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Why Do House Prices Fall? Perspectives on the Historical Drivers of Large Nominal House Price Declines

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I. Introduction

Despite many efforts to model house prices in the United States, reliably predicting when, and by how much, house prices will fall remains an elusive goal. Most efforts at modeling house prices have focused on explaining long-run equilibrium prices. The weight of evidence supports the view that in the long run, house prices are determined by employment growth and population growth, as well as levels and growth in real incomes, real construction costs, and real interest rates (Rosen 1974; Ozanne and Thibodeau 1983; Poterba 1991; Abraham and Hendershott 1992; Dipasquale and Wheaton 1990; Malpezzi et.al 1998; Case and Shiller 2003; Cutts and Nothaft 2005). Other models focus on explaining *deviations* in house prices around a long-run equilibrium. Many studies have found that prices often overshoot equilibrium prices only to revert back to mean long-run predicted values as a result of the size of the differences between actual and predicted house values and cyclical economic factors (Malpezzi 1996; Malpezzi 1998; Abraham and Hendershott 1996; Capozza, Hendershott, Mack and Mayer 2002; Zandi, Chen and Carey 2006; Case and Shiller 1989; Capozza and Seguin 1996). Still other studies model house price change, not in terms of deviations from predicted long-run values, but the variables that influence year to year changes in metropolitan house prices, such as current and past changes in population, unemployment, income, wealth or debt (Jud and Winkler 2002; Lamont and Stein 1999).

In contrast, this paper examines the influences on the probability that a metropolitan area will experience a price decline and the magnitude of declines when they occur. While this paper stops well short of developing predictive models, it provides insights into what historically, at least, has counted in metropolitan area nominal house price declines. It explores several factors that theory and empirical evidence suggest could be instrumental to the house price decline process at the metropolitan level. These include: 1) the magnitude of potential overbuilding, 2) the magnitude of job loss, 3) the magnitude of the price run-up that precedes a downturn, and 4) increases in real interest rates.

The primary finding of this paper is that the presence and magnitude of job loss and the presence and magnitude of overbuilding, as measured by a relatively simple proxy, are the crucial determinants of both the probability that a place will experience a price decline and the magnitude of the decline. Interest rates appear to play a relatively minor direct role, though they may play an important indirect role. First, they can be important contributors to economic slowdowns and recessions that slow or turn job growth negative. Second, rising interest rates, by making housing more unaffordable, can slow price appreciation and thereby abruptly reduce speculative demand and the demand for primary and second homes that may have contributed to overbuilding. While there does appear to be a relationship between how much prices go up and whether and by how much they fall, the relationship does not hold in many cases and is difficult to disentangle from the job losses and overbuilding that often occur at about the same time. For example, overheated house prices can contribute to overbuilding by sparking speculative activity and pulling forward primary and second home demand. In addition, overheating is a less robust predictor of elevated price decline probability and magnitude than overbuilding and net job loss.

This paper begins with a brief review of the literature on house prices and is followed by a more fully developed discussion and theory of what causes prices to fall, when, and in what ways. After explaining the measures of overbuilding and job loss used in the paper and the admittedly imprecise lag structures used to associate a spell of overbuilding, house price appreciation, or job loss with a spell of house price declines, the paper goes on to examine the role that overbuilding, overheating, and job loss, alone and in combination, played in house price declines in the nation's largest 75 metropolitan areas 1980-1999. The results show plainly that house price declines were more likely to occur and were more likely to be severe in places with heavy overbuilding and major employment loss, though either factor alone could also result in serious price declines. This discussion is followed by an examination of the role that interest rates and house prices played in price declines. A discussion of the current state of housing markets follows. Finally, conclusions are drawn from the theory and analysis presented in the paper.

II. Previous Literature on House Prices

Over the past thirty years, a rich literature on house prices has developed. Here some of the most salient findings of this literature are discussed. An exposition on the theory behind efforts to model prices and the technical methods used to model them are left to Appendix A.

A growing, though not entirely undisputed body of evidence suggests that the key drivers of long-run price appreciation are income growth, employment growth, and some variation of the user cost of capital or some or all of its components (which include real interest rates, marginal tax rates, and backward-looking house price expectations). Other factors also found to have an impact are construction costs and the severity of regulatory constraints on residential development (Poterba 1991; Malpezzi 1996; Case and Shiller 1989; Segal and Srinivasan 1985; Glaeser and Gyourko 2003). Demographic factors, prominently featured in Mankiw and Weil (1989), have also been found by others to have an influence on prices, especially as a determinant of population or household change.[1] However, the influence of demographics such as age and income makeup has been found to be complex, affecting prices differently at different quality levels, with any influence on average prices less pronounced (Green and Hendershott 1993).

Despite the growing consensus over the determinants of long-run house prices, house price models fall far short of explaining all the cross-sectional variations in house prices across metropolitan areas or the changes in home prices within metropolitan areas. This means that other factors are also at work. Furthermore, these long-term equilibrium models do not explain what drives deviations from long-run equilibrium prices in the short run. They also do not deal directly with the question of mean reversion (whether or not prices have a tendency to revert to a mean when they deviate from long-run predicted values) or serial correlation (whether past values of price influence current prices in the short-run or the trend in prices in the long-run). Given evidence of such serial correlation in the short and long runs, and of frequent deviations of current prices from expected prices (as predicted by long-run models), other models have been developed to examine these dynamic adjustments (Malpezzi 1996; Abraham and Hendershott 1994; Abraham and Hendershott 1996; Capozza, Hendershott, Mack, and Mayer 2002; Capozza, Hendershott, and Mack 2004).

Efforts to examine whether price changes are a random walk (uncorrelated with past changes) or are serially correlated have generally, though not exclusively, found that prices at the metropolitan level are indeed frequently negatively correlated with lagged values in the short run (suggesting reversion back to the mean when prices deviate too much above or below the mean), but positively correlated in the long run, meaning that places on higher appreciation paths tend to stay on them and vice versa (Case and Shiller 1989; Gu 2002; Gau 1984; Kuo 1996). More sophisticated modeling efforts have found that metropolitan areas in the short-run can have both mean-reverting and serial correlation tendencies. But the results of all these models are viewed

[1] Population or household changes also have advantages over employment growth as a measure of expanding or contracting metropolitan areas because they encompass demand from second-home buyers and retirees as well as primary residents.

as highly sensitive to the timeframes selected, datasets involved, and modeling approaches used (Cho 1996).

Models that explain deviations of house prices around some predicted long-run equilibrium level come closest to the concerns of this paper: What causes house prices to decline and by how much? Three types of modeling approaches are used to examine this issue, but all draw on the intuition that short-run dynamics are predictably associated with demand and supply-side variables. The first type is vector error correction models. These models assume that there is a long-run equilibrium and that short-run price movements are influenced by how far prices are from their predicted level (given the predicted values of long-run prices estimated in a first-stage regression). In a second-stage regression, current house prices are modeled as a function of predicted prices and an error term.[2] A more potent variant of this approach is an autoregressive distributed lag model. This type of model goes further by regressing current house price changes not only on predicted values from a first-stage estimation of a long-run equilibrium model with an error term, but also on current and lagged values of other variables thought to influence short-run changes in house prices. A final approach involves regressing annual changes in house prices directly on current and lagged values of variables thought to influence short-run changes in house prices, including lagged house prices and factors such as price-to-income levels, real changes in income, changes in interest rates, changes in unemployment rates, changes in wealth, changes in construction costs, changes in population, and fixed metro effects (foregoing the first-stage of fitting predicted house-price values and using them).

The theory behind short-run dynamic models is that short-term house price adjustments are influenced by recent trends in prices and a series of other factors economic factors, such as unemployment, that may cause prices to deviate from predicted long-run equilibrium values (Abraham and Hendershott 1996; Capozza et. al 2002). While most short run dynamic models include variables to capture the opposing forces of serial correlation and mean reversion, Capozza et. al.(2002) go a step further to explore the impact that market efficiency may have on serial correlation and mean reversion tendencies at the metropolitan level at different points in time. Observing that much of the literature on asset values finds serial correlation in the short

[2] The error term is sometimes decomposed into serial and mean-reverting elements when it is found to be non-random.

run but mean reversion in the long run, Capozza and his colleagues examine the influence that market efficiency may have on these two opposing tendencies. They posit that information costs, supply costs, and house price expectations shape market efficiency and therefore should influence these tendencies. Real construction costs are used as a proxy for competitive barriers to entry and regulation in a market, size of population and population change are used as proxies for information costs, and lagged change in real house prices is used to proxy for expectations. These variables are also interacted in the models. With the mean reversion factor, they find that larger metro area populations and lower construction costs have a positive impact, keeping prices closer to fundamentals. They posit that is the case because these factors reduce inefficiencies through more information from more transactions, lower transaction costs, and reduced barriers to development. Alternatively, factors that would potentially increase market inefficiency, such as high real income and population growth, high real construction costs, and land limitations are found to have a positive impact on serial correlation, theoretically as proxies for the existence of market exuberance and barriers to development, both of which cause house price responses to rise persistently above predicted long-run values.

Using a different methodology that uses lagged values but doesn't involve a two-stage divergence from mean variable, Jud and Winkler (2002) estimate a short-run dynamic model that is a single-equation regression of real percent change in metropolitan area house prices on percent changes of various lagged and contemporaneous economic indicators. Their results find price appreciation to be strongly influenced by current growth in income, population, construction costs, and interest rates, as well as current and lagged changes in wealth.

In a more recent example of a study of short-run house price dynamics, Moody's Economy.com took two different approaches to predict short-run house price changes that are worth noting (Zandi, Chen and Carey 2006). The first is a leading house price indicator (LHPI) which models the probability of house price decline according to several lagged factors, the most prominent being the deviation from the predicted long-term equilibrium price, which is itself determined by various predictors including personal income and wealth factors.[3] The first-stage equilibrium model has a proxy for market oversupply, but this proxy carries little weight. The second Moody's Economy.com model is a structural econometric model similar to the Capozza

[3] The LHPI model achieves a modest r-squared value of .15, but as an OLS estimate for a binary dependent variable, it may be a better predictor of house price movements than the r-square value indicates.

model, but the dependent variable is the magnitude of real house price change rather than the percent change in nominal house price. It includes terms for serial correlation, mean reversion, initial correction due to fundamental changes, and changes in other economic factors. Serial correlation and mean reversion as well as past house price changes are statistically signification and have large effects, while unemployment levels and user costs have significant but small negative effects on price changes. One economic variable, user cost, is interacted with the mean reversion variable and found to be statistically significant. In the end, this price change model has an r-squared value of .13, which is much lower than the .42 to .49 range of Capozza's models.

III. Why Do House Prices Fall: Towards a Theory of Major Declines

While the literature clearly provides important insights into what may drive house prices in the long run and cause prices to rise or fall in the short run, we take a different approach to examining the likelihood and extent of metropolitan house price declines. We begin by examining the probability that a large metropolitan area will experience a house price decline, and the magnitude of any declines, using variables suggested by a theory of what might cause shifts in the direction of house prices. In our view, spells of overbuilding and job loss are critical determinants. Thus, we define such spells and examine the likelihood that various severities of these spells, alone or together, will lead to price declines as well as the magnitude of these declines.

The starting point, therefore, of this work is a theory of what might cause house prices to change direction and turn negative after a period of positive growth and what distinguishes conditions likely to lead to large declines versus those likely to lead to smaller ones. In our view, price changes may be asymmetrical, behaving differently on the way up than on the way down even when similar fundamentals are at work.

Housing markets operate in the same fashion as other markets. Prices fall when supply exceeds demand and rise when demand exceeds supply.[4] When a product is oversupplied, suppliers respond by reducing output and lowering their asking prices to move inventory. As prices fall, the quantity of the product supplied falls and the quantity demanded rises until the

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[4] Prices can also fall when costs of production fall and competitive markets drive prices down to costs of production plus a competitive rate of return. Except for changes in the cost of land produced by a sudden oversupply of developed housing, the costs of producing housing have typically not fallen fast enough to account for house price declines. Thus, we focus on price declines produced by shifts in the supply and demand for goods and services.

two are brought back into equilibrium. When a product is undersupplied, prices increase and suppliers increase production to capitalize on these higher prices until supply and demand are realigned.

Things often do not go smoothly, however. In an oversupplied housing market, suppliers may be slow to lower their asking prices. In addition, output may not drop quickly because suppliers have a backlog of land and inventory they need to work through. In undersupplied markets, it may take time to bring new product online to relieve the pressure on prices. And the time it takes may be influenced by the severity of local regulatory constraints on development. Hence, behavior may differ when supply exceeds demand than when demand exceeds supply.

Dynamics of Housing Market Imbalances

Housing supply and demand often are not in equilibrium in large part because there is a long lag between when land is purchased with the intention of building homes and when homes are completed. In fact, the process of getting land entitled by local authorities and then developing it is so long that development and construction can easily take two or more years (Zelman et. al. 2006). By the time homes are completed, the level of demand can be far less than was expected at the time that capital was initially committed to residential development. Furthermore, homebuilding remains a highly competitive and fragmented industry at the local level. In any given market, hundreds of builders try to anticipate future demand. Thus, by the time housing is built, the supply added by competitors can be far greater than was originally anticipated by any one supplier. Housing is therefore quite susceptible to overbuilding.

Conversely, when markets are soft, builders may wait for clear signs of a recovery to recommit capital. As a result, coming out of a housing market downturn it is not uncommon to have a period of time when supply expansion lags demand growth. In markets where regulations constrain the amount of land available for development and extend the time and risk of land entitlement and development, supply can badly lag demand until house prices rise enough and the recovery is certain enough to jumpstart another lagged building cycle. Housing is therefore also susceptible to periods of undersupply.

What happens to prices and behavior in tight and loose markets? In tight markets, homes for sale are snapped up by anxious buyers and sell quickly. As buyers compete for a limited supply, they bid up home prices. Sellers find themselves with multiple offers after brief listing periods. Under such circumstances, buyers may fear that prices will continue to spiral higher and that failure to act will result in having to pay higher prices later and a missed opportunity for house price appreciation. Since house price appreciation expectations drive user cost calculations, buyers become more willing to go to more extreme lengths to buy a home, including allocating larger fractions of their income to housing, investing in larger downpayments, or tolerating riskier loans to lower their monthly carrying costs. Prices can rise swiftly in tight markets and become serially correlated as the promise of higher prices feeds the price run-up.

In contrast, sellers in slack markets find themselves with homes that remain on the market longer. As buyers awaken to the fact that homes are remaining longer on the market and bids are scarcer, they begin to bid less than asking prices. When time on market lengthens and sales slow, seller behavior varies depending on time urgency. Those not in a rush to sell or who do not need to sell at all tend to hold out for their asking prices at least for a time. Sellers that have a sense of urgency may balk at low-ball offers at first but then realize that they must lower their prices to sell their homes. Distressed sellers include owners who have lost their jobs, builders sitting on vacant inventory and with capital tied up in land development, speculators sitting on vacant inventory, and banks that have foreclosed on properties.

Clearly, the larger the supply of inventory in the hands of distressed sellers, the greater the risk that prices will fall rather than just grow more slowly, and that the correction will be prolonged and potentially severe. But because sellers are reluctant to lower their prices, prices tend to fall more slowly and with greater resistance than when they go up. In addition, the majority of home sales remain discretionary. Buyers who are not time-urgent can simply sit out a downturn. As a result, the behavior of prices on the way up can be different than on the way down. With the exception of a few "regime-switching" models, house price models typically do not allow for this possibility (Hall, Psaradakis and Sola 1997; Crawford and Fratantoni 2003).

Key Factors in House Price Declines

If house price swings are in fact caused by short-run shifts in the supply and demand for homes, then marginal upswings in the number of homes offered on the market and downswings in the number of homes demanded can bring about larger market corrections. A number of factors can disturb the balance of supply and demand. Demand for housing can fall for any of the following reasons:

- Job growth slows dramatically or turns negative;
- Housing affordability erodes badly as a result of increases in real interest rates or house price gains that outstrip income growth;
- Confidence in future home prices is shaken causing buyers to wait on the sidelines or exit markets (including buyers of primary residences, second homes, and homes purchased purely for investment purposes);
- Lenders constrain access to mortgage credit; or
- Returns on other investments become relatively more attractive.

The supply of homes for sale on the market, on the other hand, can exceed demand for any of the following reasons:

- Homebuilding outstrips increases in the quantity of housing demanded;
- Speculators or second homeowners exit the market and place their unoccupied homes on the market for sale;
- Job losses force distressed sales by owners unable to afford their mortgage payments or lenders that foreclose on defaulted loans; or
- Interest rate increases or expiring teaser rates on adjustable mortgages cause mortgage payment shocks that force distressed sales or defaults.

While any of these factors can cause shifts in the balance of supply and demand, we will show that significant overbuilding and job loss are the most likely to lead to price declines.

Overbuilding captures the extent to which additions to supply exceeded long-run demand during a particular period of time. Building ahead of demand often is not apparent until after the fact because supply can be temporarily absorbed by demand pulled forward, speculators and second homebuyers who may later exit the market, and job seekers who are unable to find employment. In addition, protracted job loss can cause metropolitan area population loss that is unanticipated. The greater the degree to which production exceeded sustainable demand growth over a period, the longer it is likely to take to work off the oversupply once it expresses itself, and the greater the pressure on the part of time-urgent sellers to lower their prices.

As noted above, time-urgent sellers in a slack market ultimately act like buyers in a tight market, but instead of bidding prices up as buyers do to achieve a sale in a tight market they slash prices relative to competing sellers to achieve a sale in a loose market. In overbuilt markets, most builders become time-urgent sellers because they have committed capital to land development and housing construction. To get the capital back out and to stop paying carrying costs on land and homes in the pipeline they need to sell. As a result, builders are motivated to work off inventory by lowering their prices or offering incentives (which are tantamount to reducing prices but do not show up in the recorded sales prices). Unlike speculators sitting on recently bought homes, some builders can afford to reduce their prices without incurring a loss because they bought land years earlier at prices below current market levels. For these builders, slashing prices may result in margin compression but not outright losses.

Hence, builders are often the most willing and the first to reduce prices. Once one or a few larger builders decide to try to clear out their inventory by cutting prices, others tend to follow since buyers can cancel contracts if price reductions being offered by other builders in the market exceed typical earnest money deposits on sales contracts. As this continues, either inventories are worked off quickly and production curtailed to lower demand expectations to quickly stabilize the market, or they are not and the downturn lasts longer and spills over into the broader market.

Job loss is a critical second factor because it can cause demand at the margins to drop off significantly while at the same time reducing household incomes and increasing the supply of homes on the market held by time-urgent sellers. Job losses necessitate sales as unemployed people move to other areas in search of employment and financial hardships force distressed or foreclosure sales. Furthermore, metropolitan area job loss is sometimes significant and prolonged, leading to a persistent chill in the housing market.

Given their importance, we focus in this paper on these two potential causes of house price declines. While measuring job loss is relatively straightforward at the metropolitan level, measuring the degree of overbuilding is not. In fact, overbuilding is difficult to measure even at the national level and is typically a lagging indicator because it is not until demand falters that overbuilding is clearly revealed. It eventually shows itself in mounting inventories of unsold new and existing homes for sale but can be measured most directly as the number of unsold new but not yet completed homes plus the number of existing units that are for sale *and* vacant.

Together, unsold but uncompleted homes for-sale plus existing vacant homes for sale are roughly equivalent to the number of excess units in a market at a point in time.[5] Unfortunately, there are no good measures of either of these types of homes for sale at the metropolitan level. As a result, proxies are required. One such proxy is used in this paper and turns out to be predictive of the probability of a price decline in a market. This measure is the permit intensity, defined as the short term average annual permits per capita relative to the long term median annual permits per capita of a particular metropolitan area over the long run. While ideally this measure would be adjusted for periods of unusually rapid employment growth in an area that might justify a higher ratio of current to long-run per-capita permitting, it works well as a leading indicator of price declines even without doing so.

Certainly the literature on house prices also suggests that at least in some cases, house price declines may be related to or even importantly driven by the extent to which prices rose in the period leading up to the decline. This follows from the finding that prices are often negatively correlated with lagged prices in the short run, exhibiting pressure to revert to a mean. To get back to the mean prices, they may need to fall after a period of above-equilibrium growth (though a period of slowed appreciation is also possible). It also follows that the magnitude of a run-up may influence the magnitude of a decline from the fact that expected user cost measures (which often incorporate three-year average lagged house prices) are clearly correlated with changes in house price levels.

Below, we examine the influence of house price run-ups, or overheating, on the likelihood and magnitude of subsequent price declines. We do not explore the issue in an error correction framework, however, so we remain silent on whether it is the extent of the deviation from a predicted long-run mean that may drive the likelihood and magnitude of a decline. Instead, we examine simply whether the extent of the run-up influences the likelihood and extent of a downturn. This is at least a partial test of whether the magnitude of run-ups is a primary driver or a contributor to a decline or to what extent other forces come into play.

The literature also suggests that real interest rate changes are correlated with house price movements, and that beyond some point they can be large enough to drive nominal house price

[5] While it is for-sale vacant units that place the most downward pressure on home prices, the extent of overbuilding is influenced also by any excess rental vacancies since it is the sum of these two that constitutes the full oversupply. In addition, some frustrated sellers may hold their homes off the market (which do not show up as a vacant units for sale) and some may rent.

declines. We also explore this possibility and subscribe to the view, based on extensive modeling that has already been done by others, that real interest rates (via their influence on user costs) do indeed influence house prices. The question, though, is whether interest rate swings alone have historically been large enough to show up as a major driver of the probability that places will experience house price declines, or of the magnitude of declines.

Overheated and Overbuilt Markets

Overheated and overbuilt markets leave metropolitan areas especially vulnerable to house price corrections, though whether these corrections take the form of slowdowns in price appreciation or outright declines depends importantly not only on how overheated or overbuilt they become but also on the economic conditions that follow these periods, especially the course of job growth. Thus, it is important to understand how housing markets become overheated and/or overbuilt in addition to what causes expanding housing markets to contract.

Housing markets can overheat during an economic expansion either because interest rates decline significantly or development regulations badly constrain the speed of the supply response to increasing demand. Falling interest rates reduce the carrying costs of mortgage debt and allow borrowers to pay higher prices without incurring greater monthly housing outlays. Development regulations, by slowing the supply response to increasing housing demand, can increase the length of time that markets remain tight and intensify that tightness. The longer markets remain tight, the greater the chances are that buyers will build unrealistic future house price appreciation expectations into their decisions. Higher price expectations drive down the expected user cost of capital. Even if tight markets occur during a period of flat or increasing interest rates, the incorporation of the expectation of future price increases (inflamed by bidding wars) can propel prices higher.

Overheated markets trigger escalations in house prices, homes sales, and sometimes production levels beyond those suggested by fundamentals like the rate of income growth and the sustainable demand for new primary and secondary residences. As prices escalate, speculators and second-home buyers are drawn into the market by the prospect of earning leveraged returns on a fast-appreciating asset. Entry of these buyers exacerbates an already tight supply.

Overheating is one of the conditions that also leave markets vulnerable to overbuilding. Builders respond to the added demand from investors and second-home buyers, as well as the opportunity to earn above-normal margins presented by land appreciation, by stepping up their output. But, as noted, new homes enter the supply with a considerable lag. This heightens the risk that new supply will enter the market after the economic cycle (including job growth, interest rates, and second-home demand) has peaked. Markets under these circumstances can become overbuilt. When investors exit the market or second-home buying slows substantially, supply is added back to the market as demand falls. Still, as discussed below, at least in the nation's largest metropolitan areas severe overheating does not necessarily lead to overbuilding.

Overbuilding can and often does occur even in the absence of significant regulatory constraints on development or falling interest rates. When job growth accelerates, builders build in anticipation of future job growth. Some people move to booming areas before securing jobs. Under these circumstances, builders can overshoot the mark. Places with few constraints on development may be at special risk. Where regulatory restraints are lax, competitive barriers to entry are lower. As a result, there are more builders making bets on the near-term level of housing demand and a greater chance of thinly capitalized builders being caught with unsold inventory and difficulties servicing their debt. In places with especially rapid job growth for a time, even a mere slowdown in job growth can culminate in an overbuilt market.

Common Tipping Points

Economic cycles can produce conditions that lead to an unraveling of the conditions that fuel house price growth during economic expansions. In overheated and overbuilt markets, several price-decline triggers can occur all at once or can be staggered over a few years. As the national economy heats up, interest rates frequently rise as capital becomes scarce and monetary policy becomes restrictive as the Federal Reserve works to avert inflation. Higher interest rates reduce demand and make buyers less willing to accept higher prices. After a time, higher interest rates often cause a slowdown in interest rate sensitive sectors, which results in a slowdown in job creation. If the slowdown turns into a recession, job losses occur in many metropolitan areas. Job growth slowdowns reduce demand while job losses reduce demand and add to the supply of homes for sale by forcing some to sell their homes or default on their loans.

Hence, rising interest rates can be an indirect cause of the job growth slowdowns and employment losses that produce overbuilt markets.

In overheated markets, increases in interest rates combined with price appreciation that has catapulted ahead of fundamental growth eventually force marginal borrowers out of the market, even though for a time the allure of seemingly ever-increasing prices keeps them in the market using creative financing to hold down monthly costs. As these marginal buyers exit the market, there is a greater likelihood that house price appreciation will slow. Slowing price appreciation in turn sends a signal to speculators to slow their activity or exit the market and may also reduce second-home demand. With marginal borrowers, investors, and some second-home buyers exiting the market, demand falls off sharply. Making matters worse, in some cases the market becomes overbuilt because builders made decisions on production based on the previous level of demand which included demand pulled forward and speculative demand sparked by rapid appreciation. Builders at this stage typically have full production pipelines. Thus, new-home inventory builds as sales drop and as some speculators and second-home buyers who perceive that the market has peaked place additional vacant units up for sale. Should a slowdown in job growth or a fall in employment get added to the mix, the likelihood of a price declines is apt to increase.

Even in overbuilt but not overheated markets, higher interest rates reduce overall housing demand. But these higher rates in and of themselves are likely to have only a modest impact on housing demand. Slowing price appreciation does not drive buyers or speculators out of the market because prices did not appreciate rapidly in these markets and draw unsustainable demand into the market. In the presence of even a slowdown in job growth, however, overbuilt markets can trigger a house price correction. In places that are hit by job loss, the likely impact on house prices is more severe.

By 2003, many markets in the United States had become overheated and some were overbuilt. Initially tight markets in many areas combined with 40-year lows in interest rates to drive house price appreciation well ahead of income growth. Beginning in 2004, interest rates started to increase as the Federal Reserve tightened monetary policy. Long-term interest rates, however, remained relatively unaffected and creative mortgage financing allowed marginal borrowers to stay in the market in the face of rapidly rising prices and increases in short-term interest rates. As a result, building and sales did not peak until early 2006. As house price appreciation slowed under the weight of slowing sales, investor demand slackened but housing production responded with a lag. Nationally, the number of unsold and uncompleted new homes increased and the number of homes vacant and for sale increased even more. The magnitude of overbuilding began to become apparent as a more normal, albeit perhaps slightly depressed, level of long-term demand revealed itself.

IV. Analysis

This paper analyses house price decline spells that occurred 1980-1999 in the nation's 75 largest metropolitan statistical areas in terms of their association with spells of overheating, overbuilding, and employment loss.[6] These metropolitan areas account for 60 percent of households in the United States. Focusing on these larger metropolitan areas avoids the problem of disentangling the influence of job losses in major metropolitan areas on house prices in smaller satellite metropolitan areas. Historically, these impacts have been dramatic in metropolitan conurbations around New York, Boston, and Los Angeles.

Metropolitan Area House Price Declines

As defined for this study, spells of nominal metropolitan house price decline may last several years and may include a single year of increase if prices continue to trend downward afterwards. Annual metropolitan area price appreciation levels are derived from the Freddie Mac Conventional Mortgage Home Price Index (CMHPI). The CMHPI is based on repeat sales of existing single family homes with mortgages held in Freddie Mac's portfolio. Homeowners focus most on nominal rather than real inflation-adjusted declines so we use nominal declines as our measure. We define major nominal house price declines as those where prices fell more than five percent in total from peak to trough.

Our selection of this measure yields 35 major price declines and 50 less severe declines in the 75 largest metropolitan areas during the study period. Although declines were experienced in a majority (59) of the nation's top 75 metros, fewer than half (34) experienced a major nominal house price decline. Only one metro, Honolulu, experienced two such declines.

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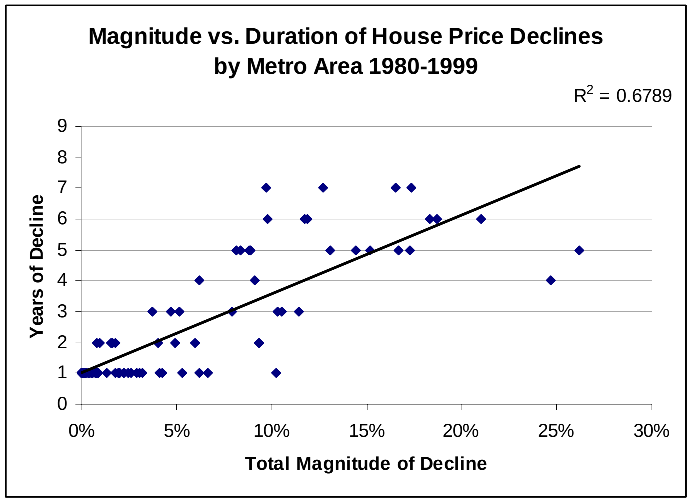
[6] Metropolitan areas are defined using constant 2003 Office of Management and Budget boundaries. The study period does not extend beyond 1999 because no large metros experienced price declines 2000-2005.

In general, longer house price declines were correlated with larger decreases in nominal prices. However, a small number of one- and two-year dips were as great as 10 percent. Periods of price decline lasted up to seven years, and got as severe as a 26 percent fall, which occurred in Oklahoma City in the mid-1980s. While all the declines (of any size) averaged 5.8 percent and lasted an average of 2.5 years, the major declines averaged 12 percent and lasted more than 4 years. Major price declines are less frequent and generally protracted while smaller declines are far more common and tend to last only a few years.



Major nominal declines occurred in large metropolitan areas in every region of the country, but were most prevalent in the Northeast and West. The Midwest had the smallest number of large metros with major declines, though many Midwest metros did experience moderate declines in the early 1980s. Of the 35 large nominal declines, 11 were in the Northeast, 1 was in the Midwest, 8 were in the South, and 15 were in the West. Southern declines were limited to metropolitan areas in Texas, Oklahoma, and Louisiana.

House Price Declines and Overbuilding

Overbuilding within a metropolitan area is defined for this study in terms of variations in permit intensity. Permit intensity is defined as the ratio of permits per capita in a given year to their long-run median level of permits per capita. Permit and population data are obtained from the US Census Bureau C-40 metropolitan permits table and Moody's Economy.com annual population estimates, respectively. Long-run or "normal" permitting levels are defined as each area's median annual permits per resident over the entire dataset 1980-2004. Overbuilding in a given year is defined as the deviation of recent permit intensity from the average annual permitting intensity for all 75 metros for all 25 years of data, where recent permit intensity is annual permit intensity averaged over the given year and the prior two years.

Spells of overbuilding are considered "associated" with house price declines if the end of the overbuilding period occurs within two years of the onset of a price decline. This measure was used after observing that in some metropolitan areas it took a couple of years for overbuilding to lead to decline while in others decline begins during an overbuilding spell. Although overbuilding and declines may be related, the specific time relationship between the two depends on other factors influencing demand conditions. Given the fact that this basic measure does not control for the correlation of periods of above average permit intensity with above average growth, the strong association found between this simple measure and house prices is remarkable. In part, it reveals that it is typical for periods of booming employment to trigger overbuilding which is then followed by a period of employment loss that throws housing markets into reverse gear.

To construct a sensitivity analysis, we define extreme overbuilding as a ratio of 3-year average permit intensity that is 3 standard deviations or more above the average annual permit intensity across all 75 metropolitan areas from 1980-1999. Severe overbuilding is defined as a ratio that is 2 to 3 standard deviations above the average, moderate overbuilding is 1 to 2 standard deviations above it, and modest overbuilding is 0 to 1 standard deviations above it. These thresholds were selected because a sensitivity analysis of house price decline on various levels of overbuilding suggested a strong threshold association between 3-year average permitting intensity and the probability of a large house price decline. We find that this threshold occurs when three year permit intensity is two standard deviations above the all-metro average (See Figure 1.1).

As shown in Table 1 below, we find that over the 1,350 possible metro-years in which our overbuilding measure is calculated, there were a total of 85 spells of overbuilding of one year or more when measured using total permitting, and there were 81 if single-family permits were used. Hence overbuilding is a relatively low probability event. Looking at the probability of house price declines occurring within two years before or after these overbuilding spells ended, we find that when three year total permit intensity reaches two standard deviations above the all-metro average—which coincidentally is also equivalent to roughly twice the all-metro average per-capita permitting levels—there are greater probabilities of a metro experiencing a decline and the decline being a large decline. While only about a third of all spells of moderate overbuilding 1-2 standard deviations above the all-metro average resulted in price declines, nearly two out of every three spells of severe overbuilding 2-3 standard deviations above the all-metro average resulted in price declines, and eleven of the twelve spells of extreme overbuilding 3+ standard deviations above the all-metro average resulted in price declines, all of which were large. When looking only at single-family permitting levels the increased probability of decline is similarly dramatic when overbuilding exceeds two standard deviations, rising from 42 to 75 percent.

Along with higher probabilities of a decline, the average magnitude of house price decline associated with overbuilding also increases significantly at the two standard deviation threshold of overbuilding (Figure 1.2). Every decline associated with overbuilding above two standard deviations exceeded five percent in nominal terms, and averaged over ten percent.

Table 1: Sensitivity of House Price Declines to Overbuilding Measure

Based on Total Permits

	Number of Instances with:				**Share of instances with:**		**Large price declines as % of all declines**	**Average magnitude of price declines**
Spell deviation from normal permitting	**Large declines**	**Any decline**	**No Decline**	**Total**	**Large declines**	**Any decline**		
+0-1 std. deviations	7	12	25	37	19%	32%	58%	6.1%
+1-2 std. devs.	3	9	16	25	12%	36%	33%	3.1%
+2-3 std. devs.	6	7	4	11	55%	64%	86%	12.9%
+3 or more std. deviations	11	11	1	12	92%	92%	100%	15.7%

Based on Single-Family Permits

	Number of Instances with:				**Share of instances with:**		**Large price declines as % of all declines**	**Average magnitude of price declines**
Spell deviation from normal permitting	**Large declines**	**Any decline**	**No Decline**	**Total**	**Large declines**	**Any decline**		
+0-1 std. deviations	7	19	25	44	16%	43%	37%	4.6%
+1-2 std. devs.	6	8	11	19	32%	42%	75%	10.4%
+2-3 std. devs.	6	6	2	8	75%	75%	100%	13.1%
+3 or more std. deviations	9	9	1	10	90%	90%	100%	15.0%

The strong threshold effects of overbuilding and the likelihood and magnitude of price declines is best illustrated graphically, as is done in Figures 1.1 and 1.2. Here, the non-linear nature of the data is plainly revealed. Comparing price response to overbuilding as determined by single family permitting with that based on total permitting shows increased sensitivity to single family overbuilding, which is expected as the CMHPI house price index used is based on repeat sales prices of single family homes, and therefore the relationship is more direct.

Figure 1.1: Propensity for House Price Declines by Overbuilding Level

(a) Total Permits (b) Single-Family Permits

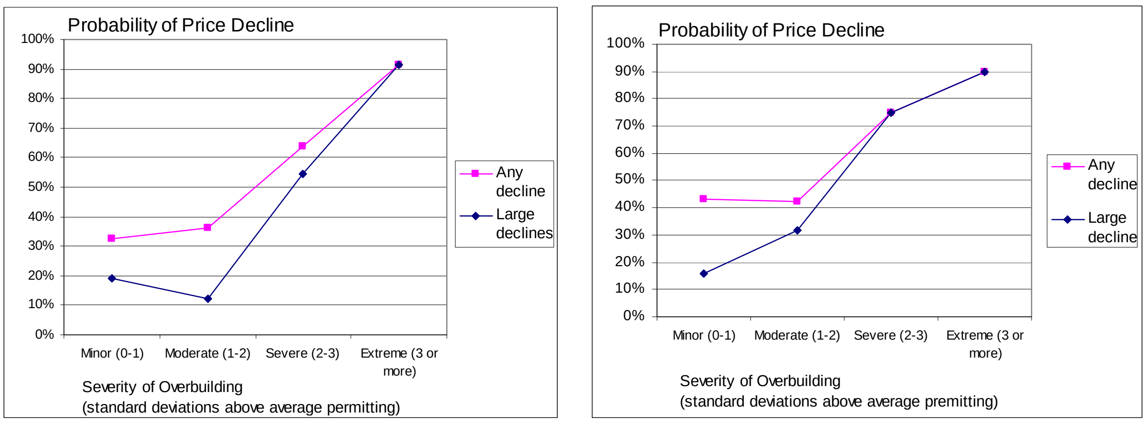
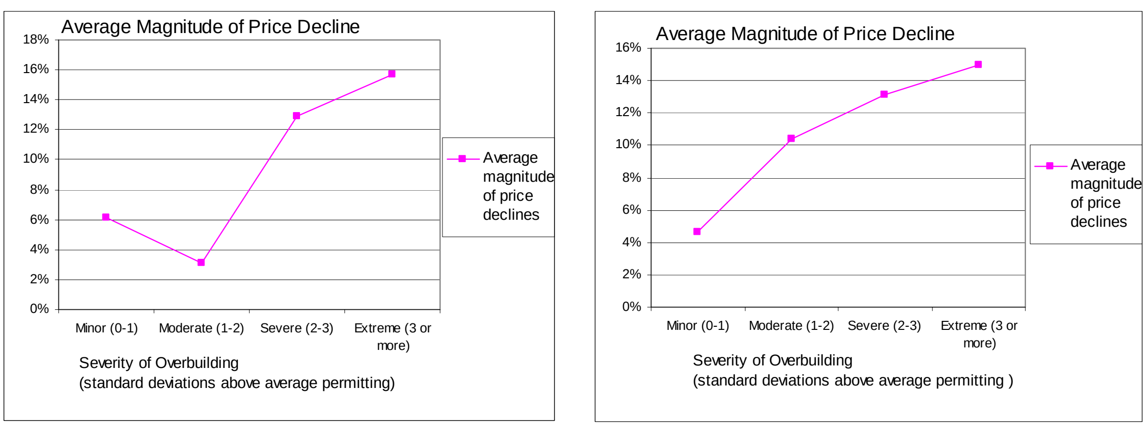


Figure 1.2: Average Magnitude of Associated House Price Decline by Overbuilding Level

(a) Total Permits (b) Single-Family Permits



House Price Declines and Employment Loss

The second hypothesized major factor behind metropolitan area house price declines is employment loss. Metropolitan area annual employment levels are obtained from the BLS ES-202 survey. This is considered the most thorough measurement of metropolitan area employment available covering the study period. Employment declines may occur across several years, similar to spells of price decline and overbuilding. The magnitude of the employment decline is measured as the total net loss in employment over one or more years until employment grows for at least two years. As with the definition of price decline spell, therefore, a single year of increase does not end the spell if the following year continues the downward trend.

Severe employment losses are defined as spells with total net losses exceeding 5 percent, while moderate employment losses total 5 percent or less. Five percent is taken as an approximation of one standard deviation above the average magnitude of metropolitan employment loss spell for the top 75 metro areas that occurred 1980-1999. One standard deviation is used as the threshold for a severe employment decline rather than 2 standard deviations as was the case for severe overbuilding because 20 employment declines were over 1 standard deviation from the mean decline but only 7 employment declines were over 2 standard deviations from it. Employment loss is considered associated with a house price decline if it begins up to two years before or after the onset of a house price decline. And again, choosing a single definition like this ignores the differences in lags to employment decline that can occur as a result of intervening variables. As an example, significant reductions in interest rates helped many places avert a more immediate house price correction after employment losses incurred during and after the 2001 economic recession.

From 1980-1999, employment loss spells occurred 125 times among the top 75 metro areas. Of these, only 20 spells involved severe employment loss exceeding 5 percent. The other 105 spells involved only moderate employment losses. As shown in Table 2 below, large house price declines exhibit sensitivity to employment losses, especially those that exceed 5 percent. For example, increasing employment loss from less than 1 percent to between 1 and 5 percent only increases the propensity of encountering a price decline from 29 to 42 percent and increasing the propensity for a large price decline from 12 to 22 percent. But employment loss above 5 percent increases the probability of price decline from 42 to 100 percent of the time and the probability of a large price decline jumps nearly threefold from 22 to 65 percent (Figure 2.1).

As suggested by the increased probability of large price decline, the average magnitude of house price decline associated with the employment loss spells increases above the one standard deviation threshold. When moving from employment loss spells of 1 percent or less to spells of 1 to 5 percent, the average associated house price decline increases from 5.5 to 7.4

percent (Figure 2.2). For all 20 spells of employment loss that exceeded the 5 percent threshold, the average house price decline was a substantial 9.0 percent. The sensitivity of this 5 percent employment loss threshold to the magnitude of house price declines is even more indicative of an important role in light of the fact that the average employment losses for these 20 instances of severe employment loss is not much higher than 5 percent, at just 7.3 percent. Also indicative of the price sensitivity to employment is that many areas that experienced large employment declines were those with a history of low price volatility, such as Cleveland, Akron, and Dayton OH, and Louisville, KY, where large changes in price would be considered less likely and therefore lack of a large price movement due to any given factor such as employment loss may not be surprising.

Table 2: Sensitivity of House Price Decline to Employment Loss Measure

		Number resulting in		Share resulting in		Large declines as % of all declines	Average magnitude of price declines
	Total Spells	Large price decline	Any price decline	Large price decline	Any price decline		
Moderate Employment loss (< 1 st dev)	105	19	38	18%	36%	50%	6.8%
Employment Loss Under 1%	*42*	*5*	*12*	*12%*	*29%*	*42%*	*5.5%*
Employment Loss 1-5%	*63*	*14*	*26*	*22%*	*42%*	*54%*	*7.4%*
Severe Employment Loss (>1 st dev)	20	13	20	65%	100%	65%	9.0%

Again, the strength of the threshold effects is amplified when construed visually in Figures 2.1 and 2.2.

Figure 2.1: Propensity for House Price Decline by Magnitude of Employment Loss

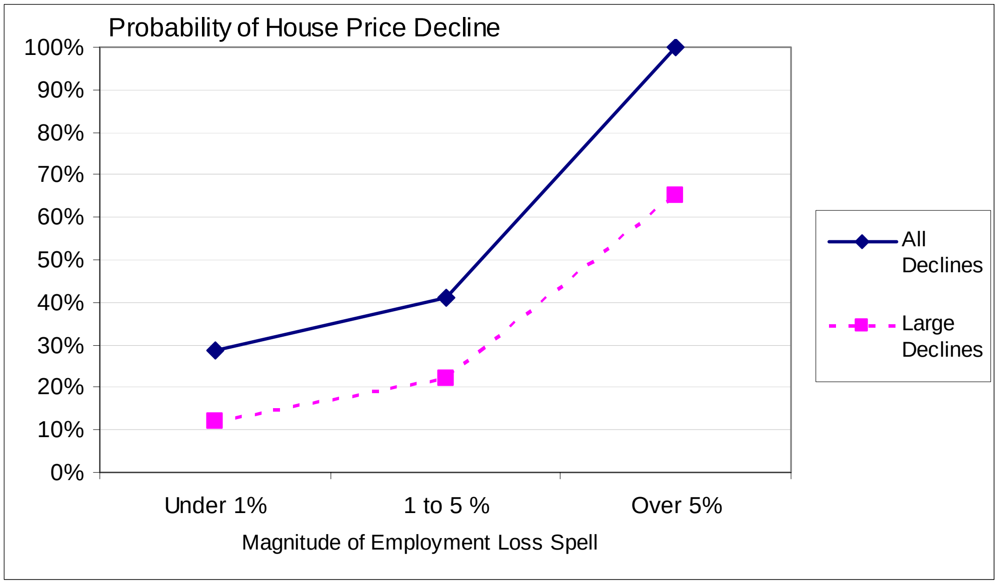
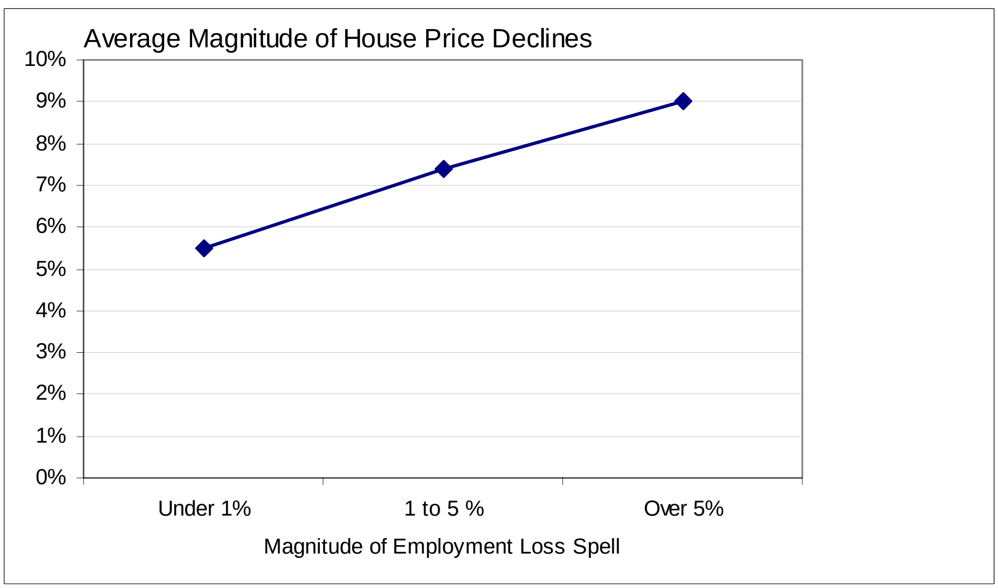


Figure 2.2: Average Magnitude of Associated House Price Decline by Employment Loss Level



The Combination of Overbuilding and Employment Loss

All else equal, the greater the degree of either overbuilding or employment loss, the higher the probability of a price decline and the greater the magnitude of the decline. Above 2 standard deviations from mean levels of building intensity and above 1 standard deviation away from mean employment loss clear threshold effects take hold.

When these extreme events occur simultaneously, the likelihood of a large price decline increases dramatically. Table 3 below displays a joint sensitivity analysis demonstrating what happens when overbuilding and employment loss occur together, as sometimes occurs following periods of economic expansion or in the few high volatility metros prone to large fluctuations in permitting and employment. Most dramatically, we find that when overbuilding is over twice the normal level (e.g. exceeding 2 standard deviations) and there was any employment loss, a large house price decline occurred 100 percent of the time. But extreme overbuilding alone, which occurred only 3 times during the study period, resulted in large house price declines 2 out of the 3 times, further underscoring the importance of overbuilding by itself as a factor in price declines.

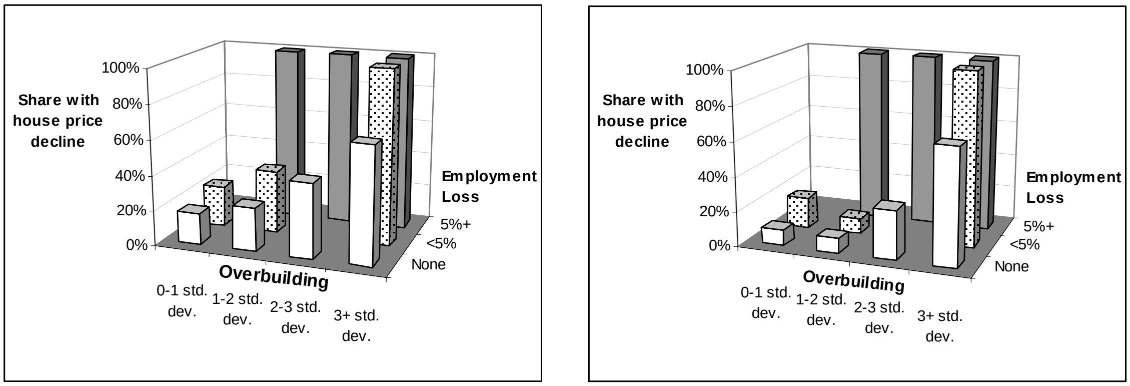
Table 3: House Price Declines and Combined Instances of Employment Loss and Overbuilding

			Employment Loss		
Overbuilding			**None**	**<5%**	**5%+**
Minor	0-1 std. dev.	Total Spells	14	23	0
	spells	Spells with Any Decline	21%	39%	-
		Spells with Large Decline	7%	26%	-
		Magnitude of Decline	*6%*	*6%*	-
Moderate	1-2 std. dev.	Total Spells	14	10	1
	spells	Spells with Any Decline	36%	30%	100%
		Spells with Large Decline	7%	10%	100%
		Magnitude of Decline	*2%*	*4%*	*8%*
Severe	2-3 std. dev.	Total Spells	7	0	4
	spells	Spells with Any Decline	43%	-	100%
		Spells with Large Decline	29%	-	100%
		Magnitude of Decline	*16%*	-	*11%*
Extreme	3+ std. dev.	Total Spells	3	3	6
	spells	Total W/Any Decline	67%	100%	100%
		Total W.Large Decline	67%	100%	100%
		Magnitude of Decline	*10%*	*18%*	*17%*

Table 3 shows that many of these conjoint events occur with very low frequency. For example, severe overbuilding and severe job loss occurred together only 4 times, and extreme overbuilding and severe job loss only 6 times. Even moderate overbuilding and minor employment losses occurred only 10 times. Thus, many of the probabilities shown in Figure 3.1 are based on very thin sample sizes. Nevertheless, the consistency of the patterns revealed in the figures is instructive. Along either employment loss or overbuilding axes, the bars (which signify the probability of the decline in “a” and of a severe decline in “b”) are higher. At high values on both axes, the bars are the highest.

Figure 3.1: Combined Overbuilding and Employment Loss Makes Price Declines Likely

(a) Probability of any house price decline (b) Probability of a severe house price decline



In summary, the results of our two sensitivity analyses suggest a strong link between probabilities and magnitudes of metropolitan house price declines and employment loss and/or overbuilding. Major house price declines exhibit the strongest associations with both measures. Even after limiting our overbuilding indicator to a strict 2 standard deviation threshold, either or both of our two indicators of overbuilding and employment loss were associated with 33 of the 35 instances of large house price declines occurring in the 75 largest metro areas between 1980 and 1999. In total, 62 of the 85 price declines were associated with at least one of these two measures. The 23 not associated were mostly very minor house price declines, with 15 amounting to less than 1 percent, and only two exceeding 5 percent (See Table 5). These two larger declines were both single-year declines, with Fresno at 6.7 percent and Salt Lake City at 6.0 percent. Salt Lake City had also experienced moderate overbuilding, but this was not reflected in this analysis due to our choice of the more stringent severe overbuilding measure.

House Price Declines and Periods of High House Price Appreciation

As discussed above, the literature on house prices suggests that tight markets can lead to markets overheating and price appreciation catapulting ahead of fundamentals like income growth. The evidence strongly suggests that in booming markets, house price appreciation expectations can increase buyer demand and willingness to pay prices in excess of long-run income fundamentals (Case and Shiller 1988, 1989). Indeed, many studies have been published on how price expectations may create bubbles in the housing market (Case and Schiller 1989; Gau 1985; Stiglitz 1990; Gu 2002; Leamer 2002).[7] Indeed, it is well established that decisions to buy homes are motivated by the expected user cost-of-capital relative to renting, and that this is determined largely by house price expectations (Belsky and Duda 2001).[8]

But the literature also suggests that prices in many instances are mean-reverting and eventually settle back down to a long-run equilibrium level either through a prolonged period of slow price appreciation or through price declines. Instead of modeling long-run prices, we adopt a simpler measure of overheated house prices that is not reliant on any particular model. We define house price overheating as any 3-year period in which the average nominal house price appreciation exceeded the average annual rate of appreciation for all metropolitan areas over the study period, which was 5.2 percent. Minimal overheating is defined as less than 1 standard deviation above the mean rate of appreciation (which equates to 3 consecutive years of appreciation averaging from approximately 5 to 11 percent per year). Moderate overheating is defined as 1-2 standard deviations above the mean rate (which equates to 3-year average price appreciation from 11 to 16 percent). Severe overheating is 2-3 standard deviations above the mean (16-21 percent price appreciation), and extreme overheating is 3 or more standard deviations above the mean (21 percent or higher).

[7] The presence and degree of serial correlation within housing markets remains a contested issue. Most studies have shown that house prices have negative serial correlation in the short run and positive serial correlation in the long run (Cho 1996, Case and Shiller 1989). However, other studies have shown correlations to be negative in the short run and increasingly more positive for increasingly longer intervals (Gu, 2002). Still others have determined price changes to be a random walk (Gau, 1984, 1985) with insignificant serial correlation.

[8] "The user cost of capital equation for homeowners relates homeowners' after-tax expenditures on mortgage interest, property taxes, maintenance, insurance, transactions costs, and the opportunity cost of invested capital to gains made through house price appreciation and forced savings through equity paydown. Among other things, it depends crucially on the rate of return on an alternative investment for the downpayment and other equity capital that a comparable renter would have invested, which determines the opportunity cost of invested capital for owners." (Duda and Belsky, 2001)

Thus defined, there were 129 spells of above average, or "overheated" house prices in the 75 largest metro areas from 1980-1999. Of these cases, 39 were moderate spells of price overheating, 20 were severe, and 7 were extreme.

When looking back at past instances of house price decline, it becomes apparent that the largest run-ups in prices don't necessarily lead to the largest declines. As Table 4 shows, even spells of severe and extreme overheating did not result in any nominal price decline within two years 44 percent of the time. Sixty percent of the time severe and extreme overheating spells did not result in a large nominal decline. Periods of moderate overheating did not result in any nominal decline an even larger 72 percent of the time or a large nominal price decline 87 percent of the time. However, it is nonetheless clear that the probability of experiencing any or a large nominal price decline is associated to some degree with the magnitude of the run-up. As seen with our overbuilding and employment loss measures, the probabilities of small and large declines increase with the level of price run-up. While only 5 percent of the 65 instances of minimal overheating were followed by large price declines, 43 percent of the 30 instances of severe overheating were followed by large price declines.

As with the overbuilding and employment loss measures, the degree of overheating in prices exhibits clear threshold effects with the probability of a house price decline, but probabilities don't peak at levels quite as high. In addition, the extent of prior price run-ups, ignoring other factors, has a linear relationship with the *magnitude* of price declines, similar to that of the employment loss measure, as opposed to the threshold relationship seen in the overdevelopment measure (See Figures 4.1 and 4.2). Average price declines associated with minimal overheating spells were already a significant 4.6 percent, though at very low probabilities, and increased to 7.2 percent for moderate overheating, 8.6 percent for severe overheating, and 11.9 percent for extremely overheated markets. In contrast, declines for places that had severe job loss and minimal job loss were 9.0 percent versus 1.6 percent, while the difference between places with severe and minimal overbuilding was 12.9 versus less than 5 percent.

Table 4: Sensitivity of House Price Decline to Price Overheating Measure

Overheating Category	Spells of overheating	Number resulting in: Large price declines	Number resulting in: Any price declines	Share resulting in: Large price declines	Share resulting in: Any price declines	Large declines as % of all declines	Average magnitude of price declines
Minimal (0-1 Std. deviations over mean)	63	3	11	5%	17%	27%	4.6%
Moderate (1-2 SD)	39	5	11	13%	28%	45%	7.2%
Severe (2-3 SD)	20	8	12	40%	60%	67%	8.6%
Extreme (3 SD and over)	7	3	3	43%	43%	100%	11.9%

Figure 4.1: Propensity for House Price Declines by Magnitude of Prior Price Overheating

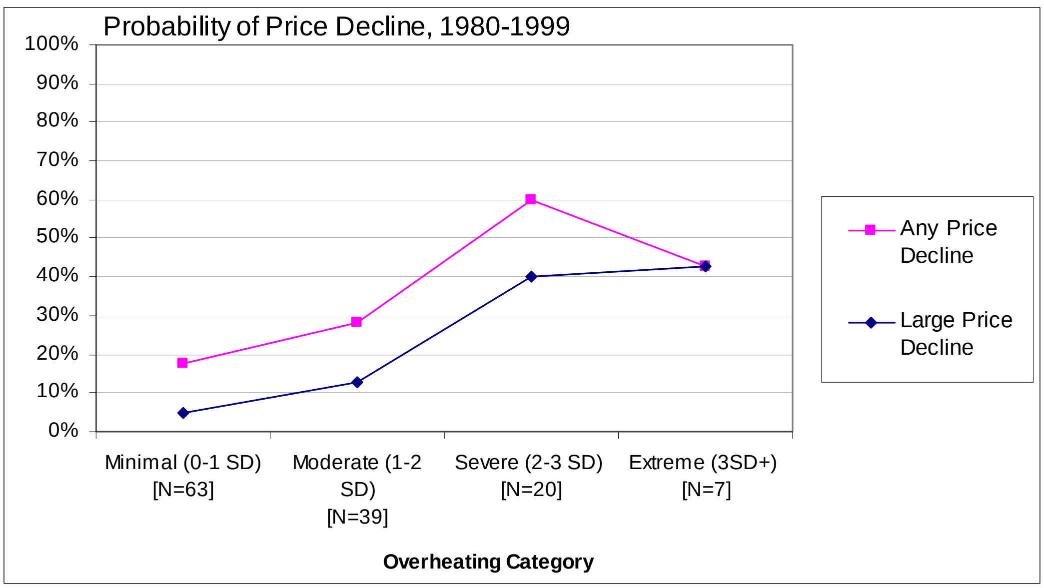
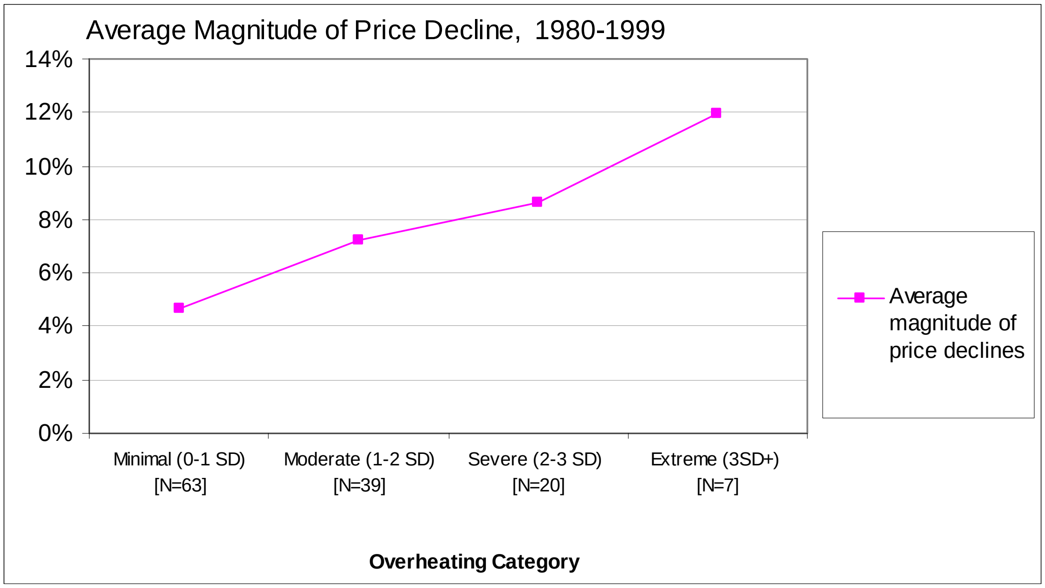


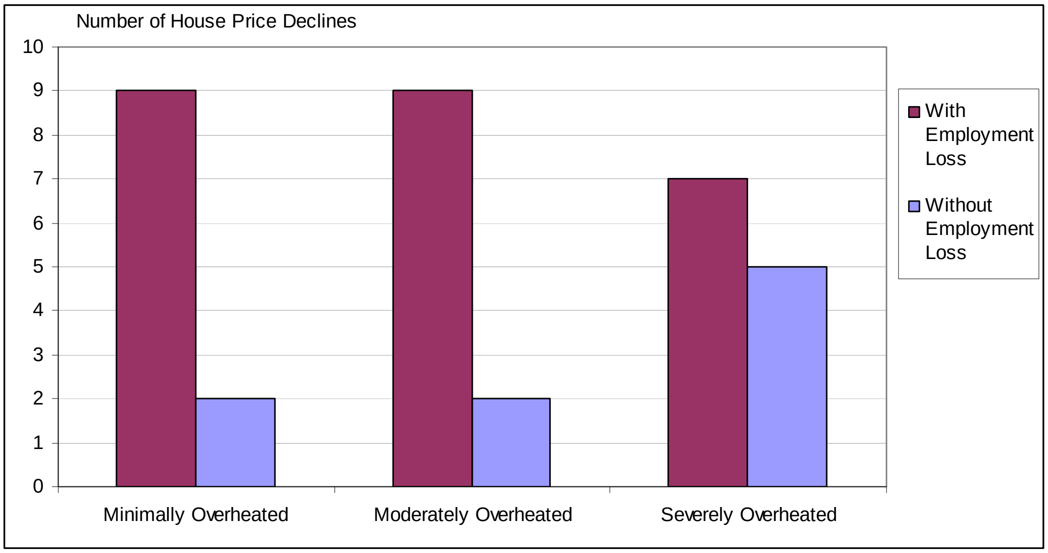
Figure 4.2: Average Magnitude of Associated House Price Decline by Prior Price Overheating



While this provides some evidence that the degree of overheating in prices does have some influence on the probability and magnitude of declines, it is important to point out that employment loss and overbuilding also weigh heavily on the probabilities and magnitudes of decline in highly overheated markets. Indeed, most overheated metros that experienced price declines were also places that had employment losses. Fully 30 of the 37 declines associated with overheating listed in Table 4 were also associated with employment loss or severe overbuilding. This includes 10 of the 11 declines associated with moderate overheating, 8 of the 12 declines associated with severe overheating, and 2 of the 3 declines associated with extreme overheating.

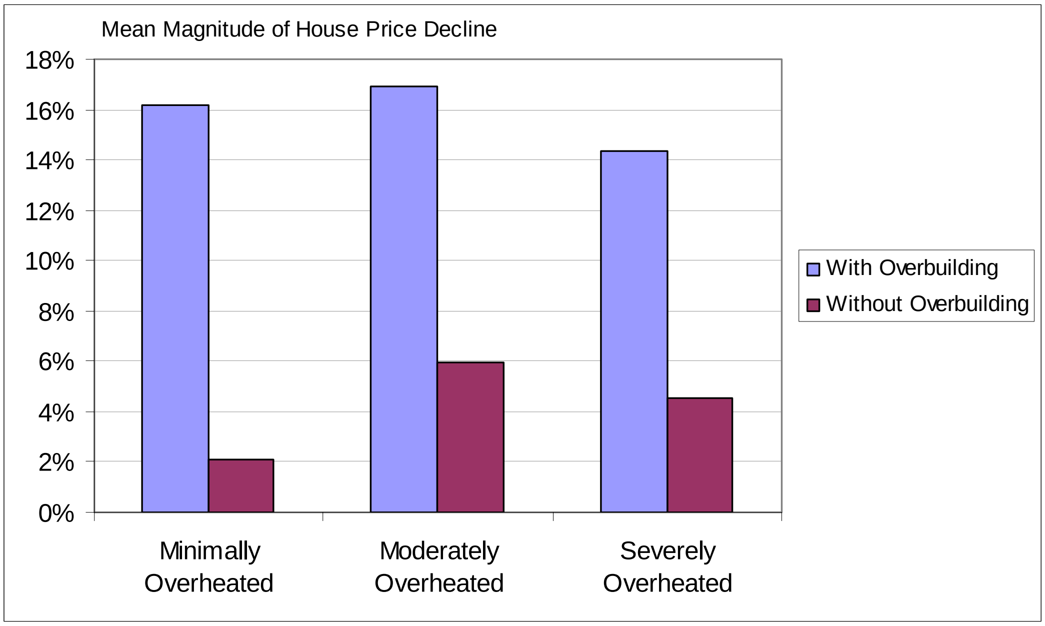
The presence of overheating in the absence of net employment losses led far less predictably to declines, while overheating in the absence of severe overbuilding led to declines of much lower magnitude. As shown in Figure 4.3(a) below, most of the declines associated with prior market overheating were in areas with subsequent employment loss. While contributing significantly to the probability of price declines, the presence of employment loss in overheated markets did not contribute to the magnitude of those declines. House price declines associated with employment loss and overheating averaged 6.7 percent, while those with overheating but without employment loss actually averaged higher, at 7.2 percent.

Figure 4.3(a): Few Declines Occurred Where Price Run-Ups Didn't Occur with Employment Loss



While employment loss added to the probability of house price declines in overheated markets but not the magnitude of those declines, overbuilding added greatly to the magnitude of the house price declines that occurred. On average, house price declines in overheated markets that were also overbuilt averaged a steep 15.5 percent, while those markets that were not overheated but not overbuilt averaged 4.2 percent. As shown in Figure 4.3(b) below, the presence of overbuilding added to the magnitude of house price decline in every category of overheating.

Figure 4.3(b): Overbuilding Led Overheated Metros to Larger Price Declines



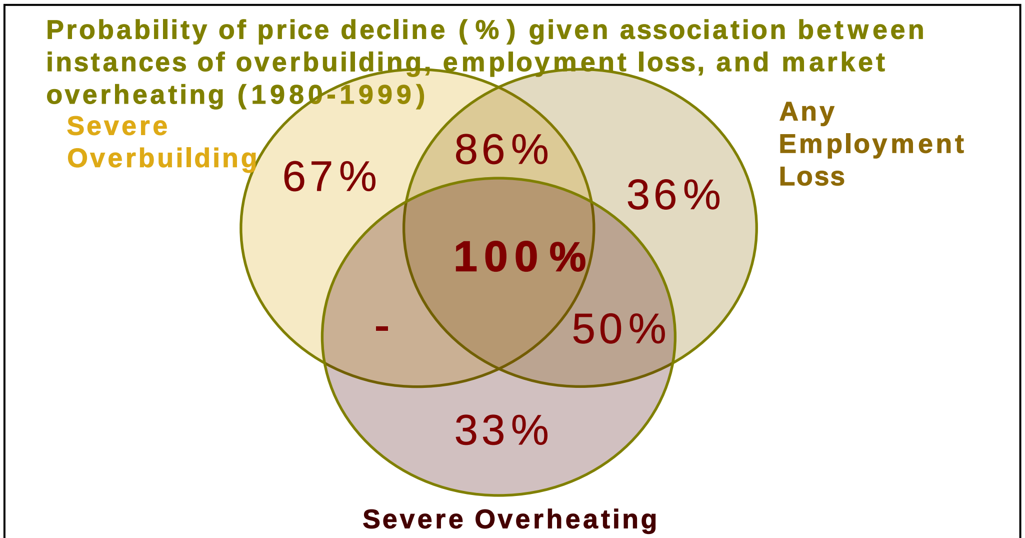
Overbuilding also increased the probability of declines in overheated markets, but unlike employment loss, overbuilding was not present in the majority of declines within overheated markets. Given the typical supply response to rising prices, one would expect overbuilding to be associated with price overheating in markets. However, of the 20 episodes of severe overheating, only 5 were associated with severe or extreme overbuilding. Furthermore, of the 40 episodes of moderate overheating, only 3 were associated with severe overbuilding above 2 standard deviations.

In summary, most price declines following instances of moderate or severe price overheating were also associated with either employment loss or overbuilding. Within overheated metros, the presence of employment loss increased the probability of price decline, and the presence of overbuilding added to the magnitude of decline. Given this, we find that the combination of both employment loss and overbuilding after a period of overheated prices led to the highest probabilities of decline and included most of the largest price declines.

Overbuilding, market overheating, and employment loss combined to increase the probability and magnitude of metropolitan house price decline in 1980-1999. When occurring alone, severe overbuilding had the highest probability of decline (67 percent), while severe overheating and any employment loss at all led to decline in approximately one third of all instances. As shown in Figure 4.4, when employment loss followed severe overheating, the price decline probabilities of both rose from about one in three instances to 50 percent. When employment losses followed severe overbuilding however, probabilities of decline increased to 86 percent. Finally, in 100 percent of the times that severe overbuilding, severe overheating, and any employment loss combined there was a price decline.

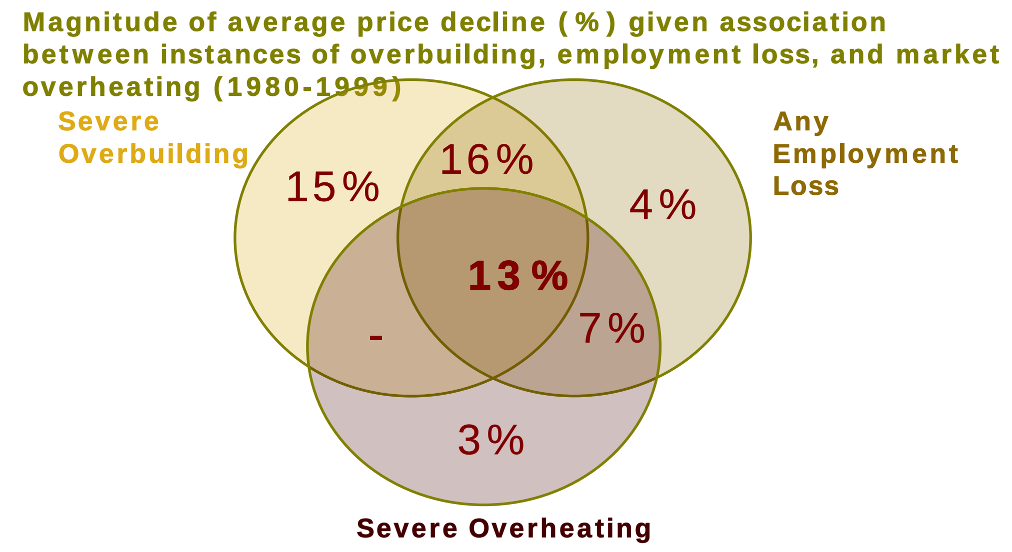
Viewing the three measurements in combination also gives an indication of their relative impacts on the magnitudes of price declines (Figure 4.5). Although means across metropolitan areas can be problematic, especially at small sample sizes, we find that overbuilding is clearly a leading factor for decline magnitude. While the four declines resulting from instances of severe overheating alone averaged 3 percent, and the 35 instances of employment loss alone led to declines that averaged 4 percent, *the four instances of overbuilding alone led to declines that averaged a significantly larger 15 percent.* Spells of overheating or employment loss that were combined with overbuilding had much higher decline magnitudes than those that didn't, as the 6 declines that associated with combined overbuilding and employment loss (without overheating) averaged 16 percent, while the 4 declines that associated with overheating and employment loss (without overbuilding) averaged just under 7 percent. When all three occurred together the 8 instances were associated with 8 price declines that averaged 13 percent.

Figure 4.4: Severe Overbuilding More Often Leads to Declines Than Overheating, But Job Loss, Overbuilding, and Overheating Are a Lethal Combination.



Note: Overbuilding and overheating used for calculation is 2 standard deviations or more.
Sources: JCHS calculations of Census Construction Data; Bureau of Labor Statistics ES 202 Employment Data; Freddie Mac Conventional Mortgages Home Price Index (CMHPI).

Figure 4.5: Severe Overbuilding is the Clear Culprit in the Magnitude of Price Declines



Note: Overbuilding and overheating used for calculation is 2 standard deviations or more.
Sources: JCHS calculations of Census Construction Data; Bureau of Labor Statistics ES 202 Employment Data; Freddie Mac Conventional Mortgage Home Price Index (CMHPI).

Our measurements captured 12 instances of overheating occurring without the presence of overbuilding or employment loss. Of these, only four occurrences resulted in a price decline, and only one of these declines was a large decline of greater than 5 percent (Table 5). These instances suggest that the degree of overheating by itself is not correlated with an increased magnitude or probability of price decline.

Table 5: With Severe Overheating but Absent Severe Overbuilding and Employment Loss, Price Declines Are less Common

Metropolitan Area	Year	Total Price Decline	Moderate Overbuilding?	Extreme Overheating?
Poughkeepsie-Newburgh, NY	1988	9.7%	Yes	.
Allentown-Bethlehem, PA	1988	1.8%	Yes	.
San Jose-Sunnyvale, CA	1981	0.6%	.	.
Tucson, AZ	1980	0.2%	.	.
Albany-Schenectady-Troy, NY	1988	.	Yes	.
Dallas-Fort Worth-Arlington, TX	1980	.	.	.
Fresno, CA	1980	.	.	.
Oklahoma City, OK	1980	.	.	.
Oxnard-Thousand Oaks-Ventura, CA	1980	.	.	Yes
Sacramento--Arden-Arcade, CA	1980	.	.	.
San Diego-Carlsbad-San Marcos, CA	1980	.	.	Yes
Seattle-Tacoma-Bellevue, WA	1990	.	Yes	.

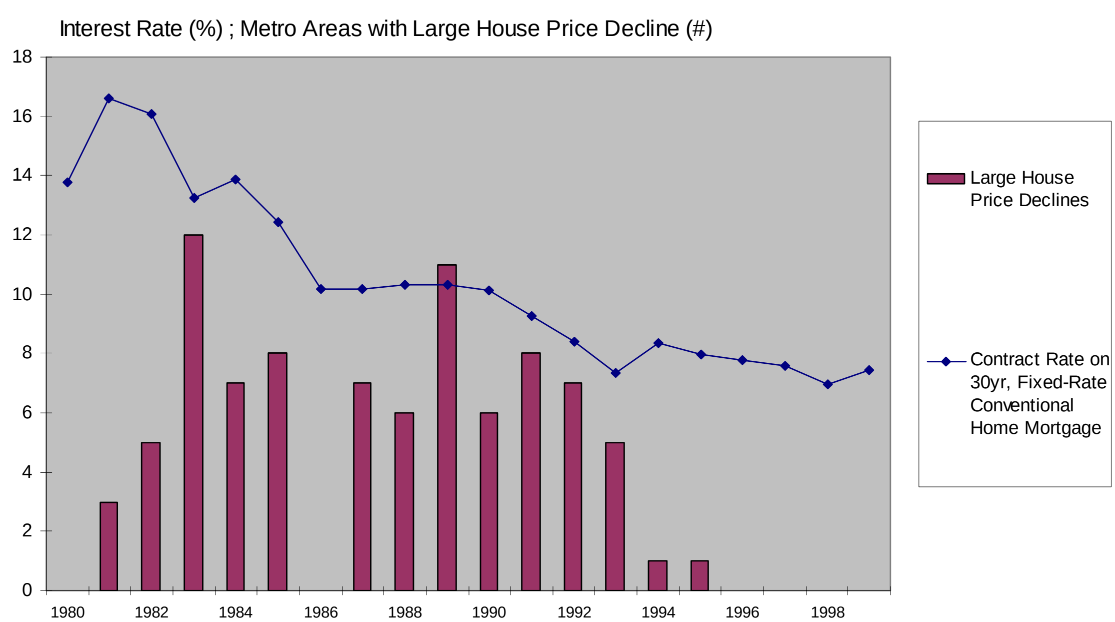
House Price Declines and Rising Real Interest Rates

An argument can be made that high interest rates might also drive house price declines by raising the costs of homeownership and reducing the value of the home to a prospective new buyer. Indeed, the literature on the subject finds that higher interest rates tend to slow house price appreciation down nationally and at the metropolitan level (Englund and Ioannides 1997; Abraham and Hendershott 1993, 1994; Ahearne et al 2005; Reichert 1990).[9] But slowing appreciation is very different from an outright decline. Indeed, interest rates have rarely been correlated with price declines in dynamic house price models and have historically not driven up the supplies of homes for sale (Schwab 1983; Iacoviello 2000; Abraham and Hendershott 1993, 1994; Johnes and Hyclak 1999). In many periods of rapid price appreciation, it is clear that backward-looking house price expectations (the belief that the recent past is prologue) trump the headwinds created by rising interest rates (Harris 1989). Indeed, despite eroding affordability from higher rates and prices rising ahead of incomes, sales can remain strong and inventories of homes for sale lean relative to the pace of sales for some time (Case and Shiller 1988; Capozza and Seguin 1995; Capozza et al 2002).

[9] However, these studies are unable to separate interest rate effects from the endogenous response of house prices to shocks in overall economic activity, which have a much greater impact (Ahearne, et. al 2005).

Indeed, the impact of interest rate swings on large metropolitan house price declines from 1980-1999 in the nation's 361 metros has not been great, at least directly. As 30-year mortgage rates declined through the 80s and 90s, instances of large house price declines at the metropolitan level occurred despite falling interest rates at several points in time (Figure 5). Although not numerous, the years of increasing rates also did not result in subsequent increases in the number of metro areas with price declines. Indeed, rates often rise because inflation expectations are higher, and people may view homes as a hedge against inflation. In addition, interest rates often increase when demand for capital is strongest, which is around periods of strong economic and job growth that propel prices higher rather than causing them to turn down. In general, one may conclude that the near-record low interest rates in the early 2000s were a unique circumstance which may have enabled 10 years to pass without any metros experiencing a single large house price decline despite moderate or severe employments losses in some metros following the 2001 recession. On the other hand, as noted below, the early 2000s have also not been characterized by the same level of overbuilding excesses as the past.

Figure 5: Mortgage Interest Rates and Instances of Large House Price Declines in the 361 Metro Areas, 1980-1999



Note: Large house price declines are nominal declines of 5 percent or greater.
Source: Freddie Mac PMMS, CMHPI 1980-1999

Controlling for Multiple Influences on House Price Declines

Having looked descriptively at the relationships between the probability and magnitude of price declines and our categories of employment growth, overbuilding, and overheating, we now turn to an econometric model to further analyze the influence of multiple factors on the magnitude and likelihood of price declines.

Model 1: Factors Impacting the Magnitude of House Price Declines

In our first model, we take a simple look at the impact of our various categories of overbuilding, overheating, and employment loss on the magnitude of the 85 instances of house price declines which occurred in 59 of the nation's top 75 metropolitan areas between 1980 and 1999.

The simple OLS model takes the form:

$$\mathbf{M} = \beta\mathbf{Z} + \varepsilon$$

where each record is an instance of price decline, and **M** is the total nominal magnitude of the price decline. **Z** is a vector of eight dummy variables we construct based on the presence of any of our economic indicators within two years of any of the price declines. As defined in the previous section, the economic indicators are severe and moderate employment loss, overbuilding more than 2 standard deviations of the 25-year mean, overheating more than 2 standard deviations above the mean, and all combinations of overheating, overbuilding, and any employment loss.

While it is clearly sensible for our model to include economic indicators that may appear in the two years leading up to a price decline, indicators that appear up to two years after a price decline are also considered determinants of the magnitude of house price decline due to the structure of our model and the nature of our indicators. Our model is not intended to be a predictive model; instead, it is a regression on the magnitude of price declines. Some of these declines lasted several years and were exacerbated by the influence of employment growth that declined but didn't turn negative until after prices fell, or by overbuilding that continued beyond the drop in prices. Since our measurements only flag the first year of actual loss of employment and flag the presence of prior overbuilding by the year it ends, not including these instances that appear after the onset of house price declines would ignore factors that potentially play a large role in amplifying the magnitude of house price declines.

The results of the magnitude model, shown in Table 6, strongly support our descriptive findings from above on the significant impact of overbuilding and employment loss on the magnitude of a house price decline. The model, which is included in Appendix C, obtains an r-squared of 0.59, explaining nearly 60 percent of the variation in the magnitudes of house price declines. Again it is worth cautioning that sample sizes are small. Overbuilding is the most consequential variable. Overbuilding alone, or in combination with employment loss or overheating, had the greatest positive contribution to price declines and the greatest significance within our model. Acting alone, overheating of prices, small employment losses, and large employment losses were not significant in explaining the magnitudes of price declines, though overheating in combination with employment loss was significant above the 99 percent level. Though statistically significant, overheating plus net employment loss had only half of the impact of overbuilding plus employment loss.

Table 6: Factor Impacts on the Magnitude of House Price Declines

Dependent Variable: Magnitude of Price Declines

Variable	**Coefficient**
Intercept	0.0173*
Overbuilding, Overheating, and Employment Loss	0.1191***
Overbuilding and Employment Loss	0.1367***
Overheating and Employment Loss	0.0594***
Overbuilding Alone	0.1305***
Large Employment Loss Alone	0.0152
Small Employment Loss Alone	0.0191
Overbuilding and Overheating Alone	0.0000
Overheating Alone	-0.0131
Observations	85
Degrees of Freedom	7
Model R^2	0.5885
Dependent Mean	0.0580

*** Indicates significance at the 1 percent level.

* Indicates significance at the 10 percent level.

In sum, all else being equal, our magnitude model tells us that the presence of overbuilding, alone or in combination with employment loss and overheating, increases the magnitude of a price decline by 12-14 percentage points, while overheating together with employment loss increases declines by about 6 percent, and employment loss or overheating alone do not have a statistically significant effects on the decline.

Model 2: Factors Impacting the Probability of House Price Declines

The second effort models the impact of overheating, overbuilding, and employment loss on the probability of a future metropolitan area house price decline, and incorporates both contemporaneous and lagged values of overheating, overbuilding, and employment loss to give a sense of the timing between these factors and future house price declines in our 75 metropolitan areas. Unlike the magnitude model, which has only 85 observations because it is run only on instances of price declines of any length, our probability model uses all 1500 metro-year observations for our 75 metropolitan areas from 1980-1999. Thus, it models the likelihood of a price decline spell starting in any particular year, which is a low-frequency event.

The results of this model support our descriptive findings that while overbuilding played a large role in increasing the magnitudes of house price declines, employment loss clearly played the greatest role in increasing the probability of metropolitan area house price declines.

We develop two probability models: first, a general model based on the existence of any of the economic indicators in the prior three years, and second, a more detailed model including all of the lagged year values for each of our indicators. The indicators include the presence of moderate employment loss (under 5 percent), severe employment loss (5 percent or greater), severe or extreme overbuilding (2 or more standard deviations above normal), moderate overbuilding (1-2 standard deviations above normal), severe or extreme overheating (2 or more standard deviations above normal), and moderate overheating (1-2 standard deviations above normal). The first model enables us to get a general view of the independent impact of prior employment loss, severe levels of overbuilding or overheating, and moderate levels of overbuilding or overheating. The detailed model separates each of these six indicators into contemporaneous values and one, two- and three-year lagged values, offering further detail on the relevant length of time between our indicators and the onset of price declines.

The first model is a simple OLS regression of house price using just six binary variables for our economic indicators occurring either contemporaneously or in any of the past three years. As shown in table 7, the resulting probability model has nowhere near the explanatory ability of the magnitude model, achieving an r-squared of just 0.074. The limited explanatory power is due in part to the nature of our model, which is built on annual observations, together with the construction of our binary independent variables, which sweep across multiple years looking for a single event. However, as each variable is constructed in a similar manner, we may still explore the relative explanatory ability of each within the model.

This type of model also supports the findings of our descriptive analysis that net employment loss, especially severe loss, clearly has the greatest impact on the probability of house price decline. The model also indicates that overheated house prices, especially those that are severely overheated, play a significant role in increasing the probability of future price declines. In fact, each of our factors has a positive coefficient in the model, indicating each plays a role in increasing the likelihood of a house price decline. With 85 total declines, assuming equal probabilities across metros, each metropolitan area had a 5.67 percent probability of facing a decline in any given metro-year. According to the model, being within three years of the start of a large employment loss increased the probability of decline by 17 percent, all else equal, while being within 3 years of the end of a spell of severe price appreciation increased the probability of decline by 9.5 percent. Being within 3 years of the beginning of a spell of moderate employment loss increased decline probabilities by 6.3 percent, and being within 3 years of the end of a moderate overbuilding spell increased decline probabilities by 5.1 percent, all else equal.

Table 7: Probability Model - General Factor Impacts on House Price Declines

Dependent Variable: Instance of the Beginning of a Price Decline

Variable	**Coefficient**
Intercept	0.0106
Any Severe Employment Loss (in past 3 years)	0.1693***
Any Moderate Employment Loss (in past 3 years)	0.0631***
Any Severe Overbuilding (in past 3 years)	0.0342
Any Moderate Overbuilding (in past 3 years)	0.0511**
Any Severe Overheating (in past 3 years)	0.0954***
Any Moderate Overheating (in past 3 years)	0.0489**
Observations	1,500
Degrees of Freedom	6
Model R^2	0.0738
Dependent Mean	0.0567

*** indicates significance at the 1 percent level

** indicates significance at the 5 percent level

Notice that severe overbuilding is not significant in this model, while moderate overbuilding is significant only at the 5 percent level. This suggests to us that multicollinearity within the model affects the relative significance of severe overbuilding, specifically due to its correlation with large employment loss. This can be seen in the correlation between these variables, the slightly higher, though still not very large, variance inflation factors of both variables within the model, and the descriptive data showing that severe overbuilding rarely leads to house price declines without the added presence of significant employment loss. Excluding the severe employment loss variable raises the significance of severe overbuilding to below the 1 percent level, but lowers the model r-squared from .07 to .05, while excluding severe overbuilding and keeping severe employment loss raises the coefficient of severe employment loss above 0.18, with minimal effect on the model's r-squared. Our interpretation of these results is that severe overbuilding does have a significant effect on the probability of house price declines, but this effect is connected to its association with large employment loss, which has the greatest independent effect on the probability of a future house price decline.

Given the likelihood that our indicators will not occur alone or independently, in order to shed further light on the possible determinants of house price decline we model different combinations of our indicators as mutually exclusive scenarios. We construct this model similarly to the lag model above, except that we use binary variables for the various combinations of any our variables occurring in the past three years. The results of this regression are given in table 8.

Looking at the factors in combination yields a still-low r-squared of 0.0777 and does not lead to a much better fit than the previous predictive model. However, relative to the other variables, as expected, the most significant factor adding to the probability of a house price decline is having endured the occurrence of all three factors - overbuilding, overheating, and employment loss - in the past three years. This condition adds a significant 35 percent to the probability of having a price decline begin in that metro-year. Even without overbuilding or overheating, having severe employment loss alone is the next most influential factor, increasing probability of a decline by 25 percent. Each of the other combinations is significant within the model except for overbuilding and employment loss without overheating, and overbuilding and overheating without employment loss.

Table 8: Probability Model 2: Interacting General Factor Impacts on House Price Declines

Dependent Variable: Instance of the Beginning of a Price Decline

Variable	**Coefficient**
Intercept	0.0175**
Overbuilding, Overheating, and Employment Loss (in past 3 years)	0.3510***
Overbuilding and Employment Loss (in past 3 years)	0.0170
Overheating and Employment Loss (in past 3 years)	0.1159***
Overbuilding Alone (in past 3 years)	0.1214***
Large Employment Loss Alone (in past 3 years)	0.2508***
Small Employment Loss Alone (in past 3 years)	0.0747***
Overheating Alone (in past 3 years)	0.0919***
Overbuilding and Overheating (in past 3 years)	0.1492
Observations	1,500
Degrees of Freedom	8
Model R^2	0.0777
Dependent Mean	0.0567

*** indicates significance at the 1 percent level

** indicates significance at the 5 percent level

These models suggest that having had employment loss, overbuilding, or overheating alone or in combination increases the probability of a house price decline occurring in the next three years, with employment loss adding the most to the probability of decline and overbuilding adding most to the magnitude. To get a more detailed glimpse of the lag structure between the end of overbuilding, the end of overheating, the beginning of employment loss, and the onset of house price declines, we now construct a new probability model using lagged values of our independent variables. Beginning with current and first three lagged values of each indicator used in our first probability model, we run a stepwise selection process to include only those variables with a significant influence on the probability of house price declines.

The resulting lag model, with coefficients shown in column 1 of Table 9, indicates that many of our variables are significant in increasing the probability of house price declines at various lags. Contemporaneous measures of employment loss and overbuilding both add to the probabilities of declines, while measures of overheating lagged by one and two years have greater impact on probabilities of house price declines than contemporaneous measures (meaning that prices are not suddenly thrown into reverse). Severe employment loss has the greatest impact on probabilities, while moderate employment losses are significant, but have relatively minor effects spread across all lagged variables. Lagged overheating is also highly significant with a large coefficient within the model, suggesting that a year or two after high appreciation ends, price appreciation is prone not just to slowing but instead to turning negative.

Column 2 in table 9 compares the way in which lagged factors affect the magnitude of the 85 instances of house price decline. Here we see further evidence that while employment loss is the key factor adding to decline probabilities, overbuilding has the greatest influence on house price decline magnitudes, and lagged overheating is a factor in both models. Using a stepwise regression on all variables, no employment variable meets the 15 percent significance level for entry into the model, while contemporaneous severe overbuilding adds 8.21 percent to the magnitude of the average decline, and severe overbuilding lagged one year adds 9.86 percent. Severe overheating lagged one year is also significant in the model, adding to the magnitude of price decline with a coefficient of 4.75 percent. The three-year lagged coefficient of moderate overheating also appears in the model as significant at the 5 percent level, but this is likely an effect of small sample size and a correlation with overbuilding that is larger than other correlations in the model.

Table 9: Separately Lagged Indicators of the Probability and Magnitude of Price Declines

Dependent Variable:	Instance of a Price Decline	Magnitude of Price Decline
Variable	**Coefficient**	**Coefficient**
Intercept	0.0117*	0.0353***
Moderate Employment Loss (Less than 5%)	0.0688***	
Lag1 Moderate Employment Loss	0.0485**	
Lag2 Moderate Employment Loss	0.0439**	
Lag3 Moderate Employment Loss	0.0718***	
Severe Employment Loss (5% or more)	0.2467***	
Lag1 Severe Employment Loss		
Lag2 Severe Employment Loss	0.3146***	
Lag3 Severe Employment Loss		
Severe Overbuilding (2+ standard deviations above average)	0.1452***	0.0821***
Lag1 Severe Overbuilding	0.0821*	0.0986***
Lag2 Severe Overbuilding	(0.0757)	
Lag3 Severe Overbuilding		0.0889**
Moderate Overbuilding (1-2 standard deviations above average)		
Lag1 Moderate Overbuilding	0.1126***	
Lag2 Moderate Overbuilding		
Lag3 Moderate Overbuilding	0.0903**	
Severe Overheating (2+ standard deviations above average)		
Lag1 Severe Overheating	0.2626***	0.0475***
Lag2 Severe Overheating	0.1319***	
Lag3 Severe Overheating		
Moderate Overheating (1-2 standard deviations above average)	0.0549	
Lag1 Moderate Overheating	0.1119***	
Lag2 Moderate Overheating	0.0810**	
Lag3 Moderate Overheating		0.0580**
Observations	1500	85
Degrees of Freedom	16	5
Model R^2	0.1265	0.3708
Dependent Mean	0.0567	0.0580

*** Indicates significance at the 1 percent level.
** Indicates significance at the 5 percent level.
* Indicates significance at the 10 percent level.

In sum, while most of our indicators add to the probability of a price decline, none does more so individually than severe employment loss, and no individual factors have the effect of the combination of all three in combination. Given the presence of decline, overbuilding has a high degree of significance on the magnitude of that decline, and an effect that more than doubles the average decline occurring without overbuilding. Overbuilding even appears to have higher influence than previous price overheating, and is significant as a current-year variable or at a one-year lag.

V. Metropolitan Areas at Risk 2007-2008

History strongly suggests that the areas most at risk of declines in house prices are those with one or a combination of at least modest employment loss, significant overbuilding and overheated prices. In order to test our indicators and gauge the state of various markets, we view the most recent metropolitan housing and employment data from the fourth quarter of 2006 through the lens of our indicators. The findings demonstrate that signs of employment loss, overbuilding, and overheating that were precursors to past house price declines 1980-1999 are also highly present in areas in the midst of decline in the fourth quarter of 2006. Findings also highlight some differences between the current period and past downturn relative to employment losses and overbuilding levels. But although there are suggestions of significant risk of price declines in additional markets, we end the section with a discussion of how comparisons with the past lead to too many uncertainties that cloud our outlook and preclude any definitive predictions.

Indicators in Recent Declines

Looking at the presence of our economic indicators in the metropolitan areas that experienced nominal house price declines from the fourth quarter of 2005 to the fourth quarter of 2006, we find that employment loss is again the most prevalent factor. Fully 10 of the top 15 largest price declines in this period occurred in areas that had net employment losses in 2005 or 2006. Of the remaining five areas with no net employment loss, overheating and overbuilding are clearly taking a toll, as one was both extremely overheated and overbuilt, two were severely overheated, one was moderately overheated, and one was moderately overbuilt.

Looking at all 29 metropolitan areas that experienced nominal house price declines from Q4 2005 to Q4 2006, only 5 metros did not have any indication of severe overbuilding or severe overheating in 2005 nor any net employment losses in 2005 or 2006. But these areas did experience either moderate overheating or moderate overbuilding. Though not resulting in net losses, these areas also had very little employment growth. In fact, average employment growth in these five areas in 2006 was a mere 0.9 percent, which was half of the average employment growth for all 361 metros and a third of the average employment growth of the metros that had not experienced a house price decline. In total, while 83 percent of all declining metros had signs of our indicators, only 33 percent of the non-declining metros experienced them.

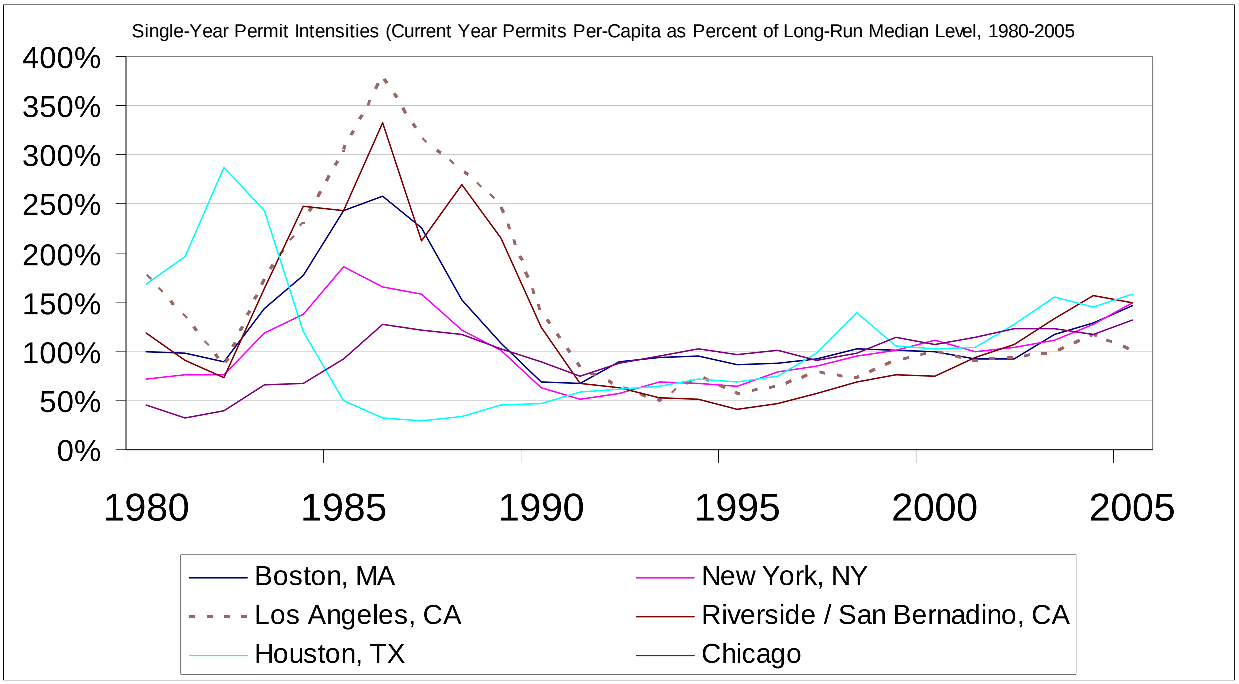
Table 10: Top 15 Metropolitan Price Declines Q4 2005 vs. Q4 2006

Metropolitan Area	Change in House Price Q4/Q4	Overheating 2005	Overbuilding 2005	Employment Growth 2005	Employment Growth 2006
Kokomo, IN	-5.1%	Below Normal	Below Normal	-1.1%	-1.1%
Waco, TX	-3.8%	Mild	Moderate	0.1%	0.9%
Jackson, MI	-3.7%	Below Normal	Mild	-0.8%	-1.5%
Santa Barbara-Santa Maria-Goleta, CA	-3.4%	Severe	Below Normal	1.8%	0.6%
Springfield, OH	-3.2%	Below Normal	Below Normal	-0.9%	-0.3%
Monroe, MI	-3.1%	Below Normal	Mild	-0.6%	-0.1%
Mansfield, OH	-2.8%	Below Normal	Mild	-0.8%	-0.8%
Yuba City, CA	-2.6%	Extreme	Extreme	2.2%	3.9%
Sacramento--Arden-Arcade-Roseville, CA	-2.5%	Severe	Mild	2.5%	2.2%
Anderson, IN	-2.5%	Below Normal	Moderate	-1.1%	-2.4%
Ames, IA	-2.3%	Below Normal	Moderate	0.0%	1.6%
Santa Rosa-Petaluma, CA	-2.1%	Moderate	Below Normal	0.8%	1.6%
Flint, MI	-1.9%	Below Normal	Mild	-0.3%	-1.3%
Canton-Massillon, OH	-1.9%	Below Normal	Mild	-0.7%	-1.2%
Detroit-Livonia-Dearborn, MI	-1.7%	Below Normal	Below Normal	0.0%	-2.0%

Comparing Recent Overbuilding to Past Levels

Unlike past downturns in the housing market, many housing markets have been helped by continued job growth since 2005. As we recall, our analysis of price declines 1980-1999 found that net employment loss clearly had the greatest effect on increasing a metropolitan area's probability of house price decline. However, even in the absence of employment loss or overheating, history suggests that areas with severe or extreme overbuilding alone are at risk of suffering house price declines. But there were also fewer instances of overbuilding in the nation's large metropolitan areas leading up to the peak permitting year of 2005 than occurred before past severe downturns in the housing market. Illustrating this fact in a few sample metropolitan areas, we see in Figure 6 how permitting intensities in metropolitan areas such as Boston, Los Angeles, Houston, and New York have been much lower and less volatile since the 1980s, but have slowly increased to peak levels in 2005.

Figure 6: Permit Intensities In Several Metros Have Become Less Volatile Since The 1980s.

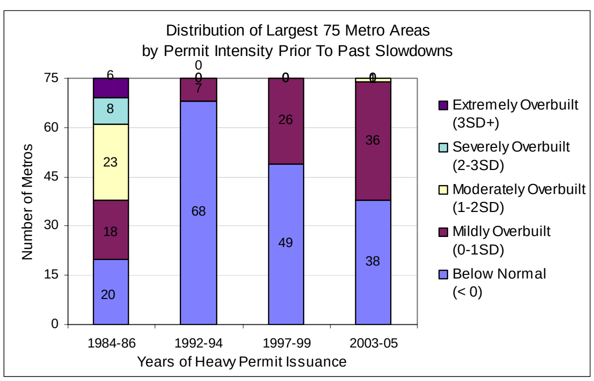


It appears that, in part, metropolitan areas such as Boston and Los Angeles did not experience house price declines following job losses associated with the 2001 recession because of their reduced permitting levels, and that markets did not become overbuilt during that period as they had in the years leading up to prior recessions. Indeed many housing markets were quite tight in the early 2000s and tightened further as the 16 easing moves by the Federal Reserve pulled buyers into the market and months' supply of new and existing homes for sale fell to near historic lows in 2003 and 2004. By 2005, however, the number of overbuilt markets increased, but still remained well below the number in the mid-1980s.

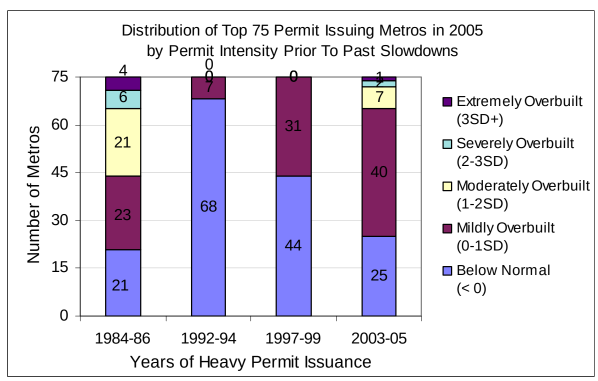
To compare recent overbuilding to that which occurred prior to past downturns across all of the metropolitan areas in our study, Figure7 (a) shows the distribution of overbuilding by degree in the 75 most populous metropolitan areas during several different time periods. As the figure shows, few markets were even mildly overbuilt prior to the 2001 recession. Notably, while overbuilding through 2005 in the largest metropolitan areas is clearly not as widespread as it was in the late 1980s, much of the recent building has occurred in smaller metropolitan areas of the South and West, particularly in Florida, the Carolinas, and the mountain states of Idaho and Colorado. In fact, fully 21 of the 75 top permitting markets in 2005 were metropolitan areas not among the 75 most populous metropolitan areas in 2000. To get a sense for potential overdevelopment in these areas, where fully 70 percent of all metropolitan area housing permits were issued, consider Figure 7 (b). We find overbuilding in the top permitting metros to be more common and more severe in 2005 than in the corrections of the 1990s, but still less severe than was seen in the mid to late 1980s. While back then, overbuilt metros included some of the largest metro areas such as Los Angeles, Boston, and Dallas, extreme overbuilding in 2003-2005 occurred in the three relatively small metros of Fayetteville AK, Panama City, FL, and Lakeland, FL.

Figure 7: Recent and Past Permit Intensity in Large Metros vs. Large Markets

(a) 75 Most Populous Areas



(b) 75 Areas Issuing the Most Permits



Uncertainties in the Outlook

In drawing analogies between the past and the present, several factors suggest proceeding with caution. For one thing, overbuilding in the nation's large markets may be understated in the current period because the measure excludes the potentially high number of permits issued just outside of a metro area's boundaries. These permits could imply overbuilding in a broader region that could influence the house price behavior within a metro. Due to increasingly diffuse metropolitan development patterns, development in nearby metros may be significant in affecting metro market permitting figures and overall market dynamics. It is therefore possible that the simple permit intensity measure used in this paper may not fare well over the course of the unfolding house price cycle in many markets in 2006 and beyond.

Furthermore, the world may have changed since the last major wave of house price declines in the late 1980s and early 1990s in ways that could write a somewhat new history of house price declines. There are five differences between this period and prior periods that make predictions about the current period based on the past potentially problematic. One is the incredible growth in the subprime mortgage industry since 2000. This has allowed borrowers who would have been previously denied credit the opportunity to buy homes and refinance existing mortgages. Inside Mortgage Finance estimates that by 2005, these loans accounted for a fifth of all originations. These loans have been issued during a time of unprecedented house price appreciation nationally, which offers significant protection against foreclosures because distressed borrowers can sell homes for a profit rather than turn the mortgage back to the lender. Its effect has been to add to the demand for homes on the market for sale and this effect has likely helped create the tight market that has driven prices so far ahead of incomes in so many areas. However, should these loans perform more poorly than expected in an economic downturn, the asset-backed securities market upon which the subprime market relies could shut down or credit standards could be tightened. This would lead to a sudden drop in demand and also potentially escalate foreclosures if borrowers could no longer refinance to a less burdensome mortgage.

A second factor is the rapid growth of so-called "exotic mortgage products." Loan Performance reports that low documentation loans, including no-stated-income and no-stated-asset loans, accounted for about 10 percent of all originations in 2005. Interest-only loans, meanwhile, increased to about 20 percent of originations and option-payment mortgages another 10 percent. These low-documentation loans and option-payment mortgages may have also helped fuel heavier speculation in real estate during the rapid run-up in prices in 2004 and 2005 than in previous cycles. These products also allowed marginal borrowers from the standpoint of affordability to stay in the market despite the rapid run-up in prices. Hence, the resistance to price increases that normally occurs when interest rates increase was not as intense. Should these products perform more poorly than expected, credit standards for these products could tighten as well and force larger unexpected reductions in demand. Indeed, this had begun to occur in the first half of 2007.

A third factor is the lowest 30-year mortgage interest rates in 40 years and the timing of the rate reductions. The aggressive easing of monetary policy that occurred in 2001 in advance of the official start of the recession and its continuation through the recession and well into the recovery helped housing not only avert its traditional role of leading the economy into recession but also kept price appreciation from slowing in most markets and on average for the nation overall. House prices have been running well above income growth to a degree not seen over the past thirty years. After such a period, a return to more normal interest rates and classic recessions may have unanticipated effects, driven in part by rising interests rates cooling the economy and driving interest-rate sectors like housing.

A fourth factor may be the high degree of speculation in the market. Loan Performance reports the investor share of prime loans in 2005 at nearly 10 percent, about 4 percentage points above the apparently more normal level of 6 percent during less heated periods of price appreciation such as the period 1999-2002. In some individual metropolitan areas the shares are much higher and the percentage point run-up greater. For example, the share nearly doubled to 15 percent or more in Phoenix and in many metropolitan areas in Florida and California in recent years. Unfortunately, statistics of this sort have only been compiled for recent years. Therefore, it is impossible to know whether previous cycles were characterized by similar periods of intense speculative activity when prices skyrocketed. Likely they were, but the broader access to finance that typifies the current period as well as much higher levels of wealth and liquidity among the top fifth of the income distribution may be leading to more speculation now. This matters because our analysis does not directly incorporate speculative buying on the upside of the housing cycle and selling on the downside on both the supply of homes for sale and the demand for them. If levels of speculation are similar in the present period to levels in the past then our analysis is little affected by the omission. If not, then the possibility exists for an oversupply to develop rapidly when speculators exit the market.

Lastly, the home building industry has consolidated significantly, especially in many of the nation's largest home building markets most at risk of having overbuilding drive imbalances in supply. These companies are mostly public and are aggressively managing their businesses for liquidity and balance sheet strength in the face of downturns. Should this lead them to pull back on production and simply shelve land for the next upturn, then supply and demand conditions could move back into balance more quickly when markets soften as a result either of problems in the real economy (job loss or higher interest rates) or from an oversupply when speculators exit markets.

Thus, it is difficult, despite the evidence presented in this paper, to predict what is in store for home prices. However, history does suggest that slowing and even modest declines in house prices are not uncommon in the face of higher interest rates even in the absence of severe or extreme overbuilding or major job loss. In addition, it suggests that unless other measures of overbuilding are more relevant in the present cycle than recent permit intensity in a metropolitan area relative to the long-run trend, house prices should not fall substantially in as many places as prior cycles unless the economy or many local markets fall into recessions.

Conclusions

In looking at past house price declines, this paper examined just two exogenous factors in depth: overbuilding and employment loss. When taken at threshold values based on standard deviations from the mean, these measurements proved surprisingly robust in explaining past periods of major house price decline, and offered the most robust set of data across the nation's metropolitan areas.

More work is needed, however, to understand how changes in the mortgage industry and the capital markets or unusually dramatic reductions in interest rates such as those that occurred in early part of the decade may influence house price dynamics. Developing other measures to explore capital market and other influences are needed, including trends in the size and volume of subprime mortgages, at-risk mortgages, speculative buying and speculative building, and even better measurements of general market oversupply are necessary for a more thorough understanding of major house price declines so that we may be able to differentiate them in the future. The measures we have used here are crude proxies for actual factors that lead to significant imbalance in supply and demand for housing across metropolitan areas. More direct measures of overbuilding at the metropolitan level would allow more robust modeling. Also worth further study is what sets apart those areas with similar conditions, such as overbuilding or overheating alone, that do and do not experience prices declines.

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Appendix A: Deviations of House Prices from Underlying Long-Run Equilibrium

The basic theory of house price determination holds that house prices result from a market-clearing process, whereby market prices are set at a level that effectively balances supply and demand for housing at equilibrium (Rosen 1974). Following this theory, a single model for house price is reduced from two parallel equations for supply (Q_s) and demand (Q_d), which are shown for any market *i* at time *t* as:

$$Q^s_{i,t} = f(P_{i,t}, \mathbf{I}^s_{i,t}, \mathbf{N}^s_{i,t}, \mathbf{Z}^s_{i,t}) \quad (1)$$

$$Q^d_{i,t} = f(P_{i,t}, \mathbf{I}^d_{i,t}, \mathbf{N}^d_{i,t}, \mathbf{Z}^d_{i,t}) \quad (2)$$

where P is the current asset price of housing, $\mathbf{I}^s$ and $\mathbf{I}^d$ are sets of exogenous economic variables respectively influencing supply or demand, $\mathbf{N}^s$ and $\mathbf{N}^d$ are sets of demographic variables, and $\mathbf{Z}^s$ and $\mathbf{Z}^d$ are sets of other explanatory variables. Following the basic theory, because price is a determinate of both supply and demand, and there is an equilibrium, t*, whereby supply equals demand, or

$$Q^s_{i,t*} = Q^d_{i,t*}, \quad (3)$$

there is also an equilibrium price, $P_{i,t*}$ which allows us to substitute equation (1) and (2) into (3) to get the single, reduced-form model for house prices at their long-run equilibrium:

$$P_{i,t*} = f(Q^s_i, Q^d_i) = f(\mathbf{I}^s_i, \mathbf{I}^d_i, \mathbf{N}^s_i, \mathbf{N}^d_i, \mathbf{Z}^s_i, \mathbf{Z}^d_i) = f(\mathbf{X}_i) \quad (4)$$

As used in Follain and Malpezzi (1980), Malpezzi, Chun, and Green (1998), and Chang, Cutts and Green (2005), a log-linear model of house prices has several advantages to the linear form within hedonic house price models, including their ability to weigh percentage change in house price to unit change in the characteristic variables and their ability to mitigate heteroskedasticity. Ozanne and Thibodeau (1983), Black (1990), and Poterba (1991) take the model one step further in using a log-log transformation on city-level data to better explain house price changes across cities. Following these studies, we may rewrite equation (4) as the following:

$$\ln P_i = \alpha_0 + \Sigma^n \beta_n I_{i,n} + \Sigma^m \gamma_m \mathbf{N}_{i,m} + \Sigma^r \delta_r \mathbf{Z}_{i,r} + \varepsilon \qquad (5)$$

where ln P_i is the natural log of house prices in market i, β_n, γ_m, and δ_r are sets of regression coefficients upon *n* economic (**I**) variables, *m* demographic (**N**) variables, and *r* other explanatory (**Z**) variables and ε is an error coefficient.

Also called mean reversion models, equilibrium models are accepted for their simplicity as well as their relatively intuitive concept of a fundamental price firmly based on single equation of exogenous market fundamentals affecting supply and demand. Past studies have used various different indicators of market fundamentals to model long-run house price drivers. Mankiw and Weil (1989) focus solely on demand side factors and find a strong correlation between demographic demand for owner occupied housing and real house prices. Green and Hendershott (1993) find demographic factors hugely exaggerated by Mankiw and Weil after allowing for separate influences of real income and other economic factors. Case and Shiller (2003) show that per capita income alone accurately explains price volatility in all but 9 US states, including 99 percent of the variance in house prices in Wisconsin over the past 20 years. Another commonly used explanatory demand variable is user cost of housing, also know as "imputed rent", widely defined as six components of opportunity costs (Hendershott and Slemrod, 1983; Poterba, 1984; Himmelburg et al., 2005) including the expected rate of house price appreciation, as well as inflation, interest, and marginal tax rates, maintenance costs and a risk-premium for owning (Poterba 1991; Podenza and Johnson 1988; Dipasquale and Wheaton 1992). Most studies conclude that though demand variables do affect asset prices, they are not the only force affecting prices. Since Mankiw and Weil (1989), most studies include supply-side variables. The most common such variable used is construction costs (Dipasquale and Wheaton 1992; Poterba, 1991; Green and Hendershott 1993; Abraham and Hendershott, 1993). [10]

[10] Dipasquale and Wheaton (1992), develop an even more comprehensive model that incorporates both physical and capital markets effects on the long-term equilibrium price of housing.

Other studies have added proxies for local land availability (Follain 1979), or fixed-effect coefficients suggesting influence from local land availability and growth management policies (Malpezzi 1996; Jud and Winkler (2002). Few have studied the direct impact of government restrictiveness on land prices, as Segal and Srinivasan (1985), who find that the percentage of developable land removed by regulation has a positive impact on long-run house prices. Based on the open cities model, fixed-effect models find significant MSA-specific differences in house price dynamics, which indicate areas of chronic house price imbalance, but fall short of isolating the specific cause of the differentiation.

Although they can be useful and effective, even with relatively few explanatory variables, the fatal flaw of mean reversion models is that they are built upon the assumption of efficient markets and instantaneous movements to market equilibrium. Several studies have found inefficiencies in the market (Case and Shiller 1989; DiPasquale and Wheaton 1994), and sluggish reactions to shifting demand fundamentals (Mankiw and Weil 1989) that inhibit market-clearing actions. In reality, when fundamental forces are constantly in flux, even if a market is constantly moving toward equilibrium it may never actually arrive there (Riddel 2004).

Though fixed-effect models may come closest to controlling for imbalances across markets, in the end, a model based on the assumption of market efficiency is fundamentally flawed if markets are not efficient, and a model assuming instantaneous movements to equilibrium do not explain the price dynamics of markets not at equilibrium. Following these two main flaws within the mean reversion model, two lines of study emerged. The first line looks toward explaining the degree of efficiency within the markets, defined as the degree to which current prices act as unbiased predictors of future prices, and the second line of study looks at drivers of house prices more broadly in order to explain the short-term dynamics of prices that are not at equilibrium.

Testing for Market Efficiency

According to Fama (1970), there are three tests for market efficiency: weak, semi-strong, and strong form efficiency. Studies on housing markets generally test for weak-form efficiency, or the hypothesis that investors cannot receive above average returns using publicly available data on past prices and returns.[11] In the absence of weak-form efficiency, prices may not be

[11] Cho 1996

driven by market fundamentals, but rather by misinformation or potentially misleading assumptions about the value of housing as an asset. This scenario may take the form of a bubble market, where expectations of future price appreciation, based purely on prior appreciation levels, elevates prices well above the intrinsic value of the houses. It may also be predictable inertia, which allows for the establishment of profitable trading rules for buyers and sellers in the markets (Fama 1970, Cho 1996).[12]

Studies that look to detect and measure the degree to which the current change in housing price itself may act as an unbiased predictor of its future movement use models that test for serial correlation within house price changes. The most direct way to test for this is to regress the current price change upon lagged price change variable with the hypothesis of randomness. Case and Shiller (1989) find significant evidence of serial correlation in house prices of several metro areas through regressions on a dual sample house price index, regressing current metro house price changes in sample A on 1-year lagged house price changes in sample B.

$$\Delta P^{A}_{t} = \beta_0 + \beta_1 \Delta P^{B}_{t-1}$$

Most studies have shown that house prices have negative serial correlation in the short run, and positive serial correlation in the long run (Cho 1996; Case and Shiller 1989),[13] supporting the theory that although prices may diverge from fundamental values for short periods of time, in the long run, prices will generally revert to their long-run equilibrium values. However, other studies have shown correlations to be negative in the short run and increasingly more positive for increasingly longer intervals (Gu 2002); still others have determined price changes to be a random walk (Linneman 1986; Gau 1984, 1985) with insignificant serial correlation. There is much controversy, as serial correlation is very sensitive to individual model specification, as well as time frames (e.g. how do you define long-term vs. short-term), bias within various data sets, and time of study (serial correlations for most time frames have become more positive in the past 12 years vs. the previous 12 years) (Gu 2002).

[12] Linneman (1986) using hedonic price indices for Philadelphia, determined that houses with below average prices had above average appreciation levels.
[13] Serial correlation could be either positive (increases lead to more increases), negative (increases lead to decreases), or neutral (random fluctuations about the mean).

Explaining the Return Path to Equilibrium: Vector Error Correction Models

Whereas the above tests focus narrowly on detecting market inefficiencies and the presence of serial correlation, a second type of study looks to better explain and model short term house price dynamics when prices diverge from fundamentals. As in Kennedy (1998), equilibrium models are too inflexible to explain dynamic adjustments and specification of time lags in economies where fundamental values are often away from equilibrium. Vector-error correction (VEC) models, however, may build upon the fundamental relationships discovered in equilibrium models, with an added focus on the short term dynamics of house prices when sudden disequilibria appear in the long-term trend between house prices and house price drivers. (Malpezzi 1996; Abraham and Hendershott 1996; Capozza and Hendershott 2002). They may also identify macroeconomic factors behind fluctuations in house prices across countries, such as Iacoviello (2000), who find that adverse monetary shocks have generally a significant negative impact on real house prices, and suggest timing and magnitude of the response in house prices can be partly justified by output levels and financial differences across national markets.

Following equation (5), the basic equation for changes in house price can be generalized as:

$$\Delta P_t = \beta_0 + \beta_1 \Delta P^*_t + \varepsilon_t \qquad (6)$$

where ΔP_t is the current change in house price, ΔP^*_t is the predicted change in the equilibrium price based on changing fundamentals, and ε_t is an error term accounting for a random divergence from equilibrium. Studies on house price adjustment dynamics, such as Hendershott (1993) posit that the error term is not completely random, rather it reflects adjustment dynamics. Within this error, they attempt to isolate dynamic components of serial correlation, which may work against a return to equilibrium, and mean reversion, which is the "correction" term that moves prices back toward equilibrium as in the following:

$$\varepsilon_t = \gamma_0 + \gamma_1 \Delta P_{t-1} + \gamma_2(\ln P^*_{t-1} - \ln P_{t-1}) + \varphi_t \qquad (7)$$

where γ_1 measures the degree of serial correlation, and γ_2 measures mean reversion. In general, VEC models regress price changes as a factor of a measure of the disequilibria of the current price, and possibly lagged adjustment rates. They may also look at current divergences from simple long-term ratios, such as price to income levels (Malpezzi 1996), or they may use hedonic regression to measure divergences from “fundamental prices” based on a constant quality hedonic housing price (Meece and Wallace1993; DiPasquale and Wheaton 1994). As implicit in equation (7), most VEC models use a two step approach, the first to estimate equilibrium price as a regression of house price on such factors as construction costs, income, employment growth, and changes in real after-tax interest rates, and the second to regress house price changes as a function of the current distance from the equilibrium price estimated from the first equation. (Abraham and Hendershott 1996).

The two stages of the vector error correction model take the form:

Stage 1) $P^*_t = \alpha_0 + \alpha_1 C_t + \alpha_2 E_t + \alpha_1 Y_t + \alpha_1 R_t$

where P^*_t is the log of equilibrium house price appreciation at time t, C_t is real construction cost inflation, E_t is employment growth, Y_t is per capita income growth, R_t is change in real after-tax interest rate.

Stage 2) $\Delta P_t = \beta_0 + \beta_1 \Delta P^*_t + \beta_2 \Delta P_{t-1} + \beta_3 (P^*_{t-1} - P_{t-1}) + \Phi_t$

where ΔP_t is the change in the log of house price at time t, ΔP_{t-1} is the lagged change in the log of price (the serial correlation term), $(P^*_{t-1} - P_{t-1})$ is the lagged distance from equilibrium price (the reversion term) and Φ_t is an error term.

While VEC models are two step equations showing both equilibrium values and responses to divergence from equilibrium, a slightly different type of model, the distributed lag model, focuses on perfecting equation 6) above with the inclusion of lagged determinant variables to form a single difference equation from the equilibrium model to model house price changes as a response to current and past changes, or shocks, in fundamental house price drivers. For example, Jud and Winkler (2002), model real house price changes as a function of real changes in income, wealth, construction costs and after-tax interest rates, as well as changes in population and a MSA specific fixed effect variable, and then include lagged values of these variables. They find lagged construction costs and wealth indexes to have significance in predicting current price appreciation across metros. Poterba (1991) uses a distributed lag model to test the effect of persistent shocks to the economy on the current economy by regressing current changes in real incomes and unemployment rates on one and two year lagged annual changes. Lamont and Stein (1999) regress house price appreciation on contemporaneous as well as two lag variables for each dependent variable to find significance in contemporaneous change in per-capita income, the first-year's lag of house price appreciation, the first year's lag of price to income ratio, and the interaction between previous leverage measures and current income changes. Distributed lag models are simple and easy to interpret. However, as single equation models, distributed lag models cling to the economic concept of constant market equilibrium, but lose the ability of VEC models to explain the impact of divergence from long-run drivers with elements of serial correlation and mean reversion. Other disadvantages are their limited ability to differentiate between short and long term drivers of house price, that they must assume that the wide array of drivers within the model are separate and exogenous, and that they are subject to high variance given the potentially large and disparate annual fluctuations in house price drivers when all are viewed in terms of annual percent change.

The advantageous characteristics of lag models and VEC characteristics may be combined together to form a more robust autoregressive distributed lag model (ADL) that has house price appreciation not as a function of deviation from equilibrium, but also of lagged changes in other determinants such as employment growth, interest rates, and construction costs. The combined explanatory power of lag and error-correction models gives these models the ability to apply economic theory to both changes in the equilibrium price as well as the adjustment dynamics of prices that have fallen out of equilibrium. For example, Abraham and Hendershott (1993, 1996) model real house price appreciation on the change in local price deviation, as well as on real construction costs, incomes and employment as well as with one year lag of price appreciation. Capozza, Hendershott, and Mack (2004) extend this model even further to measure the degree to which differences in the dynamic response of metro areas to shocks to the local economy are determined by drivers of inefficiency in the housing markets, such as information costs, supply costs, development constraints and growth expectations. Therefore, they measure not just the degree of serial correlation and mean reversion, but the degree to which they are associated with potential determinants of market inefficiency such as population growth, real income growth, and real construction costs.

The Capozza model for *k* metros is as follows:

$$\Delta P_{kt} = (\alpha_0 + \Sigma_i \alpha_i (Y_{kit} - Y^*_i))\Delta P_{t-1} + (\beta_0 + \Sigma_i \beta_i (Y_{kit} - Y^*_i))(P^*_{t-1} - P_{t-1}) + \gamma \Delta P^*_t + \Phi_t$$

where Y_i is the set of potential determinants of market inefficiency and Y_i^* are their respective mean values. Information costs are proxied by transactions volume, which the Capozza model has determined by the metro area's population and income growth.[14] Supply costs are proxied by real construction costs, which are expected to increase serial correlation and lower mean reversion. Expectations or "euphoria" in the housing markets are proxied by real income growth, with strong markets expected to have higher serial correlation than weaker markets.

The Capozza model concludes that higher real income growth, a higher metro area population and lower construction costs lead to higher mean reversion. At the same time, they find that higher real income and population growth, higher real construction costs, and more land limitations increase serial correlation. With these findings, the study then explores the abilities of this model further, looking at the coefficients of mean reversion and serial correlation resulting from the above model to gain a four part categorization of metro area price adjustment dynamics in response to sudden changes in equilibrium prices as either oscillating or nonoscillating and converging or diverging from equilibrium.

The Road from Here

Although the models above closely track equilibrium prices, adjustment dynamics as a function of economic shocks, and indicators of efficiency in the market clearing process, it is important to note that these models are largely built from periods of positive price appreciation. With little exception, these models do not include any essential factors of market imbalance that lead to major house price decline, and instead weigh heavily on potential price inflators such as per-capita income growth, construction costs, and land and regulation restrictiveness. For

[14] Low information costs are expected to bring a higher degree of mean reversion, as fully knowledgeable buyers and sellers are able to move more efficiently towards the market's equilibrium price.

instance, while including per capita income, which has been shown to best match the consistent positive house price appreciation in low-volatility markets, many do not include any factors that may indicate increased market-wide pressure to sell, such as unemployment or unemployment rates, defaults or default rates, and for the most part, employment loss. Nor do these models include any measure of implied overbuilding, such as recent development levels, as a determinant of market price dynamics, choosing instead to use proxies for regulation or general ease of building. Lastly, these models do not include direct measurements of the quantity of housing on the market, such as is measured in month's supply of for-sale housing or even vacant, for-sale housing supply, either of which could directly signal downward pressure in prices.

Appendix B: Metro Areas with Large House Price Declines (Over 5%) 1980-1999 by Employment/Overbuilding/Overheating Category and Magnitude of Decline

Geography (MSA)	First Year of House Price Decline	Total Magnitude of Large House Price Decline	Category
Los Angeles-Long Beach-Santa A	1991	18.71%	Overbuilding, Overheating, and Employment Loss
New Haven-Milford, CT	1989	17.34%	Overbuilding, Overheating, and Employment Loss
Hartford-West Hartford-East Ha	1989	16.53%	Overbuilding, Overheating, and Employment Loss
Worcester, MA	1989	11.88%	Overbuilding, Overheating, and Employment Loss
Springfield, MA	1990	11.74%	Overbuilding, Overheating, and Employment Loss
Bridgeport-Stamford-Norwalk, CT	1989	10.56%	Overbuilding, Overheating, and Employment Loss
Providence-New Bedford-Fall Rive, MA-RIr	1990	8.89%	Overbuilding, Overheating, and Employment Loss
Oklahoma City, OK	1984	26.16%	Overbuilding and Employment Loss
Houston-Sugar Land-Baytown, TX	1983	20.99%	Overbuilding and Employment Loss
Riverside-San Bernardino-Ontario	1992	17.28%	Overbuilding and Employment Loss
Tulsa, OK	1984	14.41%	Overbuilding and Employment Loss
Boston-Cambridge-Quincy, MA-NH	1990	10.29%	Overbuilding and Employment Loss
New Orleans-Metairie-Kenner, LA	1985	9.77%	Overbuilding and Employment Loss
San Diego-Carlsbad-San Marcos	1991	8.86%	Overbuilding and Employment Loss
Austin-Round Rock, TX	1987	24.67%	Overbuilding Alone
San Antonio, TX	1985	18.31%	Overbuilding Alone
Dallas-Fort Worth-Arlington, TX	1987	11.42%	Overbuilding Alone
Oxnard-Thousand Oaks-Ventura C	1991	16.66%	Overheating and Employment Loss
Honolulu, HI	1981	10.24%	Overheating and Employment Loss
Poughkeepsie-Newburgh-Middleton	1989	9.70%	Overheating and Employment Loss
San Jose-Sunnyvale-Santa Clara	1991	9.14%	Overheating and Employment Loss
San Francisco-Oakland-Fremont	1991	8.17%	Overheating and Employment Loss
New York-Northern New Jersey-L	1989	7.94%	Overheating and Employment Loss
Portland-Vancouver-Beaverton O	1981	5.31%	Overheating and Employment Loss
Detroit-Warren-Livonia, MI	1982	9.34%	Large Employment Loss Alone
Pittsburgh, PA	1981	6.18%	Large Employment Loss Alone
Honolulu, HI	1995	15.18%	Small Employment Loss Alone
Sacramento--Arden-Arcade--Rose	1992	13.11%	Small Employment Loss Alone
Baton Rouge, LA	1983	12.69%	Small Employment Loss Alone

Las Vegas-Paradise, NV	1983	9.34%	Small Employment Loss Alone
Bakersfield, CA	1993	8.37%	Small Employment Loss Alone
Syracuse, NY	1994	6.21%	Small Employment Loss Alone
Denver-Aurora, CO	1987	5.17%	Small Employment Loss Alone
Fresno, CA	1983	6.67%	None
Salt Lake City, UT	1987	6.01%	None

<u>**Appendix C: The Models**</u>

Model 1: Magnitude of all 85 spells of House Price Decline in the Top 75 Metropolitan Areas, by Association with Economic Indicators

Dependent Variable: Magnitude of Price Declines

	Single Family Permits[15]				**Total Permits**			
Variable	**Coeff**	**Std.Error**	**T Value**	**Pr > |t|**	**Coeff**	**Std.Error**	**T Value**	**Pr > |t|**
Intercept	0.0382	0.0102	3.73	0.0004	0.0173	0.0093	1.85	0.0680
Overbuilding, Overheating, and Job Loss	0.0918	0.0191	4.80	<.0001	0.1194	0.0187	6.39	<.0001
Overbuilding and Employment Loss	0.1290	0.0250	5.15	<.0001	0.1367	0.0187	7.32	<.0001
Overheating and Employment Loss	0.0196	0.0232	0.84	0.4007	0.0594	0.0171	3.48	0.0008
Overbuilding Only	0.0000	.	.	.	0.1305	0.0234	5.59	<.0001
Large Employment Loss Only (5% +)	0.0009	0.0191	0.04	0.9646	0.0152	0.0171	0.89	0.3751
Small Employment Loss Only (<5%)	0.0022	0.0142	0.16	0.8757	0.0191	0.0126	1.52	0.1318
Overbuilding and Overheating Only	0.0000	.	.	.	0.0000	.	.	.
Overheating Only	-0.0340	0.0376	-0.91	0.3682	-0.0131	0.0317	-0.41	0.6801
Observations	85				85			
Degrees of Freedom	6				7			
Model R^2	0.4054				0.5885			
Dependent Mean	0.0580				0.0580			

[15] A single family permit-based overbuilding measure was included to compare its ability to explain house price declines with the total permitting measure. However, overbuilding based on total permitting resulted in better fit models both for the magnitude and probability of declines. Therefore, total permitting levels have been used throughout the text to indicate metropolitan area overbuilding levels.

Model 2: Lagged Effects on House Price Decline Probabilities

Dependant Variable: Instance of Price Decline

	Model 1: Six Grouped Variables		**Model 2: Stepwise Selection at 15%**	
	Single Family Permits	**Total Permits**	**Single Family Permits**	**Total Permits**
Intercept	0.014*	0.011	0.016**	0.012*
Any Minor Employment Loss	0.063***	0.063***		
Minor Employment Loss			0.074***	0.069***
Lag1 Minor Job Loss			0.052**	0.049**
Lag2 Minor Job Loss			0.047**	0.044**
Lag3 Minor Job Loss			0.071***	0.072***
Any Large Employment Loss	0.172***	0.169***		
Large Employment Loss			0.256***	0.247***
Lag1 Large Job Loss				
Lag2 Large Job Loss			0.351***	0.315***
Lag3 Large Job Loss				
Any Severe Overbuilding	0.020	0.034		
Severe Overbuilding			0.152***	0.145***
Lag1 Severe Overbuilding				0.082*
Lag2 Severe Overbuilding				(0.076)
Lag3 Severe Overbuilding			(0.140)**	
Any Moderate Overbuilding	0.018	0.051**		
Moderate Overbuilding				
Lag1 Moderate Overbuilding				0.113***
Lag2 Moderate Overbuilding				
Lag3 Moderate Overbuilding				0.090**
Any Severe Overheating	0.098***	0.095***		
Severe Overheating				
Lag1 Severe Overheating			0.221***	0.263***
Lag2 Severe Overheating			0.160***	0.132***
Lag3 Severe Overheating				
Any Moderate Overheating	0.050***	0.049**		
Moderate Overheating			0.060*	0.055
Lag1 Moderate Overheating			0.108***	0.112***
Lag2 Moderate Overheating			0.082**	0.081**
Lag3 Moderate Overheating				
Observations	1500	1500	1500	1500
Degrees of Freedom	6	6	13	16
Model R^2	0.0702	0.0738	0.1194	0.1265
Dependent Mean	0.0567	0.0567	0.0567	0.0567

**** denotes significance at the 1% level* *** denotes significance at the 5% level*
** denotes significance at the 10% level*

Appendix D: Alternate Overbuilding Measure: Extremes in Annual Permits-to-New Jobs

It is conceivable in areas experiencing especially rapid increases in employment that permits per thousand population might spike because underlying demand fundamentals justify it. In such cases, it would be mistaken to classify a place with permits more than double their long-run median as being overbuilt. To address this issue, an alternative measurement of overbuilding may be used to identify areas instances when extremes in permitting run concurrent with high employment gains. This alternate measurement takes the ratio of the sum of prior three years of permitting to the sum of the prior three years of jobs growth for each metro area and then compares this ratio to the long-run ratio of total housing units to jobs between 1980 and 2000, which is taken as the 1990 ratio of metro area total housing units to employment. In this manner, we can identify which places may be seeing housing permits spike simply because permits per job have increased with long-run housing units to jobs in a market.[16]

By using our measure of permit to employment growth relative to the long-run relationship between housing units and employment in a given metropolitan area, we can further restrict our areas of overdevelopment to reflect areas where such high levels of permitting were justified by especially large employment growth. Comparing permits and employment gains over the last three years of the spell of overdevelopment, only a third of the overbuilt areas were issuing more permits than new jobs were being added. Of these, fully nearly 90 percent were associated with house price declines, almost all of them large declines exceeding 5 percent. The one area that did not see a decline when permitting outpaced job growth for the prior three years was Miami, FL, which suggests an influx of retirees and vacation/recreational homeowners in the market.

We can also measure the degree of overbuilding in each market by subtracting from actual permits an estimate of the number of permits that would have been issued, based on the past three years of employment growth, if the metro built according to the 1990 ratio of housing units to employment. We then take this level as a percentage of the total housing stock in 1990 to get a measure of the magnitude of overbuilding. The result for all instances of overbuilding only achieves a limited r-squared value.

[16] An added appeal of this approach is that it normalizes permits per job in a metropolitan area to its long-term trend. For example, Miami and Phoenix have historically had high ratios of housing units per job because they are significant second home destinations. Similarly, Riverside has a high housing unit per job ratio because much of the population commutes outside the metropolitan area to get to their jobs.