Very Preliminary

CONSUMER HEDGING UNDER HOUSE PRICE UNCERTAINTY: THEORY AND EMPIRICS OF HOUSING PRESALES IN KOREA

Doo-Won Bang,[1] Hyuck-Shin Kwon,[2] Tsur C. Somerville[3], and Seung Dong You[4]

2021.05.28.

SUMMARY

This paper studies consumer strategies in housing markets of presale properties, to which recent papers in the housing literature pay increasing attention. Unlike the papers presenting a theoretical model from the prospective of a housing developer, our paper proposes a theoretical model from the perspective of a risk-averse housing consumer who wants to hedge against risks of housing prices. The paper provides empirical evidence that supports the theory with a unique data set of 2,000 condominium presale projects in Korea over the 2007-2014 period. The Korean case is interesting, as a public guarantee scheme protects presale buyers from project default and project delay. We show that a consumer who purchases a preselling condominium acquires a tool to hedge against housing price risks. Obtaining the benefit, such a consumer is distinguished from a speculator and a noise trader suggested in previous studies.

[1] Senior Research Fellow, Korea Housing and Urban Guarantee Corporation.
[2] Senior Manager, Korea Housing and Urban Guarantee Corporation.
[3] Associate Professor, Sauder School of Business, University of British Columbia.
[4] (corresponding author) Associate Professor, Department of Economics and Finance, Sangmyung Uni.. Email: peter.you@sauder.ubc.ca, peteryou@smu.ac.kr, Tel: +1-778-522-2925.

I. INTRODUCTION

We investigate the benefits of consumers who purchase an under-construction condominium unit of presale, which becomes widely available in international housing markets. Unlike consumers *in spot (housing) markets*, in which properties after their construction is substantially completed are traded, consumers often face several issues *in presale (housing) markets*, in which, before the construction completion or even before the construction start, uncompleted properties are traded. In the housing presale literature, several issues have been widely discussed and the issues include risks of project default (Ong, 1999; Deng and Liu, 2009; Chan *et al.*, 2012), delays of project schedule (Barbara *et al.*, 2007; Tang and Wang, 2017), and asymmetric information on housing quality or developer's moral hazard (Chau *et al*, 2007).

The issues above mentioned are commonly addressed in Korean housing markets, as most condominium developers list uncompleted units on the (pre)sale listing.[5] After a long discussion, in 2004, the government announced a road map of no presales that, from the year of 2008, housing presales would be banned for projects financed and developed by any organizations under the government umbrella. Nevertheless, in dampened housing markets with the Global Financial Crisis (GFC) in the late 2000s, this plan was withdrawn.

With housing market booms following the GFC, a new debate on housing presales resumed; many participants in housing markets appeared to think that consumers obtained little benefits from signing a presale contract. They argued that many speculators bought uncompleted properties, as discussed in Fu and Qian (2010) and that many presale buyers could be those who falsely believed their market information, so called noise traders in Yiu *et al.* (2009).[6] In order to keep those speculators or noise traders away from housing markets, moreover, some policy makers asked strong measures similar to Hong-Kong anti-speculation measures in 1994, as discussed in Wong *et al.* (2006).

Arguing the need of consumer protection in the presale market, in 2018, the Korean government announced another road map, which was a somewhat relaxed version of the previous road map. For condominium projects constructed or financed by public entities, by 2022, under-construction condominium units could be listed on the presale listing after more than 80 per cent of their construction project was completed. In particular, the Ministry of Land, Transport and Infrastructure announced, "by reducing the number of housing presales, consumer choices would

---

[5] According to the Ministry of Land, Infrastructure and Transports, condominiums occupied 78 per cent of housing units completed in 2019.

[6] Many ordinary people consider housing speculations immoral and greedy activities, even though the speculations may produce some positive effects such as stabilizing housing prices (Wong *et al.,* 2005).

significantly improve."[7] At the same time, some politicians and professionals argued that only developers would be better off in presale markets, in which consumer choices were too restricted.[8]

From the perspective of real estate developers, Liu and Chau (2019) recently examine incentives for presales, claiming that developers in Hong Kong hedge against house price fluctuations. Using a real options framework, Lai *et al.* (2004) analyze the value for developers who presell their uncompleted products. Edelstein *et al.* (2012) propose that a representative agent can take an allocation strategy for their (under-construction) units into two types of housing markets. Many of previous studies (Ong, 1999; Chan *et al.*, 2008; Chung and Lo, 2018, Li *et al.*, 2018) discuss incentives or benefits for developers, who can default or abandon their project.

The Korean case is interesting, as presale buyers are protected from their developer's decision of defaulting or abandoning the project. Based on the Housing Act, a developer who presells more than 30 under-construction housing units (20 under-construction units before June 2014) in a project is required to obtain a guarantee letter from the public entity, Housing and Urban Guarantee Corporation (HUG). In case that the project is defaulted or abandoned, the HUG completes the project or reimburses installment payments on behalf of the buyers upon their collective decision. By assuming no counterparty's risks, as a result, we can build a model of a representative household who wants to keep away from house price risks. Fan *et al.* (2012) propose that both buyers and sellers participate in presale markets to avoid house price risks. On the other hand, Edelstein *et al.* (2012) suggest that according to belief on future housing market dynamics, some people purchase an uncompleted unit and the other purchase a completed unit. Similar to their arguments, we claim that consumers participate in a presale housing market in order to hedge against house price fluctuation. With a novel data set in Korean presale markets, moreover, our paper provides empirical evidence that highlights consumer strategies.

We contribute to the literature by proposing both theory and empirical evidence on Korean presale housing markets. Unlike most previous studies on presales that provide an excellent theory, recently Li and Chau (2019) provide sophisticated empirical evidence, highlighting incentives for developers. Li *et al.* (2018) also empirically study development strategies using presale mechanisms in Hong Kong. In our view, our paper can be their complement, as it articulates incentive for consumers who buy an uncompleted condominium unit. As already mentioned, Fan *et al.* (2012) and Edelstein *et al.* (2012) suggest that consumers have incentives of participating presale markets. Nevertheless, our paper can also be their complement, as it contains empirical evidence. As far as we know, our paper is the first research on the Korean presale market, where most of under-construction condominium units are traded in presale markets. Korea has a unique presale guarantee system managed and operated by the Korea Housing Urban Guarantee

[7] See the Korean government's press opinion (in Korean) released on June 13, 2018. The policy measures covered public and private housing markets; in public housing markets, the government would promote spot sales by gradually reducing presales from 2018 and in private housing markets, it would provide incentives of public land, financing, and guarantee for developers who sell their products in spot markets.
[8] This argument can be found in mass media; for an example, see http://www.jjan.kr/news/articleView.html?idxno=1145303 (in Korean: accessed in Feb 2020).

Corporation (HUG) under the Ministry of Land Transport and Infrastructure. As the public guarantee system protects presale consumers from risks of project default or delay, it enable us to build a simple model of a representative presale consumer. As a result, that presale consumers are distinguished from speculators in Fu and Qian (2010) or noise traders in Yui *et al.* (2009).

Our paper is structured as follows. Section 2 provides a simple overview on the presale housing market in Korea. Section 3 presents a theoretical model of a representative agent who wants to avoid risks arising from uncertain house prices and Section 4 delivers empirical evidence of the theoretical model. Section 5 concludes.

II. AN OVERVIEW ON HOUSING PRESALES IN KOREA

During the period of rapid economic development, the allocation of capital into housing markets was inadequate (Kim and Suh, 1991). From the early 1970s, Korea strategically invested capital to restructure its economy from light industries to export-oriented heavy and chemical industries. In order to promote housing development, at the same time, policy makers designed and proposed a few housing construction drives, which had failed to implement with no accompanying capital investment (You, 2019). [9]

Most housing developers could not finance capital from a formal financial market; financial institutions, such as commercial banks who had many lending opportunities in industrial sectors, hesitated to provide capital in housing sectors. Housing developers turned their attention to informal financial markets and housing presales indigenously emerged. There seemed to be many presale speculators and noise traders in Korea, as in Fu and Qian (2010) and in Yui *et al.* (2009), respectively, during the period of rapid economic developments that led to housing markets of housing shortage. On the 1977 Housing Construction Promotion Act, which legally acknowledged the existence of presale practices, the government reinforced developers to obtain an approval and for such an official approval, presale prices should meet government guidelines. To boost housing supplies, policy makers could neither invest enough capital with little budget nor attract enough capital from financial institutions.

In order to attract capital in housing markets, in 1977, the policy makers designed and implemented a unique saving scheme called as ‘public housing saving account.’ Households who maintained such a public housing saving account for a certain period of time could obtain a priority in the waiting line for a presale unit (not a construction completed dwelling unit). Such a priority was determined according to the type of such a saving account, the saving period, and other criteria. The priority played a role of qualification that a household could apply to buy an under-construction unit, which did not mean that the household could purchase a presale unit. The winner among qualified households who casted lots received the right to purchase a presale unit and sometimes,

[9] In 1980, policy makers planned to build 500 thousand housing units over 10 years, even though the estimated number of (existing) housing units in the early 1980s was only 540 thousand.

the number of qualified household per unit was often more than several hundreds. In markets of chronic housing shortage, many households signed a presale contract with such a saving account.

In housing markets, nonetheless, presale buyers were vulnerable to risks such as the project default, the project delay, and the developer's moral hazard. The issues received keen attention during the period of the two million housing unit construction derive that announced in 1988 and continued to the early 1990s. For the protection of presale dwelling buyers, in 1993, initiated a formal program of presale guarantee (insurance), which was similar to performance bond that reduces both risk from delay of the project schedule and credit risk from the developer who may fail to complete the construction project. The sole presale guarantee provider, Construction Guarantee Cooperative (CGC), also had a warranty bond program that provided a guarantee on quality for presale units. Its successor, the Korea Housing and Urban Guarantee Corporation (HUG) currently operates the (public) presale guarantee, which needs to be distinguished from private guarantees in Hong Kong. Furthermore, the 2004 revision of the Housing Act introduced a mandatory warranty against 'all the defects' covering for 10 years after the delivery of a condominium, even though the unrealistically strict requirement was revised in 2009.[10]

<Table 1> presents the annual number of condominium units obtained a sale permit (issued right after issuing the building permit) and the annual number of condominium units obtained a HUG presale guarantee from 2013 to 2019. In 2013, for example, 78 per cent of units obtained a sale permit obtained a presale guarantee from the HUG. Those figures would be a minimum that presents the fraction of presold units, as a developer is not legally required to obtain a HUG guarantee with less than 30 presale units (less than 20 presale units before June 2014).[11]

[Insert Table 1 here]

Developers who want to sell their units after the completion of a project would find it difficult to finance development cost; capital providers, such as commercial banks, are likely to require such developers to submit a performance bond from their parent or sister companies who would complete the project in case of default. Even though a developer succeeds to obtain a development loan, its costs appear not to be reasonable. In Korean presale schemes, moreover, developers can finance the less amount of construction loans with the more number of presale units sold, as the purchasers pay installments on a regular basis until the end of the construction. As a result, almost all developers who build more than 30 units choose to list their uncompleted (and guaranteed) units on the presale listing. In Hong Kong, as Chan *et al.* (2008) suggest, units presold can play a role of signaling the developer's ability to finance. Upon receiving a guarantee letter from the HUG,

[10] The period of a warranty on structural defects remained for 10 years. However, the period of warranties on other minor defects was shortened; for example, the period of a warranty on flooring was shortened to 5 years.

[11] For 1st hand sales in Hong Kong from 1993 to 2014, presold units occupied less than 46 percent of total sales (Li and Chau, 2019: 211).

however, a developer is able to obtain a guaranteed loan to finance construction cost in Korea; with more units of presale sold, the loan amount decreases and its conditions become more favorable.

III. THEORY OF HOMEBUYER HEDGING

1) The General Model

We build a theoretical model for a representative consumer who wants to avoid risks of housing prices. Based on the local zoning ordinances, the density decision is assume to be already made; q units on a condominium development site are to be built. It is an innocuous assumption, as Korean condominium developers start preselling their under-construction units with a sale permit issued after reporting the housing start. The building permit issued before the housing start already includes information on the number of housing units and on their detailed types and specifications.[12] For convenience, moreover, all the units are identical and infinitely divisible and will be absorbed in the housing market, as in Capozza and Li (1994).

Our model assumes that construction of a condominium project is instantaneously completed with no development lags in Bar-Ilan and Strange (1996); as in Capozza and Helsely (1990), there is no risks in development process except volatile housing prices. Korean consumers who bought a presale condominium unit can significantly reduce the counterparty risks arising from their developer with the HUG guarantee. The completed units are to be equipped with a degree of quality that a representative household originally expects; there is no moral hazards, as in Chau *et al.* (2007). The no-moral hazards assumption will be relaxed in our empirical model, as mandatory warranties required by the Housing Act may not cover some minor defects.

In a competitive housing market, our representative renter household is better off by purchasing housing units, as in Fan *et al.* (2012). Taking into consideration of volatile house prices, the household makes a decision of purchasing condominium units in the two different types of housing markets. In the presale market, the household is to purchase h ($0 \leq \mathrm{h} \leq \mathrm{q}$) units at presale price p and in the spot market, she is to purchase the remaining $\mathrm{q} - \mathrm{h}$ (≥ 0) units at spot price $\tilde{s}$. With the subjective probability density function on the spot price $f(\tilde{s})$, the household can make a choice between accepting the predetermined price and waiting until $\tilde{s}$ is realized.

We propose a risk-averse household who consider hedging against house price risks using a presale agreement. In the literature of presales, existing studies such as Li and Chau (2019) examine presale developer strategy in presence of house price uncertainty. On the other hand, our study examines consumer strategy in presence of house price uncertainty. All the units are listed for

[12] In order for the protection of consumers in presale markets, the sales permit system was amended in 2005. A developer can hardly make any changes of a design of her undergoing project; the developer is allowed to do so as long as all of the consumers who purchased any uncompleted units on the project agree on the design change.

presale and our consumer determines the number of units purchased in either market.[13] As a result, this model is distinguished from the model of Fan *et al.* (2012) or of Edelstein *et al.* (2012).

A household has a utility function of von Neumann-Morgenstern U and maximizes her utility by consuming the other composite good x; the utility function satisfies $U' = \partial u/\partial x > 0$ and $U'' = \partial^2 u/\partial^2 x \leq 0$ for any x. The goal of the household is to maximize her utility function

$$\max_{\{h\}} \mathrm{EU}(x) = \int_0^{\infty} U(\tilde{x}(h))\, f(\tilde{s}) d\tilde{s}, \tag{1}$$

$$\text{where } \tilde{x}(\mathrm{h}) \equiv \bar{w} - \{\tilde{s}(q-h) + ph\}, \tag{1'}$$

where the riskless endowment $\bar{w}$ and the household has a deep pocket, as $\tilde{x}\,(h) > 0$ for any $\tilde{s}$ or h. This assumption is similar to that of Fan *et al.* (2012), who propose a strategy of asset allocations between housing purchased in either presale market or spot market and other assets for risk-averse households who maximize their expected utility of terminal wealth.

The first-order condition is

$$\frac{\partial\, \mathrm{EU}(x)}{\partial\, h} = \int_0^{\infty} U'(\tilde{x})(\tilde{s} - p)\, f(\tilde{s}) d\tilde{s} = 0. \tag{2}$$

And the second-order condition $\frac{\partial^2\, \mathrm{EU}(\tilde{x})}{\partial\, h^2} = \int_0^{\infty} U''(\tilde{x})(\tilde{s} - p)^2 d\tilde{s}$ is assumed to hold with $U''(\tilde{x}) < 0$.

Equation (2) appears to be similar to the condition in Holthausen (1979). In order to hedge against risks of house price, our household determines an optimal level of purchasing presale units, whereas the producer in Holthausen (1979) determines the amount of hedging the output in order to manage risks of output price. In addition, this result seems to be similar to Koppenhaver and Swindler (1996) who examine risk management under input price risks. Unlike the previous models, our model examines consumer-hedging strategy. This paper also includes empirical evidence supporting the theory in a consumer market that the previous paper failed to do so. We can rearrange the equation (2) into

$$E[U'(\tilde{x})(\tilde{s} - p)] = EU'(\tilde{x})E(\tilde{s} - p) + cov[U'(\tilde{x}), \tilde{s}] = 0 \tag{3}$$

If $\mathrm{p} = E(\tilde{s})$, the household purchases all the units in the presale market, as the covariance term in equation (3) is zero if and only if $h^* = q$. The covariance term in equation (3) is positive if and only if $h^* < q$, as an increase in $\tilde{s}$ leads to a decrease in $\tilde{x}$, which leads to an increase in marginal utility. In presale markets, no short-selling is available and the term is negative if and only if $h^* >$

[13] In Li and Chau (2019), on the other hand, a consumer cannot buy a non-completed residential unit, as the developer may not list the unit for presale.

q, as an increase in $\tilde{s}$ leads to an increase in $\tilde{x}$, which leads to an decrease in marginal utility. As a result, if $\mathrm{p} = E(\tilde{s})$, then a risk average household would buy all the units in the presale market $(h^* = q)$. This outcome is somewhat distinguished from Edelstein *et al.* (2012) who assume heterogeneous agents. If $\mathrm{p} < E(\tilde{s})$, then she would buy more than the total number of units in the presale market $h^* > q$. And If $\mathrm{p} > E(\tilde{s})$, then she would buy less than the total number of units in the presale market $h^* < q$. As we cannot short-sell units (or sell more than q), we conclude that if $\mathrm{p} \leq E(\tilde{s})$, then $h^* = q$, and that if $\mathrm{p} > E(\tilde{s})$, $h^* < q$.

Our theoretical model can be distinguished from previous theories in the housing presale literature. Previous studies such as Lai *et al.* (2004), Chang *et al.* (2008), Edelstein *et al*. (2012). Fan *et al.* (2012) estimate the value of a presale option and explore relationships between the option and development strategies.

2) The Model with a CAAR Utility Function

In order to derive more testable implications for the next section, we propose a CARA (Constant Absolute Risk Aversion) utility function, as Edelstein *et al.* (2012) and Fan *et al.* (2012) do. Without loss of generality, we define a spot house price

$$\tilde{s} = \mu_{\tilde{s}} + v_{\tilde{s}}, \tag{4}$$

as $\tilde{s}$ is sum of mean $\mu_{\tilde{s}}$ and mean-zero random variable $v_{\tilde{s}}$ with its volatility $\sigma_{\tilde{s}}^2$. Therefore, we have the expected value

$$E(\tilde{x}) = \overline{w} - E(\tilde{s})(q-h) - ph = \overline{w} - \mu_{\tilde{s}}(q-h) - ph, \tag{5}$$

where $Var(\tilde{x}) = (q-h)^2\sigma_{\tilde{s}}^2$.

Equation (1) can be converted to the CARA (Constant Absolute Risk Aversion) utility function

$$U = E(\tilde{x}) - \frac{1}{2}A\,\sigma_{\tilde{s}}^2, \tag{6}$$

where A is the Arrow-Pratt risk premium. With equation (6), we can derive an explicit closed-from solution, which helps us understand a clear picture of our theoretical model. Thus, equation (6) converts to

$$U = \overline{w} - \mu_{\tilde{s}}(q-h) - ph - \frac{1}{2}A\,\sigma_{\tilde{s}}^2(q-h)^2. \tag{7}$$

The existence of a presale market allows the household to set house price determined before the completion of a project. The spot house price is random and prior to the realization of the spot price, the presale price is known to the renter household, as in Sinai and Souleles (2005), who wants to keep away from uncertain housing cost. However, if the household waits for a realized spot house price, then she needs to bear costs of uncertainty. Before the uncertainty is resolved, nonetheless, note that a consumer has an option to avoid uncertainty, as a developer in Li *et al.* (2018) does. The first order condition is

$$\frac{\partial U}{\partial h} = (\mu_{\tilde{s}} - p) + A\,\sigma_{\tilde{s}}^2(\mathrm{q} - \mathrm{h}^*) = 0. \tag{8}$$

The equilibrium condition, the optimal presale unit purchased is

$$h^* = q - (p - \mu_{\tilde{s}})/A\,\sigma_{\tilde{s}}^2. \tag{9}$$

And the second-order condition $\frac{\partial^2 W}{\partial h^2} = -A\,\sigma_{\tilde{s}}^2 < 0$ is confirmed.

With q, the developer offered p in the presale market. The household purchases some units in the presale market and the other units in the spot market, if p$>\mu_{\tilde{s}}$. On the other hand, she purchases the maximum number of q uncompleted units, if $p \leq \mu_{\tilde{s}}$. In order to make the model consistent with our project-level data, we covert equation (9) to

$$h^*/q\ = 1 - (p - \mu_{\tilde{s}})/(\sigma_{\tilde{s}}^2 A\, q). \tag{9'}$$

Note equation (9)' may have boundary two boundary conditions; $h^*/q\ = 1$ if p$<\mu_{\tilde{s}}$, as short-selling is restricted and $h^*/q\ = 0$ if p$>\mu_{\tilde{s}}$+$\sigma_{\tilde{s}}^2 A\, q$, as p is high.

The equation (9)' produces testable hypotheses. In the presale market, i) at higher p, the household purchases less under-construction units of presale. ii) At higher $\mu_{\tilde{s}}$, the household purchases more units. iii) With higher A, the household purchases more units and if $A \to \infty$, the household purchases all the under-construction units. iv) With higher $\sigma_{\tilde{s}}^2$, the household purchases more units and if $\sigma_{\tilde{s}}^2 \to \infty$, the representative household purchases all the under-construction units. v) With a larger project, the household purchases more units.

We can compare strategies of our representative household with those of a developer in Li and Chu (2019). With higher degree of uncertain house prices, our representative household purchases more uncompleted units, as their developer who faces higher uncertainty of house prices has stronger incentive to presell. With the larger size of a development project, our household purchases more units and their developer presells more units. Previous studies such as Li and Chu (2019) and Edelstein *et al.* (2012) argue that 'housing developers' presell their under-construction units in order to avoid house price risks. Their implications are close to those of our theory that 'housing consumers' also participate in presale housing markets in order to hedge against house price risks. Nonetheless, our model treats housing as a consumption good and the theory fails to consider a house as an investment. Our agent expedites a decision of housing purchase in an uncertain environment and this strategy is somewhat seemingly different from real options strategies in Capozza and Helsley (1990) and You (2014).

IV. EMPIRICAL EVIDENCE IN THE KOREAN PRESALE MARKET

1) Empirical Model and Data

We can analyze the consumer strategy in equation (9)', which can be converted to the empirical model

$$hq = \beta_0 + \beta_1\, rhp + \beta_2\, shp + \beta_3\, vol + \beta_4\, rp + \beta_5\, size + \beta_x X \tag{10}$$

where hq is the fraction of unit presold h^*/q, rhp is presale price p, shp is the expected spot price $\mu_{\tilde{s}}$, vol is volatility of house prices $\sigma_{\tilde{s}}^2$, rp is risk premium A, and $size$ is project size q, respectively in equation (9). β_i (for $i = 1, 2,3,4, 5$) is the coefficient of each variable, respectively and β_0 is the constant. In addition, we may control for the vector of other covariates X and $\beta_x$is the vector of their coefficients.

With condominium projects guaranteed by the HUG from September 2009 to December 2014, we collected 2,000 observations after cleaning a data set; the HUG has its own internal policies of releasing the data and due to construction lag, we use the most recent market information as of 2020. In order to underwrite a presale guarantee, the HUG receives project information including prices of units and their characteristics. On a regular basis, the HUG receives a progress report that includes updated information such as units sold.

[Insert Table 2 here]

The list of variables and their descriptions in our empirical model in equation (10) are listed in <Table 2>. The dependent variable hq is measured by the percentage of presale units actually sold on the first progress report, which is required to be submitted within first four months (including the month of the presale start date) of the presale start date. [14] Note that q units in equation (9) are listed on the presale listing and h^* units are actually sold. <Table 3> delivers the summary statistics of the variables. Note that 49 per cent of units listed for the presale listing are sold within less than 4 months. The presale variable that accounts the fraction of units presold on a project is

[14] We can proxy the presale variable by other measures and, for a robustness check, we use the percentage of units listed for presale but unsold before the completion of a construction.

distinguished from the presale variable in Li and Chau (2019: 220) and Li *et al.* (2018).[15] Nonetheless, none of units can be sold even after the completion of a construction.[16]

[Insert Table 3 here]

Our empirical model has five key determinants. Firstly, presale prices are open to the public, as developers submit presale prices to both local authorities (upon applying for a sale permit) and HUG (upon applying for a guarantee); those prices tend to be invariant during the period of a construction project. According to the location of a development project and the time of issuing a presale permit, presale prices vary. A relative measure that takes into account both location of a project and its time of issuing a sale permit seems required. We proxy rhp by the ratio of an average of presale prices per unit of size on the development site to an average price per unit size of its neighboring (existing) condominiums within the same sub-province level (Si, Gun and Gu) district on the month of the listing. The prices of the existing properties at the sub-provincial level and their sizes are collected from R114, one of well-known local house price information providers. On average, the average price per a unit size for preselling units is 46.8 per cent point higher than that for existing condominium units within the same district.

For shp, secondly, we need an assumption that our representative agent makes forecasting on local house prices. Over the six-month time horizon before an issuance of sales permit, we proxy shp by a percentage change of the sub-provincial level house price index using the KB Kookmin Bank house price index, which releases price indices every month.

For vol, thirdly, we adopt a simplest possible volatility measure. From equation (4), we have $\sigma_{\tilde{s}}^2 = (\tilde{s} - \mu_{\tilde{s}})^2$, which can be converted to $\sigma_{\tilde{s}} = |\tilde{s} - \mu_{\tilde{s}}|$ for a time-varying proxy of the volatility, where $\tilde{s}$ is the log difference of an index at each time and $\mu_{\tilde{s}}$ is the mean of log differences during the sample period, as in Hull (2005). As in Liow (2009) for international securitized property markets and in So (2000) for stock markets, we calculate $\sigma_{\tilde{s}}$ the absolute mean deviation with the monthly sub-provincial level KB Koomin Bank index.

Fourthly, we proxy rp by builder's ranking of construction capability evaluation in the year of the sale permit. Our data only includes project information and we assume that our representative agent's risk attitude is proxied by a builder's ranking or reputation; note that higher ranking implies higher risk attitude for a representative agent. Firm's reputation decreases its total risk and its unsystematic risk but increases its systematic risk (Delgado-García et al, 2013). In development

[15] All the units in a project tend to be listed for presale in Korea. As long as the developer continues to proceed construction, she cannot charge higher than the price approved by government or is not allowed to withdraw the presale. In Hong Kong, however, only some units in a project can be listed for presale and its developer seems to negotiate their prices and decided to delay sales of listed units after construction completion.

[16] Korean professionals call the unsold units after the completion of a construction as 'chronically' unsold units. This naming indirectly implies that housing market players seem to assume that they tend to sell most of under-construction units before the completion of a construction.

projects, in Korea, the HUG guarantee covers project defaults or delays. Nonetheless, completed units may have lower quality than consumers expected; for example, consumers find minor defects of their unit after moving-in. In addition, being reputable seems to favor the attraction of stakeholders including consumers and Korean builders consider ranking of construction capability evaluation seriously, as reputation is its intangible asset (Robert et al, 2002; Gaultier-Gaillard and Louisot, 2006).

Lastly, $size$ is the number of units on a project and an average number of units is 596. The largest project has 7,200 units and the smallest project that obtained a HUG guarantee before June 2014 has 21 units.

For the other covariates, we need to take into account of time value of money, as many presale purchasers finance their installment payments. Interest rates for those installment loans tended to be linked to mortgage rates and in 2017 the Financial Supervisory Service started to classify those installment loans as mortgages, even though strictly speaking those loans are not mortgages that require collaterals. In a development project, proximity to a park can be an important component, as we consider projects of condominium building of high population density.[17] We use quarterly unemployment rates at the province level in order to control for local economic conditions, as most of other alternative local economic indicators are available on a yearly basis. In addition, we control for local consumer price index.

2) **Empirical Evidence of Presales**

<Table 3> delivers the key empirical results for equation (10). Model 1 has five key covariates, as in our theoretical model. Their coefficients are statistically significant and except the coefficient of $vol,$ the other coefficients have the same sign suggested from our theoretical model. Consumers purchase more uncompleted units of a development project, as the average presale price is lower than the average price of existing neighboring condominiums and as their local house price index increased more over the last six month. Consumers take into account relative prices of presale condominiums and (existing) condominiums, as they have an option to purchase an existing unit. Moreover, they purchase more presale units in markets where the house price index at the sub provincial level rose more recently. Those results imply that consumers in the presale housing market purchase pre-sale condominium units in order to hedge against housing price fluctuations. Nonetheless, an estimated coefficient of vol seems to favor a real options theory, which needs to be investigated further. In our theoretical model, an agent makes a presale contract to mitigate uncertainty, which is close to theories in hedging. As in Titman (1985) and Capozza and Helsley (1990), nevertheless, an agent waits until uncertainty is resolved in a traditional theory of real options.

With higher risks premiums in equation (9)’, a representative agent buys more uncompleted units of a development project. Consumers in housing markets pay attention to reputation of their builder

[17] According to the building code, a building of more than four floors is classified as a condominium (or apartment).

(Chau *et al*, 2007) and they would ask lower premiums if their builders have higher reputation, which is proxied for ranking of construction capability evaluation. Model 1 predicts that, other things being equal, consumers buy 2.3 per cent of the presale units more as the ranking improves by 100. With more housing units, the project risk is likely to reduce as unsystematic risk can be diversified away. With an increase by 100 units in a project, consumers buy 3.6 per cent units of the project more.

By controlling for X that includes mortgage rates, proximity to a park, employment rates and consumer price indices, Model 2 produces the same results with Model 1, even though the coefficient for vol turns insignificant. Many presale consumers finance their installments in the form of presale loans and the number of purchased unit increase with lower financial burdens. Units located to be near a park are preferred and the sign of unemployment representing local economic condition is the same as expected although it is not statistically significant. In addition, we control for local consumer price indices, even though most consumers in housing market make a decision by observing nominal values.

[Insert Table 4 here]

3) Presale Analysis Dealing with a Structural Break

Both Model 1 and Model 2 support our theory, even though the estimated coefficient for vol seems to support a real options theory. Our empirical data covers the period Sep 2009 to Dec 2014, during which the national condominium market received temporary impacts from the GFC. As seen in [Figure 1], the national housing market somewhat dampened in late 2008 but rebounded back in late 2009. From 2012, nonetheless, the market faced a temporary downturn. As a result, Bang *et al.* (2019) articulate that presale markets went through several different economic cycles after the GFC.

[Insert Figure 1 here]

Following Bai (1997), Bai and Perron (1998), and Bai and Perron (2003), we run empirical tests in order to infer the existence of multiple structural breaks using the monthly KB Kookmin Bank index from 2009 to 2014.[18] Due to the limitation of observations, we imposed a single structural break on the national housing price index and the Bai and Perron (1998) model confirmed the structural break in Mar 2011.[19] With the results, the period Sep 2007 to Mar 2011 is defined phase

[18] Several statistical tests confirm that the national housing price index has up to five structural breaks.

[19] Bai and Perron (1998)'s test results are as follows

Break Test	F-value	Critical Value	Break dates	Sequential
0 vs. 1[b]	43.90	8.58	1	2011.03
1 vs. 2	6.62	10.13		

Note: b indicates that the test is statistically significant at the 5 % significance level.

I and the period Apr 2011 to Dec 2014 is defined as Phase II; phase I may be referred to as appreciation phase or strong market and phase II may be referred to as stabilization phase or dampening market.

Model III has two separate regressions in two different phases; the phase I has 1,290 projects and phase 2 has the remaining 710 projects. In the former appreciation phase, the estimated coefficients for the five key covariates are statistically significant and their signs are the same as our theoretical model predicts. In the strong market, it seems reasonable that consumers participate more in the presale market with more volatile house prices, which supports our theory. In the dampening market, consumers seems to adopt a real options strategy, even though the estimated coefficient for vol is insignificant. With a higher degree of house price risks, in a strong market where house prices exhibit an increasing trend, consumers have stronger incentives to buy a presale house in order to mitigate house price risks. In a dampening market where house prices exhibit a stabilized trend, on the other hand, consumers have stronger incentives to wait to see with a higher degree of house price risks. This is somewhat consistent with what we expected, as housing presales became widespread when housing price rose very rapidly.

In addition, model 4 controls for provincial areas, as housing markets exhibit somewhat different regional patterns of price movements. After controlling for 16 provincial areas, model 4 produces the same results for vol. The estimated coefficients for the other key covariates show the same results that our theoretical model predicts, even though some estimated coefficients become slightly less significant. In the strong market, more volatile house prices encouraged more consumers to purchase condominium units, whereas in the dampening market, they made them to delay making a presale contract, even though the coefficient of vol is not statistically significant. In the strong market, moreover, consumers might pay less attention to reputation of builders, some of whom keep good local reputation. In the dampening market, nonetheless, the national reputation was more seriously considered.

4) Robustness Test

The previous sections analyze the determinants of presale units purchased by consumers on the first report. During the construction period, nonetheless, builders are required to submit progress reports on a quarterly basis and the number of sold presale units can vary. The units sold on the first progress report may contain limited information over the construction period. For the guarantor, moreover, the number of unsold units is more critical for risk management than the number of sold units.

Our theory is flexible enough to incorporate unsold units of presale. A project includes q units, all of which is listed on the presale listing. With (time-invariant) q units, the number of units unsold is $(q - \mathrm{h}^*)$, where h^* is a time-varying variable. As a result, equation (9)' is converted to

$$(q - h^*)/\, q \ = \ (p - \mu_{\tilde{s}})/(\sigma_{\tilde{s}}^2 A q), \qquad (9)''$$

where $(q - h^*)/\, q$ is the fraction of unsold presale units uhq and the equation (9)'' also has the two boundary conditions. We can see that uhq increases with higher p and decreases with higher $\mu_{\tilde{s}}$. If no short-selling is allowed, uhq decreases with $\sigma_{\tilde{s}}^2$ ($uhq = 0$, if $\sigma_{\tilde{s}}^2 \rightarrow \infty$), uhq decreases with ($uhq = 0$, if $A \rightarrow \infty$), and uhq decreases with q. Housing consumers is more likely to hesitate to sign a presale agreement at higher p, at lower $\mu_{\tilde{s}}$, with lower $\sigma_{\tilde{s}}^2$, with lower A, and with less q.

With several uhq observations for each presale project, we construct a panel data set, which includes 48,775 observations. A fixed-effect panel model seems to be appropriate, as the development project-specific effect can be correlated with the covariates. We do not control for the other covariates, as other covariates X are national, provincial, or time-invariant variables and there may be perfect linear dependence. The summary statistics of the panel data are in Appendix 1.

<Table 5> delivers empirical results of the panel model. For model 1, the five key covariates have a statistically significant estimated coefficient, whose sign is the same as what our theory predicts; uhq increases with rhp and rp but decreases with shp, vol, and $size$. By controlling for province dummies, for model 2, the estimated coefficients remain invariant and their sign, except that of rp, is statistically significant.

[Insert Table 5 here]

V. CONCUSION

Highlighting consumer strategies of hedging against house price risks, our paper argues that consumers in an uncertain housing market can be better off by participating in the presale market. Our theory is confirmed by empirical evidence with a data set composed of 2,000 condominium development projects. In Korea, note all under-construction units of most projects tend to be listed on the presale listing and those on the presale listing are required to covered by a public guarantee, that enables housing consumers to be protected from their counterparty risks. Both theory and empirics confirm that using a presale agreement in housing markets, consumers exercise an strategy of mitigating house price risks.

Not only general practices in development projects in Korea but also its guarantee system enabled us to focus on housing consumers by abstracting from housing developers, whose strategies in presale markets have been widely investigated in the literature. Nevertheless, two strategies that this paper takes little account can be explored further in future research. In housing markets, policy makers implement various strategies in order to achieve their goals; for example, their goal is to keep speculators or noise traders away from presale markets. Moreover, consumers may not fulfil their obligations after signing a presale contract. In some circumstances, consumers who signed a presale contract may decide not to receive the delivery of a housing unit. In a housing presale market, those housing policies or consumer strategies could be worthwhile to receive further attention.

REFERECES

Bai, J. (1997) . "Estimation of a Changing Point in Multiple Regression Models. " *Review of Econometric and Statistics* 79: 551-563.

Bai, J. and P. Perron (1998) . "Estimating and Testing Linear Models with Multiple Structural Changes. " *Econometra* 66: 47-78.

Bai, J. and P. Perron (2003) . "Computation and Analysis of Multiple Structural Change Models." *Econometra* 18: 1-22.

Bang, Doo-Won, Kwon, Hyuck-Shin and Kim, Myeong-Hyeon (2019). "Spillover Effects of Regional Apartment Business Cycles Using Factor-Augmented VAR Model (in Korean)." *Housing Studies Review* 27.3: 147-171.

Barbara Y.P. Leung, Eddie C.M. Hui & Bill Seabrooke (2007) . “Asymmetric Information in The Hong Kong Forward Property Market,” *International Journal of Strategic Property Management*, 11:2, 91-106, DOI: 10.1080/1648715X.2007.9637563

Bar-Ilan, Avner, and William C. Strange (1996). "Urban Development with Lags." *Journal of Urban Economics* 39.1: 87-113.

Capozza, D.R. and Y. Li. (1994). “The Intensity and Timing of Investment: The Case of Land.” *American Economic Review* 84(4): 889–904.

Capozza, Dennis R., and Robert W. Helsley (1990) "The Stochastic City." *Journal of Urban Economics* 28.2: 187-203.

Chau, K. W., Siu Kei Wong, and C. Y. Yiu (2007). "Housing Quality in the Forward Contracts Market." *Journal of Real Estate Finance and Economics* 34.3: 313-325.

Chan, Su, Fang Fang, and Jing Yang (2008). "Presales, Financing Constraints, and Developers' Production Decisions." *Journal of Real Estate Research* 30.3: 345-376.

Chan, Su Han, Ko Wang, and Jing Yang (2012). "Presale Contract and its Embedded Default and Abandonment Options." *Journal of Real Estate Finance and Economics* 44.1-2:` 116-152.

Chung, San-Lin, and Chien-Ling Lo (2018) . "Who Benefit from the Presale Contract? Perspective of Options to Default." 2018, FMA San Diego Conference.

Deng, Yongheng, and Peng Liu (2009). "Mortgage Prepayment and Default Behavior with Embedded Forward Contract Risks In China’s Housing Market." *Journal of Real Estate Finance and Economics* 38.3: 214-240.

Delgado-García, J. B., de Quevedo-Puente, E., and Díez-Esteban, J. M. (2013). The Impact of Corporate Reputation on Firm Risk: A Panel Data Analysis of S panish Quoted Firms. *British Journal of Management*, 24(1), 1-20.

Edelstein, Robert, Peng Liu, and Fang Wu (2012). "The Market for Real Estate Presales: a Theoretical Approach." *Journal of Real Estate Finance and Economics* 45.1: 30-48.

Fan, Gang-Zhi, Ming Pu, and Seow Eng Ong (2012). "Optimal Portfolio Choices, House Risk Hedging and the Pricing of Forward House Transactions." *Journal of Real Estate Finance and Economics* 45.1: 3-29.

Fu, Yuming, and Wenlan Qian (2010). "A Closer Look at Short-term Speculation on the Street: Evidence from a Residential Presale Market." Available at SSRN 1572035.

Gaultier-Gaillard, S., and Louisot, J. P. (2006). "Risks to reputation: A global approach." T*he Geneva Papers on Risk and Insurance-Issues and Practice*, 31(3), 425-445.

Holthausen, Ducan M. (1979). "Hedging and the Competitive Firm under Price Uncertainty," *American Economic Review* 69(5). 989-994.

Hull, John C. (2005) *Fundamentals of Futures and Options Markets*, Prentice Hall.

Koppenhaver G. D. and S. Swindler (1996). "Corporate Hedging and Input Price Risk," *Managerial and Decision Economics* 17, 83-92.

Kim, K. H., & S. H. Suh (1991). "An Analysis of Optimality of Housing Investment in Korea." *International Economic Journal*, 5(1), 91-103.

Lai, R. N., Wang, K., & Zhou, Y. (2004). "Sale before completion of development: pricing and strategy," *Real Estate Economics*, 32(2), 329-357.

Li, L, Helen X. H. Bao, and K. W. Chau (2018) . "On the Strategic Timing of Sales by Real Estate Developer: To Wait or To Presale," Available at SSRN 3178006.

Li, Ling, and K. W. Chau (2019). "What Motivates a Developer to Sell before Completion?." *Journal of Real Estate Finance and Economics* 59.2: 209-232.

Liow, K.H. (2009). "Long-term Memory in Volatility: Some Evidence from International Securitized Real Estate Markets." *Journal of Real Estate Finance and Economics* 39, 415. https://doi.org/10.1007/s11146-008-9120-8

Ong, S. E. (1999). "Aborted Property Transactions: Seller Under-Compensation in the absence of Legal Recourse." *Journal of Property Investment & Finance.*

Roberts, Peter W., and Grahame R. Dowling. (2002). "Corporate reputation and sustained superior financial performance." *Strategic management journal* 23.12: 1077-1093.

Sinai, Todd, and Nicholas S. Souleles (2005). "Owner-occupied Housing as a Hedge Against Rent Risk." The *Quarterly Journal of Economics* 120(2): 763-789.

So, Mike K. P. (2000). "Long-term Memory in Stock Market Volatility," *Applied Financial Economics*, 10:5, 519-524, DOI: 10.1080/096031000416398

Tang, Wei, and Yuan Wang (2017). "Incomplete Information and Real Estate Development Strategy: Evidence from Hangzhou, China." *Habitat International* 63: 1-10.

Titman. S. (1985). " Urban Land Prices under Uncertainty," *American Economic Review* 73(5), 505-514.

Wong, S. K., Yiu, C.Y., Tse, M.K.S. and Chau, K.W. (2006). "Do the forward sales of real estate stabilize spot prices?." *Journal of Real Estate Finance and Economics 32*.3: 289-304.

Yiu, C. Y., Siu Kei Wong, and Kwong Wing Chau (2009). "Transaction Volume And Price Dispersion in the Presale and Spot Real Estate Markets." *Journal of Real Estate Finance and Economics* 38.3: 241-253.

You, S. D. (2014) . "The Leveraged City." *Real Estate Economics* 42.4 (2014): 1042-1066.

You, S. D. (2019) . "Public Rental Housing in Korea." *Housing Finance International* 33(4): 25-31.

Table 1. Sale Permits and Presale Guarantee

Year	No of Condominium Units Authorized by Sale Permit (A)	No of Condominium Units Presale-Guaranteed by HUG (B)	B/A*100
2013	204,806	161,483	78.8%
2014	258,545	228,548	88.4%
2015	396,458	364,079	91.8%
2016	337,050	319,459	94.8%
2017	217,894	186,294	85.5%
2018	174,033	163,147	93.7%
2019	201,811	179,158	88.8%

Table 2. Variables and Definition

Variables			Description	Data Source
Dependent	hq	Purchased presale units	Percentage of presale units sold on the first progress report (%)	HUG
Key covariates	rhp	Relative price	Ratio of an average of presale prices to an average of prices for the project's neighboring properties	HUG and R114
	shp	Price appreciation	Local house price appreciate rate over the 6 month period right before issuing the sale permit (annual rate)	KB Kookmin Bank
	vol	Price volatility	ABS(average of log differences of monthly index during the sample period- log differences of monthly index)	KB Kookmin Bank
	rp	Builder reputation	Construction capability evaluation ranking	Ministry of Land, Transport & Infrastructure
	$size$	Project size	Number of units per project	HUG
Other covariates (X)	$rate$		Mortgage rate (%)	Bank of Korea
	$park$		Proximity to a park (within 1 km)	R114
	$unemp$		Unemployment rate (%)	Bank of Korea
	$lcpi$		Log(consumer price index= 100 as of 2010)	Bank of Korea

Table 3. Statistics

	Variables	Obs	Mean	Max	Min	Std. Dev.
Dependent	hq	2,000	49.2	100.0	0.0	38.4
Key covariates	rhp	2,000	146.8	943.7	35.7	51.2
	shp	2,000	1.75	19.35	-4.14	3.52
	vol	2,000	0.74	6.89	0.01	0.70
	rp	2,000	184	1,000	1.0	304
	$size$	2,000	596	7,200	21	530
Other covariates (X)	$rate$	2,000	5.66	7.58	3.33	1.14
	$park$	2,000	0.31	1	0	0.46
	$unemp$	2,000	3.19	5.00	2.70	0.37
	cpi	2,000	98.11	109.38	91.05	6.82

Table 4. Empirical results (dependent: hq)

	Model 1		**Model 2**		**Model 3**				**Model 4**			
					Phase I (2007.09-2011.03)		**Phase II** (2011.04-2014.12)		**Phase I** (2007.09-2011.03)		**Phase II** (2011.04-2014.12)	
	Coefficient	t - Value	Coefficient	t - Value	Coefficient	t - Value	Coefficient	t - Value	Coefficient	t - Value	Coefficient	t - Value
rhp	-0.075	-4.993[a]	-0.099	-6.206[a]	-0.099	-6.206[a]	-0.031	-0.742	-0.023	-1.270	-0.070	-1.607
shp	0.024	10.369[a]	0.037	7.236[a]	0.037	7.236[a]	0.030	8.497[a]	0.030	5.376[a]	0.020	4.765[a]
vol	-0.044	-3.783[a]	0.037	2.597[a]	0.037	2.597[a]	-0.040	-1.082	0.027	1.929[c]	-0.043	-1.184
rp	-0.023	-4.659[a]	-0.022	-3.826[a]	-0.022	-3.826[a]	-0.019	-2.256[b]	-0.009	-1.593	-0.036	-3.791[a]
$size$	0.036	3.746[a]	0.042	3.822[a]	0.042	3.822[a]	0.053	2.694[a]	0.066	5.932[a]	0.043	2.208[b]
$rate$			-0.225	-9.145[a]	-0.225	-9.145[a]	0.097	1.903[c]	-0.226	-9.170[a]	0.065	1.280
$park$			0.075	3.720[a]	0.075	3.720[a]	0.036	1.079	0.061	3.104[a]	0.059	1.782[c]
$unemp$			0.011	0.334	0.011	0.334	-0.033	-0.757	0.004	0.119	-0.001	-0.026
$lcpi$			-5.725	-10.186[a]	-5.725	-10.186[a]	3.548	1.800[c]	-5.674	-10.151[a]	0.918	0.462
constant	0.476	6.398[a]	27.772	10.642[a]	27.772	10.642[a]	-16.639	-1.775[c]	27.119	10.448[a]	-4.079	-0.432
province dummies	No		No		No				Yes			
adjusted R^2	0.090		0.134		0.161		0.141		0.231		0.198	
obs	2000		2000		1290		720		1290		720	

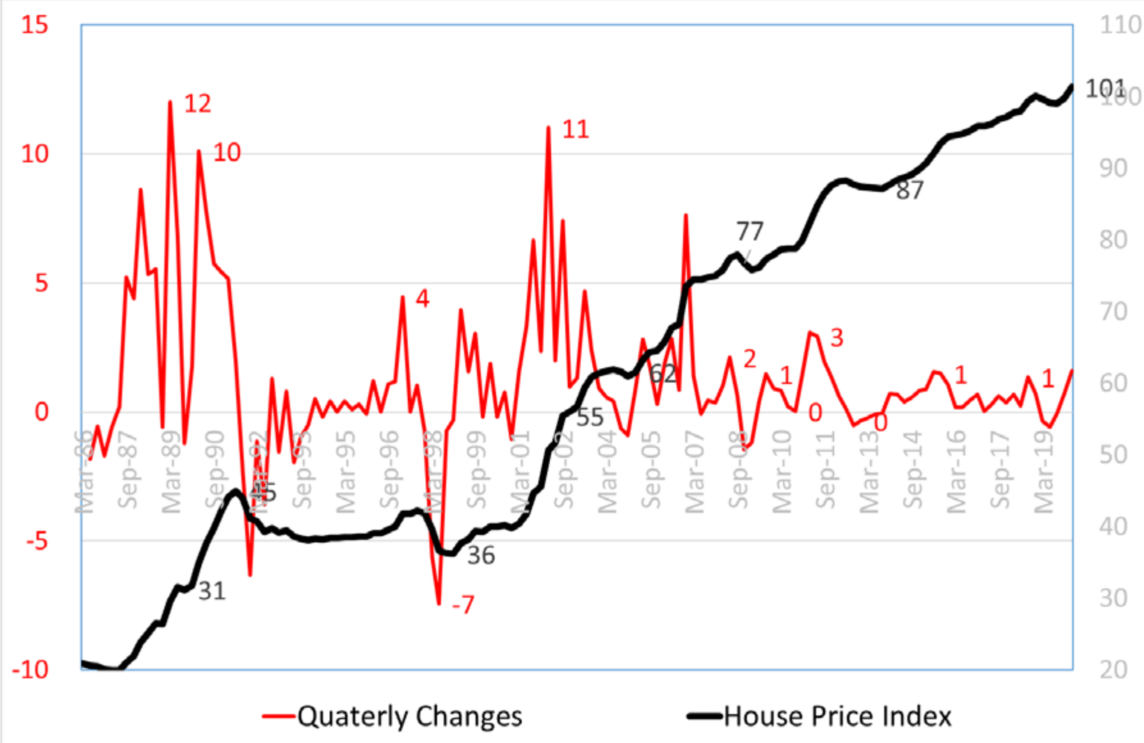
Note: a/b/c are statistically significant at the 1 %/5 %/10 % significance level, respectively.

Table 5. Robustness Test: Fixed-effect Model (dependent: uhq)

	Model 1		**Model 2**	
	Coefficient	t - Value	Coefficient	t - Value
rhp	0.113	42.559 [a]	0.090	30.800 [a]
shp	-0.009	-18.164 [a]	-0.011	-22.542 [a]
vol	-0.018	-11.418 [a]	-0.010	-6.179 [a]
rp	0.004	3.964 [a]	-0.001	-1.372
$size$	-0.061	-33.921 [a]	-0.069	-37.731 [a]
constant	0.507	36.885 [a]	0.601	33.866
province dummies	No		Yes	
adjusted R^2	0.073		0.108	
obs	48,775		48,775	

Note: a/b/c are statistically significant at the 1 %/5 %/10 % significance level, respectively.

[Figure 1] Trend of Condominium Price Index from 1986 to 2020 (100 as of 2019)



Source: KB Kookmin Bank

Appendix 1. Summary statistics for Panel Model

	Variables	Obs	Mean	Max	Min	Std. Dev.
Dependent	*uhq*	48,775	29.3	100	0.00	32.8
Covariates	*rhp*	48,775	150.8	943.7	35.7	54.3
	shp	48,775	0.955	19.349	-5.147	3.087
	vol	48,775	0.972	6.891	0.002	0.928
	rp	48,775	129	1,000	1	245
	size	48,775	633	7,200	21	534