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A Rational Explanation for Boom-and-Bust Price Patterns in Real Estate Markets

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This paper develops a stylized model to provide a rational explanation for the boom-and-bust price movement pattern that we frequently observe in the real world. Our stylized model indicates that there are three conditions to form a boom-and-bust price pattern in a community: a move-in of high income residents, wide income gap between new and existing residents, and supply process that leads to an inventory buildup. It seems that, based on these three conditions, China is more likely to experience a boom-and-bust price movement pattern than a developed country with a more mature and less vibrant economy.

Keywords:

Real Estate Cycles; Boom-and-Bust; Supply Decision; Moving Costs

1. Introduction

The boom-and-bust price movement pattern in the housing market has been observed in many countries during the past six decades. The magnitudes of the price movements (from boom to bust) in some countries seem too large to be justified by rational explanations. In some areas, the prices can double in one year and/or drop more than half in a short period of time (for example, Hong Kong in 1997 and Las Vegas in 2011). More importantly, the boom-and-bust price movement pattern is a recurring phenomenon. Since the pains of having a boom-and-bust cycle can be deep and widespread, it is difficult to understand why people do not learn from past lessons. In other words, if a boom-and-bust price pattern is due to the mistakes of market participants, then through a learning process, we should expect the magnitude of a cycle to be decreasing over time. However, this is not what we have observed in the real world.

Many researchers have tried to understand the reason for cycles and the main driving factors of these cycles. More importantly, why do boom-and-bust price patterns occur only in certain cities during a certain time period? Despite the research efforts, it might be fair to say that we still have conflicting views about cycles and do not know the causes of the extraordinary rise and decline in house prices in certain areas. The lack of theoretical explanations on cycles could be attributed to the fact that, while we know the general meaning of a boom-and-bust price movement, we do not empirically know the formation and bust of a cycle. Since we cannot clearly define a cycle empirically, it might be difficult to explore the reasons for its formation. The lack of empirical studies on the boom-and-bust price pattern might be due, at least partially, to the lack of high quality publicly available information on housing prices and economic fundamentals of an area.

Case and Shiller (1988, 1989) are the first to explore the serial correlations in housing prices by using a large dataset of transaction prices in the U.S.A. They report that housing appreciation rates are positively serially correlated. Other scholars follow this line of research by using more sophisticated statistical methods or including economic fundamentals in the estimation of a cycle. The research performed by Abraham and Hendershott (1996), Malpezzi (1999), Meen (2002), Capozza et al. (2004), Himmelberg et al. (2005), Wheaton, (2005), Wheaton and Nechayev (2008), Lai and Order (2010), and Glaeser et al. (2010) are representative works in this direction. However, it might be safe to conclude that those studies, while enhancing our understanding about cycles, still fail to give us a clear idea on how cycles are formed (or busted).

Recent studies by Piazzesi and Schneider (2009), Ferreira and Gyourko (2011) and Titman et al. (2011) have begun to provide some clues on the formation of cycles. Piazzesi and Schneider (2009) argue that a small fraction of optimistic households can make a large impact on the price movement in a community. Ferreira and Gyourko (2011) examine a large dataset and present several observations about cycles. First, they report that the magnitude of the initial price jump at the start of a boom is significant. Furthermore, they report that local income is the only demand shifter that also has a significant change around the start of a local housing boom. Finally, the observation that income growth rate jumps together with house price appreciation rate applies only to areas with inelastic housing supply. Titman et al. (2011) have similar observations. They find that the demand momentum drives the price momentum observed in the housing market and the supply rigidity determines if the price momentum will last or reverse. Indeed, while supply rigidity in the initial stage will fuel a price increase in the market, a significant price drop can only occur if there is a significant inventory buildup during the price run-up period. The evidence from these three papers seems to collectively reveal three observations. First, a housing boom is originated by an initial jump in the demand by a fraction of the residents in a community. Second, the transactions made by a fraction of the residents are sufficient to make a significant price impact to the area. Third and finally, supply elasticity seems to play an important role, although the details of its impacts are still not totally clear.

Since future demand is difficult to estimate and construction takes time, the supply decision of developers is made under uncertainty. Because the total supply is determined by the construction decisions of all developers in the market, the construction decision of one developer will affect the construction decisions of other developers. The literature on real options provides some useful guidance on how developers make a construction decision under uncertainty and in an oligopoly market (see, for example, Titman (1985), Williams (1993), Grenadier (1996), Wang and Zhou (2000, 2006) and Lai et al. (2007) for a discussion of issues related to real options). In recent years, Blackley (1999), Mayer and Somerville (2000), Jud and Winkler (2002), Harter-Dreiman (2004), Green et al. (2005), Glaeser et al. (2006), Saiz (2010), and Wang et al. (2012) have provided some empirical evidence on the determinants of the supply decisions of developers. While the evidence on this issue is still thin, it might be safe to conclude that the magnitude of the uncertainty affects housing starts and that a significant supply responsiveness to price (that is, the sensitivity of supply change to a price change in the market) is documented at least in some city-level data.

Motivated by the recent empirical evidence on boom-and-bust price patterns, this paper develops a stylized model to provide a rational explanation of cycles. Our model starts with a stable community. If a small portion of high income residents moves into a community, it will drive up the price in the community. If a developer continues to build up the inventory, then price will fall once the low income residents start to move out of the community and create more vacant units. Our next section will provide a conceptual framework of our model. Section Three discusses the model dynamics and gives a realistic scenario for a boom-and-bust price movement pattern. Section Four addresses the policy implications of the model and the last section concludes.

2. Model Framework

Our model critically depends on the concepts in which observed property prices are determined by marginal trades and that not all properties in a given market are simultaneously available for trade. Consequently, we can clearly distinguish between two prices: transaction price P and implicit price V. In our definitions, while both prices are determined by the supply and demand conditions in a community, there is a difference on what constitutes the supply and demand in each case. In our definition, an implicit price in a community is determined by the number of units and the income level of all residents in the community, by assuming that all residents (new or existing) in the community can buy and sell their properties at any given time. In other words, this is the price that residents (with a given level of income) are willing to pay for properties in a particular neighborhood. However, since it is likely that not all residents will tender their homes at any given time period (due to jobs, family ties, and moving costs), we can only infer this implicit price, but cannot directly observe it from market activities.

On the other hand, the transaction price is determined by marginal trades, which is based on the available supply (new units supplied by developers plus vacant units created by residents who have moved out of the community) and active buyers in the market (new residents who have just moved into the community) at a given period. In other words, the transaction price definition recognizes that not all properties will be available in the market for sale and not all existing residents will simultaneously sell their homes. In reality, transactions prices are the prices that we can directly observe from the marketplace and are often used to measure the property price movement in a community.

Given these two definitions, it is clear that the transaction price (which we can observe) could differ from the implicit price (which we cannot observe). In a stable community where the income level of residents who move into a community is the same as that of existing residents, and where the numbers of residents who move into (and out of) the community can be estimated with reasonable accuracy, the implicit price and the transaction price should be similar. However, if the residents who move into a community have a higher level of income (or can pay more for housing consumption) than the existing residents, then the transaction price (determined by the new high income residents) we observe will be higher than the implicit price. The boom-and-bust pattern that we frequently observe in real estate markets can be explained by examining the movements of these two prices. In the next sub-section, we will clearly define the implicit price and the transaction price in relation to the real income I, number of residents who move out of a community, j, number of residents who move into a community, m, and new supply from developers, k. We will then discuss the strategies of each player (residents who move in, residents who move out, and developers) in the three subsequent sub-sections to complete the model framework.

2.1 Transaction and Implicit Prices

To begin the analysis, we assume that at the initial period, there are two identical communities. Both communities have n_0 residents and n_0 units of identical houses (which are occupied by the n_0 residents). In other words, at period 0, we assume that demand equals supply and the market is in equilibrium. The n_0 residents have an identical real income level I_0. (It should be noted that, while it is true that only a fixed percentage of the income of residents can be spent on housing consumption, to simplify our notations, we use I_0 as the income level that residents are willing to spend on housing consumption.) Consequently, a higher resident income level means a higher price in the community. We define, at the initial stage, the implicit price of a housing unit in a community as the total available income $n_0 I_0$ in a community divided by the number of units n_0 available in the same community. This implicit price can also be interpreted as the price that a resident has to pay for a property in other communities with identical characteristics as this community. Given this specification, at time 0, the implicit price V_0 in the community is

$$V_0 = \frac{n_0 I_0}{n_0}. \quad (1)$$

Assume that in period 1, the developers will supply k_1 housing units to the community. During the period, there will also be m_1 new residents (with a real income level I_1) who will move into this community and j_1 existing residents (with a real income level I_0) who will move out of the community. Under this circumstance, the implicit price in the community at the end of period 1 is defined as

$$V_1 = \frac{(n_0 - j_1) I_0 + m_1 I_1}{n_0 + k_1}. \quad (2)$$

V_1 represents the price that the residents are willing to pay if all the properties are available for sale during the period and is based on the total real income $((n_0 - j_1) I_0 + m_1 I_1)$ and the total inventory $(n_0 + k_1)$ in the community.

Similarly, we assume that there will also be m_2 new residents (with a real income level I_2) who will move into the community and j_2 existing residents who will move out of the community in period 2. In addition, the developers will supply k_2 housing units to the community. To simplify the notations, we assume that all the j_2 residents who move out of the community are with a real income level I_0. Given this assumption, the implicit price V_2 in the community in period 2 is

$$V_2 = \frac{(n_0 - j_1 - j_2)I_0 + m_1 I_1 + m_2 I_2}{n_0 + k_1 + k_2}. \tag{3}$$

On the other hand, we assume that at the end of each period, the transaction price is determined by the number of residents (with a real income level I) who move into the community and the number of properties on the market (the new supply k and number of residents who move out j) at the end of the period. It should be noted that because of moving costs, not all of the residents will put their properties on the market even if the prices are attractive. Given this, the transaction prices in periods 0, 1 and 2 can be specified as

$$P_0 = \frac{n_0 I_0}{n_0} = I_0, \tag{4}$$

$$P_1 = \frac{m_1 I_1}{k_1 + j_1} = \frac{m_1}{k_1 + j_1} I_1 \tag{5}$$

and

$$P_2 = \frac{m_2 I_2}{(k_1 + j_1 - m_1) + k_2 + j_2} = \frac{m_2}{(k_1 + j_1 - m_1) + k_2 + j_2} I_2, \tag{6}$$

respectively.

The price level in a community in period 1 is determined by the income level of the newcomer $m_1 I_1$ and the available units $(k_1 + j_1)$ in the market. Clearly, when supply equals demand ($\frac{m_1}{k_1 + j_1} = 1$), Equations (2) and (5) indicate that P_{1_1} is greater than (or equal to) V_1 if I_1 is greater than (or equal to) I_0 (similar arguments also apply to Equations (3) and (6)). Under this circumstance, the change in prices is only influenced by the change in income levels of residents in the community. However, when $\frac{m_1}{k_1 + j_1} \neq 1$, in addition to the income effect, the excess supply (or demand) will put an additional downward (or upward) pressure on the price level in the community. Given this, the next three sub-sections will discuss the determinants of the number of residents who will move into a community, m, the number of residents who will move out of a community, j, and the new supply k.

2.2 Move-in Decision of Newcomers

We let the number of new residents who will move into a community, m, be exogenously determined. Newcomers will have to sell their existing homes and find a new home in the new community. Since such moves take time, we assume that these individuals will have to make a decision to move at the beginning of a period in order to move into another community at the end of the period. Once the moving decision is made, they cannot change their decisions and will have to move regardless, since they will have to sell their current homes.

At the time (period) when individuals make a decision to move into a community, they know the inventory of homes in the last period, vacancy level, transaction price, and implicit price in the community (for example, in period 1, they know all the information in period 0). They also have general knowledge about the estimated new supply from developers for the next period, and the estimated number of residents who will move into or out of the community. The information is available for the newcomers to make a decision on the price that they will pay. This also implies that, while in period 0 they can have an estimate of the transaction price and the implicit price at the end of period 1, the realized prices at the end of period 1 could differ from their estimates. Given this, the decision of new residents to move into a new community will not be affected by the realized price at the end of the period. Consequently, the number of residents who will move into a community is an exogenous variable in this stylized model.

2.3 Supply Decision of Developers

The objective of a developer is to maximize his/her profits in the next period. Developers will supply new units to the market as long as they expect a positive net demand in the next period. In other words, even if they believe that the community will eventually be overbuilt in the long run, they will still build as long as they can sell their products in the short run. In addition, because constructions take time to complete, developers will have to make construction decisions well ahead of the realization of the projected net demand. For a single-family housing unit, the actual construction time can be more than six months. Given the time to obtain building permits and construct required infrastructures (such as roads, water, waste water, and utilities), it is fair to say that the average construction time lag will be more than one year. As such, developers will have to begin construction at least one year ahead of the projected positive demand.

It is also costly for developers to stop a construction process once construction starts because all costs are sunk. In other words, because of the construction-lag problem, in period 0, developers will have to estimate the existing number of vacant units and the net demand (the number of the residents who will move into the community minus the number of the residents who will move out of the community in period 1) before starting the construction process. We assume that the number of new residents and vacant units are common knowledge to all parties involved. However, the information on the number of residents who will move out of the community is difficult to obtain, and as such, developers will have to use an estimated number $\tilde{\jmath}$ to make their supply decision. Since the supply decision can be observed by all players in the market, the estimation by developers on the number of residents who will move out of the community, $\tilde{\jmath}$, should also be common knowledge to all players in the market.

When the expected net demand $m - \tilde{\jmath}$ is positive and larger than the number of vacant units u in the market, developers will supply new units to the market in the amount of $k = m - \tilde{\jmath} - u > 0$. It should be noted that u could be negative (which represents unfilled demand) if developers undersupply the market in this period. However, when this happens, developers will supply u additional units to make up for this unfilled demand in the next period. If, however, $m - \tilde{\jmath} < u$, developers will not supply any more units to the market and $k = 0$. It should be noted that these assumptions are made to simplify the model presentation. It is possible that a developer will keep on building even if $m - \tilde{\jmath} < u$. One possible reason is that the developer has to utilize the existing machineries and employees because they are fixed costs. The other reason could be that the developer has only a small equity stake in the project. The loss in equity can be compensated by the profits from being the contractor of the project. Wang and Zhou (2000) also argue that developers may overbuild simply to compete for development opportunities. However, overbuilding will only make the boom-and-bust patterns more severe, and so we decide to ignore this possibility to keep the model simple. With this model setup, the total inventory in a community at the end of each period can be estimated with certainty. If the total number of units in a community at the initial period is n_0, then at the end of periods 1 and 2, the total number of units available in the community will be $n_1 = n_0 + k_1$ and $n_2 = n_0 + k_1 + k_2$, respectively.

It should be noted that k_1 and k_2 are based on the estimations of m, $\tilde{\jmath}$ and u. In our model, while both m and u are public information that can be obtained without errors, the number of residents who will move out of the community, $\tilde{\jmath}$, in each period is private information that developers can only conjecture (and the conjecture is subject to errors). It is important to know that, in order to maximize profits, developers should build as long as there is a demand. Given this, we assume that developers will infer the number of existing residents who will move out from the community in this period from the number of residents who moved out of the community in the last period. In other words, if the developers in this period observe fewer (more) than the number of residents who were expected to move out of the community in the last period, they will revise their estimation by decreasing (or increasing) the number of residents they expect to move out this period. Consequently, when $\tilde{\jmath}_1 = j_0$, $k_1 = m_1 - \tilde{\jmath}_1 - u_0 = m_1 - j_0 - u_0$ and the move-out decisions of the existing residents in this period affect the supply decisions of developers in the next period.

More importantly, it should be noted that in this model, the move-out decisions of existing residents and the supply decisions of developers could result in an inventory buildup process. To see this, we assume that there is a community with 500 existing residents and 500 housing units. The developers expect that there will be 25 new residents moving into this community in each of the next 3 periods. At the beginning of the period, the developers also expect that, on average, 10 existing residents will move out of the community in each period. Consequently, the developers supply 15 units $(25 - 10 = 15)$ to the market in the first period. However, if the developers find out that only 3 residents moved out of the community in the first period, they will revise their estimate on the number of residents who will move out from the community in the next period from 10 to 3. Since there are 7 units of unfilled demand from the first period, the developers will supply a total of 29 units $(25 - 3 + 7 = 29)$ to the market, assuming that at the end of the second period, the developers observe that 3 residents move out of the community. With this information, the developers will supply a total of 22 units $(25 - 3 = 22)$ in the third period. However, what will happen if 24, instead of 3, existing residents decide to move out of the community in the third period? It should be noted that, in this example, the total number of residents who moved out of the community during this 3-year period is still 30 $(3 + 3 + 24 = 30)$, as projected by the developers at the beginning of the period.

In this example, the total number of units in the community will be changed from the 500 units (at the beginning of the period) to 515 units (500 existing units plus the 15 new units) at the end of the first period. The demand in this period is 25 units, but there are only 18 units of supply in the market (15 units supplied by the developers and 3 units supplied by the residents who moved out of the community). This situation will certainly fuel an increase in the transaction price in the community. In the second period, the total number of housing units is 544 units (515 existing units plus 29 new units). The demand for housing is 32 units (25 new demand plus the 7 units of unfilled demand from the first period), and the total number of units in the market is 32 (29 units supplied by the developers and 3 units supplied by the existing residents). In the third period, the total number of units in the community is 566 units (544 existing units plus 22 new units). The demand for housing units is 25. However, we now have 46 units of supply in the market (22 units supplied by the developers and 24 units supplied by the existing residents). This situation will put tremendous downward pressure on the price in the community. The example shows a possible inventory buildup process during a boom-and-bust period (even if the developers have correctly estimated the aggregate net demand over the 3-year period). Given this, it is important to understand the strategy of existing residents that underlie their move-out (or stay) decisions, which is the main driver of the inventory buildup that will lead to a boom-and-bust price movement pattern.

2.4 Move-out Decision of Existing Residents

In our model, the number of newcomers to a community is exogenously determined. The number of units supplied to the market (or the supply decision of developers) is endogenously determined, but not forward looking. However, the number of residents who will move out of a community is endogenously determined in our model. In addition, their decisions should be mainly forward looking, which involve the selection of the best time to move out. In our model, it is the number of existing residents who decide to move out that drives the boom-and-bust price patterns in a community.

At the beginning of each period, existing residents will decide if they want to stay in the community. There are two reasons to move out of a community. The first is stochastic and unsystematic, which is related to changes in the personal condition of a resident. The second is systematic, which is related to the price movement in the community. Similar to a move-in decision, we also assume that the decision of a resident to move out has to be made at the beginning of the period and cannot be changed once made. (This assumption is quite reasonable since it will take time for the resident to look for a new job or find a new home in the new community.) When existing residents decide to move out, they will tender their houses to the market.

When a resident believes that the transaction price is higher than the implicit price in a community, there is an incentive for the resident to sell his/her property and buy a comparable property in another community. This will happen when the new residents moving into a community have a higher income than the existing residents. Under this circumstance, the transaction price of a property (based on the higher income level of the new residents) in the community is higher than the implicit price (partially based on the lower income level of the existing residents) that the existing residents are willing to pay for the property (as defined in Equations (2) and(5)). In other words, at time t, whenever $P_t - V_t = G_t > 0$, there is an incentive for the existing residents to move out of the community. However, this condition ($P_t - V_t = G_t > 0$) alone does not guarantee that they will move out for two reasons. First, the residents have ties to the community and there are transaction costs to move out. Second, in anticipation of the movement of future prices, existing residents will develop a bidding strategy to find the optimal time to sell.

In other words, the costs to move not only include the explicit moving costs, but also the ties of a resident to the community and his/her job. The resident might not be able to find a similar job in another community if s/he decides to arbitrage the difference between the transaction price and the implicit price. This resident will also need to start building new relationships and friendships in a new community. It might take time for the resident to become familiar with the new environment. In our model, we assume that the cost to move out varies by individuals and is private information. We define the cost to move out for the i-th existing resident at time t as $c_{i,t}$. Given this, an existing resident will consider to arbitrage the difference between the transaction price and implicit price only if the difference is large enough to cover his/her moving costs (that is, $P_t - V_t - c_{i,t} = G_t - c_{i,t} > 0$).

However, it should be noted that even if the transaction price is higher than the sum of the implicit price and the moving cost (when $G_t - c_{i,t} > 0$), existing residents might not automatically sell their properties and move out. When anticipating future residents with a higher income to move in, existing residents will wait to see if others in the community will sell their properties. They realize that, when the new residents have a higher income level than the existing residents, the future transaction price should be higher if the current residents do not begin to tender their properties. Under this circumstance, it might be optimal for an existing resident to wait if s/he believes that other existing residents will also wait. This belief (that others will wait) will hold if the resident expects that other existing residents have relatively higher moving costs.

Since the moving cost of a resident is private information, at the beginning of every period, each existing resident will speculate on the moving costs of other existing residents to decide whether to tender his/her property and move out of the community. We define $c_t = (c_{1,t}, \dots, c_{n,t})$ as the moving costs of n existing residents at the beginning of period t, with $c_{i,t}$ as the private information of the i-th existing resident. We further assume that $0 \leq c_{1,t} \leq c_{2,t}, \dots \leq c_{n,t}$ where $c_{1,t}$ is the lowest moving cost, and $c_{2,t}$ to $c_{n,t}$ are defined as the second lowest to the highest moving costs of the residents in the community. We assume that, while not exactly knowing the moving costs of all residents, each resident can speculate on the ranking of his/her own moving costs relative to that of others in the same community. An existing resident will not tender his/her property if s/he does not observe a sufficient number of existing residents who tender their properties. In other words, if a resident believes that his/her moving costs should be the 10th lowest in a community, this resident will not tender his/her property until 9 other existing residents tender their properties first.

We also assume that, at the beginning of every period, each resident has his/her own estimate of the moving cost structure $\widetilde{c_t} = (\widetilde{c_{1,t}}, \dots, \widetilde{c_{n,t}})$. The moving cost information of existing residents will be gradually released to the market as they sequentially move out. At the end of each period, and after observing the number of residents who have moved out of the community, each existing resident can update his/her information on the moving costs of the remaining residents. If the number of existing residents who have moved out of the community turns out to be lower (higher) than expected, the remaining residents will interpret that other existing residents should have moving costs that are higher (lower) than what they had originally estimated. Thus, the move-out exercise of any existing resident will affect the remaining residents' moving cost estimates of others. This, in turn, will affect the moving decisions of the remaining residents in the next period.

However, it is also reasonable to assume that existing residents will wait indefinitely when they can earn an arbitrage profit (when $P_t - V_t - c_{i,t} = G_t - c_{i,t} > 0$) by tendering their properties to the market. While it might be optimal for an existing resident to wait if other residents are also waiting, we assume that each existing resident also has a maximum reservation profit $R_{i,t}$. Whenever the arbitrage profit $G_t - c_{i,t}$ is greater than the maximum reservation profit of a resident, $R_{i,t}$, this resident will stop waiting and tender his/her property in the next period.

It should be noted that the moving costs of an existing resident can also be affected by the moving decisions of other residents. In other words, moving costs decline as residents with similar backgrounds begin to move out of the community. This can be justified by the fact that when a similar type of resident leaves a community, those who stay behind may enjoy lower tangible or intangible benefits. For example, when higher income residents begin to move in and lower income residents begin to move out, the property tax in the community might become too high for the existing residents. (This is part of the reason why California has the Property 13 legislation to protect existing residents from a property tax increase due to the move-in of high income residents.) In addition, the social-cultural aspects of lifestyle in the community might dramatically change or traffic congestion might become too severe for some to endure. More importantly, the community might become too expensive for the lower income residents to live in. Thus, as more existing residents move out of the community, the moving costs of those who remain will be reduced. We assume that this effect on the moving costs of the remaining residents is equal and known to all existing residents. We use a coefficient $\theta(l)$ to represent this effect, where l represents residents who have already moved out. We set $\theta(0) = 1$ and $\theta(l)$ is a decreasing function of l. Under this specification, when all the existing residents stay in the game, we have the moving cost structure $\left(c_{1,t}, \dots, c_{n,t}\right)$ just as before. After the resident with the lowest moving cost $c_{1,t}$ moves out, the remaining $n-1$ existing residents have a moving cost structure

$$\left(\theta(1)c_{2,t}, \dots, \theta(1)c_{n,t}\right) = \theta(1)\left(c_{2,t}, \dots, c_{n,t}\right). \tag{7}$$

The distribution of the remaining $n-1$ moving costs of existing residents is updated period by period. Similarly, after l existing residents have moved out, the remaining $n-l$ residents have a moving cost structure

$$\left(\theta(l)c_{l+1,t},\dots,\theta(l)c_{n,t}\right)=\theta(l)\left(c_{l+1,t},\dots,c_{n,t}\right) \tag{8}$$

It should be noted that the lower the moving cost, the easier it is for the existing residents to move out of the community.

To sum up, in the initial period, when the transaction price in a community begins to increase, existing residents might not want to move out of the community (and arbitrage the price difference) because they believe that other residents might have higher moving costs. In later periods, however, if the remaining residents observe that more residents than expected are moving out of the community, they might revise their belief and will also move out of the community. The move-out of existing residents will happen sooner or later for two reasons. First, existing residents will move out whenever the difference in the transaction prices is higher than their maximum reservation profit. This means that the higher the transaction price, the higher the likelihood that more existing residents will tender their properties. Second, the moving costs of existing residents decrease as the number of new residents (with higher income) moving into a community increases. This means that it is more likely for an existing resident to move out of a community as the number of new residents in the community increases. Given this, the move-out decision of existing residents is endogenously determined in the model and the move-out will happen whenever the transaction price is high enough and/or there are enough new residents in the community. It should be noted that the moving (or staying) decision of existing residents will affect the supply level of properties in a community and hence, the transaction price level in the community. In our model, this decision is the main factor that causes a boom-and-bust price pattern in a community.

3. The Dynamics

Within this conceptual framework, we are able to explain the boom-and-bust price movement pattern that we frequently observe in the real world. In our framework, the price level is determined by the type of residents (high or low income) who will move into a community, and by the timing of the move-out decisions of the existing residents through their effect on the supply level in the community. Depending on the parameter values of these two variables, we should be able to come up with different patterns of price movement. In this paper, we will only concentrate on one realistic scenario that will result in a boom-and-bust pattern. To explain the boom-and-bust pattern, we will use a three-period model to describe the factors that relate to the boom and the bust periods. We will accomplish this by first establishing the conditions for a stable price movement pattern, and then describing how prices can deviate from the stable state to form a boom-and-bust pattern. We term the community with a stable price pattern and the community with a boom-and-bust price pattern as Community A and Community B, respectively.

3.1 A Stable Community

We start the analyses by discussing the conditions for a community to maintain a stable price movement. We define a price movement as stable when the price change is identical to the change in real income. From Equations (1)to (3), we know that the implicit price in a community is determined by the real income level of all the residents and the total supply level in the community. From Equations (4) to (6), we know that the transaction price in a community is determined by the real income level of the new residents and the net supply level in the community. For this stable community, we assume that the real income level of the new and existing residents during three consecutive periods are the same, or $I_0 = I_1 = I_2 = I$. Note that n_0 is the number of existing residents. From Equations (1) and (4), the implicit price V_{s0} and the transaction price P_{s0} in Community A at period 0 are

$$V_{s0} = \frac{n_0 I_0}{n_0} = I_0 = I \tag{9}$$

and

$$P_{s0} = \frac{n_0 I_0}{n_0} = I_0 = I, \tag{10}$$

respectively.

When the real income levels do not change ($I_0 = I_1 = I$), and the supply level of the next period k_1 is the same as the net demand (the difference between the number of residents who move into and move out of the community), or $m_1 - j_1$, then from Equations (2) and (5), we know that the implicit price V_{s1} and the transaction price P_{s1} in the stable community at the end of period 1 are

$$V_{s1} = \frac{(n_0 - j_1)I_0 + m_1 I_1}{n_0 + k_1} = I \tag{11}$$

and

$$P_{s1} = \frac{m_1 I_1}{k_1 + j_1} = I_1 = I, \tag{12}$$

respectively. Similarly, with the same conditions that $I_0 = I_1 = I_2 = I$ and $k_2 = m_2 - j_2$, then from Equations (3) and (6), we know that the implicit price V_{s2} and the transaction price P_{s2} in the stable community at the end of period 2 are

$$V_{s2} = \frac{(n_0 - j_1 - j_2)I_0 + m_1 I_1 + m_2 I_2}{n_0 + k_1 + k_2} = I \tag{13}$$

and

$$P_{s2} = \frac{m_2 I_2}{(k_1 + j_1 - m_1) + k_2 + j_2} = I_2 = I, \tag{14}$$

respectively.

It is clear that, under the assumption of a stable real income and when supply equals demand, the implicit price in a community is always equal to the transaction price in the community. Under this circumstance, residents of a community will move in and out only based on personal reasons, which are stochastic. More importantly, under this circumstance, the moving decisions of residents do not affect the movement of the price level.

3.2 A Boom-and-Bust Community

We now analyze the boom-and-bust price movement pattern in Community B. For this community, we assume that the real income levels of new and existing residents during the three periods are different. Specifically, we assume that $I_0 < I_1 > I_2$. In other words, the new residents who move into the community in period 1 have a higher income than the existing residents. However, this trend is reversed in period 2, where the newcomers have a lower real income than the newcomers of period 1. From Equations (1) and (4), the implicit price and the transaction price in Community B at time 0, V_{b0} and P_{b0}, respectively, are

$$V_{b0} = \frac{n_0 I_0}{n_0} = I_0 \tag{15}$$

and

$$P_{b0} = \frac{n_0 I_0}{n_0} = I_0. \tag{16}$$

At this stage, the residents of Communities A and B are both willing to pay the same transaction price (which is the same as the implicit price) for the same type of community. The residents of these two communities, therefore, can move freely from one community to the other. We assume that, in period 1, the real income level of the new residents who move into Community B increases at a rate of g_1 (or $I_0(1 + g_1) = I_1$). From Equations (2) and (5), we know that the implicit price V_{b1} and the transaction price P_{b1} in Community B at the end of period 1 are

$$V_{b1} = \frac{(n_0 - j_1)I_0 + m_1 I_1}{n_0 + k_1} = \frac{(n_0 + m_1 - j_1)}{n_0 + k_1} I_0 + \frac{g_1 m_1}{n_0 + k_1} I_0 \tag{17}$$

$$= \frac{(n_0 + m_1 - j_1)}{n_0 + k_1} I_1 - \frac{(n_0 - j_1) g_1}{n_0 + k_1} I_0 \tag{18}$$

and

$$P_{b1} = \frac{m_1 I_1}{k_1+j_1} = \left(\frac{m_1}{k_1+j_1}\right) I_1, \tag{19}$$

respectively.

Equations (17) and (19) clearly indicate that there are two effects that cause the difference in the implicit price and the transaction price in a community: the real income effect and the supply effect. To see the real income effect, we first exclude the supply effect by holding $k_1 = m_1 - j_1$. Under this circumstance, since $\left(\frac{m_1}{k_1+j_1}\right) = \frac{(n_0+m_1-j_1)}{n_0+k_1} = 1$, the P_{b1} reported in Equation (19) is clearly larger than the V_{b1} reported in Equation (18). This means that, in Community B, the transaction price will be higher than the concurrent implicit price. It is also clear that the implicit price in Community B, V_{b1}, (reported in Equation (17)), is higher than the concurrent implicit price in Community A, V_{s1}, (reported in Equation (11)). This means that the new residents (with a higher income) in Community B will push up the transaction price in the community to a level that is higher than the concurrent implicit price that an average resident of Community B is willing to pay. Furthermore, with the higher income group, the implicit price in Community B (the price that an average resident in Community B is willing to pay) is also higher than the concurrent implicit price in Community A (the price that an average resident in Community A is willing to pay). Additionally, because of new residents moving into Community B, Equations (7) and (8) indicate that the ties of the existing residents to the community will be reduced. In fact, since the environment in Community B is changed by the new residents, the lower income group (existing residents) in this community will find their own lifestyles to be more in line with that of Community A (the stable community) than with the new lifestyle in their own community. This means that the move-in of new residents reduces the moving costs of the existing residents.

Under this circumstance, the existing residents in Community B will have an incentive to sell their homes at the higher transaction price and move to Community A, where the environment could be more suitable for them and the transaction price is lower. By doing so, these residents can obtain not only a similar or better lifestyle, but also profit from the difference between the transactions prices in these two communities. However, some of the existing residents might not want to move out yet because of moving costs and their expectation that the price might continue to go up. It is clear that, as long as this group of existing residents holds on to their properties, the difference between the transaction price and implicit price will widen if the real income level of the new residents keeps on increasing.

The income effect can be amplified by the supply effect. For example, if the supply level of the next period k_1 is less than the net demand $m_1 - j_1$ (or $k_1 \leq m_1 - j_1$), then $\frac{m_1}{k_1+j_1} > 1$ and $\frac{(n_0+m_1-j_1)}{n_0+k_1} > 1$. When $k_1 + j_1$ and m_1 are only a small fraction of n_0, most likely $\frac{m_1}{k_1+j_1} > \frac{(n_0+m_1-j_1)}{n_0+k_1} > 1$. From Equations (18) and (19), we know that the gap between the transaction price P_{b1} and the implicit price V_{b1} in Community B will be even larger under this condition. In other words, the supply effect ($k_1 \leq m_1 - j_1$) should have a greater impact on the transaction price than on the implicit price in the community. That is, the supply factor will further push the transaction price upward (relative to the implicit price).

To sum up, the transaction price in a community can be pushed up by the move-in of new residents with a higher real income level. While the higher transaction price gives the existing residents an incentive to move out, some of the existing residents might decide to stay put because they anticipate that the transaction price will continue to increase if other existing residents also remain in the community. In the first period, the developers anticipate that some existing residents might move out of the community and do not supply enough units to the community. Since those residents did not move out at the end, the shortage in supply further pushes up the transaction price to a level that cannot be justified by the real income level alone. If richer residents continuously move into the community, then the transaction price in the community will be increased at a rate faster than the income growth rate of the community. This is when we see the boom period of the cycle. However, this boom period could also be the period for developers to build up the inventory. When developers realize that existing residents did not move out of the community during the boom period, they will begin to anticipate that fewer residents will move out of the community in the future, and consequently will begin to supply more units to accommodate the expected number of new residents (while ignoring the possibility that many existing residents could move out). When this happens, one will expect to see a huge vacancy once the boom period ends and existing residents begin to move out.

We now begin to discuss the bust period (or period 2). We assume that in period 2, the real income level of the new residents decreases (rather than increases) at a rate of g_2 (or $I_1(1 - g_2) = I_2$). From Equations (3) and (6), we know that the implicit price V_{b2} and the transaction price P_{b2} in the boom-and-bust community (Community B) at the end of period 2 are

$$V_{b2} = \frac{(n_0-j_1-j_2)I_0+m_1I_1+m_2I_2}{n_0+k_1+k_2} \tag{20}$$

and

$$P_{b2} = \frac{m_2I_2}{(k_1+j_1-m_1)+k_2+j_2}, \tag{21}$$

respectively. To simplify the presentation, we let $k_1 = m_1 - j_1$ (and $n_1 = n_0 + k_1 = n_0 + m_1 - j_1$) and define I_{0-1} as a weighted average real income of all existing residents (with real income I_0 or I_1) at the end of period 2. With this simplification, Equations (20) and (21) can be re-written as

$$V_{b2} = \frac{(n_1 - j_2)I_{0-1} + m_2 I_2}{n_1 + k_2} \tag{22}$$

and

$$P_{b2} = \frac{m_2 I_2}{k_2 + j_2}, \tag{23}$$

respectively. Note that Equations (22) and (23) resemble Equations (17) and (19). Given this, our analyses of Equations (17) and (19) also apply to Equations (22) and (23). The only difference is that we now assume $k_2 > m_2 - j_2$ and $I_{0-1} > I_2$, in contrast to our earlier assumptions that $k_1 > m_1 - j_1$ and $I_0 < I_1$.

To see the negative real income affect, we first exclude the supply effect by holding $k_2 = m_2 - j_2$. Since $\frac{m_2}{k_2 + j_2} = 1$ and $\frac{(n_1 + m_2 - j_2)}{n_1 + k_2} = 1$, similar to our analyses of Equations (17) and (19), we know that the value of P_{b2} reported in Equation (23) should be less than the value of V_{b2} reported in Equation (22) if $I_{0-1} > I_2$. This means that, in Community B, the transaction price will be lower than the implicit price when the lower income group moves into the community.

What does this mean for the price dynamics of Community B? Recall that there is a group of existing residents (with a real income level I_0) who should move to Community A, but decided otherwise because they anticipated that the price in their community will keep rising. However, when this belief changes, it is in their best interest to sell their properties and move to Community A before more residents in their community put their properties on the market. In other words, the existing residents who have low moving costs (and do not like the new environment created by the new residents) should now tender their properties.

The increase in the supply from the existing residents will create an additional force that further pushes down the transaction price. To see this supply effect, we assume, for instance, that the number of existing residents who will move out of the community is sufficiently large so that $m_2 - j_2 < 0$. Since $k_2 \geq 0$ (negative supply is not allowed), we know that $k_2 > m_2 - j_2$. Consequently, $\frac{m_2}{k_2 + j_2} < 1$ and $\frac{(n_1 + m_2 - j_2)}{n_1 + k_2} < 1$. When $k_2 + j_2$ and m_2 are only a small fraction of n_1, most likely $\frac{m_2}{k_2 + j_2} < \frac{(n_1 + m_2 - j_2)}{n_1 + k_2} < 1$. From Equations (22) and (23), we know that, on top of the real income effect, the additional supply (resulting from the move-out of existing residents) could push the transaction price further below the implicit price in the community. We now see the bust period of a cycle.

How can this happen? Recall that the developers should have estimated the supply level by forecasting the number of residents who will move into (and move out of) a community, and decide on the building volume based on the difference between these two estimates. However, there are existing residents who should move out of a community (because they should be better off living in another community) but did not (because of moving costs and/or their anticipation that prices in the community will rise further). Because the developers will build enough units to accommodate all residents including those who should have moved out, the market during the boom period will accumulate inventory. Those residents, however, will begin to move out of the community when the market condition changes. This will, in turn, increase the supply level and further push down the transaction price level. It is fair to say that, the larger the inventory buildup during the boom period, the greater the pressure to push down the transaction price level during the bust period.

In comparing Equation (23) with Equation (14), it is clear that when the number of residents who move out of a community is more than the number of residents who move in, the transaction price in a boom-and-bust community (Community B) can be much lower than that in a stable community (Community A) at the end of the cycle. The increase in the inventory during the boom period is the key reason why the price can go bust. Without an inventory buildup period, Equations (23) and (14) indicate that the income effect alone will not be able to cause a serious boom-and-bust price pattern as the price level will move in tandem with the real income level.

4. Policy Implications

Our analyses indicate that there are three necessary conditions for a community to form a boom-and-bust price movement pattern. First, there must be changes (increases and/or decreases) in the income level of this community. However, this condition alone will not cause a cycle. If all residents have an increase (or decrease) in income, the price level will accordingly rise (or fall). This means that the price level will fluctuate with the movement of income. Under this circumstance, we will not observe a boom-and-bust price pattern unless there is a boom-and-bust real income pattern, which is unlikely to happen.

Given this, another necessary condition is that there is a wide income distribution. In other words, residents are heterogeneous in the income level. This means that, while some residents (with a higher income) are comfortable with the transaction price level in the community, others might not be. Under this circumstance, some residents (with a lower income) may have a stronger incentive to move out. However, they may not immediately move out because they anticipate that others will not immediately move out either. The need to select an optimal time to move out will only happen if there is a wide distribution of incomes.

Finally, there must be an inventory buildup process during the boom period. We know that there are some low income residents who should have moved out, but did not do so in the initial period. Since it is in the best interest of the developers to supply units to all residents, including those who should move out, the developers will build even if they believe that some of the residents will move out in the future. This will increase the inventory level during the boom period. The bust phase will follow once the income effect becomes negative and/or once the existing residents begin to move out (because they perceive that others will also move out). Based on the three conditions (a change in income level, wide distribution in income levels, and inventory buildup during the boom period), we can begin to predict what types of communities (or countries) are more likely to experience a large boom-and-bust cycle.

Which countries or communities are more likely to experience a large change in real income in a short period? The answer must be developing countries or communities with a move-in of new industries (that pay higher wages or produce more wealth). Which types of cities have a wide distribution of incomes? The answer must be cities that are experiencing a change in industrial structures. (For example, a change from agricultural to manufacturing jobs, or from manufacturing to information-related jobs.) In either case, many cities in China and other Asian countries fit these criteria. It might be fair to say that there are more cities in Asia (and particularly in China) than in developed countries that are currently in this type of situation. This indicates that a boom-and-bust price movement pattern is more likely to be observed in Asia (and especially in China) at least under this current economic environment. However, there is not much that a policy maker can do. The fast and uneven growth of income has caused many problems to the affected societies and the boom-and-bust price pattern is just one of them. We do not expect that we can see a quick fix to this problem if we need to first fix the income distribution problem.

However, as a policy maker, it might be important to look at another type of income that affects the real estate market. We all know that investors (especially those in China) also speculate in the residential property market. When a small portion of people in a society becomes rich quickly, this group of people will seek instruments to invest in. If one of the instruments they find is residential real estate, then there will be a flow of additional income into the properties of a community (just like a higher income group moving to a lower income area, as discussed before). Since investors and residents have different objectives (with the former looking for investment returns, while the latter looking for housing consumption) the investors might be willing and able to pay a higher price for a residence if they place more weight on future price appreciation. (It should be noted that we do not consider an investment in income-producing properties, such as apartments, as a housing investment.) In other words, for an identical residence, investors might be willing and able to pay a price higher than that which can be justified by the current rental income alone (or by the current income of the residents).

When this happens, the inflow of investment income will have the same effect as the move-in of higher income residents. (See Chen et al. (2012) for a good discussion on investment demand in Taiwan.) It should be noted that investors do not have moving costs (which prevent residents from moving out of their current community), and therefore, are not attached to the communities they invest in. This means that they will move out very quickly when the price begins to decline. It might be fair to say that the investment demand can help form a boom-and-bust pattern. As such, a policy maker might need to seek ways to discourage investment capital from entering into a residential community on a short term basis.

As discussed in the model, we believe that the bust of a cycle mainly results from an inventory buildup process (or from the vacancy level caused by the move-out of existing residents at the end of the cycle). In addition, we will not observe a large boom-and-bust cycle unless there is an inventory buildup process during the boom period. In our model, we assume that developers are rational and make supply decisions period by period based on the realized and the projected demands in each period. In other words, the maximum risk is the possibility of not being able to sell the units that they had built in one period. This assumption normally holds in the U.S., where builders take down some lots from subdivision developers who control phasing decisions in a rational way. However, if developers cannot make supply decisions period by period, then it is more likely for the developers to build up the inventory since they cannot adjust the supply based on market conditions. Is it possible that developers will have to make supply decisions several periods before they can observe the realized demand in each period? We believe that it is quite possible in many Asian cities (especially in Hong Kong or other cities in China where a land auction system is used).

There are at least two unique systems in the China property market. The first is the land lease auction system. The consequence of this system is that development size tends to be large as the site and buildable size of each auctioned land lease tend to be large. Furthermore, since the timing of the land supply is controlled by the government through an auction process, there is a tendency for developers to stock up land leases so that they do not need to worry about the possibility of running out of development opportunities. (See Qu and Liu (2012) and Lai and Wang (1999) for a discussion on the land lease auction system and the land bank practice by developers in China and Hong Kong.) With big development projects and a land bank (which does not produce income), developers might have less control on their supply decisions.

The second unique system in China is the presale system. While the presale system is also used in other countries, it is the predominant method of selling development projects in China. Since most development projects in China are dense developments that might take a longer time to complete, the gap between the time to start a pre-sale (and construction) and the time the demand is finally realized is normally longer than what we have observed for single family residences in the U.S. Wang et al. (2000), Lai et al. (2004), Chan et al. (2008), Chan et al. (2012), and Fang et al. (2012) have studied the impacts of the pre-sale system on the supply decisions of developers. In general, the conclusion is that developers will tend to supply more units to the market and the market will be more volatile when compared to markets without the pre-sale system. This also puts another restriction on the ability of developers to make a supply decision period by period based on the actual realized demand.

To sum up, our model indicates that it might be helpful for regulators to discourage investment demand in the housing market because, under the right conditions, it could be a force that can cause a boom-and-bust pattern. In China, the land lease auction system (and the associated land bank practice) and the presale system encourage developers to take on large projects and prepare for development opportunities well in advance. This means that it will be difficult for developers to stop developments when market conditions change. If the aim of a regulator is to minimize the chance for a boom-and-bust price pattern to occur, the regulator should figure out policies that will discourage developers from stocking up land (or holding land banks) and/or engaging in multi-period developments that require large investments in infrastructures at the early stage of the development.

5. Conclusions

This paper has developed a stylized model to explain the frequently observed boom-and-bust price movement patterns. We show that, with the inflow of a group of wealthy residents, the transaction price in a community will be pushed upward. If this inflow lasts for a while and developers build up the inventory in the community during this price run-up period, we will see a significant price drop after the inflow of new capital stops. The price movement pattern derived from this stylized model seems to conform to what we have observed in the real world. For policy makers, our model indicates that the key to minimizing the impact of a boom-and-bust cycle is to prevent an excessive inventory buildup at the price run-up stage. Although a slow increase in the inventory might fuel a price increase at the initial stage, the reduced level of inventory will also reduce the level of a price drop when the cycle ends. The amount of involvement by a government in the inventory control effort and better tools for controlling inventory buildup are topics for future studies.

The weakness of our model is that it does not allow the players to have a perfect foresight based on all available information. Instead, players will have to make decisions period by period after the information in each period is revealed to the public. Furthermore, our stylized model can only give the conditions that drive a particular outcome (the boom-and-bust price movement pattern), but cannot exactly model ways to endogenously derive these conditions (or determine if the moves are the optimal moves of the players). The weakness can be corrected if we are able to more explicitly model the supply decisions of developers and the moving decisions of existing residents and allow for perfect foresight.

It appears that the results of our current model will still hold if we allow developers to make supply decisions to maximize their total profits during the boom-and-bust period. However, we find it very difficult to model the move-out decisions of existing residents. When is the optimal time for the existing low income residents to arbitrage the transaction price difference by moving from one community to another community that better matches their income levels and lifestyles? Clearly, this decision must have something to do with their moving costs as well as those of other residents in the same community. Since the decision of one resident to move out affects the move-out decisions of other residents and because the moving cost of each resident is private information, we have failed to find a suitable utility (or objective) function to model this type of behavior. We believe that a model that can solve this problem will greatly enhance our understanding about the boom-and-bust price movement pattern.

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