House Prices, Bubbles and City Size

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Abstract

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1. Introduction

Over the past fifteen years, real house prices have changed dramatically in the United States. Between 1998 and 2006, real house prices increased by almost 80% nationwide and more than doubled in metropolitan areas such as New York, Los Angeles and San Francisco. In 2007, the housing bubble burst. This burst not only resulted in a decline in house prices of about 35% nationwide, but also in a federal takeover of mortgage lenders such as Fannie Mae and Freddie Mac, increasing foreclosure rates, bankruptcies and a global credit crisis. This bubble in the American housing market at the beginning of the new millennium and its subsequent burst have led to an increased interest in the relationship between house prices and the demand for housing in both financial and urban economics. In this paper, we link these two strands of literature on house prices. Combining the financial economic literature on expected future returns on housing with the new urban economics model of the spatial distribution of land and housing prices, we are able to capture the previously theoretically unexplained but widely accepted fact that larger cities, and therefore larger expected urban growth, increases average housing prices.

Recent econometric applications in the field of urban economics in relation to house prices focus on estimating the supply elasticities of housing production (Mayer and Somerville 2000; Green et al., 2005) that can be derived from the standard framework of Capozza and Helsey (1989; 1990), where real house prices are a function of the size of the metropolitan area, real construction costs, the expected growth premium and the real cost of owner-occupied housing. In an attempt to explain housing bubbles, attention has shifted to the effect of regional supply constraints on the size of a regional housing bubble. Glaeser et al. (2008) analyze house price fluctuations over the past 25 years, and demonstrate that price increases were generally higher in cities with a relatively inelastic housing supply. However, with respect to the latest housing bubble, they observe that only a few of the cities with an inelastic housing supply experienced a large increase in house prices. This suggests that supply constraints do not provide a sufficient explanation for the most recent housing bubble.

Several researchers recently explored the relationship between city size and the expected growth in house prices. Gyourko, Mayer and Sinai (2006) discuss the seemingly permanent growth in house prices in its regional context, and define so-called “superstar cities,” where the house prices grew permanently 1 to 3 percent more per year compared to the average city in the United States. Their analysis ends with the observation that these superstar cities seem to be characterized by a permanent additional rent. This additional rent cannot be explained by the increase in income (economic growth), interest or mortgage rates, or changes in amenities or regulations such as tax advantages. Moreover, a theoretical model that explains the existence of this permanent additional rent is not presented, and hence, the theoretical fundamentals behind this additional rent in general and the recent housing bubble in particular are not given. With respect to the most recent bubble and burst, Case and Shiller (2003) point to expectations of high and steady future house price increases, amplified by social imitation (contagion), as the most important explanation. Based on a survey among individuals that recently bought a house in Boston, Los Angeles and San Francisco, Case and Shiller (2003) found that most of the respondents believed that the long-term average expected annual increase in future price changes was about 15 percent. This belief was mainly based on the expected increase in the number of people that would prefer to live in these cities. The reasons for this increase in demand and the (theoretical) reasons for its supposed effect on house prices were absent from the paper.

We argue that the supposed effect of expectations for future urban development on prices is at least somewhat realistic. The element of consumers' expectations is traditionally embedded in financial economics, which has investigated macroeconomic house price developments and predominantly builds on the work of Hendershott and Slemrod (1983) and Poterba (1984). In this literature, house prices are often analyzed as a function of the cost of housing, the return on houses, the stock of houses, and economic growth. It is often assumed that a portion of the current house price is based on the expected return on housing caused by a future increase in the real house price. Expected future returns on housing provide an explanation for high house prices that can otherwise not be explained (Himmelberg et al, 2005). In this sense, housing bubbles are based on unrealistic views about future price developments or may be subject to speculation in that home buyers are willing to pay premiums for housing because they expect high returns to this investment in the future (Case and Shiller, 2003).

A mechanism of expectations related to city size and future local housing demand has, to our knowledge, not been incorporated in a theoretical urban economic framework explaining house price bubbles. Instead, modern regional housing market economics is generally based on the New Urban Economics that started with the papers of Alonso (1964) and Mills (1972) on the monocentric city model, in which the costs and development of houses are related to the distance to the Central Business District (CBD). The CBD is contingent on the assumption that firms have a steeper bid-rent than households. The bid-rent curve for households implies that house prices decline with distance to the CBD. The concentration in the center of agglomerations may be explained by pecuniary interactions between consumers and firms (Papageorgiou and Thisse, 1985).[1]

Applying the new urban economics model to derive the fundamentals for the expected future return on house ownership, we focus on housing costs in relation to the distance to the fringe of the city instead of the more commonly used distance to the CBD. In this way, we derive a theoretical relationship between average housing costs and the size of a monocentric city, suggesting that the expected growth of a city can explain (a part) of the expected future return on houses.[2] In a dynamic context, we take into account that the price of a house depends on its future returns, and thereby on expectations regarding future regional economic and demographic developments. We econometrically test the theoretically derived relationship between the house price and the size of the city for metropolitan areas in the US using a two-way fixed effects panel model over the periods 1970-2005 and 1990-2005. In line with our theoretical model and the wider literature on house prices, we find that the expected growth of demand is an important factor for explaining housing prices, and that an increase in the expected growth of demand (due to the availability of jumbo mortgages, for example) provides a good explanation for the recent

[1] However, monopolistic competition with pecuniary interactions may lead to polycentric patterns (Fujita, 1988). Non-pecuniary externalities may also induce multiple centers (Fujita and Ogawa, 1984). The concentration of activity and centers in a general equilibrium model evolving over time in several stages is presented by Anas (1988, 1992). Recent research in urban economics involves an analysis of either the effects of different types of housing in a theoretical general equilibrium context (Arnott et al., 1999), or applied land use transport interaction (LUTI) general equilibrium models for cities (Anas and Liu 2007).

[2] The increasing geographic importance of multiple centers in an agglomeration economy has been demonstrated by Anas et al. (1998). We assume that, with respect to the metropolitan areas we investigate, the relation between city size and the mean house price still holds. The main argument is that a possible change in spatial structure due to the increasing size of the city has less influence on the price of houses than the increase in city size itself. This seems likely, as the size of the city is determined by the wages that can be earned in the city. However, future research is needed to investigate the effect of the existence of multiple centers and changes of the house prices.

strong house price growth in superstar cities as defined by Gyourko et al. (2006). The recent reduction in house prices can be explained by an adjustment in expectations regarding future housing demand, in which cities with larger unrealistic expectations experience relatively larger reduction in house prices.

2. Price of Housing, House Prices and City Size.

In the new urban economics model, the value of housing depends on its location within a city. We define the Price (or value) of housing at a specific location in the city with respect to the given value of housing at the fringe of the city. This gives the relationship between the price of housing and the city size. The regional price of a house is the discounted future price of housing. Discounting the total of all future values of housing gives us the relation between the mean price of a house in a city and expectations regarding the growth of the city.

Spatial Urban Markets

Traditionally, central in the spatial model of the value of a house is its location with respect to the Central Business District (CBD). The larger the distance between the house and the CBD, the higher the commuting costs that should be deducted from the value of the house. New houses will be constructed and the city will grow until the value of the house equals the cost of producing it and the alternative value of the land. This is the main content of the Alonso (1964) and Mills (1972) models, which relate the value of a house to its distance from the CBD.

The price of housing P_{ho} at the fringe of the city should, in equilibrium, be equal to the value of housing and its production costs. To produce housing, one first needs to acquire land. Usually the cost of land equals its alternative usage. We will here make the assumption that there is only one exogenous price of land that is the same in every region.[3] The costs of acquiring land P_l are therefore exogenous to the model. Besides land, there are costs of land conversion and

[3] Introducing an endogenous price of land based on its alternative usage would not add to the point made in this paper. Moreover, in many countries the land prices are nowadays often determined by the government, based on external effects such as the "value of open space" and environmental issues. The modeling of external effects falls mostly outside of the field of economics, and we therefore refrain from it.

construction c, and interest costs i. Notice that instead of a yearly agricultural rent we now have a price for land that, opposite to what is usual in the urban economics literature, has to be capitalized.

Instead of analyzing the distance of the house at location d to the CBD, we will analyze the distance of the house from the fringe f of the city. In both cases, the distance is measured along the radius of the circular city. Although both models are exactly the same, our formulation will prove more useful to derive the effect of the change in city size on the price of housing. This is done in the next subsection. Location d is still defined as the distance from the CBD.

We now have all of the information necessary to mathematically describe the price of housing at location *d* as

(1) $$P_{ho}(d) = ic + iP_l + (f - d)\tau \quad ,$$

where τ is the commuting cost per unit of distance.

City Size and the Price of Housing

The price of housing increases when a city grows. This is caused by the increased distance between the CBD and the fringe of the city in combination with the unchanged price for land and conversion costs. Following the literature we apply the standard assumption of circular cities to the theoretical analysis presented. Given the density σ of square distance measure per developed housing lot, we can therefore describe the stock of housing in the city as

(2) $$H = \pi f^2 \sigma$$

Combining both previous equations gives the following relation between the price of housing, density and city size:

(3) $$P_{ho}(d) = ic + iP_l + \tau\left(\sqrt{\frac{H_t}{\pi\sigma}} - d\right)$$

We included the subscript *t* to denote the time period. In a dynamic context, we are interested in how city growth will affect the housing price at any location *d* in the city. Taking the derivative with respect to the housing stock, we get

(4) $$\frac{\delta P_{ho}(d)}{\delta H_t} = \frac{1}{2\tau\sqrt{\sigma\pi H_t}}$$

From equation (4), it becomes clear that the increase in price will be uniform throughout the city and is related to commuting costs, housing density and the original size of the city.

The Price of a House in Different Cities

The price of a house differs from the price of housing, as it represents the entire discounted future value of a house. Thus, the price of a house is not only determined by the present price of housing, but also by the future price of housing and therefore the expected growth rate of the city. The price of a house in a city, or metropolitan area, *m* and location *d* is equal to

(5) $$P_{h,m,t}(d_m) = \int_0^\infty P_{ho,m,t}(d_m)\, dt$$

We assume that the price of land at the fringe is exogenously given and the same for all cities.[4] Moreover, we take a continuous time approach for both capital costs and the national discount rate *r*, and it is assumed that the long run capital cost rate equals the discount rate. This gives the following integral for the price of a house in city *m* and at location *d*.

(6a) $$P_{h,m,t}(d_m) = c + P_l + \int_0^\infty \tau\left(\sqrt{\frac{H_{0,m}e^{g_m t}}{\pi\sigma_m}} - d\right)e^{-rt}dt$$

Which equals

(6b) $$P_{h,m,t}(d_m) = c + P_l + \int_0^\infty(-\tau d_m)e^{-rt}dt + \tau\left(\sqrt{\frac{H_{0,m}}{\pi\sigma_m}}\right)\int_0^\infty e^{\left(\frac{1}{2}g_m - r\right)t}dt$$

The price of a house is therefore

[4] Note that this assumption only affects our results when the price of land at the fringe changes with the growth of the city. However, it is not expected that these changes will be significant.

(7) $$P_{h,t}\left(d_m\right)=c+P_l-\frac{\tau d_m}{r}+\frac{\tau\sqrt{\frac{H_{0,m}}{\pi\sigma_m}}}{r-\frac{1}{2}g_m}$$

The condition for the existence of a price is that $r>\frac{1}{2}g_m$; this condition is easily interpreted: the effect of population growth on the price should be smaller than the discount rate, as the price would otherwise go to infinity.

We are interested in the relationship between the price of a house and the growth rate of a city. We therefore take the derivative with respect to the growth rate. This gives us the following equation describing the theoretical relation between the growth of the city and the mean house price in the city:

(8) $$\frac{\delta P_{h,m}}{\delta g_m}=\frac{\tau\left(\pi\sigma_m\right)^{-\frac{1}{2}}\left(H_{0,m}\right)^{\frac{1}{2}}}{2\left(r-\frac{1}{2}g_m\right)^2}=\frac{\tau}{2\sqrt{\pi\sigma_m}}\frac{\sqrt{H_{0,m}}}{\left(r-\frac{1}{2}g_m\right)^2}$$

Urban Housing Markets and the Financial Markets Literature on House Prices

The financial economics literature on house prices is based on standard models by Hendershott and Slemrod (1983) and Poterba (1984). These models focus on the relationship between the annual costs of housing and the house price. Following Himmelberg et al (2005), the annual cost of house ownership $R_{h,m,t}$ depends on national factors, such as the risk-free interest rate r_t^{rf}, the tax rate ι, the mortgage interest rate r_t^{mo}, the maintenance costs κ_t, and a risk premium γ_t.[5] Besides these national factors, the cost of house ownership depends also on regional factors such as the regional price of a house $P_{h,m,t}$ and the regional return on house ownership $q_{m,t}$ due to a future house price increase. We summarize the cost of house ownership in the following equation:

(9) $$R_{h,m,t}=\left[r_t^{rf}-\iota r_t^{mo}+\kappa_t+\gamma_t-q_{m,t}\right]P_{h,m,t}$$

[5] Assuming that the risk premium is region-specific will not change our results if the risk premium does not change with city size.

In equilibrium, the annual cost of house ownership should equal the cost of renting a house. A large difference between the cost of house ownership and the cost of renting a house may indicate the presence of a housing bubble (see, for instance, Himmelberg et al. 2005).

Although the analysis is straightforward, a problem lies in determining the regional return on owning a house due to future house price increases. Himmelberg et al. (2005) argue that this return was realistic at the beginning of this century and that there was no housing bubble. They refer to the study of Gyourko et al. (2006) on superstar cities to explain the high and seemingly permanent return on house ownership in these cities. However, there is no theoretical foundation for this return on house ownership besides the possible natural limitation on the growth of a city that may drive up prices in the absence of an increase in housing stock. The previous section demonstrated that an alternative theoretical explanation for this return follows from the new urban economics model. The return on house ownership is driven by the growth of housing demand and thereby the growth of the city itself. We argue that this theoretical explanation of the regional difference in house price dynamics completes the framework from the financial markets literature to analyze housing prices.

From equation (9), it follows that the regional return on house ownership $q_{m,t}$ is the only factor that explains the regional difference in house price dynamics. Our focus is on the analysis of the difference in house price dynamics across cities; in the remainder of the paper we therefore return to the urban economics model presented in the previous section.

3. An Empirical Analysis of Regional Differences in House Prices Dynamics

In order to validate our theoretical model, we conduct some econometric tests in which we assess the elasticity of house prices to city size. We employ two datasets to estimate this relation. The first dataset is based on the US Census decennial information on the median house value based on owners' estimates of the property value and the housing stock for 983 metropolitan and micropolitan statistical areas for the period 1970-2000. The second dataset contains annual information on median house prices based on actual sales and the housing stock for 106 metropolitan statistical areas for the period 1990-2005 and draws on data from the National Association of Realtors enhanced with information from the US Census on the metropolitan housing stock in the 1990s.

We first analyze the effect of the city size on the cost of housing in metropolitan areas. From the theoretical equations (1) and (2), we know that the relation between the cost of housing and the city size is non-linear. We can rewrite equation (3) as follows

(10) $$P_{h,m,t}(d_m) = ic_t + iP_{l,t} - \tau_t d_m + \frac{\tau_t}{\sqrt{\pi\sigma_m}}\sqrt{H_{m,t}},$$

where the cost of housing depends on the square root of the housing stock. In the empirical analysis, the change over time in the factors that are not explained by the model should also be taken into account. Therefore, the subscript t is added to those factors already mentioned in equation (3). Taking the logarithms of all fixed terms together (interest rate, construction costs, price of land and the transportation costs), equation (12) can be reduced to the following additive specification:

(11) $$\ln P_{h,m,t} = \beta \ln \sqrt{H_{m,t}} + \delta_m + \delta_t + \varepsilon_{m,t}$$

where the average house price in metropolitan area m at time t is a function of the square root of the housing stock in metropolitan area m at time t. Please note that the location d does not affect the change in price, it only determines the price at location d relative to the fringe of the city. This is in line with equation (8), which demonstrated that all house prices in the city rise by the same amount if the size of the city grows. In the previous section, we also derived the relation between the house price and the growth of cities. This theoretical framework explained why cities that are expected to grow have higher housing prices than cities that are not growing. This two-way fixed effects model captures differences across cities that are more or less constant over time (δ_m), such as amenities, and differences over time that are common to all cities, such as transportation cost (δ_t). In other words, we control for house price differences across different cities and years that are not accounted for by the housing stock variable. Hence, the estimated coefficient β can be interpreted as the shift in housing price associated with city enlargement and most closely approximates our theoretical model.

Rewriting equation (7) gives us the following equation:

(12) $$P_{h,m,t}\left(d_m\right)=c_t+P_{l,t}-\frac{\tau_t d_m}{r}+\frac{\tau_t}{\sqrt{\pi\sigma_m}}\frac{\sqrt{H_{m,t}}}{r-\frac{1}{2}g_{m,t}},$$

where the housing stock is now corrected for the expected growth rate of the city and the long run rate of return on capital. Henceforth, we assume that the long-term return on capital equals 3 percent.[6] Similar to equation (11), we employ a log-normal two-way fixed effects panel model to estimate equation (12) across cities.

(13) $$\ln P_{h,m,t}=\beta\ln\sqrt{H_{m,t}}+\delta_m+\delta_t+\varepsilon_{m,t}\text{, where }\beta=1$$

In equation (13), we constrain the coefficient of $\ln\sqrt{H_{m,t}}$ to 1. This implies that, for the moment, we assume that the expected growth rate of house demand $g_{m,t}$ equals 4 percent. This is a reasonable first approximation given an economic growth rate of 3 percent combined with a small population growth rate. We calculate the actual figures for the expected growth rate of house demand for every city-year from the residuals $\left(\varepsilon_{m,t}\right)$ using equation (12).

4. Econometric Estimations

The Relation between City Size and House Prices

Models 1 and 2 in Table 1 show the results of the two-way fixed effects panel estimation on median house prices in US cities. In line with our theoretical model and the wider literature on house prices, we find a positive effect of (the square root of) city size on urban houses prices in both periods under observation. We find an overall elasticity of .80, controlling for city- and time-specific effects. This means that if the size of a city increases by 1%, the median house price in the city goes up by 0.8%, holding all else constant. Despite the appearance of a modest

[6] The results are not sensitive to the assumption of an expected return to capital of 3 percent except for extreme low and high values.

to good connection between city size and house prices overall, the observed elasticity significantly deviates from the theoretically expected elasticity of 1.0 and a large proportion of the variance in house prices remains unexplained.

INSERT TABLE 1 ABOUT HERE

More specifically, the elasticity of city size to house prices seems to vary considerably across cities (see Figure 1). Cities like Atlanta, Charlotte and Las Vegas appear to have relatively inelastic housing markets. Despite considerable population growth over the past 40 years, real house prices only increased modestly in these cities. In contrast, for cities like San Francisco and San Diego, the real median house prices rose by over 4 percent per year between 1990 and 2005, while the square root of the housing stock increased by less than 1 percent per year in the same period. Gyourko et al. (2006) label the latter type of cities "superstar" cities: cities that experience a relatively high demand, a limited increase in the housing stock and a high level of real house price appreciation.

INSERT FIGURE 1 ABOUT HERE

Explaining Superstar Cities and More Recent House Price Bubbles

House price differences between cities may therefore result from differences in the expected growth of housing demand *g* across cities. Although *g* cannot be directly measured, its value can be approximated for each city by running a constrained two-way fixed effects model, in which we force the coefficient of $\ln\sqrt{H_{m,t}}$ to equal one. The residuals from the fitted model contain random error and omitted variables, which cannot be observed. Given our two-way fixed effects model, these omitted variables represent factors that differ within cities across years (see also Cheshire, 1999). Probably the most important of these omitted variables represented by the residuals is the expected growth of housing demand $g_{m,t}$, particularly given that house prices are very volatile compared to visible changes in fundamentals (Glaeser et al., 2008).

In a dynamic context, the growth in real annual average house prices in cities like San Francisco and San Diego are not explained by an increase in the housing stock but by an increase in the expected growth rate of demand $\Delta g_{m,t}$. When this increase in the expected growth in demand $\Delta g_{m,t}$ exceeds the growth of the square root of the housing stock $\sqrt{H}$, house prices will grow – assuming constant returns to capital within cities across time periods. Hence, housing bubbles are not a result of an increase in demand, but a result of an increase in the expected growth of demand. In fact, a small change in g can distort house prices severely. The expected growth in demand $\Delta g_{m,t}$ is most often a result of a shock in the number of potential homebuyers in combination with an existing supply limit of housing within a metropolitan area. Figure 3 shows the relationship between the annual average expected growth in the demand growth rate and the annual average real price growth.

The rise in house prices in superstar cities between 1970 and 2000 can be mainly ascribed to the rise of white-collar occupations in or nearby these metropolitan areas (Silicon Valley, financial services expansion at the East Coast), which increased the number of potential homebuyers on the local housing market, and herewith the expected growth of demand $g_{m,t}$. At the same time, these cities were characterized by an increasing number of binding restrictions on the development of new sites, which further increased $g_{m,t}$ (see also Glaeser et al. 2005a; 2005b; 2008)

As can be seen in Figure 2, the increase in $g_{m,t}$ (1998-2005) has been much higher in coastal housing markets than in the other parts of the United States, and indicates the house price bubble in these metropolitan areas.[7] However, the most recent house price bubble (from 1998 onwards) is different from previous bubbles, in the sense that it is mainly set off by the increasing availability of mortgages, particularly jumbo and second mortgages. Although Glaeser et al. (2008) claim that during a bubble "*more inelastic places will have a larger shift in prices, while more elastic places will have a larger increase in new construction*," this relationship has been virtually absent in the latest bubble (see Figure 3). In fact, metropolitan areas such as Cape Coral and Riverside experienced an increase in both new construction and house prices. This is further supported by the fact that there is a small negative relationship between new construction growth and the growth in the expected growth of demand (not shown, but figure can be provided).

[7] The estimated g in the graph is based on an expected return rate to capital of 3 percent

INSERT FIGURE 2 AND 3 ABOUT HERE

The most important explanation for why superstar cities experienced the largest price bubble in the past 10 years (see Figure 2) is thus not their supply limit (which was already accounted for in existing prices), but other factors that increased the expected growth of demand. In particular, the high house price to household income ratio in these cities, in combination with relaxed rules to obtain mortgages, has played a major role (see Figure 4) in the bubble.[8] Whereas in Wichita or St. Louis, with a household income to home price ratio of 2, most potential homebuyers were already able to obtain a mortgage, in Los Angeles or San Francisco, with a much lower household income to home price ratio, many potential homebuyers that were initially excluded from the local housing market could now enter this market. In superstar cities, the number of potential home buyers therefore increased relatively more than in other cities, which has resulted in a higher $\Delta g_{m,t}$ in these cities, and hence in higher prices.

INSERT FIGURE 4 ABOUT HERE

This increase in the number of potential homebuyers was enabled by the increasing availability of mortgages, made possible by the relatively lax underwriting standards of mortgage lenders. This assertion is supported by the strong correlation between the share of outstanding jumbo mortgages (purchase money and refinancing) in the total value of outstanding mortgages and $\Delta g_{m,t}$ (Figure 5).[9] Jumbo mortgages are mortgages with a loan amount above the industry-standard definition of conventional conforming loan limits. Whereas in the past jumbo mortgages were primarily offered for high-end real estate, in the early 2000s, jumbo mortgages spread to the general public, and especially to cities with high increases in house prices.

[8] Data on building permits and house price to household income ratios were obtained from the State of Nation's Housing 2006.

[9] Jumbo mortgage data was obtained from Mortgagedataweb.com

The strong relationship between the increasing availability of mortgages and rising expectations of future housing demand is in line with the empirical findings of Wheaton and Nechayev (2008), who show that growth in the fundamentals does not explain house price growth between 1998 and 2005 very well. Yet the house price bubble in the beginning of the 21st century was not a nation-wide phenomenon. Especially in large metropolitan areas and metropolitan areas characterized by many second homes and subprime mortgages, the growth in house prices was much larger than forecasted by the growth in fundamentals. Of course, the causality of the relationship between jumbo mortgages and inflating house prices is far from clear and more research is needed here. Moreover, the increase in jumbo mortgages may well have been a joint product, along with inflation of house prices, of changes in the institutional, political and regulatory environment at the beginning of the 21st century (Coleman IV et al., 2008).

INSERT FIGURE 5 ABOUT HERE

Early Signs of a Housing Bubble

It was described in the previous section that the large increase in $g_{m,t}$ was mainly concentrated in the coastal urban housing markets of the United States. Only in exceptional circumstances with expected large regional migration these regional differences in the expected demand for housing will be large. This variation in the regional expected demand for housing is therefore a suitable early warning indicator for a regional house price bubble.

More formally, we have estimated a cross-section where the average $g_{m,t}$ should be constant over time.[10] In Figure 6 we show the development of the standard deviation in $g_{m,t}$. The sharp increase in the standard deviation from 2003 onwards shows that expectations regarding the future demand for housing are extremely high in some metropolitan areas when compared to other metropolitan areas. In other words, the increase in the standard deviation is an indicator of the existence of a regional house price bubble.

[10] Note that the average of the errors in the cross-section is zero, which implies that the average $g_{m,t}$ is constant over time and not over metropolitan areas.

INSERT FIGURE 6 ABOUT HERE

House of Cards and Foreclosures

Cities with larger unrealistic expectations also experienced relatively larger reductions in house prices. This can (partly) be explained by the sharper downward adjustment in expectations regarding future housing demand in these cities. Figure 7 shows a strong correlation between the average annual growth in the expected growth of demand between 1998 and 2006 and real house price development in the period 2006-2008.[11] Especially in Californian cities, characterized by a high expected growth rate in demand in the period 1998-2005 (Los Angeles, San Diego, San Francisco), house prices have dropped dramatically, by about 25% per year. In addition, there is a modest to strong correlation between the average annual growth in the expected demand between 1998 and 2006 and the half-yearly average foreclosure rates for the period 2008-2009 (see Figure 8).[12] This indicates that households in cities that have experienced a housing bubble face greater budget difficulties.

Of course, there are other important reasons for falling house prices and an increasing number of foreclosures in cities. First, one can think of macroeconomic conditions such as an increase in (adjustable) mortgage rates, decrease in economic growth, and increasing unemployment. These factors may have played an important role in the decrease in house prices in, for example, Atlanta, Denver, and Detroit. Second, there may be factors not included in our model that caused speculative building behavior in metropolitan areas like Las Vegas, Phoenix, and Miami (Hubbard and Mayer, 2009) and the subsequent downward house price adjustment. However, these factors coincide with a strong decline in the expected future demand of housing.

INSERT FIGURE 7 AND 8 ABOUT HERE

[11] Data on house price developments between 2006 and 2008 were obtained from the State of the Nation's Housing 2009.

[12] Foreclosure data for the period 2008-2009 was obtained from RealtyTrac.

5. Concluding Remarks

In this paper, we add to the literature on house prices in urban economics and financial economics by demonstrating the importance of expectations of future housing demand on current house prices. In doing so, we combine the Alonso-Mills model with insights from the behavioral financial markets literature and provide a theoretical explanation for the return on house ownership. This return is based on the future growth of the city. Hence, the expectations of the growth of the city, and thereby the growth in housing demand, is an important factor in explaining the present house price. This is illustrated by an empirical analysis of the most recent housing bubble in the United States.

Using historical data, our estimations show that the most recent bubble was driven by irrational expectations regarding the future housing demand fuelled by a widespread availability of credit. In other words, there were strong indications of the existence of a housing bubble. The inelastic housing supply that explained earlier house price bubbles did not provide a good explanation for the most recent bubble. The downward adjustment of expectations regarding future housing demand offers an important explanation for the subsequent burst of the bubble. Besides providing an explanation of the housing bubble, we provide an early warning system for the possible presence of a house price bubble. We show that there was a clear indication of a house price bubble in certain cities from 2003 onwards. With this knowledge, policy and market corrections could have taken place earlier, and the size of the bubble and its subsequent burst may have been mitigated.

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TABLE 1 – TWO-WAY FIXED EFFECTS PANEL ESTIMATES OF MEDIAN HOUSE VALUES

	Model 1, 1970-2000 *Two-Way Fixed Effects*	Model 2, 1990-2005 *Two-Way Fixed Effects*
ln *vHousing Stock*	0.817 (.060)**	0.802 (.262)**
R^2	0.743	0.200
Hausman Statistic	237.7**	13.95**
F-test fixed effects	125.5**	209.6**
Number of Observations	3752	1680
Number of Cities	938	105

Notes:

Cluster-robust standard errors in parentheses, ** p<0.01

City- and time-specific effect estimates are not displayed

The Hausman statistic tests the two-way fixed effects model versus the two-way random effects model; a significant Hausman statistic favors the two-way fixed effects model. Similar tests comparing the two-way fixed effects model with mixed fixed and random effects models (city random effects/time fixed effects and city fixed effects/time random effects) also indicated that the former is preferred.

FIGURE 1. HOUSING STOCK GROWTH VERSUS HOUSE PRICE GROWTH

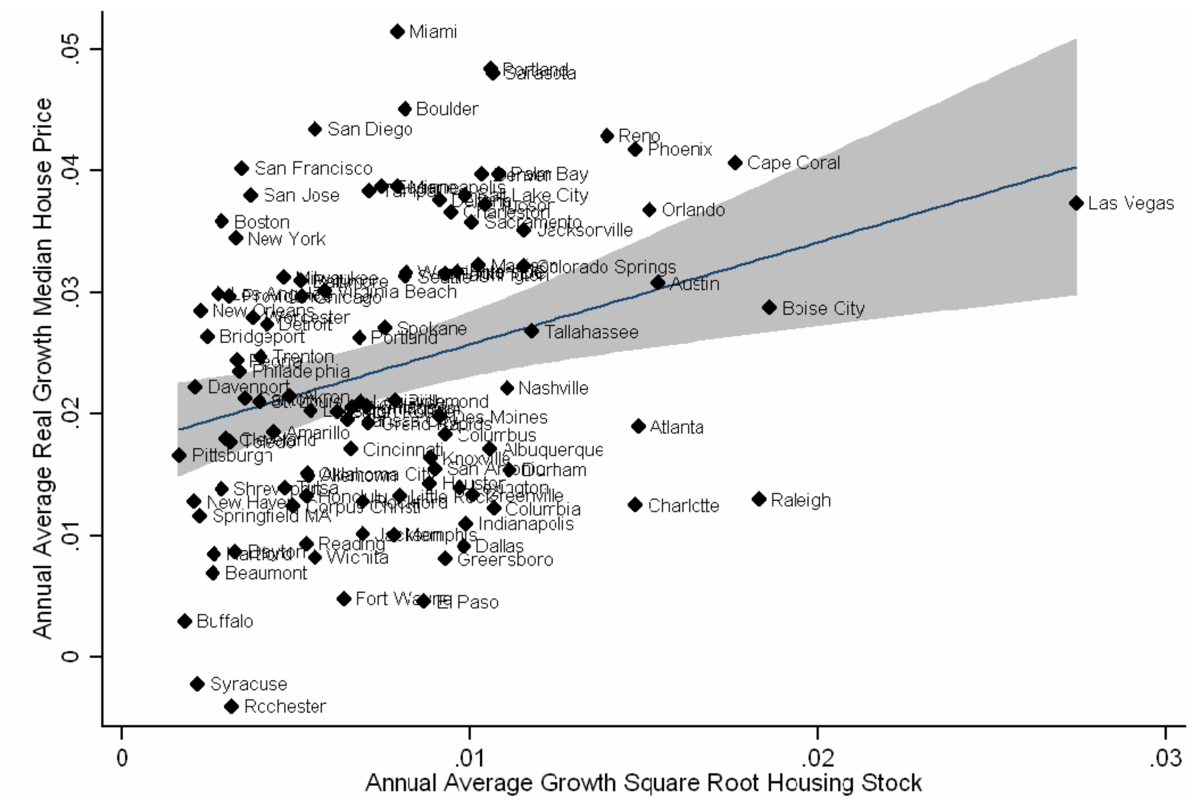


FIGURE 2. THE EXPECTED LONG-TERM GROWTH IN DEMAND BY METROPOLITAN AREA AND YEAR

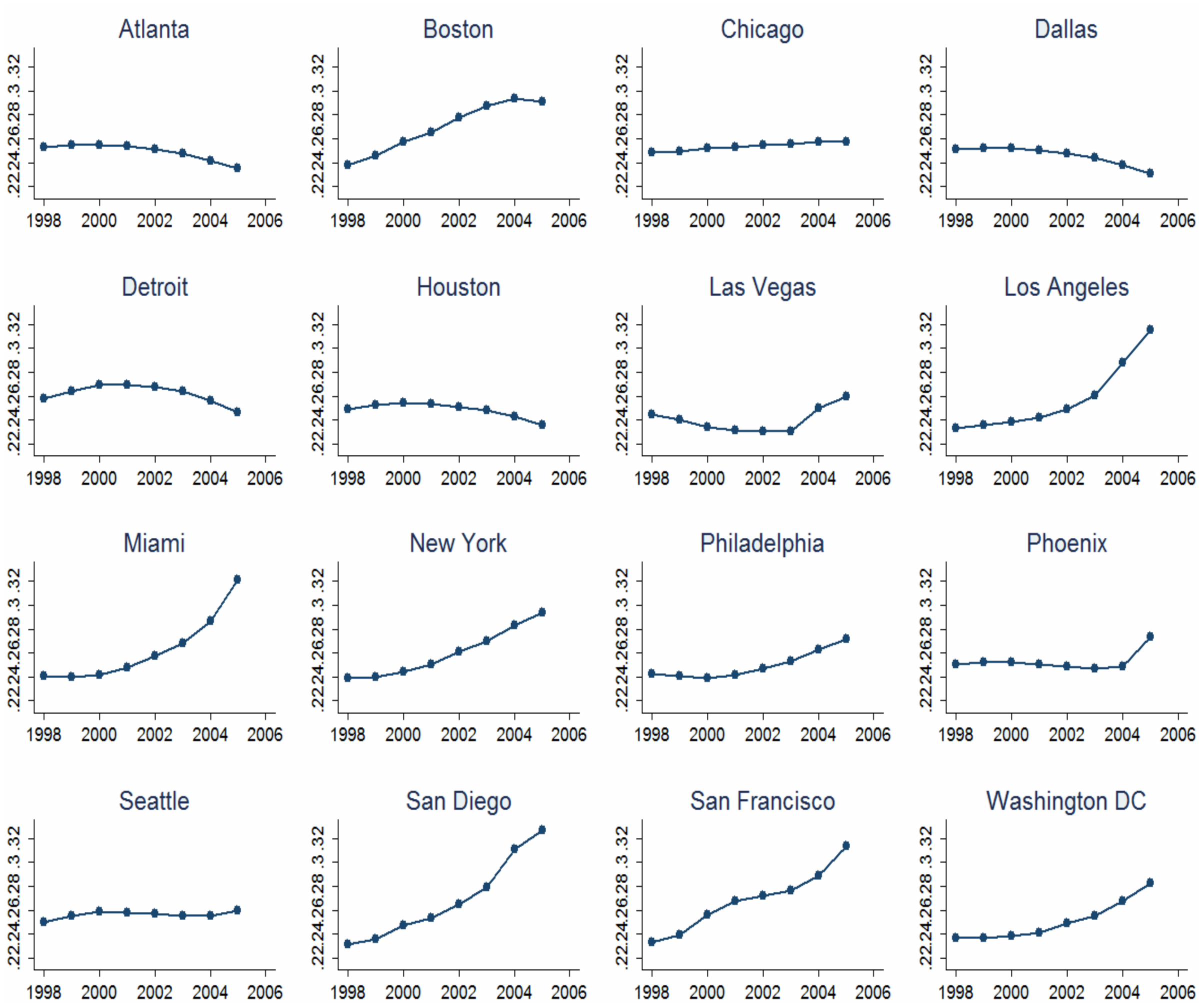


FIGURE 3. NEW CONSTRUCTION GROWTH VERSUS HOUSE PRICE GROWTH

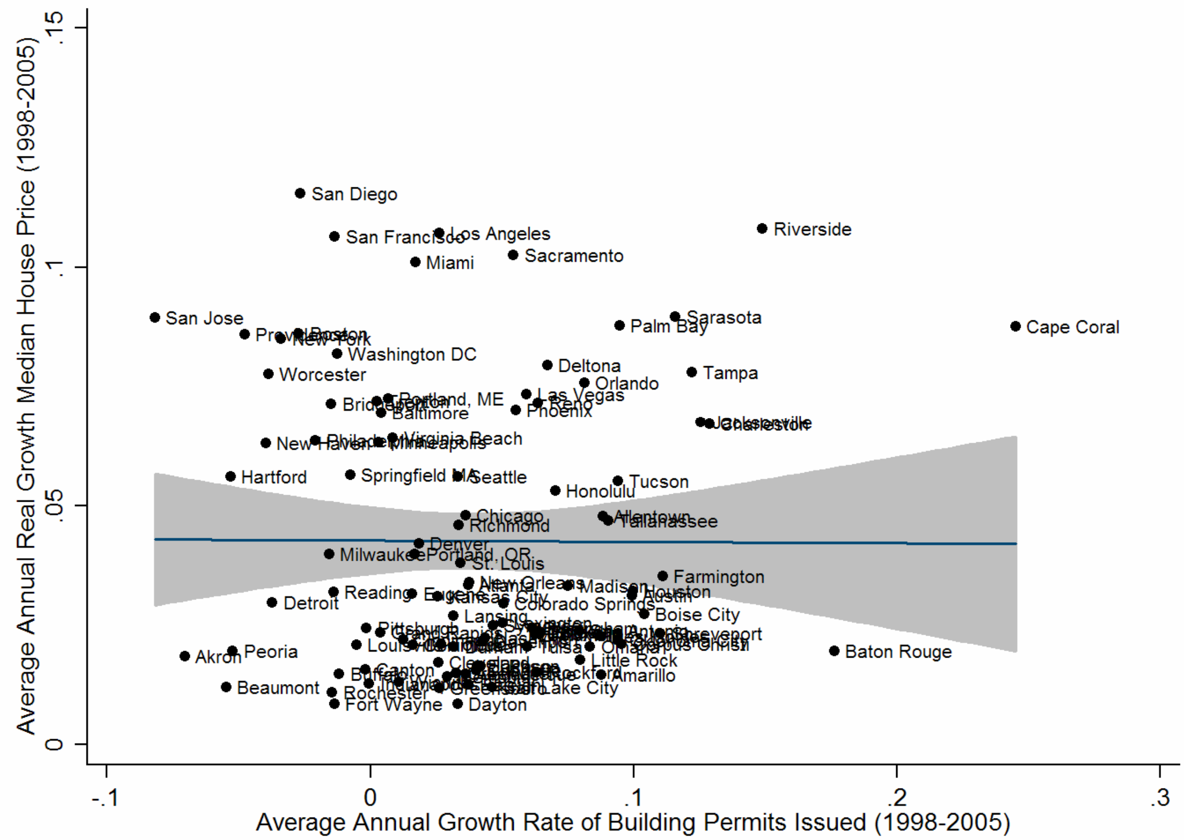


FIGURE 4. HOUSE PRICE TO INCOME RATIO AND $\Delta g_{m,t}$

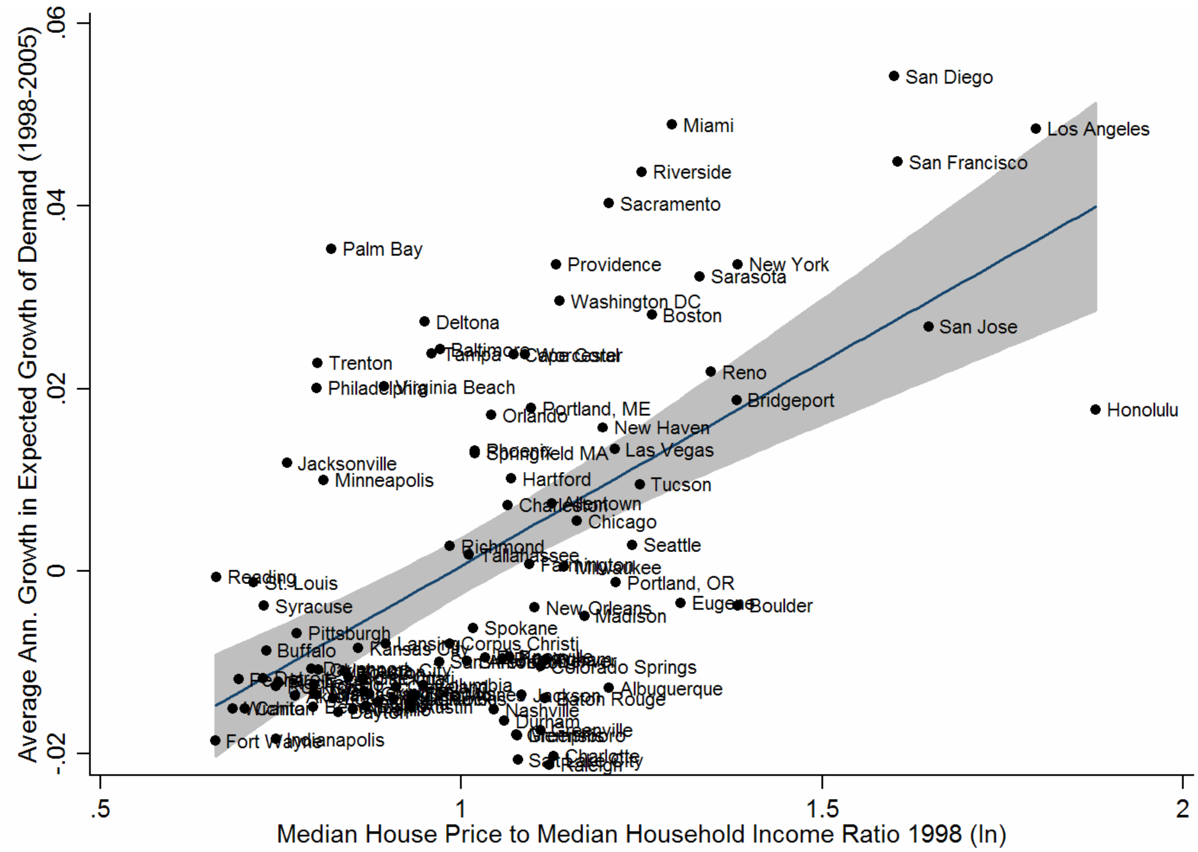


FIGURE 5. SHARE OF JUMBO MORTGAGES AND $\Delta g_{m,t}$

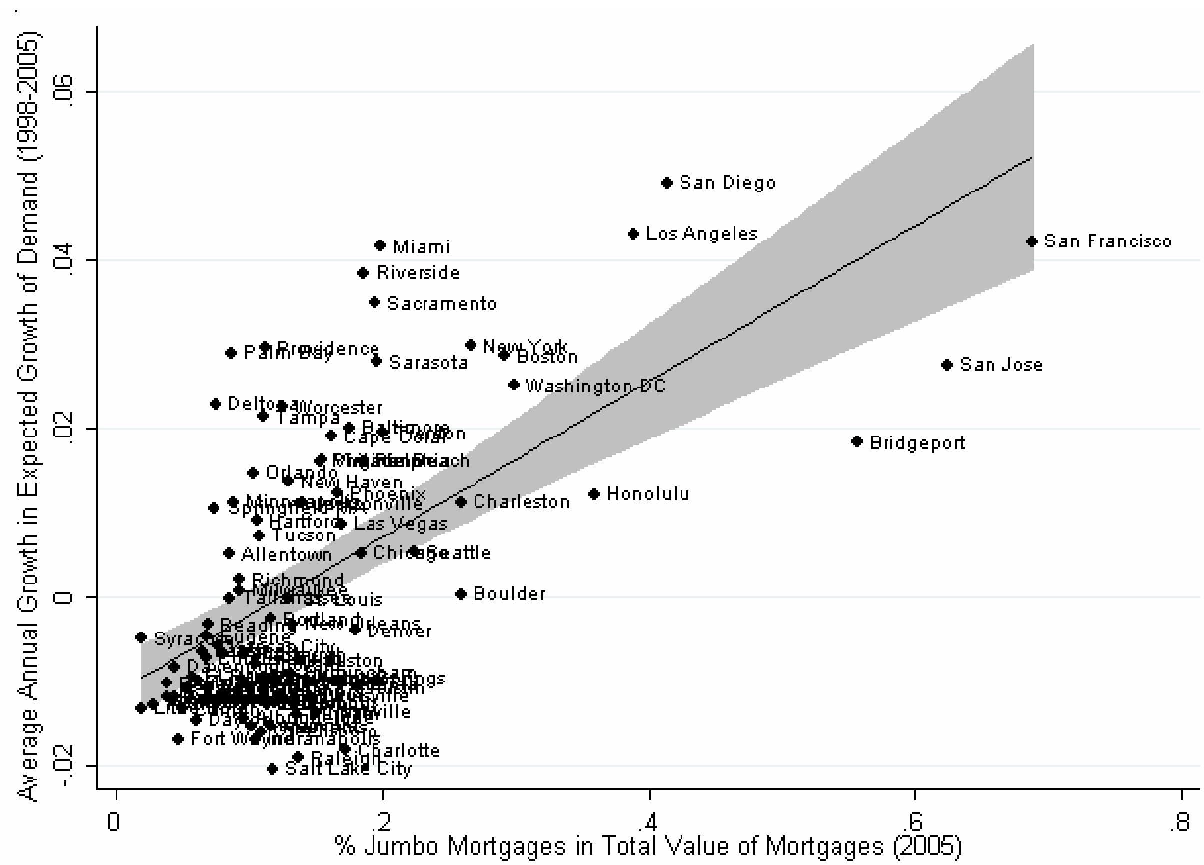


FIGURE 6. THE STANDARD DEVIATION OF THE REGIONAL EXPECTED GROWTH IN DEMAND FOR HOUSING

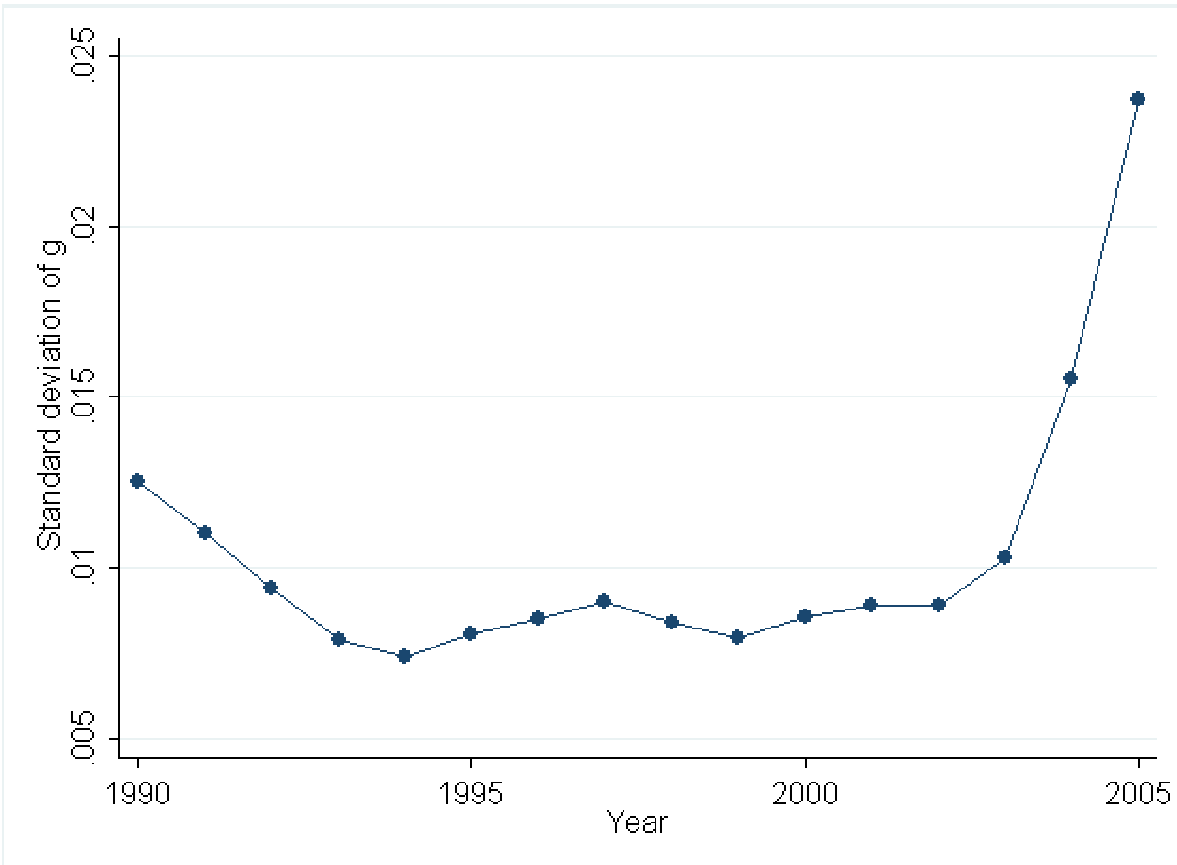


FIGURE 7. DECLINE IN HOUSE PRICES AND $\Delta g_{m,t}$

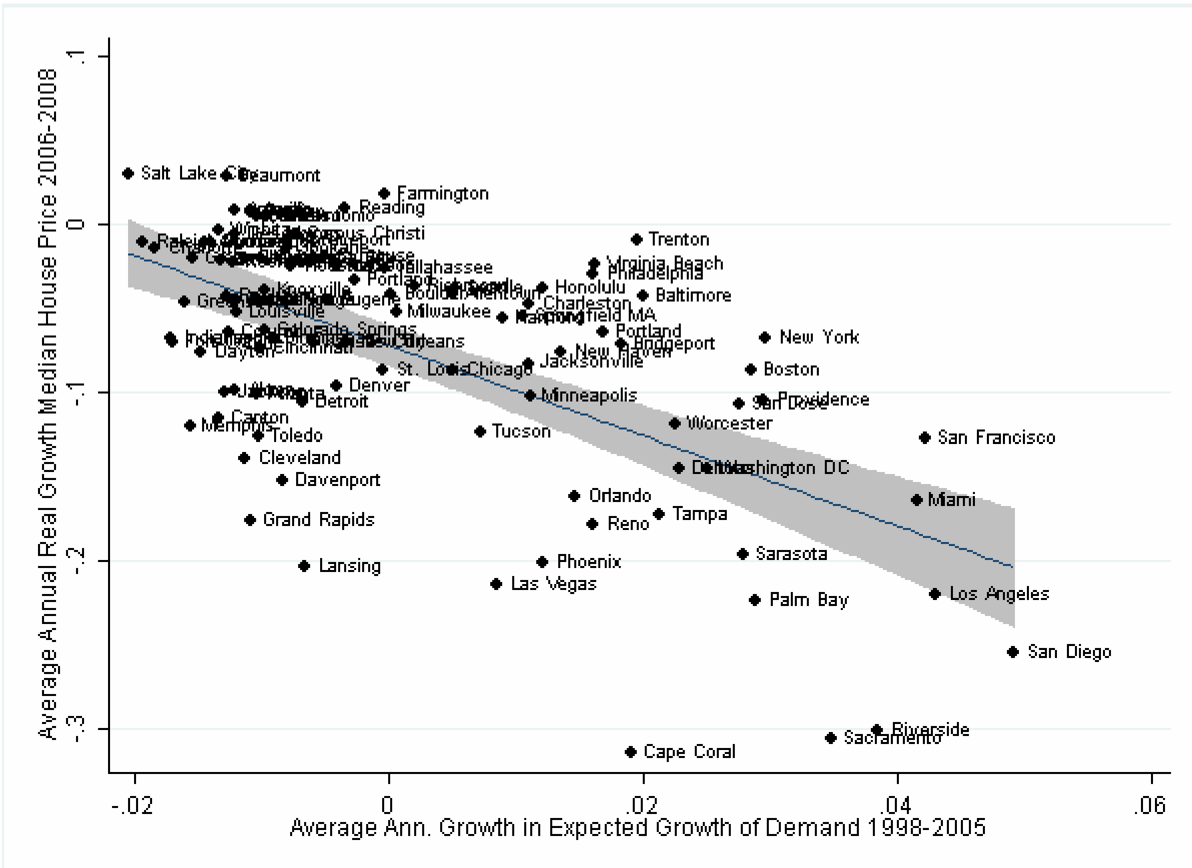
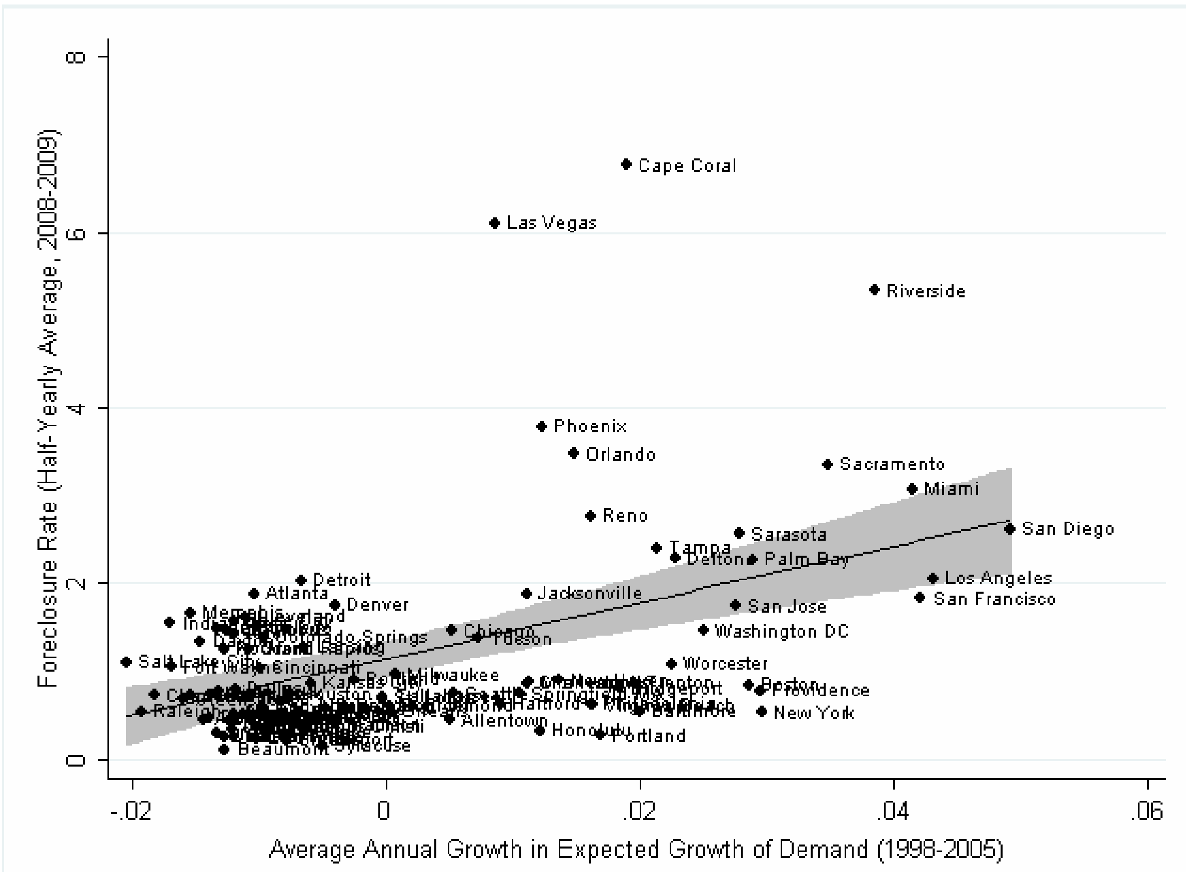


FIGURE 8. FORECLOSURES AND $\Delta g_{m,t}$



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