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# Housing price bubbles, new supply, and within-city dynamics☆

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ABSTRACT

Although there is broad recognition that cities differ in their tendency to experience house price bubbles, most studies assume away any possibility of within-city heterogeneity in response to a bubble. We develop a model that suggests that this assumption may be appropriate when markets are rising but can be far from reality on the bust side of a bubble. During a housing boom, new construction and related supply adjustments by developers ensure stable relative prices between low- and high-quality segments of the housing market. On the bust side of a bubble, however, reduced housing starts allow demand-side forces and mortgage default to create pressure for relative prices to diverge across market segments. Absent a change in technology, as markets recover and new construction rebounds, relative prices should revert back to pre-crash levels. Evidence based on 2000–2013 single-family home sales in Phoenix, Arizona supports this modeling framework. Additional evidence also suggests that high rates of mortgage default contributed to divergence in relative prices when markets crashed.



## 1. Introduction

It is widely recognized that there is tremendous heterogeneity across cities in their tendency to experience house price bubbles. There is also broad recognition of conditions that have likely contributed to this heterogeneity (e.g. Case and Shiller, 1989; Glaeser et al., 2008; Shiller, 2008, 2014; Glaeser and Nathanson, 2015).[1] Nevertheless, most previous studies implicitly assume away within-city variation in house price volatility in response to a bubble, typically without any conceptual justification for doing so. This leaves an important gap in our understanding of the nature and impact of house price bubbles that this paper begins to address. We develop a simple supply-side model of new housing development within an individual city and then examine implications of the model using single family home sale data from Phoenix, Arizona, 2001–2013. Results from both the conceptual model and the empirical analysis establish conditions under which house price bubbles will tend to have homogenous within-city effects on house price growth on the boom side of a bubble but potentially heterogeneous effects when markets crash.

Central to our model, the housing market is divided into quality tiers from low to high. Home builders are then assumed to direct new construction towards the highest yielding quality segment of the market up to the point where marginal returns are equalized across segments. We show that this ensures that relative prices between high and low quality homes remain nearly constant when price levels are rising on the boom side of a bubble. When markets crash, however, development is curtailed and the disciplining

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[1] Glaeser, Gyourko, and Saiz (2008), for example, examine house price volatility and volatility in housing starts at the metropolitan level for 79 metropolitan areas from the mid-1980s to 2006. Using topographic features as a proxy for housing supply elasticity (e.g. Saiz, 2010), they show that metropolitan areas with inelastic supply exhibit greater price volatility and lesser volatility in new construction. They conclude that supply-constrained metropolitan areas are more subject to volatility arising from house price bubbles driven by demand side factors. More recent work by Genesove and Han (2013) report analogous patterns within cities. Specifically, using American Housing Survey data, they provide evidence that areas close to the periphery of a city with elastic opportunities to build additional housing experience larger building booms and less price volatility when demand is growing.

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effect of new construction is diminished. This allows for the possibility that forces outside of our model, including demand-side factors and mortgage default, may prompt relative prices to diverge in ways that may be difficult to anticipate. Absent any change in production technology, a further prediction of our model is that relative prices will revert back to pre-crash values as markets recover and new construction rebounds.

In establishing these principles our work contributes to a small but growing number of studies that recognize that house price bubbles can have heterogeneous within-city effects on housing markets. Leventis (2012), McManus (2013), McMillen (2016), and Landvoigt et al. (2015) all stratify the housing market into "price tiers" and report evidence of divergence in price across market segments. How to stratify the housing market is not straightforward, however, and the manner in which this is done affects opportunities to investigate different features of bubble episodes. Stratifying the housing market by price category, as with the studies noted above, is convenient since house value is readily observed. But this also complicates efforts to analyze price-tier movements since house price is sensitive to both supply and demand features of the market. Moreover, especially in volatile periods uneven rates of house price movements between low and high-valued price tiers could cause some homes to transition between value categories which further complicates efforts to model heterogeneous responses to a bubble. Landvoigt et al. (2015) use structural methods and also classify homes into price tiers based on initial period values as part of their strategy for how to allow for these challenges. They then consider the influence of demand-side factors and access to mortgage credit on house price bubbles and within-city market heterogeneity. Leventis (2012), McManus (2013), and McMillen (2016) do not attempt to explain what drives observed patterns of within-city heterogeneity in home price movements but instead focus more on providing detailed statistical descriptions of the underlying patterns.[2]

Our paper takes a different approach. We classify homes based on square footage of the floor space for small homes up to mansions, and then measure house price appreciation using size-stratified repeat sales models that difference away other time-invariant attributes of the homes. Detailed arguments in support of this procedure are provided later in the paper (in Section 2.2). Here we emphasize that because floor space is a manufactured, largely time-invariant feature of the home, stratifying the market in this fashion allows us to more clearly highlight the influence of new home construction and the supply side of the market, a primary goal of the paper.[3]

As noted above we explore empirical implications of our model using single family home sales in Phoenix, Arizona, 2001–2013. Phoenix is a large, rapidly growing metropolitan area surrounded by extensive open, easily developed land.[4] It also recently experienced a dramatic boom-bust cycle in real estate prices as is evident in Fig. 1a. The figure plots a monthly repeat sales home price index which we estimated for Phoenix from 2001 to 2013. The 95% confidence band for the index is also displayed and confirms that the index is very precisely estimated over the entire sample horizon. Bearing that in mind, notice that prices rose at a modest pace from 2001 to 2003, doubled 2004–2006, crashed 2007–2009, and stabilized in early 2009. Prices began to recover in 2011 and increased 50% between 2011 and 2013. This pattern is largely mirrored in home sales in Fig. 1b. As also shown in Fig. 2, permits for 1-unit housing construction peaked in 2005 and then crashed, hitting a trough in 2009 where the permit series largely remained to the end of the sample horizon in 2013.

The dramatic boom-bust event in Phoenix provides an ideal setting in which to examine implications of our model. In the empirical work to follow, we show that consistent with our theory, house prices grew at nearly identical rates across quality segments of the market during the boom period. During the crash, however, price indexes for small homes fell notably further causing relative prices between large and small homes to diverge. As markets began to recover in 2011, relative prices began to shift back to pre-crash levels, consistent with a central prediction of our model.

It is worth emphasizing that our model of developer behavior does not predict how relative prices may diverge when construction is depressed or even that price divergence would necessarily occur. Reaching outside of our model, we present additional evidence that high rates of mortgage default and related distressed sales in the small-home sector likely caused small home price indexes to fall further during the crash.[5] While intuitive, that explanation raises other questions. Our model predicts that during the recovery phase of a bubble any post-crash divergence in relative prices should revert back to pre-crash levels. The implied ability to forecast changes in relative prices could present profit making opportunities to homebuyers, analogous to an ability to pick higher yielding stocks (risk-adjusted). That in turn suggests the presence of arbitrage opportunities and a violation of the efficient market hypothesis (EMH). One possible resolution to this puzzle is that following the crash, investors may have perceived small-home purchases to be increasingly risky relative to larger homes, possibly because of rising mortgage default rates. Under this view, *anticipated* mean reversion in post-crash relative prices could reflect market compensation for an increase in perceived comparative risk in the small-home sector. Although we do not rule this out, we believe that at least two other mechanisms likely also contributed to post-crash divergence in relative prices.

Later in the paper, we provide evidence that during the boom phase of the bubble homebuyers adopted unrealistic expectations of future returns, and also that homebuyer assessments of market value jumped ahead of those of sellers. This is suggestive – but not conclusive – that homebuyers may have also paid inadequate attention to market fundamentals during the post-crash period. Moreover, widely publicized size-stratified house price indexes such as those presented later in the paper were largely not available during our sample period.[6] Even forward looking homebuyers, therefore, may have been *unaware* of the extent of price divergence that developed following the crash. This view of the post-crash divergence in relative prices suggests that information gaps may exist and that publication of size-stratified house

[2] McMillen (2016) also shows that heterogeneous shifts in price levels across price-tiers in Chicago have important implications for property value assessments and related property tax liabilities.

[3] We are aware of only two other papers that explicitly model the impact of new home construction on house price dynamics, which are Head et al. (2014) and Rosenthal (1999). Head et al. (2014) calibrate a model that highlights the role of housing search and allows for new construction but does not segment the market by quality. Rosenthal (1999) shows that the market value of a newly built structure closely tracks construction costs while also regulating the value of older home structures. Additional evidence and conceptual arguments suggest that home value shocks are driven primarily by shocks to the market value of the land itself but not the building, a result that is echoed in recent papers by Davis and Palumbo (2008), Nichols et al. (2013), and Davis et al. (2016).

[4] Haughwout et al. (2012) report that during the 2000–2006 housing boom in Phoenix, quarterly sales of raw land for new residential development typically totaled 10,000–20,000 acres per quarter.

[5] Distressed-sale homes tend to be under-maintained as in Lambie-Hanson (2015), Gerardi et al. (2015) and Haughwout et al. (2013). In addition, high mortgage default rates are likely to have released an unusual number of existing homes onto the market for sale, temporarily expanding supply. We elaborate on these points later in the paper.

[6] It is worth noting that this could easily change. Zillow, for example, has recently begun to post home price indexes to their website stratified into five categories based on 1 to 5+ bedrooms using a very different methodology from the repeat sales methods employed here (see http://www.zillow.com/research/data/).