

American Enterprise Institute Conference on
Collateral Risk: Moderating Housing Cycles and
their Systemic Impact



Actuarial Values of Housing Markets

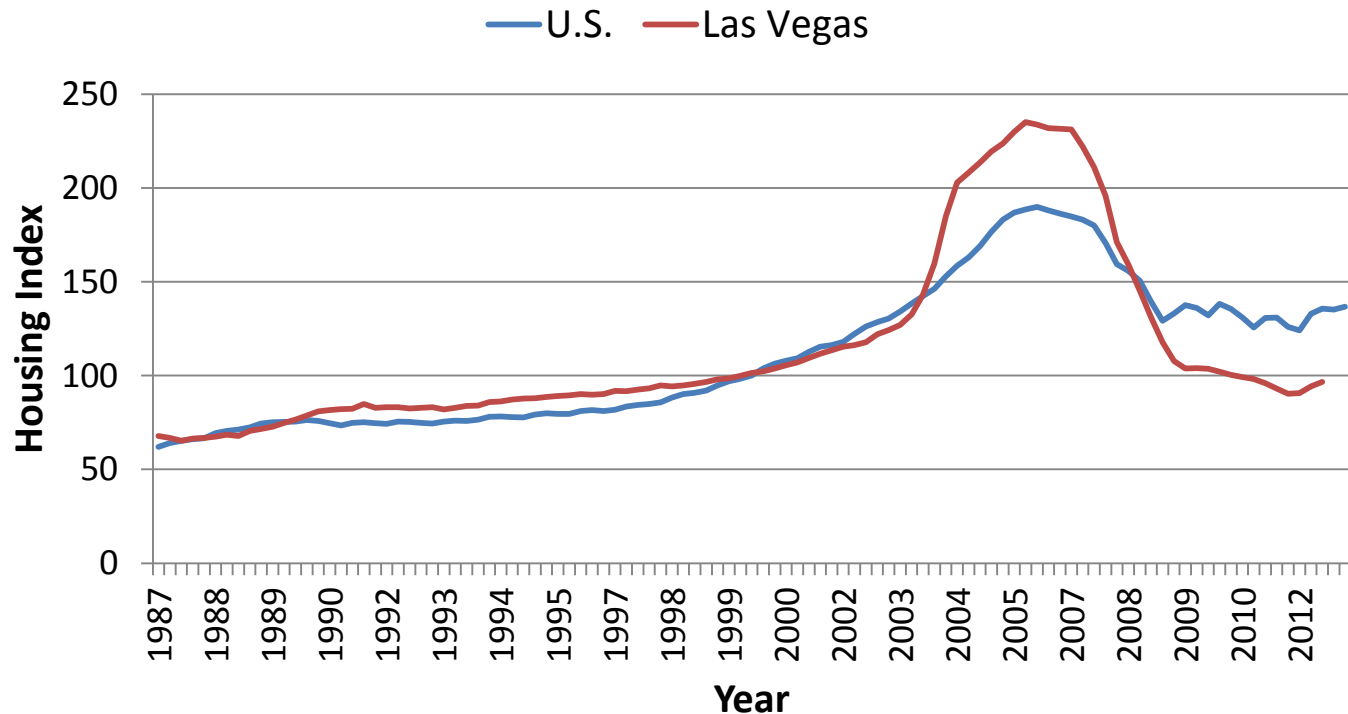
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**Recently joined the Geneva Association*

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

Case-Shiller Housing Price Index



1. Mark-to-market is the culprit of the recent financial crisis
 - ✓ M2M of mortgage loans
 - ✓ M2M of MBS, CDOs, and CDO²
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 Market

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

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

Adjusted Quarterly Change_t is controlled in the range of [Floor_t , Cap_t]

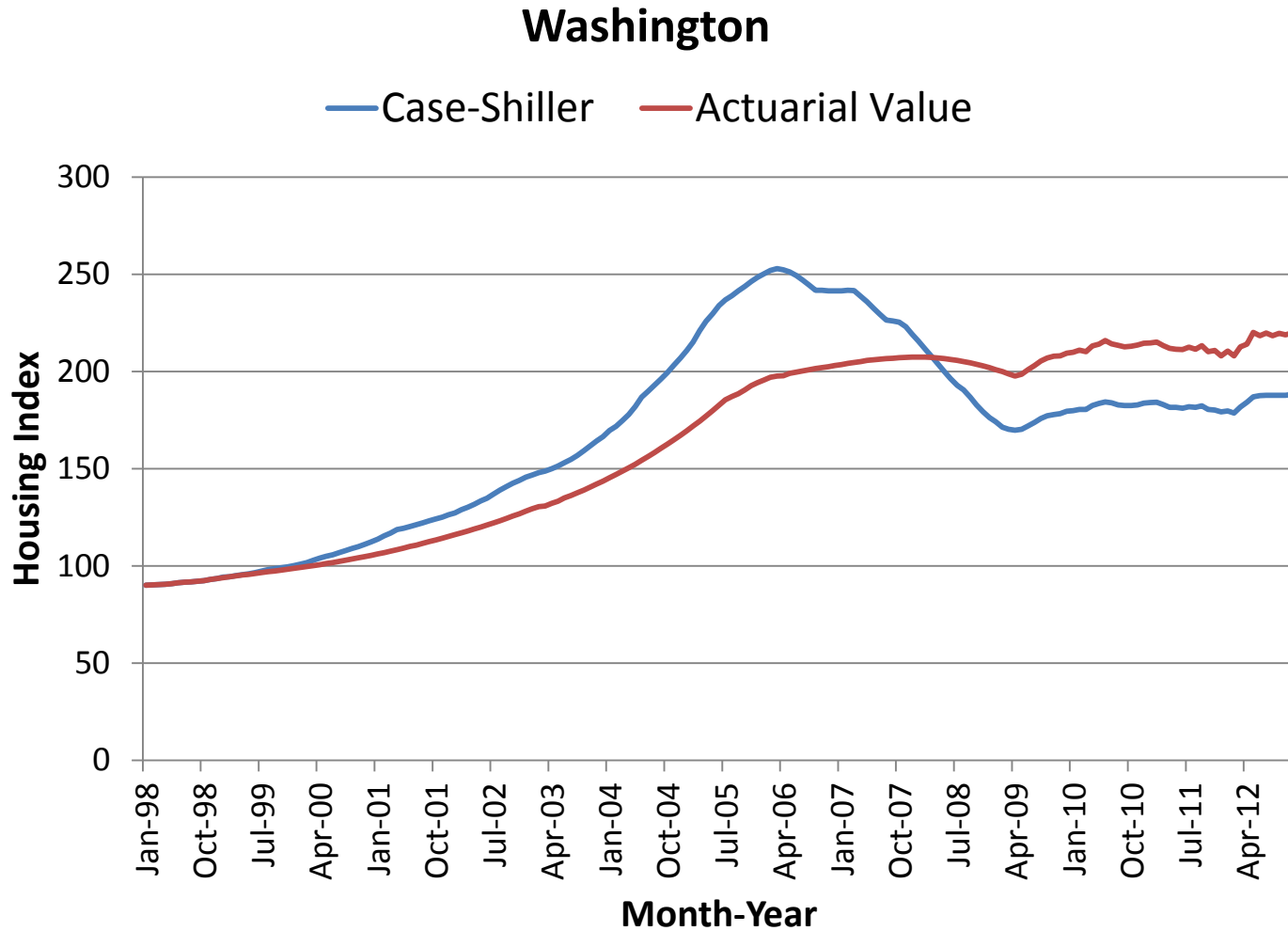
$$\text{Cap}_t = \text{Mean (Quarterly Change in last 10 years)} - \text{drift} \\ + \text{Volatility (Quarterly Change in last 10 years)}$$

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

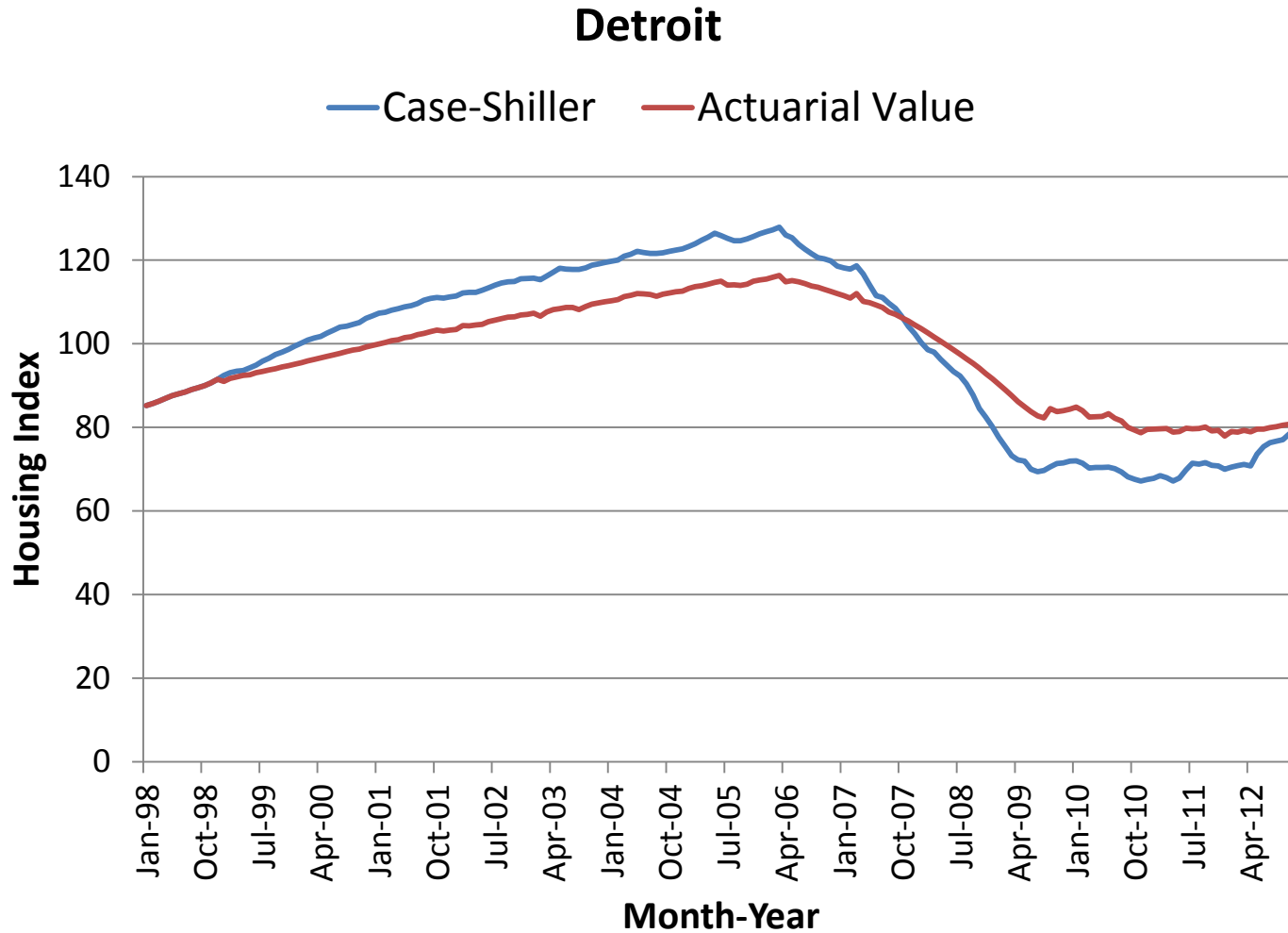
A Key of Calculating Actuarial Value

1. The unique strength of the Housing Actuarial Value method 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 meaningful factors, such as construction cost, demographic distribution, migration, etc.
3. Some of these factors will be previewed on the following slides.

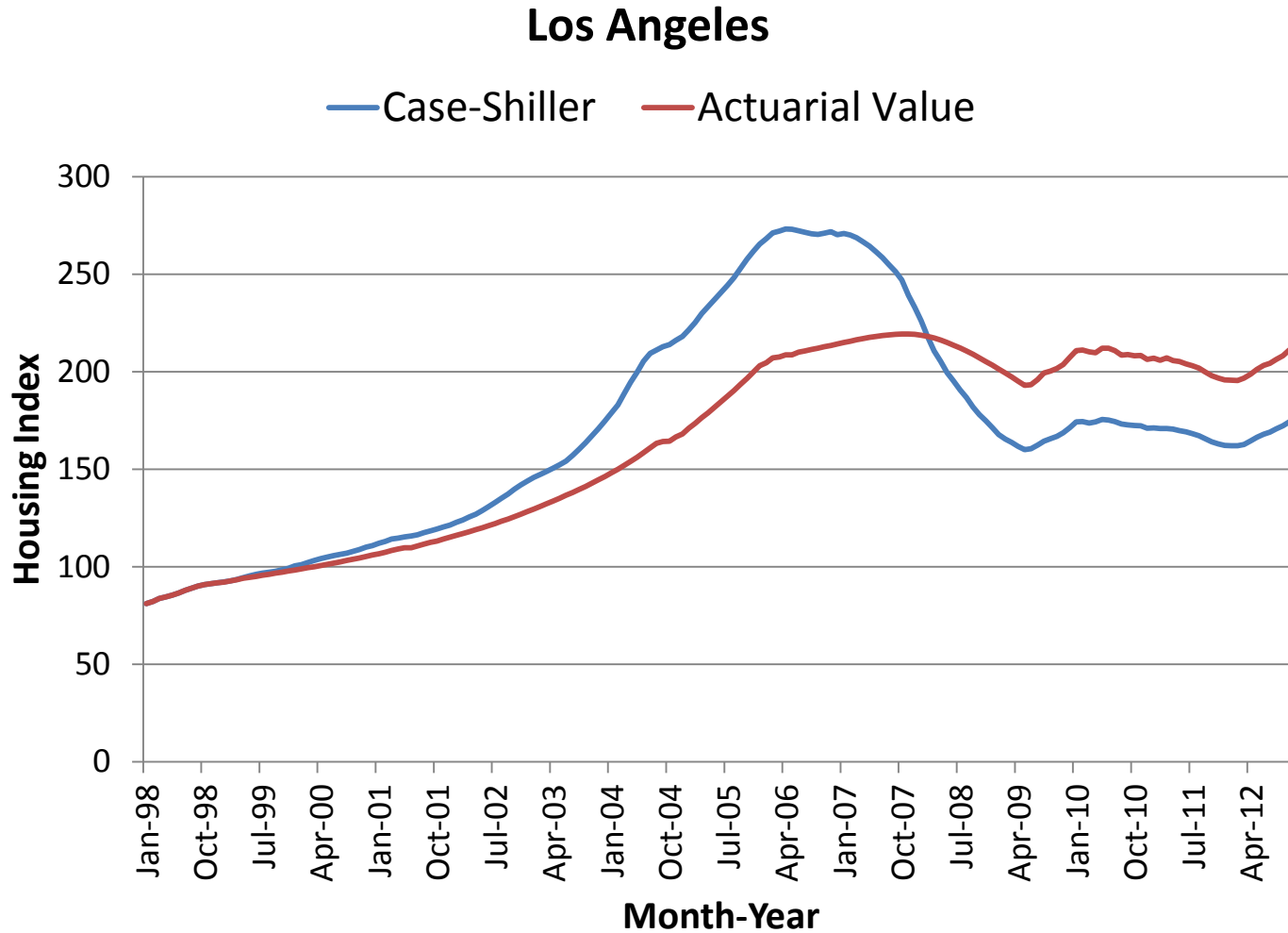
Washington DC Housing Actuarial Value



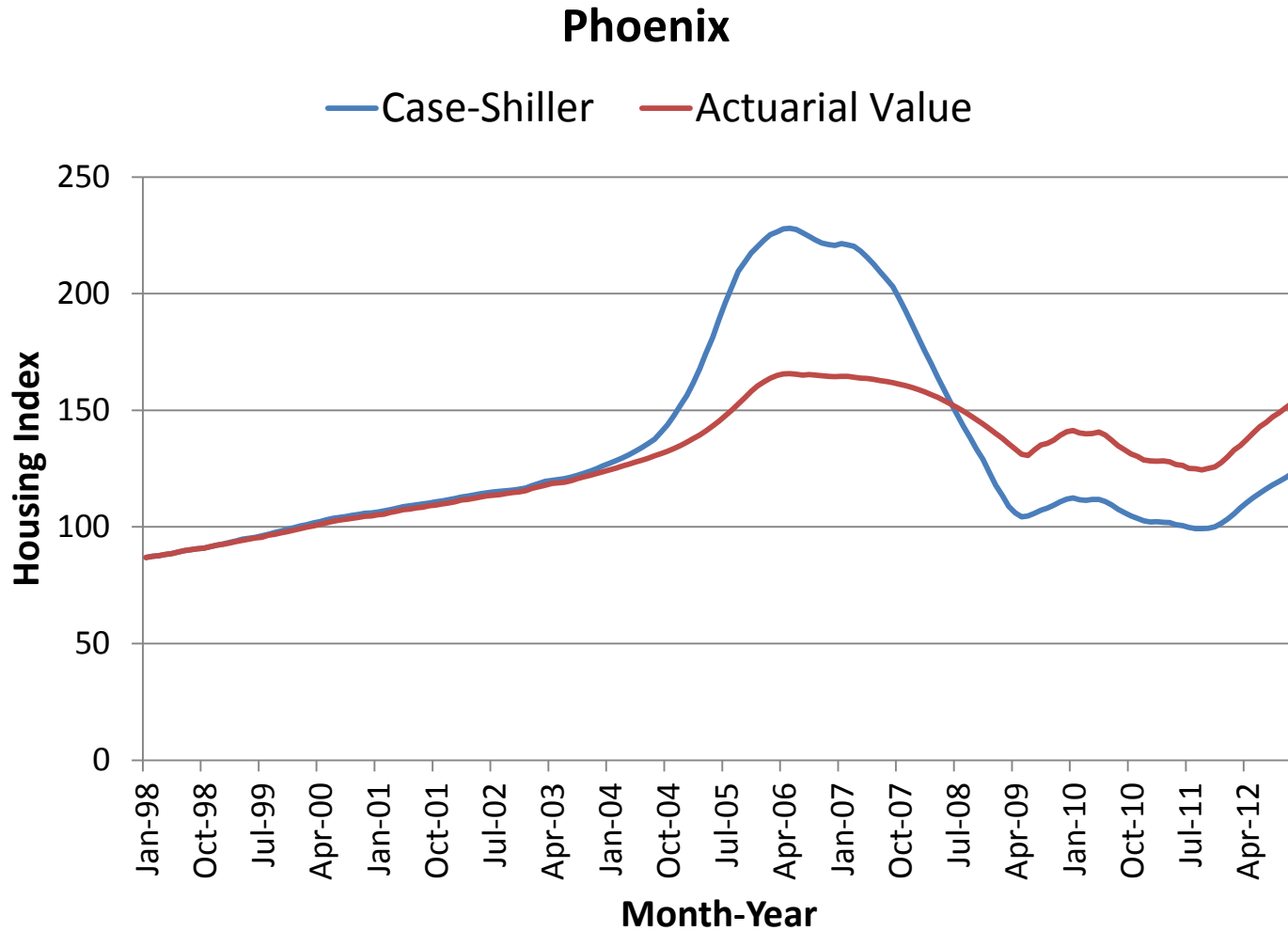
Detroit Housing Actuarial Value



Los Angeles Housing Actuarial Value

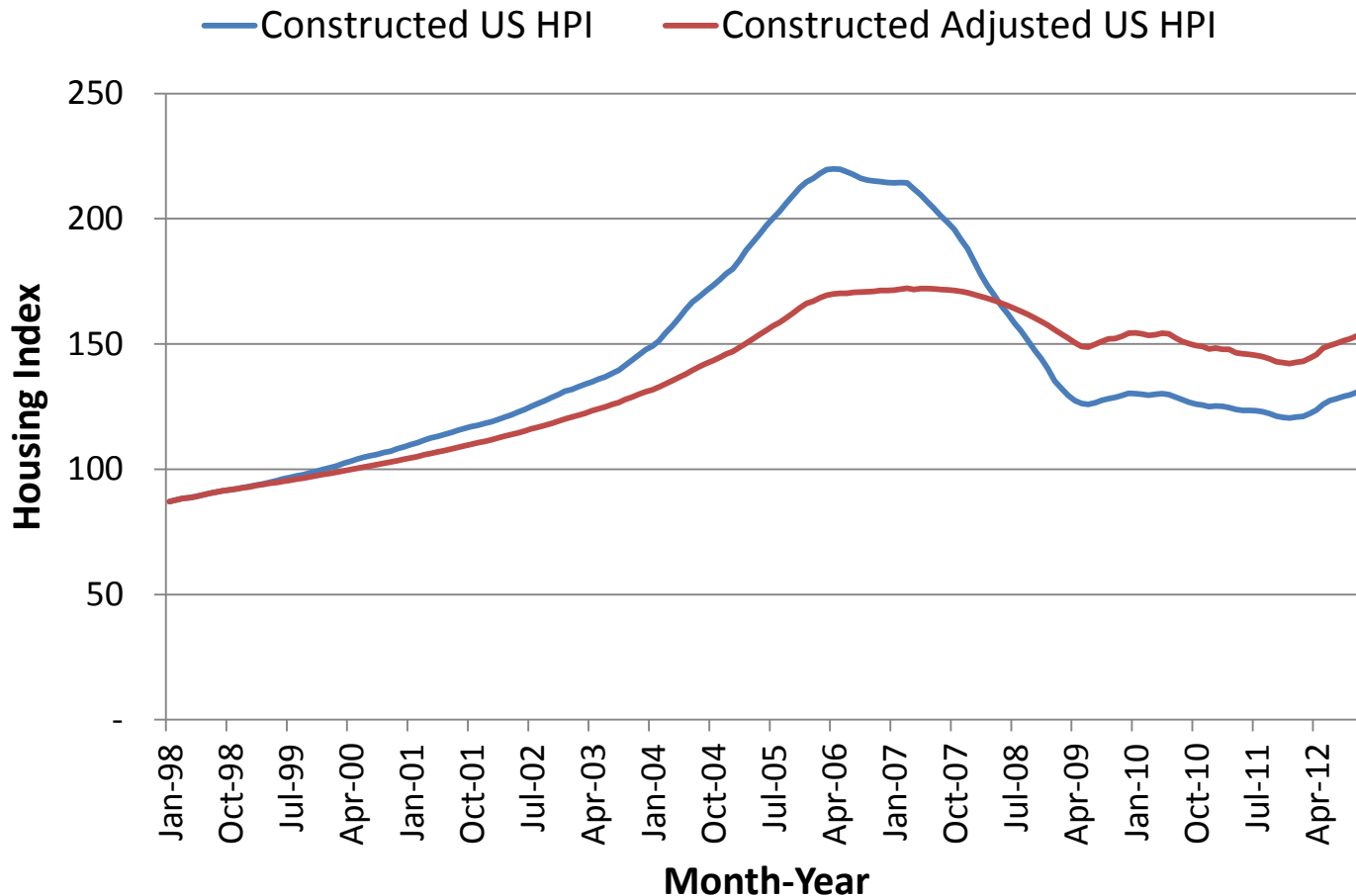


Phoenix Housing Actuarial Value



U.S. Housing Actuarial Value

U.S. National Constructed HPI vs. Actuarial Value

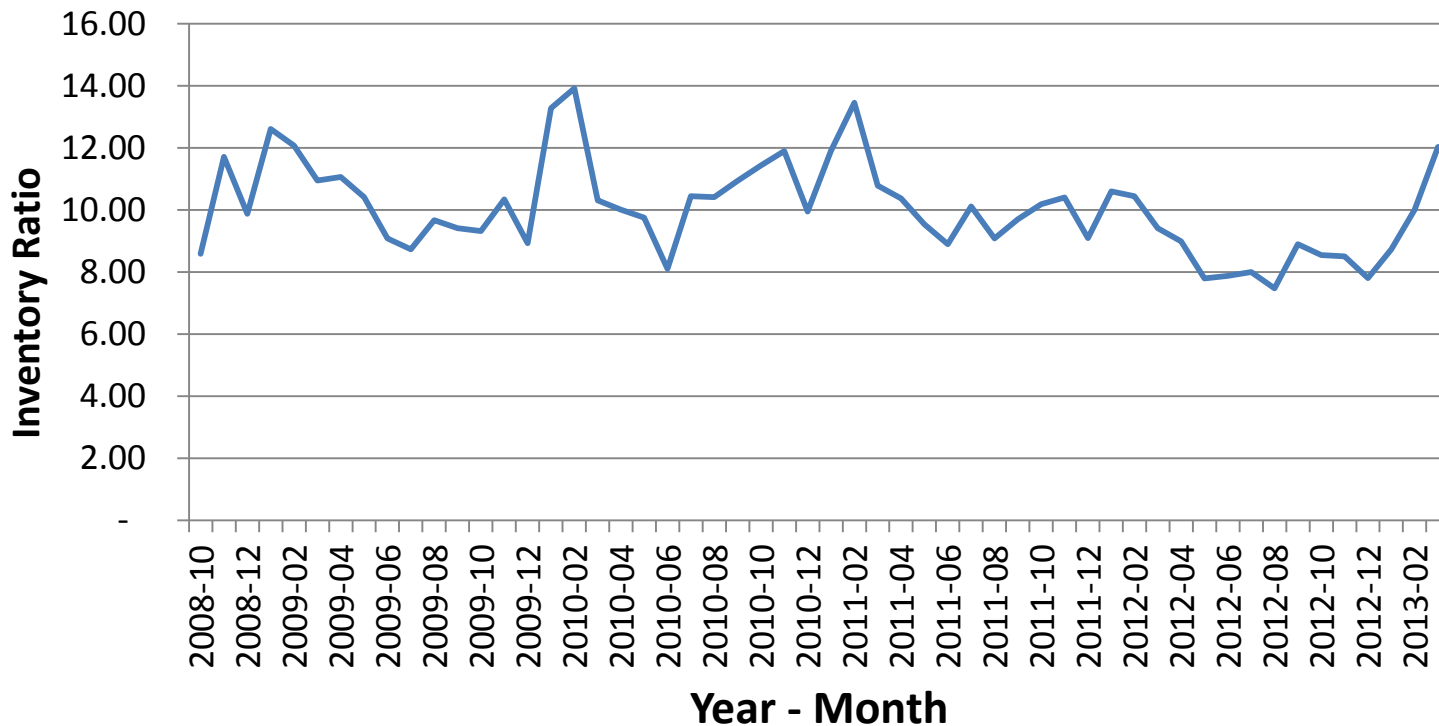


1. So how are the actuarial values calibrated?
2. We calibrate the drift term to reflect the combined effects of economic and demographic factors impacting the supply and demand of housing units in a metropolitan area

Supply of Housing Units

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

U.S. Housing Market Inventory Supply*



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

We have observed two types of houses for sale.

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”*.

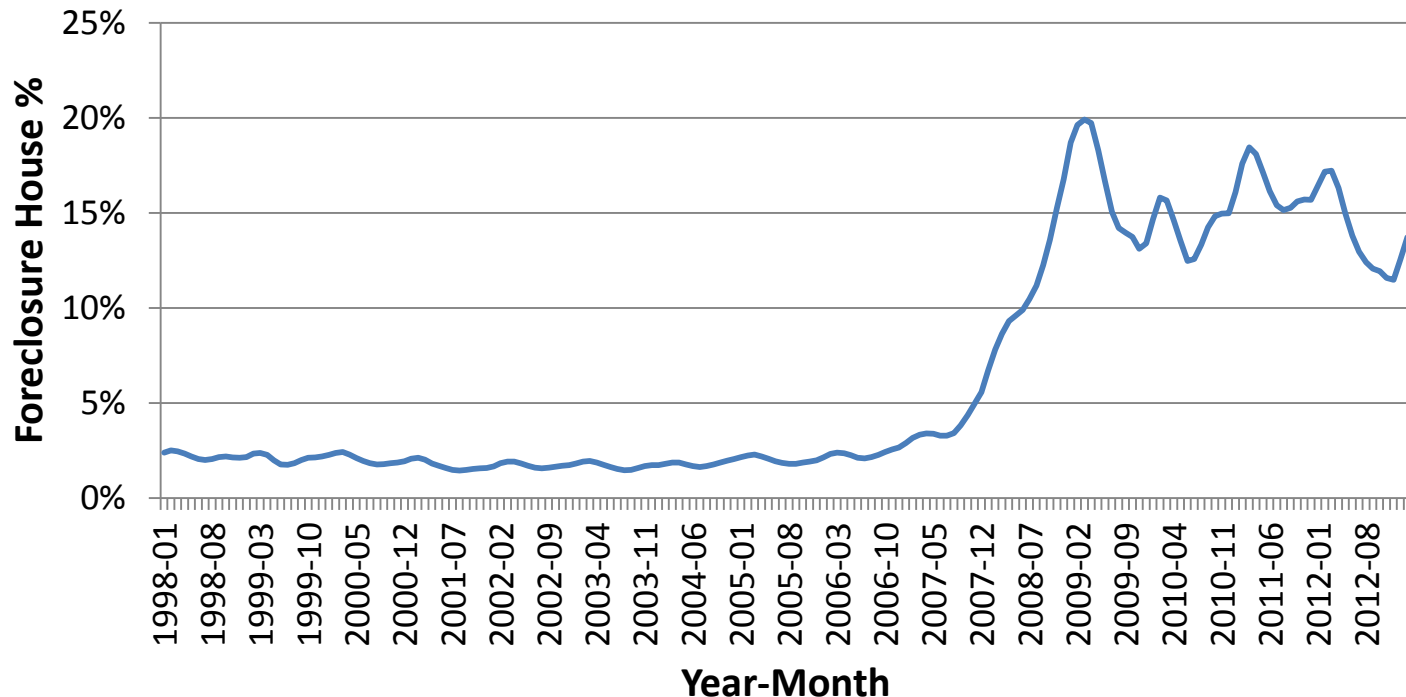
“Forced-to-sell” houses can be further divided into four classes:

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.

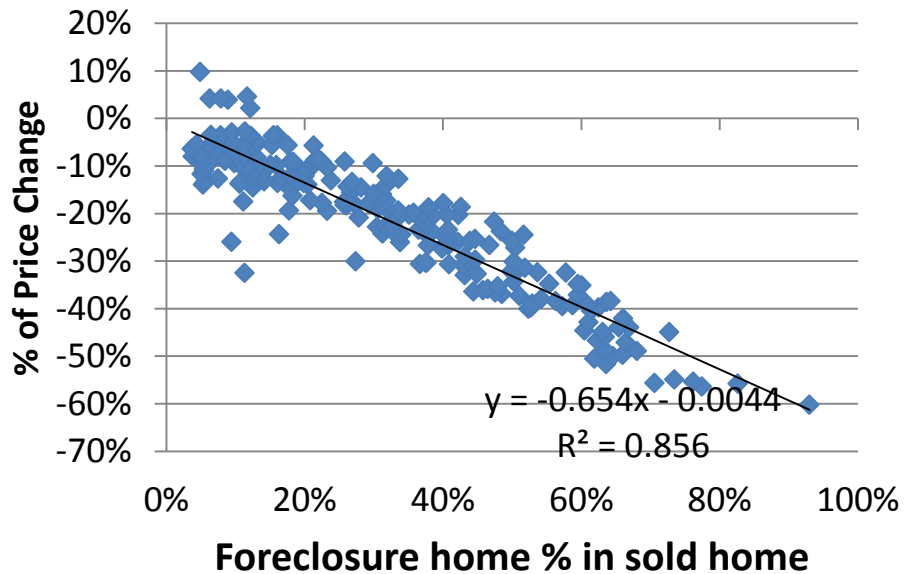
Foreclosure House % in Transactions



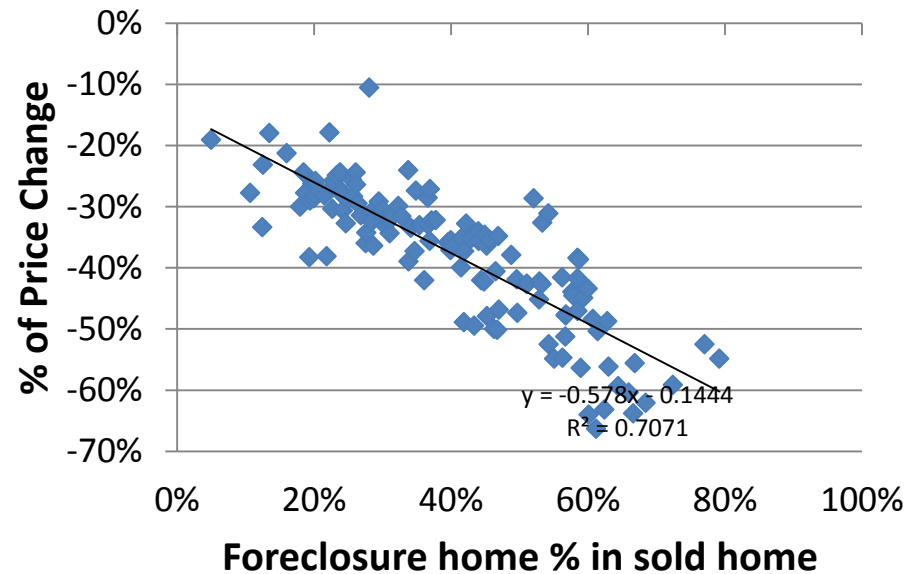
Foreclosure Houses

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 %*



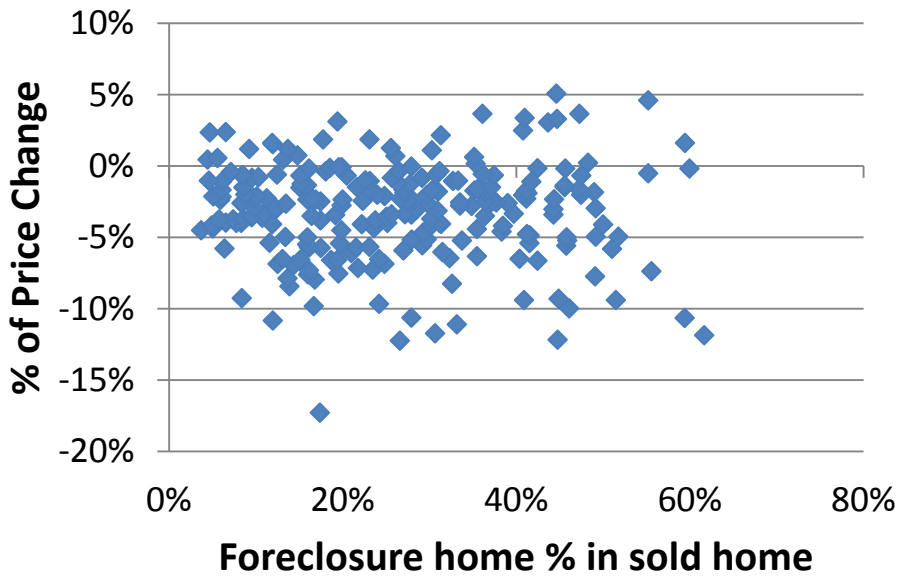
Phoenix 2008-2010 House Price Change vs. Foreclosure Home %



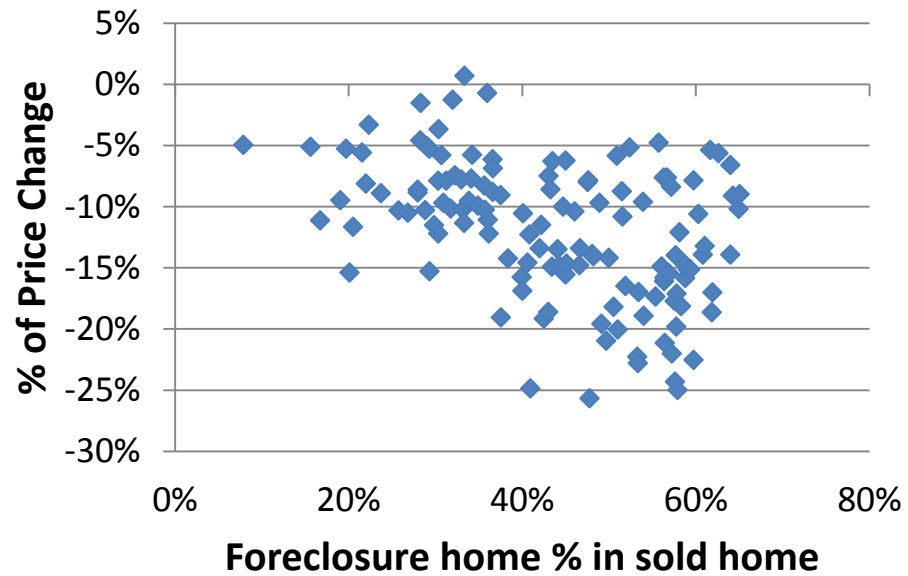
Foreclosure Houses

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

Los Angeles 2010-2011 House Price Change vs. Foreclosure Home %



Phoenix 2010-2011 House Price Change vs. Foreclosure Home %



Newly Built Houses

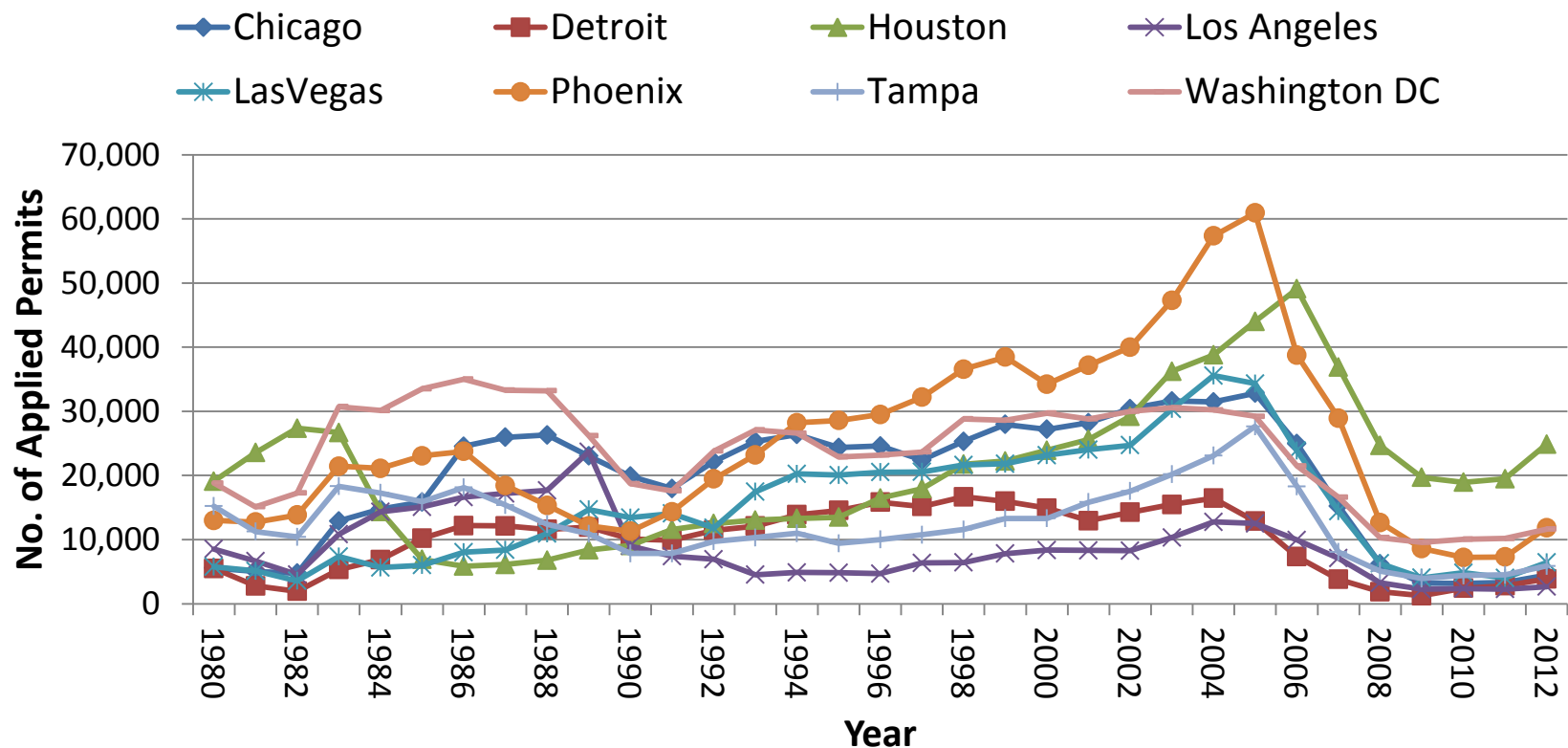
Generally speaking, newly built houses are under more pressure to sell in a short time than owner-occupied homes. Builders of new homes normally have liquidity constraints and incur carry-costs of serving their bank loans.

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.

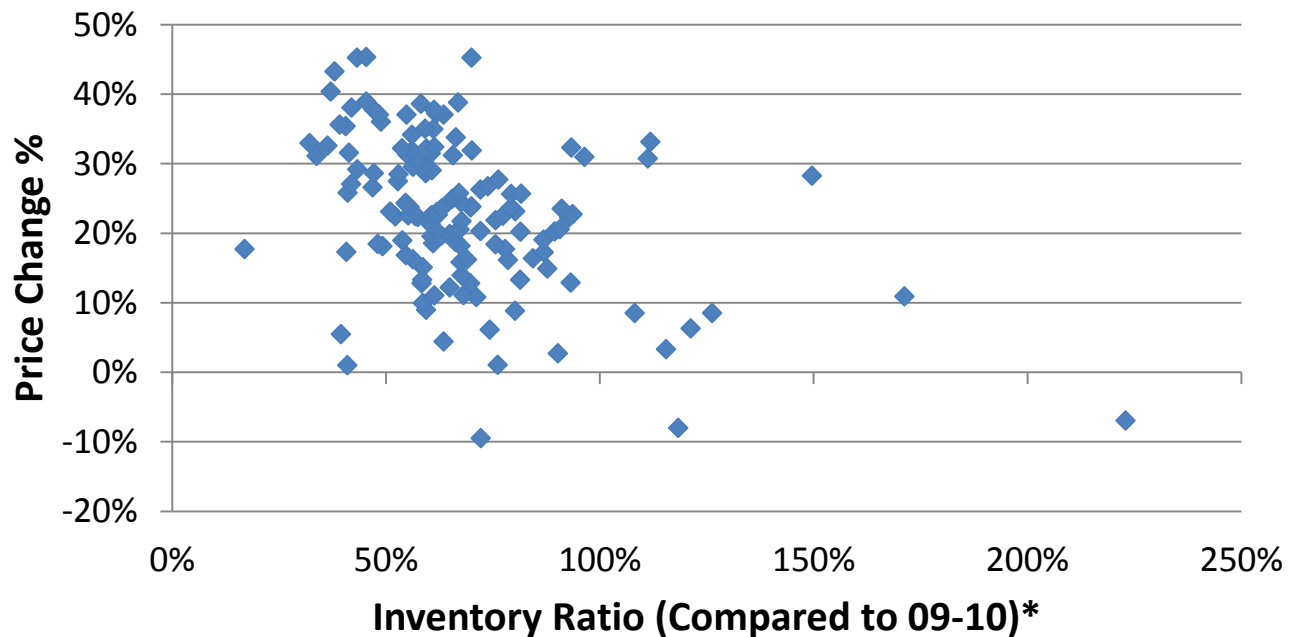
Single Family Building Permit



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.

Phoenix 2012-2013 Price Change % vs. Inventory

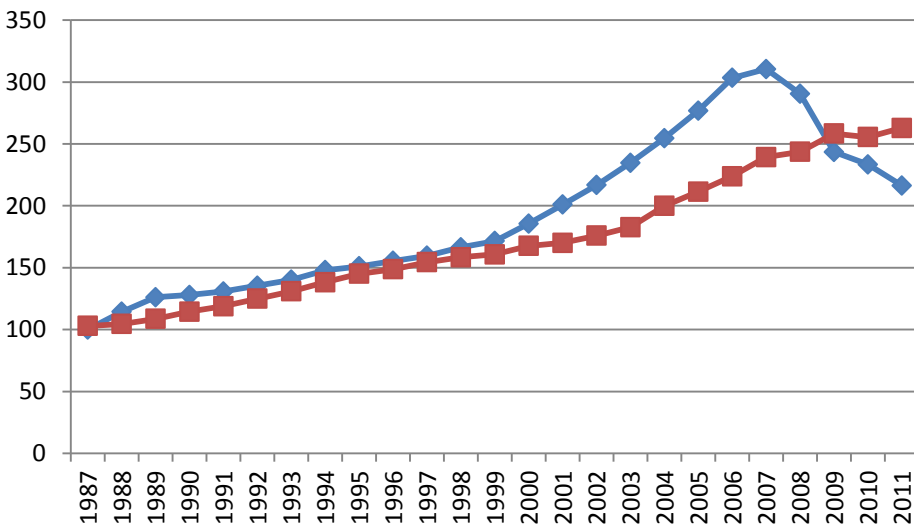


Newly Built Houses

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

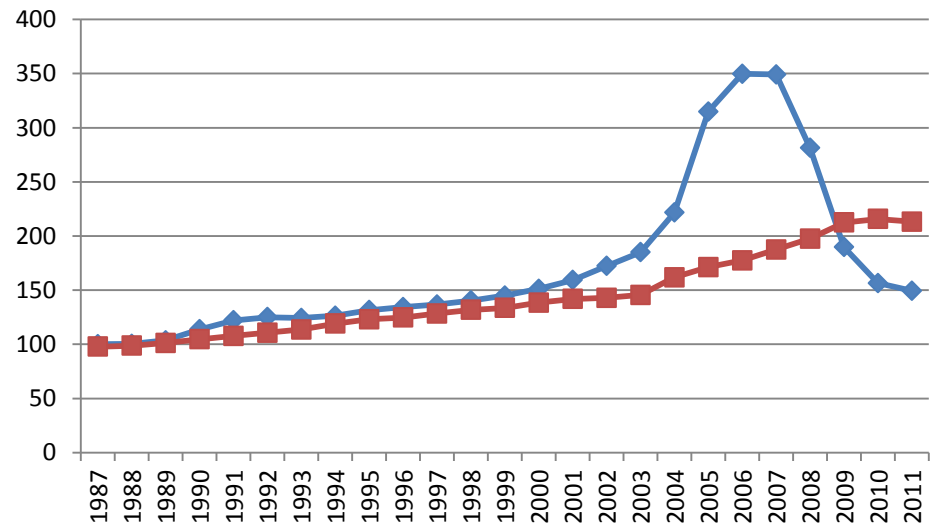
Chicago

- ◆ Case-Shiller Adjusted Index
- Construction Cost Adjusted Index



Las Vegas

- ◆ Case-Shiller Adjusted Index
- Construction Cost Adjusted Index



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

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%

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.

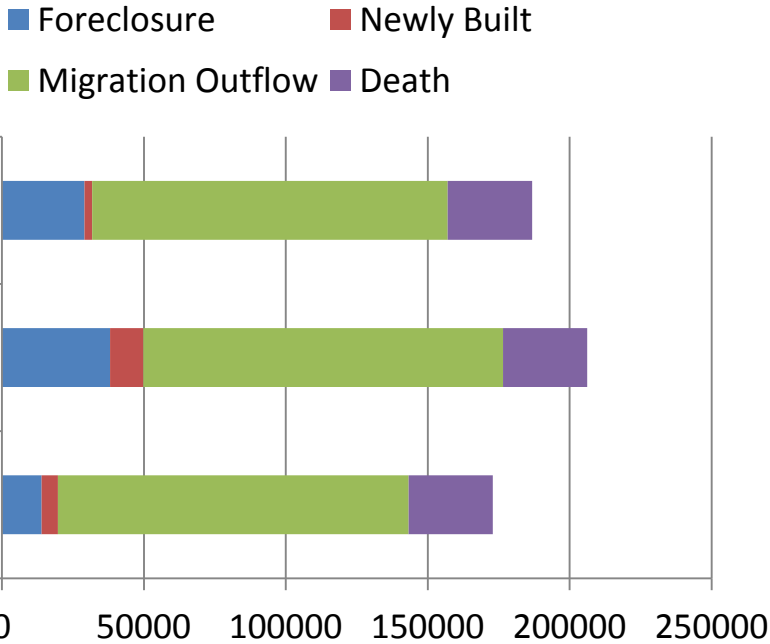
Single Family Building Permit Applications in Tampa	
1996	10,006
1997	10,745
1998	11,573
1999	13,309
2000	13,293

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.

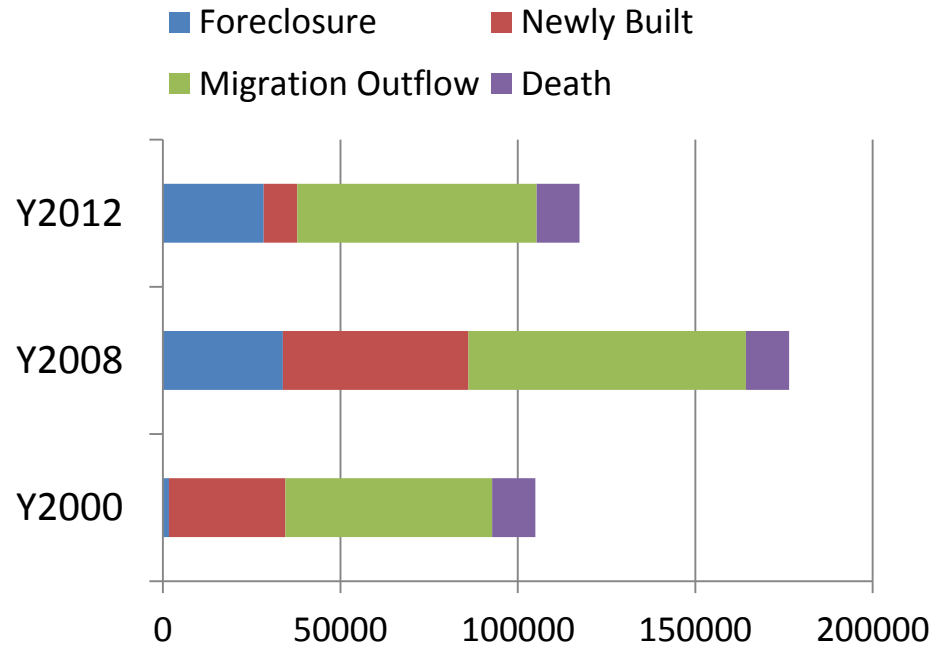
Dynamics of Housing Units Supply

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

Los Angeles



Phoenix



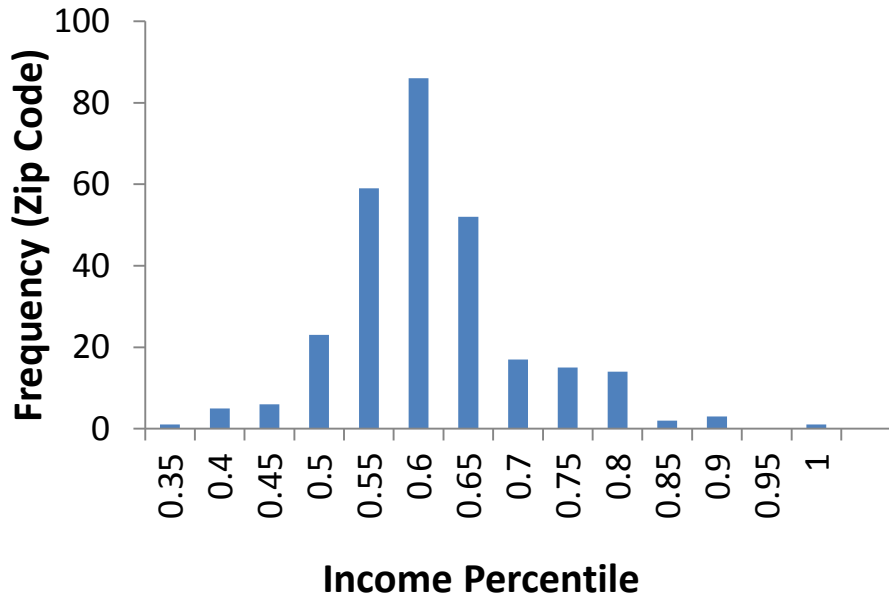
We also consider factors affecting the **demand of housing units**, including:

- 1) Household income distribution
- 2) Age distribution

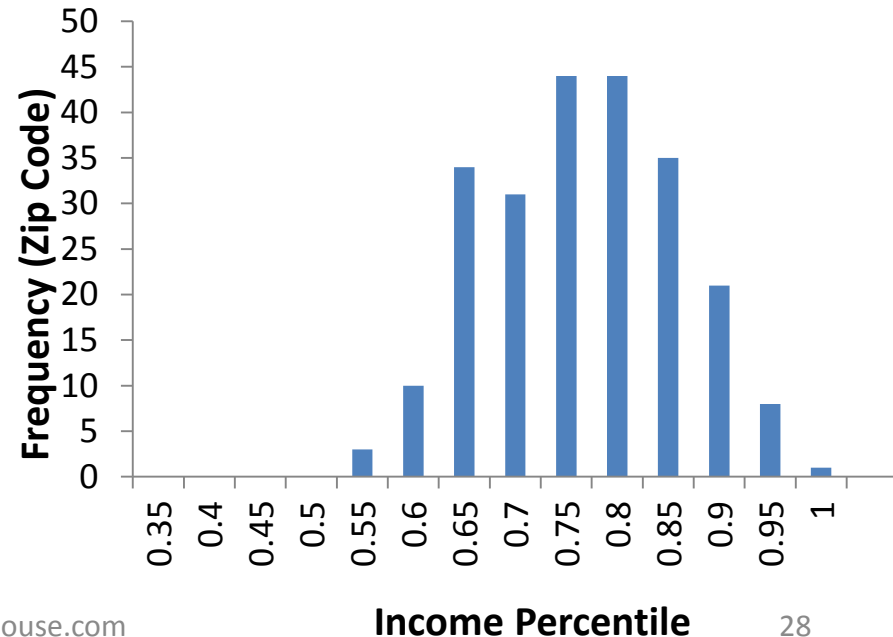
Household Income Distribution

Traditionally, researchers 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**

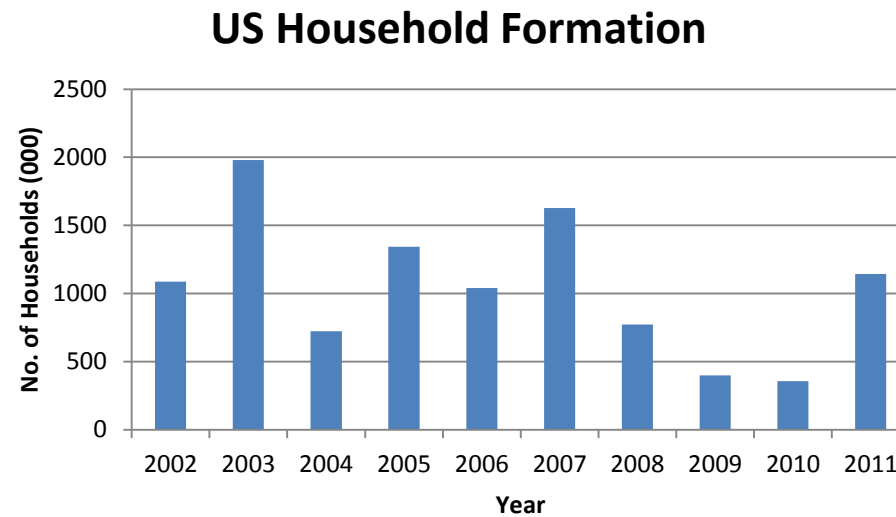


**Chicago 2008 House Price Implied
Income Percentile**



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.

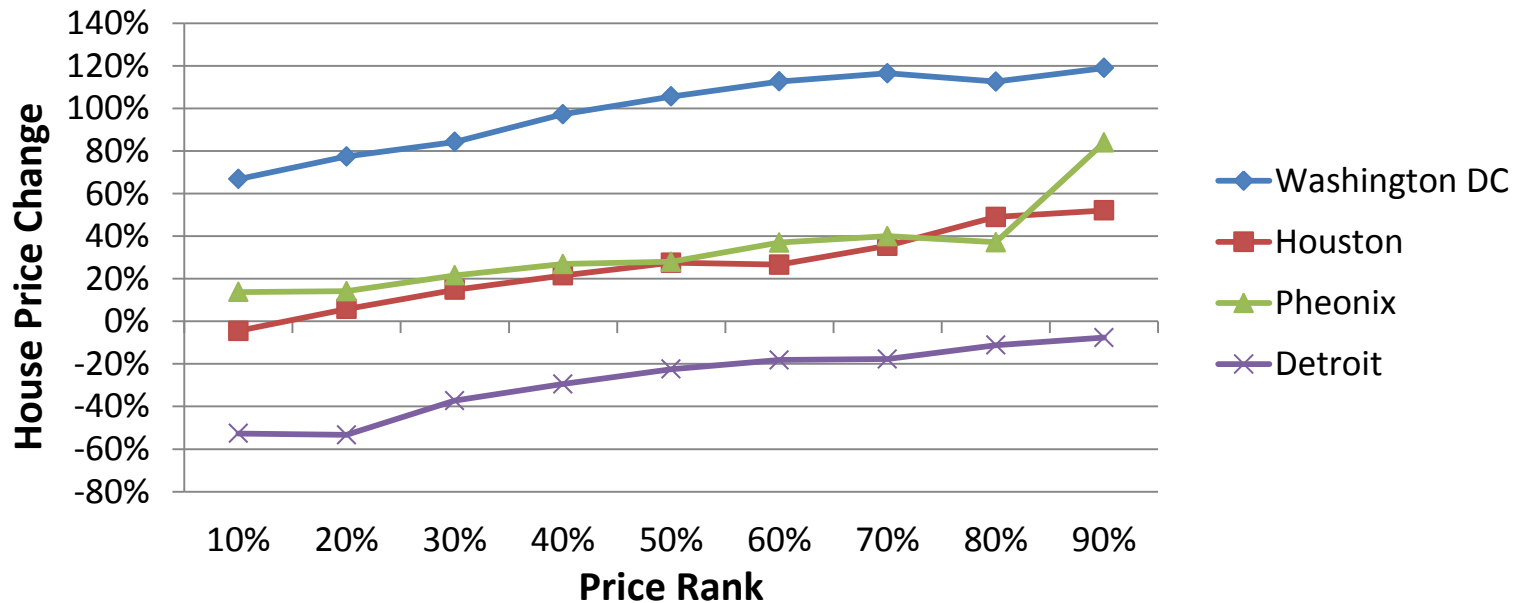


It is fair to expect this temporary delay of household formation will result in a rebound of this rate, which would increase the demand for housing. Since young adults are typically the driver of household formation, it is important to analyze age distributions within metropolitan areas, especially for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

House Price Change by Price Ranks



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.

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.