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Over-Confidence and Cycles in Real Estate Markets: Cases in Hong Kong and Asia

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Studies on the calibration of subjective probabilities find that people tend to over-estimate the precision of their knowledge. In this paper we develop a semi-rational model and apply it to the real estate markets in Hong Kong and other Asian countries. The key point is that a person is rational about her/his private information until her/his private information is confirmed by a clearly defined market signal. Using a pre-sale as a mechanism of updating a developer's beliefs, this paper analyzes the impact of over-confidence on overbuilding and cycles in real estate markets. Our finding indicates that a pre-sale activity will increase the magnitude of over-building and over-confidence will increase the volatility in real estate markets. Our model also has implications to the well-established literature dealing with the issue of over-capacity in many industrial sectors.

Keywords

Market signal, over capacity, pre-sale, real estate cycle, semi-ration model

Introduction

In the past, researchers who model real estate markets normally assume that market participants are completely rational when making investment decisions. However, the empirical literature in the psychology field reports that people are not always rational. They not only are over-confident about the precision of their private information, but also update their information on the accuracy of their private information in a biased manner. The evidence from the psychology literature casts some doubt on the reasonableness and robustness of the assumption that investors are completely rational.

Prior to 1990, most researchers in the finance field also assume that investors in the financial market are completely rational when modelling financial behavior. Recently, however, it has become increasingly difficult for the rational models to explain why returns in the financial market tend to exhibit momentum and reversals. In recent years, several finance researchers begin to relax the assumption that investors are completely rational. By incorporating the findings from the psychology field, they assume that investors are rational in all aspects except that they might be over-confident about their own private information. Research along this line of thought has produced fruitful results and is able to explain the observed momentum trading and market under- and over-reactions. (For a list of recent articles on these issues, see Jegadeesh and Titman (1993), Barberis, Shleifer, and Vishny (1998), Daniel, Hirshleifer, and Subrahmanyam (1998), Odean (1998), Hong and Stein (1999), and Lee and Swaminathan (2000).)

In this paper, we investigate the implications of over-confidence in the real estate market. The model we develop is sort of a "semi-rational model" in the sense that the developer is rational except when her/his private information is confirmed by a clearly defined market activity. When a developer's private information is confirmed, our model assumes that the developer will become irrational and rely more on her/his private information in making investment decisions.

Our model is developed using the unique pre-sale system prevailing in Asian real estate markets as the framework. In other words, we treat the pre-sale activity as a way for a developer to confirm her/his private belief. If the pre-sale level conforms to a developer's original belief, then the developer will become over-confident about her/his ability to estimate future demand level. Otherwise, the developer will behave rationally. With the pre-sale system and over-confidence on the developer's part, we show that the real estate market will become more over-supplied and have a more prominent real estate cycle. The results of our model confirm the stylized facts that cities in Asian countries tend to have higher vacancy rates and longer real estate cycles than cities in North America and other parts of the world.

The remaining sections of this paper are organized as follows. In the next section, we will describe briefly the pre-sale system prevailing in Asian cities. The following section contains our model development, in which the decision making process is divided into three phases. We will show how over-confidence can be developed in these 3 phases. We then apply our model to explain the real estate cycles and over-building in Asian real estate markets. The last section contains our conclusions.

Pre-sale Activities in Hong Kong

In many Asian countries, developers are allowed to sell residential units of their development projects prior to the completion. Buyers of the property will begin to make payments immediately after signing the purchase contract. This method allows buyers to secure the right to purchase a property and possess ownership upon making the final payments (usually at the time the building is completed), thus reducing the uncertainty on the availability and the price level of future properties. On the other hand, developers will be able to receive income prior to the completion of the project, thus reducing the risks associated with the long investment horizon of the property development.

The rules and regulations governing the pre-sale activities vary among Asian countries. In some places, pre-sale begins before construction is actually started. Developers can decide whether to continue or to terminate the development project based on the number of buyers in the pre-sale. While in other countries (such as Hong Kong), pre-sale is allowed only when the development is in progress or is almost completed.

In Hong Kong, developers need to obtain consent of pre-sale before they can conduct a pre-sale. The consent of pre-sale is usually granted 20 months before the estimated date of completion. Within six months after obtaining permission for sale, a developer can start selling the units through internal sales and/or public sales. Although regulations change over time, in general developers are required to put on to the market no less than a certain percentage (say 20%) of the units approved for presale in each batch of public sale. Hong Kong developers normally offer numerous payment options to buyers. The down payment of a flat can range from 10% to 100% of the flat's purchase price.

The existence of pre-sale offers developers an alternative source of financing their projects. The source of financing is normally quite important. This is true because, depending on the sizes and backgrounds of the developers, long- or short-term construction loans can be very small and limited, if available. In addition, the risk of holding completed units is effectively reduced through presales. This is especially important in cities with many large-scale developments (such as Hong Kong), where the development of one project will create a one-time substantial increase in supply in the residential market.

The purpose of this paper is to examine another important aspect of the pre-sale system. That is, developers can actually use the pre-sale system as an information-gathering tool. To start a development process, because of construction lag, developers will have to estimate the future demand to make a construction decision today. In Hong Kong and many Asian countries where large-scale developments are common, the forecasted demand level is particularly important in decision making as the development phase (and hence the construction lag) will normally be longer than in cities in other regions (such as North America or Europe).

It is convincing to argue that the pre-sale system can serve as an information gathering system for developers. In a large development with many phases, developers will have the freedom to decide the timing of the phases of the project. In other words, a developer can launch a pre-sale, and if the result is good, the developer can speed up her/his development plan. (This means an increase in supply in the market.) If the pre-sale result is not as good as the developer originally expected, the developer could revise the estimate of future demand and slow down the development process. (This means a decrease in supply in the market.) A similar argument can be applied to developments of relatively small scale. Even if there is only one development phase, the developer can still control the speed of the construction. In other words, developers of smaller projects can still use the trial-sale information to adjust the speed of supply.

Asian real estate markets are known for their high vacancy rates and long lasting real estate cycles. To give a few examples, table 1 and table 2 of Lai and Wang (1999) illustrate the volatile patterns of the price movement and new units supplied in Hong Kong during the 1973-1997 period. The popular press also notes that the price level of Hong Kong properties in 2001 is about

50% to 60% lower than the price level in 1997. Similarly, the popular press reports that the vacancy rate of residential units in Taiwan is around 10%, a rate much higher than that observed in the United States. The price and volume movements in some China cities (such as Shanghai) are believed to be even more volatile than in Taiwan and Hong Kong.

With the pre-sale system as an information-gathering tool, this paper shows that development volatility should be amplified if developers are over-confident about their own estimates of the market demand. In other words, the paper attempts to analyze a unique institutional feature in Asian real estate markets to provide one more possible explanation for the long standing puzzle on real estate over-supply and cycle. Since throughout the paper we will use the pre-sale system as an information-gathering tool, we will term it trial-sale from this point on.

The Model

We assume that there is a single developer and there are $\tilde{d}$ customers, each with the same given reservation price P. The customers are ready to purchase one unit of product at a price that is equal to or smaller than P. We assume that the developer is risk-neutral. Let c be the construction cost per unit and X be the number of supplied units. (Naturally, we assume that $P > c$.) We also assume that there are two types of information in the market: public information and private information. The public information is available to all participants in the market. However, only the developer possesses private information.

There are three periods in our model: period 1(date 0), trial-sale period, and the final phase. In period 1 (date 0), the developer observes both the public information as well as receives her/his own private information. Based on the public and private information received, the developer will form her/his belief about the demand in the market at the final phase. After the belief is formed, the developer will decide an amount for a trial-sale in period two. At this stage, we assume that the developer is rational in her/his estimation and does not place excess weight on the private information she/he possesses.

The information received from the trial-sale (period 2), however, will change the developer's estimate of demand. It is this part that we assume the developer might behave irrationally. That is, if the developer's private information is confirmed by the pre-sale, then the developer will put more weight on her/his private information when estimating the total demand and deciding the number of units to build in the final phase (period 3).

To begin, we assume that there are two states for the demand: d_H and d_L ($d_H > d_L$) with probabilities p and 1-p, respectively. The parameters $\tilde{d}$, P, d_H, d_L, and p are all public information. The expected demand for the period is $E(d) = p\, d_H + (1-p)\, d_L$. At date 0, the developer receives both the public information on the distribution of the demand (such as $E(d) = p\, d_H + (1-p)\, d_L$) as well as her/his own private information. The developer might receive two types of mutually exclusive private information: one positive signal (G) or one negative signal (B) about the future demand.

The positive private signal (G) indicates that d_H will be the future demand. However, the developer also realizes that this positive private signal might not be accurate and therefore, assigns a probability a that the private signal might be inaccurate. Similarly, a negative private information (B) indicates that d_L will be the future demand, with a probability $ß$ that the signal could be wrong. In this regard, a can be interpreted as the probability that the positive private signal (G) will not be realized and $ß$ is the probability that the negative private signal (B) will not be realized. We define

$$a = p(B|d_H) < \frac{1}{2} \text{ and } b = p(G|d_L) < \frac{1}{2}. \quad (1)$$

We specify $a < ½$ and $ß < ½$ to indicate that the developer's private information is informative. (If $a = ß = ½$, then the private signal contains no information.) Let y be the number of units supplied by the developer. When the developer is risk-neutral, the profit function II is

If $y \in [d_H, d_L]$, then

$$\begin{aligned} \text{II} &= p[Py - cy] + (1-p)[Pd_L + P'(y - d_L) - cy] \\ &= (pP + (1-p)P' - c)\,y + (1-p)(P - P')\,d_L \end{aligned} \quad (2)$$

which is linear in y.

If $y > d_H$, then

$$\begin{aligned} \text{II} &= p[Pd_H + P'(y - d_H) - cy] + (1-p)[Pd_L + P'(y - d_L) - cy] \\ &= (P' - c)y + p(P - P')d_H + (1-p)(P - P')d_L \end{aligned} \quad (3)$$

P' is the price of one unit of production if the supply level of the developer (y) is higher than the realized demand (d_H or d_L). We assume that the consequence of over-building is serious so that $P' < c$. Under this circumstance, there is no incentive for the developer to build as many units as possible.

Period 1: Date 0

Equation (2) and equation (3) provide us with the basis to calculate the optimal supply level of a developer. If the developer has no private information (that is, if the developer decides the number of units to supply to the market based solely on public information), then the number of units supplied will be a function of parameters (such as p, P, and c) and the optimal number of units supplied by the developer is $\bar{y} \geq d_L$. Specifically, we know

1). If $pP + (1\text{-}p)\,P' < c$, then $\bar{y} = d_L$.

2). If $pP\,(1\text{-}p)\,P' > c$ $pP(1-p)P' > c$, then $\bar{y} = d_H$.

3). If $pP + (1\text{-}p)\,P' = c$, then $\bar{y}$ can be any number between d_L and d_H.

However, if the developer has private information and uses the private information to update the public information she/he receives, then the supplied units will be dependent upon the signal the developer receives. When a positive signal G is received, the supplied units will be $\bar{y}(G) \in [d_L, d_H]$. Specifically, we know

1). If $p(d_H|G)P + (1 - p(d_H|G))P' > c$, then $\bar{y}\,(G) = d_H$.

2) .If $p(d_H|G)P + (1 - p(d_H|G))P' < c$, then $\bar{y}\,(G) = d_L$.

3). If $p(d_H|G)P + (1 - p(d_H|G))P' = c$, then $\bar{y}\,(G)$ can be any number between d_L and d_H.

Similarly, when a negative signal B is received, the supplied units will be $\bar{y}(B) \in [d_L, d_H]$. Specifically, we know

1). If $p(d_H|G)P + (1 - p(d_H|G))P' > c$, then $\bar{y}\,(B) = d_H$.

2) .If $p(d_H|G)P + (1 - p(d_H|G))P' < c$, then $\bar{y}\,(B) = d_L$.

3). If $p(d_H|G)P + (1 - p(d_H|G))P' = c$, then $\bar{y}\,(B)$ can be any number between d_L and d_H.

Period 2: Trial-Sale

In our model, a developer will initiate a trial-sale before she/he decides on the final number of units to supply to the market. The maximum number of units the developer will build is d_L, with or without private information. There are two possible outcomes from the trial-sale: s_H and s_L ($s_H > s_L$). A trial-sale level above s_H would indicate that the demand level of the period is better than d_H. Similarly, a trial-sale level below s_L would indicate that the demand level for the period is worse than d_L. (We further assume that $s_H < d_L$ to simplify our analysis.) Over-confidence occurs when the positive private information (G) is followed by the higher trial-sale level s_H or when the negative private information (B) is followed by the lower trial-sale level s_L.

Let $a_s = p(s_L|G)$ and define a_s as the probability that a low trial-sale level will be reached after a positive signal is received. In other words, a_s is the probability that a positive private signal G will not be confirmed by a high trial-sale level s_H. Similarly, $ß_s$ can be defined as the probability that a high trial-sale level will be reached after a negative signal B is received. In other words, $ß_s$ is the probability that a negative private signal B will not be confirmed by a low trial-sale level s_L. Since in the paper we focus on the consequences of over-confidence and trial-sale, without loss of generality, we assume $a_s = b_s = 1/2$.[1]

When $p(s_L|G) = p(s_H|B) = \frac{1}{2}$, $p(s_H|G) = p(s_L|B) = \frac{1}{2}$., we have

$$p(s_H) = p(G)p(s_H|G) + p(B)p(s_H|B) = \frac{1}{2} \tag{5}$$

and

$$p(s_L) = p(G)p(s_L|G) + p(B)p(s_L|B) = \frac{1}{2} \tag{6}$$

Under this circumstance, the probabilities of having a high trial-sale level and low trial-sale level are both 1/2.

Period 3: Final phase

We assume that at date 0 the developer does not have overconfidence, but if the private information is confirmed based on a pre-specified rule (such as the one defined in the previous section), over-confidence occurs. After the trial-

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[1] That is, we assume away the information content of the trial-sale result. Under this circumstance, the sole function of the trial-sale is to confirm the developer's private information.

sale, the developer revises her/his estimate of future demand and her/his confidence level on the private information and then decides to build a certain number of housing units for the final phase, taking the amount of the trial-sale as inventory.

Let $p(d_H|G)$ and $p(d_L|B)$ be the revised probabilities of the demand level conditional on the observed signals G and B, respectively. If we assume that the developer behaves rationally (and will not be over-confident about the precision of her/his private signal), based on the Bayes' rule, the conditional demand probabilities can be calculated as

$$p(d_H|G) = \frac{p(d_H)p(G|d_H)}{p(G)} = \frac{p(1-a)}{p(1-a)+(1-p)b} \tag{7}$$

and

$$p(d_L|B) = \frac{p(d_L)p(B|d_L)}{p(B)} = \frac{(1-p)(1-b)}{(1-p)(1-b)+pa} \tag{8}$$

<u>Case 1: with a confirmed private signal</u>

When a positive signal G is received and followed by a high trial-sale level s_H (or when a negative signal B is received and followed by a low trial-sale level s_L), then the private signal G (or private signal B) is confirmed. Under both circumstances, we assume that the developer will be more confident about her/his private information. Consequently, the developer will over-estimate the precision of her/his private information and reduce the probability of making a mistake from a and ß to $\overline{a}$ and $\overline{b}$, respectively. Naturally, we assume $\overline{a}$ < a and $\overline{b}$ < ß. Consequently, the over-confident conditional demand-probabilities, or equation (7) and equation (8), can be re-written as

$$\overline{p}(d_H|G) = \frac{p(1-\overline{a})}{p(1-\overline{a})+(1-p)\overline{b}} > p(d_H|G) \tag{9}$$

and

$$\overline{p}(d_L|B) = \frac{(1-p)(1-\overline{b})}{(1-p)(1-\overline{b})+p\overline{a}} > p(d_L|B) \tag{10}$$

Let $\overline{p}$ be the price of one unit of product at the trial-sale stage and x be the additional units supplied after the trial-sale but before the demand is realized. The developer's profit $R(x, G, s_H)$ can be specified as:

(i) If d_H is realized, then

$$R(x,G,s_H,d_H) = \overline{P}s_H + P(d_L + x - s_H) - c(d_L + x)\text{, if } x \le d_H - d_L \tag{11}$$

or

$$R(x,G,s_H,d_H) = \overline{P}s_H - c(d_L + x) + [\frac{d_H}{d_L + x}P + (1 - \frac{d_H}{d_L + x})P'](d_L + x - s_H) \quad \text{if } x > d_H - d_L \tag{12}$$

(ii) If d_L is realized, then

$$R(x,G,s_H,d_L) = \overline{P}s_H - c(d_L + x) + [\frac{d_L}{d_L + x}P + (1 - \frac{d_L}{d_L + x})P'](d_L + x - s_H). \tag{13}$$

Consequently, the expected profit of the developer is

$$\begin{aligned} E(R) &= \overline{p}(d_H|G)R(x,G,s_H,d_H) + (1 - \overline{p}(d_H|G))R(x,G,s_H,d_L) \\ &= \overline{p}(d_H|G)\left\{\overline{P}s_H - c(d_L + x) + \left[\frac{d_H}{d_L + x}P + (1 - \frac{d_H}{d_L + x})P'\right](d_L + x - s_H)\right\} \\ &+ (1 - \overline{p}(d_H|G))\left\{\overline{P}s_H - c(d_L + x) + \left[\frac{d_L}{d_L + x}P + (1 - \frac{d_L}{d_L + x})P'\right](d_L + x - s_H)\right\} \end{aligned} \tag{14}$$

The first order condition of equation (14) is

$$\overline{p}(d_H|G)\frac{d_H s_H}{(d_L + x)^2}(P - P') + (1 - \overline{p}(d_H|G))\frac{d_L s_H}{(d_L + x)^2}(P - P') = c - P' \tag{15}$$

When we assume that a developer could behave irrationally when her/his private information is confirmed by the trial-sale activity, the optimal supply level $x(G, s_H)$ can be written as

$$\overline{x}(G,s_H) = \sqrt{\overline{p}(d_H|G)\frac{d_H s_H(P - P')}{c - P'} + (1 - \overline{p}(d_H|G))\frac{d_L s_H(P - P')}{c - P'}} - d_L \tag{16}$$

However, it should be noted that, if we assume that the developer behaves rationally (and will not be over-confident about her/his private information) even if a positive signal G is received and followed by a high trial-sale s_H, the optimal supplied units $x(G,s_H)$ is

$$x(G,s_H)=\sqrt{p(d_H|G)\frac{d_H s_H(P-P')}{c-P'}+(1-p(d_H|G))\frac{d_L s_H(P-P')}{c-P'}}-d_L \cdot \quad (17)$$

It is clear that the difference between equation (16) and equation (17) is caused by the difference $\overline{p}(d_H|G)$ and $p(d_H|G)$. From equation (9), we know that $\overline{p}(d_H|G) > p(d_H|G)$. Under this circumstance, $\overline{x}(G, s_H) > x(G, s_H)$.

Following a similar procedure, we can solve

$$\overline{x}(B,s_L)=\sqrt{(1-\overline{p}(d_L|B))\frac{d_H s_L(P-P')}{c-P'}+\overline{p}(d_L|B)\frac{d_L s_L(P-P')}{c-P'}}-d_L \quad (18)$$

and

$$x(B,s_L)=\sqrt{(1-p(d_L|B))\frac{d_H s_L(P-P')}{c-P'}+p(d_L|B)\frac{d_L s_L(P-P')}{c-P'}}-d_L \quad (19)$$

Similarly, we define $\overline{x}(B, s_L)$ as the optimal supply when the developer is over-confident about the precision of her/his private negative signal when the signal is confirmed by a low trial-sale level. However, if the developer behaves rationally (and will not be over-confident) about the negative signal, then the optimal supply level will be $x(B, s_L)$. It should be noted that the difference between equation (18) and equation (19) is due to the difference between $\overline{p}(d_L|B)$ and $p(d_L|B)$. Since from equation (10) we know that $\overline{p}(d_L|B) > p(d_L|B)$, it is clear that $\overline{x}(G, s_H) > x(G, s_H)$.[2]

Case II: without a confirmed private signal

If a positive signal G is received and followed by a low trial-sale level s_L (or when a negative signal B is received and followed by a high trial-sale level s_H),

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[2] To ensure that over-supply always occurs and the first order condition is always satisfied, we only need to assume that $\frac{P}{c} > \frac{d_H}{s_L}$. See Wang and Zhou (2000) for a detailed explanation of the intuition behind this assumption.

then the private signal G (or private signal B) is not confirmed. Under both circumstances, the developer is rational about (and will not over-estimate the precision of) her/his private signal. Consequently, the developer will use probabilities a and $ß$ to update the public information she/he receives. Following the same procedure we used in Case I, we obtain

$$x(G,s_L)=\sqrt{p(d_H|G)\frac{d_H s_L(P-P')}{c-P'}+(1-p(d_H|G))\frac{d_L s_L(P-P')}{c-P'}}-d_L \quad (20)$$

and

$$x(B,s_H)=\sqrt{(1-p(d_L|G))\frac{d_H s_H(P-P')}{c-P'}+p(d_L|G)\frac{d_L s_H(P-P')}{c-P'}}-d_L \quad (21)$$

Over-Confidence and Supply Volatility

We can derive rich implications by comparing the optimal supply levels derived under different conditions. Specifically, we are interested to find out if the trial-sale system (together with the over-confidence assumption) affects the supply level (and the variance of the supply level) of a developer. To accomplish this, we first note that expected demand and the variance of demand are

$$E(\tilde{d})=pd_H+(1-p)d_L \quad (22)$$

and

$$nar(\tilde{d})=p(1-p)(d_H-d_L)^2 \quad (23)$$

respectively. The expected supply $\tilde{y}$ when we assume that a developer will be over-confident about her/his private signal if the signal is confirmed by the trial-sale is

$$\begin{aligned}E(\tilde{y})=&\frac{1}{2}p(G)\left[\bar{x}(G,s_H)+x(G,s_L)\right]\\&+\frac{1}{2}p(B)\left[x(B,s_H)+\bar{x}(B,s_L)\right]+d_L>E(\tilde{d})\end{aligned} \quad (24)$$

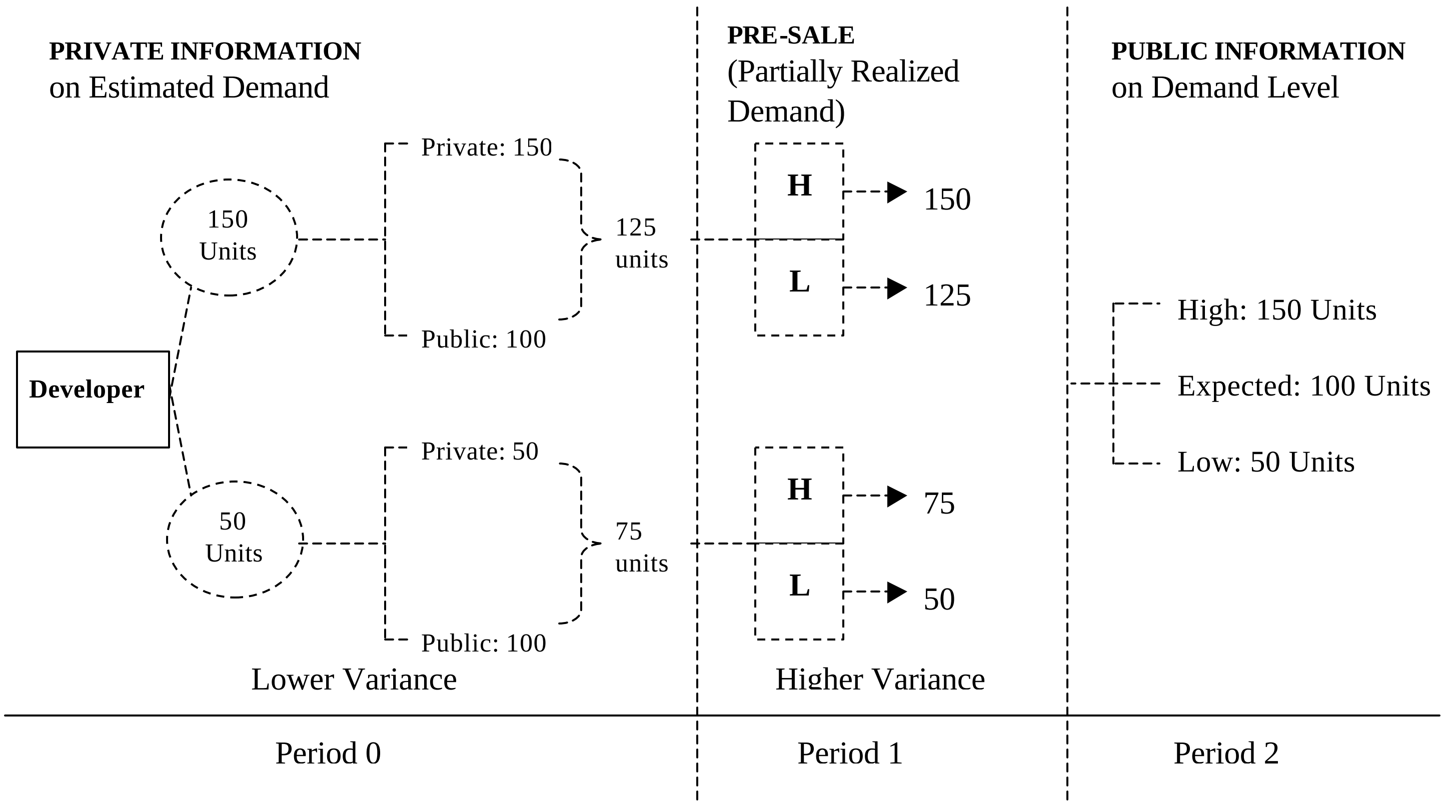
Equation (24) predicts that, with a trial-sale system, the expected supply level is always larger than the expected demand level. This result holds regardless of whether we assume that developers are over-confident or not. This implication provides a convincing explanation as to why the property markets in Asian countries seem to be more over-built than in cities in other regions of the world. This result also provides one more possible explanation for the literature on over-building.

While it is not clear if over-confidence will increase or decrease a developer's expected supply level, it is clear that over-confidence will cause excessive volatility. To see this, let $d_L + \tilde{x}$ be the total supplied units without over-confidence and choose model parameters properly such that E($\tilde{y}$) = $E(d_L + \tilde{x})$. Let $var(\tilde{y})$be the volatility with over-confidence, then

$$
\begin{aligned}
& nar(\tilde{y}) - nar(d_L + \tilde{x}) \\
& = p(G)(\overline{x}(G, s_H) - x(G, s_H))\left[\overline{x}(G, s_H) + x(G, s_H) - 2E(\tilde{y})\right] \\
& + p(B)(\overline{x}(B, s_L) - x(B, s_L))\left[\overline{x}(B, s_L) + x(G, s_L) - 2E(\tilde{y})\right] \\
& > 0
\end{aligned} \tag{25}
$$

Equation (25) is true because, from the definitions, we know that $\overline{x}$ $(G, s_H) > x(G, s_H) > E(\tilde{y})$ and $\overline{x}$ $(B, s_L) > x(G, s_L) > E(\tilde{y})$. Equation (25) indicates that the over-confidence of a developer will increase supply volatility in the market. When a developer's estimation is confirmed by the trial-sale, the developer will place more and more weight on her/his own information in the decision-making. In other words, if the developer is optimistic about the market, the developer will be even more optimistic about the market if the trial-sale activity confirms her/his original belief. Figure 1 provides an intuitive explanation as to why this should be the case. It should be noted that, when the supply variance is large, it is reasonable for us to observe large real estate cycles.

Figure 1: An illustration of the over-confidence framework



More implications on the relationship between over-confidence and supply volatility can be obtained by assuming that there is no noise in the trial-sale level, or $s = s_H = s_L$. Under rational expectations, when s is not too small, we have

$$x(G) = \sqrt{p(d_H|G)\frac{d_H s(P-P')}{c-P'} + (1-p(d_H|G))\frac{d_L s(P-P')}{c-P'}} - d_L \qquad (26)$$

and

$$x(B) = \sqrt{p(d_H|B)\frac{d_H s(P-P')}{c-P'} + (1-p(d_H|B))\frac{d_L s(P-P')}{c-P'}} - d_L \qquad (27)$$

If we further assume that a = $ß$ and $p = 1/2$, then $var\ (d_L + \tilde{x}) = var\ (\tilde{x})$, where

$$nar(\tilde{x}) = \frac{(P-P')s}{c-P'}(\frac{1}{2}E(\tilde{d}) - \frac{1}{2}\sqrt{d_H d_L + 4(a-a^2)nar(\tilde{d})}). \qquad (28)$$

Equation (28) indicates that an increase in a (or $ß$) will lead to a lower (rather than a higher) supply volatility. Since the supply volatility increases as a and $ß$ decrease, it indicates that as the level of over-confidence increases (that is, when a is replaced by a smaller $\bar{a}$), the supply volatility will increase. (Note that $\bar{a} < a$.)

To summarize, the existence of the trial-sale will ensure that the developer supplies more units to the market than the estimated demand level. When developers are over-confident about her/his private information, the increased supply variance will most probably result in a long-standing real estate cycle. The results of our model confirm the empirical observation that Asian countries with the trial-sale system tend to have a large over-supply and cycles in their real estate markets.

Conclusions

In this paper we show that the pre-sale system and over-confidence of developers could be a reason for the observed overbuilding and cycles prevailing in Asian real estate markets. Numerous research have been done on the persistence of excess vacancy and real estate cycles since Maisel (1993) pointed out that real estate markets rank among the most cyclically volatile industries. Our paper adds one more dimension to the possible causes of real estate cycles and excess vacancy, with a special application to certain Asian real estate markets.

However, it should also be noted that, although the result of our analysis is based on a unique pre-sale system that is popular in Asian countries, our implications could be generalized to real estate markets without a trial-sale system. For example, in the U.S., the sale of subdivision lots is based on a "take down" system by builders. The number of lots taken by builders provides a tool for a developer to update her/his belief on the future demand and to revise the speed of developing the subdivision. In this regard, our model, with a slight modification, should also be able to explain the market behavior of certain U.S. real estate markets.

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