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The State of the Portland MSA Housing Market

Portland State University. Northwest Economic Research Center

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NeRC

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Portland State UNIVERSITY

ACKNOWLEDGEMENTS

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OnPoint Community Credit Union is the largest credit union in Oregon with 309,000 members and $4.3 billion in assets. OnPoint is member-owned and locally managed from offices in Portland. For more than 83 years, OnPoint has been a reliable constant in the lives of members and their families, providing a safe place to save and borrow money. In addition, OnPoint has a longstanding commitment to strengthen local communities through giving, volunteer work, and education. Founded in 1932, OnPoint's membership is available to anyone who lives or works in one of 13 Oregon (Benton, Clackamas, Columbia, Crook, Deschutes, Jefferson, Lane, Linn, Marion, Multnomah, Polk, Washington and Yamhill) and two Washington counties (Skamania and Clark) and their immediate family members.

NERC is based at Portland State University in the College of Urban and Public Affairs. The Center focuses on economic research that supports public-policy decision-making, and relates to issues important to Oregon and the Portland Metropolitan Area. NERC serves the public, nonprofit, and private sector community with high quality, unbiased, and credible economic analysis. Dr. Tom Potiowsky is the Director of NERC, and also serves as the Chair of the Department of Economics at Portland State University. Dr. Jenny H. Liu is NERC's Assistant Director and Assistant Professor in the Toulan School of Urban Studies and Planning. This report and accompanying research was completed by Peter Hulseman, with research assistance from Michael Paruszkiewicz, Emma Willingham, and Hieu Nguyen.

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Executive Summary

On its surface, the rapid increase of home prices in the Portland Metropolitan Statistical Area (MSA) resembles the overheated moments before the housing bubble burst in 2007. OnPoint Community Credit Union, concerned that history may already be repeating itself, asked the Northwest Economic Research Center (NERC) to investigate speculation within the Portland housing market, provide a forecast of home prices, and summarize potential market headwinds and tailwinds.

To accomplish this, NERC estimates the change in local home prices due to 'fundamental' drivers. Using population and income to estimate a fundamental home price index (HPI), this analysis compares the fundamental HPI with the actual level of the Case-Shiller HPI to indicate that home values within the Portland MSA are, within a margin of error, correctly valued. This method indicates that increasing growth in income and migration significantly contributes to rising home prices. This comparison also shows a period of undervaluation following the burst of the last bubble, which helps to explain the price growth of the past few years (the 'expansion phase' of the recovery).

This analysis uses Error-Correction (EC), General Autoregressive Moving Average (GARMA), and Ordinary Least Squares (OLS) models to forecast the inflation-adjusted Case Shiller HPI to the end of the year. The inherent strengths and weaknesses of these models necessitate a discussion of their assumptions and consequent limitations. Encouragingly, each of the models describes the same basic story: that average home sale prices will increase at a decreasing growth rate from June to at least December 2016. Changes to land use and building height restrictions are among the external shocks to home prices not included in the model. Since predicting policy decisions is fraught with risk, real-world awareness of potential political outcomes should accompany all forecasts based on known factors.

Due to data limitations, not all of the indicators NERC feels are important to HPI are explicitly included in the models. Instead, these indicators offer supporting evidence. Generally, they describe a tight housing market with high demand (as indicated by income, employment, and migration) and low supply (as indicated by housing permits and inventory levels). This analysis corroborates the model estimations and supports the forecasts.

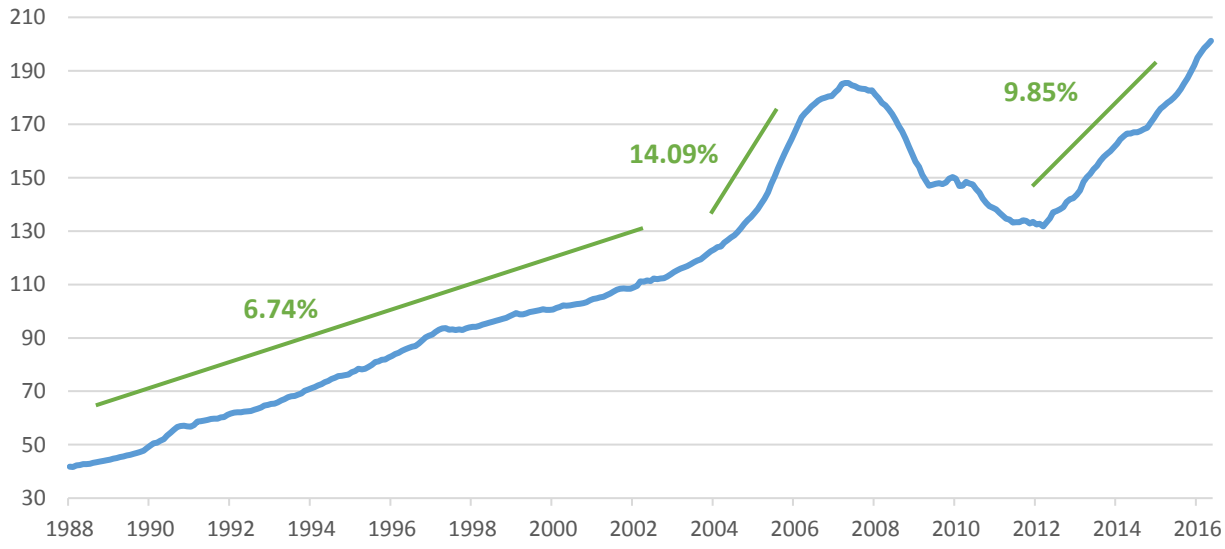
Introduction

Still rising from the depths of the Great Recession, many buyers in the Portland housing market remain unable to catch their collective breath. With a housing affordability crisis and skyrocketing demand, people are beginning to refer to the mid-2000s housing bubble. However, real growth can warrant rising prices, there can be genuine economic reasons for rising demand, and affordability problems tend to occur in areas that are getting wealthier. This analysis will explore whether the area's economic fundamentals warrant this high level of home price growth, detail market conditions, and provide a home price forecast.

However, prior to that, an exploration of the last bubble will determine if history is already repeating itself. Figure 1 below shows three separate periods of growth for the Case-Shiller Home Price Index (HPI) for the Portland Metropolitan Statistical Area (MSA). The first, 6.74% from 1988 to the end of 2002, shows relatively consistent growth through the late eighties and the entirety of the nineties. Then, in 2003, home prices began to grow at a significantly faster annual clip of 14.09% through mid-2006. This incredible growth ultimately proved unsustainable as home prices crashed in 2007, eventually bottoming out in 2012. Since then the Portland MSA has seen a strong average annual growth rate of 9.85%.

These growth rates give a good idea of how the mid-2000s housing bubble looked – especially the discord between the relatively moderate growth rate of the nineties and the large growth rate during the housing boom. However, growth rates are only part of the story. Tracking the factors that accompanied the mid-2000 housing boom will indicate if what the Portland MSA is currently experiencing is unwarranted speculation or a strong recovery.

Figure 1- Case Shiller Home Price Index for Portland MSA with Average Annual Growth Rates

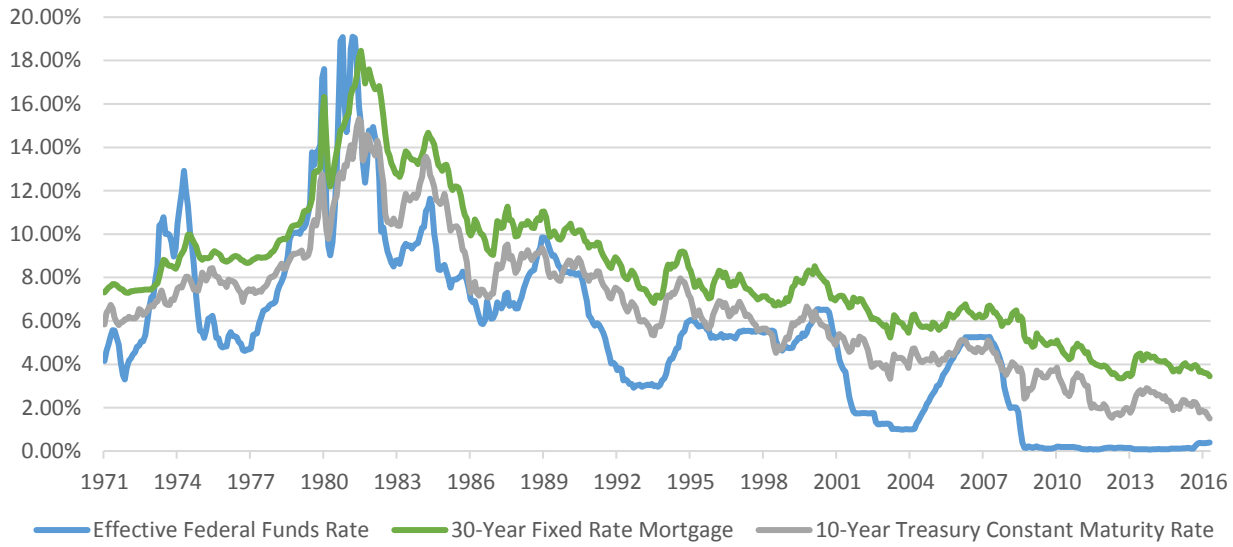


The Mid-2000's Housing Bubble

It is easy to conflate the burst of the housing bubble and the Great Recession due to their clear relationship. However, despite the two being highly interrelated and simultaneous phenomena, it is possible to tease out separate catalysts for each. Consensus among economists is that a major cause of the housing bubble was the zeitgeist known as 'irrational exuberance', whereas the brunt of the fault for the recession lies with the extreme leveraging of mortgage debts. This leaves two sets of factors to keep track of, those that indicate the likelihood of a housing bubble and those that indicate the damage that the bursting of a housing bubble would cause to the larger economy.

A good starting point to begin tracking the factors that led to the housing boom and the Great Recession is the much smaller recession that preceded them. The bursting of the dot-com bubble in early 2000 led Alan Greenspan's Federal Reserve to lower the target federal funds rate, consequently putting downward pressure on mortgage rates (see Figure 2). This accommodative policy environment fueled borrowing and was one of the causes of the mid-2000s credit boom (see the increased level of mortgage debt in Figure 3)[1].

Figure 2 – Various Interest Rates, May 1971 – July 2016[2]



Today the real interest rate[3] and 30-year average fixed-mortgage rate are hovering around all-time lows. However, total mortgage debt outstanding has yet to return to pre-recession highs, even in nominal terms (see Figure 3).

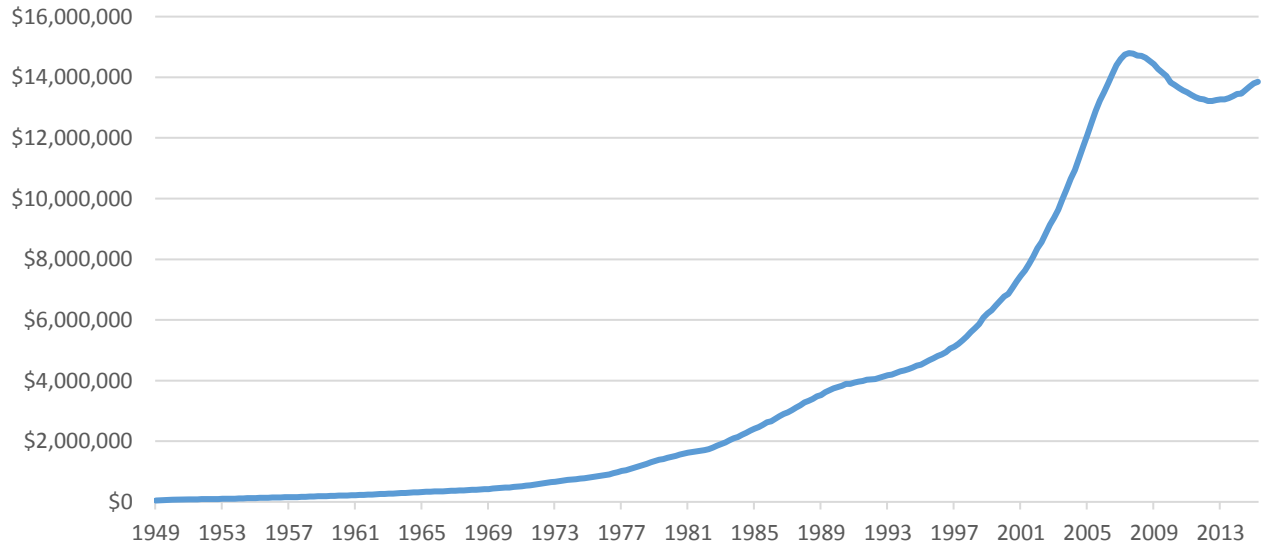
[1] Holt, Jeff. "A summary of the primary causes of the housing bubble and the resulting credit crisis: A non-technical paper." The Journal of Business Inquiry 8, no. 1 (2009): 120-129.
[2] Data from the Board of Governors of the Federal Reserve System and Freddie Mac.
[3] The real interest rate is equal to the nominal interest rate minus inflation. Because interest rates exist over the life of an asset, the current real interest rate is estimated using the expected rate of inflation.

Low mortgage rates, politics, and relaxing regulations all encouraged subprime lending in the early 2000s. Since, under normal lending practices, subprime borrowers often could not afford the houses they were purchasing, their participation in the market increased demand and prices without the usual corresponding increase in economic fundamentals. Since subprime lending spurred non-fundamental price growth, by definition it contributed to artificially inflated housing prices. Today, policies such as the Dodd-Frank act have introduced (and reintroduced) many regulations for the financial sector that include tighter restrictions on mortgage lending. Perhaps consequently, there has been little sign of a resurgence of subprime lending in the housing market until recently.

Although subprime lending certainly played a role in the housing bubble, 'irrational exuberance' is likely more culpable for the rampant overvaluation of houses. 'Irrational exuberance' is a phrase coined by Alan Greenspan at the onset of the late nineties stock bubble and adopted by Robert Shiller as the title for his seminal book on asset bubbles[4]. It refers to a cultural mood that leads to systematic asset overvaluation; in this case, the society-wide belief that, since home prices had not fallen since the Great Depression, it was highly improbable or even impossible that home prices will ever fall[5].

Since people perceived house-prices as ever-increasing, "flipping houses", subprime lending, securitizing mortgages, and buying a home beyond the normal price range appeared to be near risk-free ways of making money. Since any asset with perceived high returns and low risk is going to be exceptionally expensive, as this speculative fervor increased so did home prices.

Figure 3 – Mortgage Debt Outstanding, Millions of Dollars, Federal Reserve Board



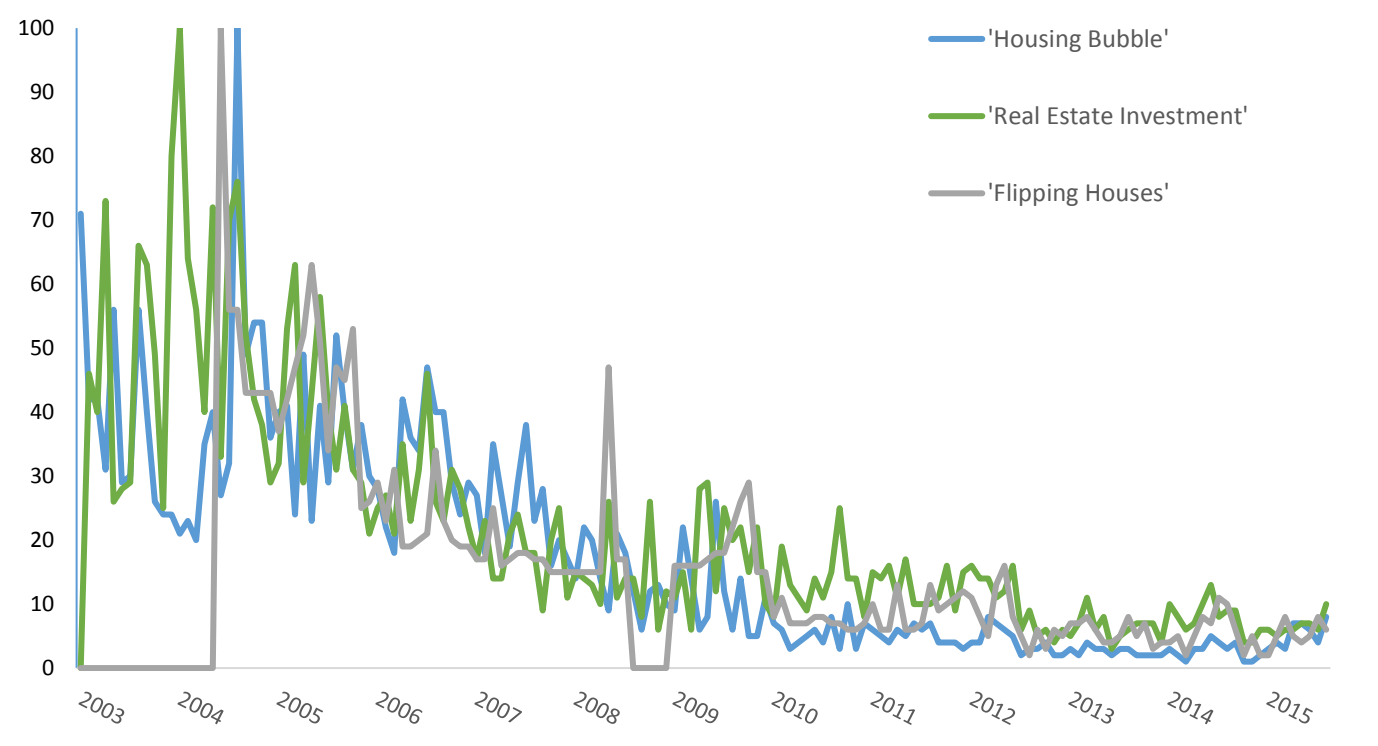
[4] Shiller, Robert J. Irrational Exuberance. Princeton, N.J.: Princeton University Press, 2005.
[5] This is an example of the fallacy of unwarranted extrapolation.

Irrational Exuberance: Evidence via Google Trends

'Irrational Exuberance', or the complex set of behavioral factors responsible for market overvaluation, is by nature difficult to quantify. One method to capture this zeitgeist is through and examination of Google search phrases in the Portland MSA. Figure 4 below shows the Google Trend history of three phrases typically associated with 'irrational exuberance' in relation to the housing bubble.

In a Google Trend graph, the vertical axis represents how often an area searches for a particular term relative to the total number of searches. The number is indexed and normalized, so a '100' indicates the period when Oregon had the biggest proportion of global searches for the given term, relative to its own history. Notably the largest spikes happened between late 2003 and mid-2005, before steadily declining from that point on. This fits in well with NERC's estimated timeframe of the bubble for the Portland MSA (see Figure 14).

Figure 4 – Google Trends by Search Phrase in Oregon



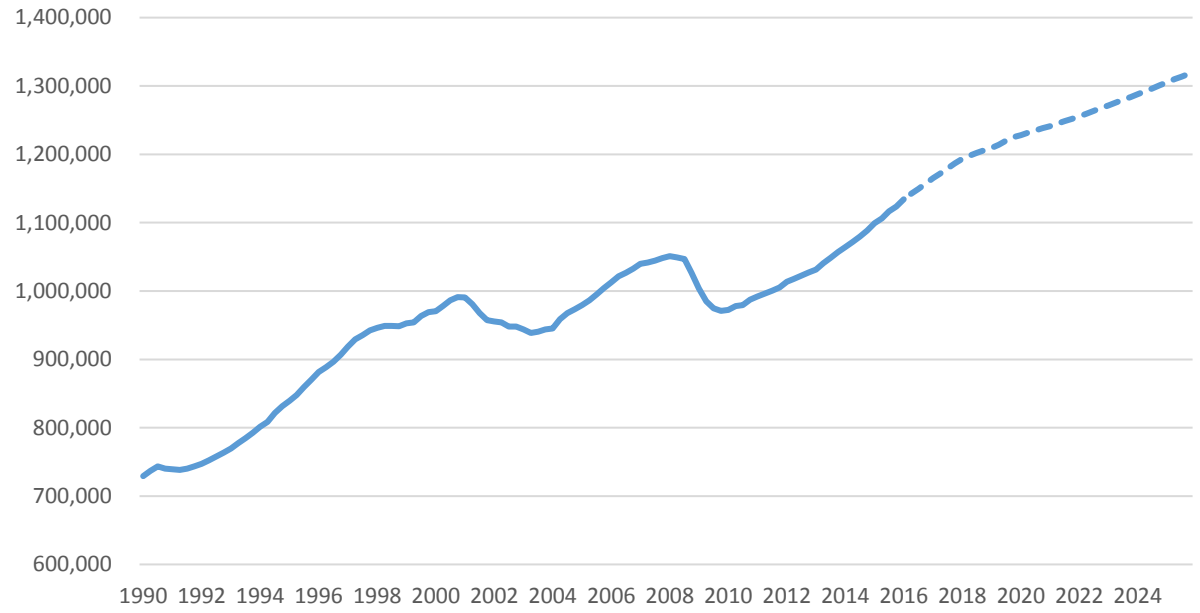
Current Market Factors

Since historical relationships predicate statistical analysis, there exists the possibility that a variable that was previously unrelated (or unquantifiable) becomes a strong influence on current and future outcomes. In addition, many of the variables in the forecasting models (see methodology) warrant a qualitative discussion, as a purely statistical exploration would paint an incomplete picture.

Employment and Income

Two of the most fundamental economic indicators are employment and income. In terms of home prices, income and employment indicate whether people can afford current and future increases. NERC forecasts employment in the Portland MSA will continue its strong recovery until reaching the rate of full-employment (see Figure 5) indicating that buyers will continue to enter the housing market (assuming home prices are correctly valued).

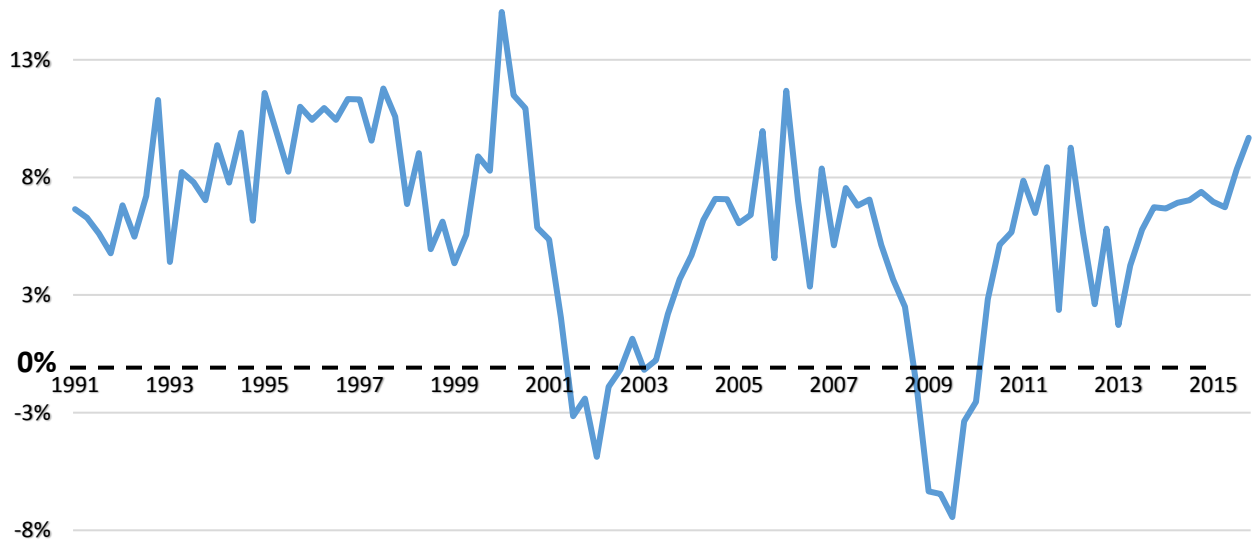
Figure 5–Total Nonfarm Employment, Bureau of Labor Statistics and NERC, Portland MSA



Wage growth finally picked up from its relatively weak post-crisis pace in the second half of 2015. All indications[6] are that this has continued into 2016. Figure 6 shows both the recent upturn in wages, and the effect of the recession on wages. Taken in conjunction with the increasing levels of employment, improving wages indicate that people can now afford higher priced housing. Employment and wages are also strong factors for net migration, which the subsequent section discusses.

[6] Particularly in the national Employment Situation Reports from the Bureau of Labor Statistics.

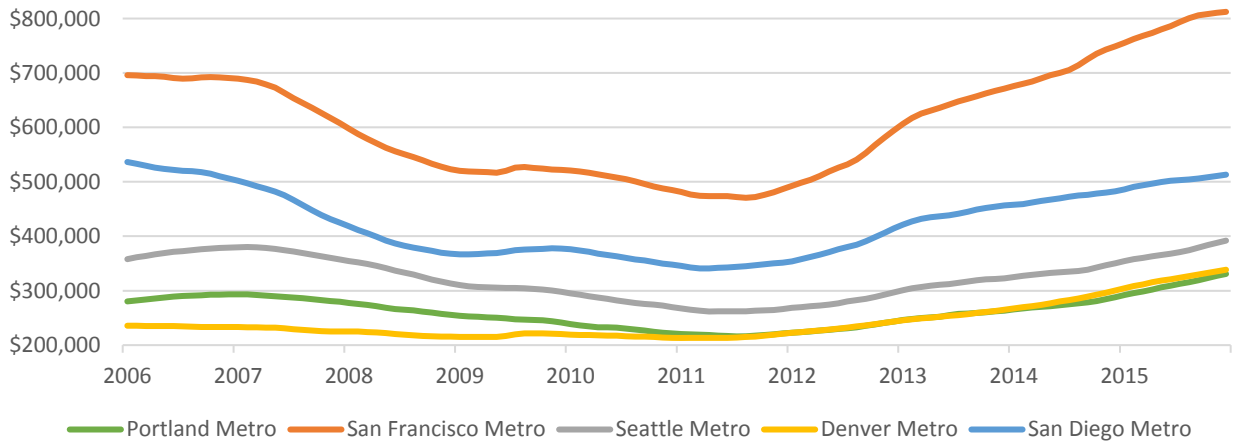
Figure 6 – Quarterly Wage Growth, Bureau of Labor Statistics (QCEW), Portland MSA



Migration and Portland's Relative Affordability

Despite the recent surge in home prices, Portland remains among the cheapest major West Coast cities to buy a house. This is partly because home price levels have historically been lower in Portland than its neighbors, but also because Portland's growth in home prices is average for these cities since 2010. In fact, places like San Francisco have had significantly higher rates of growth until 2015. Figure 7 shows the relative costs of five of the West Coast's largest metros.

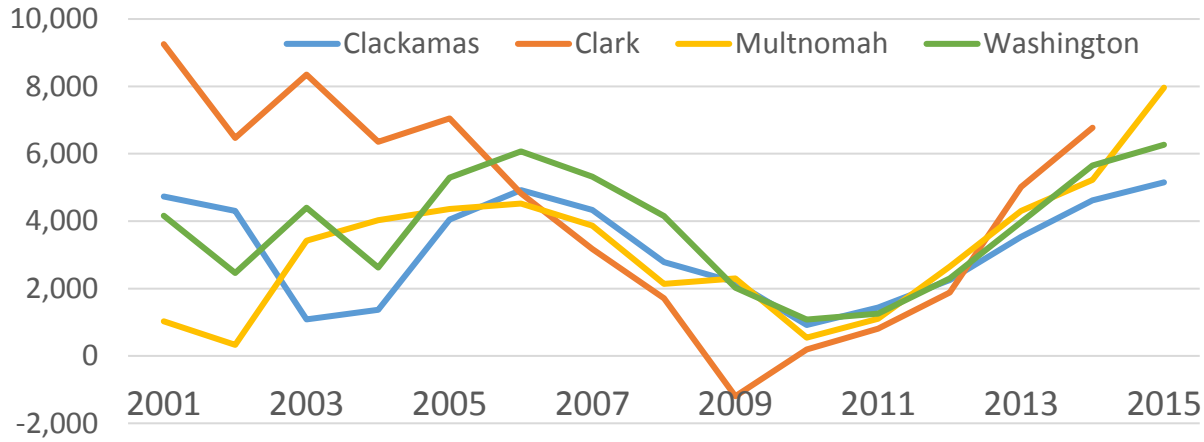
Figure 7– Home Price 'Zestimates[7]' by Metro Area, Zillow



[7] Zillow's estimated market value index. See the methodology for more details: http://www.zillow.com/research/zhvi-methodology-6032/

The combination of a strong job market with relatively lower house prices, Oregon and the Portland MSA have among the nation's highest rates of in-migration – which in turn increases demand for housing. Figure 8 shows the total net migration for the four largest Portland MSA counties, and gives evidence of a return to peak levels by 2015. Of the variables that affect population forecasts – migration, death rates, and birth rates – migration has by far the strongest affect due to its high variability.

Figure 8 – Net Migration by Portland MSA County, 2001-2015



This strong migration is included in the statistical analysis[8] in the form of population growth, and is one of the fundamental drivers of home prices. It is of note that in 2015 roughly 28.5% of all migrants to Oregon were Californian and 16% were Washingtonian (as determined by licenses surrendered to the Oregon DMV). Considering the affordability problems in San Francisco and Seattle, Portland's relative cheapness, and their proximity, this is of little surprise.

Housing Permits and Inventory

Outside of income and employment, the next most vital economic indicator of economic activity is housing supply. Good proxies for housing supply are new housing permit applications and homes available for sale (inventory). New permits indicate increasing home supply, which creates downward pressure for home prices. As seen in Figure 9, new housing permits have been among the slowest recovering economic indicators in the Portland MSA[9]. Relative to the strong migration and income-driven demand, the supply is lagging behind. Often, lagging supply is due to strict land zoning laws[10]. While input prices, such as wages and lumber, have increased only moderately in the Portland MSA, these regulations have made land progressively more valuable. The affordability problems Portland is

[8] Specifically the Ordinary Least Squares (OLS) and Fundamental HPI models. See below.
[9] See Appendix A for NERC's Permits Forecasts
[10] Glaeser, E. L., & Gyourko, J. (2002). The impact of zoning on housing affordability (No. w8835). National Bureau of Economic Research.

experiencing puts a magnifying glass up to land-use planning, and reports such as the City of Portland's recent *Portland Comprehensive Plan* hint at more accommodative zoning requirements.

Figure 9 – Single Family Permits, Portland MSA

Not only is the Portland MSA producing new buildings at a relatively slow rate, but also fewer homes are available for sale than ever before. Homes available for sale are hovering around decade lows (see Figure 10) and, at the rate they are selling, would only last for approximately two months before supply would be depleted (see Figure 11).

Figure 10 –Portland MSA Homes Available for Sale, Seasonally Adjusted (SA), Monthly, RMLS Market Action Report

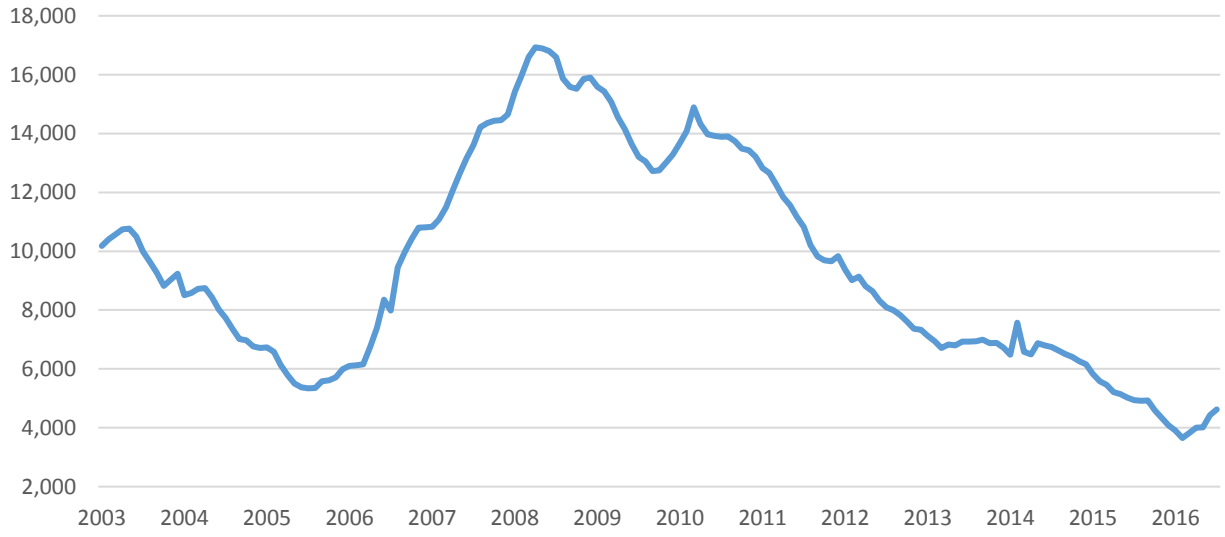
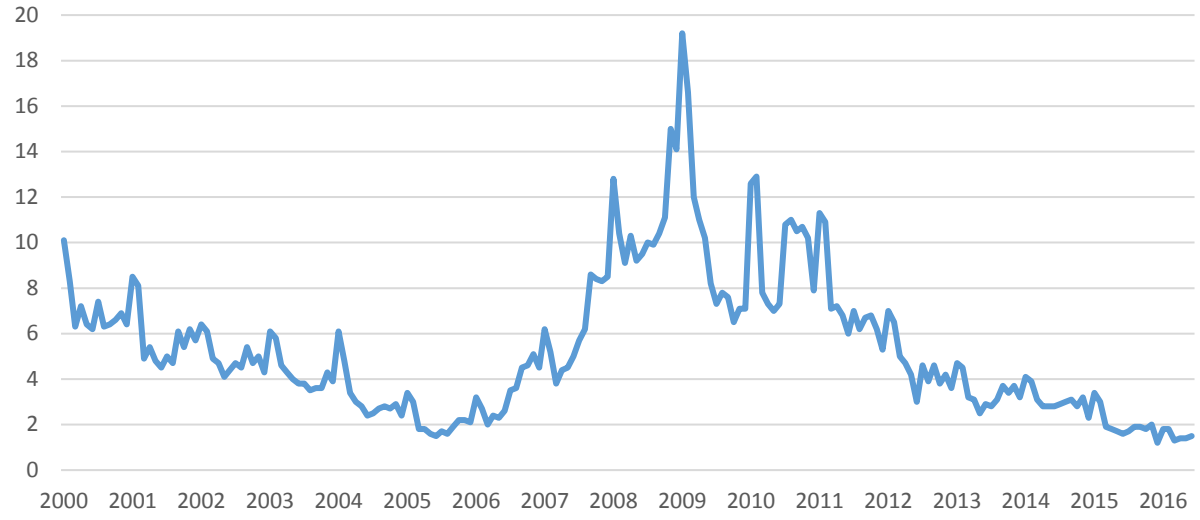


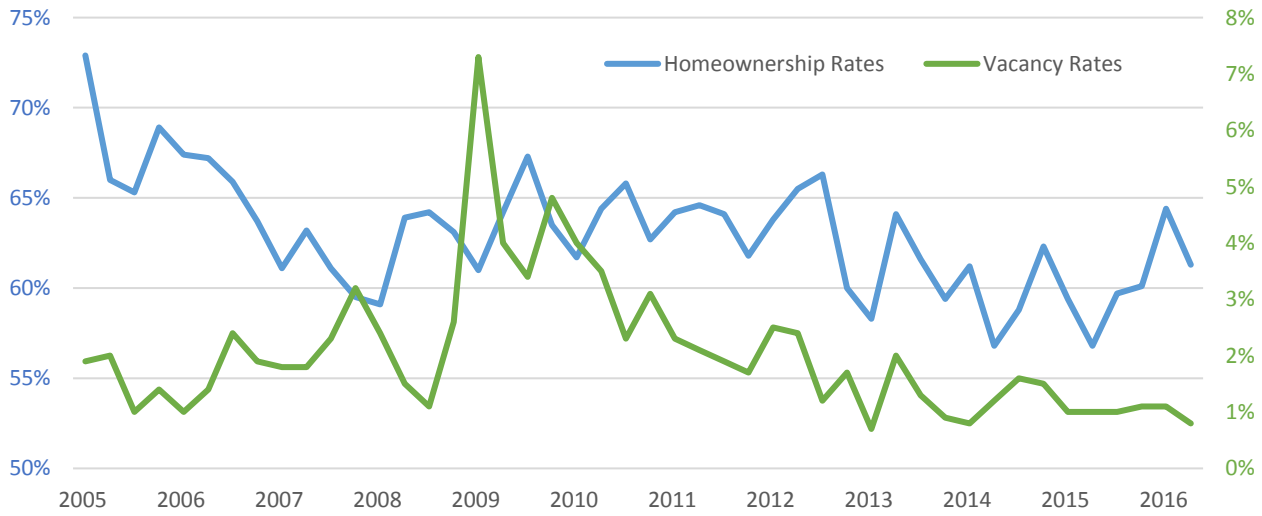
Figure 11 – Portland MSA Months of Inventory, Monthly, RMLS Market Action Report



Homeownership and Demographic Shifts

A demographic group that is of great importance to homeownership trends is the 20-30 year old cohort. Having recently replaced the baby-boomers as the largest cohort in size, they will soon be entering the 30-40 year old age bracket– a movement that typically constitutes the greatest uptick in homeownership. As Figure 12 shows, homeownership rates and vacancy rates are at historic lows, meaning when the 20-30 year old cohort ages into the homeownership years there will be greater demand, an increase in the overall homeownership rate, and even more upward pressure on home prices. Homeownership and vacancy rates are simply another way of gauging the tightness of the market.

Figure 12 – Census Homeownership and Homeowner Vacancy Rates for the Portland MSA



Methodology

NERC's two modeling goals are to (1) estimate an index that determines the current and historical fundamental value of houses and (2) forecast the actual level home prices. To accomplish this, NERC uses a variety of tools. The estimation technique for the fundamental Home Price Index (HPI) is, by necessity, simple. Including too many variables makes the model vulnerable to picking up noise related to the exact phenomena it is supposed to ignore – speculation-led price fluctuations such as the mid-2000s bubble. The forecasting models use more mathematically complex techniques, which add precision to the forecast at the cost of higher risk for theoretical error. However, by using three models, NERC mitigates these downsides by ensuring that the forecast estimates provided are rigorous across specifications.

Fundamental HPI Model

The first modeling task is to estimate the current and historical fundamental value for houses. Separating out an asset's "intrinsic" worth from speculative mispricing is a difficult and subtle task that necessitates a strong theoretical foundation and a high-threshold for variable inclusion. This report defines the fundamental price as fluctuations in the inflation adjusted Case-Shiller HPI due to corresponding fluctuations in population and real per capita income. The Case-Shiller Price Index is inflation adjusted with the Portland MSA Consumer Price Index (CPI) sans shelter to prevent the exponential growth seen in nominal price series. NERC estimates the fundamental HPI using Ordinary Least Squares (OLS) and displays the results below in Table 1.

Table 1: Fundamental HPI

Dependent Variable:	Real HPI, SA		Sample: 1990M01-2016M05	
Variable	Coefficient	Standard Error	t-Statistic	Probability
C	-4.970794	2.194043	-2.265586	2.42%
Log(Population)	0.327755	0.168832	1.941308	5.31%
Real Personal Income Per Capita	4.66244	1.466506	3.179284	0.16%
Adjusted R-Squared	0.674504			

"Fundamental" implies that the drivers of the relationship are the most closely linked with supply and demand for the given market. For example, in a simple labor market model, available jobs would be a proxy for supply, the number of job seekers would be a proxy for demand, and together they would be the fundamental drivers of wages (the price variable). In this equation, population acts as a supply constraint, income proxies for demand, and HPI is the price variable. Since the Portland MSA has an exhaustible supply of buildable land, as more people enter the metro and purchase a home the supply decreases, which puts upward pressure on prices. Similarly, if someone's income increases then he/she can afford a higher quality house, which will increase the area's average home price. Since these two variables rarely decline, it follows that home prices should rise consistently. There is evidence of speculative mispricing when the fundamental HPI and actual HPI diverge. This report uses the phrase 'speculative mispricing' to indicate when an asset is either overvalued or undervalued relative to its fundamental drivers.

HPI Forecast Models

NERC's second modeling task is to forecast home prices. Home prices are driven by a wide variety of factors that are either difficult to quantify, e.g. speculation, or difficult to forecast, e.g. land-use regulations. Given these restrictions, NERC uses three distinct models to forecast home prices, each with their own strengths and limitations. Just as in George Box's famous aphorism "All models are wrong but some are useful," the usefulness of the models below depends on an understanding of their purpose.

The first model used is an error-correction model (EC). An EC model assumes an equilibrium – i.e. the estimated fundamental HPI – and estimates the reaction of the dependent variable – i.e. the real Case-Shiller HPI[11]– to disequilibrium[12]. Assuming the correct estimation of the model, the error-correction term pushes the dependent variable back towards the assumed equilibrium. Since the forecast begins in a slight disequilibrium in May 2016, the model pushes the subsequent months HPI down towards the level of the fundamental HPI. If this model's predictions diverge away from the actual price without a corresponding exogenous[13] shock then that indicates speculative mispricing is taking place. Table 2 displays the results of the EC model below.

Table 2: Error-Correction Model

Dependent Variable:	Change in Real HPI, SA			Sample: 1990M01-2016M05
Variable	Coefficient	Standard Error	t-Statistic	Probability
C	0.000369	0.00019	1.947733	5.2%
Error-Correction Term (Last Period's Difference between HPI and the Fundamental HPI, Cubed)	-0.160633	0.091722	-1.751303	8.1%
The Change in Last Period's HPI	0.786979	0.034757	22.64221	0.0%
Adjusted R-Squared	0.620014			

A General Autoregressive Moving Average model (GARMA), the second model used, is atheoretical in that it contains no other variables outside of historical responses to itself. These exclusively use autoregressive (AR) and moving average (MA) terms that estimate the linear relationship between the current value and last period's value and error respectively. Financial analysts typically use atheoretical approaches more often than their economist counterparts do; however, this particular technique is among the most accurate for short term HPI forecasting[14]. Table 3 displays the results of the GARMA estimation.

[11] Even though the relationship between the variables in the models are in real terms, the forecasts are of the nominal HPI.
[12] Malpezzi, Stephen. "A simple error correction model of house prices." Journal of housing economics 8, no. 1 (1999): 27-62.
[13] Exogenous in this context refers to any variable outside the model (e.g. mortgage rates).
[14] Miles, William. "Boom–bust cycles and the forecasting performance of linear and non-linear models of house prices." The Journal of Real Estate Finance and Economics 36, no. 3 (2008): 249-264.

Table 3: General Autoregressive Model

Dependent Variable:	Log of HPI, SA		Sample: 1990M01-2016M05	
Variable	Coefficient	Standard Error	t-Statistic	Probability
C	5.226581	0.470939	11.09822	0%
AR(1)	1.455484	0.014893	97.7304	0%
AR(3)	-0.456123	0.014728	-30.96938	0%
MA(3)	-0.352558	0.05899	-5.976539	0%
Adjusted R-Squared	0.999845			

The final model uses ordinary least squares (OLS) to regress home prices on the unemployment rate, the mortgage rate, population, inventory (lagged six months), and last period's rate of change in home prices. Table 4 displays the exact specification for this model. Inventory is directly included in this model, and the recent uptick in inventory is a large reason for the waning price growth forecast. NERC does not go as far as forecasting inventory, but should the increasing rate of new construction hold, then the market will eventually loosen. The low supply (inventory) and rising demand (income) are major drivers of the model's results, and thus good variables to track for predicting future movements.

Table 4: OLS Model

Dependent Variable:	Logged Difference of SA HPI		Sample: 1990M01-2016M05	
Variable	Coefficient	Standard Error	t-Statistic	Probability
C	-0.004756	0.001452	-3.274755	0.1%
Logged difference of unemployment	-0.08124	0.020943	-3.87906	0.0%
Logged difference of last period's HPI	0.62266	0.059799	10.41247	0.0%
Logged difference of population	5.233963	1.361523	3.844198	0.0%
Difference of Inventory from Six Months ago	-2.94E-06	1.14E-06	-2.594091	1.1%
Adjusted R-Squared	0.758179			

The population variable loosely captures the effect of Portland's inelastic land supply. To avoid a sprawling metropolis, the Oregon Metro strictly regulates density outside of its borders while simultaneously encouraging density within through the Urban Growth Boundary. However, if there were no UGB, then the effect of an increasing the population would have a less marked effect on supply (and home prices). The inclusion of population in the model means that there is some accounting for this controlled land supply.

Although the prevailing mortgage rate certainly affects home prices, scholars have shown this to be a long-run phenomenon that does not statistically exist in the short-term[15]. NERC attempted a number of econometric techniques – including variable manipulation and assorted lag structures - and were not able to capture a statistically significant short-term relationship between mortgage rates and HPI. Both the data's frequency (monthly) and brief history (earliest data begins January of 1990) limit this analysis to the short-term.

Model Evaluation

A typical technique for evaluating model performance is by forecasting in sample and measuring the difference between the forecast and the actual data (see Appendix D for output). Of the three models implemented in this study, the worst performer is the Error Correction model. This is not surprising as the movement from an over/undervalued house back to the fundamental price is often slow and incongruous. Because of this incongruity, this model fares poorly in the evaluation framework. If the actual price lines up with the fundamental price, and one assumes that this will continue, it follows that the EC model will be the most precise (given an accurate forecast of the fundamental price). Thus, the forecast for the EC model going forward is practically the same as the forecast of the fundamental HPI. This will be accurate given that this equivalency holds and NERC has accurately modeled the fundamental HPI.

The GARMA model is the most accurate of the three for short-term forecasting (it has the lowest mean absolute percent error); and the OLS Forecast does the best job of catching the turns and over a longer period (variance is the largest component of the mean square error and its predictions are the closest to the final in-sample value). These differences conform to expectations since the GARMA primarily uses short-term fluctuations to predict short-term fluctuations, and the OLS model is dependent on the evolution of longer-term economic variables. Since the OLS model is dependent on forecasts of other economic variables, it is less precise than it appears in sample (where it is predicting based on the actual, non-forecasted, values).

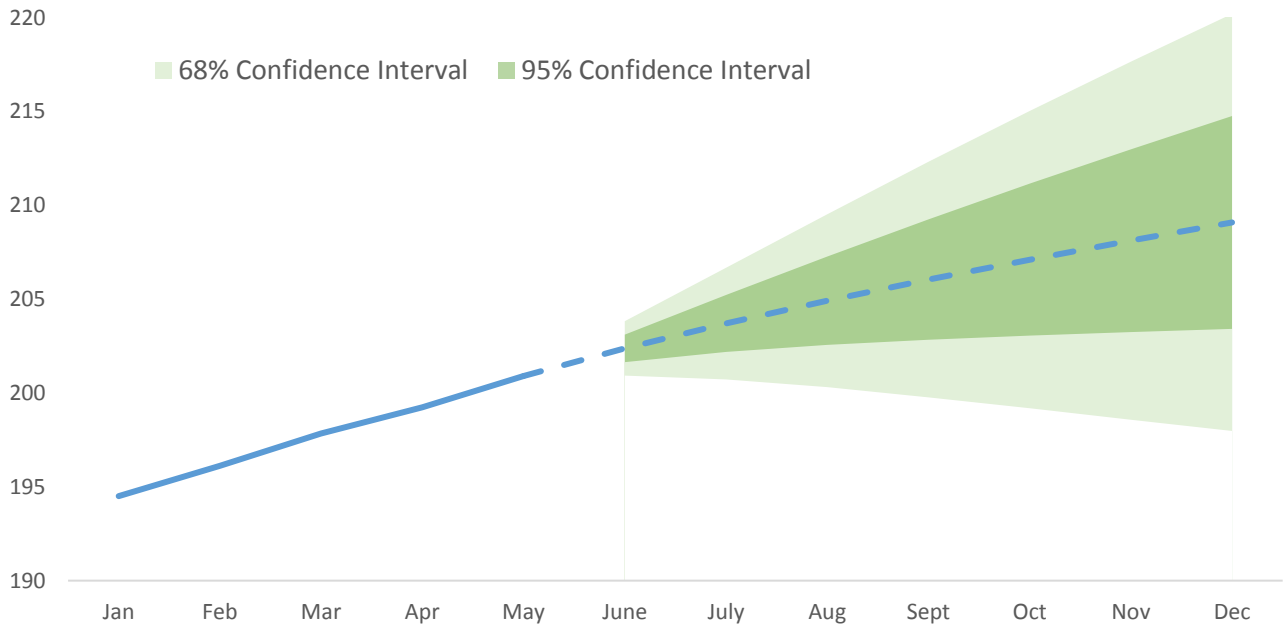
Each of these models has a specific purpose: The EC model helps to highlight speculative mispricing, the GARMA model predicts near-term HPI fluctuations, and the OLS model gives an idea of where home prices will be in the longer run. Each of these models also has certain limitations. Economic variables do not influence the GARMA model, so the relationship weakens significantly as the economic landscape changes. The OLS model is dependent on the relationship between HPI and its predictors remaining relatively stable, as well as the forecast of those predictors being accurate. As mentioned above, the EC model enforces an equilibrium and is only as predictive as the strength of the relationship.

One concern, unrelated to assumptions made, is each models' quickly expanding confidence intervals. The confidence intervals for the EC forecast, shown below in Figure 13, emphasize the uncertainty in forecasting home prices too far into the future. For example, these confidence intervals imply a roughly 15% chance of the HPI declining by the end of the year. A slight decline in HPI is not unprecedented, but

[15] McGibany, J. M., & Nourzad, F. (2004). Do lower mortgage rates mean higher housing prices?. Applied Economics, 36(4), 305-313.

would certainly be unexpected given the current market conditions. This is not to indicate the model is without predictive power, simply that there is a range of possible outcomes given each of the assumptions and this range will expand beyond the point of usefulness over a long enough timeline. The other forecasts have similar confidence intervals (see Appendix C).

Figure 13 – Forecasted (EC) Case-Shiller HPI with 68% and 95% Confidence Intervals, Portland MSA 2016



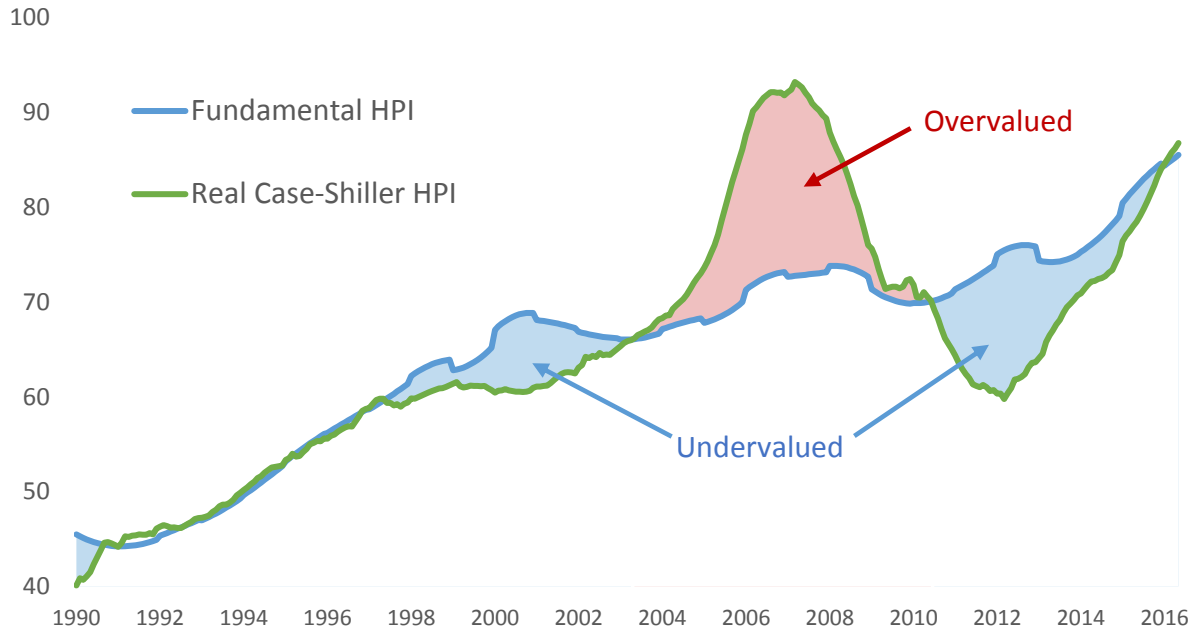
Results

Using the estimated equations, NERC forecasts HPI in three different ways and estimates the historical fundamental HPI to give a quantitative description of historical market divergence from fundamentals. Except for unemployment, the data for which is from the Oregon Office of Economic Analysis (see Appendix B, Figure 18), this analysis uses NERC's forecasts of the necessary right-hand side variables.

Fundamental HPI Back-cast

The fundamental home price index confirms not only that there was a large bubble starting in 2003 and ending sometime around 2009, but also that this was followed by a period of undervaluation as lending standards tightened, foreclosures increased and, in general, demand fell. This undervaluation partially explains why home prices have been able to grow so quickly in recent years relative to the economic fundamentals – home prices are playing catch up[16]. Although, some economists peg the bubble's beginning date to be earlier than 2003, this does not discount NERC's estimated timeframe since prices rose nationally well before they did in the Portland MSA (see Appendix B Figure 19). Figure 14 shows the history for the fundamental HPI.

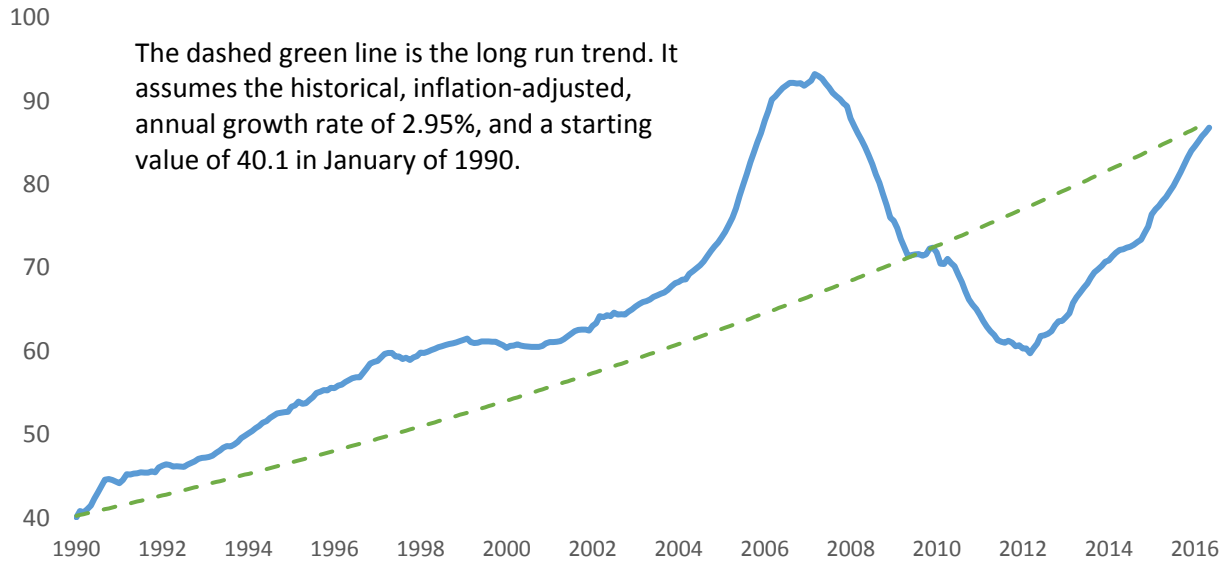
Figure 14 – Real Case Shiller Index, fundamental Home Price Index, Portland MSA



One area of concern is that population and income data are typically of an annual frequency and released with a 1-2 year lag meaning we must estimate Population and Income for 2016. However, it adds confidence that the estimated lines up with more simple metrics such as a comparison with the long-trend (see Figure 15).

[16] Business-cycle scholars refer to this as the 'recovery stage'.

Figure 15 – NERC's Estimated Real Case-Shiller HPI[17] with Long Run Trend



While one may perceive the fundamental HPI to indicate that home prices are correctly valued, there exists some margin of error since the determinants of the current fundamental HPI are forecasts themselves. To clarify, income and population may be slightly higher than NERC forecasted for 2016 and home prices would then be correctly priced or even under-valued. Thus, the fundamental HPI drifting slightly above or below the actual HPI is an unremarkable event.

Notably, the real Case-Shiller HPI barely surpasses the fundamental HPI as of May 2016. This does not mean home prices will not fall, just that there is no evidence in this model of the speculative mispricing. The late growth in the fundamental HPI is due to the recovery of wages and strong in-migration.

Forecasts

Taking into account the above concerns, NERC forecasts that home prices will continue to rise in the Portland MSA but that the growth rate will decline (see Table 5). Should this not be the case, and prices continue to accelerate, this alone would not be indicative of a bubble unless this growth is driven by unjustified speculation. Variables that are not included in the models could, for non-speculative reasons, drive prices up (or down) significantly.

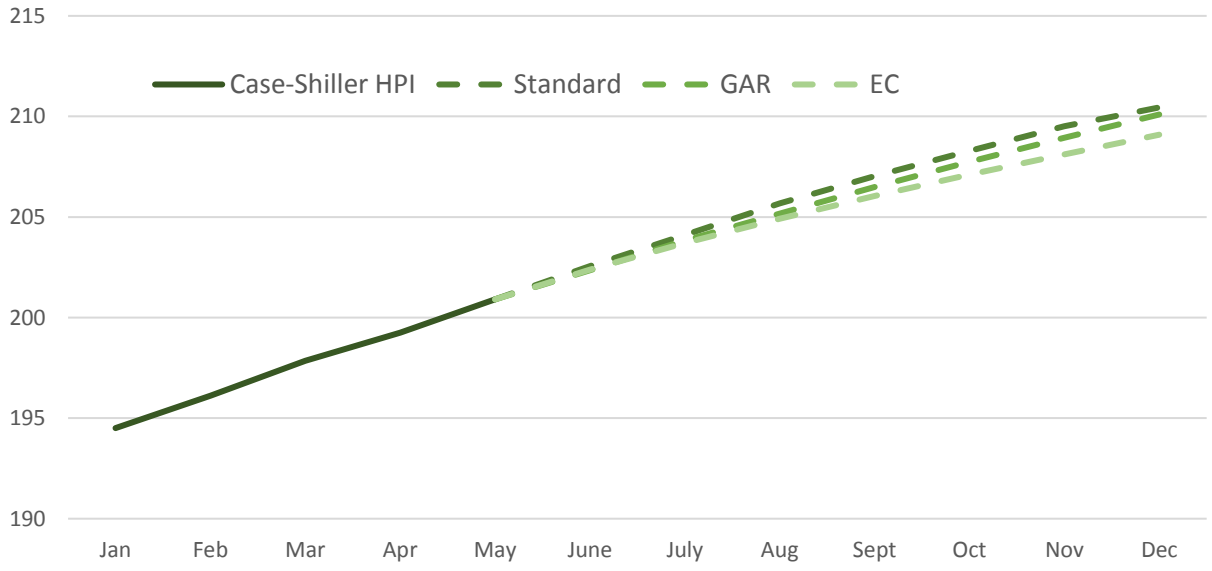
Not only do all three forecasts give similar results, but they also predict a similar long-term annual growth rate of roughly 6%. This is within 1% of the pre-bubble annual growth rate discussed in the introduction and provides a good baseline for how home prices should typically grow. Figure 16 shows how close each of the forecasts are to one another.

[17] NERC forecasts CPI-sans-shelter (1982-1984 = 100) for the Portland MSA until May 2016, and uses the actual values of the Case-Shiller index to derive the Real Case-Shiller HPI.

Table 5 – EC, GARMA, and OLS HPI Forecasts with annualized growth rates, 2016

Month	EC Forecast	GARMA Forecast	OLS Forecast
May[18]	200.91	200.91	200.91
% Annual	*9.99%*	*9.99%*	*9.99%*
June	202.38	202.36	202.57
% Annual	*8.79%*	*8.68%*	*9.91%*
July	203.71	203.83	204.11
% Annual	*7.87%*	*8.70%*	*9.13%*
August	204.92	205.17	205.68
% Annual	*7.16%*	*7.93%*	*9.25%*
September	206.05	206.49	207.03
% Annual	*6.60%*	*7.72%*	*7.88%*
October	207.11	207.74	208.28
% Annual	*6.18%*	*7.26%*	*7.27%*
November	208.12	208.95	209.51
% Annual	*5.85%*	*6.96%*	*7.09%*
December	209.09	210.10	210.45
% Annual	*5.60%*	*6.60%*	*5.35%*

Figure 16 – Forecasted Case-Shiller HPI by Model, 2016



[18] The number for May is the actual Case-Shiller HPI and is included for reference.

Conclusion

The upsurge in home prices over the past few years is not only a result of an increase in the economic fundamentals but also due to the nascent recovery of the housing market. Just as Gross Domestic Product experiences an 'expansion phase' following a recession, everyone also expect home prices to rebound following a significant downturn. Percent growth tends to be higher during this rebound when compared to other periods due in part to a 'base effect' (lower starting levels inflate percent growth calculations). It can be helpful to view growth relative to a given historical period, rather than month-to-month or period-to-period changes. For example, NERC estimates the Portland MSA real Case-Shiller HPI is roughly 7% below the pre-recession peak of nine years ago. The commonly reported Case-Shiller HPI, which does not account for inflation, puts the Portland MSA at roughly 9% above the pre-recession peak. As with all price levels, accounting for inflation strongly influences the narrative.

A range of other market factors corroborates the argument that home prices are rising for "true" economic reasons. A simple approach for understanding these factors is to split them into two categories: those that affect supply and those that affect demand. Income best predicts demand since people can afford homes that are more expensive when it rises. Consequently, rising incomes will increase the average price of houses. Due to Portland's relatively strict land-use planning and the principle of scarcity, land value (and therefore home value) should continue to rise as more and more people fit into a limited space[19]. Both the supply side of the equation and the demand side point to rising home prices – a pattern that NERC expects to continue into the future. Basic economics of supply and demand predict the same outcomes as technical models.

Although the Portland housing market is exceedingly tight, with inventories just above their lowest point since 2000, NERC finds that home prices are approximately valued at their fundamental worth. Should there be a wave of new construction then there is some risk of housing prices falling; similarly, housing prices could continue their strong growth if the dearth of supply continues. NERC concludes that rising home prices will continue, albeit with some decline in growth rate, until the end of the year.

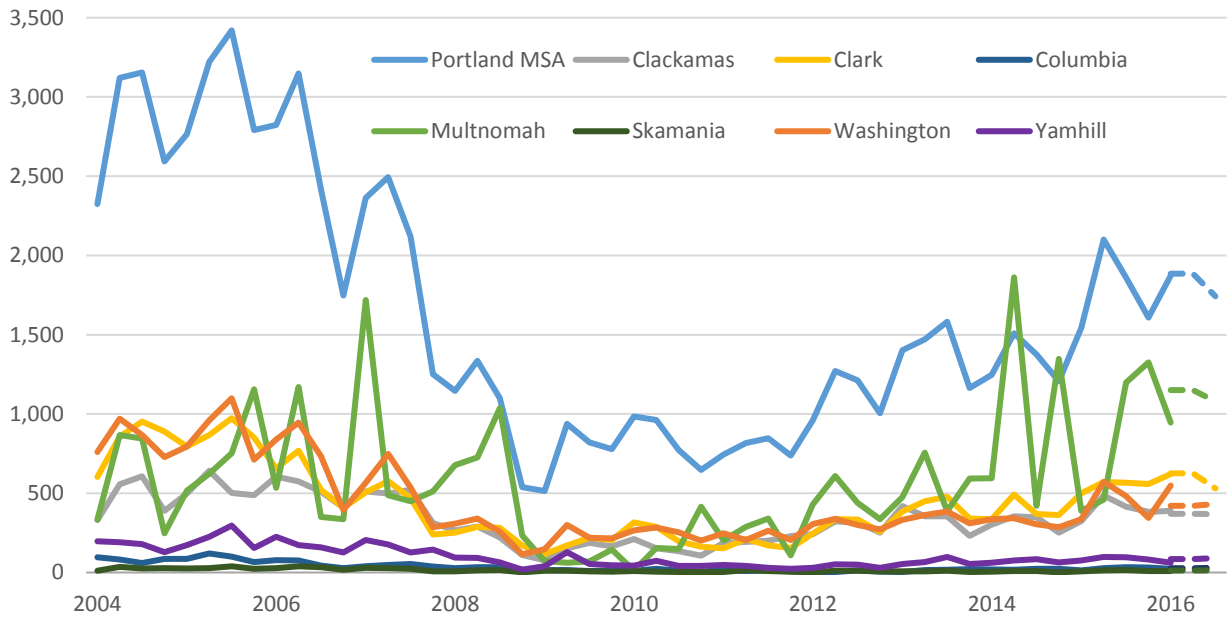
[19] Actual land-use planning does not happen in a vacuum. Presumably, as density increases and buildable land becomes scarcer, then land-use requirements will be relaxed.

Appendix A: NERC County Housing Permits Forecasts

Table 6- Forecasted Single Family Housing Permits by County, Census Building Permit Survey

Place	2015Q1	2015Q2	2015Q3	2015Q4	2016Q1	*2016Q2*	*2016Q3*
Clackamas	325	486	415	383	389	370	368
Clark	500	570	567	558	621	626	531
Columbia	14	27	33	32	23	27	30
Multnomah	285	334	252	202	220	267	269
Skamania	8	13	15	9	9	13	13
Washington	336	572	482	344	548	421	432
Yamhill	76	98	96	81	62	85	90
Portland MSA	1,544	2,100	1,860	1,609	1,872	1,885	1,742

Figure 17 – Forecasted Single Family Housing Permits by County, Census Building Permit Survey



Appendix B: Other Data

Figure 18 – Oregon Unemployment Rate, Forecasted by the OEA

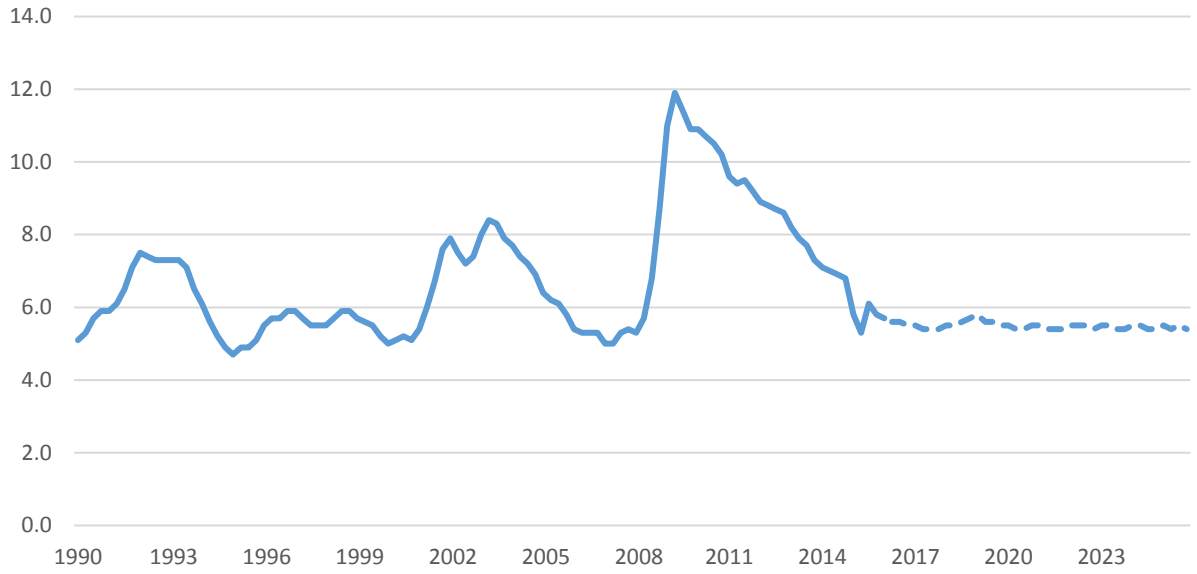
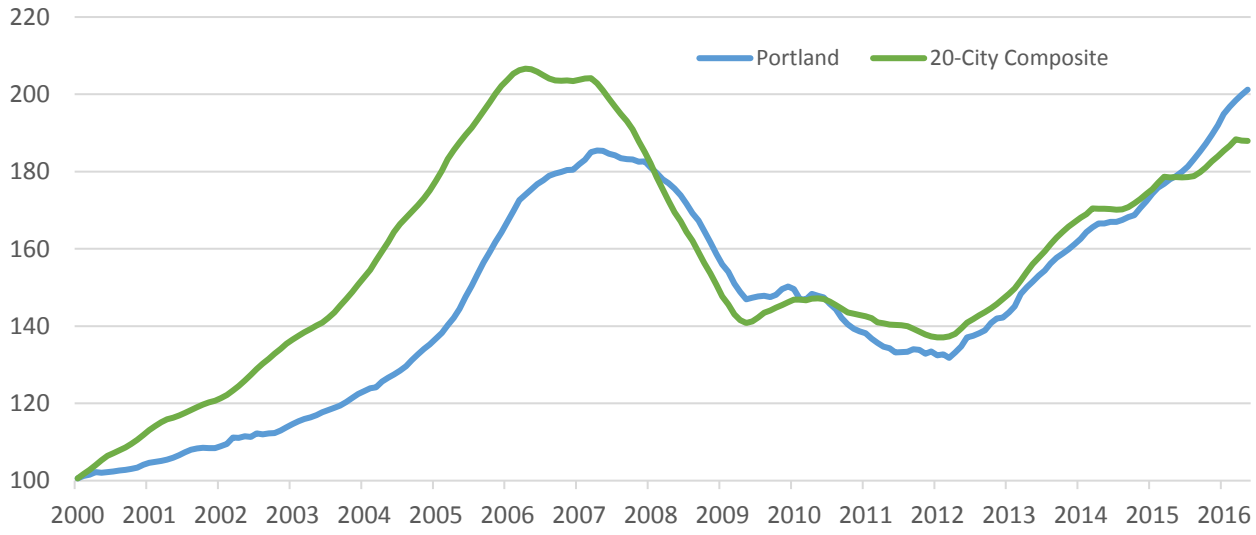


Figure 19 –Case Shiller Index, Portland MSA and 20-City Composite



Appendix C: Confidence Bands

Figure 20 – Forecasted (GARMA) Case-Shiller HPI with 68% and 95% Confidence Intervals, Portland MSA 2016

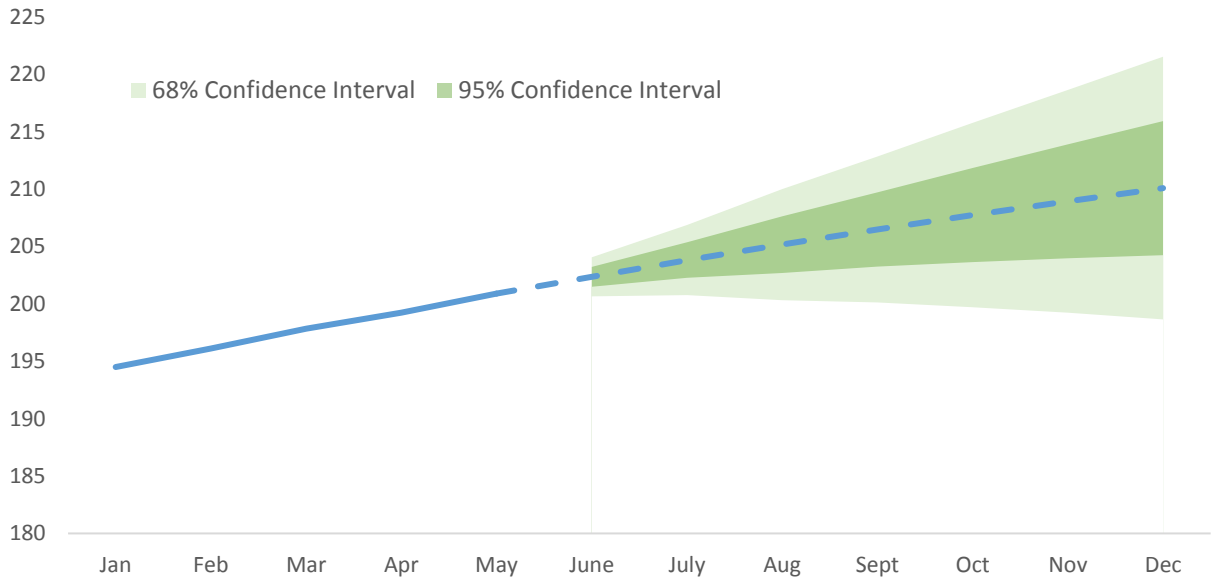
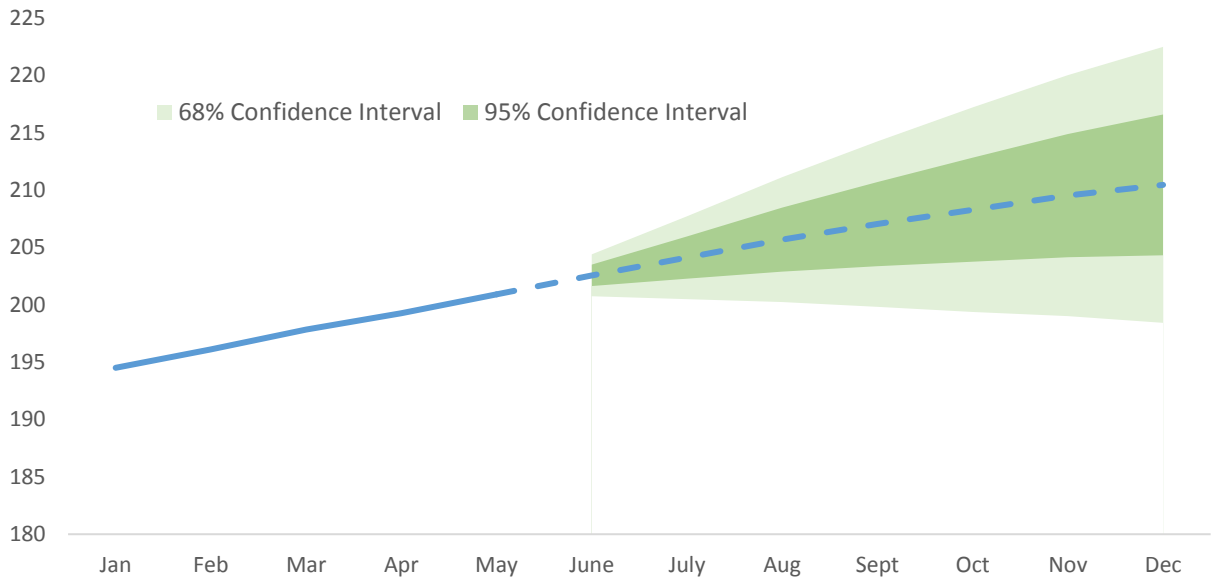


Figure 21 – Forecasted (OLS) Case-Shiller HPI with 68% and 95% Confidence Intervals, Portland MSA 2016



Appendix D: Forecast Error

Table 7- One-Month out Forecast Error

Sample:1990m01-2014m12	Forecast: 2015m01		
Model	GARMA	OLS	Error-Correction
Mean Absolute Percent Error	0.05%	1.55%	1.88%

Table 8- Full Sample Forecast Error

Sample: 1990m01-2016m05	Forecast: 1990m01-2016m05		
Model	GARMA	OLS	Error-Correction
Mean Absolute Percent Error	9.89%	5.49%	9.48%
Theil Inequality Coefficient	0.067	0.022	0.077
Bias Proportion	0.161	0.060	0.156
Variance Proportion	0.007	0.180	0.094
Covariance Proportion	0.831	0.758	0.749
Predicted for 2016m05	190	201	207
Actual for 2016m05	202	202	202