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Housing price appreciation, investment opportunity, and firm innovation: Evidence from China

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ABSTRACT

The impact of housing price appreciation on firm innovation may be negative. Housing price appreciation generates real estate investment opportunities with high returns, making manufacturing firms more likely to diversify into the real estate industry. With limited resources, once investing in real estate development, these firms will invest less in innovation. By examining manufacturing firms in China for the period 1999–2007, we provide evidence by finding that housing price appreciation negatively influenced manufacturing firms' innovation propensities. Additionally, we further explore the underlying mechanism by examining the likelihood of listed firms' diversification into the real estate industry, and how the diversification influenced their patenting. Consistent with the investment opportunity hypothesis, we find that (1) housing price appreciation stimulated firms to enter the real estate industry, and a firm's invention patenting was negatively influenced subsequent to its real estate diversification; (2) the negative effect was more pronounced where housing price growth rates were higher.

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1. Introduction

Recent studies have documented that housing booms can positively influence firms' innovation through the collateral enhancement channel. Specifically, housing booms increase the value of firm-owned real estate, thus enhancing a firm's external financing capacity; a higher capacity, in turn, results in more investment (Barro, 1976; Stiglitz and Weiss, 1981; Hart and Moore, 1994). The collateral enhancement effect is well documented regarding both firm innovation (e.g., Mao, 2015; Cao et al., 2015; Rong and Ni, 2015) and capital investment (e.g., Gan, 2007; Chaney et al., 2012). Meanwhile, housing booms may negatively influence firms' innovation through the investment opportunity channel.

Specifically, housing price surges generate real estate investment opportunities with high returns and thus divert capital away from innovative sectors (e.g., the manufacturing sector), thereby leading to less innovation (Miao and Wang, 2014). In contrast to ample evidence on the collateral enhancement effect on firm innovation, there is so far little evidence from the investment opportunity channel. Taking advantage of China's recent housing boom, this paper attempts to fill the gap by documenting a negative relationship between housing price surges and firm innovation.

During the housing boom, it is common that housing prices are surging in some areas while remaining stable in others. Though real estate investment opportunities with high returns are generated only in the areas with housing price surges, with free flow of capital, the interest rate increases but remain equalized across areas. Manufacturing firms in developed countries such as the U.S. generally do not diversify into the real estate industry. Therefore,

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regardless of their locations, these firms become more financially constrained only due to the same rising interest rate and thus invest less in innovation in the same manner. Consequently, the negative investment opportunity effect on firm innovation, which may be substantial, is mostly absorbed by year fixed-effects and largely ignored by previous studies on U.S. firms.

The situation during China's recent housing boom was somewhat unique. It has been witnessed that numbers of manufacturing firms did diversify into the real estate industry. Consequently, manufacturing firms in different areas should have behaved differently. In areas with housing price surges where high-return investment opportunities were generated, market segmentation only allowed local manufacturing firms to capture these investment opportunities. Once investing in real estate development, these firms, financially constrained, should have invested less in innovation. In contrast, in areas with stable housing prices, no such investment opportunities were generated. Therefore, manufacturing firms in these areas did not diversify and thus did not reduce their innovation. As a result, we are able to identify the negative effect of housing price appreciation on firm innovation by exploiting regional variations in China.

In 1998, China's Central Government released an announcement of providing housing benefits in cash rather than in the welfare housing. Since then, with the surging demand for housing, the real estate industry has experienced rapid growth over the next decade. During our examination period 1999–2007, China's major cities experienced housing price surges, with the highest annual growth rate being 20%. We use housing price appreciation to capture the uneven distribution of housing price surges across China. Our empirical strategy uses the following source of identification: the comparison of innovation propensities of firms across city-years with different variations in housing price appreciation. We measure a firm's innovation propensity based on its innovation input (i.e., R & D expenditures), as well as its innovation output (i.e., new product output). Our firm-level data come from the Annual Survey of Industrial Firms conducted by China's National Bureau of Statistics (NBS). We restrict our examination to those manufacturing firms located in 35 major cities where the housing price index is available during our examination period.

By regressing manufacturing firms' innovation propensities on one-year lagged housing price appreciation with control for other influential factors as well as firm (city), year, ownership-type, and industry fixed effects, we find that the effect of lagged housing price appreciation is significantly negative.¹ The negative relationship is significant for both the extensive margin (measured by proba-

bility of having R & D expenditures or probability of having new products) and the intensive margin (measured by ratio of R & D expenditures over total output or ratio of new product output over total output).

Using one-year lagged independent variables should have alleviated the possible endogeneity issue, and fixed-effect estimations should have removed the influence of persistent determinants of both housing price appreciation and innovation propensities. However, it does not necessarily estimate the causal effect of housing price appreciation on firms' innovation propensities. Following Mian and Sufi (2011) and Chaney et al. (2012), we use the interaction term of long-term interest rates and the city-level housing supply elasticity as the instrument for housing price appreciation. The argument for this instrument is that variations in this interaction term affect housing price appreciation but should not directly affect firms' innovation decisions. Our IV estimations show a causal and negative relationship from housing price appreciation to innovation propensities.

So far, we have confirmed the negative relationship between housing price appreciation and firm innovation. If the investment opportunity story is true, one should further expect that (1) housing price appreciation should have stimulated local firms to diversify into the real estate industry, and (2) the diversification should have negatively influenced their innovation. Though we do not have the information on real estate development for manufacturing firms, we manually collect the related information for listed firms. We first regress the likelihood of listed non-real estate firms' entry to the real estate industry on lagged housing price appreciation for 2000–2007. We find that housing price appreciation did stimulate firms to diversify into the real estate industry. We further confirm the causality by using the same interaction term as the instrument.

Before 2007, listed firms were not required to report their R & D expenditures. As a result, few firms reported R & D expenditures before 2007, making this measure unreliable. To generate a convincing proxy for the extent of firm innovation, we manually collect listed firms' patenting records. Particularly, we should be among the first to take subsidiaries' patenting into account to ensure that the collection process is complete. It is well acknowledged that patents are heterogeneous in quality. We address the quality issue by only counting invention patents, which are the most original among three types of patents granted by the SIPO (State Intellectual Property Office) of China.

We then regress listed firms' patenting on whether they have diversified into the real estate industry. We find that a firm's entry to the real estate industry was associated with a decrease in its patenting. Consistent with the investment opportunity story, the negative relationship was more pronounced in cities where housing price growth rates were higher. Moreover, we further find that the negative effect on patenting was mainly attributed to the drop in subsidiaries' patenting rather than that in headquarters' patenting.

This paper is closely related to the recent emerging literature about the positive effect of housing booms on firm innovation through the collateral enhancement channel. By examining U.S. listed firms for 1993–2006, Mao (2015) and

¹ Housing price surges in China follow a well-known pattern across cities. Compared to other cities, the so-called "first-tier" cities, including Beijing, Shanghai, and Guangzhou, have had the most price run-ups. One should expect that the firms in the "first-tier" cities are on average more innovative than other cities as these cities have the most universities and the most talents. To control for this cross-sectional variation, we include city dummies in our estimations. Our identification thus mainly comes from the over-time variations of housing price appreciation within cities.

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