Actuarial Values of Housing Markets

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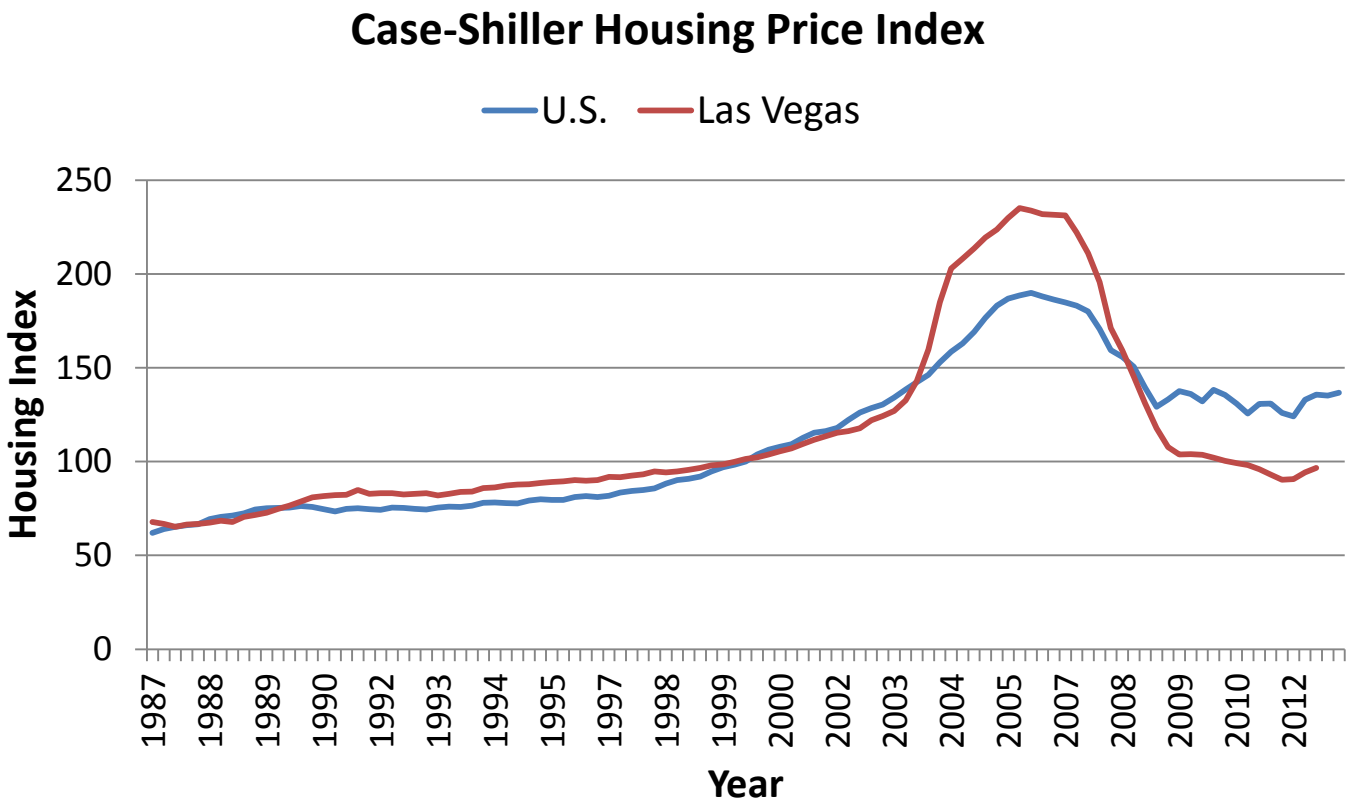
Atlanta, September 22nd, 2014

Market Values of Housing Markets

For mortgage lenders, traditional loan-to-value metrics can be unreliable. For example, 80% loan-to-value in June 2006 became 112% (or 184% in Las Vegas) loan-to-value in June 2010



Search for Other Than Market Values

1. Mark-to-market is the culprit of the recent financial crisis
   - ✓ M2M of mortgage loans
   - ✓ M2M of MBS, CDOs, and CDO^2
2. Capital rules relying solely on market values cannot achieve counter-cyclical effects
3. We examine a candidate: the actuarial approach

Actuarial Value of Housing

1. We construct an actuarial measure of value that incorporates a broader set of economic and demographic factors.
2. The resulting measure of value is shown to be less volatile than market value, and more representative of housing's sustainable value.

Data Used to Construct Actuarial Values

Data	Data Source
Case-Shiller Index	S&P
Housing Market Inventory Supply	Zillow
Foreclosure Home % in Transaction	Zillow
Newly Applied Building Permit	Census Bureau & Texas A&M University
Housing Inventory	Zillow
Construction Cost	Marshall & Swift/Boeckh
Demographic Information	U.S. Census Bureau
Households with Age Information	U.S. Department of Housing and Urban Development
Household Income at Zip Level	Internal Revenue Service
U.S. Household Formation	U.S. Census Bureau
International Sale in Housing Market	National Association of Realtors
Mortgage Loan Standard	Ellie Mae Origination Insight Report
House Price at Zip Level	Zillow

Actuarial Value Formulas

$$\text{Quarterly Change}_t = \text{HPI}_t / \text{HPI}_{t-1} - 1$$

Adjusted Quarterly Change$_t$ is controlled in the range of [Floor$_t$, Cap$_t$]

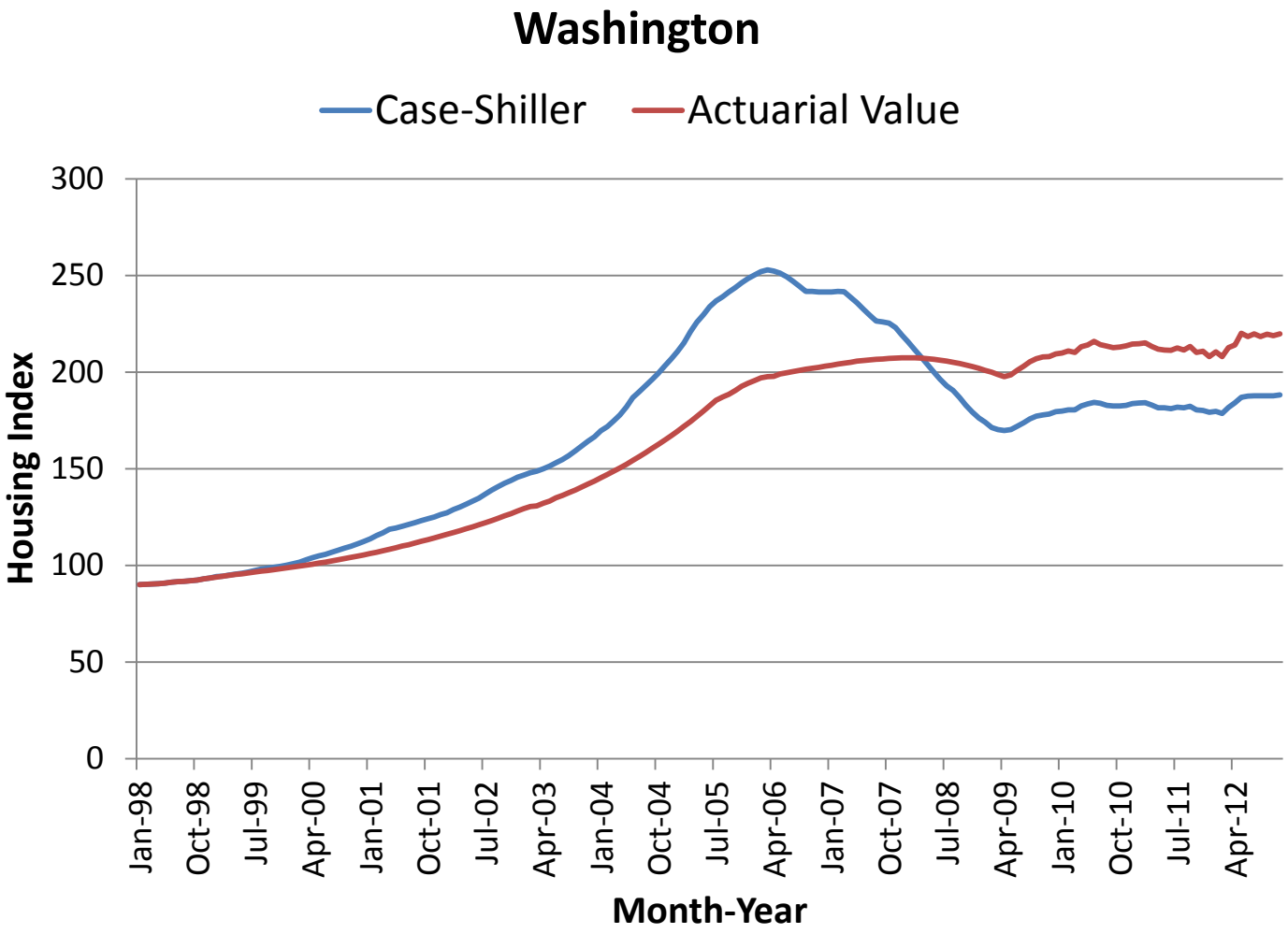
$$\text{Cap}_t = \text{Mean (Quarterly Change in last 10 years)} - \textbf{drift} + \text{Volatility (Quarterly Change in last 10 years)}$$

$$\text{Floor}_t = \text{Mean (Quarterly Change in last 10 years)} - \textbf{drift} - \text{Volatility (Quarterly Change in last 10 years)}$$

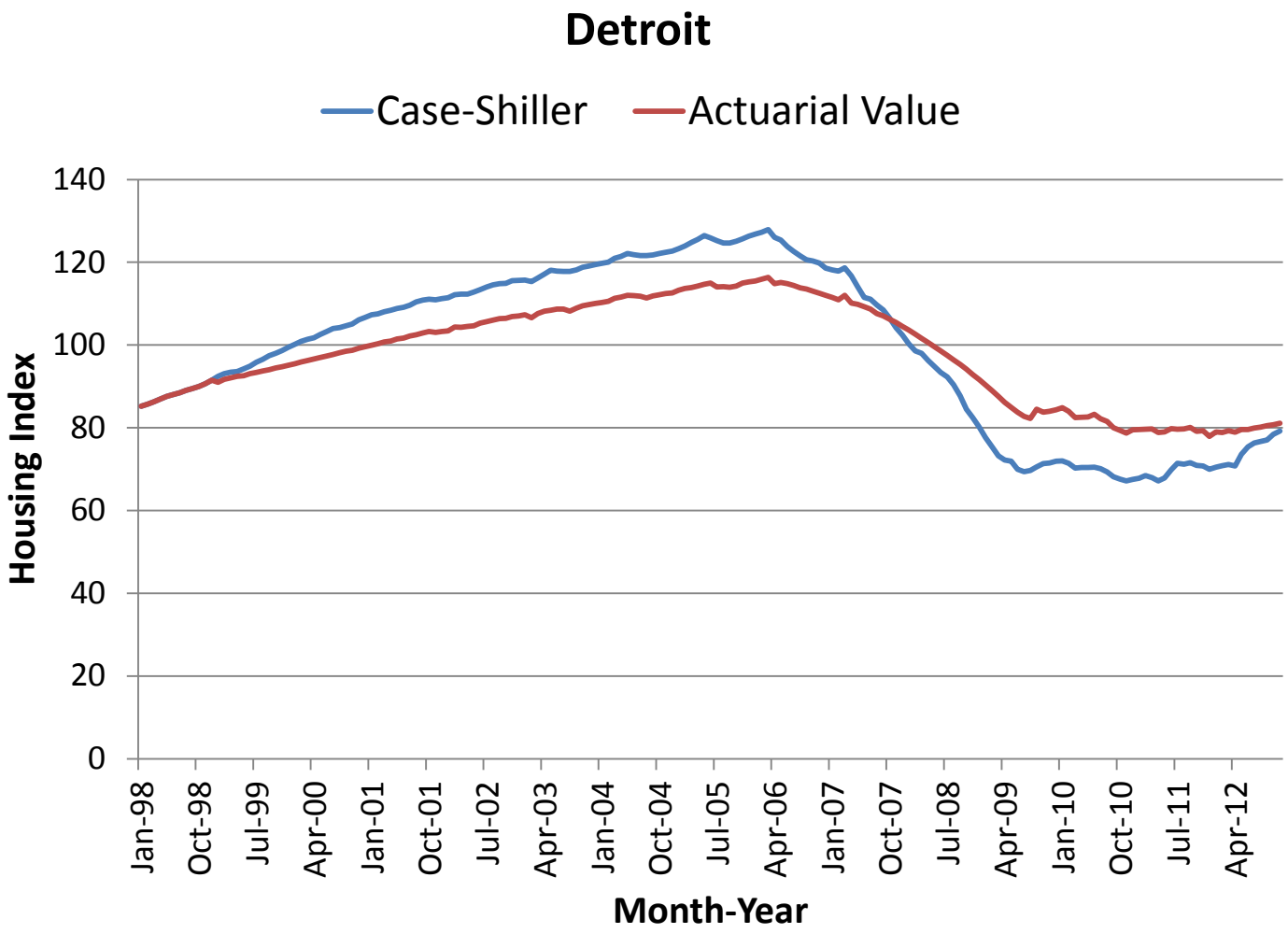
A Key of Calculating Actuarial Value

1. The unique strength of the Actuarial Housing Valuation is derived from the inclusion of factors specific to the metro area being measured, through the use of the *drift* term.
2. The drift for any particular area is determined by several important factors, such as construction cost, demographic distribution, migration, etc.
3. Some of these factors will be previewed on the following slides.

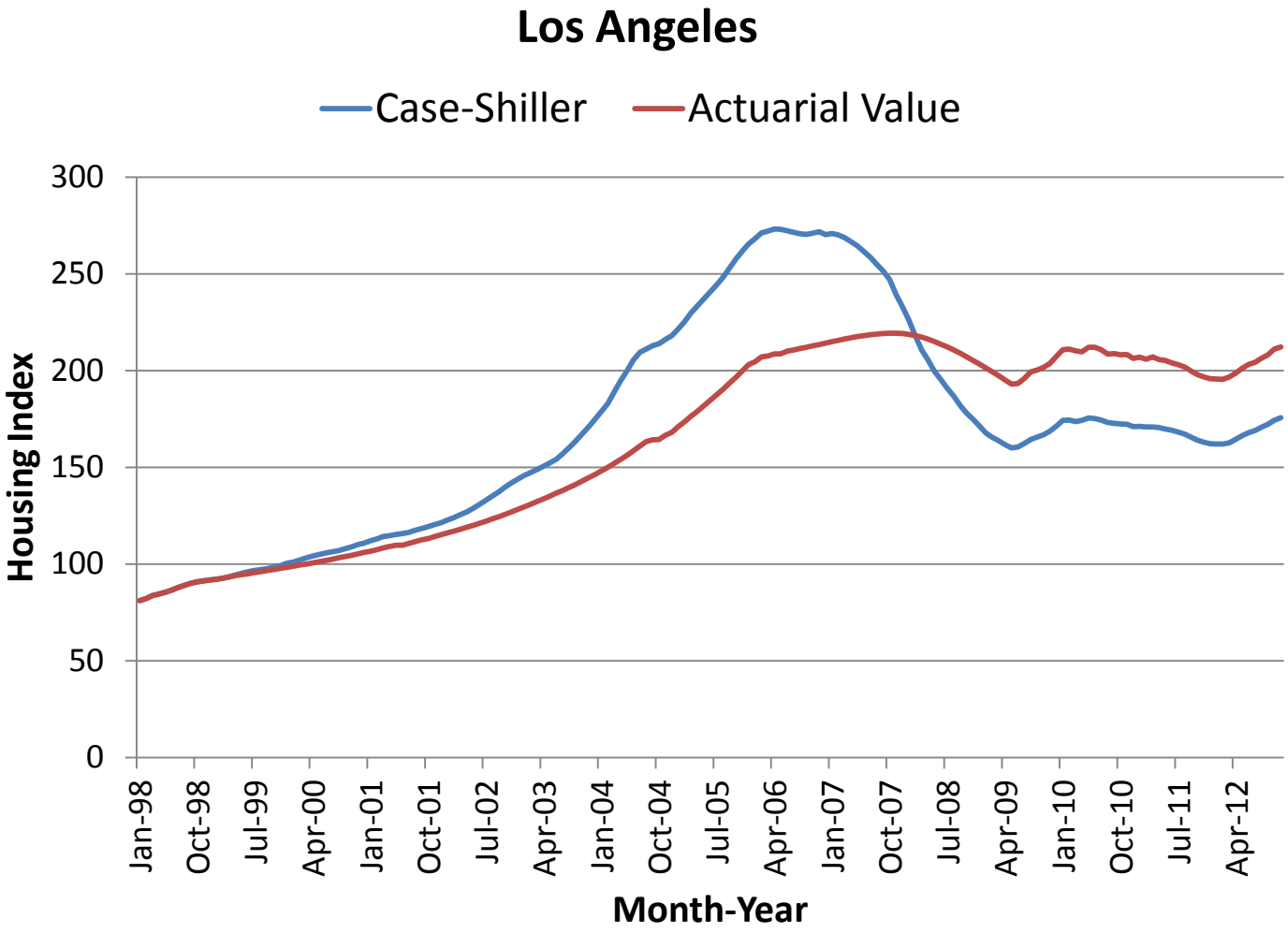
Washington DC Housing Actuarial Value



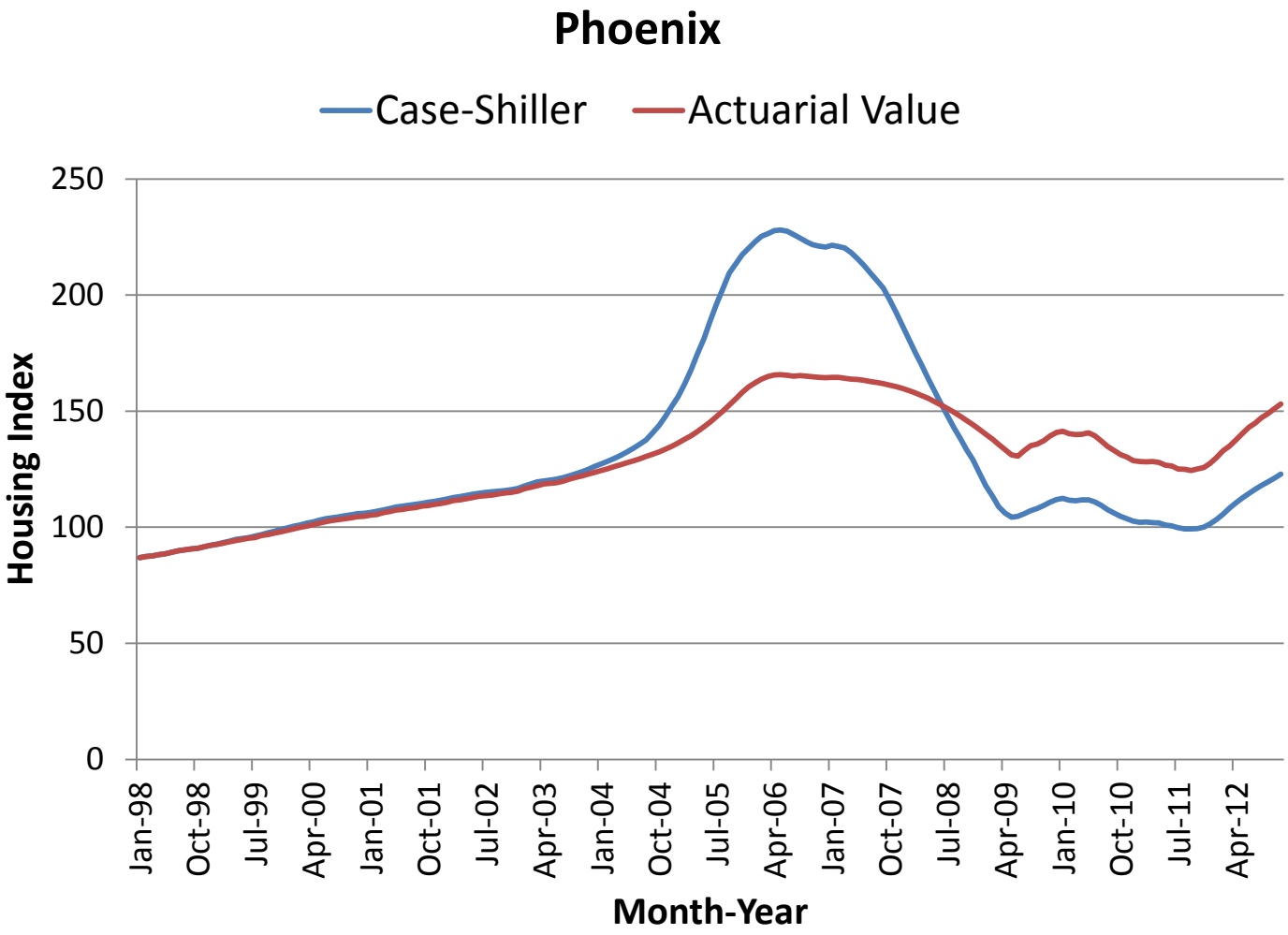
Detroit Housing Actuarial Value



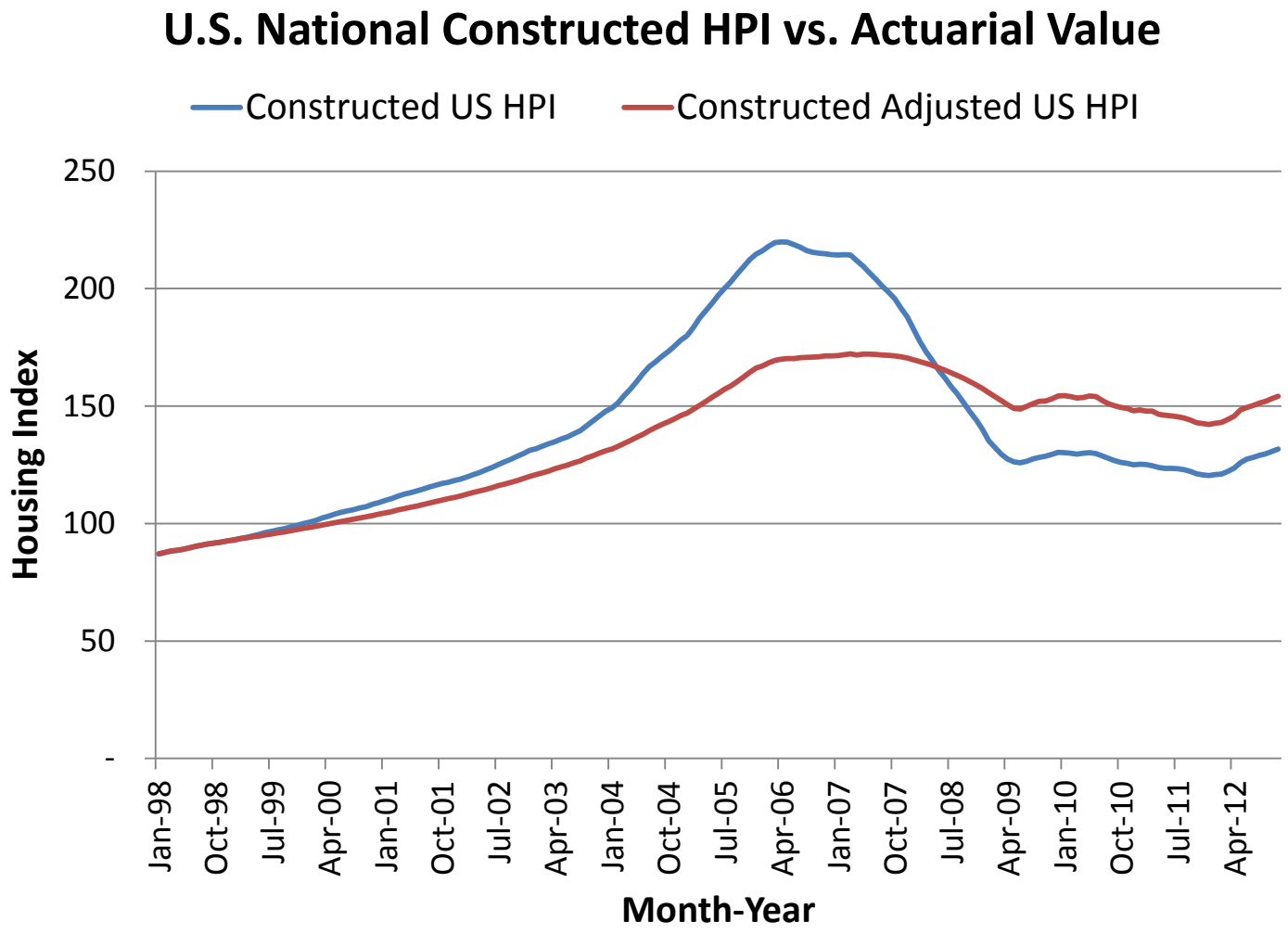
Los Angeles Housing Actuarial Value



Phoenix Housing Actuarial Value



U.S. Housing Actuarial Value

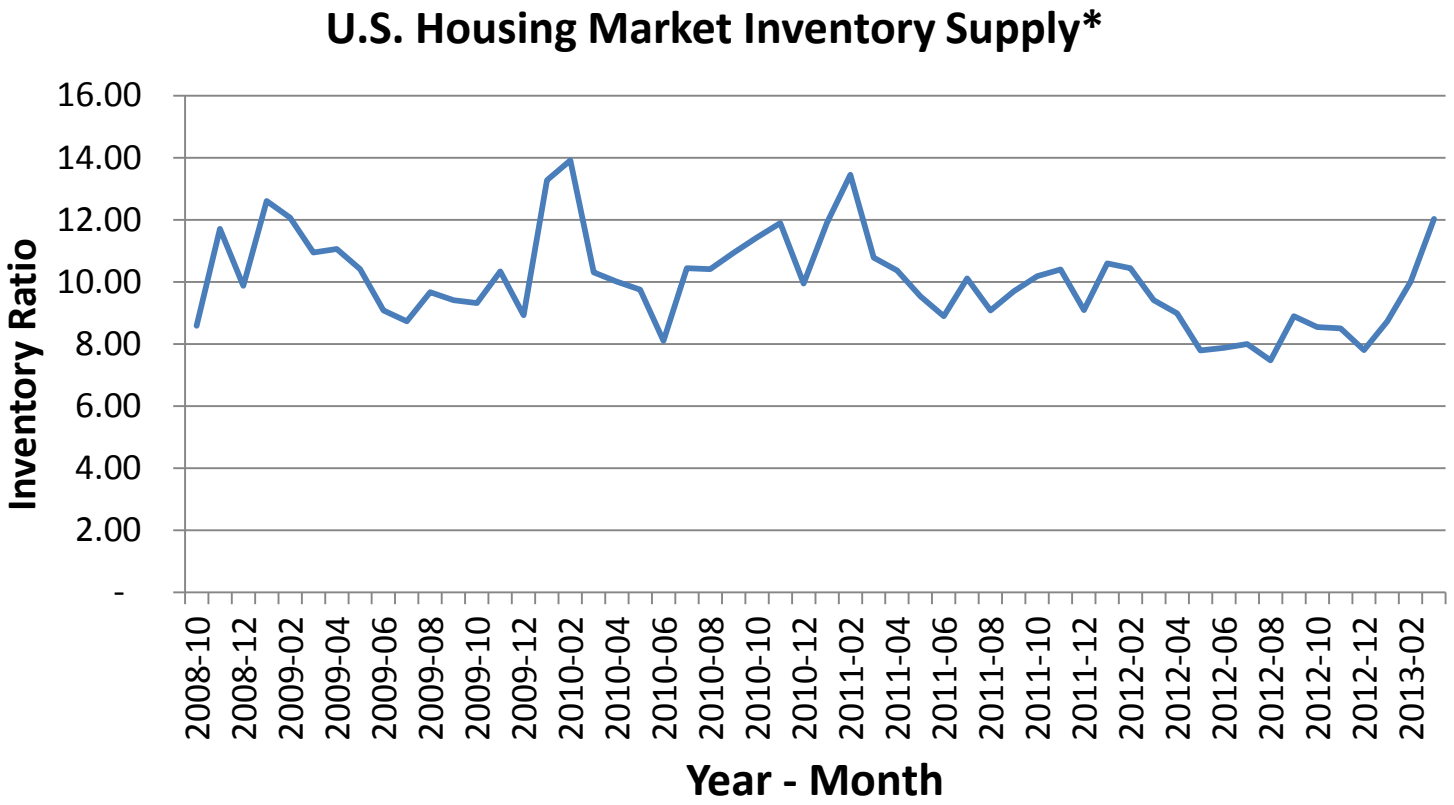


How Are Actuarial Values Calibrated?

1. So how are the actuarial values calibrated?
2. We calibrate the drift term to reflect the combined effects of economic and demographic factors impacting the supply and demand of housing units in a metropolitan area

Supply of Housing Units

Over the last five years, about 10% of houses in the market are sold every month on average.



* Inventory Supply is the total number on listings at the end of a month divided by the number of homes sold in that month.

Supply side: Willing to sell vs. Forced to Sell

We have observed two types of house listings.

1. Some homeowners have the flexibility to withdraw their home listing if their home is not sold within some time window (e.g., 1-2 months). We categorize this type as "*Willing to sell*"
2. Some home listings were not withdrawn from the market even after extended listing periods that failed to attract a buyer. These listings were periodically adjusted to reduce the asking price. We categorize this type as "*Forced to sell*".

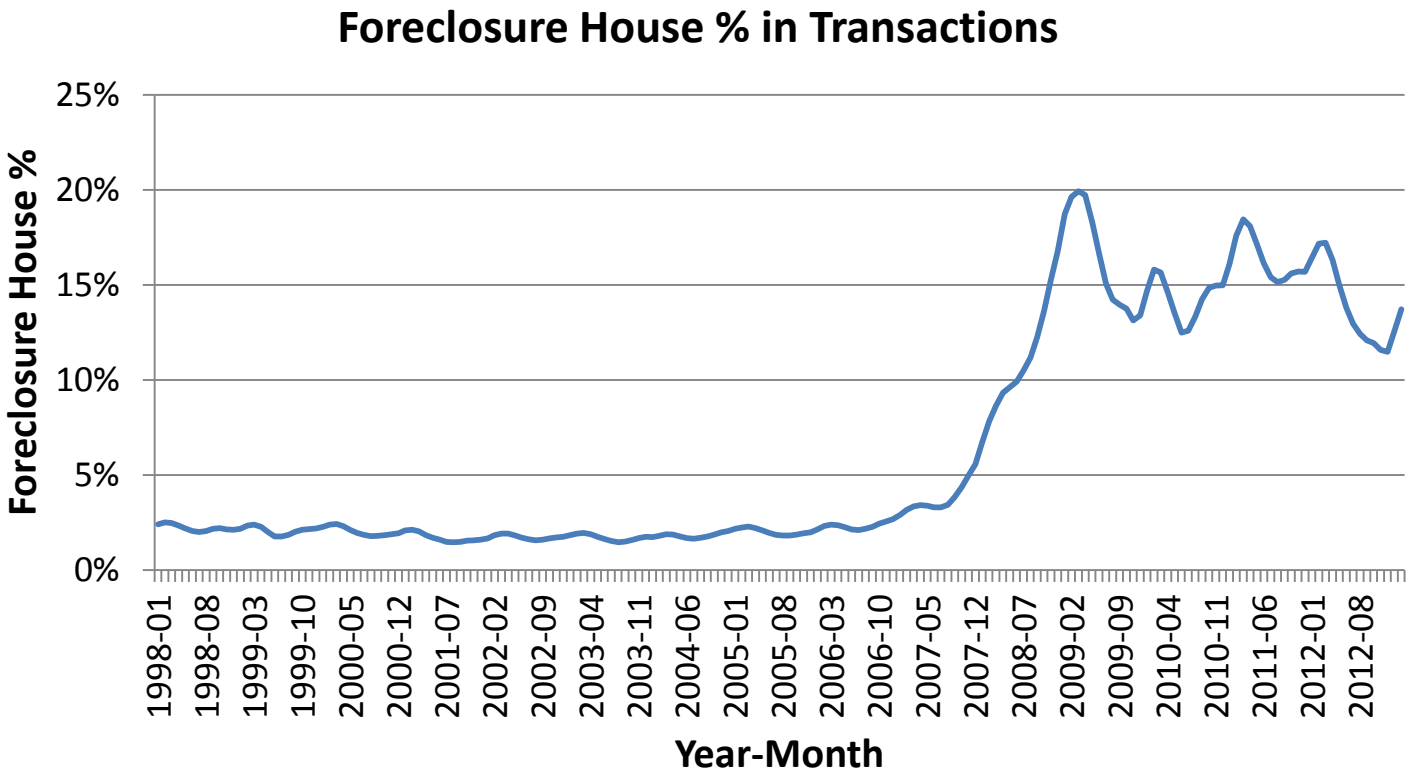
Forced to Sell Houses

"Forced-to-sell" houses can be further divided into four classes:

1. Foreclosure Houses
2. Newly Built Houses
3. Migration Outflow
4. Death

Foreclosure Houses

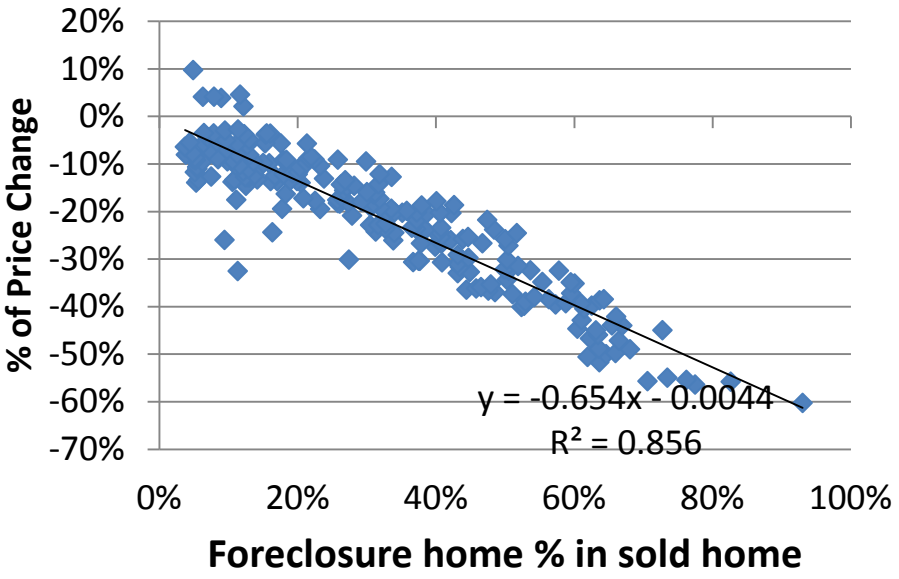
Before 2006, the foreclosure homes % in all US was around 2%. This ratio jumped to 20% in 2009 and remained high after that. Since late 2007, the abnormally high level of foreclosure rate can have material impact on the housing prices, cause a departure from long-term “equilibrium” housing values.



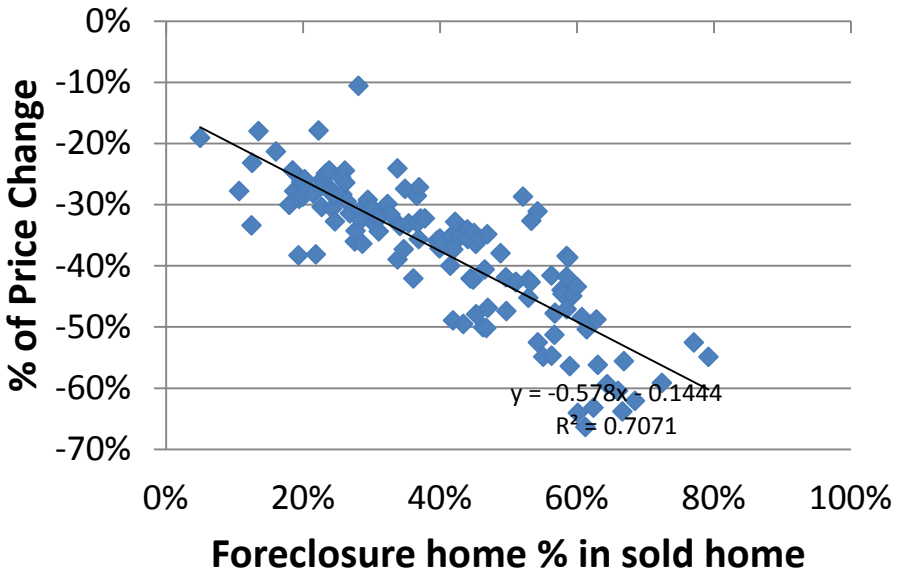
Foreclosure Houses

Our analysis show that foreclosure home % increases explain a big part of the price drops during 2008-2010.

Los Angeles 2008-2010 House Price Change vs. Foreclosure Home %*

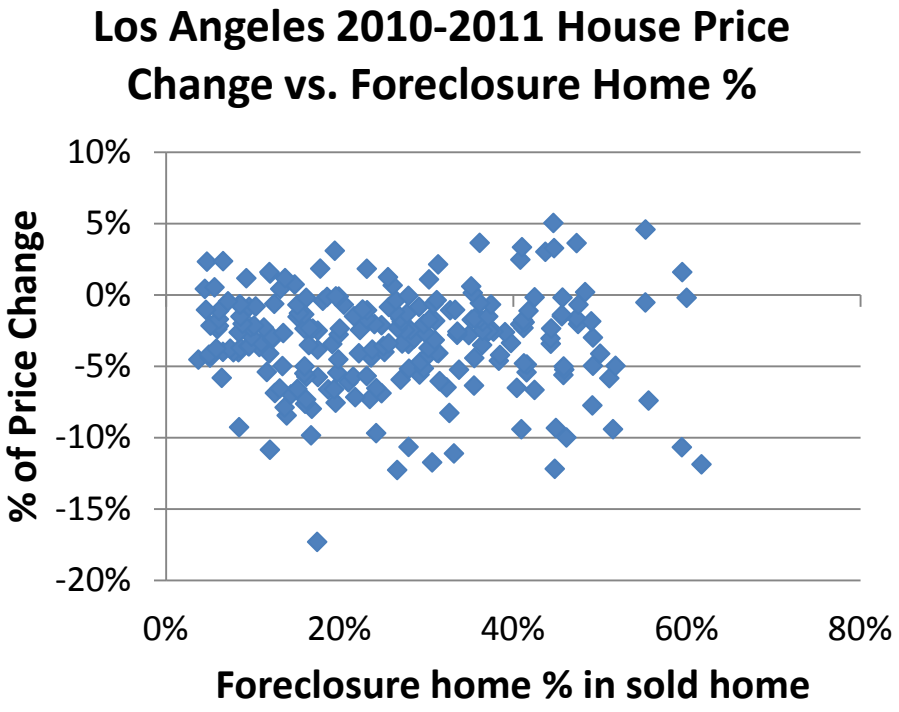


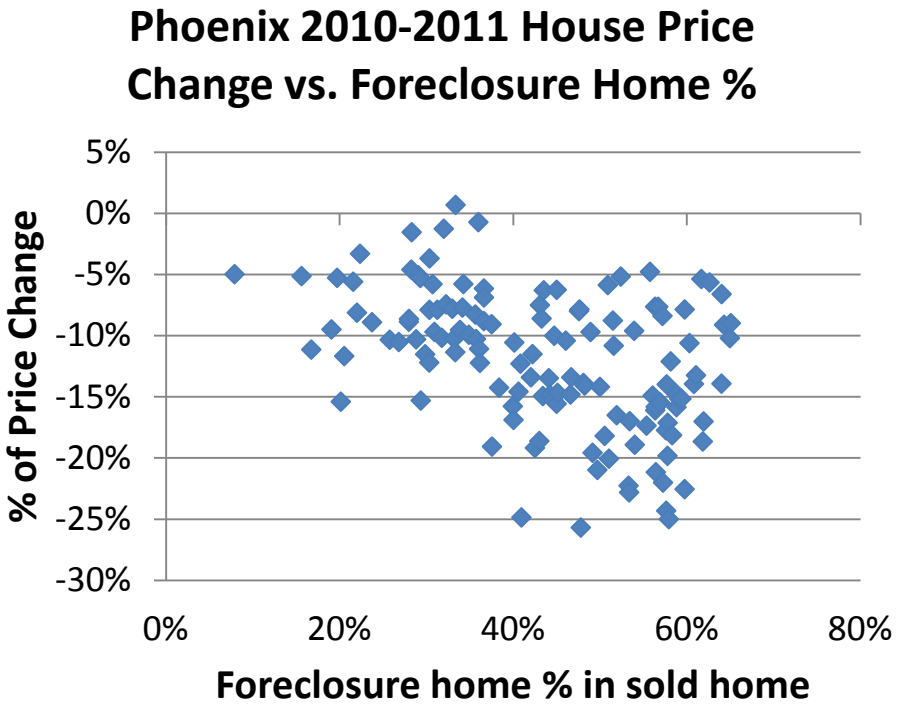
Phoenix 2008-2010 House Price Change vs. Foreclosure Home %



Foreclosure Houses

However, this strong relationship soon disappeared after 2010. Below are the graphs of this relationship in 2011. Similar results are also observed in 2012.





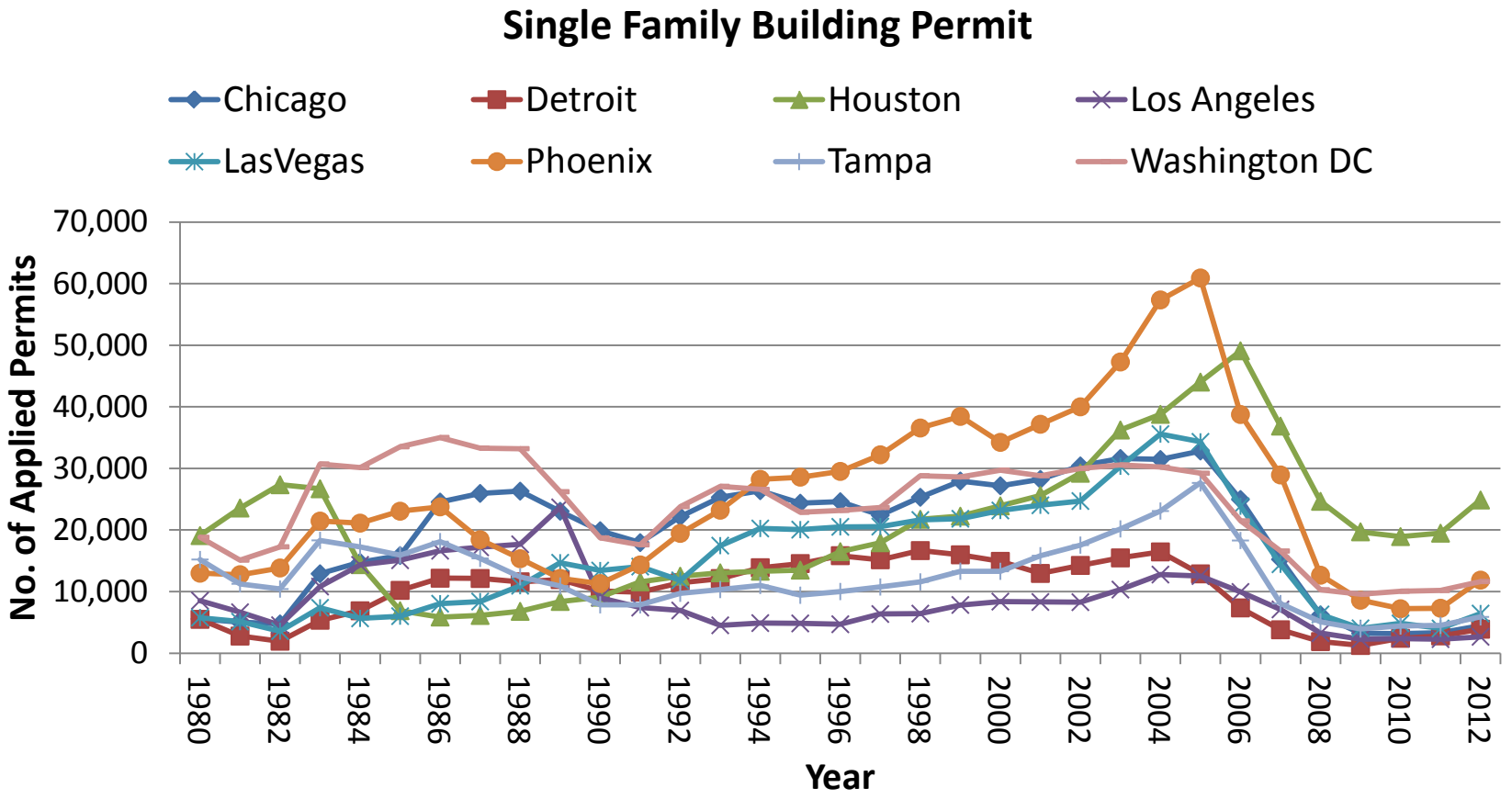
Newly Built Houses

Generally speaking, newly built houses are under more pressure to sell in a short time than owner-occupied homes. Builders of new homes normally have liquidity constraints and incur carry-costs of serving their bank loans.

However, data for newly built houses is not readily available. In this study we use building permit as a proxy indicator of newly built homes.

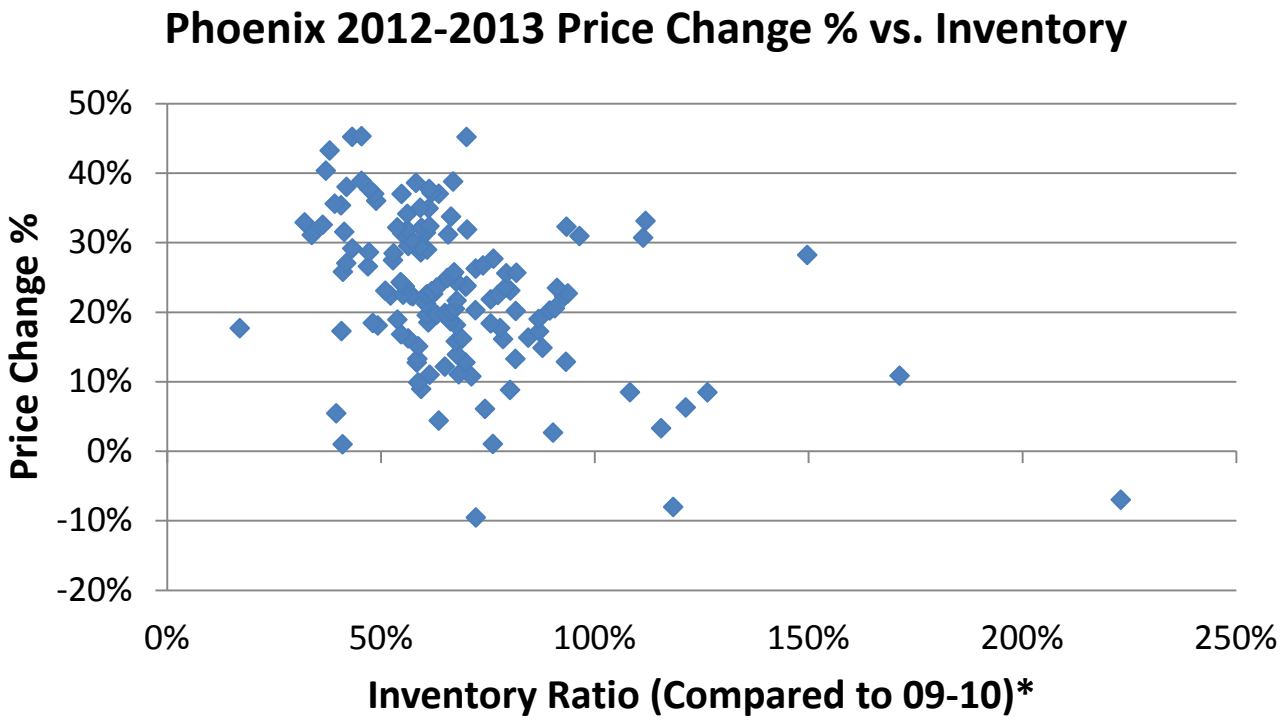
Newly Built Houses

During 2002-2006, there was a dramatic increase in building permit applications. The cumulative effect of fewer newly built houses from 2008-2012 eventually led to a low inventory of house supply.



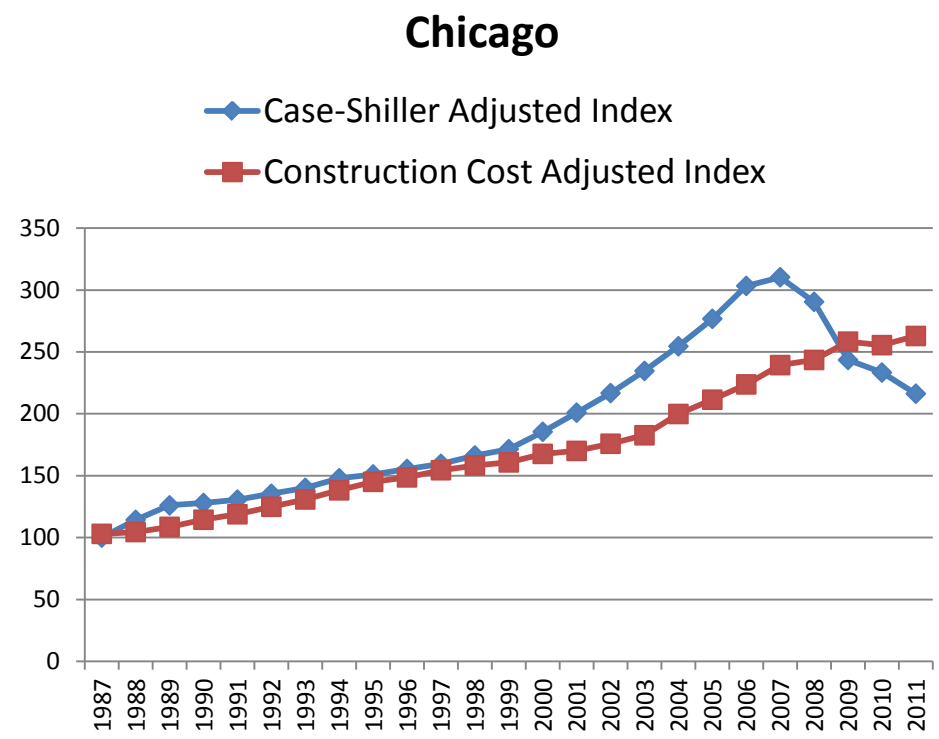
Newly Built Houses

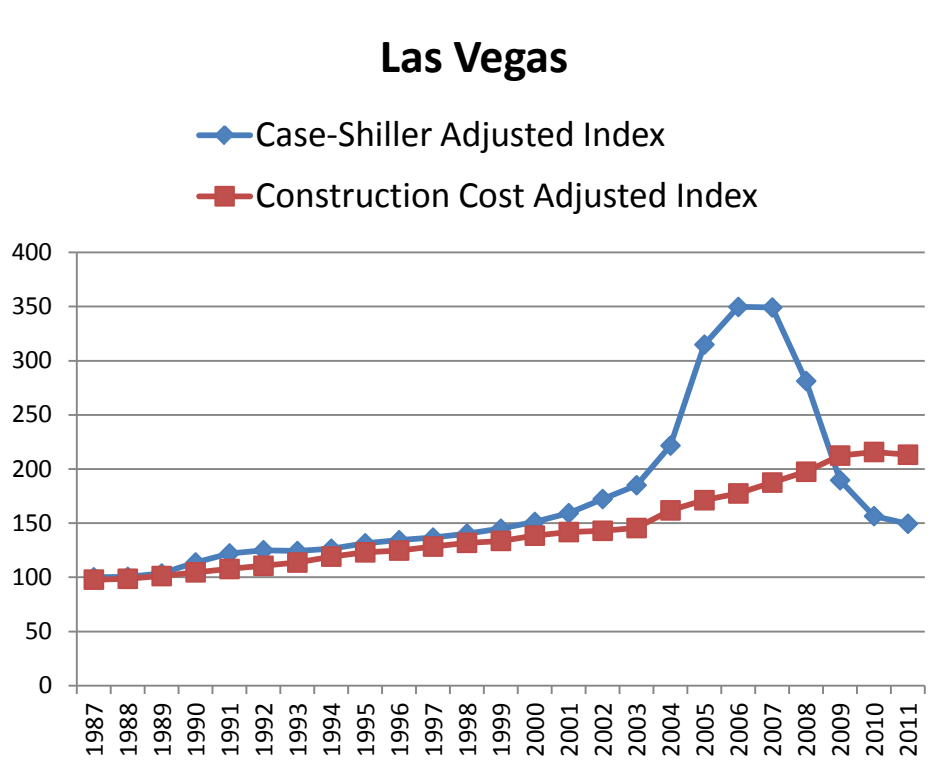
It can be argued that the housing market recovery since 2012 has been fueled by reduced levels of inventory. Other factors, such as mortgage rates, foreclosure rates and household income have not changed significantly from 2011 to 2012.



Newly Built Houses

Housing prices dropped below the construction costs in 2009-2011, which led to the recently low supply of newly built houses.





Data Source: Marshall & Swift/Boeckh - Residential Construction Cost Index.

Migration Outflow

From 2000 to 2008, among eight metropolitan areas, Detroit is the only one which experienced a net population decrease due to the high negative net migration.

	Chicago	Detroit	Houston	Las Vegas	Los Angeles	Phoenix	Tampa	Washington DC
2000 Population	9,098,629	4,452,558	4,715,417	1,375,535	12,365,624	3,251,887	2,396,011	4,796,065
2000-2008 Net Migration	(119,923)	(237,573)	468,210	380,112	(420,191)	717,353	328,419	137,771
2000-2008 Population Change	470,995	(27,448)	1,012,726	490,211	507,184	1,030,012	337,750	562,065
2000-2008 Population Change %	5.2%	-0.6%	21.5%	35.6%	4.1%	31.7%	14.1%	11.7%

Death

In Tampa, the number of homes for sale due to death are roughly equivalent to those newly built.
Below are the single family building permit applications in Tampa from 1996 to 2000.

Single Family Building Permit Applications in Tampa	
1996	10,006
1997	10,745
1998	11,573
1999	13,309
2000	13,293

If we simply assume 2 deaths will empty 1 house, the houses for sale from death for Tampa year 2000 is 14,288. And the five year average single family building permit applications is only 11,785.

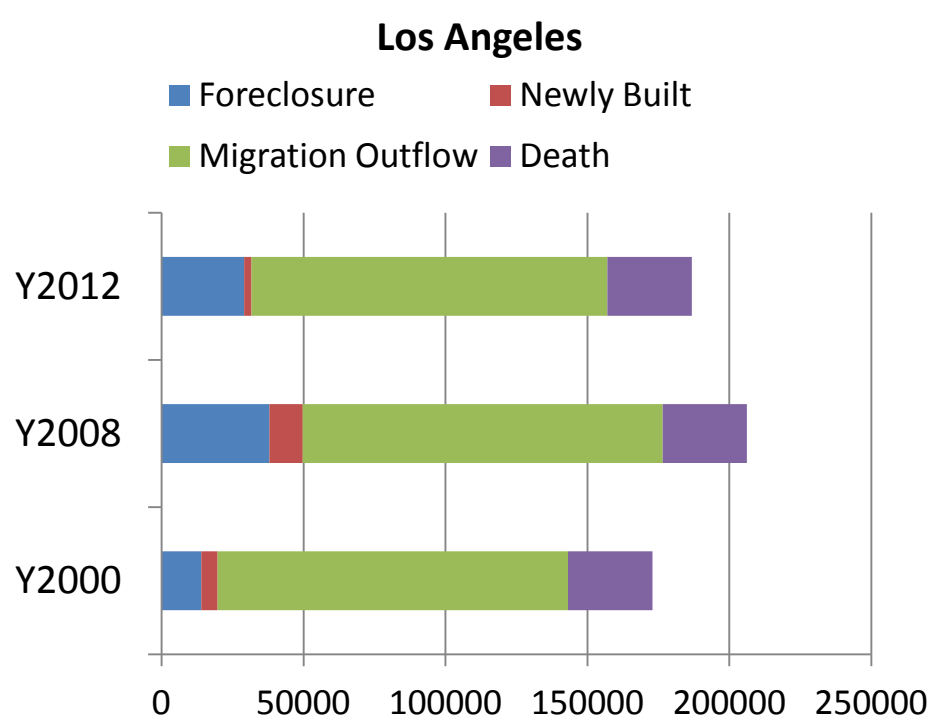
Death

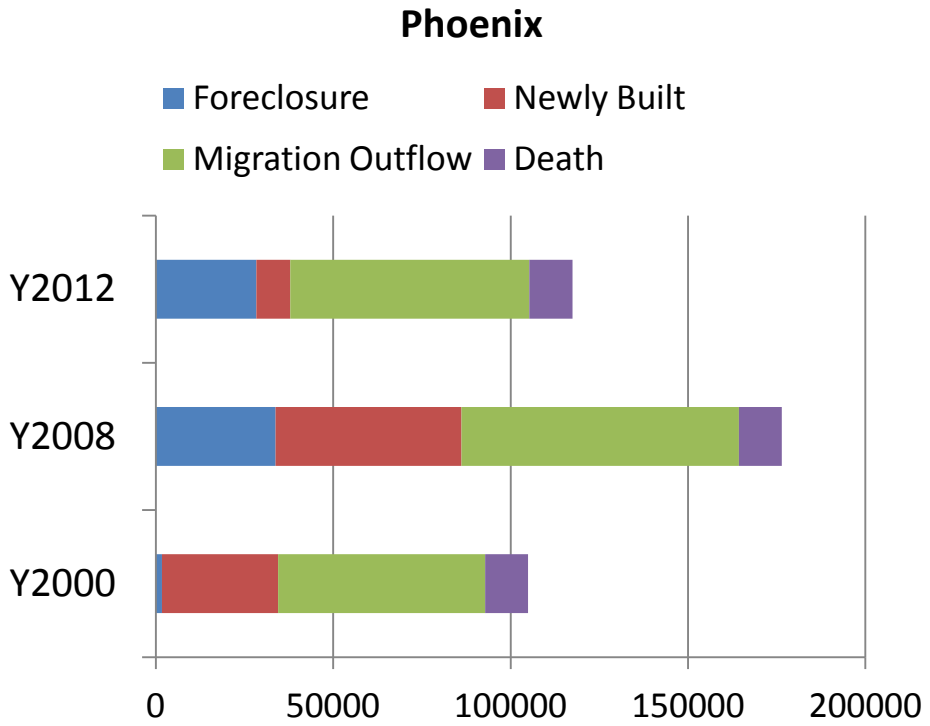
The old people % in Tampa is significantly higher than other metro areas'. The age distribution should be taken into account for future local housing market projection.

Y2000	Total Households	Age 62+ Households	Age 62+ %	Deaths	Deaths/Total Households
Tampa	1,009,284	337,379	33.4%	28,577	2.83%
Chicago	2,971,619	676,459	22.8%	60,119	2.02%
Detroit	1,695,304	419,494	24.7%	39,407	2.32%
Houston	1,462,676	239,397	16.4%	28,319	1.94%
Las Vegas	588,350	143,105	24.3%	10,320	1.75%
Los Angeles	3,133,781	655,301	20.9%	59,352	1.89%
Pheonix	1,194,271	288,563	24.2%	24,272	2.03%
Washington	1,848,021	340,126	18.4%	29,838	1.61%

Dynamics of Housing Units Supply

The graphs below show the different “forced to sell” components for Los Angeles and Phoenix before, during and after the housing bubble.





What about the Demand Side?

We also consider factors affecting the **demand of housing units**, including:

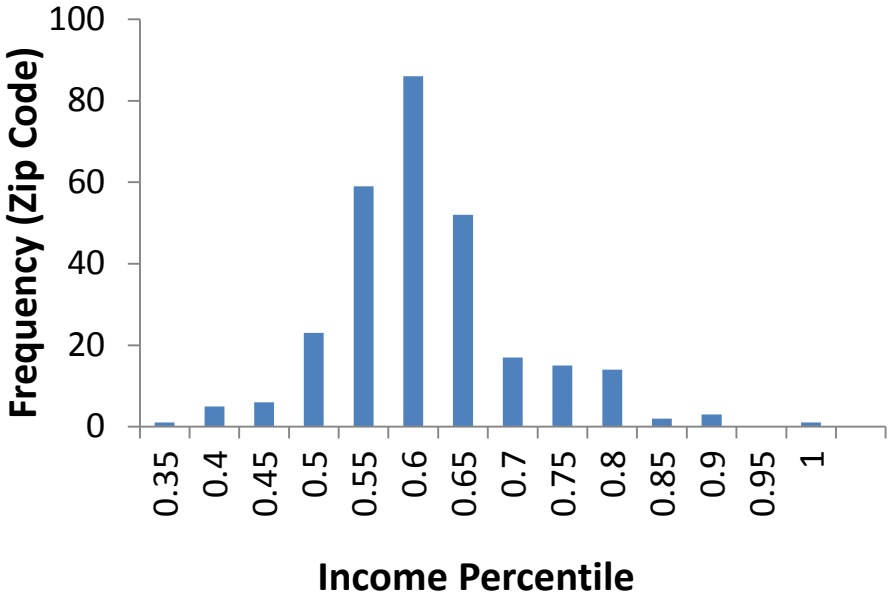
1) Household income distribution

2) Age distribution

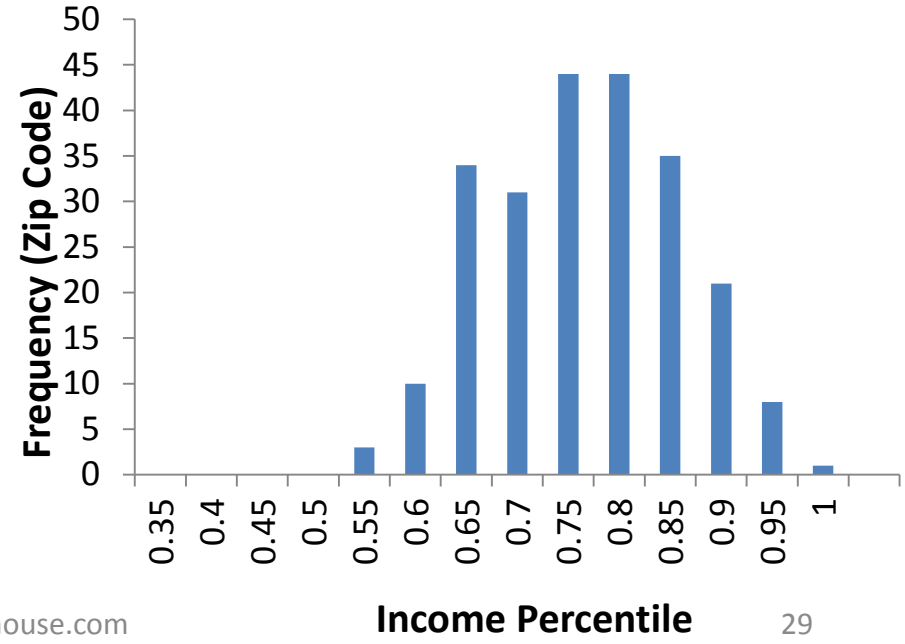
Household Income Distribution

Traditionally, researches use the ratio of median house price to median household income as the indicator for measuring housing affordability. Our research indicates that this ratio may not be the best indicator. We have found that a higher percentile (e.g. 65%) of the income distribution is a better metric than the median (50%) to match with transacted house prices.

Chicago 1998 House Price Implied Income Percentile

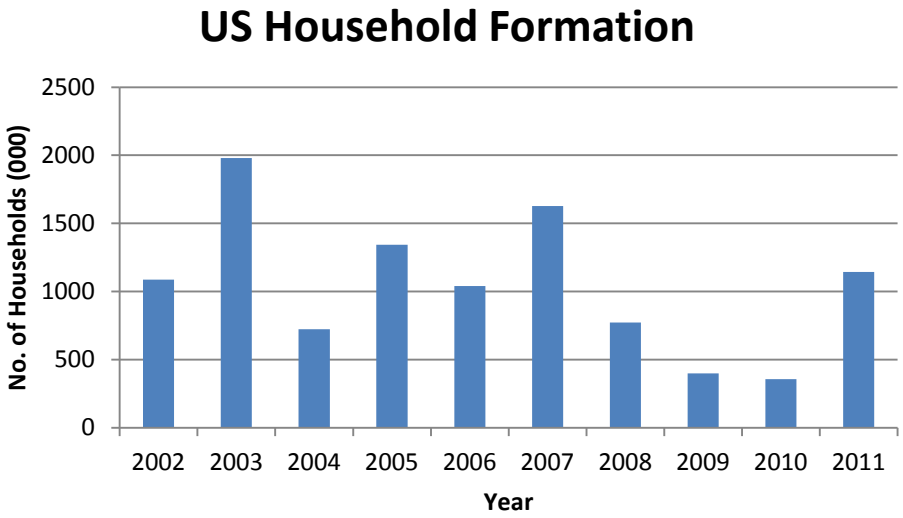


Chicago 2008 House Price Implied Income Percentile



Age Distribution

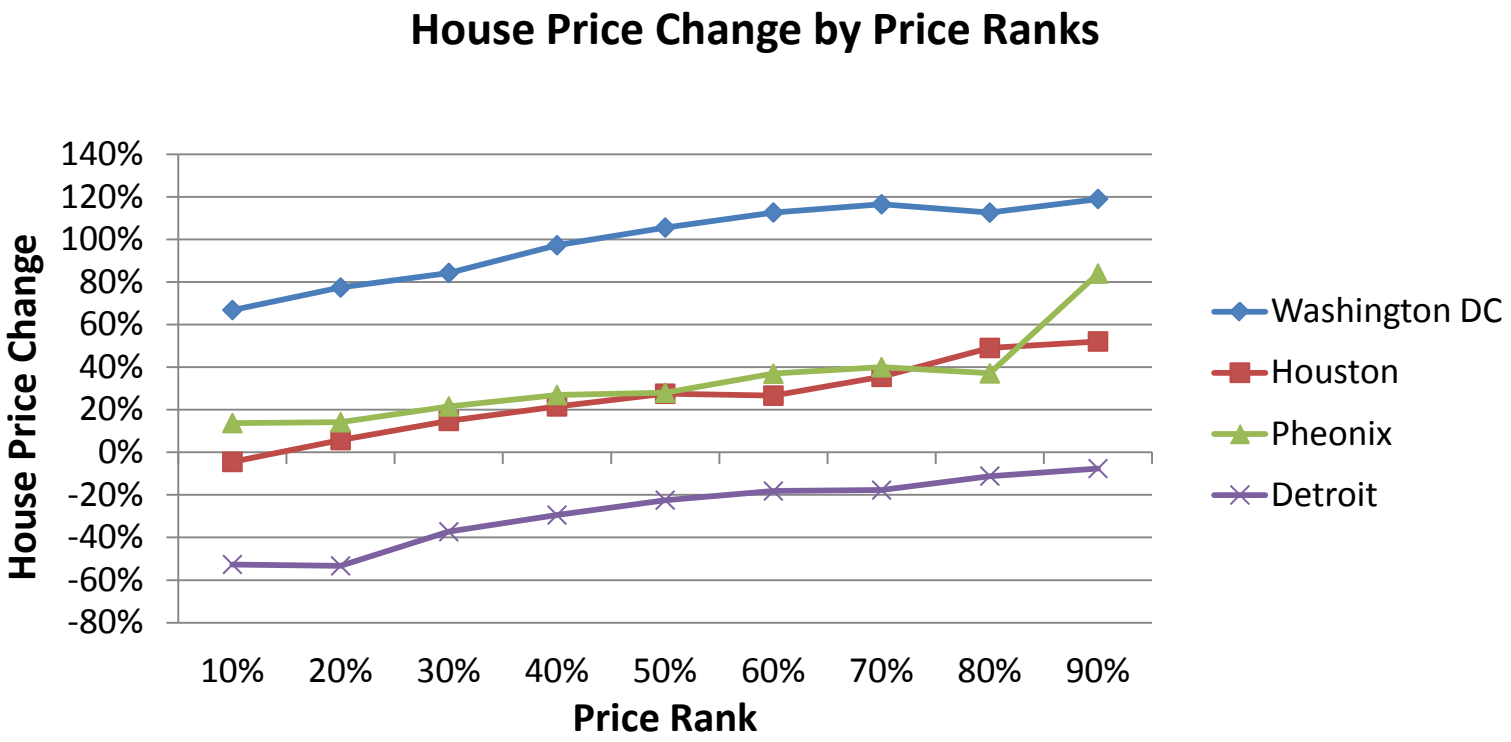
After the financial crisis, a decrease in household formation is observed during 2008 to 2010. Below is the graph of the recent ten years of US household formation data.



It is fair to expect this temporary delay of household formation will result in a rebound of this rate, which would increase the demand for housing. Since young adults are typically the driver of household formation, it is important to analyze age distributions within metropolitan areas, especially for the 18 to 35 age group.

An Area of Future Research

It is observed that different price ranks have different price changes in the past years. Below is the graph of the house price changes from 12/1999 to 12/2012 for different price ranks of several metro areas.



Conclusions

1. We have presented an actuarial method of valuing residential properties for metropolitan areas, by incorporating key factors affecting the supply and demand for houses.
2. The housing actuarial values hold the promise of being useful to lenders and regulators in implementing counter-cyclical measures.
3. Further research is needed to expand the data collection and to refine the analysis.

Appendix: China Housing Market

Compared to the U.S. housing market, China's housing market has several significant differences.

1. Carry cost and maintenance fees
2. Density of population and migration

Appendix: Carry Cost

Compared to the U.S. housing market, China's housing market has a much lower long term carry cost. This is mainly due to two reasons:

1. Most residences in China are apartments, which require minimal effort to maintain. The annual maintenance fee can be as low as zero for an empty apartment.

2. Currently, there is no property tax in China. The only long-term carry cost is the property management fee, which is usually lower than 0.1% of the apartment value.

Appendix: Density of Population and Migration

China has four tiers (levels) of cities, which have varying population densities and migration conditions.

The Level one and two cities in China have extreme population densities and are experiencing a continuous migration. For example, the New York metro area has the highest density of population in the U.S. in 2008 with 2,826 people per square mile. For Shanghai, this number was more than 12,000.

Appendix: Density of Population and Migration

On the other hand, Level three and four cities in China have a comparatively lower population density. For Level three and four cities in middle and western China, the effect of migration from rural areas is offset by the trend of residents continuously moving out to Level one and two cities.

The limited demand and over-supply in some Level three and four cities results in the phenomenon of “ghost cities”.

Appendix: Density of Population and Migration

Below is a population table of the Level one and three cities in China eastern and non-eastern area. Beijing, Shanghai, and Guangzhou are Level one cities and others are all Level three cities.

Cities in the East	2000 Population	2010 Population	Change %	Cities not in the East	2000 Population	2010 Population	Change %
北京 (Beijing)	13,569,000	19,612,000	45%	洛阳 (Luoyang)	6,227,655	6,549,486	5%
上海 (Shanghai)	16,737,734	23,019,148	38%	开封 (Kaifeng)	4,575,500	4,671,659	2%
广州 (Guangzhou)	9,943,000	12,700,800	28%	吉林市 (Jilin)	4,485,494	4,414,681	-2%
嘉兴 (Jiaxing)	3,583,000	4,501,700	26%	宜昌 (Yichang)	4,149,308	4,059,686	-2%
珠海 (Zhuhai)	1,235,582	1,560,229	26%	柳州 (Liuzhou)	3,430,800	3,554,400	4%
金华 (Jinhua)	4,571,900	5,361,600	17%	株洲 (Zhuzhou)	3,581,820	3,803,387	6%
汕头 (Shantou)	4,671,100	5,391,000	15%	九江 (Jiujiang)	4,511,564	4,728,763	5%
温州 (Wenzhou)	7,558,000	9,232,100	22%	宝鸡 (Baoji)	3,632,351	3,716,731	2%

Acknowledgments

- Thanks to the Casualty Actuarial Society for sponsoring this research project.
- The Risk Lighthouse team performed data collection and analysis. Scott Andrew served as an advisor.
- Marshall & Swift/Boeckh provided the construction cost data.