



# Policy change, amenity, and spatiotemporal dynamics of housing prices in Nanjing, China



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## ABSTRACT

Understanding the spatiotemporal heterogeneity of the housing market is critical for formulating land/housing policies and achieving sustainable urbanization. This study analyzes the housing transactions at the city, community, and apartment levels in Nanjing, focusing on the effects of government policy and amenity. We find that housing prices have appreciated significantly in Chinese cities, and prices also vary within cities. We also find that changes in government policies, especially policies for the development of new urban districts and public facilities, significantly influence the spatiotemporal heterogeneity and dynamics of housing prices. Moreover, high-quality schools provided by governments are evidently exerting an increasing influence on housing values, while proximities to parks, (sub-)CBDs and government service centers also emerge as important factors. We can therefore summarize that housing price variation within Chinese cities is largely institutionally driven, and the Chinese government is the dominant agent of creating uneven urban development in China. We suggest that development policies should consider the need and location of residential areas and improve their access to public facilities to promote intra-urban equality in the housing market.

## 1. Introduction

Since the market-oriented housing reforms began in 1998, housing prices have shown an enormous upswing due to the processes of urbanization and housing commercialization in China (Logan et al., 1999; Yang and Chen, 2014; Timberlake et al., 2014). In recent years, all major cities have experienced a surge in housing prices, with the national average housing price soaring from 1854 yuan per m<sup>2</sup> in 1998 to 5932 yuan per m<sup>2</sup> in 2014 (Shi et al., 2016). According to Numbeo<sup>1</sup> in 2015, China's housing price-to-income ratio, at 22.95, ranked fourteenth globally and second in Asia. Undoubtedly, the home has become the most valuable property and the single largest expenditure for most households, accounting for approximately 70% of households' assets in 2015, as reported by China Household Finance Survey<sup>2</sup>. Housing has also become one of the most significant factors in wealth inequality and a major challenge for achieving a sustainable and equitable society (Li et al., 2016b).

The spatial heterogeneity and dynamics of housing prices at the

provincial and inter-urban scales have attracted wide attention. The determinants of housing prices are usually attributed to differences in socioeconomic and geographical characteristics, such as location (Geng et al., 2015), urban hierarchy (Gong et al., 2016), demographic effects (Mankiw and Weil, 1989; Plantinga et al., 2013), incomes (Abelson, 1997; De Bruyne and Van Hove, 2013), government policies (Bramley and Leishman, 2005; Shi et al., 2016), and the quality of living (Saphores and Aguilar-Benitez, 2005). However, intra-urban patterns and determinants of housing prices in China require further investigation. In addition to residential patterns, previous studies have focused frequently on accessibility and location within urbanized areas, notably proximity to the CBD, metro stations, bus stops, highways, as well as commercial and public facilities (Panduro and Veie, 2013; Pope and Pope, 2015; Schwartz et al., 2014; Xiao et al., 2016; Tian et al. 2017). Although the literature has significantly advanced our understanding of spatiotemporal variations in housing prices, the spatial dynamics of intra-urban housing prices requires more systematic consideration of institutional and policy characteristics, especially in China (Li et al.,

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<sup>1</sup> Numbeo is the world's largest database of user-contributed data about cities and countries worldwide (<https://www.numbeo.com>).

<sup>2</sup> The Survey and Research Center for China Household Finance Survey (SRCCHFS) is an internationally renowned Chinese academic institute that designs and implements surveys and maintains a comprehensive repository of microdata, including three databases on Chinese households, small-and-micro enterprises, and community governance, respectively (<http://chfs.swufe.edu.cn/>).

2016b; Yang and Chen, 2014).

In China, the government's frequent and proactive counter-cyclical interventions in the housing market are an important feature of policy-making in the authoritarian political setting (Zhou, 2016). Nevertheless, since previous studies largely focus on the inter-urban scale, the intra-urban heterogeneity of housing prices in response to policy interventions has not been thoroughly examined (Liu et al., 2016; Logan et al., 1999). Moreover, given the significance of public facilities in China, an examination of variations in housing values associated with differences in public goods (Agarwal et al., 2016; Wen et al., 2014b) is needed. Finally, most of the studies focus on listed prices rather than the transaction prices that provide real market prices (Banzhaf and Farooque, 2013). This study focuses on the intra-urban spatiotemporal heterogeneity and dynamics of the housing market in Nanjing at the city, community, and apartment levels, paying particular attention to the influences of policy changes and urban amenities.

## 2. Literature review

### 2.1. Policy change, amenity, and housing prices

The mechanisms affecting housing prices have generated considerable scholarly debate from various theoretical perspectives such as the theory of demand and supply, consumer behavior, and institutional economics (Ball, 1973; Islam and Asami, 2009). Demand and supply conditions as well as exogenous macroeconomic variables have been applied to explain market segmentation and price changes (Tse, 1998; Tiwari and Parikh, 1998). Real estate has multiple attributes that can be grouped into three categories: structural, neighborhood, and locational characteristics (Liao and Wang, 2012; Saphores and Li, 2012; Yu et al., 2007). Structural attributes refer to the structural and architectural qualities of a property such as dwelling size, year of construction, and orientation (Schlöpfer et al., 2015). Neighborhood and locational characteristics mainly include the environment surrounding the dwelling and the attributes of a residential area such as accessibility, socioeconomic conditions, proximity-related externalities, and ecological environment (Yao and Fotheringham, 2015; Yu et al., 2007). By regressing housing prices against corresponding variables of the above mentioned housing characteristics in a hedonic model, scholars have identified significant determinants of housing prices (Liao and Wang, 2012).

In China, urban development and the land market are shaped both by the planning efforts of the government and by market forces (Yue et al., 2010; Wei, 2015). Governmental regulatory policies relating to zoning, land use planning, and home purchase restrictions exert an important influence on housing prices (Asfour, 2017; Bramley and Leishman, 2005; Islam and Asami, 2009; Locke et al., 2017). Traditionally, the housing market is thought to be dominated by individual traders, who usually make decisions based on local influences, and may react strongly to sudden policy changes (Zhou, 2016). Therefore, East Asian housing regimes, which experience frequent governmental intervention, provide a valuable opportunity for investigating the relationship between governmental intervention and housing prices (Doling and Ronald, 2014). In China, especially, decentralization has compelled local governments to assume responsibility for local development (Wei et al., 2013), prompting them to use land and housing development as the means of propelling urban development and economic growth (Doling and Ronald, 2014).

Both central and local governments adopt housing policies that seek both to maintain property values of land and housing, and keep housing affordable. On the one hand, when there is a drop in housing prices governments usually initiate policies, such as reducing the down-payment requirement and the baseline mortgage interest rate, or restricting the supply of residential land, to encourage transactions and protect the values of land and housing (Roh and Wu, 2016). On the other hand, when housing prices soar governments tighten policies, by raising the

down-payment requirement and the baseline mortgage interest rate, or by exerting purchase restrictions on some buyers, to maintain housing affordability for the general population (Roh and Wu, 2016; Shi et al., 2016). Zhou (2016) further finds that compared with the downtown area, suburbs are more sensitive to policy change. However, a study focusing on how policy change affects transactional dynamics and spatial variability at an intra-urban level is still needed.

In addition to implementing changes in policy that directly target the housing market, governments also control the spatial distribution of urban amenities. Such amenities, which include natural, historical, and modern features are assumed to be critical factors determining residential housing values (Li et al., 2016a). In classical urban economic models, such amenities include CBDs, public schools, good air quality, forest coverage, as well as accessibility to facilities; all of which have been regarded as decisive factors in housing market (Xu et al., 2015; Zawadzki et al., 2017). For example, Agarwal et al. (2016) find that in the 6 months before school relocation events in Singapore private housing prices within 1-km zone and in 1-km to 2-km zone from the old school decline by 2.9% and 6.0%, respectively, Wen et al. (2014a) find that the average distance of the effect of West Lake in Hangzhou is 3.98 km and that the price elasticity of location in proximity to West Lake shows significant variations in different directions.

Compared with the central government, local governments in China pay more attention to land and housing values because they are important revenue sources (Zhang et al., 2014). Therefore, local governments tend to prioritize a combination of policies and measures to improve urban amenities, including old city renewal, new town construction, public facilities configuration, and environmental protection and renewal (Lin, 2009). However, the joint effects of various amenities still require a thorough investigation.

### 2.2. Spatial heterogeneity, dependence, and housing prices

Spatial heterogeneity, namely non-stationary dynamics across space, refers here to spatial variations in housing prices and household preferences (Yao and Fotheringham, 2015; Yu et al., 2007). Rosen (1974) introduced the hedonic price model, which has subsequently been widely employed for estimating housing values. A hedonic price model is usually constructed in both linear and log forms, and is calculated using multiple regression methods such as the ordinary least squares (OLS), fixed- and random-effects model (Helbich et al., 2013). Although a number of studies have attempted to develop more accurate explanatory variables, functional forms, and regression methods to improve the hedonic price model, the recent literature has paid more attention to the potential restrictions of the traditional parametric modeling approach, namely its stringent assumptions, and its neglect of spatial effects (Kiefer, 2011; McGreal and Taltavull de La Paz, 2013; Tse, 2002; Tang and Yiu, 2010; Wu and Sharma, 2012).

The housing market of a polycentric metropolis comprises several disequilibrium submarkets. Scholars have argued that delineating the housing market into different areas and estimating separate hedonic equations for each submarket constitute a useful methodology for examining spatial heterogeneity (Bourassa et al., 2003; Wen et al., 2014a). Some studies have also investigated directional and distance-based heterogeneities of housing prices relating to various neighborhoods and locational attributes such as a CBD location, access to railway stations, and green space (Dadashpoor et al., 2016; Geng et al., 2015; Xu et al., 2015). Alternatively, local spatial models such as moving window regression (MWR), and especially geographically weighted regression (GWR), have been widely employed in the hedonic model to control spatial heterogeneity (Farber and Yeates 2006; Yu et al., 2007).

On the other hand, spatial dependence indicates that homes in the same neighborhood tend to have similar structural characteristics, and their prices depend largely on attributes of proximity such as neighborhood and locational characteristics (Yao and Fotheringham, 2015;

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