Detecting Overheating Housing Markets and Turning Points Ex Ante

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Abstract

We present two supply and demand conditions which indicate, after a significant run up in prices, the probability of a reversal in home price growth several months before home prices begin to fall. It is a two-step process: We track when markets are overvalued using the cost of owning versus renting. This relative value - owning versus renting - tells us something about buyersô expectations of future value. In a market where buyers have strong expectations about future price increases, so much so that they are overpaying by 40% to own rather than rent a similar property, the probability of a reversal goes up. A problem with this approach is that markets often stay overvalued for long periods of time. Mean reversion does not always happen right away. So we cannot tell using this one variable alone when the market will turn. A second variable is needed to signal a reversal in buyer and seller intentions. Inventory-to-sales is a measure of how fast the current supply of homes on the market will be absorbed. It conveys the intentions of the supply side of the market relative to the intentions of the demand side. Extremely high inventory, during a period when the ratio of owning-to-renting is high, portend markets going from boom to bust with a high probability one to six months before the inflexion point. Our results are based upon data for 20 United States cities for which we have data on both variables going back to into the early 2000s that have not previously been used in research.

Key words: house prices, user cost, rents, bubbles

Economic Literature Codes: R31, G21

1. Introduction

For either a bank, mortgage insurer, guarantor or MBS investor perhaps the second most important task after determining borrower risk characteristics is understanding geographic risk and possible home price changes. Most risk models are highly dependent on a home price forecast. For the price forecaster, it is straightforward to extrapolate a time series. As we all eventually come to learn the hard way, however, it is less easy to tell when the series will abruptly change trend and enter a different pattern or regime. The housing boom/bust of 2007/2012 was highly destructive.[1] How could we have missed it?

The existence of bubbles and our ability to detect them ex ante are issues still up for debate. Many academic economists who think in terms of time series analysis disagree that such questions should exist. For many people, prices observed in the stock market and other asset markets are widely described as random walks. Home prices reflect all of the available information. They are equal to the discounted flow of rents. And, if home price changes truly follow a random walk, bubbles cannot exist.

History, however, repeatedly has shown that single-family home prices have major continuous run-ups and then turning points especially at the local level. In such cases, one would have to offer the explanation that there occurred the chance arrival of a string of positive and then subsequent negative news, or that fundamentals in the market have changed and no one recognized it. But the failure of thousands of forecasters, regulators, financial institutions, politicians, the Federal Reserve chairman and millions of homebuyers to correctly detect this repeated chance arrival of positive information during 2004 and 2005 as anything but chance information suggests again that the theory of a random walk does not fit housing. The repeated failure of efficient markets and present value models to explain asset price levels has led academic researchers to introduce the concept of bubbles as a way to explain price deviations from their present value relationships.

Long-term sequential home price declines, most often, occur for two reasons: The first reason is economic malaise. The economic viability of a geographic area declines and the demand for shelter in the area falls below the supply. Home prices, in this scenario, fall gradually over time.

The second reason is that markets overheat and then contract. The sequence in this kind of a housing cycle follows a relatively normal path whereby housing prices rise relative to other asset prices, leading to speculative home buying as the investment function of a home begins to dominate the shelter function; then at some point, home prices rise quicker than incomes or rents;

[1] The national housing bust started in 2007Q2 and lasted through 2012Q2.

this leads to more buying to get ahead of future price increase; homebuyers use more leverage to buy a home and loan-to-values rise close to 100%. This first part of a bubble is the *run-up phase*. At some point, however, even as prices continue to rise, the market reverses itself and supply begins to exceed demand. This second part (when prices are still rising but inventory is increasing even as demand is falling off) is the *contraction phase*. In the last stage, prices of homes, having become out-of-line with intrinsic value, begin to fall to re-establish an equilibrium as more supply comes onto the market. In this third part, prices contract (*price contraction phase*). This paper attempts to show that data exists that can tell us when the market is in the contraction stage ï after the run-up, but before prices fall.

The ability to project, ex ante, the unwinding of a bubble in the housing market before prices fall depends upon: (1) the recognition/acceptance that markets move through the run-up and then the contraction phase of a housing cycle similar to how they have done before because of economic forces and that (2) one has the ability (the data) to track near-term supply and demand conditions and near-term relative prices to determine where the market is in that cycle.

Current supply and demand conditions can be captured using inventory-to-sales ratios and relative prices (buy-versus-rent and price-to-income) can be tracked using the sales price of homes, rental prices of homes and median incomes. Sales prices for local markets have been available for many years, but good inventory-to-sales data and buy-to-rent data have only become available since mid-2013.

The variable that we use to measure overheating is the ratio of the cost of owning to renting (buy-versus-rent, BVR, or B/R). Economic theory tells us that the monthly cost of owning and the cost of renting should equilibrate. If home prices rise relative to rent for long periods of time and BVR does not trend back to one, there is evidence that a market is overvalued. Our research extends to 20 core-based statistical areas (CBSAs), which have a minimum data history back to August 2004. Home prices overheated and fell rapidly over this long time series for these 20 CBSAs. This unique dataset on three bedroom single family properties provides a sample through which we can define overheating, contraction and turning points. It has not previously been used for research.

Knowing that a market is overvalued (the run-up phase) is not enough. We need to understand how supply and demand unfold in the months prior to prices falling (the contraction phase). This second stage question relies on using inventory-to-sales data and how they change in the months before home prices start to turn down. Our contribution is that we apply this two-step methodology (1. define and time stamp a bubble and 2. track inventories in the unwinding stage before prices fall) to a unique data set on 20 U.S. cities.

In the next section, we review the literature that asks can bubbles exist, i.e., can a market be overvalued outside a given range? This is necessary, in order for us to understand how buyers and

sellers could misprice housing in a given geographic market. This mispricing by homeowners leads to a somewhat predictable pattern to the housing cycle. In Section 3 we explain why using user cost-to-rents to measure exuberance is better than price-to-rents, price-to-income, or trading volume and we highlight the economic content of the variable inventory-to-sales. Section 4 defines the data and our model. Section 5 shows our results. The last section is our conclusion.

This paper is written from the view of the practitioner who is concerned about risk, month-to-month, year-after-year in the portfolio of homes in America.

2. Literature review on bubbles and three important central issues

The Efficient Market Hypothesis (EMH, Fama 1965, 1970) assumes that current prices fully reflect all public and private information. It contends that market, non-market and inside information is all factored into and that no one has monopolistic access to relevant information. It assumes a perfect market, rational agents, and concludes that prices will then follow a random walk and market excess returns are impossible to achieve consistently. In an efficient market, at any point the actual price of the security will be a good estimate of its intrinsic value. Efficiency, for Fama, means not only that security prices follow a random walk, but also that they wander around their intrinsic or true value. By logical extension, bubbles do not exist if markets are efficient and all agents were rational. The market for housing has some of these attributes.

One of the first critics of the EMH came from Shiller (1981) who pointed to the statistically significant difference of volatility between stock prices (their ñassessedò value) and real variables related to their ñtrueò value ï e.g. dividends. Several researchers in the late 1990s including Shiller, tried to test to see if housing markets were efficient (Case and Shiller, 1990). The authors conclude that the market for single-family homes did not appear to be efficient since year-over-year home price changes tend to be followed by changes in the same direction in the subsequent year.

Muellbauer and Murphy (1997) argue that some form of credit rationing, and transactions costs all contribute to long run-ups in home prices. Himmelberg et al. (2005) noting the large run-up in home prices in the early 2000s suggested that nonlinearities in the discounting of rents could lead home prices to sharply respond to changes in interest rates in certain markets. Their sample, which extended up to 2004, is the period right before the bust. Glaeser and Gyourko (2006) try to explain the large run up-in house prices using income, amenities and interest rates. In essence, both of these papers argued that fundamental factors could explain the run up in home prices -- homebuyers were rational.

However, the 2007/2012 U.S. housing bust, with its large historic price turns in many geographic markets around the nation settled the question for most people. The EMH is not a good descriptor

of the U.S. housing market. The 2007/2012 experience showed that homebuyers can display moments of irrational exuberance; housing markets can overheat.

As early as 2003, Shiller suggested there might be a bubble in housing (Shiller 2003). Shiller later (Shiller 2008) argues that failure to value housing based upon its fundamentals combined with future home price optimism lead to feedback-speculative bubbles where home prices are set well above their intrinsic value. Therefore, it is difficult to explain whether house prices in 2006 were too high using a purely rational model.

In subsequent papers, the perfect rationality assumption has been relaxed, allowing the models to shift the focus to how bubbles get started and under what conditions they would burst. The study of bubbles has expanded to explore the effects of perverse incentives and bounded rationality. Another group of research focuses on market transactions in which one group of agents is irrational.

One substantive idea to come out of the bounded rationality thinking that directly applies to housing is the idea of herding. DeMarzo, Kaniel and Kremer (2008) introduce a relative wealth model, in which an individual agentôs utility depends on not only her absolute wealth but also on her relative wealth (i.e., the agentôs so-called ñkeeping up with the Jonesesò preferences). If that dependency is strong, agents will prefer to participate in bubbles as long as other agents do so, in order to not fall too far behind their peersô wealth during the bubbles upside.

This herding behavior is often amplified by the popular news media. News stories often focus on assets and liabilities with good past performance. Even if investors might be skeptical that this performance will continue, news stories signal the existence of others who have had great success. Once a market has turned, however, the media is quick to point out the risks (market information is not always information-based). The point of this for someone tracking housing is that swings in home prices can happen very quickly.

A final group of papers comes under the title of rational bubbles. Kermani (2012) proposes a model of booms and bust in housing driven by the interplay between relatively low interest rates and an expansion of credit. Glaeser, Gyourko, and Saiz (2008) suggested that rational bubbles can exist when the supply of housing is fixed, but not with elastic supply and a finite number of potential homebuyers. Beyond these early works are two dominant strands of thought that are important to this paper. One relies on heterogeneous beliefs of investors while another relies on heterogeneous time horizons of investors. The first strand of rational bubbles based on investor behavior posits that investors could have access to all the information that other investors have, but each investor is differentiated because they have different prior belief distributions possibly due to psychological biases. In such a case, investors with non-common priors can agree to disagree even after they share all their information. An attractive feature of heterogeneous-belief bubbles is that they

predict that bubbles are accompanied by large trading volume and high price volatility, as for example in the model by Scheinkman and Xiong (2003). DeFusco, Nathanson, and Zwick (2017) also point to the role of speculators as the cause of asset bubbles. Investors expect prices to increase after past increases. These authors, however, argue that investors can have homogenous beliefs based upon common information yet have heterogeneous horizons regarding how long they will hold a property. Investors with shorter time horizons tend to pull out of the housing cycle before owners who plan to continuously occupy a purchased property. So for DeFusco et al. (2017), it is neither ordinary homebuyers who irrationally bid up home prices using a home as investment good, nor investors who differ in their beliefs. The run up in prices is due to speculative investors with short time horizons who do not expect to live in the home. They find that a sharp rise in non-occupant purchases explains much of the variation in purchase volume across and within CBSAs between 2000 and 2005.

This focus on investors who rationally enter and exit a market, however, ignores the ordinary homebuyer. For the ordinary homeowner, even though housing functions as a source of shelter it also functions as an investment. If there were no investment role to housing, bubbles would be less likely. This is because there would be less incentive to buy more house than one would need. Real home prices would rise roughly with the cost of materials and/or the ability of a geographic area to attract in-migration, or faster than other areas mainly due to it having a better job market or a better climate. Housing, however, does have an investment role. The ability to borrow money, to leverage oneôs down payment, has made it a powerful asset to make, or lose, money for its owners. These buyers are both the people who intend to live in the home, as well as those who are speculative buyers. These ordinary home buyers, this paper argues, can be irrational.

The asset pricing literature long ago showed how difficult it is to confirm the presence of a bubble (e. g., Flood and Hodrick, 1990). More recently, however, Phillips, Shi and Yu (2015) show that housing bubbles can be tested for and time stamped using a right-tailed augmented Dicky Fuller test. Their approach is one that measures if homebuyers are paying considerably more for a house over time than suggested by its intrinsic value (rent) or its equilibrium value (income) -- stationarity has been violated. We adopt this theoretical view, but use a more heuristic model. The ability to determine if a market is overvalued depends upon accepting that buyers can display periods of irrational exuberance and that one has the ability to establish this at any point in time by looking at the cost of owning versus the cost renting close substitutes. Rent in a sense measures fundamental or intrinsic value. In our framework, a housing market can overheat when potential homebuyers (or homeowners), as a collective group, have unreasonably high expectations about future capital gains, and they pay significantly more to own a house than to rent a similar property. So, for this paper, the cost of owning not being close to the cost of renting is a telltale sign of a bubble, ex ante. Given this, how can the practitioner determine overvaluation?

2.1 How can we measure if a market is overvalued?

According to Minsky (1982) and Kindleberger (2000) there are three kinds of bubbles: ones that go up and then crash suddenly and more or less totally, ones that go up and then go back down again without a hard crash, and ones that go up and reach a peak and then go into a period of financial distress and then later crash. The vast majority are the latter. Oil followed the first pattern in 2008, peaking at $147/barrel in June 2008, then plunging to the low 30ôs by November 2008 before recovering. Real estate in the early 1990ôs followed the second pattern, going back down the way it went up. This was because residential homeowners have an emotional investment in their houses and refuse to believe or accept the falling prices after the peak. So they do not sell, and volumes collapse rather than prices.

Moreover, an overvalued housing market could unwind without popping. It could do this by incomes simply inflating over a long period of time (essentially, incomes, population or rents would rise faster than prices). It is also interesting to think that an overvalued housing market like those that we currently witness in Canada, New Zealand and Australia could remain in disequilibrium indefinitely, with the cost of owning much higher than the cost of renting, as long as there is trade exchange imbalance and strong capital inflows from an external source (China). Houses are places where people park money. These markets would remain overvalued over the long run. And it is true that an overvalued housing market could quickly crash in the first two ways Kindleberger points out above and we might not detect its turning.

However, it is equally likely that a boom/bust evolves the third way Kindleberger suggested (in three stages) -- it goes up and reaches a peak, goes into a period of financial distress and then later crashes). In this evolution, the build-up to the peak could last a long time. If this is/were the case (a building up to the peak ï the *run-up phase*) we practitioners should at least be aware that a market has become overvalued and that there is a probability that it will turn.

2.1.a Vector error correction models with $P_t > P_t^*$ (VECMs)

In 2007Q2, the median home price for the nation fell for the first time in recently recorded history. It then fell for the next 19 consecutive quarters for a cumulative decline of 23 percent. How did we miss it? Actually, there were debates and several research papers written during the buildup which contained evidence suggesting the magnitude of the potential price declines using a two-stage fitted home price index approach. As early as 2003, Shiller suggested there might be a bubble in housing. Gallin (2004, 2006) using a user cost and rent approach argued that housing was overvalued. Gao, Lin and Na (2009) using a two stage vector error correction model (VECM) also suggested that many markets were dramatically overvalued. The two stage VECM models rely on forecasting an equilibrium home price P_t^* in the first stage and comparing it to actual prices P_t in stage 2. If $P_t > P_t^*$ then a market is overvalued. The problem is that knowing that a market is

overvalued is a necessary condition, but not a sufficient condition to say that a strong downturn is going to happen next. The reason is that an overvalued market could unwind in several ways.

2.1.b Trading volume by investors with short time horizon is high (STIs)

A second approach to determine if a market is overvalued relies on investors with short time horizons. In these models, some buyers plan to sell after one year, while others plan to hold for many years. DeFusco et al. (2017) specify a term structure for extrapolation. They model a housing market populated by investors with extrapolative heterogeneous horizons. They believe that extrapolation declines with the forecast horizon so that short-run expectations display more sensitivity than long-run expectations. Importantly, they find that the marginal effect of short-term potential buyers on the price and the volume is quantitatively large and find that a sharp rise in the non-occupant purchases explains much of the variation in volume across CBSAs and across time between 2000 and 2005.

For these authors, homebuyers have extrapolative expectations, not irrational expectations ï they expect prices to go up after past increases, but no faster than past increases. As speculators they do not look at intrinsic value (e.g., rent). So it is neither homebuyers who intend to live in the property nor property investors planning to rent the property who cause a market to become mispriced, it is purchases by speculative buyers with short horizons. A telltale sign of a bubble is thus when there is a rising share of speculative buyers. For these authors, volume peaks well before prices and their ability to measure the rise in volume is an indicator that the market is overheating.

2.1.c Buy-versus-rent > 1.4 (BVR)

A third approach to determine if a market is overvalued, is based upon the net present value of housing. Poterba (1984) and Verbrugge (2008) offers the classical treatment. In these asset pricing models, price equals the net present value of future rents or the net flow of utility from living in a particular house. Alternatively, since rents which are paid at the end of the month are known today, this could be restated as the asking monthly rent should be equal to the user cost of owning a home or,

$$P_t (k_t + \tau_t - g_t) = R_t, \quad (1)$$

where P_t is the current price of home, R_t represents monthly rent, k_t is some discount rate, τ_t are the monthly tax rates, g_t is the expected constant growth in home prices each period ($g_t = (P_{t+1} - P_t)/P_t$), with P_{t+1} a one-period forward expected future price. The left hand side of Equation 1 is a simplified version of the user cost of owning a home. We can rearrange Equation 1 such that,

$$P_t (k_t + \tau_t - g_t)/R_t = 1, \text{ or } B_t/R_t = 1. \quad (2)$$

The user cost of owning a home can also be thought of as the anticipated monthly cost of someone thinking of purchasing a home. Thus in Equation 2, we rewrite the cost of owning for a month (the numerator) as our variable B_t.

Following Poterba (1984) and others, we could think of rent being an intrinsic (or true, or fundamental) value for housing much the way financial analysts see dividends as the intrinsic value determining a stockôs price except housing is not frictionless like the stock market.[2] The cost of owning should not deviate too far from the cost of renting. If B_t becomes much higher than R_t then it is cheaper to rent than own and price should fall; if B_t becomes much lower than R_t then it is cheaper to own than rent and price should rise. Economic forces should cause mean reversion over time. For this paper, a market is overvalued when, the monthly cost of owning greatly exceeds the cost of renting for long period of time.

2.2 Who causes a market to become overvalued?

A market might be considered irrational if no coherent model of real estate values can justify prices (Glaeser 2013). He argues that the high prices paid prior to the 2007/2012 national bust were typically compatible with reasonable models of housing valuation and defensible beliefs about future price growth. For Glaeser, buyers did not appear to be irrational, but are rather cognitively limited investors who work with simple models, instead of a comprehensive general equilibrium framework.

2.2.a VECMs

The VECM models are agnostic about who causes a market to be overvalued.

2.2.b Short-term investors (STIs)

DeFusco et al. (2017) stress the role of investors ï borrowers with simultaneous mortgages on multiple properties which are not intended for rental, in explaining mortgage credit growth during the boom and then the subsequent bust. For these authors, recent price changes will differently draw in short-term investors who amplify volume by selling more frequently and destabilizing prices through positive feedback. These buyers quickly move out of the market when prices begin to fall. Short-term investors amplify volume by selling more frequently, and they destabilize prices

[2] Intrinsic (or true, or fundamental) in the sense that the buying and renting are connected irrespective of economic conditions. Prices should equal the net present value of future rents or the net flow of utility from living in a particular house. Rents and home prices should more together as an economy grows. One the other hand, an equilibrium price (P_t^* as estimated in a VECM) is an estimated valued from the economic data present at that time and may not be connected to actual home prices.

through positive feedback. For these authors, volatility is caused by investors, not homebuyers who intend to live in the property.

2.2.c BVR

This paper disagrees with (Glaeser 2013) and argues that when buyers pay nearly 40 percent or more to own a near-identical property which they could rent, they are betting on future price growth continuing for some period of time and the market not correcting. They are acting imprudently ï or irrationally. So this paper follows more the thoughts of Kindleberger (1978), Shiller (2008) and DeMarzo, Kaniel and Kremer (2008), and accepts that the ordinary homebuyers can act irrationally. This irrationality causes not just short term investors to overpay, but everyday people who are buying a house to live in it to overpay. We are saying that bubbles (Case and Shiller 2003) can occur when expectations of future increases rather than changes in intrinsic value drive current home prices up. We also argue that focusing solely on investors assigns too much importance to this class of homebuyer.

The cause of the bubble is important to understanding how to measure overheating. This paper argues that potential homebuyers can display a period of irrational exuberance and we can measure it by seeing how much more homebuyers pay relative to their potential rent on near-identical property.[3]

2.3 How can we tell when a bubble will pop?

Above we cited several papers that correctly identified that markets in 2005 were overvalued. That is an important piece of information. The problem is that knowing that a market is overvalued is a necessary condition, but not a sufficient condition to say that a strong downturn is going to happen next. The reason, as noted above, is that an overvalued market could unwind in several ways.

2.3.a VECMs

The VECM models cited above have a clear methodology for determining if a market is overvalued, but this approach offers little in the way of specifying when markets will turn. Larson (2011) and Gupta and Miller (2009) model home price appreciation using a two-step vector error correction (VECM) approach to test a VECM modelôs abilities to forecast peaks and declines. Since home prices should revert to their equilibrium value, the VECM models should have a good chance at predicting turning points. Larson tests eight different types of models for their ability to

[3] Both the price data for building our buy variable and the rent data are for three bedroom properties.

predict turning points.[4] He finds that VECMs were relatively successful in predicting that a turning point would occur. Their ability to predict when they will turn, however, is weak. This is what we see in the earlier research. These earlier works, try to track actual home prices (P_t) relative to an equilibrium home price (P_t*). The equilibrium price is determined using variables such as income, population, housing stock and other economic drivers.

There are two practical problems for the practitioner concerned with risk in the housing market in trying to define an equilibrium house price value. The first is that identifying an assetôs equilibrium value is difficult. Right-hand side variables have to be specified and a model has to be estimated. There is also the issue of how much history to use. Second, in the U.S., the Department of Census tracks median household income and population, but actual values are known only after a year and a half after the current period.

For researchers specifying an equilibrium value (P_t*), a market is overvalued when $P_t > P_t$*. Using this approach, it is easy to say when a market is overvalued. Unfortunately, VECMs using this approach do not indicate when the market will turn. What is needed in addition to the knowledge that home prices are overvalued relative to some equilibrium value ($P_t > P_t$*), is information about whether buyers are entering/leaving the market faster than sellers are entering/leaving the market. We would want this information as far in advance of home prices falling as possible.

2.3.b STIs

DeFusco et al. (2017) using data on 50 million home sales from 2000-2011 show that the volume of purchases by investors with short-time horizons peaks well before prices. So by tracking trading volume of investors we have an idea when prices will fall.

2.3.c BVRs

How can we tell when a bubble will pop? Looking at some data on Los Angeles will provide some insights.

Chart 1 shows the buy/rent ratio (B/R) and year-over-year home price appreciation (HPA) for Los Angeles through three housing cycles.[5] The variable HPA could be used to determine exuberance, but using buy/rent shows clearly why a market is overvalued ï buyers are paying too much to own vis-à-vis rents. It is not necessary to say that rent represent true value. It requires only that we say

[4] He tests 5 univariate models: 2 autoregressive models, 1 autoregressive fractionally integrated moving average, 1 unobserved component, and 1 random acceleration model. He also tests 3 multivariate models: 1 vector autoregressive and 2 vector error correction models.

[5] We use B/R or BVR as the notation for our buy/rent variable.

homebuyers have a choice (buy/rent), that the two goods are close substitutes, and that the cost of owning and the cost of renting is widely known.

The buy/rent data goes back to the year 1983, as does the home price data. Home price growth ranged roughly from +5% to -5% over the period from 1983 to 1987. In 1987, year-over-year HPA rose into double digits and buy-to-rent went above 1.7 (Point A in Chart 1). House prices were too high relative to rents. The cost of owning was more than 70 percent higher than the cost of renting. The market had overheated, and remained overheated for several years. The market did not quickly revert to B/R = 1. If information had been available about where we were in that first housing cycle, we could have made better decisions. After 3 years of home prices being too high and buy/rent being greater than 1.4, home price growth slowed and turned negative in 1990Q4. Year-over-year HPAs were negative for six years following the 1990Q4 dip. This is a housing bust by anyoneôs standard. Point B in Chart 1, shows again, a market that is overvalued, but now it is 2007. The variable buy/rent reaches values as a high as 2.0. We see that buy/rent remained above 1.8 for many months before the bust.

In both cases, the buy/rent data told us that home prices were/are too high (the market was overvalued) when the B/R rose above 1.4. It told us that the relative prices were out-of-line by comparing what the cost of owning a home for a month actually were to what home owning should have been relative to rent. Points A and B in Chart 1 show that prices were/are too high relative to rent. The market had over valued housing. It did so for many years before prices finally turned negative. This is a lot of information well before both busts. However, even though we can see that Los Angeles was overvalued, we just did not know when the market would turn. We needed additional information about seller behavior.[6]

3. Inventory-to-sales

Local realtor associations have tracked demand and supply for properties in their local markets since the 1990s. They often collect data on inventories of homes for sales (I) and quantity of homes sold that month (S) on a monthly periodicity. The inventory-to-sales ratio (inventory/sales, ITS, or I/S) is an absorption rate. It measures how fast the current stock of homes for sales in the market, can be sold given the current monthôs count of sales. For example, if there are 1,000 homes on the market at the end of the period, and in that current month 100 houses were sold, then at that sales rate it would take 10 months to clear the market.

[6] As of January 2018, Canada, New Zealand and Australia had housing markets that were overvalued using the B/R approach. It is not clear when these markets will turn.

Anecdotal evidence indicates that an I/S ratio is a slightly leading indicator of price changes. A common message one absorbs from reading the analysis of several local realtor websites that track I/S data is that practitioners believe markets are traditionally ñin-balanceò somewhere around 6 or 7 months of supply. This rule of thumb has likely been developed over a many of years of watching the market. So at an inventory-to-sales of around 7.0 months, we would expect real home price growth to be near zero (+/- 2%). If I/S gets larger than this, we would expect home prices to fall in the near future.

The dotted blue line in Chart 1 and also Chart 2 show year-over-year home price appreciation (HPA). Home price growth was very strong during the Reagan defense build-up years as the California aerospace and defense industry hired thousands of skilled workers. Detente, the collapse of the Berlin Walls and the subsequent peace dividend produced the opposite effect and was felt the most severely in Southern California as defense workers were no longer in-demand by 1990 ï an exogenous shock.

We have data on inventory-to-sales (I/S) going back to the early 1990s for some of our 20 CBSAs. The red line in Chart 2 shows I/S starting in 1990Q1 for Los Angeles.[7] Chart 2 shows, an abridged, but essentially the same view of three housing cycles as does Chart 1. By 1990Q1, during the aerospace bust, I/S climbed into the high teens. There were too many homes for sale on the market (Point A in Chart 2). There was plenty of information that housing prices would turn prior to its turning. Home price growth went negative in 1990Q4. Then after six years of negative home price appreciation, the Los Angeles housing market began to recover. The I/S ratio fell through the 7.0 months of supply and home price changes were once again positive. The late 1990 and early 2000s were boom times (again) in Los Angeles. Nominal HPA was often in double digits. Home price changes of this magnitude were unprecedented, but given the continuous length of time during which home prices continued to grow an aura arose of ñThis time it is different.ò During these 30 quarters, the I/S ratio was under 5 months of supply ï the housing market was very tight. The I/S ratio was signaling that there was a shortage of homes. But then somewhere around mid-2006, the I/S ratio began signaling that the market was reversing itself as I/S rose above 7.0 months of supply (Point B in Chart 2).

Chart 3 shows only 12 months of data to highlight the point. The bars show I/S and the line shows HPA. In the three months of 2006Q4, I/S increased to above 7.0 months of supply indicating that the excess-demand had dissipated (Point B in Charts 2 and 3). Then in 2007Q3, real home price changes in Los Angeles went negative as I/S rose above 14 months of supply. A buy-versus-rent greater than 1.4 and an inventory-to-sales greater than 7.0 were necessary and sufficient conditions

[7] The CA I/S historical data comes from the California Association of Realtors. More subsequent quarters are based upon data from RedBell. Zillow.com is now also producing I/S data for local markets.

for indication of a market about to turn. In Los Angeles, from the charts, we would have known this with a high probability six months before prices fell.

Using inventory-to-sales is better than using trading volume of short-horizon investors for two reasons: 1) The numerator (inventory of homes for sale on the market) contains information in addition to the information contained in the denominator (sales volume). It tells us how much house volume sellers have placed for sale in the market at the current point in time. What drives prices in housing is not just short-term investor sales volume, it is sales volume by all buyers and sellers relative to the number of all houses sitting on the market. The I/S ratio is thus more robust than investor sales volume alone. 2) The inventory-to-sales ratio is easy to measure month-after-month using MLS data. No estimation about buyer preferences are necessary.

We test our hypothesis empirically below for 20 major U.S. CBSAs.

4. Data and model

Our dependent variable is a zero/one variable, where one indicates that a market will turn down in the future, but has not yet turned. To build our dependent variable, we look at historical data on home price changes for 20 CBSAs. When prices peaked during the 2007/2012 national housing bust we assigned a value of 1 for the 6 months prior to the bust. We are trying to capture the

Six month contraction phase.

Dependent Variable At Inflexion Point				
	ITS	BVR	HPA	Variable
Oct-06	8.74	1.79	4.0%	0
Nov-06	8.24	1.75	5.0%	0
Dec-06	7.26	1.74	5.0%	0
Jan-07	9.94	1.76	6.0%	0
Feb-07	9.78	1.78	5.0%	0
Mar-07	8.82	1.76	4.0%	1
Apr-07	11.10	1.78	5.0%	1
May-07	10.00	1.81	6.0%	1
Jun-07	10.30	1.88	7.7%	1
Jul-07	11.40	1.91	7.7%	1
Aug-07	12.70	1.88	3.8%	1
Sep-07	.	.	-6.0%	.
Oct-07	.	.	.	.

Home prices peak in Los Angeles

contraction phase of the cycle when home prices are continuing to rise, BVR is high and inventory-to-sales have started to rise. This gives us 6 observations with a value of one for each CBSA. Data at, and after the inflection point, however, are not used because we are interested in the impact of BVR and ITS only in the period prior to the bust to see what forward looking impact these two variables have during the contraction stage. All other observations of the dependent variable before the contraction stage are assigned a zero (an example is in table below).

Table 1 shows the descriptive statistics for buy-versus-rent and inventory-to-sales. The monthly rent data on three bedroom detached homes comes from RentRange. The RentRange rent data extends back to January 2009. Data prior to January 2009 come from HUDôs survey of fair market rents (FMRs) for three bedroom properties. FMRs are gross rent estimates. They include the shelter rent plus the cost of all utilities, except telephones. Because the RentRange values are median values of actual rents on three bedroom properties they are considered better estimates of rent than the FMR estimates. FMR rent values overlap the RentRange values from January 2009 onwards providing a way to adjust the FMR values to meet RentRange rent values and concatenate FMR rents prior to January 2009 onto the RentRange rent series. Our three bedroom rent values go back earlier than August 2004 for 16 of our 20 CBSAs.

We needed to be able to calculate BVR across time and CBSA. Our buy variable (B_t) is calculated as the principal, interest and taxes on three bedroom homes using a 100% LTV mortgage in a given CBSA purchased in time period t. Using a 100% LTV mortgage addresses the issue of the opportunity cost of any money not used for the down payment. As a practical matter, we do not calculate the variable g_t specified in Equation 1 because how much and when price expectations change over the course of the cycle seem unknowable.[8] The monthly home price data for three bedroom homes is constructed from a CoreLogic median home price series for all bedroom properties. The CoreLogic all bedroom price series was adjusted by the ratio of three bedroom home prices to all bedroom home prices from the two Zillow.com price indices to get a time series of three bedroom home prices.

Inventory-to-sales data after 2006 are from RedBell. Data prior to that came from local realtor websites. This ITS dataset has been collected over a period of years and has not previously been used for research. For Chicago, IL we only have ITS data starting in August 2004 for 6 observations. Other CBSAs have longer histories.

[8] Our BVR values could consequently overstate the cost of owing.

Table 1. Descriptive Statistics For 20 CBSAs						
name	**variable**	**N**	**MIN**	**MAX**	**MEAN**	**STD**
Boston, MA	ItoS	22	5.3	15.2	8.8	2.8
Boston, MA	bvr	22	1.4	1.8	1.6	0.1
Chicago, IL	ItoS	6	4.8	7.9	6.0	1.1
Chicago, IL	bvr	6	1.0	1.1	1.0	0.0
Dallas, TX	ItoS	42	4.5	9.9	6.3	1.2
Dallas, TX	bvr	42	0.8	1.3	1.0	0.1
Houston, TX	ItoS	50	4.2	10.9	6.4	1.5
Houston, TX	bvr	50	0.9	1.1	1.0	0.1
Las Vegas, NV	ItoS	30	1.3	13.9	6.3	4.0
Las Vegas, NV	bvr	30	1.8	2.4	2.1	0.2
Los Angeles, CA	ItoS	37	2.1	12.7	6.0	3.1
Los Angeles, CA	bvr	37	1.5	1.9	1.7	0.1
Miami, FL	ItoS	36	2.8	26.0	11.8	8.1
Miami, FL	bvr	36	1.0	1.6	1.4	0.2
Minneapolis, MN	ItoS	37	2.9	9.5	6.0	1.9
Minneapolis, MN	bvr	37	1.0	1.3	1.1	0.1
New York, NY	ItoS	34	2.8	9.4	5.6	1.9
New York, NY	bvr	34	1.4	1.8	1.6	0.1
Orlando, FL	ItoS	32	1.2	15.6	5.9	4.8
Orlando, FL	bvr	32	1.1	1.9	1.5	0.3
Philadelphia, PA	ItoS	48	3.0	13.1	6.1	2.1
Philadelphia, PA	bvr	48	0.8	1.2	1.0	0.1
Phoenix, AZ	ItoS	37	0.1	13.2	5.1	4.0
Phoenix, AZ	bvr	37	1.0	1.7	1.4	0.3
Portland, OR	ItoS	24	2.0	12.8	5.0	2.5
Portland, OR	bvr	24	1.5	1.7	1.6	0.1
Sacramento, CA	ItoS	24	2.0	5.9	3.7	1.1
Sacramento, CA	bvr	24	1.3	1.4	1.4	0.0
San Diego, CA	ItoS	23	4.9	9.6	6.8	1.3
San Diego, CA	bvr	23	1.3	1.8	1.5	0.2
San Francisco, CA	ItoS	38	1.4	8.9	3.4	1.4
San Francisco, CA	bvr	38	1.0	2.1	1.8	0.3
San Jose, CA	ItoS	48	1.9	13.0	4.7	2.7
San Jose, CA	bvr	48	1.1	2.2	1.9	0.3
Seattle, WA	ItoS	24	2.5	8.3	4.8	1.7
Seattle, WA	bvr	24	1.5	1.7	1.6	0.1
Tampa, FL	ItoS	30	1.2	20.0	6.0	4.9
Tampa, FL	bvr	30	0.8	1.3	1.0	0.2
Washington, DC	ItoS	24	1.1	5.2	2.7	1.5
Washington, DC	bvr	24	1.1	1.8	1.5	0.2

Once we have built up our (0/1) dependent variable for each CBSA, we specify the following logit model:

$$\log (p/(1-p))_i = Ŭ + ɓ * ITS_i + ɔ * BVR_i + e_i. \quad (3)$$

Where P is our bubble indicator defined above, ITS is inventory-to-sales, BVR is buy-versus-rent. We have 646 i observations obtained by stacking all observations for each 20 CBSAs on top of each other.

5. Empirical results

Table 2 shows the results of Equation 3. Both of our independent variables have the expect sign and are significant. Increases in the B/R or I/S increase the probability of a market turning. The results of the Equation 3 allow us to calculate the probabilities of the market switching momentum.

Since we are interested in understanding the probability of an inflection point under different market conditions (i.e., anticipate a turning point) one to six months into the future, we set up a grid of possible future scenarios shown in Table 3 below and calculate probabilities.

Table 2. Model Results

	Variable	
Constant	-4.7234	
Pr > ChiSq	<.0001	
I/S	0.3453	
Pr > ChiSq	<.0001	
B/R	0.6208	
Pr > ChiSq	0.04	
N	646	
CBSAs	20	
	Intercept Only	**Intercept + Covariates**
AIC	622.178	486.933
SC	626.649	500.345
-2log	620.178	480.933
Sommers'd		0.69
Gamma		0.70
Tau-a		0.21
C		0.85

We have argued above that a buy/rent ratio greater than 1.4 with an inventory/sales ratio that is rising and becomes greater than seven months of supply are necessary and sufficient conditions to indicate that a market is turning -- we are in a bubble, and now we are in the *contraction phase*. We would not be concerned about values of BVR < 1.4 because that shows that homebuyers are acting responsibly. We can see how low the probabilities are for BVR values < 1.4 in the table below. On the other hand, a BVR > 1.4 means that homebuyers in a market are willing to pay 40% more to buy a house than to rent the house. This could be a sign of irrational exuberance.

Table 3. Probabilities Of A Market Turning

ITS	Prob w/BVR=1	Prob w/BVR=1.2	Prob w/BVR=1.4	Prob w/BVR=1.6	Prob w/BVR=1.8	Prob w/BVR=2.0
1	2.3%	2.6%	2.9%	3.3%	3.7%	4.2%
2	3.2%	3.6%	4.1%	4.6%	5.1%	5.8%
3	4.5%	5.0%	5.6%	6.3%	7.1%	8.0%
4	6.2%	6.9%	7.8%	8.7%	9.8%	10.9%
5	8.5%	9.5%	10.6%	11.9%	13.2%	14.7%
6	11.6%	12.9%	14.4%	16.0%	17.7%	19.6%
7	15.6%	17.3%	19.2%	21.2%	23.3%	25.6%
8	20.7%	22.9%	25.1%	27.5%	30.1%	32.8%
9	27.0%	29.5%	32.2%	34.9%	37.8%	40.8%
10	34.3%	37.2%	40.1%	43.1%	46.2%	49.3%
11	42.5%	45.5%	48.6%	51.7%	54.8%	57.8%
12	51.0%	54.1%	57.2%	60.2%	63.1%	66.0%
13	59.5%	62.5%	65.4%	68.1%	70.7%	73.2%
14	67.5%	70.2%	72.7%	75.1%	77.4%	79.5%
15	74.6%	76.9%	79.0%	81.0%	82.8%	84.5%
16	80.6%	82.4%	84.2%	85.8%	87.2%	88.5%
17	85.4%	86.9%	88.2%	89.5%	90.6%	91.6%

Table 3 and Chart 4 shows the result of this exercise. The probability of the market turning from a boom to a bust assuming an I/S ratio of 10 months of supply are 34.3%, 37.2%, 40.1%, 43.1%, 46.2% and 49.3% for a B/R for 1.0, 1.2, 1.4, 1.6, 1.8, and 2.0, respectively. Chart 4 shows that the probability that an overheated market is about to turn rises with higher ITS. Buy-versus-rent can tell us we are in a bubble, however, it is excess inventory which pops the bubble. So now we can tell when markets have overheated and we have a signal when they will reverse course. An I/S = 11 and a BVR = 1.6 gives us better than a 50/50 chance of the market turning.

In 1990Q3, the buy/rent for Los Angeles was 1.7 and inventory/sales was 17 months of supply. The probability of the market turning was nearly 90% before it turned, point A in Chart 4. In 2006Q3, the buy/rent for Los Angeles was 1.8 and inventory/sales was 14 months of supply. The probability of the market turning was about 77% (point B in Chart 4). The fact that there was so much supply on the market in both periods, given that the buy/rent ratios were so high, were necessary and sufficient conditions to indicate the market was turning, one to two quarters before home prices fell.

In the contraction stage ï before home prices fell ï banks, investment firms and ordinary potential home buyers began to understand that housing was overvalued. Demand dried up and supply increased, prices did not fall right away, but the I/S ratio began to rise above 7.0 months of supply. It told us that the market had turned before prices fell. Following B/R and I/S gives market watchers the ability to track markets and alter policy decision before prices begin to fall.

6. Conclusions

The national 2007/2012 housing bust should never have happened and after witnessing the destruction one might think that society would never see the purchase market for housing get so misaligned with intrinsic values. Here, we use rents to indicate intrinsic value.

A look at the housing market at the time this paper was being written would show that home prices have risen dramatically vis-à-vis income in many major U.S. CBSAs, especially those in California. The buy/rent ratio in San Jose is near 1.4. Homebuyers are willing to pay close to 40% more to own a home than to rent. However, the inventory of homes in that market is very low ï near two months of supply. The probability of a market correction is about 4 percent. The inventory of homes for sale would have to grow rapidly to raise the probability of a major correction. Underwriting standards in the U.S. since 2009 have been very tight. There has been very little speculative buying using low down payment loans.

User costs can deviate from rents for significant periods of time. In CBSAs where purchase costs (in the form of down payments or monthly payments) are high, the reasons the two variables deviate could be due to buyers rationally expecting home prices to rise faster than incomes if the local economy is very strong and there exists finite supplies of buildable land. Buyers are aware of what it cost to rent for a month versus own for a month and choose to buy on the belief that the two will not equilibrate in the near term. However, we have seen periods where homebuyers have been willing to pay more than 40% to own a home rather than rent and eventually home prices fall. A mean-reverting mechanism does exist when homes are expensive relative to rents, but house price psychology in a bubble can delay that turning point for many quarters. In these cases, buyers continue to bid up housing relative to renting and housing can overheat.

This paper finds that when a market is overvalued (B/R is greater than 1.4) and that excess supply is building (as measured by I/S rising above 7 months of supply), even while home prices are rising, then there exists necessary and sufficient information to determine that the market will turn ï the mean-reversion correction process is functioning several quarters before the price turn.

Understanding borrower behavior and market functioning, nonetheless, is complex and it is still in its infancy. This buy/rent methodology is experimental and it is one of the many ways in which one could track risk at the local market level.

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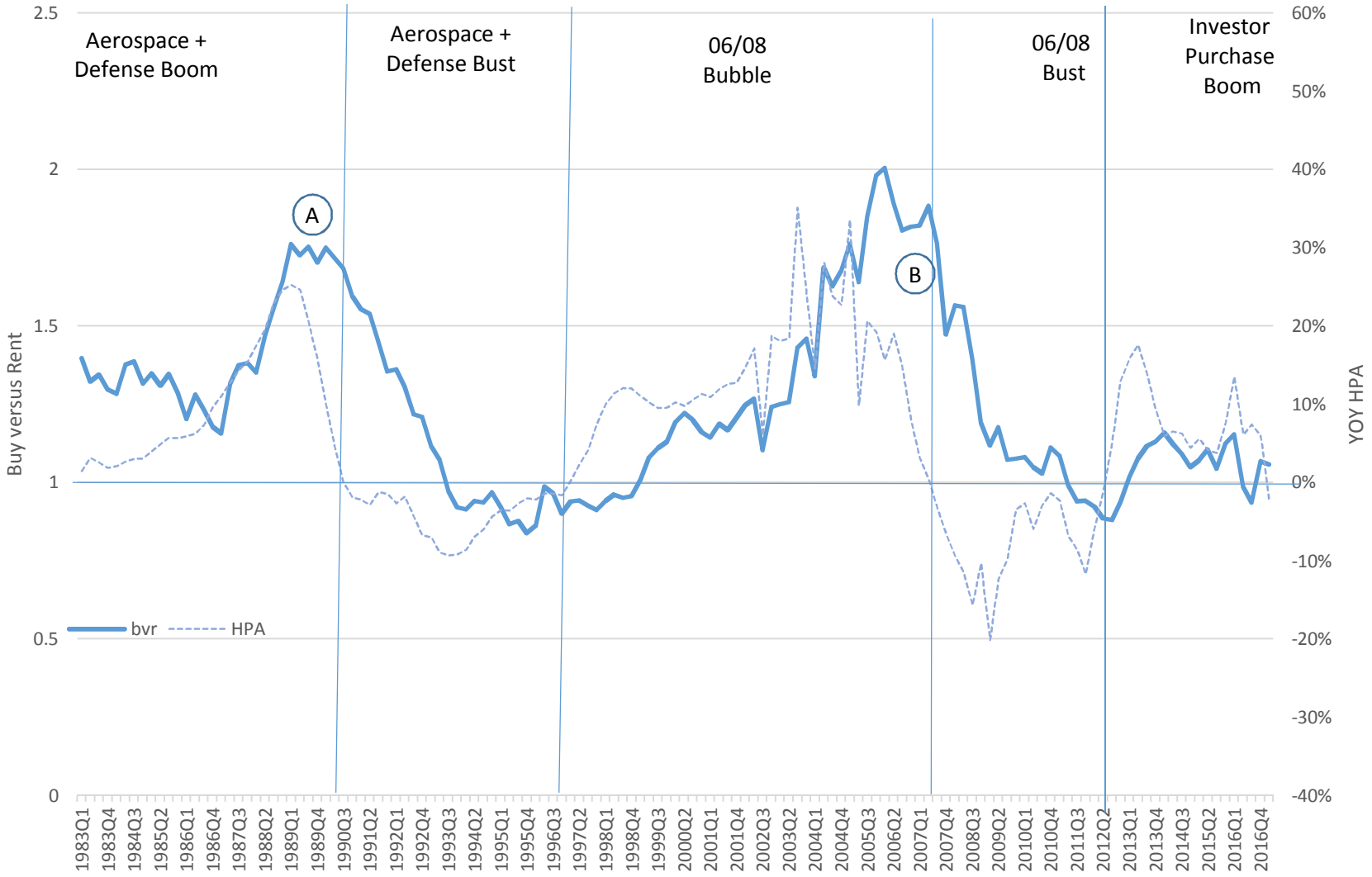
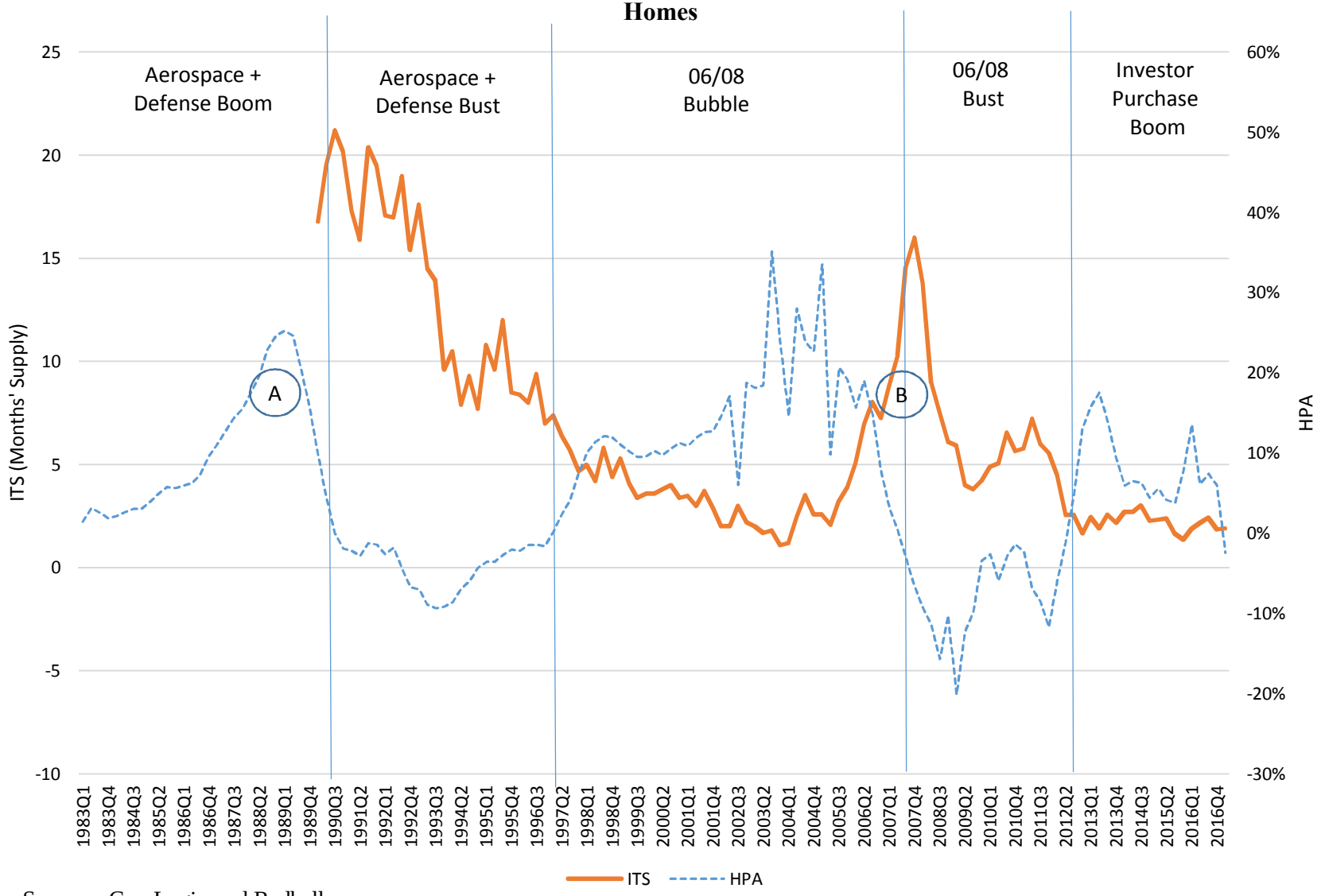
Chart 1. Los Angeles Over Three Housing Cycles:
Year-Over-Year Home Price Appreciation (HPA) And Buy-To-Rent (BVR) For 3 Bedroom Homes



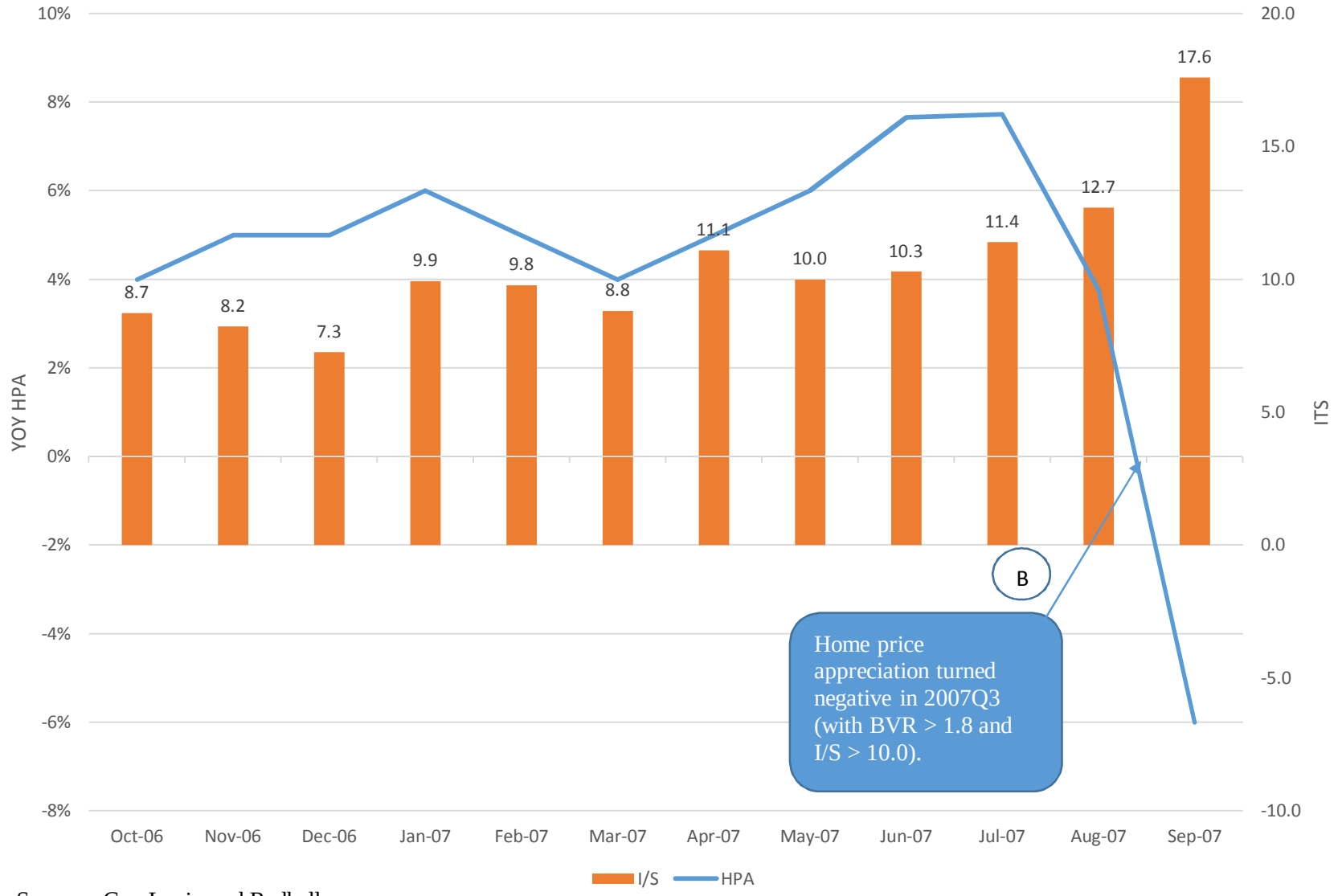
Sources: CoreLogic and RentRange.

Chart 2. Los Angeles Over Three Housing Cycles:
Year-Over-Year Home Price Appreciation (HPA) & Inventory-To-Sales (ITS) For 3 Bedroom Homes



Sources: CoreLogic and Redbell.

Chart 3. Los Angeles At The Peak During The 07/12 Housing Bust:
Home Price Appreciation (HPA) And Inventory-To-Sales (ITS) For 3 Bedroom Homes



Sources: CoreLogic and Redbell.

Chart 4. Probability Of A Turning Point In The Housing Market Using Buy Versus Rent (BVR) And Inventory To Sales (ITS)