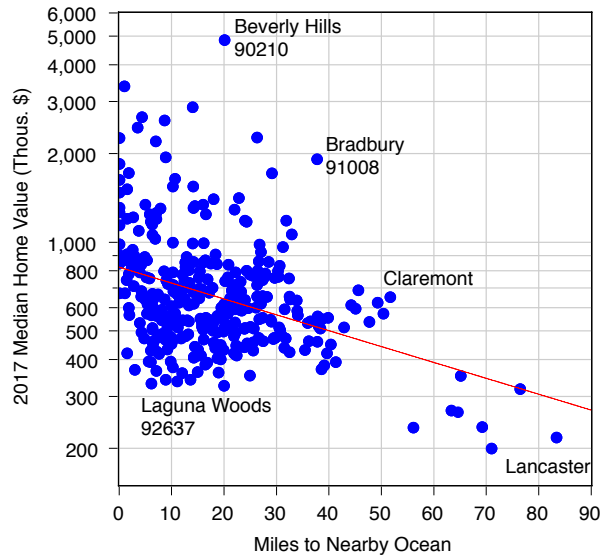
Sources: Zillow and author's calculation based on Census' American Community Survey 5 Year (2010-2014)

Equation 3 Housing Price Regression Model

Log(Price) April 2017	=	α	+	City Human Capital Index	+	Miles to Ocean	+	Housing Supply	+	City of L.A.	+	OC	+	Chinese Resident %	+	Young (Age 25 to 34) %
			β_1		β_2		β_3		β_4		β_5		β_6		β_7	
(estimator)		5		0.008		-0.01		-0.005		0.06		-0.12		0.004		0.012
(t-stat)		(52)		(15)		(-11)		(-4.4)		(2.3)		(-3.9)		(3.1)		(4.3)
Adj.R squared = 0.62				Observation = 338												

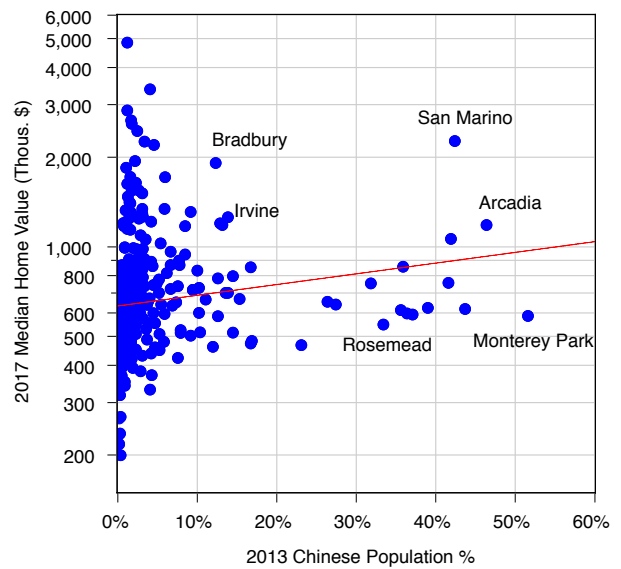
Equation 3

Figure 8 Correlation Between Miles to Ocean and Median Home Value by Zip Code, April 2017



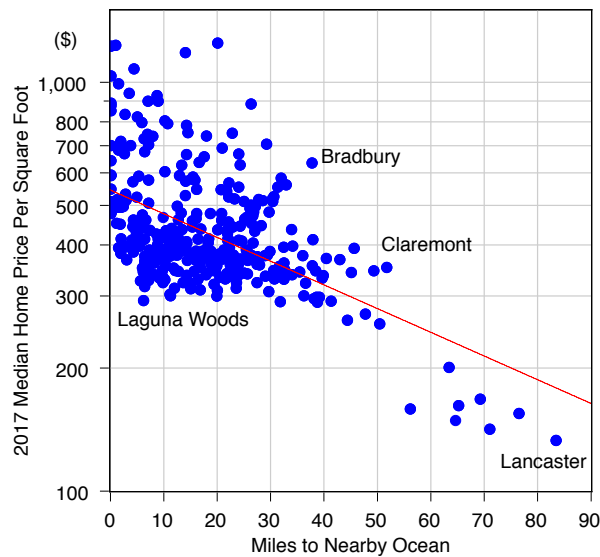
Sources: Zillow and author's calculation

Figure 10 Correlation Between the Percentage of Chinese Population and Median Home Value by Zip Code, April 2017



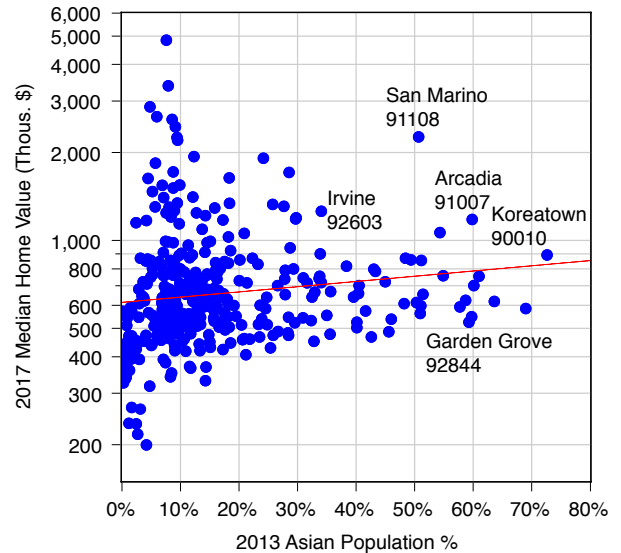
Sources: Zillow and Census' American Community Survey 5 Year (2011 to 2015)

Figure 9 Correlation Between Miles to Ocean and Median Home Value Per Square Foot by Zip Code, April 2017



Sources: Zillow and author's calculation

Figure 11 Correlation Between the Percentage of 2013 Asian Population and Median Home Value by Zip Code, April 2017



Sources: Zillow and Census' American Community Survey 5 Year (2011 to 2015)

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Housing Prices Prediction with Rents

One could argue that housing rents and prices are determined jointly and therefore could be essentially the same variable. To consider this concern, we remove the rents from

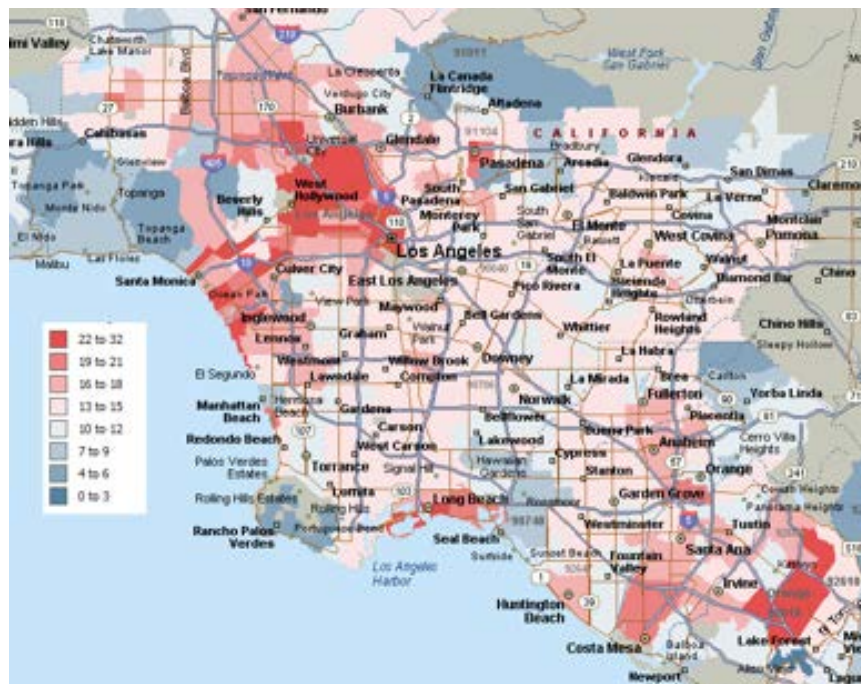
our regression. The result shows that all the variables we discussed are still significant as follow. In general, the factors we described before that were statistically significant are still robust predictors for home prices without considering rents. The adjusted R squared does drop from 0.92 to 0.62.

Figure 12 The Percentage of Chinese / Chinese American Population in Los Angeles Metro, 2013



Source: Census' American Community Survey 5 Year (2011 to 2015)

Figure 13 The Percentage of Residents Age 25 to 34 in Los Angeles Metro, 2013



Source: Census' American Community Survey 5 Year (2011 to 2015)

Predicted Housing Prices vs Actual Housing Prices

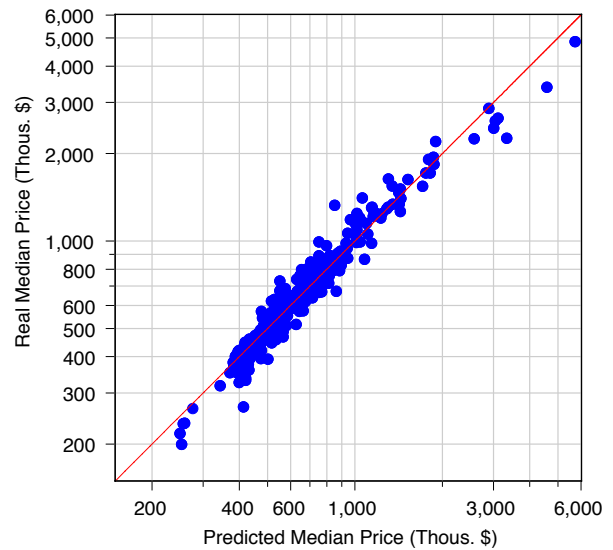
We can use our model (Equation 2)³ to predict the home prices given those six factors and compare them to the actual home prices as shown in Figure 14. By and large, our model predicts well with the actual home prices. If we believe our model is correct and complete, then we can say those zip codes above the red line (45% line) are overvalued since their actual price is higher than the predicted price. In contrast, those zip codes below the 45% line are undervalued because their actual median prices are lower than predicted prices.

Figure 15 shows the difference of the actual home prices and predicted prices based on Equation 2 where the color red means those zip codes are overvalued and the color blue means they are undervalued. The darker the color, the bigger the difference between actual and predicted. Figure 16 shows the difference of the actual home prices per square foot and predicted prices per square foot based on Equation 3.

Note that we do not suggest that those zip codes that are undervalued will see higher price growth in the future. As can be seen from the upper right corner of Figure 14, those extremely expensive zip codes are mostly undervalued. Why? One reason is that the home prices are so high that they are beyond reach even for many of the rich. As such, their price growth will be smaller than other cheaper zip codes. Equation 3 shows this hypothesis. We found three factors that can explain the median home price growth from 2014 to 2016. Of course, the major predictor is the rent growth from

2014 to 2016. Second, there is a negative correlation between median home price growth from 2014 to 2016 and median home price levels in 2012. In other words, high home price zip codes would have a lower price growth rate, perhaps because fewer and fewer Americans or internationals would be able to afford such expensive homes.

Figure 14 The Actual Median Home Prices and Predicted Home Prices by Zip Code in Los Angeles Metro, 2017



Sources: Zillow and author's calculation

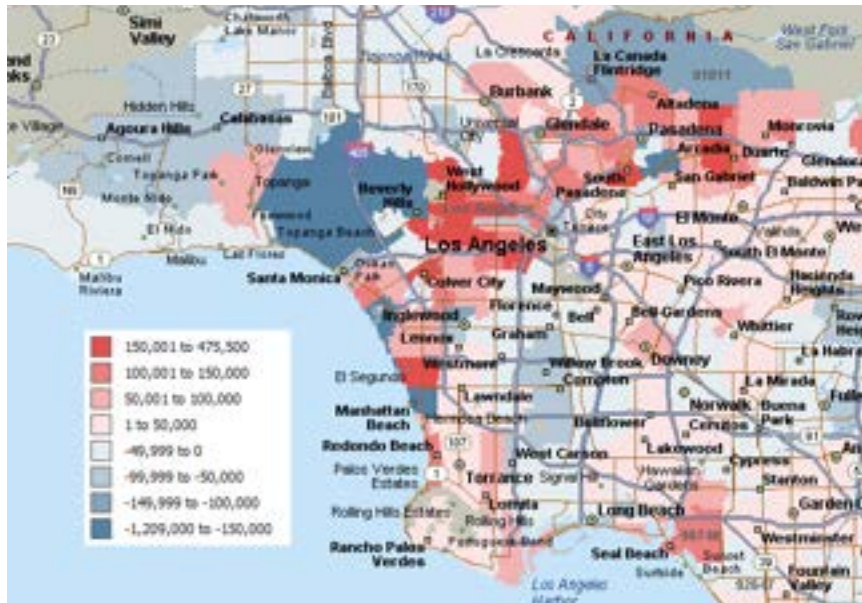
Equation 4 Housing Price Regression Model

Price growth 14'-16'	=	α	+ β_1	Rent Growth 14'-16'	+ β_2	Log(price) In 2012	+ β_3	City of Los Angeles
(estimator)		0.9	0.7		-0.06		0.025	
(t-stat)		(6.5)	(11)		(6)		(2.8)	
Adj. R squared = 0.57				Observation = 339				Equation 4

5. Here we use the log rents in April 2017 instead of April 2013 to get a better prediction.

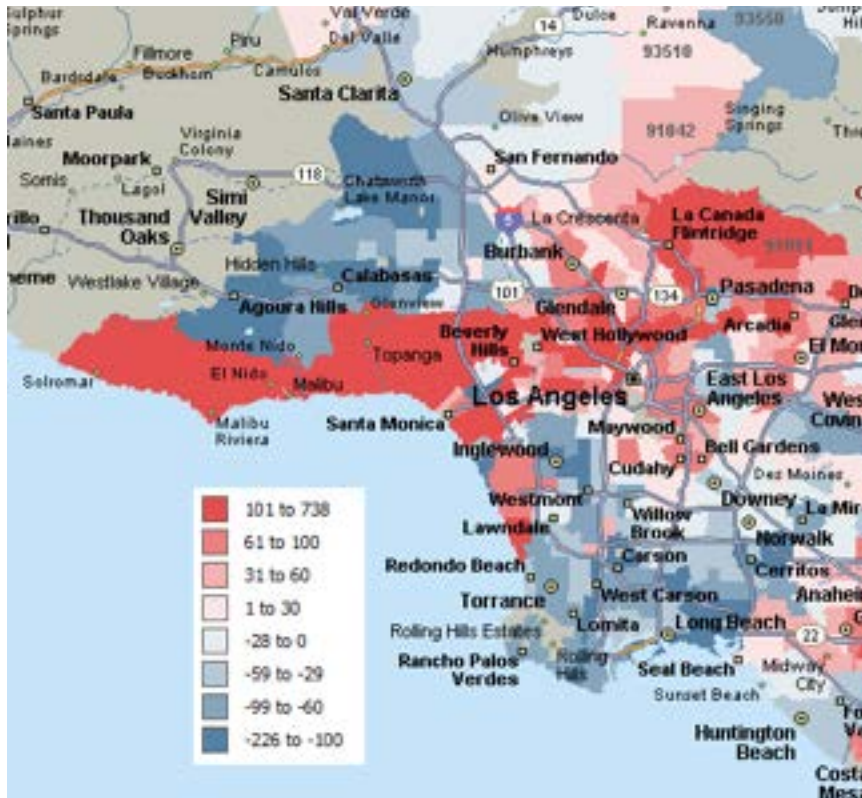
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Figure 15 The Difference Between the Actual Median Home Prices and Predicted Home Prices by Zip Code in Los Angeles Metros, 2017



Sources: Zillow and author's calculation

Figure 16 The Difference Between the Actual Median Home Prices Per Square Foot and Predicted Home Prices Per Squared Foot (Without Rent Factor) by Zip Code in Los Angeles Metros, 2017



Sources: Zillow and author's calculation

Conclusions

Based on the fundamentals (high demand and limited supply) of the housing markets around the country and particularly in Los Angeles, extremely high home prices in Los Angeles might persist for some time. In terms of the macroeconomy and business cycle given the historically low interest rates, home price growth might continue until the next recession hits.

Taking a closer look at the housing markets by zip code in the Los Angeles metro, we suggest the following take-aways:

- The median rent (level and growth rate) could explain most of median home price (level and growth rate) of a zip code in Los Angeles.
- Variation of rent across zip codes is correlated with the following factors: (1) Median household income (positive), (2) Distance to the ocean (negative because distant zip codes represent a lower level of natural amenities), (3) Human capital index (positive), (4) New housing supply (negative), (5) City of Los Angeles (positive) - indicating that zip codes in Los Angeles have higher rent than otherwise. The reason could be some cultural amenities and superstar city characteristics, such as skyscrapers, headquarters, theaters, museums, and an international airport provided by global cities, which are located in the City of Los Angeles, (3) Orange County (negative) indicating that Orange County zip codes have lower rent than L.A. County's. One reason could be its farther distance from Downtown L.A. and LAX airport.
- Beyond rents, we find two additional variables that can explain the variation of median home price of a zip code: (1) Chinese/Asian population percentage (positive), echoing what we have heard over the past several years. Affluent Chinese investors like to buy homes in those communities where there is already a higher percentage of Chinese residents. (2) Young (age 25 to 34) residents (positive), meaning that a zip code with more young residents tends to have a higher median home price. The reason could be the certain demographic trend toward urban vibrancy and cultural amenities in an area, will drive up the home price.