



Identifying the determinants of housing prices in China using spatial regression and the geographical detector technique



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ABSTRACT

This study analyzed the direction and strength of the association between housing prices and their potential determinants in China, from a tripartite perspective that takes into account housing demand, housing supply, and the housing market. A data set made up of county-level housing prices and selected factors was constructed for the year 2014, and spatial regression and geographical detector technique were estimated. The results of the study indicate that the housing prices of Chinese counties are heavily influenced by the administrative level of the county in question. On the basis of results obtained using Moran's *I*, the study revealed the presence of significant spatial autocorrelation (or spatial agglomeration) in the data. Using spatial regression techniques, the study identifies the positive effect exerted by the proportion of renters, floating population, wage level, the cost of land, the housing market and city service level on housing prices, and the negative influence exerted by living space. The geographical detector technique revealed marked differences in the relative influence, as well as the strength of association, of the seven factors in relation to housing prices. The cost of land had a greater influence on housing prices than other factors. We argue that a better understanding of the determinants of housing prices in China at the county level will help Chinese policymakers to formulate more detailed and geographically specific housing policies.

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1. Introduction

With the implementation of its “housing system reform” policy in 1998, China entered a period of rapid growth in housing prices, which have since maintained an annual growth rate of 7% (Lin & Tsai, 2016; Shih, Li, & Qin, 2014). Behind the success of China's newly developed real estate industry, however, the country faces a serious challenge in the emergence of marked regional differences in housing prices (Li & Gibson, 2013; Zhang, Hui, & Wen, 2015). With the highest national average housing price in May 2014 (in Xicheng District, Beijing) reaching a level 67.7 times that of the

lowest (Huzhong District, Da Hinggan Ling, Heilongjiang Province), regional imbalances in housing prices become a burning issue, attracting considerable attention from the nation's policy makers and scholars alike not least because of their effects on rural–urban migrants' settlement decisions (Zang, Lv, & Warren, 2015; Li, 2010). The existing literature addressing regional differences in housing prices in China falls into two main categories, which can be differentiated on the basis of the scale of the research (Shih et al., 2014; Wang, Wang, & Wei, 2013). The first category of work comprises provincial studies, which reveal housing prices in provinces in the eastern coastal region to be considerably higher than those in China's central and western regions. The second category of studies focuses on the city scale, demonstrating the existence of differentiation patterns between spatial agglomerations (between inland areas and the three urban agglomerations of southeast coastal areas) and between urban administrative levels (between provincial capitals and prefecture-level cities) simultaneously. China is a

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vast country, and as such it is important to note that regional inequality in housing prices is apparent not only between provinces or cities, but even at the county scale. Taking Harbin as an example, the housing prices of Nangang District, Daoli District, and Daowai District are 8079 yuan/m², 7726 yuan/m², and 7356 yuan/m², respectively; however, the housing prices of Binxian County, Mulan County, and Tonghe County are only 2783 yuan/m², 2952 yuan/m², and 3024 yuan/m², respectively. We note that the housing prices varied significantly across counties in Harbin. If studies of housing prices still focus on provinces and cities, it is impossible to characterise the significant imbalances among counties. There are 2872 counties in China (including the districts of prefecture-level and county-level cities) and county is the basic administrative unit. A county-level analysis would allow researchers to draw more accurate conclusions (Cohen, Ioannides, & Thanapisitikul, 2016), enabling scholars to identify more detailed patterns and mechanisms in the uneven distribution of housing prices.

The factors influencing housing price are complex. An increasing number of studies have been undertaken into these factors in recent years, with the most frequently adopted perspective being one which focuses on supply and demand frameworks (Fortura & Kushner, 1986; Huang & Lu, 2016; Osmadi, Kamal, Hassan, & Fattah, 2015). From the point of view of demand, income and demographic variables constitute the key impact factors (Mankiw & Weil, 1989). Income affects housing demand through the influence it exerts in relation to housing purchasing power (Zhang et al., 2015), a link demonstrated by Nellis and Longbottom's (1981) in their case study of the United Kingdom, which empirically confirmed real income to be the most important factor in housing price. Taking sample cities in Canada as an example, Fortura and Kushner (1986) also found income to constitute a key factor in housing demand, identifying that a 1% increase in household income raises house prices by 1.11%. Similar results were arrived at by Holly, Pesaran, and Yamagata (2010) in their study of the United States and, using unique cross-sectional data on the majority of German counties and cities for 2005, Bischoff (2012) also identified an interdependence between real estate prices and income. Demographic variables are a second important set of factors influencing housing demand (Buckley & Ermisch, 1983; Hui, Wang, & Jia, 2016). Just as population growth and population shrinkage will respectively increase or decrease housing demand, thereby affecting housing price (Capozza & Schwann, 1989; Maennig & Dust, 2008), low population mobility will also result in decreases in housing demand (Gabriel & Nothaft, 2001). In addition, urban economic fundamentals—i.e., indicators such as per capita disposable income, population, the unemployment rate, and housing vacancy rates—have also been found to affect housing prices (Shen & Liu, 2004).

Adopting a housing supply perspective (Davidoff, 2013), Glaeser and Gottlieb (2009) hold that housing prices represent the interaction of supply conditions. Land supply and housing construction costs, for instance, can both directly affect housing supply and influence housing prices (Li, 2010)—while Potepan (1996) found land supply to be the most important factor affecting housing supply, Holmes, Otero, and Panagiotidis (2011) have showed that opportunity costs for builders (when considered in relation to alternative forms of investment), as well as construction costs, both influence housing prices. Bischoff (2012) found land price to constitute a key factor affecting housing supply and housing prices. Further, housing supply elasticity must also be taken into account, as this limits affordability for buyers (Glaeser, Gyourko, & Saks, 2006; Quigley & Swoboda, 2010).

Housing prices have thus been studied from both supply and demand perspectives, and a diverse range of factors affecting urban housing price have been identified. Combining these two

perspectives, Manning (1986) developed an equilibrium model to explain inter-city variation in housing price appreciation. Manning's empirical model, which considered 16 independent variables reflecting both housing demand and housing supply, was able to account for 68.8% of housing price appreciation. Based on a supply and demand framework, Malpezzi (1996) similarly analyzed inequality in housing prices between cities by looking at income, population mobility, non-economic factors (for instance, topography), and the management/legal environment. Using panel data for 62 metropolises in the United States, Capozza, Hendershott, Mack, and Mayer (2002) found that city size, real income growth, population growth, and real construction costs all correlate positively with housing price. In addition, Holmes et al. (2011) found labor and capital mobility to constitute key factors affecting housing prices. In addition to supply and demand frameworks, the housing market itself also constitutes an important determinant in relation to housing prices and an important focus in existing literature (Mahalik & Mallick, 2016; Pillaiyan, 2015). Adopting such a perspective, Hwang and Quigley (2006) found vacancies and residential construction activity in the owner-occupied housing market are also an important factor affecting housing price. From this brief review of existing literature, it is apparent that research into housing prices would benefit from adopting a comprehensive framework able to take into account all three perspectives of housing supply, housing demand, and the housing market.

Importantly, the majority of the studies mentioned above did not take into account spatial effects, including spatial spillovers, spatial dependence, and the spatial heterogeneity of housing prices among neighboring regions (Canarella, Miller, & Pollard, 2012; Bitter, Mulligan, & Dall'Erba, 2007). It is almost inevitable that spatial autocorrelation or spillovers effects exist in geographic data (Chiang & Tsai, 2016; Yu, 2015). Cohen et al. (2016) examined the spatial effects in house price dynamics and found spatial diffusion patterns in the growth rates of urban house prices from 363 metropolitan statistical areas in the United States for 1996 to 2013. In fact, such autocorrelation, if ignored, can lead to biased or even misleading conclusions (Ma & Liu, 2015). Kuethe and Pede (2011) explicitly incorporated locational spillovers through a spatial econometric adaptation of a vector autoregression model. Their results suggested that the inclusion of spatial information led to significantly lower mean squared forecast errors. This is particularly pertinent in the study of housing prices, given that existing literature has clearly identified that marginal prices vary across space, and it constitutes a major oversight not to take this into account. Analyses of inequality in housing prices should therefore, in addition to the consideration of housing supply, housing demand, and the housing market, also address the influence exerted by spatial effects.

Through their study on the impact factors influencing housing prices in China—a subject particularly pertinent to the present study—Chen, Guo, and Wu (2011) found rural-urban migration and urbanization to have had important impacts in relation to provincial housing prices. Working in a similar vein, Li and Chand (2013) found levels of income, construction costs, impending marriages, user costs, and land prices to constitute the primary determinants of house prices in China's 29 provinces. From a sample made up of 14 Chinese cities, Shen and Liu (2004) found economic fundamentals and variables relating to urban households (i.e., per capita disposable income, population, unemployment rate, and vacancy rate) to constitute key factors influencing housing prices. Wen and Goodman (2013) found urban land price to maintain an endogenous interrelationship with housing price in 21 Chinese provincial capitals. Similar results were also arrived at by Du, Ma, and An (2011) in relation to four major cities in China. Wang and Zhang

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