Incomplete information and real estate development strategy: Evidence from Hangzhou, China

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In many developing countries like China, the rising housing demand is accompanied by developers' strategic delay of land development. To explain this puzzle, this paper employs the framework of Option Games with incomplete information, and examines how incomplete information affects the timing and phasing strategy of real estate development. Based on a project-level dataset from Hangzhou city of China, we estimate a hazard model for development timing, and take into account the developer’s self-selection of phasing strategies. Major findings of this research are: first, incomplete information undermines the acceleration effect of competition on development timing. Second, this delay effect disappears when the project is developed in multi-phases. Moreover, we show that the estimation can be severely biased without addressing developer’s selection problem. Based on our results, we suggest the government should promote the establishment of a public housing transaction platform, to help the developers overcome the limitations of incomplete information and speed up the development cycle.

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1. Introduction

Rapid urbanization in developing countries has generated large amount of demand for urban housing. According to the World Bank (2013), developing countries will accommodate an additional 2.7 billion urban dwellers by the end of 2050. While there is large scale of unutilized land in urban area, housing shortage remains pressing in developing countries (Zhang & Ball, 2016). Some studies stress that the housing supply lag is a big issue. For instance, Dasgupta, Lall, and LozanoGracia (2014) find that housing investment follows demand with a lag of 8 or 9 years in sub-Saharan Africa. The supply lag has led to increasing housing costs. As an evidence, housing prices in China have been surging in more than one decade, with annual growth rate above 9% during 2003–2015. Mak, Choy, and Ho (2007) claim that the lag of housing supply is one contributor to China’s rising housing prices.

Since the market-oriented housing reform in 1998, China has made great progress in improving the housing conditions for urban residents (Shi, Chen, & Wang, 2016). The urbanized area in China has more than doubled since 2000, in marked contrast with the growth rate of urbanization rate being 55%. Why does Chinese government fail to accommodate new urban dwellers in spite of substantial land supply? Many studies ascribe the housing shortage in China as an outcome of policy failure. Specifically, it could arise from land use control policy (Yan, Ge, & Wu, 2014); land use efficiency (Chen, Chen, Xu, & Tian, 2016); lack of public housing policy for low income family (Shi et al., 2016; Yap, 2016); lack of efficient financial market (Ferguson & Smets, 2010).

In an ideal real estate market, provided there is sufficient supply of land, developers will respond to the increase of housing price by building more housing units. China has experienced massive rural-to-urban migration and thus generated huge demands for urban housing. Surprisingly, despite the fast growing demand, only 64% of the purchased urban land parcels in China are developed during 2000–2010, leaving 1348 km2 parcels under-developed (three
times of total land purchase in 2010.\footnote{Source: National Bureau of Statistics. This phenomenon is not particular for China. Even in mature markets such as the United States, we can find large scale of vacant or underutilized land parcels (Titman, 1985).} Pioneering study of Real Options by Titman (1985) presents a novel analytical framework to understand the rationale behind these strategic investment delay. When there exists incomplete information\footnote{Following Grenadier (1999) and Childs et al. (2002), incomplete information in this paper refers to the unobserved determinants of property demand or value, also defined as information noise in the literature (Childs et al., 2001 2002).} about housing demand, to minimize the risk of misjudging the market, one strategy for the rational developers is to wait and obtain information by observing the strategic behaviors of their competitors, which leads to strategic investment delay (Grenadier, 1999; Mayor et al. 2001; Childs, Ott, & Riddiough, 2001 2002). In this regard, in the emerging market that lacks essential market information, it is not surprising to have a large amount of residential land vacant in spite of strong housing demand.

In addition to delaying the development and observing their competitors’ behaviors, an alternative strategy the investors can choose is to discover the information of market demand themselves by pilot investment. In case of housing development, phasing development\footnote{Phasing development refers to the pattern in which real estate projects are developed and sold in multi-phases.} in urban fringe or blighted urban land is an illustration of this strategy (Childs, Ott, & Riddiough, 2002; Tse, 1998). While this pattern is observed in numerous metropolitan areas throughout southern United States (Ott, Hughen, & Read, 2012), it is even more prevalent in China. For example, 63% of our sample projects (from Hangzhou City during 2005–2011) adopt this strategy, with the large scale of projects adopting phasing sale being 4.4. While the phasing strategy is helpful in obtaining market information, it simultaneously affects the timing decision of housing projects. However, little has been done to jointly examine the effect of incomplete information on phasing sales and timing decision of housing development.

This paper provides a new insight into the housing shortage in China from the perspective of real estate developer’s behaviors. Specifically, under the framework of classic Real Option theory, it investigates how incomplete information together with competition and uncertainty affects real estate development strategies as well as investment timing. For this purpose, we manually collect 783 pre-sale certificates of 251 residential projects in Hangzhou City of China from 2005 to 2011. We estimate a hazard model for development timing, and take into account the developer’s self-selection problem in their phasing strategies. Results show that phasing development can internalize the benefit of information spillover and thus reduce the delay effect of incomplete information. This study is particularly important for the emerging market that lacks essential information on market demand.

The contribution of this paper lies in three folds: first, we empirically examine the effects of incomplete information on development timing, lending support to the existing theoretical predictions. Second, we exploit a selection correction model to reduce the potential bias caused by the endogeneity of phasing choices. We show that failure to deal with selection problems can result in substantial bias in estimating the true effects of uncertainty on development timing. Finally, our results provide a new evidence on understanding the rationale behind the phasing development strategy. The paper proceeds as follows. Section 2 provides a literature review and proposes the hypotheses. Section 3 discusses the identification strategy. Section 4 describes data and variables for empirical analysis. Empirical findings are reported and discussed in Section 5. The final section concludes.

2. Implications of Real Options with incomplete information

The framework of Real Options has been broadly applied to interpret the timing decisions of real estate development. In this framework, the opportunity to develop a real estate project is analogous to a call option, and the timing decision is equivalent to an optimal exercise decision for the option. Standard Real Options approach emphasizes the role of uncertainty in delaying optimal investment timing (Titman, 1985). This prediction has been verified by many empirical studies in the real estate sector (e.g., Cunningham, 2006; Bulan, Mayer, & Somerville, 2009). To account for strategic interactions between investors, standard Real Options models are further extended to Option Games models (pioneering work includes Williams, 1993; Grenadier, 1996; among others). These models claim that competition tends to erode the option value thus accelerates investment due to the existence of pre-emption advantage.

Based on the framework of Option Games, recent studies come up with another question: when investors do not own perfect information about the market value of the asset, their investment strategies will be potentially affected by information noises (Grenadier, 1999; Mayor et al. 2001; Childs et al. 2001 2002). Grenadier (1999) develops an equilibrium framework for option exercise games with asymmetric private information. In his framework, agents’ investment decision will reveal their own private information on the asset value, which in turn changes other agents’ value evaluations and investment decisions. Mayor, Schonbucher, Wilmott, Whalley, and Epstein (2001) model the effect of information noise on investment decision using theory of optimal filtering. They demonstrate that investor’s learning effect can reduce the uncertainty arising from information noises, leading to an earlier exercise of the options. Following this work, Childs et al. (2002) introduce information noise into Grenadier (1996)’s duopoly model to consider interactions between investors and the information spillovers brought by lead development. Their model demonstrates that information noise will undermine the pre-emption advantage of lead investment and thus lead to a strategic investment delay.

In spite of the theoretical progress in analyzing the role of incomplete information, empirical evidences are quite limited. Yamazaki (2001) is among this small literature. Based on a parcel-level dataset in Japan, he measures information noise using the residual variances of a series of hedonic regressions of land prices. However, the estimated noises are shown to exert a negative effect on option values, which translates to an early exercise of development option. This finding is inconsistent with Childs et al. (2002)’s prediction.

Compared to financial market, real estate market is often characterized as poorly liquid and decentralized.\footnote{One of the key features that make real estate market differ from an ideal financial market is liquidity. According to Shiller (1998), “illiquid [real asset] markets tend to be markets where the individual assets are idiosyncratic, having quality characteristics that are unique to each asset sold, assets that are difficult to describe or measure”. With poor liquidity, asset price estimation will typically occur with error. Zheng, Chau, and Hui (2015) verify the role of liquidity risk in housing investment returns. Decentralized trading is another distinct feature of real estate market. Continuous trading facilitates arbitrage by well informed agents, bringing the prices of financial products to their fundamental prices (Childs et al., 2001). By contrast, decentralized trading in real estate markets inhibits arbitrage, generating difficulty in price discovery.} The valuation of real estate typically contains plenty of information noises, especially in emerging markets like China (Hui, Wang, Yiu, & Wong, 2013). Rapid urban growth in China is characterized by large-scale real estate development in urban fringe. Yet in most cases developers lack
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