

The Role of Speculation in Real Estate Cycles

Stephen Malpezzi*

and

Susan M. Wachter†

Revised Draft, June 18, 2002

Zell/Lurie Real Estate Center

Working Paper #401

The Role of Speculation in Real Estate Cycles

Stephen Malpezzi* and Susan M. Wachter†

Revised Draft, June 18, 2002

*The Center for Urban Land Economics Research
School of Business
University of Wisconsin
975 University Avenue
Madison, WI 53705
smalpezzi@bus.wisc.edu
<http://www.bus.wisc.edu/realestate>

†Professor of Real Estate and Finance
Wharton School of Business
Lauder-Fischer Hall
University of Pennsylvania
Philadelphia, PA 19104
wachter@wharton.upenn.edu

Stephen Malpezzi is Associate Professor, and Wangard Faculty Scholar, in the Department of Real Estate and Urban Land Economics at the University of Wisconsin – Madison. Susan Wachter is Professor of Real Estate and Finance at The Wharton School of the University of Pennsylvania.

This paper has been prepared for the July 2002 joint meeting of the American Real Estate and Urban Economics Association and the Asian Real Estate Society, held in Seoul, Korea. A previous version was prepared for the March 2002 workshop on speculation sponsored by the Lincoln Institute of Land Policy, Cambridge, Mass. We are grateful to the participants in that session, especially the organizers, Roz Greenstein and Mark Gottdiener, and Michael Ball and Bertrand Renaud. However opinions expressed in this paper are those of the authors, and not of any institution. This paper is still preliminary and will be revised. Please do not cite this version without permission. Comments and criticisms are especially welcome.

Executive Summary

Our study investigates the role of speculation in real estate cycles. We find that even a simple model of lagged supply response to price changes and speculation is sufficient to generate real estate cycles. Second, the volatility of prices – the biggest purported downside of “speculation” – is strongly related to supply conditions. Even more interestingly, the effect of speculation itself depends on supply conditions. Markets with more responsive regulatory environments, or less natural constraint (from physical geography), will experience less volatility as well as less behavior characterized as speculation. Demand conditions in general, and speculation in particular, can contribute to a boom and bust cycle in housing and real estate markets – but the effects of speculation appear to be dominated by the effect of the price elasticity of supply. In fact, the largest effects of speculation are only observed when supply is inelastic. Thus effective policies will focus on improving the efficiency of the supply of developable land, and real estate generally, including the development of an appropriate regulatory framework for real estate.

Introduction

Recently, Prof. Lee Phil-Sang of Korea University gave voice to a commonly held view of the role of speculation in real estate markets:

The economy, already suffering from unemployment and fluctuating prices, is now being plagued by rampant real estate speculation. This real estate speculation boom is an archfiend wielding terrible power, capable of blowing out the flickering signs of a hopeful economic recovery. In the Kangnam area, south of the Han River, outright acts of apartment purchase right speculation bear an uncanny resemblance to speculation in action at a bustling, lively gambling table. Dealers and owners are colluding to buy up purchase rights of newly built apartments in order to boost apartment prices after which they will walk away with enormous profits from trading. (Lee 2002).

Real estate prices are by their nature prone to cycles.¹ While Prof. Lee's statement is among the stronger we've found in print, many observers in many countries point to speculation in land or real estate markets as a prime mover of such cycles.² Notably, Korea's Minister of Construction Lim In-Taik was recently quoted "The rise in housing prices derives from a combination of factors like low interest rates, the excessive number of real estate speculators, and insufficient supply of housing."

In this paper we focus on the latter two explanations for housing price increases and volatility; we will set out why we believe these factors are key for understanding the source of cycles. The paper first discusses alternative definitions of speculation. We then develop a conceptual model of how real estate and local business cycles can be causally related to, *inter alia*, demographic and economic fundamentals, financial conditions and banking policies, and supply conditions, such as natural geography and

¹ See Case, Goetzmann and Wachter (1997), Abraham and Hendershott (1996), Wheaton (1999) and Borio, Kennedy and Prowse (1994), for example.

the regulatory environment for development.³ We then develop a simulation model to examine whether land speculation is primarily a cause of, or a symptom of, property cycles. Specifically, the model helps explain how real estate speculation is linked to volatility in land prices, and in turn to the elasticity of supply. Special emphasis is placed on the role played by the regulatory environment for development and the effect this has on the key elasticities.

One striking feature of financial crises associated with business cycle downturns is that the most seriously affected economies often first experience a collapse in property prices and a consequent weakening of banking systems before going on to experience an exchange rate crisis, a financial crisis, and a business cycle bust.⁴ Although this sequence does not necessarily imply a causal link, the collapse in land prices is clearly of central importance to recent Asian financial crises, especially in Japan, Indonesia, and Thailand.⁵ If banking systems in these countries had not been damaged by the speculative boom in land markets followed by the collapse in land prices, these foreign exchange crises would have been less devastating, and the prospects for economic recovery in Japan, for example, would be much brighter than they now appear. The conceptual framework developed in this paper can be used to interpret recent examples of land price booms and busts leading local business cycles.

On the regulatory front, our model explains how the amplitudes of cycles, and the relationship between cycles and speculation, is affected by the elasticity of supply of real

² See Atterhog (1995), Feagin (1986), Korea Herald (2002), Korea Times (2002), Nguyen Hong (2002), Suiter (2000), and Tan (2002), among many others.

³ See Pollakowski and Wachter (1990), Malpezzi (1999) and Case (2000).

⁴ See Herring and Wachter (1999) and Renaud, Zhang and Koeberle (1998).

⁵ Mera and Renaud (2000).

estate.⁶ This in turn has several determinants, some of which (like natural constraint) are difficult to modify by changes in government policy. But the regulatory environment is shown to be another fundamental determinant of supply conditions, and our results can be used to analyze the impacts of regulatory frameworks of housing markets.⁷

Fundamentals of Asset Pricing

Housing is an *asset* that yields a flow of services over time.⁸ This leads us to the basic concept of stocks and flows. Examples of stocks and their corresponding flows are legion:

Stock	Flows
Wealth	Income
National Debt	Deficit
House Value	House Rent

The distinction between stocks and flows matters in several respects. For example, sometimes housing rents and asset prices move in tandem, and sometimes they move in different directions (see DiPasquale and Wheaton 1992, and Renaud, Pretorius and Pasadilla 1997). Exactly how these move with respect to each other is a central issue of the large literature on the user cost of housing capital (Green and Malpezzi, forthcoming; Blackley and Follain 1996).

⁶ See Malpezzi (1999, forthcoming).

⁷ Much of the paper will refer to housing markets, but the general concepts we discuss are applicable to other forms of real estate (office, retail, industrial, farmland, etc.). We focus on housing partly because it is by far the largest part of the real estate market in all countries, and partly because more research, especially empirical work we rely upon below, has been undertaken on housing markets than other forms of real estate.

⁸ This section draws heavily on Green and Malpezzi (forthcoming).

Economists are careful in their use of the word "price." Rent is not really price, but an *expenditure*, comprising price and quantity, i.e. $R=PQ$. What real estate brokers call "sales price" is not really strictly speaking a price either, but the market value of a unit, or the present value of net rents (a "stock" or "asset" concept). Thus, when we analyze housing we refer to (1) the rental price per unit of housing services and (2) the quantity of housing services produced by a unit. The product of these is rent.⁹

Rents are translated into values or asset prices using the concept of present value. The relationship between rents and values is straightforward:

$$V = \sum_{t=0}^T \frac{E[R_t - C_t]}{(1+i)^t}$$

where V is the present value (a stock concept), R_t is rent (a flow concept), C_t is the recurrent cost of maintaining the unit, property taxes, etc., i is the discount rate, and t is the life of the asset. For simplicity, much real estate analysis uses "rent" loosely as a synonym for "net operating income," or rent measured net of operating costs.¹⁰ Perhaps most importantly, E is the "expectations operator:" real estate investors are not omniscient, and must assign a value to a property today based on *expectations* of the time path of net rents in the future. Most real estate textbooks discuss expectations in a cursory fashion if at all, but as we will see, the nature of expectations is central to pricing, and to our paper.

In the special case where rents are net, net rents are constant over time, and the time horizon is long,

⁹ (1) If we can or will assume that all units in our analysis are the same — that all yield the same Q — then rent can be interpreted as a price. (2) If we are not willing to make such an assumption, we can use hedonic indexes to "standardize" the quantity of housing services.

$$V \equiv \frac{E[R]}{i}$$

What if expected rents are not constant? Let us initially relax that stringent assumption, but for simplicity initially assume they are growing at some constant rate. If i is the discount rate for constant rents, but net rents for a given property are growing at rate g , it is straightforward to show that value is approximately:

$$V \equiv \frac{E[R]}{i - g} = \frac{E[R]}{c}$$

where we use c to denote the capitalization or “cap rate.”¹¹ We also point out once again that most real estate texts, whatever their notation, drop the expectations operator E , and neglect discussion of expectations.

Defining Speculation, and Related Terms

What is Speculation?

A tongue in cheek definition of speculation is: when *I* invest in real estate in a rising market, it’s to safeguard my financial well-being and provide for my retirement and my family. When *someone else* does it, it’s speculation. So the term speculation, used in its most general sense, can be thought of as a synonym of ‘investment.’

However, there are several other senses in which the term is used.

¹⁰ In what follows, for notational simplicity we’ll assume that R denotes NOI or net rents, and drop explicit discussion of operating costs C .

¹¹ The simple relationship $c = (i - g)$ is a poor approximation when g is a very large positive or negative number; and clearly as g approaches i the relationship breaks down. A zero or negative cap rate is not admissible.

Sometimes the term ‘speculation’ is used to signify something about the time horizon of the investor. In some cases, the term is used to denote short-term investors, rather than those who buy and hold. It is also used to identify investors who purchase (or option, or otherwise obtain control of) a parcel of land but who hold it vacant (or in a current less-intensive use) in anticipation of a profitable development opportunity in the future (Colwell 1999). Speculation in this sense is intimately bound up with the question of the optimal timing of development (Titman 1985; Mayo and Shephard 2001; Capozza 1976).

Speculation also means arbitrage. Markets with many investors – many buyers and sellers – are ‘thick’ or ‘liquid’ markets where, if prices are observable, participants have good information about at least current prices. On the other hand, thin or illiquid markets are those in which the costs of discovering prices can be costly, and in fact these prices can be volatile (Barkham and Geltner 1996; Lin and Vandell 2001 a and b).

Adding more participants to a market is usually thought of as stabilizing, under the reasonable assumption that the new market participants are as well informed as previous ones. But it is possible to conceive of cases where the new investors are ill-informed, for example ‘out of towners’ (foreigners) who ‘pay too much,’ possibly with short time horizons and a desire to move in and out of these investments quickly (‘hot money’).

Second, speculation can be used to describe a world in which investors’ expectations are formed in some inaccurate way.¹² For example, many models of

¹² ‘Inaccurate does not necessarily mean ‘irrational’ in the sense we define rational expectations above (expectations based on all available information). If the only available information is recent price changes, adaptive expectations will be rational, even if they are wrong. Perfect foresight (being right) is actually a stronger condition than being rational.

speculative bubbles are based on adaptive expectations, or extrapolations of recent trends. When prices are rising, speculators enter the market and demand increases. When prices are falling, they bail out. The other form of speculation we model explicitly is speculation in the form of adaptive expectations. In this case, demand will increase in dP_t .

While we do not explicitly model speculation in the sense of holding period, this kind of speculation is related to liquidity and thus included implicitly. When arbitrage speculators enter the market, adding liquidity, it is reasonably assumed that these are mostly short term investors, as arbitrage investors by their nature tend to buy and sell more rapidly than most other investors.

A more rigorous and useful definition requires some discussion of other concepts, including the efficiency of a market, the way expectations about future states of the market may be formed, and a price “bubble.” To these we now turn.

What Is an Efficient Market?

As a matter of definition, economists often refer to real estate’s market price as its value. The value of an asset is, by definition, equal to what economic actors are willing to pay for it. But do markets and economic actors efficiently price real estate? To analyze market inefficiency, one needs to have a model that specifies the attributes of an efficient market. As defined by Malkiel,

“a capital market is said to be efficient if it fully and correctly reflects all relevant information in determining security prices...Formally, the market is said to be efficient with respect to some information set...implies that it is impossible to make economic profits by trading on the basis of [that information set].”

Economic profits signify an excess or abnormal return. Earning excess profits in capital markets means trading profits accrue above the market rate of return. An efficient capital market is one where economic profits do not exist. Because the information is incorporated into prices, the investor is unable to make profits by trading on the information.

There are three common definitions of market efficiency; each is defined based on the information set used in price formation. The first, known as the weak form, states that future price movements cannot be predicted based on an information set containing all past price movements. The semi-strong form states that prices should reflect all publicly available information, which would include not only past price information but also all public financial information and any other information that might affect real estate prices. The third variant, the strong form, says that even material, nonpublic information is priced into real estate values. Thus each of these definitions describes conditions under which markets can be said to be efficient, in one sense or another.

Most economists now rely on the weak definition, namely that future prices cannot be predicted based on past price information and consequently historic prices are of no value in forecasting future prices. This leads to the related concept of a “random walk,” in which asset price changes follow a random pattern. Thus if real asset price formation follows a random walk, it is not possible to earn excess investment profits, and there will be no incentive for speculation. However, as we will see, there is a large body of evidence – and cogent theory – suggesting that real estate markets are far from perfectly efficient.

Do real estate investors price real estate based on past price trends? If so, the random walk does not hold, it is possible to predict pricing based on past trends, and excess profits could be earned by investors who know this is how other investors will price real estate. Thus much depends on how real estate investors, including home owners, form their expectations of future real estate prices. If expectations are “backward looking” and depend on extrapolating past price changes, then real estate prices will not form a “random walk.” The alternative, efficient market hypothesis of the formation of price expectations requires rational expectations, i.e. that expectations of future prices be formed based on how market forces, demand and supply, actually impact market prices; all that is knowable about these forces are incorporated into prices, without estimation bias, so that no one can profit from past (publicly available) information. The empirical literature finds considerable evidence for backward looking expectations in real estate pricing. Research supports the finding that real estate markets often violate the random walk and rational expectations hypotheses (Ott, Riddiough, Yi and Yoshida 2000).

Why Expectations are So Important

Real estate price and rent growth expectations are central to the efficient pricing of real estate. For example, if market demand is expected to grow and rents and asset prices are expected to increase over time, asset prices will be a higher multiple over rents than otherwise. Formulating expectations or “speculating” about the course of future rent trends is a necessary part of determining the price one should be willing to pay for an asset. This is neither inefficient nor undesirable. On the other hand, if price expectations

are based on extrapolation of past price increases, we will show that this is likely to lead to classic speculative bubbles. Investors are “speculating” on a continuation of the past high rates of price appreciation. We term such price expectation formation based on extrapolation, speculation, and show how such speculation leads to real estate cycles even when there is no cyclical in the underlying demand and supply fundamentals. We both define backward looking expectations as speculation and show how such price formation leads to cyclical.

We do not, however, assume that such pricing is inefficient in the sense that trading profits can be earned under such circumstances. A concept related to market inefficiency and bubbles is “excess volatility.” All interesting economic series are volatile. What is meant by “excess?” Contrary to assuming that volatility is evidence of the possibility of trading profits, such pricing may persist because trading on “excess volatility” is not feasible.

Herring and Wachter (1999, 2002) present a model that provides the basic rational for why excess volatility and bubbles may occur in real estate markets and yet trading profits are not possible. As discussed below, the model is based on the prevailing prices being set by “optimists” who are subject to “disaster myopia” in their pricing behavior. Because such investors have not seen any downturns in their investing experience, they assume that such events will not occur and that past experience, of long-term price increases, based on continuing increases in demand in markets with limited supply, will persist. In efficient markets, such pricing behavior is countered by informed investors who profit by selling the asset short until the price falls to the fundamental price. Investors can expect to profit from such short sales until the market returns to the

efficient price. But this mechanism is not effective in limiting the positive deviations of the market price of real estate from the fundamental price because there are few organized markets for selling real estate short. This inability to sell real estate short and consequences for optimist-generated run-ups in prices is due to heterogeneity, a fundamental attribute of real estate.

With no short sales, optimists- those with reservations prices above the fundamental value- will strongly influence prices. And they are likely to remain in business so long as the upward trend in prices continues even if their optimism is unfounded by analysis of fundamental value. Even if they earn substandard returns, they are likely to be able to borrow against their capital gains so long as lenders rely on market prices above the fundamental price when determining the value of real estate as collateral.

Financial institutions' lending processes contribute to the formation of bubbles through speculative pricing. Even if investors earn substandard returns, they are likely to be able to borrow against their capital gains so long as lenders rely on speculatively generated market prices when determining the value of real estate as collateral. Agency problems that cause lenders to misprice real estate are discussed in Allen (2001). Managers of financial institutions have incentives to lend at prices above fundamental prices to increase profits in good states of the economy, since only long-term managers lose if they underprice loans and are discovered in bad states of the economy, Pavlov and Wachter (2002). (Even without mispricing in the asset market, such underpricing of lending itself drives asset prices above fundamental levels,(Pavlov and Wachter, 2002.) Moreover, such mispricing may result from the use of the correctly determined current

asset price in the loan underwriting process, when future prices are correctly expected to decline but this expectation is not incorporated, as it should be, into the lending decision. Either way incorrect expectations of future price appreciation, whether originating in the asset or loan market, are self-fulfilling as the bubble builds. As lending is liberalized and leveraged increased at the same time that prices are inflated (as the result, in part, of bank's capital reserves' growth), moral hazard further undermines lenders' incentives to price loans efficiently and exacerbate these underlying forces for the provision of excessive credit (Herring and Wachter 1999, 2002).

How Are Expectations Formed?

There are several models extant of how expectations are formed. Understanding expectations is central to understanding speculation and bubbles. In brief, the most common models of expectations are: myopic expectations, perfect foresight, "rational" expectations, and adaptive expectations. As we will see, these concepts are related, and not all are necessarily mutually exclusive.

In brief (to be expanded below): *Myopic expectations* models assume investors are "flying blind" going forward. At the other extreme, *perfect foresight* assumes that people know the future. *Rational expectations* state that people use all available information to make optimal forecasts about the future (although what is meant by all available information, and how it is used, remains to be developed). *Adaptive expectations* assumes that people are backward looking, that we assume the future will be like the (recent) past.

While the rational-expectations assumptions state that people use all available information to make optimal forecasts about the future, perfect foresight assumes that people have perfect information about the future, this latter assumption is clearly wrong and goes beyond the rational expectation argument of best estimates of future price appreciation based on all available information. (The result of rational expectations is that changes in asset prices over time should be unpredictable. When changes in a variable are unpredictable, the variable is said to follow a random walk.) On the other hand, the hypothesis that the expected price level is based on past values of the actual price level, rather than all available information, is termed adaptive (or backward – looking) expectations. Much of the inflation expectation literature suggests that individuals indeed look to past experience to estimate future inflationary outcomes, generating adaptive expectations. Myopic pricing, short sighted pricing behavior which fails to take account of probable future negative pricing events, can be the outcome of basing future expectations on past pricing. Why are some real estate investors, the optimists, myopic?

Herring and Wachter argue that investors show a particular form of adaptive expectations and myopic pricing behavior, disaster myopia, due to the low-frequency and non-observation of negative events. The ability to estimate a low frequency event- like a collapse in real estate prices- depends on the frequency with which the shock occurs. The low frequency of speculative bubbles, may to permit estimation of shock probabilities with much confidence.

Specialists in cognitive psychology have found that decision makers formulate subjective probabilities on the basis of the ease with which the decision maker can

imagine that the event will occur (Tversky and Kahneman 1982)] At some point, this tendency to underestimate shock probabilities is exacerbated by the threshold heuristic (Simon 1978). This is the rule of thumb by which busy decision makers allocate their scarcest resource, managerial attention. When the subjective probability falls below some threshold amount, it is disregarded and treated as if it were zero.

The availability of information to formulate subjective probabilities and the low threshold likelihood of the event which limits the attention paid to estimating this likelihood together cause “disaster myopia,” the tendency over time to underestimate the probability of low frequency shocks and, in the case of real estate investment, this underestimation itself generates the bubble.

What is a “Bubble?”

The backward-facing or adaptive expectations speculative pricing behavior described above will drive actual investment decisions as well as prices. As higher prices, over time, increase supply, these prices are no longer sustainable. The bubble, rather than dissolving, bursts, as optimistic investors are wiped out and no longer have the capital to act in real estate markets, nor do lenders whose collateral is now worth less than their loans. The result is a credit crunch and “disaster magnification” with potential runs on banks, in the aftermath of a collapse in real estate price.

More formally, recall our present value model from above:

$$V = \sum_{t=0}^T \frac{E[R_t]}{(1+i)^t}$$

where, as noted above, R is net rent; and we have used the term V^* to indicate a particular *fundamental* present value calculated on the basis of net rents without a bubble.¹³ In an influential – and somewhat controversial – paper Blanchard (1979) sets out a theory of “rational” bubbles. Blanchard points out that V^* is not the only admissible rational solution. Suppose in addition to the fundamentals (net rents) we define a periodic “bubble component” b_t ; then any V_t of the following form will also satisfy arbitrage conditions and be “rational:”

$$V_t = V_t^* + b_t, \text{ with } E_t[b_{t+1}] = (1+i)b_t$$

Thus, if at time t an asset is overvalued by an amount b_t , a rational investor will still purchase such an asset, if the degree of overvaluation is expected to grow by a rate equal to or greater than the appropriate discount rate. In turn, this implies that a necessary condition for bubbles to form is serial correlation in price changes. However, to anticipate results below, in our model bubbles will be self-limiting because new supply is being built.

A number of studies have been undertaken to test (1) the existence of serial correlation in housing price changes, and (2) the existence of bubbles. While both tests raise theoretical and econometric issues, direct tests for bubbles are particularly problematic, since theory provides little guide as to the exact process involved in forming a bubble.

While many studies document the existence of serial correlation in prices, the evidence on whether these lead to bubbles is somewhat mixed. Several papers provide evidence of serial correlation in North American housing price changes, such as Case and

¹³ This paragraph draws on Hardouvelis (1988), which contains a particularly cogent discussion of efficiency and “bubbles.”

Shiller (1989), Hamilton and Schwab (1985) and Malpezzi (1999). Englund and Ionnides (1997) find strong serial correlation in housing prices across 15 OECD countries. Kim and Suh (1993) examined Korean and Japanese housing price data, and fit a particular form of the bubble model derived in the spirit of Blanchard and Kahn (1980). In Japan they found evidence of both nominal and real “bubbles;” but in Korea they were unable to reject the null of no bubble in Korean real housing prices. Kim and Kim (1999) find that Korean land prices are cointegrated with GDP and stock prices, suggesting that at least in the long run real estate prices are tied to fundamentals.

Other literature focuses on potential *causes* of bubbles. Some papers like Ortalo-Magné and Rady (2001) focus on the demand side. Others like Malpezzi (1999) include supply side determinants, notably natural constraint, and the role of the regulatory environment. It is to the latter that we now turn.

What Does the Regulatory Environment Have to Do with Speculation?

A theme of our paper is that, while speculation is usually thought of as a demand-side phenomenon, whether demand side events do result in a bubble will depend on supply conditions and will determine whether speculation will be observed and whether price “bubbles” will form. Excessive and inappropriate regulations “in-elasticize supply” and lead to rising real estate prices. Higher prices that then drop increase defaults and adversely affect the soundness of the financial system, leading to credit crunches which then magnify the downturn.

Of course many things besides regulations affect supply, notably natural constraints. Honolulu and San Francisco would likely be expensive markets even in the

absence of stringent regulatory regimes. That said, many studies have demonstrated the strength of the relationship between the regulatory environment and housing and real estate prices. Studies of the U.S. include Pollakowski and Wachter (1990), Segal and Srinavisan (1985), Black and Hoben (1985), Rose (1989), Shilling, Sirmans and Guidry (1991), Malpezzi (1996), Malpezzi, Chun, and Green (1998) and Malpezzi (1999 a). International studies include Angel (2000), Evans (1999) and Monk and Whitehead (1995) as well as Bramley (1993), Angel and Mayo (1996), Malpezzi (1990) and Malpezzi and Ball (1991). A decade and a half ago, in his careful review of housing supply and demand studies, Professor Edgar Olsen wrote

Empirical studies of the supply of housing service are as scarce as studies of its demand are abundant. Indeed, there are not enough studies of any parameter to make it worthwhile to discuss the central tendency of the estimates. [I]t is abundantly clear that the marginal benefit from studying housing supply is much greater than the marginal benefit from studying housing demand.

Of course at the time Olsen wrote, there were already several important studies of the supply side of the real estate market, such as Muth (1960), Ozanne and Struyk (1978) and Follain (1979). But in the past decade or so the number of empirical studies of housing supply, including estimates of that key parameter, the price elasticity of supply (β), have greatly increased. As noted by Malpezzi and Mayo (1997), housing demand parameters are remarkably stable and predictable across countries and places; supply parameters vary much more. More detailed surveys can be found in Bartlett (1989), DiPasquale (1999), and Malpezzi and MacLennan (2001). Here we briefly summarize a few key points that will be important for our modeling effort below.

First, several studies of the U.S. housing market, such as Follain (1979), Muth (1960), Stover (1986), Smith (1976), and Malpezzi and MacLennan (2001) suggest that long run supply elasticities in the U.S. are high; in fact, Muth and Follain cannot reject the hypothesis that long-run U.S. supply curves are perfectly flat. Other studies cited here find supply elasticities on the order of 10 or higher.

Second, a number of other studies, such as Topel and Rosen (1988) and Poterba (1991) find positive but distinctly lower elasticities, on the order of 2-3. Malpezzi and MacLennan present some evidence that both (a) the very high elasticities of Follain and of Muth and (b) the low elasticities of Topel and Rosen and of Poterba may be due to the particular time period chosen for analysis. Malpezzi and MacLennan show that there is no long run trend in housing prices post-World War II, but there are long cycles. The low elasticity studies tend to use data that begin in a trough and end near a peak, while the high elasticity studies pick periods of declining prices or of a more complete cycle. Thus, Malpezzi and MacLennan argue (and present estimates consistent with) high long run supply responsiveness, but they also point out that full adjustment can take a decade or more.¹⁴

By now the fact that excessive regulation leads to high prices is well documented. What is less widely appreciated is the effect regulations have on second moments and risk. Malpezzi (forthcoming) demonstrates that more stringently regulated markets are also more volatile. Following Malpezzi (forthcoming) we can illustrate the process in a simple comparative static fashion with Figures 1 and 2. In Figure 1, a heavily regulated

¹⁴ Of course, it bears repeating, since the thrust of some of this research is often misinterpreted, that regulation *per se* is neither good nor bad. What matters is the cost and benefits of particular regulations under specific market conditions. Regulations need to be put to the cost-benefit test, as any other private or public economic activity.

market with fairly inelastic supply has an initial demand shock characterized by the demand curve moving from D_1 to D_2 . Given this demand shock in a very inelastic short and medium run supply, little supply response is observed and prices increase substantially from P_0 to P_1 . But over the very long run, there is some elasticity even in the most convoluted markets. Eventually, markets and governments do respond to extraordinary price increases and supply shifts out. This results in a housing price crash from P_1 to P_2 .

Contrast this with Figure 2, which is more or less the same except that the markets are more elastic. The initial increase does give rise to a price run up over the medium term, as one would expect, but the run up is much less. Therefore the boom and bust cycle is moderated. These are indicated by shifts from P_0' to P_1' and back down to P_2' .

These processes are not merely a theoretical curiosity. Take the example of Korea: a country with an extremely stringent regulatory environment that has greatly inelasticized supply. Many studies such as Kim (1993), Hannah, Kim and Mills (1990), and Green, Malpezzi, and Vandell (1992) have documented the especially convoluted Korean regulatory system and Malpezzi and Mayo (1997) have shown that this leads to a very inelastic housing supply.

But at some point, as prices skyrocket and shortages become more apparent, the Korean government responds as it did with the Two Million Houses Program in 1990. This has the effect of shifting an inelastic supply curve to the right in a series of discrete jumps. Figure 3 illustrates. After the crash from P_1'' to P_2'' , the process starts over again. As demand grows further, prices rise again to P_3'' .

Thus a world in which government responds to rising housing prices by one time programs to get the market moving, as in Korea's or Sri Lanka's Two Million Houses Program, can be characterized as occasionally *shifting* an inelastic supply curve to the right. This leads perforce to a boom and bust cycle. Reform measures that tackle the root causes of inelastic supply have the effect of *flattening* the supply curve and moderating the boom and bust cycle, reducing risk for investors.

Figures 4 and 5 present some evidence on the relationship between regulation and second moments of housing prices using U.S. metropolitan area data. The dependent variable is the standard deviation of annual changes in “Agency” price changes (repeat sales from Fannie Mae, Freddie Mac), 1979-96. The independent variables are the standard deviation of annual changes in Bureau of Economic Analysis MA real income per capita, 1978-94, and the standard deviation of annual changes in Bureau of Economic Analysis MA employment, 1978-94. Our regulatory measure is from Malpezzi-Chun-Green (Real Estate Economics, 1998). Higher is more stringent. Both the plot and the regression show that regulation increases risk.

So far our discussion is static. But speculation is primarily a dynamic phenomenon, and it is to dynamics that we now turn.

A Simple Dynamic Model of a Housing Market

Our model is a modification of models presented in Malpezzi and Mayo (1997), and extended in Malpezzi and MacLennan (2001). In particular our point of departure is a revision of the stock adjustment model in the latter paper. The stock adjustment model is required for studying dynamics, and is preferred on other grounds as well, given

housing's durable nature, construction lags and significant transactions costs. Following Malpezzi and Maclennan, we begin by writing:¹⁵

$$\begin{aligned}Q_D &= \delta (K^* - K_{-1}) \\K^* &= \bar{\alpha} + \alpha_1 P + \alpha_2 Y + \alpha_3 N \\Q_S &= \bar{\beta} + \beta_1 P \\Q_D &= Q_S\end{aligned}$$

All variables are natural logarithms and coefficients are approximately elasticities; bars indicate intercepts. The variables are defined as follows:

$$\begin{aligned}Q_D &= \log \text{ quantity of housing demanded} \\Q_S &= \log \text{ quantity of housing supplied} \\P &= \log \text{ of the relative price per unit of housing} \\Y &= \log \text{ of income} \\N &= \log \text{ of population}\end{aligned}$$

where K_{-1} is the stock of housing in the preceding period, K^* is the desired stock, and δ is the adjustment per period.

Next we simplify notation somewhat. Since our purpose here is simulation, we can choose arbitrary starting values for variables, drop intercepts, and assume that the relationship between the desired stock, income and population is known and that the demand is separable so that we can subsume Y and N into a generalized demand for stock, D , where D is the amount of stock demand conditional on realized income and population, but on a unit price; that is, we define D such that $K^* = D + \alpha_1 P$, $\alpha_1 < 0$.

¹⁵ Our notation is similar to but slightly different from Malpezzi and Maclennan's. We have also recently noted that Kim and Kim (1999) have developed a model and approach very similar in spirit to our own; their model has several differences, and apparently does not give rise to cycles as ours does. Among papers that model cycles explicitly, see especially Wheaton (1999).

Our other extension of Malpezzi and MacLennan is to explicitly introduce time, including especially temporal lags in supply. Suppressing the intercept, and slightly revising subscripts, we re-write the supply function as:

$$Q_{St} = \beta_0 P_t + \beta_1 P_{t-1} + \beta_2 P_{t-2} + \dots + \beta_n P_{t-n}$$

For the moment, for notational convenience suppose that our supply function is of order two, that is $Q_{St} = \beta_0 P_t + \beta_1 P_{t-1}$. Then substituting our revised expression for K^* into the expression for Q_D , equating supply and demand, and solving for P_t , yields the following:

$$P_t = \frac{\beta_1}{\beta_0 - \delta \alpha_0} P_{t-1} + \frac{\delta}{\beta_0 - \delta \alpha_0} D - \frac{\delta}{\beta_0 - \delta \alpha_0} K_{t-1}$$

As we will see below, the lags in supply will be necessary *and* sufficient to generate changes in the price of housing, but the focus of this paper is speculation, and speculation is usually thought of as a demand-side phenomenon. We follow the discussion above by assuming that the expectations of “speculators” are adaptive, i.e. depend on recent past changes in prices. Hence we augment the demand side of the model so that demand is a negative function of the price level (as before), but now demand is also a positive function of recent price changes. That is, we will examine an alternative model where $K^* = D + \alpha_1 P + \alpha_4 dP$, $\alpha_1 < 0$, $\alpha_4 > 0$.

Now we are ready to write out our simulation model. D is exogenous, and in most simulations will either be subject to a one-time shock, or will be growing over time (as incomes and populations rise in most housing markets. The capital stock grows by the quantity of new housing supplied (i.e. we ignore depreciation for notational simplicity). Thus our simulation model can be expressed as:

$$\begin{aligned}
K_t^* &= D_t + \alpha_1 P_t + \alpha_4 (P_t - P_{t-1}) \\
P_t &= \frac{\beta_1}{\beta_0 - \delta \alpha_0} P_{t-1} + \frac{\delta}{\beta_0 - \delta \alpha_0} K_t^* - \frac{\delta}{\beta_0 - \delta \alpha_0} K_{t-1} \\
Q_s &= \beta_0 P_t + \beta_1 P_{t-1} \\
K_t &= K_{t-1} + Q_s
\end{aligned}$$

Our modeling will focus on two parameters of special interest, and their interaction: the price elasticities of supply (β_i), and the elasticity of demand with respect to price changes, α_4 .

Simulation Results

For simulation purposes, we first set initial conditions. The initial price of housing in period $t=0$ is normalized at one, so the log price variable $P=0.0$, the stock of housing is initially assumed in equilibrium at 1000. In our first set of simulations we first set $D = K = K^* =$ (the log of) 1000 units. We then shock D so that the desired stock of housing, K^* , increases by 20 percent to 1200; in this first simulation, D remains at this level in succeeding periods. We initially set the price elasticity of demand for housing α_1 at -0.8, consistent with literature surveyed in Mayo (1981) and Olsen (1986). The stock adjustment parameter δ is initially set equal to 0.5.

In these first simulations we examine two alternative assumptions about price elasticities of supply (β_i), and two alternative assumptions about the elasticity of demand with respect to price changes, α_4 . As mentioned above, we begin with a very simple lag structure: the supply of new construction depends on two β_i , β_0 (the contemporaneous elasticity) and β_1 (a one period lag). While the literature on housing supply has been growing, to our knowledge the best most studies attempt is some estimate of either short

or long-run elasticities of supply; little is known about explicit lag structures. Estimates of supply elasticities range from statistically indistinguishable from zero (in seriously restricted markets like Korea and Malaysia, as described in Malpezzi and Mayo 1997) to statistically indistinguishable from infinity (in the long run, in the U.S., as in Muth 1960, Follain 1979, and Malpezzi and MacLennan 2001). Green, Malpezzi and Mayo (2000) find a wide range of estimated elasticities, from under 3 in some metropolitan areas like San Francisco, San Jose, Boston, Albany, Boston, New Orleans, Pittsburgh, and Honolulu—cities that are either hemmed in geographically, compact, or not growing. Other metropolitan areas have estimated supply elasticities of greater than 10: Dallas, Atlanta, Phoenix, Charlotte, Columbus, Kansas City, Indianapolis, Tampa-St. Petersburg, Grand Rapids, and Houston, for example. In our initial simulations, we will only consider two extreme values – a total price elasticity of 0.2 (highly inelastic), and a total price elasticity of 10.0 (fairly elastic).

We have not been able to find any estimates of the elasticity of demand for housing with respect to previous price changes. Changes in prices affect expectations and therefore per period housing costs. Our prior belief is that this elasticity would be modest, so we consider two alternatives: an elasticity of zero (“no speculation”) and an elasticity of 0.1 (“speculation”).

Figures 6 and 7 present the time paths of prices under alternative parameter variables. Figure 6 presents the elastic case, and figure 7 the inelastic case. In each figure, the solid line presents the case when α_4 takes the value 0, and the dotted line the case when α_4 is 0.1.

The first thing to notice about these figures is that the model generates cycles, although we have modeled a one-time persistent shock to demand. The cycles stem from two sources: (1) the fact that prices are a function of the stock of housing, so that new supply, and hence the stock, is related to current and past prices; and (2) the speculative parameter α_4 , when that parameter is nonzero.

Next, and perhaps unsurprisingly, the market is more volatile in the inelastic case. In the elastic case, the supply of housing expands fairly rapidly to match the increase in demand; hence, prices don't rise much. On the other hand, in the inelastic case, prices rise by as much as 20 percent (in the "no speculation" case) and by over 30 percent when supply rigidities are exacerbated by investors who follow past price trends and form expectations adaptively.

Just as interestingly, especially given the topic of the conference, is the fact that in the elastic case speculation matters hardly at all; while in the inelastic case, there is a substantial difference in outcomes. Without "speculation," at least as we have characterized it in this particular simulation, an inelastic market is subject to an initial run-up in prices that is dissipated over time. With "speculation," prices boom more strongly in the initial period, and actually decline below the initial equilibrium price, as a volatile cycle is formed.

Of course these particular numbers are only stylized values from a simulation; we have tried to calibrate the model in line with empirical research, where possible, but it is clear that some important parameters – notably our measure of demand adapting to recent house price changes, α_4 – are not known with any precision. Still, we believe we make a

plausible case that it is supply conditions, rather than speculation *per se*, that is the most important driver of housing market performance.

Preliminary Conclusions

Our preliminary conclusions are simple yet, we believe, powerful. The model suggests, first of all, that even a simple model of lagged supply response to price changes and speculation is sufficient to generate real estate cycles. Second, the volatility of prices – the biggest purported downside of “speculation” – is strongly related to supply conditions. Even more interestingly, the effect of speculation itself depends on supply conditions. Markets with more responsive regulatory environments, or less natural constraint (from physical geography), will experience less volatility as well as less behavior characterized as speculation.

The policy implications of this model and our review are strong, and very consistent with previous authors such as Case (1993), Kim and Kim (1999), and Kim and Suh (1993). Demand conditions in general, and speculation in particular, can contribute to a boom and bust cycle in housing and real estate markets – but the effects of speculation appear to be dominated by the effect of the price elasticity of supply. In fact, the largest effects of speculation are only observed when supply is inelastic. Thus effective policies will focus on improving the efficiency of the supply of developable land, and real estate generally, including the development of an appropriate regulatory framework for real estate.

Future Work

While we believe the current draft has already clarified our thinking on speculation, it is clear that the paper can be improved in several respects. Most obviously, we intend to undertake a wider range of simulations, and continue to test and refine the model. For example, alternative lag structures for the supply response will be examined, a la Wheaton (1999). Second, we intend to refocus attention to the literature as well as to our own econometric work to obtain better estimates of the parameters. We can also consider alternatives to our initial adaptive expectations mechanism for the formation of housing market expectations.

References

- Abraham, Jesse M. and Patric H. Hendershott. Bubbles in Metropolitan Housing Markets. *Journal of Housing Research*, 7(2), 1996, pp. 191-208.
- Allen, F. 2001. Presidential Address: Do Financial Institutions Matter? *The Journal of Finance*. 56:1165-1176.
- Amihud, Yakov and Haim Mendelson. Liquidity, Asset Prices and Financial Policy. *Financial Analysts Journal*, November/December 1991, pp. 56-66.
- Angel, Shlomo. *Housing Policy Matters: A Global Analysis*. Oxford, 2000.
- Angel, Shlomo and Stephen K. Mayo. Enabling Policies and Their Effects on Housing Sector Performance: A Global Comparison. Paper presented to the Habitat II Conference, Istanbul, Turkey, June 1996.
- Atterhog, Mikael. Municipal Land Management in Asia: A Comparative Study. United Nations Economic and Social Commission for Asia and the Pacific, 1995.
- Benveniste, Larry, Dennis R. Capozza and Paul J. Seguin. The Value of Liquidity. *Real Estate Economics*, 29(4), 2001, pp. 633-60.
- Barkham, R.J. and David M. Geltner. Price Discovery and Efficiency in the UK Housing Market. *Journal of Housing Economics*, 5(1), March 1996, pp. 41-63.
- Bartlett, Will. *Housing Supply Elasticities: Theory and Measurement*. York, UK: Joseph Rowntree Memorial Trust Working Paper No. 2, 1989.
- Black, J. Thomas and James Hoben. Effect of Policy Restrictions on Residential Land Prices. *Urban Land*, 43(4), 1984, p. 4.
- Blackley, Dixie M. and James R. Follain. In Search of the Linkage between User Cost and Rent. *Regional Science and Urban Economics*, 26, 1996, pp. 409-31.
- Bramley, Glen. Housing Market Adjustment and Land-Supply Constraints. *Environment and Planning A*, 31(7), July 1999, pp. 1169-88.
- Blanchard, Oliver. Speculative Bubbles, Crashes, and Rational Expectations. *Economics Letters*, 4, 1981, pp. 387-9.
- Borio, C.E.V., N. Kennedy and S.D. Prowse. Exploring Aggregate Asset Price Fluctuations Across Countries. BIS Economic Papers, No. 40, 1994.
- Capozza, Dennis R. The Efficiency of Speculation in Urban Land. *Environment and Planning A*, 1976, pp. 203-15.

Capozza, Dennis R. and Gregory M. Schwann. The Value of Risk in Real Estate Markets. *Journal of Real Estate Finance and Economics*, 3(2), June 1990, pp. 117-140.

Case, Bradford, William N. Goetzmann and Susan M. Wachter. The Global Commercial Property Market Cycles: A Comparison Across Property Types. Paper presented to the International AREUEA Conference, Berkeley, June 1997.

Case, Karl E. Real Estate and the Macroeconomy. *Brookings Papers on Economic Activity* 2, 2000, pp. 119-162.

Case, Karl E. Taxes and Speculative Behavior in Land and Real Estate Markets. *Research in Urban Economics*, 9, 1993, pp. 225-39.

Case, Karl E. and Robert J. Shiller. *The Behavior of Home Buyers in Boom and Post-Boom Markets*. Yale University, Cowles Foundation Discussion Paper No. 890, 1988.

Case, Karl E. and Robert J. Shiller. The Efficiency of the Market for Single Family Homes. *American Economic Review*, 79(1), March 1989, pp. 125-37.

Case, Karl E. and Robert J. Shiller. Forecasting Prices and Excess Returns in the Housing Market. *AREUEA Journal*, 18, 1990, pp. 253-73.

Cho, Man. House Price Dynamics: A Survey of Theoretical and Empirical Issues. *Journal of Housing Research*, 7(2), 1996, pp. 145-172.

Clayton, Jim. Rational Expectations, Market Fundamentals and Housing Price Volatility. *Real Estate Economics*, 24(4), Winter 1996, pp. 441-70.

Clayton, Jim. Are Housing Price Cycles Driven by Irrational Expectations? *Journal of Real Estate Finance and Economics*, 14(3), 1997, pp. 341-63.

De Bondt, Werner F.M. Real Estate Cycles and Animal Spirits. In Joseph Pagliari (ed.), *The Real Estate Portfolio Handbook*, Richard Irwin, 1995.

DiPasquale, Denise. Why Don't We Know More About Housing Supply? *Journal of Real Estate Finance and Economics*, 18(1), January 1999, pp. 9-24.

DiPasquale, Denise and William C. Wheaton. The Markets for Real Estate Assets and Space: A Conceptual Framework. *AREUEA Journal*, 20(2), Summer 1992, pp. 181-198.

Eckart, Wolfgang. Land Speculation and the Rental Price of Housing. *Journal of Urban Economics*, 13(1), 1983, pp. 1-21.

Evans, Alan W. The Land Market and Government Intervention. In Paul Chesire and Edwin S. Mills, (eds.), *Handbook of Regional and Urban Economics*. Volume 3, Elsevier, 1999.

Feagin, Joe R. Urban Real Estate Speculation in the United States: Implications for Social Science and Urban Planning. In Rachel G. Bratt, Chester Hartman and Ann Meyerson, *Critical Perspectives on Housing*, Temple University Press, 1986.

Follain, James R. The Price Elasticity of the Long Run Supply of New Housing Construction. *Land Economics*, 55, 1979, pp. 190-99.

Green, Richard K. and Stephen Malpezzi. *A Primer on U.S. Housing Markets and Policy*. Urban Institute Press for the American Real Estate and Urban Economics Association, forthcoming 2002.

Green, Richard K., Stephen Malpezzi and Stephen K. Mayo. Metropolitan Specific Estimates of the Price Elasticity of Supply of Housing, and Their Sources. Paper Presented to the American Real Estate and Urban Economics Association, Boston, January 2000.

Green, Richard K., Stephen Malpezzi and Kerry Vandell. Urban Regulations and the Price of Land and Housing in Korea. *Journal of Housing Economics*, 3, 1994, pp. 330-56.

Hamilton, Bruce and Robert Schwab. Expected Appreciation in Urban Housing Markets. *Journal of Urban Economics*, 18(1), July 1985, pp. 103-18.

Hannah, Lawrence, Kyung-Hwan Kim and Edwin S. Mills. Land Use Controls and Housing Prices in Korea. *Urban Studies*, 30, 1993, pp. 147-56.

Hardouvelis, Gikas A. Evidence on Stock Market Speculative Bubbles: Japan, the United States, and Great Britain. *Federal Reserve Bank of New York Quarterly Review*, 13(2), Summer 1988, pp. 4-16.

Herring, Richard J. and Susan Wachter. Real Estate Booms and Banking Busts: An International Perspective. Washington, D.C.: The Group of 30, Occasional Papers, 1999.

Herring, Richard J. and Susan Wachter. Real Estate Bubbles. In George Kaufman (ed.), *Asset Price Bubbles: Implications for Monetary, Regulatory and International Policies*., MIT press, 2002.

Higgins, Matthew and Carol Osler. Asset Market Hangovers and Economic Growth: The OECD During 1984-93. *Oxford Review of Economic Policy*, 13(3), 1997, pp. 110-34.

Kim, Chung-Ho and Kyung-Hwan Kim. Expectations and Housing Price Dynamics Following Deregulation. *International Real estate Review*, 2, 1999, pp. 126-42.

Kim, Kyung-Hwan. An Analysis of Inefficiency Due to Inadequate Mortgage Financing: The Case of Seoul, Korea. *Journal of Urban Economics*, 28, 1990, pp. 371-90.

Kim, Kyung-Hwan and Hahn Shik Lee. Real Estate Price Bubble and Price Forecasts in Korea. Department of Economics, Sogang University, Processed, 2000.

Kim, Kyung-Hwan and Seoung-Hwan Suh. Speculation and House Price Bubbles in the Korean and Japanese Real Estate Markets. *Journal of Real Estate Finance and Economics*, 6(1), January 1993, pp. 73-88.

Korea Herald. Minister Requests Restraint in Housing Price Hikes. March 16, 2002.

Korea Times. Crackdown on Real Estate Speculators Intensifying. February 9, 2002.

Krainer, John. A Theory of Liquidity in Residential Real Estate Markets. *Journal of Urban Economics*, 49, 2001, pp. 32-53.

Lee, Phil-Sang. Nightmarish Real Estate Speculation and Currency Crisis. *Korea Times*, January 31, 2001.

Lin, Zhenguo and Kerry D. Vandell. Asset Allocation with Liquid and Illiquid Markets. University of Wisconsin, Center for Land Economics Research Working Paper, 2001.

Lin, Zhenguo and Kerry D. Vandell. Illiquidity and Real Estate Risk. University of Wisconsin, Center for Land Economics Research Working Paper, 2001.

Magill, Michael and Martine Quinzii. Incomplete Markets over an Infinite Horizon: Long-Lived Securities and Speculative Bubbles. *Journal of Mathematical Economics*, 26(1), 1996, pp. 133-70.

Maisel, Sherman J. A Theory of Fluctuations in Residential Construction Starts. *American Economic Review*, 53, June 1963, pp. 359-83.

Malpezzi, Stephen. A Simple Error-Correction Model of Housing Prices. *Journal of Housing Economics*, 8, 1999, pp. 27-62.

Malpezzi, Stephen. Tales from the Real Side: Urban Development Research and Its Implications for Housing Finance in Developing and Transition Economies. *Cityscape*, forthcoming.

Malpezzi, Stephen and Duncan MacLennan. The Long Run Price Elasticity of Supply of New Construction in the United States and the United Kingdom. *Journal of Housing Economics*, September 2001.

- Mayer, Christopher J. and C. Tsurriel Somerville. Residential Construction: Using the Urban Growth Model to Estimate Housing Supply. *Journal of Urban Economics*, 48(1), July 2000, pp. 85-109.
- Mayo, Stephen K. and Stephen Sheppard. Housing Supply and the Effects of Stochastic Development Control. *Journal of Housing Economics*, 10(2), June 2001, pp. 109-28.
- Mera, Koichi and Bertrand Renaud. *Asia's Financial Crisis and the Role of Real Estate*. M.E. Sharpe, 2000.
- Mills, Edwin S. and Ronald Simenauer. The Elusive Speculative Bubble in Housing. Northwestern Center for Real Estate Research Working Paper, 1991.
- Muellbauer, John and Anthony Murphy. Booms and Busts in the UK Housing Market. *Economic Journal*, 107, 1997, pp. 1701-27.
- Muth, Richard F. The Demand for Non-Farm Housing. Arnold Harberger, *The Demand for Durable Goods*, University of Chicago Press, 1960.
- Muth, Richard F. Expectations of House Price Changes. *Papers of the Regional Science Association*, 59, 1986, pp. 45-55.
- Nguyen Hong. Speculators Fuel City's Property Boom. *Vietnam Investment Review*, May 4, 2002.
- Olsen, Edgar O. The Demand and Supply of Housing Services: A Critical Review of the Empirical Literature. E.S. Mills (ed.), *Handbook of Regional and Urbna Economics*, V. 2, Elsevier, 1987.
- Ortalo-Magné, François and Sven Rady. Housing Market Dynamics: On the Contribution of Income Shocks and Credit Constraints. Center for Economic Studies Working Paper, 2001.
- Ott, Steven H., Timothy J. Riddiough, Ha-Chin Yi and Jiro Yoshida. On Demand: Cross-Country Evidence from Commercial Real Estate Markets. Processed, 2000.
- Ozanne, Larry and Raymond Struyk. The Price Elasticity of Supply of Housing Services. In L.S. Bourne and J.R. Hitchcock, *Urban Housing Markets: Recent Directions in Research and Policy*, University of Toronto Press, 1978, pp. 109-38.
- Park, Chan Il and Jene K. Kwon. The Hyper-Inflation of Land and Consumption Behavior. *International Economic Journal*, 10(4), Winter 1996, pp. 47-58.
- Pavlov, Andrey and Susan M. Wachter. The Option Value of Non-Recourse Lending and Inflated Asset Prices. Wharton Real Estate Working Paper Series. February 27, 2002.

Pollakowski, Henry O. and Susan M. Wachter. The Effects of Land Use Constraints on Housing Prices. *Land Economics*, 66(3), August 1990, pp. 315-24.

Poterba, James M. House Price Dynamics: The Role of Tax Policy and Demography. *Brookings Papers on Economic Activity* 2, 1991.

Renaud, Bertrand. The 1985-1994 Global Real Estate Cycle: An Overview. *Journal of Real Estate Literature*, 5(1), January 1997, pp. 13-44.

Renaud, Bertrand. Speculative Behavior in Immature Real Estate Markets: Lessons from the 1997 Asia Crisis. Paper presented to the Lincoln Institute of Land Policy, Cambridge, Mass.: March 2002.

Renaud, Bertrand, Frederik Pretorius and Bernabe Pasadilla. *Markets at Work: Dynamics of the Residential Real Estate Market in Hong Kong*. Hong Kong University Press, 1997

Renaud, Bertrand, Ming Zhang and Stefan Koeberle. How the Thai Real Estate Boom Undid Financial Institutions: What Can Be Done Now? Paper presented to the NESDB Seminar on Thailand's Economic Recovery and Competitiveness, Bangkok, May 20, 1998.

Riddiough, Timothy J. The Economic Consequences of Regulatory Taking Risk on Land Value and Development Activity. *Journal of Urban Economics*, 41(1), January 1997, pp. 56-77.

Rose, Louis A. Urban Land Supply: Natural and Contrived Restrictions. *Journal of Urban Economics*, 25, 1989, pp. 325-45.

Segal, David and Philip Srinivasan. The Impact of Suburban Growth Restrictions on U.S. Housing Price Inflation, 1975-78. *Urban Geography*, 6(1), 1985, pp. 14-26.

Shear, William B., Susan M. Wachter and John C. Weicher. Housing as an Asset in the 1980s and 1990s. *Housing Finance Review*, 3(4), 1984.

Shiller, Robert J. *Market Volatility*. MIT Press, 1989.

Simon, Herbert A. Rationality as Process and Product of Thoughts. *American Economic Review*, 68 (May), 1978, pp. 1-16.

Smith, Barton A. The Supply of Urban Housing. *Quarterly Journal of Economics*, August 1976, pp. 389-405.

Stover, Mark. The Price Elasticity of Supply of Single Family Detached Housing. *Journal of Urban Economics*, 20, 1986, pp. 331-40.

Suiter, Jane. New Bacon Report Likely to Recommend Tax on Speculators. *Irish Times*, June 2, 2000.

Tan Wei Ping. Don't Let Up on Property Speculators. *The Business Times* (Singapore), January 22, 2002.

Titman, Sheridan. Urban Land Prices Under Uncertainty. *American Economic Review*, 75, 1985, pp. 505-14.

Topel, Robert and Sherwin Rosen. Housing Investment in the United States. *Journal of Political Economy*, 96(4), 1988, pp. 718-40.

Tversky, Amos, and Daniel Kahneman. Availability: A Heuristic for Judging frequency and Probability. In D. Kahneman et al, eds., *Judgment under Uncertainty*. New York: Cambridge University Press, 1982.

West, Kenneth D. Bubbles, Fads and Stock Price Volatility Tests. NBER, 1988.

Wheaton, William C. The Cyclic Behavior of the National Office Market. *AREUEA Journal*, 15, 1987, pp. 281-99.

Wheaton, William C. Real Estate "Cycles:" Some Fundamentals. *Real Estate Economics*, 27(2), Summer 1999, pp. 209-30.

Demand Shocks with Inelastic Supply: Boom and Bust

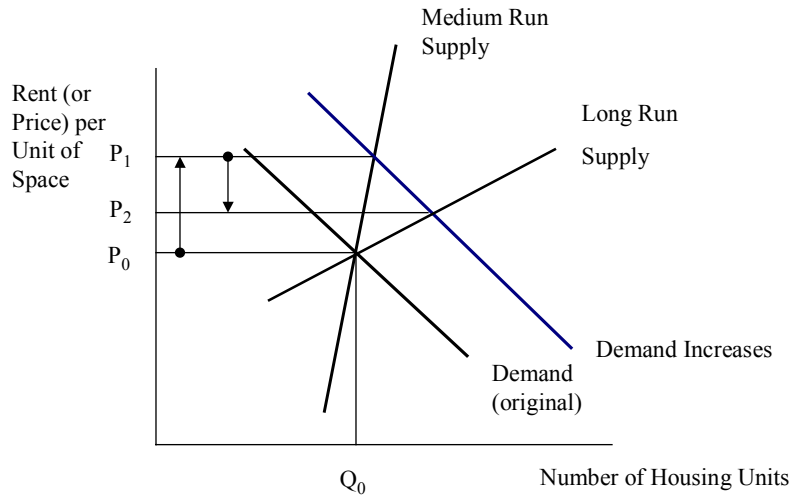


Figure 1

Demand Shocks with Elastic Supply: Lower Price Shocks, Less Volatility

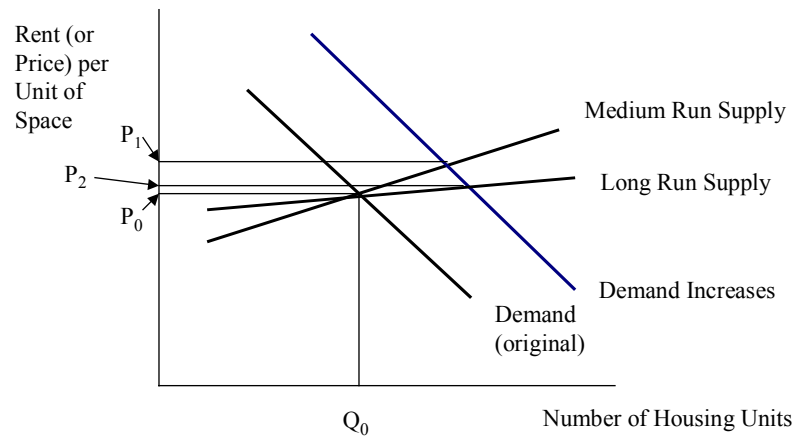


Figure 2

Demand Shocks with Inelastic Supply, Followed by a “Million Houses Program”

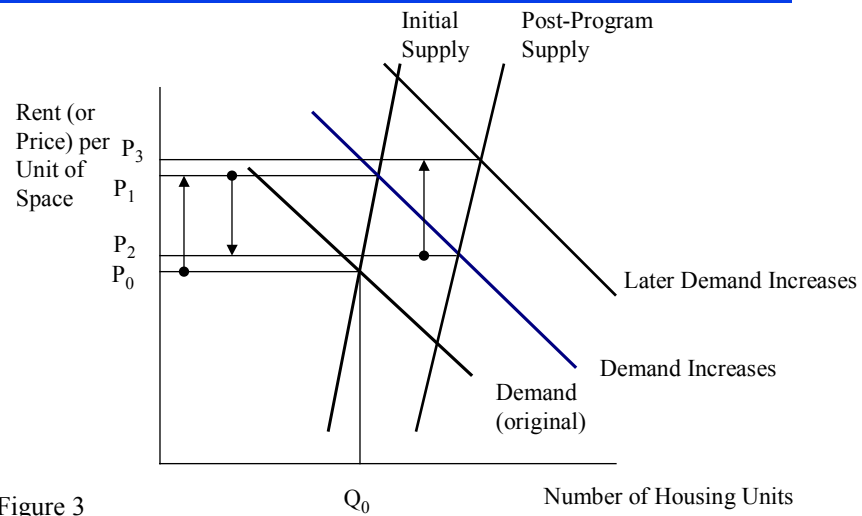


Figure 3

Std Dev of Real Avg House Price Change (1979-96) and Regulation (1989)

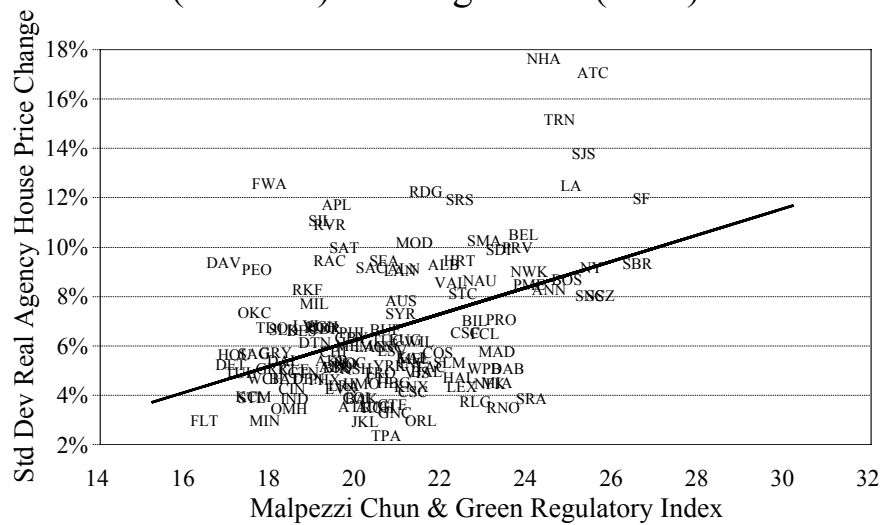


Figure 4

— (Linear Fit)

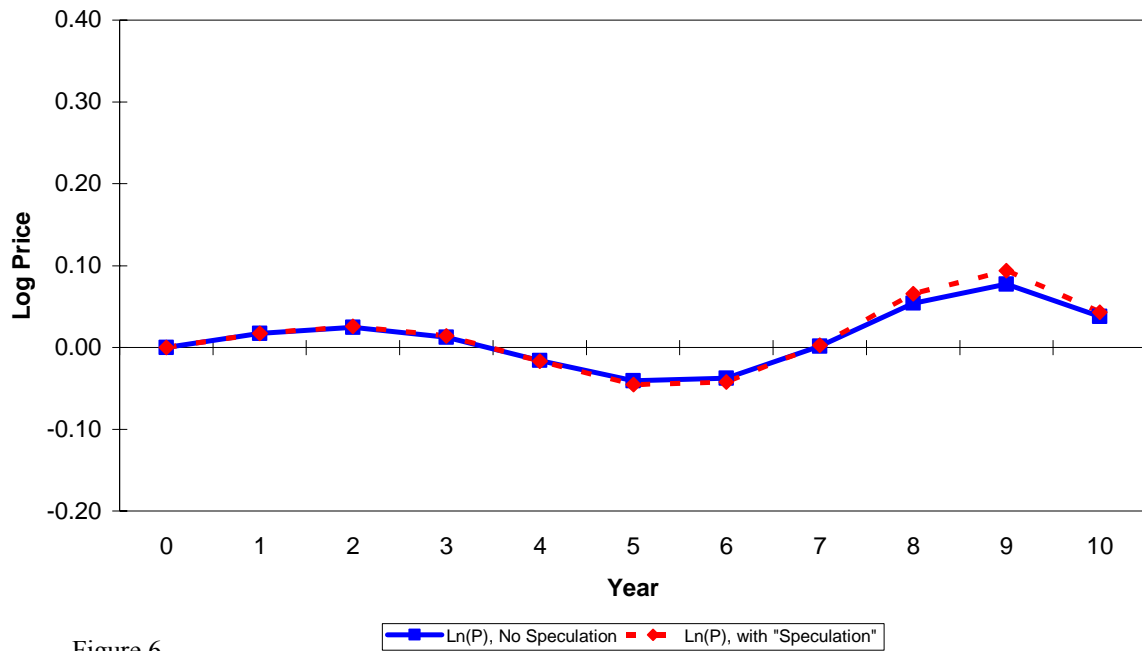
Exploratory Regression, Explaining Standard Deviation of Annual Agency Housing Price Changes, U.S. Metro Areas

	Standardized Coefficient	t-Statistic	Prob > t
Std Dev of Real Changes in Income Per Capita	-0.10	-1.1	.2877
Std Dev of Annual Changes in Employment	0.26	2.7	.0073
M-C-G Regulatory Index	0.42	5.3	.0001
Intercept	-0.00	-2.9	.0046

Adjusted R-squared: 0.21
Degrees of freedom: 125

Figure 5

Simple Housing Supply Dynamics Elastic Supply



Simple Housing Supply Dynamics Inelastic Supply

