What Predicts the Long-Term Home Price Appreciation of a City?

Evidence From 1995 to 2012

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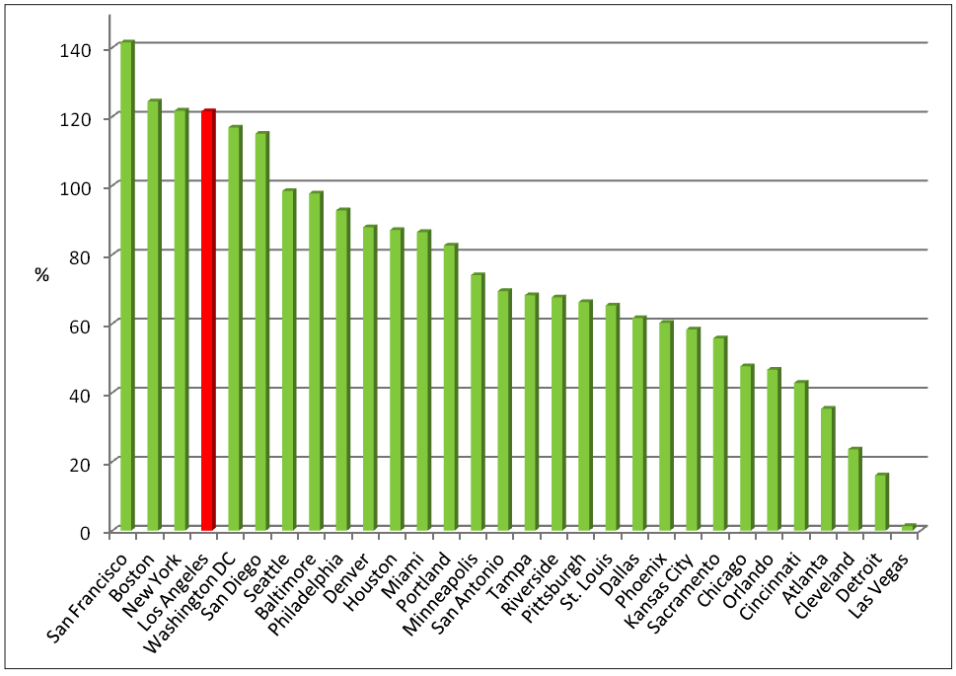
As the housing market stabilizes after its monumental boom and bust of the 2000s, we can perhaps now return to a discussion of the fundamentals of housing prices. Beyond the housing bubble, what explains the home price growth disparity across cities in the U.S.? In the long run, just like all other free-market products, we believe that regional home price growth is determined mainly by local fundamentals, i.e., demand and supply.[1] This report will examine some common-sense factors to see how they explain the home price growth across 303 metropolitan areas in the U.S. in both a statistical and economic context.

Figure 1 displays the nominal single-family home price appreciation from 1995Q1 to 2012Q3 according to the Federal Housing Finance Agency (FHFA) for the 30 largest metropolitan areas in the U.S. Note that we chose this period because 1995 is the earliest year for which we have data for an important determinant (building permits) in our research. More importantly, following the 5-year housing boom period (2002 to 2006) and the 5-year slump (2007 to 2011), 2012 is the beginning of the housing market recovery. As a result, we believe that 2012Q3 would be a reasonable ending point for our fundamental analysis. In other words,

Figure 1 Single-Family Home Price Appreciation from 1995Q1 to 2012Q3 for the 30 Largest Metropolitan Areas in the U.S.



Source: Federal Housing Finance Agency

non-fundamental factors, such as psychological fad and panic, irrational expectation of future home prices, subprime mortgage fiascos, while important during the later part of the 1995-2012 period, are not major determinants of house price levels at the endpoint of the period. Therefore, the net change from 1995 to 2012 is largely free of their influences.

We can see that San Francisco has the highest home price appreciation—142% (5% compounded growth per year) over the past 18 years, followed by Boston's 124%, New York's 122%, Los Angeles's 122%, Washington D.C.'s 117%, Miami's 87%, Phoenix's 60%, Chicago's 48%, Atlanta's 35%, Detroit's 16%, and Las Vegas' barely 1%. The question is: What explains this prodigious difference of home price growths across cities in the U.S.?

SUPPLY AND DEMAND

Determinants that we believe explain this disparity can be summarized into two categories: demand factors and supply factors. Demand factors include mostly economic factors, such as income growth, employment growth, and population growth of a city, but also non-economic factors, e.g. amenities and climate. Dynamics of all economic factors in the past will to some extent be projected into the growth of rent and house price in the future. It is not surprising that when a city has higher income, employment, and population growth, or when it has better amenities, the home demand in the city rises.

Supply, summarized as the growth of building permits, is determined mainly by three factors: (1) the cost of land, which varies according to the availability of developable land (a natural factor), (2) government regulations (a man-made factor), and (3) physical building costs. In the following regression analysis, we do consider that cities with a high percentage of undevelopable land will have higher construction costs. By and large, however, we assume that the growth of costs of building a home and its quality improvement does not vary significantly across the country. In theory, the gap between the growth of supply and the growth of demand in a city should predict long-term home price appreciation. Just as in introductory Economics, the bigger the gap (supply minus demand), or the larger supply elasticity, the smaller the home price appreciation. For simplicity's sake, as a representative variable of demand we use personal income growth, which potentially includes all the income, employment, and population growth of a city.

LITERATURE REVIEW

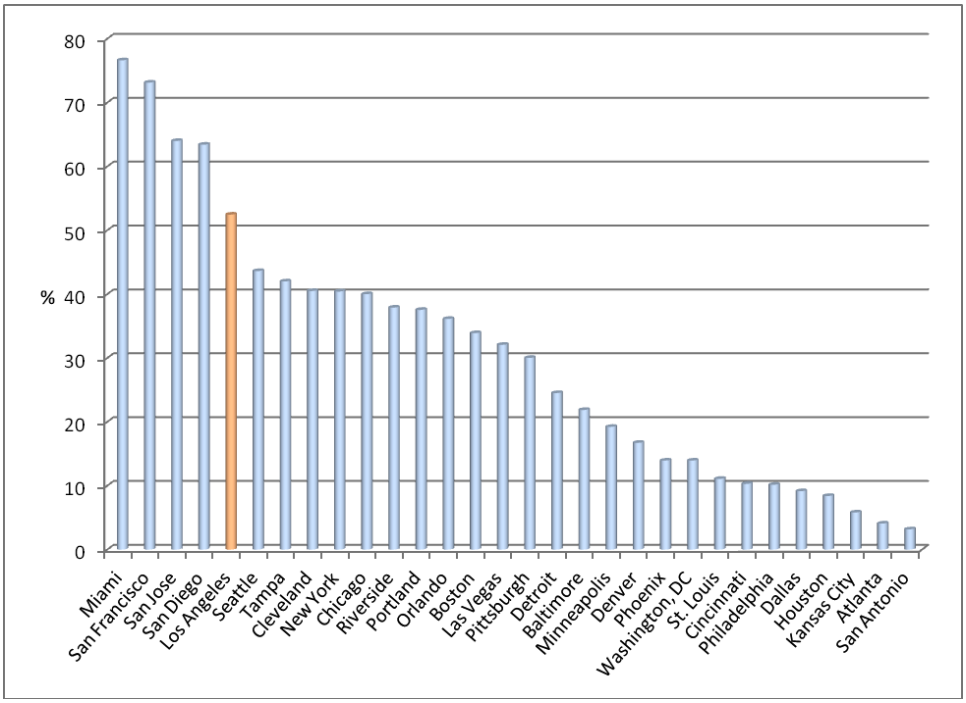
While literature in determinants of housing price is considerable, most of them focused on either one or several demand-side or supply-side factors. Few have analyzed a comprehensive supply-and-demand framework. Our study proposes a simple but holistic empirical model to answer the question by using the latest period (1995-2012) of data. We summarize major important findings in the literature.

- Malpezzi et al. (1998)[2] find that the income level and the past income growth are positively related to housing prices and rents in 1990. Larger cities generally have higher housing prices. Changes in population are not a significant predictor. More stringent regulation predicts higher housing prices and rents.
- Moretti (2004)[3] summarizes the social return of human capital. He suggests that a city with high human capital will increase productivity beyond the individual level, will reduce criminal participation, improve voters' political behavior, and create land price premiums.
- Glaeser, Gyourko, and Saks (2005)[4] suggest that since 1970, housing price appreciation is accompanied by large reductions in residential development, mostly in coastal cities. The limited housing supply is mostly driven by the result of a changing regulatory regime that makes large-scale development increasingly difficult in expensive regions.
- Quigley and Raphael (2005)[5] also find that the stringency of regulation is the main reason of the disparity of housing supply and housing prices across 407 cities in California.
- Saiz (2010)[6] calculates the exact measurement of undevelopable land of cities, which could contribute to its inelasticity in supply. Figure 2 displays the percentage of undevelopable area within 50 km of the metro center for the 30 largest metro areas.

RATIO OF BUILDING PERMIT GROWTH TO PERSONAL INCOME GROWTH

To further understand the gap between supply and demand, we consider the ratio of total building permit growth to personal income growth. In this ratio, the numerator is the total number of building permits issued between 1995 and 2012 over a metro's population in 2003[7] (middle point

Figure 2 The Percentage of Undevelopable Area within 50-km of a Metro Center for the 30 Largest Metropolitan Areas in the U.S.



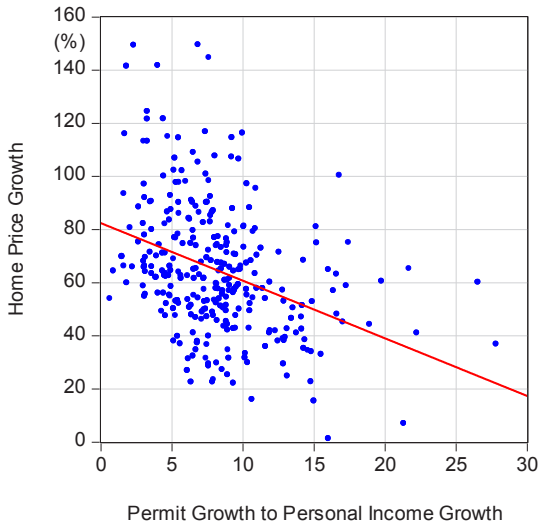
Source: Albert Saiz (2010)

of the sample period), multiplied by 100. The denominator is the nominal total personal income growth from 1995 to 2011. When the ratio is large, which means that home supply outpaces demand, we expect a lower home price appreciation. Conversely, when the ratio is small, which means that home supply has not caught up with demand, we expect a higher home price appreciation.

Figure 3 presents a simple correlation between these two variables among 303 metropolitan areas[8] in the nation. The home price growth rate is calculated by the nominal single-family home index (all transactions) from 1995Q1 to 2012Q3 according to the FHFA. The scatter chart seems to support a simple theory. The downward-sloping line implies an inverse relationship between the supply-to-demand ratio and home price growth. If the ratio is lower, home price appreciation is larger. From the sample of 303 cities, the mean of the supply-to-demand ratio is 8.2 and the median is 7.7.

In Table 1, we list the 30 largest metropolitan areas' home supply-to-demand ratio and the home price growth over this 18-year period. It is obvious that Northeast Coastal and Californian cities have a less than accommodating home supply to meet their demand. As a result, they have higher

Figure 3 The Correlation Between Home Price Growth (1995-2012) and the Ratio of Permit Growth to Personal Income Growth (1995-2011)



Sources: Home price is from the Federal Housing Finance Agency, permits are from the Census Bureau, and personal income growth and population are from the Bureau of Economic Analysis.

Table 1 Home Price Growth (1995-2012) and Supply-to-Demand Ratio for the 30 Largest Cities

		Home price appreciation 95 - 12	Supply to demand ratio	Saiz (2010) supply elasticities
1	San Francisco	142	1.8	0.66
2	Boston	124	3.3	0.86
3	New York	122	4.4	0.76
4	Los Angeles	122	3.3	0.63
5	Washington DC	117	7.4	1.61
6	San Diego	115	4.7	0.67
7	Seattle	98	7.6	0.88
8	Baltimore	98	5.3	1.23
9	Philadelphia	93	4.9	1.65
10	Denver	88	9.3	1.53
11	Houston	87	7.9	2.3
12	Miami	87	6.9	0.6
13	Portland	83	7.2	1.07
14	Minneapolis	74	8.9	1.45
15	San Antonio	69	7.5	2.98
16	Tampa	68	10.6	1
17	Riverside	68	8.2	0.94
18	Pittsburgh	66	4.9	1.2
19	St. Louis	65	8.5	2. 36
20	Dallas	62	9.1	2.18
21	Phoenix	60	11.9	1.61
22	Kansas City	58	9.6	3.19
23	Sacramento	56	8.6	N/A
24	Chicago	48	7.9	0.81
25	Orlando	47	13.4	1.12
26	Cincinnati	43	9.5	2.46
27	Atlanta	35	14.3	2.55
28	Cleveland	24	7.9	1.02
29	Detroit	16	10.6	1.24
30	Las Vegas	1	16.0	1.39

Sources: Home price is from the Federal Housing Finance Agency, supply to demand ratio is calculated by the author, and supply elasticities are from Saiz (2010).

home price growth and less affordable housing than other cities. Saiz (2010)[9] uses the median home price, number of households, and physical and regulatory constraints from 1970 to 2000 to calculate the supply elasticity of metro areas, as shown in Column 3 of Table 1. It is reasonable to see a strong correlation between his sophisticated supply elasticity estimations and our simple supply-to-demand ratio.

Note that in this report, we use only the single-family home price because of the data availability. However, for the building permits issued, we include both single- and multifamily units. We assume that even the number of multi-family unit permits will have an impact on the single-family home price growth. That is because when the supply of multi-family units is abundant, it will ease the demand

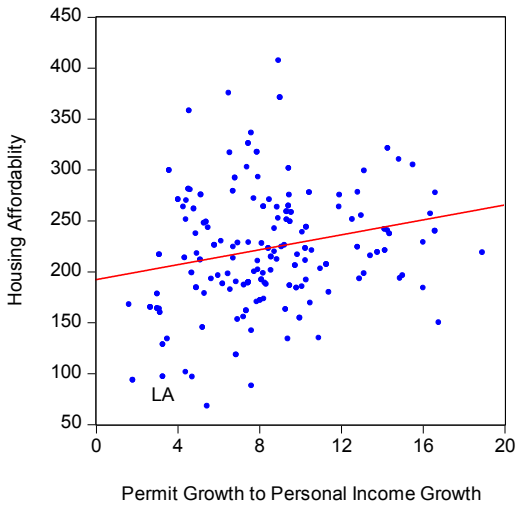
for single units, therefore reducing the price appreciation of single-family homes.

HOUSING AFFORDABILITY

The National Association of Realtors publishes an index of housing affordability index regularly. In interpreting their index, a value of 100 means a family with a median income has exactly enough income for a median-priced home, assuming a 20% down payment. The lower the value, the less likely it is that a family will be able to afford a home in the city. L.A.'s index number of 96.8, along with San Francisco's 93.5, San Jose's 87.9, San Diego's 96.6, and Honolulu's 68.1, are the least affordable cities in the nation when it comes to housing.

Figure 4 exhibits the association between the housing affordability index in 2011 and the ratio of supply-to-demand for around 100 metro areas in the U.S. We can see the implied upward-sloping line in the scatter chart. That is, the larger the supply-to-demand ratio, the more affordable the housing market will be in the city. This echoes the implications of Figure 3 and Table 1.

Figure 4 The Correlation Between Housing Affordability in 2011 and the Ratio of Permit Growth to Personal Income Growth (1995-2011)

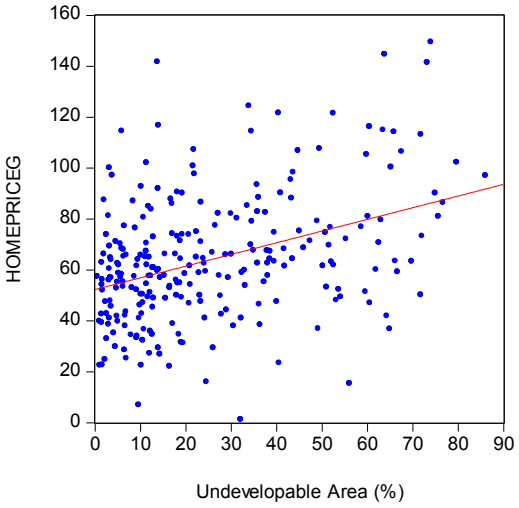


Sources: Housing affordability is from National Association of Realtors, permits are from the Census Bureau, and personal income growth and population are from the Bureau of Economic Analysis.

MULTIVARIABLE REGRESSION ANALYSIS

In previous sections, we used a single variable—the supply-to-demand ratio—to explain the difference of home price growth across cities. Although it is intuitive and the result is evident, it is far from complete. For instance, if we plot the correlation between the percentage of the undevelopable area of a city and home price growth, we can also get a positive relationship as shown in Figure 5. The questions are: (1) Is the supply-to-demand ratio (in Figure 3) or the undevelopable land (Figure 5) a better predictor for home price appreciation? (2) Is supply-to-demand ratio simply driven by undevelopable land?

Figure 5 The Correlation Between Home Price Growth (1995-2012) and Saiz (2010)'s Undevelopable Area of A City



To answer these questions, let's look more broadly to see how all major factors predict home price appreciation across cities from 1995 to 2012. We consider the following factors: (1) Home supply: total building permits issued during 1995-2012 over the 2003 population. In order to consider home supply from existing homes in light of the out-migration occurring in cities such as Detroit, we include declining populations divided by average household size, which is 2.6, as additional home supply to the change of building permits; (2) Economic growth: nominal personal income growth from 1995 to 2011; (3) Human capital: First 5 LA/ UCLA City Human Capital Index in 2008. This

index is computed based on the average education attainment of adult residents in a city.[10] One tenth of the index value represents the average schooling year of residents in the city. We suspect that a more educated city could create a home price premium for reasons such as safety and better school districts.

(4) Climate: the average temperature in January. It is well known that a migration from the Snow Belt to the Sun Belt has been occurring since technology advancements such as air conditioning have come into play. It is of interest to see if the weather still plays a role in affecting home price growth; (5) Ocean proximity: for cities facing either the Atlantic Ocean or the Pacific Ocean, we assign them as 1.[11] Otherwise, 0. There might be two premiums for cities adjacent to the ocean. First are amenities[12], and the second is convenience of international trade and traveling; (6) Geographic constraint: Saiz (2010) constructs a land unavailability index for cities in the U.S. because of its mountainous areas and internal water. The index is presented as the percentage of undevelopable area within 50-km radius of metro center. As a supply-side factor, we suspect that a higher index value will increase the building cost and home price growth over time; and (7) City size: the 2003 population. We suspect that the size of a city could partly represent its amenities, e.g. a more diversified lifestyle and a more public infrastructure.

A simple Ordinary Least Squared regression is computed as follow:

$$\textbf{Home Price Growth} = \alpha + \beta 1 \cdot \textbf{Home supply} + \beta 2 \cdot \textbf{Economy} + \beta 3 \cdot \textbf{Human capital} + \beta 4 \cdot \textbf{Climate} + \beta 5 \cdot \textbf{Ocean} + \beta 6 \cdot \textbf{Geography} + \beta 7 \cdot \textbf{City size} + \varepsilon$$

First, an adjusted R-squared of 0.53 means that these seven variables will be able to explain 53% of the variation of home price growth for these 245 cities. Second, the larger the absolute value of t-statistics, the more statistically significant that variable will be in explaining the home price growth. Therefore, home supply (building permit growth, t=-10.0) is the most statistically significant determinant in predicting home price growth. Economic growth (personal income growth, t=9.7) is the second most significant determinant. Land constraint / Undevelopable area is the (t=5.4) is the third most significant determinant. Human capital (t=5.4) is the fourth most significant determinant. Ocean proximity (t=3.8) is the fifth significant one. To our surprise, climate

The estimation results are presented as follows:

Table 2 Estimation Results

	Coefficient	t-Statistic	Probability
Intercept (α)	-129	-4.1	0.00
Home Supply	-2.53	-10.0	0.00
Economic Growth	0.44	9.7	0.00
Human Capital	1.26	5.4	0.00
Climate	-0.21	-1.7	0.08
Ocean	15.2	3.8	0.00
Geography	0.36	5.4	0.00
City Size	0.0000011	1.7	0.09
Adjusted R-squared:	0.53		

(t=-1.7) and city size are not statistically significant (t=1.7) factors. The insignificance of the climate factor implies that the Sun Belt premium that we used to see may have waned between 1995 and 2012.

Home supply has a negative impact on home price growth and all other significant factors have a positive influence, which again echoes the previous results of Figure 2 and Table 1. Although the estimators could be biased and could be far from illuminating causality, it might be of interest to get a rough idea of their economic/quantitative significance. Controlling other factors, over an 18-year period, the interpretations of these coefficients are:

1) A 10% nominal personal income growth predicts 4.4% home price growth. To be sure, personal income growth includes the growth of income, employment, and population.
2) An additional school year on average predicts an additional 13% home price growth. The evidence suggests that improvement of public schools is not only the interest for school districts, teachers, and parents, but also for all home owners, investors and real estate developers.
3) For those cities that are on either the East or West Coast, they predict 15% higher home price growth than those cities that are in inland regions.
4) A 10% more undevelopable area within 50-km radius from a metro center predicts 3.6% higher home price growth.

5) For the home supply, let's use Los Angeles (including both L.A. and Orange Counties) as an example. From 1995 to 2012, L.A. issued 410,496 permits totally, which is about 22,800 per year. That results in a permit-to-population ratio of 3.23%, considering the population of 12.7 million in 2003 for the L.A. metro area. Note that the average of permit-to-population ratios across 303 metro areas is 9.2%.

Over this period, L.A. home prices increased by 122%, which is about 4.5% compounded per year. Our regression estimator suggests that if L.A. were to increase its permits to 50,000 annually, then its permit-to-population ratio will be 7.1%, which is a ratio like Chicago's (6.6%). Our model predicts that the total period home price appreciation in L.A. would be 113% instead of 122%, which is 4.3% per year. That is, even if L.A. doubles its permit supply, it would contribute only 0.2 percentage point less to the home price appreciation per year.

Let's now take San Diego as another illustration. From 1995 to 2012, San Diego issued 184,633 permits totally, which is about 10,257 per year. That results in a permit-to-population ratio of 6.33%, considering a population of 2.9 million in 2003 for the San Diego metro area. Over this period, San Diego home prices increased by 115%, which is about 4.3% compounded per year. Our regression estimator suggests that if San Diego were to increase its permits to 20,000 annually, then its permit-to-population ratio will be 12.4%. Our model predicts that the total period home price appreciation in San Diego would be 100% instead of 115%, which is 3.9% per year. That is, if San Diego doubles its permit supply, it would contribute 0.4 percentage point less to the home price appreciation per year.

The magnitude of the economic impact on home price growth of building permits seems to be outlandishly small. Indeed, it is. We suggest two reasons: (1) the model is far from perfect; and (2) Los Angeles metro is extremely large in terms of its population. Even doubling the number of building permits would have only a slight impact on the permit-to-population ratio.

Despite the economic significance of home supply on home price growth being uncertain, we are sure that an increase in home supply does reduce the home price growth over the long run based on its statistical significance.

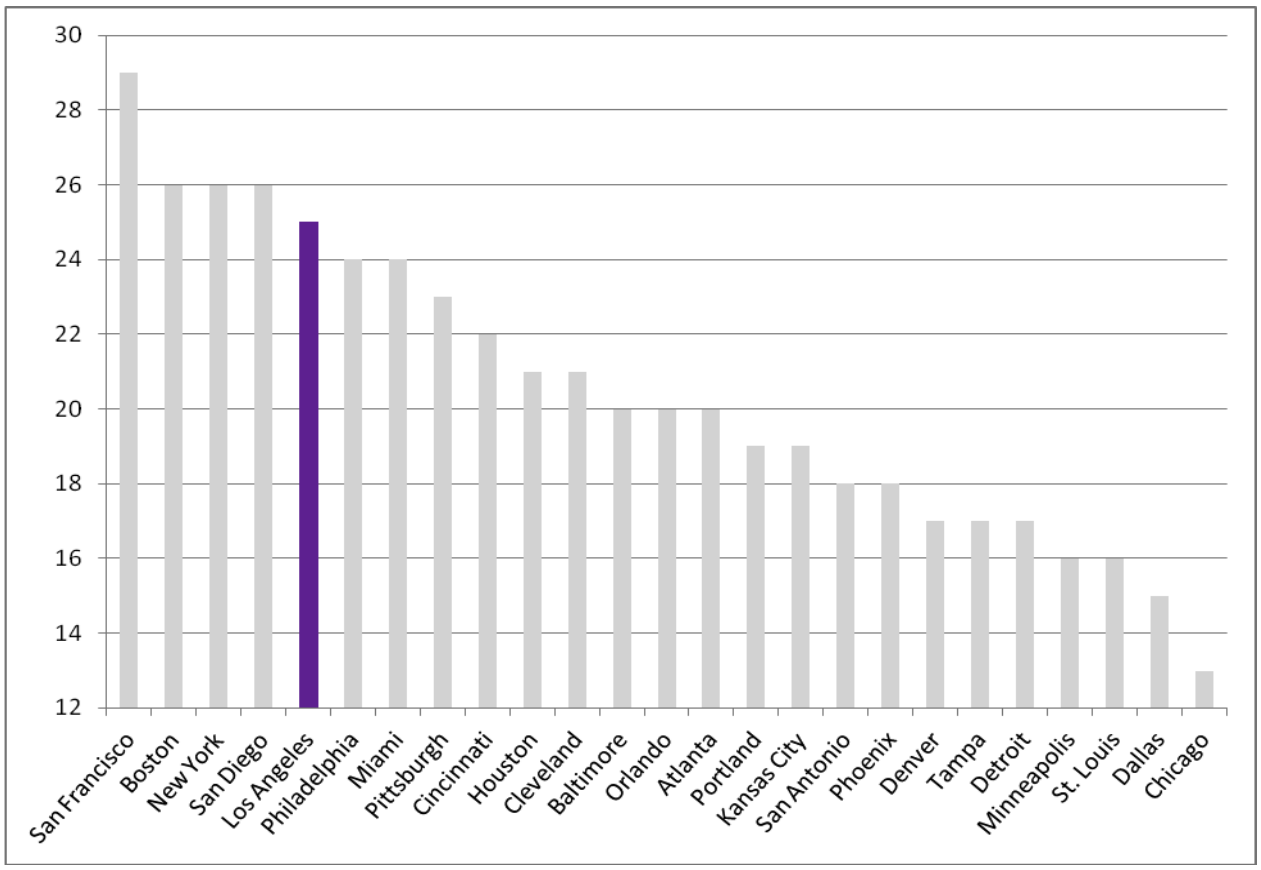
HOME SUPPLY AND HOUSING AFFORDABILITY

If regional home price growth is driven by demand factors, such as income growth, employment growth, population growth, or human capital enhancement (educated worker migration or local public school improvement), it is a vibrant and resilient trend for a city. Residents should celebrate and embrace the steadily rising home prices.

However, if regional home price growth is driven by supply factors with a limiting amount of building permits driving up the home price, then we suggest that it will hamper city growth. This is because the less affordable housing will increase the cost for renters and potential immigrants to the city. As a result, this will also increase the cost of businesses because employers will have to offer higher wages to compensate the higher cost of living that employees are facing.

Why does L.A. have a low permit-to-population ratio? There are several possible reasons for a relatively low number of residential buildings in L.A.: (1) L.A. has a large average size of family for its residents. (2) A higher building cost, which is created by various building codes for earthquake safety and the limited availability of land. These natural factors discourage some builders' development. Indeed, in Saiz's (2010) careful calculation, 52% of L.A. County is undevelopable because of its water, the ocean, and steep slopes. Compared to Chicago and New York's 40%, D.C.'s 14%, Dallas's 9%, and Atlanta's 4%, L.A. ranks 14th out of 95 cities subject to physical/natural constraint in urban development. (3) Zoning and other restrictions and regulations also hinder development. By conducting a nationwide survey, Gyourko, Saiz and Summers (2008)[13] created the Wharton Residential Urban Land Regulation Index to measure the stringency of local regulatory environments pertaining to land use or housing. The higher the index, the more regulatory constraints there are on housing supply. Out of 50 states, California ranks 9th (index=0.59) for its man-made restrictions on home supply while the national average has an index number of 0. Among U.S. cities, L.A.'s number is 0.51, compared to D.C.'s 0.33, Chicago's 0.06, Atlanta's 0.04, Dallas's -0.35, and Kansas City's -0.8, which indicates its higher rigidity on housing supply. (4) Lastly, there is no robust public transportation in L.A. to support more residential buildings.

Figure 6. Malpezzi (1996)'s City Regulation Index



Source: Malpezzi (1996)

Malpezzi (1996) also suggests that California cities have higher stringency of regulation on home supply. Based on the index (the higher the value, the more stringent the regulation), Los Angeles with the index number of 25, ranks on the top in terms of its man-made constraint.

Regardless of the relative importance of these factors, an adequate number of construction and building permits in line with the demand of homes in a city is likely to temper home price appreciation and to provide affordable housing. For L.A., as its housing market recovers gradually, a vertical development rather than a horizontal one by building more multi-family units accompanied with appropriate urban planning will relieve its affordability problem and therefore attract more businesses and talents. What's more, it will reduce L.A.'s carbon emission because we will be able to have more efficient residences that will utilize fewer cars and more public transportation.

CONCLUSIONS

The take-away points from our report are as follow:

- From 1995 to 2012, we have seen a wide disparity of home price growth across cities.
- We suggest five determinants to explain the housing price appreciation difference across cities: (1) Home supply, (2) Economic growth, (3) Geographic constraint, (4) Human capital, and (5) Ocean amenities.
- L.A. has a relatively low supply of homes considering its population and economic growth compared to most other cities. We suggest that a higher supply of homes, especially multi-family homes, by reducing unnecessary regulation barriers will help relieve the housing affordability problem in L.A.

ENDNOTES

1. *National factors, such as interest rates, mortgage rates, inflation rates, will affect home price growth. However, we assume national factors will have the same influence on all the cities; therefore they can explain little on the disparity of home price growth across cities.*
2. *Stephen Malpezzi, "Housing Prices, Externalities, and Regulation in U.S. Metropolitan Areas," Journal of Housing Research , (1996), p209-241.*
3. *Enrico Moretti, "Human Capital Externalties in Cities," in Handbook of Regional and Urban Economics, Vol 4, (2004), p2244-2291.*
4. *Edward Glaeser, Joseph Gyourko, and Raven Saks (2005), American Economic Review, (2005), p329-333.*
5. *John Quigley and Steven Raphael, American Economic Review, (2005), p323-328.*
6. *Albert Saiz, "The Geographic Determinants of Housing Supply," Quarterly Journal of Economics, (2010), p 1253-1296.*
7. *Apparently, a bigger city will issue more building permits over time. To control the city size, we divide the total building permits issued from 1995 to 2011 by the city's population in 2003.*
8. *There are 365 metropolitan statistical areas, but building permit data is available for only 303 metropolitan areas.*
9. *See endnote 6.*
10. *For details, see http://www.uclaforecast.com/chci/.*
11. *We consider coastal cities where its centers are within 80km of the Atlantic or Pacific Ocean. We do not consider cities along with Greta Lakes or Gulf of Mexico (except cities in Florida) because the main underlying implication is their amenities.*
12. *See Rappaport J. and Jeffery Sachs, "The United States as a Coastal Nation," Journal of Economic Growth, (2003), p 5-46.*
13. *Joseph Gyourko, Albert Saiz, and Anita Summers, "A New Measurement of the Local Regulatory Environment for Housing Markets: The Wharton Residential Land Use Regulatory Index," Urban Studies, (2008), p 693-729.*