The Role of Speculation in Real Estate Cycles

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Abstract

This paper develops and simulates a model to examine whether land speculation is primarily a cause of, or a symptom of, property cycles. The model suggests that the volatility of prices—the biggest purported downside of "speculation"—is strongly related to supply conditions. Moreover, while demand conditions in general, and speculation in particular, contribute to boom and bust cycles in housing and real estate markets, the impact of speculation is dominated by the effect of the price elasticity of supply. In fact, the large impacts of speculation are only observed when supply is inelastic.

Introduction

Real estate prices are by their nature prone to cycles (*e.g.*, Borio, Kennedy and Prowse, 1994; Abraham and Hendershott, 1996; Case, Goetzmann and Wachter, 1997; and Wheaton, 1999). Observers in many countries point to "speculation" in land or real estate markets as a prime mover of such cycles (see Feagin, 1986; Atterhog, 1995; Suiter, 2000; *Korea Herald*, 2002; *Korea Times*, 2002; Hong, 2002; and Tan, 2002, among many others). But speculation has many definitions, and there are many other candidate determinants of cycles as well. This paper first discusses alternative definitions of speculation. A conceptual model is then developed 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 the regulatory environment for development (Pollakowski and Wachter, 1990; Malpezzi, 1999; and Case, 2000). A simulation model is developed 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 (Renaud, Zhang and Koeberle, 1998; and Herring and Wachter, 1999). 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 (Mera and Renaud, 2000). If banking systems in these countries had not been damaged by the speculative boom in land markets followed by the collapse of

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land prices, these foreign exchange crises would have been less devastating, and economic recovery in Japan, for example, would have occurred more quickly. The conceptual framework developed in this paper can be used to interpret recent examples of the land price booms and busts leading local business cycles.

On the regulatory front, the model developed in this paper explains how the amplitudes of cycles, and the relationship between cycles and speculation, are affected by the elasticity of supply of real estate. This in turn has several determinants, some of which (like natural constraints) are difficult to modify by changes in government policy.[1] But the regulatory environment is shown to be another fundamental determinant of supply conditions, and the results can be used to analyze the impacts of regulatory frameworks of housing markets.[2]

Fundamentals of Asset Pricing

Housing is an *asset* that yields a flow of services over time.[3] The relationship between house value and house rents is key to the modeling of cycles. 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 (Blackley and Follain, 1996; Green and Malpezzi, 2003).

In addition, rent as usually conceived and measured 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 housing is analyzed it refers to (1) the rental price per unit of housing services, P, and (2) the quantity of housing services produced by a unit, Q. The product of these is rent, R.[4]

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

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

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.[5] 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 will be seen, the nature of expectations is central to pricing, and to this paper.

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

$$V \cong \frac{E[R]}{i}. \tag{2}$$

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:

$$V \cong \frac{E[R]}{i - g} = \frac{E[R]}{c}, \tag{3}$$

where c is used to denote the capitalization or "cap rate."[6] 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 is 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.

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.[7] Speculation in this sense is intimately bound up with the question of the optimal timing of development (Capozza, 1976; Titman, 1985; and Mayo and Sheppard, 2001).

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, 2001a, b; and Capozza, Hendershott and Mack 2004).

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 illinformed, 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.[8] For example, many models of 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. In this case, demand will increase in dP_t.

While speculation is not explicitly modeled here 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."

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 (1996): "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 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 (Case and Shiller, 2003).

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 will be seen, 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 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, this is likely to lead to classic speculative bubbles. Investors are "speculating" on a continuation of the past high rates of price appreciation. Such price expectation formation is based on extrapolation, which is speculation, and such speculation leads to real estate cycles even when there is no cyclicality in the underlying demand and supply fundamentals. Backward looking expectations is defined here as speculation and how such price formation leads to cyclicality will be demonstrated.

However, such pricing is not assumed to be 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.

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 even 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 expected decline 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 the bank's capital reserves' growth), moral hazard further undermines lenders' incentives to price loans efficiently and exacerbates 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 will be seen, these concepts are related, and not all are necessarily mutually exclusive.

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 the future will likely 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 that 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 (1999) 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 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.[9]

The availability of information to formulate subjective probabilities and the low threshold likelihood of the event that 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 the present value model from above:

$$V = \sum_{t=0}^{T} \frac{E[R_t]}{(1 + i)^t}, \tag{4}$$

where, as noted above, R is net rent; and the term V^* is used to indicate a particular *fundamental* present value calculated on the basis of net rents without a bubble.[10] In an influential—and somewhat controversial—paper Blanchard (1979) sets out a theory of "rational" bubbles. The author points out that V^* is not the only admissible rational solution. Suppose in addition to the fundamentals (net rents) a periodic "bubble component" is defined as b; then any V_t of the following form will also satisfy arbitrage conditions and be "rational:"

$$V_t = V^*_t + b_t, \text{ with } E_t[b_{t+1}] = (1 + i)b_t. \tag{5}$$

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 the 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 Hamilton and Schwab (1985), Case and Shiller (1989) and Malpezzi (1999). Englund and Ioannides

(1997) find strong serial correlation in housing prices across fifteen 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.

What Does the Regulatory Environment Have to Do with Speculation?

A theme of this 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" 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. 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 Black and Hoben (1985), Segal and Srinivisan (1985), Rose (1989), Pollakowski and Wachter (1990), Shilling, Sirmans and Guidry (1991), Malpezzi (1996), Riddiough (1997), Malpezzi, Chun and Green (1998) and Malpezzi (1999). International studies include Malpezzi (1990), Angel and Mayo (1996), Monk and Whitehead (1996), Bramley (1999), Evans (1999) and Angel (2000).

Olsen (1986), in his careful review of housing supply and demand studies, 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 (1986) 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). Below are a few key points that are important to the model.

First, several studies of the U.S. housing market, such as Muth (1960), Smith (1976), Follain (1979), Stover (1986), 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.

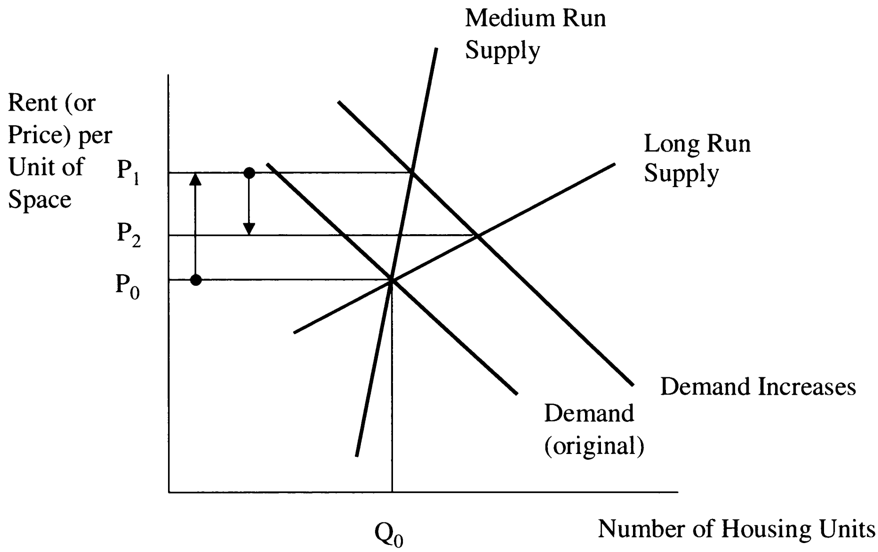
Second, a number of other studies, such as Topel and Rosen (1988) and Poterba (1991) find positive but distinctly lower elasticities, on the order of 2–3. Malpezzi and Maclennan (2001) present some evidence that both (1) the very high elasticities of Muth (1960) and Follain (1979) and (2) the low elasticities 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.[11]

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), the process can be illustrated in a simple comparative static fashion with Exhibits 1 and 2. In Exhibit 1, a heavily regulated 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 Exhibit 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 Hannah, Kim and Mills (1990), Kim and

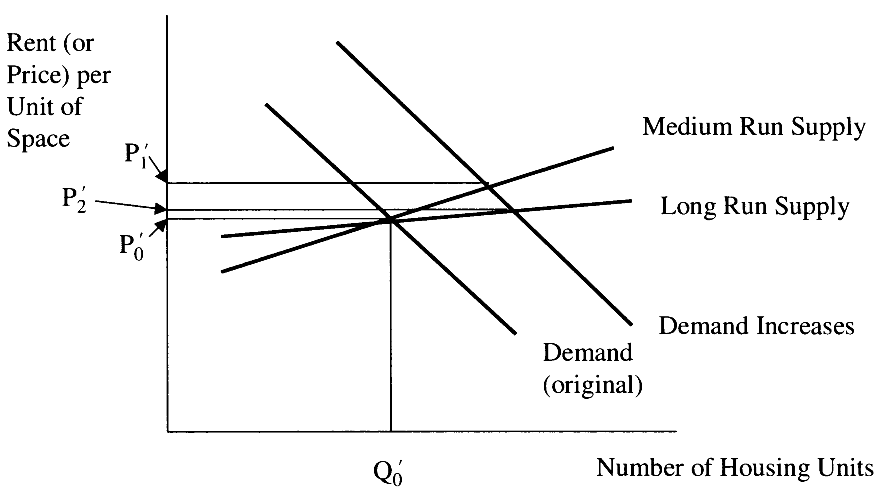
Exhibit 1
Demand Shocks with Inelastic Supply: Boom and Bust



Suh (1993), and Green, Malpezzi and Vandell (1994) 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.

Exhibit 2
Demand Shocks with Elastic Supply: Lower Price Shocks, Less Volatility



This has the effect of shifting an inelastic supply curve to the right in a series of discrete jumps (Exhibit 3). 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.

Exhibits 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), 1979–1996. The independent variables are the standard deviation of annual changes in Bureau of Economic Analysis MA real income per capita, 1978–1994, and the standard deviation of annual changes in Bureau of Economic Analysis MA employment, 1978–1994. The regulatory measure is from Malpezzi, Chun and Green (1998). Higher is more stringent. Both the plot and the regression show that regulation increases risk.

So far the discussion has been static. But speculation is primarily a dynamic phenomenon, and it is to dynamics that the discussion now turns.

Exhibit 3
Demand Shocks with Inelastic Supply, Followed by a "Million Houses Program"

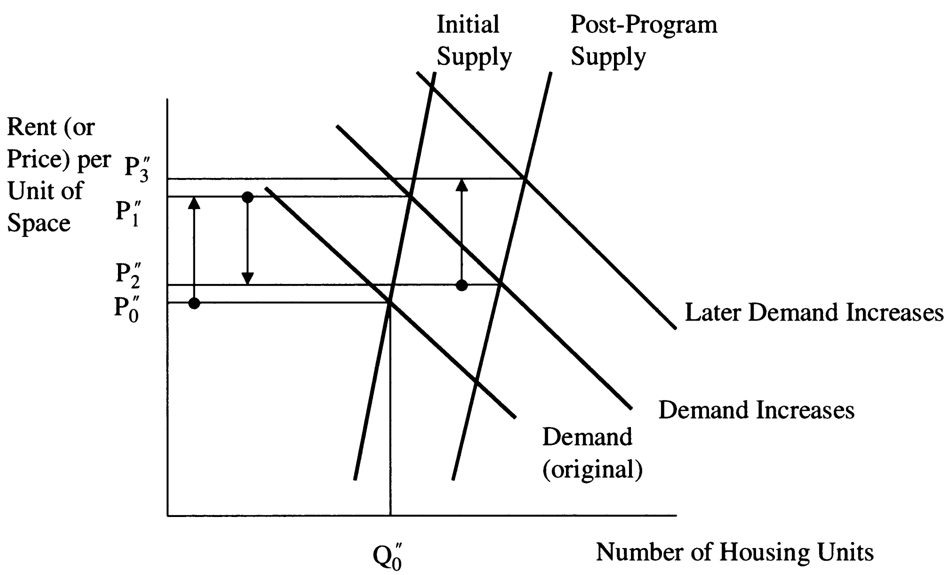
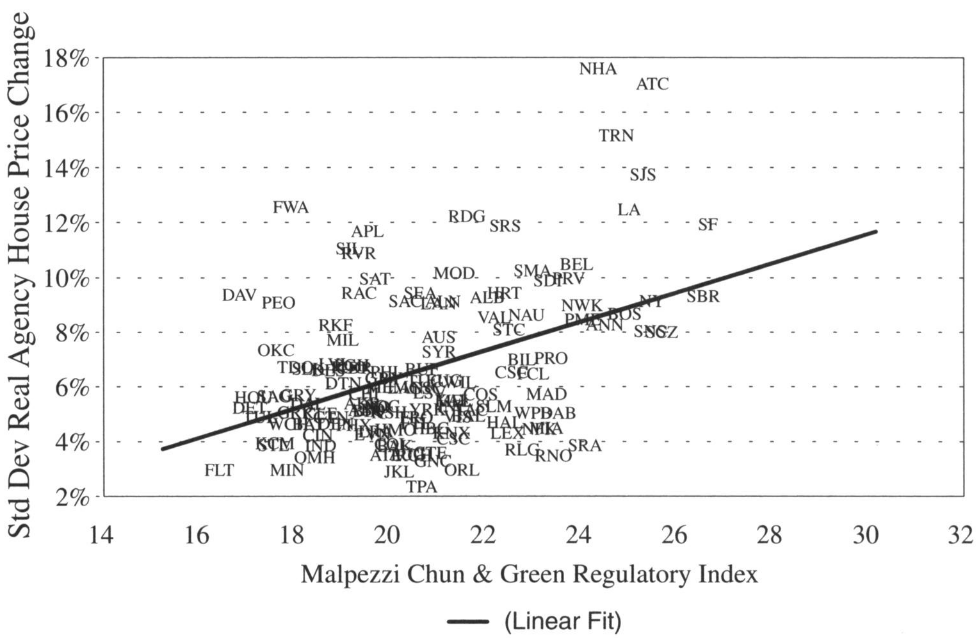


Exhibit 4
Std. Dev. Of Real Avg. House Price Change (1979–96) and Regulation (1989)



A Simple Dynamic Model of a Housing Market

The model is a modification of models presented in Malpezzi and Mayo (1997), and extended in Malpezzi and Maclennan (2001).[12] In particular, the 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,

Exhibit 5
Exploratory Regression, Explaining Standard Deviation of Annual Agency Housing Price Changes, U.S. Metro Areas

	Standardized Coefficient	*t*-Stat.	Prob > |t|
Standard deviation of real changes in income per capita	−0.10	−1.1	.2877
Standard deviation of annual changes in employment	0.26	2.7	.0073
M-C-G Regulator Index	0.42	5.3	.0001
Intercept	−0.00	−2.9	.0046

Notes: Adjusted R^2 = .21; degrees of freedom = 124.

given housing's durable nature, construction lags and significant transactions costs. Following Malpezzi and Maclennan:[13]

$$
\begin{aligned}
Q_t^D &= \delta(K_t^* - K_{t-1}).\\
K_t^* &= \overline{\alpha} + \alpha_0 P_t + \alpha_1 Y_t + \alpha_2 N_t.\\
Q_t^S &= \overline{\beta} + \beta_0 P_t.\\
Q_t^D &= Q_t^S.
\end{aligned} \tag{6}
$$

All variables are natural logarithms and coefficients are approximately elasticities; bars indicate intercepts. Time is denoted by subscript t, and the variables are defined as follows:

Q^D = Log quantity of housing demanded per period (flow demand);
Q^S = Log quantity of housing supplied;
P = Log of the relative price per unit of housing;
Y = Log of income;
N = Log of population;
K_{t-1} = Stock of housing in the preceding period;
K* = The desired stock; and
δ = The adjustment per period.

See Wheaton (1999) for alternative lag structures.

Next, the notation is simplified somewhat. Since the purpose here is simulation, arbitrary starting values can be chosen for the variables, the intercepts can be dropped, and an assumption made that the relationship between the desired stock, income and population is known and that the demand is separable so that Y and N can be subsumed 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, D is defined such that $K^* = D + \alpha_0 P$, $\alpha_0 < 0$.

The other extension of Malpezzi and Maclennan (2001) is to explicitly introduce time, including especially temporal lags in supply. Suppressing the intercept, and adding subscripts for additional periods, the supply function can be re-written as:

$$Q_{St} = \beta_0 P_t + \beta_1 P_{t-1} + \beta_2 P_{t-2} + \ldots + \beta_n P_{t-n}. \tag{6}$$

For the moment, for notational convenience, suppose that the supply function is of order two, that is $Q_t^S = \beta_0 P_t + \beta_1 P_{t-1}$. Then substituting the revised expression for K^* into the expression for Q^D, equating supply and demand:

$$\beta_0 P_t + \beta_1 P_{t-1} = \delta(D_t + \alpha P_t - K_{t-1}), \tag{7}$$

and solving for P_t, yields:

$$P_t = \frac{-\beta_1}{\beta_0 - \delta\,\alpha_0} P_{t-1} + \frac{\delta}{\beta_0 - \delta\,\alpha_0} D - \frac{\delta}{\beta_0 - \delta\,\alpha_0} K_{t-1}. \tag{8}$$

As seen 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. Next, the expectations of "speculators" are assumed to be adaptive (*i.e.*, depend on recent past changes in prices). Hence, the demand side of the model is augmented 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, an alternative model will be examined where $K^* = D + \alpha_0 P + \alpha_3 dP$, $\alpha_0 < 0$, $\alpha_3 > 0$.

Now the simulation model can be written. D is exogenous, and will be subject to a one-time shock. The capital stock grows by the quantity of new housing supplied (*i.e.*, depreciation is ignored for notational simplicity). Thus, the simulation model can be expressed as:

$$\begin{aligned} D_t &= + \alpha_0 P_t + \alpha_3 (P_t - P_{t-1}) - K_t^*. \\ P_t &= \frac{-\beta_1}{\beta_0 - \delta\alpha_0} P_{t-1} + \frac{\delta}{\beta_0 - \delta\alpha_0} D_t - \frac{\delta}{\beta_0 - \delta\alpha_0} K_{k-1}. \\ Q_S &= \beta_0 P_t + \beta_1 P_{t-1}. \\ K_t &= K_{t-1} + Q^S. \end{aligned} \tag{9}$$

The 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_3.

Simulation Results

For simulation purposes, the initial conditions must be presented. 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 the first set of simulations, $D = K = K^* =$ (the log of) 1000 units. D is then shocked so that the desired stock of housing, K^* increases by 20% to 1200; in this first simulation, D remains at this level in succeeding periods. The price elasticity of demand for housing α_0 was initially set 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, 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_3, are examined. As mentioned above, a very simple lag structure is developed: 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, most studies only attempt 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 three in some metropolitan areas like San Francisco, San Jose, Boston, Albany, Boston, New Orleans, Pittsburgh and Honolulu—cities that are either hemmed in geographically, are compact, or not growing. Other metropolitan areas have estimated supply elasticities of greater than ten: Dallas, Atlanta, Phoenix, Charlotte, Columbus, Kansas City, Indianapolis, Tampa–St. Petersburg, Grand Rapids and Houston, for example. Evenson (2003) also finds evidence that supply elasticities vary by metropolitan area. In the simulations, two extreme values are considered: a total price elasticity of 0.2 (highly inelastic) and a total price elasticity of 10.0 (fairly elastic).

No estimates of the elasticity of demand for housing with respect to previous price changes were identified. Changes in prices affect expectations and therefore per period housing costs. The belief here is that this elasticity would be modest, so two alternatives are considered: an elasticity of zero (“no speculation”) and an elasticity of 0.1 (“speculation”).

Exhibits 6 and 7 present the time paths of prices under alternative parameter variables. Exhibit 6 presents the elastic case, and Exhibit 7 the inelastic case. In each exhibit,

Exhibit 6
Simple Housing Supply Dynamics
Elastic Supply

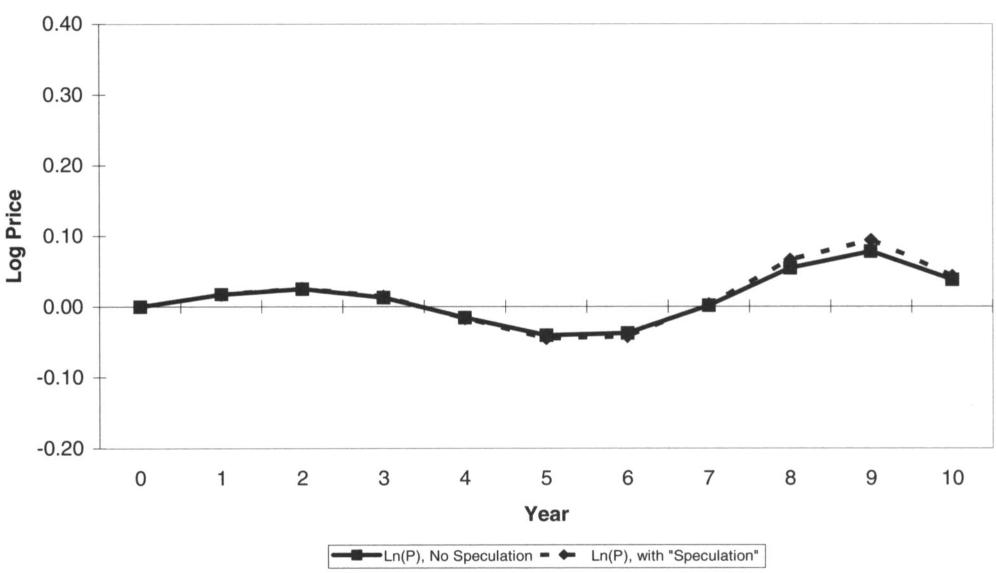
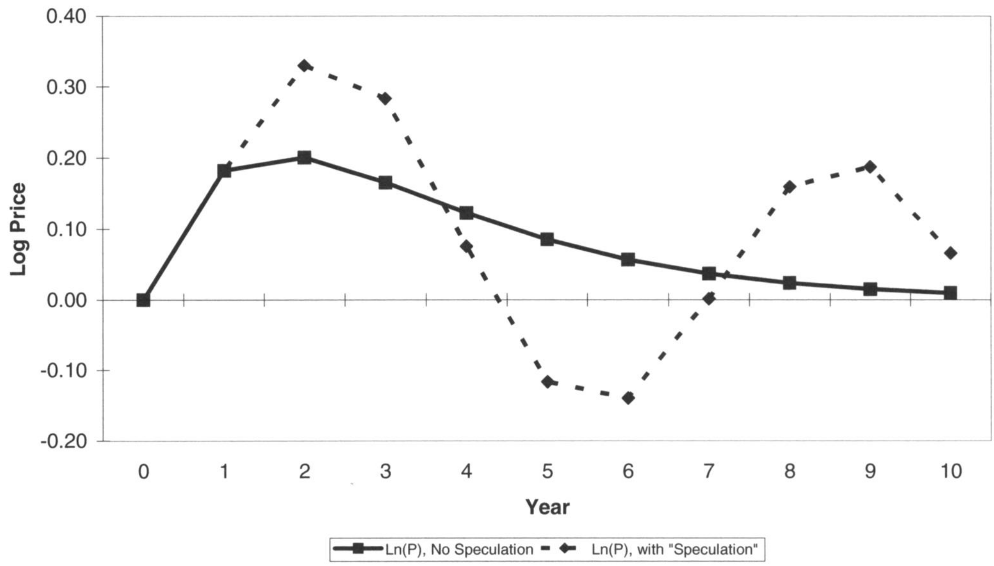


Exhibit 7
Simple Housing Supply Dynamics
Inelastic Supply



the solid line presents the case when $\alpha 4$ takes the value 0, and the dotted line the case when α_4 is 0.1.

The first thing to notice about these exhibits is that the model generates cycles, although a one-time persistent shock to demand has been modeled. 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 $\alpha 4$, 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 do not rise much. On the other hand, in the inelastic case, prices rise by as much as 20% (in the "no speculation" case) and by over 30% when supply rigidities are exacerbated by investors who follow past price trends and form expectations adaptively.

In fact, 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 characterized here, 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; the model has been calibrated in line with empirical research, where possible, but it is clear that some important parameters—notably the measure of demand adapting to recent house price changes, $\alpha 4$—are not known with any precision. Still, a plausible case is made that it is supply conditions, rather than speculation *per se*, that is the most important driver of housing market performance.

Conclusion

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 fewer natural constraints (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.

Endnotes

1. Malpezzi (1999) presents empirical evidence on the relationship between supply conditions and amplitudes of price cycles.
2. Much of the paper will refer to housing markets, but the general concepts are applicable to other forms of real estate (office, retail, industrial, farmland, etc.). The focus is 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, has been undertaken on housing markets than other forms of real estate. See Wheaton (1999) and especially McDonald (2002) and references therein for additional discussion of cycles in office markets.
3. This section draws heavily on Green and Malpezzi (2003).
4. (1) If all units in the analysis are assumed to be the same—that is, all yield the same Q—then rent can be interpreted as a price. (2) If such an assumption is not made, hedonic indexes can be used to "standardize" the quantity of housing services.
5. In what follows, for notational simplicity, assume that R denotes NOI or net rents, and drop the explicit discussion of operating costs C.
6. 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.
7. See discussion from the World Bank's 1998 Development Forum on Land, Real Estate and the Economy, archived at http://www2.worldbank.org/hm/landecon/author.html. See especially comments by Peter Colwell.

8. 'Inaccurate' does not necessarily mean 'irrational' in the sense rational expectations is defined 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 that being rational.
9. Some behavioral literature emphasizes cases where people seem to overestimate low probability events (shark attacks) and other literature emphasizes cases where people seem to underestimate such catastrophes (the market for earthquake insurance). Behavioral models, including Tversky and Kahnenman's (1982) "prospect theory" can encompass either kind of outcome, depending on how the model is framed and the transactions costs of collecting information about risk (see Kunreuther and Pauly, 2004).
10. This paragraph draws on Hardouvelis (1988), which contains a particularly cogent discussion of efficiency and "bubbles."
11. 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.
12. A number of papers discuss models very similar in spirit to the simple model developed here; a partial list includes Wheaton (1999), Kim and Kim (1999), McDonald (2002), Leung and Chen (2003) and Capozza, Hendershott and Mack (2004),
13. The notation used here is similar to but slightly different from Malpezzi and Maclennan's (2001).

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