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Spatial interrelations of Chinese housing markets: Spatial causality, convergence and diffusion

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ABSTRACT

This paper comprehensively tests the spatial interrelationships of 10 housing markets in the Pan-Pearl River Delta (Pan-PRD) in China, including the properties of spatial causality, convergence and diffusion patterns. The pairwise Toda-Yamamoto Granger causality tests suggest widely existing leading-lag relationships between housing markets; a unidirectional causal flow from the eastern-central area to western China can be tentatively confirmed. However, there is a lack of sufficient evidence supporting pairwise long-run *cointegration* and *convergence*, indicating a diverged interurban housing market in the Pan-PRD. In the short run, the spatial-temporal diffusion model manifests the importance of the spillover effect from neighbouring cities in predicting one city's house price changes. Furthermore, the generalized impulse response functions (GIRFs) clearly depict the transmission pattern of shocks to one chosen city. The diffusion pattern is characterized by the fact that the shocks first spread to nearby cities with cities further away taking a longer time to respond.

1. Introduction

After the financial crisis in 2008, many governments have been attempting to stimulate depressed housing markets through policy interventions. However, whether the interventions can work as expected relies heavily on our understanding of housing markets. To provide deeper insights into house price behaviour, many scholars advocate an investigation into a series of interrelated regional markets rather than a single national market (Meen, 1996; Yunus and Swanson, 2013). Indeed, the structure of regional housing markets is likely to vary significantly across space given the huge differences in local amenities, economic conditions, and regulation constraints, among other considerations. Simply aggregating a bundle of local housing markets into a national unit could lead to severe misunderstanding, particularly in a country in which the regional housing markets are highly differentiated.

Regional housing markets are neither identical nor independent. A large volume of literature has provided evidence supporting the interrelations of regional housing markets (e.g., Giussani and Hadjimatheou, 1991; Holly et al., 2011; Pollakowski and Ray, 1997). Specifically, researchers find that house price changes in an area depend significantly on what occurred in other areas' housing markets. Among the various interrelations of local housing markets, long-run *integration*, which describes a situation in which local house prices maintain an equilibrium relation in the long-run, has long been a concern because of its policy implications. If local housing markets are highly integrated, a unified nation-wide housing policy will be sufficient; otherwise a basket of diversified, locally-oriented policies are necessary. Another parallel research agenda has concentrated on the so-called ripple effect whereby house price shocks to an area will gradually diffuse to other areas, with areas further away being slower to respond to the shocks. Statistical evidence for long-run integration and a ripple effect of regional house prices has been found, for example, in the UK markets by Alexander and Barrow (1994), Meen (1996), Cook (2003) and Holmes and Grimes (2008), although certain studies cast doubt on it (Abbott and Vita, 2013; Ashworth and Park, 1997; Drake, 1995).[1]

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[1] It should be noted that the mixture of the evidence is partly due to the different understanding of the term '*integration*' ('*convergence*') and '*ripple effect*'. We will discuss this in the literature review.

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While a large amount of empirical evidence for long-run and short-run patterns of house prices is already available, the underlying behavioural mechanisms are not yet clear. Meen (1999) proposed five possible explanations for the patterns in the UK market: migration, equity transfer, spatial patterns in the determinants of house prices, spatial arbitrage, and coefficient heterogeneity. Although the transitional economy of China makes its housing market significantly different from the UK market, we have observed the presence of such factors which can cause a certain pattern of house prices. For example, the loosening of *Hukou* restrictions has largely accelerated labour mobility between areas and consequently induced the equity transfer among regions.[2] The information transmission pattern, namely, that housing market information usually flows from "superstar" cities to "normal" cities (Wu and Deng, 2015), raises the chance of spatial arbitrage. Hanink et al. (2012) showed significant coefficient heterogeneity among Chinese county-level housing markets. However, whether these factors can result in long-run integration of regional housing markets remains unclear. From the national perspective, the current migration pattern, flowing from less developed Western China to developed Eastern China, is likely to induce the divergence of housing markets between the East and West rather than market integration. However, local housing markets within the East or the West have a larger chance to be integrated. Spatial patterns of house price determinants also provide us with a confusing hint regarding the long-run integration of local house prices. Province-level real GDP per capita, used as a proxy for income, is found to be convergent in Eastern and Western China, but not in Central and North-eastern China (Su and Chang, 2013).

Given such arguments, the spatial interrelations of Chinese local housing markets appear to be an interesting question to answer. Indeed, much effort has been dedicated to this issue in recent years. For example, Wang et al. (2008) examined the long-run and short-run properties of house prices based on cities within 5 sub-national areas during the period 1997Q4–2007Q1. Huang et al. (2010b) conducted research on nine major Chinese cities during a similar time span (1999Q1–2008Q3), and Li and Li (2011) on nine cities in Pearl River Delta for the period 2001Q1–2010Q4. In general, these studies confirmed the spatial interrelations of housing markets among different cities and they found long-run equilibrium relationships between these markets.

Using a new data set of house price indexes for 10 cities within the Pan-Pearl River Delta (Pan-PRD) spanning from June 2005 to May 2015, this paper comprehensively investigates the spatial-temporal interrelations between city-level housing markets. Specifically, we are particularly interested in the following three questions. First, is there any 'spatial causality' in the interurban housing markets so that the historical house price information in one market can be used to predict the current house prices in other markets? Second, are the house price indexes of ten cities converged (integrated) or segmented in the long-run? Third, is there a distinct house price diffusion pattern so that shocks to one particular market can propagate to other markets gradually?

To our knowledge, this is the first paper that focuses on the spatial interrelations of housing markets in the Pan-PRD area in South China. This area is of great interest given its economic importance and policy implications. Since the reform and opening-up started at 1978, the cities of Pearl River Delta (PRD) in Guangdong province, such as Shenzhen and Guangzhou, have been rapidly developing due to their advantageous location and access to Hong Kong and Macao. Meanwhile, most Central and Western provinces, which provide a large amount of cheap labour for Guangdong and thus can be seen as the hinterland, still struggled with low economic growth. To narrow the gap of development between these areas, "Pan-Pearl River Delta Regional Co-operation Framework Agreement" was signed by 11 relevant governments in 2004. This initiative aims to remove the trade barriers between cites, promote the economic linkages and interaction between eastern, central and western China, and finally achieve the economic integration of this area. The results of this paper shed light on the extent to which the cities in this cooperation framework are linked with each other and the degree to which their markets have been integrated. Thus, this paper might have great implications for policy makers.

Our results suggest widely existing pairwise leading-lag relations among the housing markets under investigation. That is, a city's housing market is generally interrelated with the markets of other cities. However, in contrast to most of the previous studies that support the long-run integration of interurban housing markets, we find rare evidence for pairwise cointegration relationships between cities in the Pan-PRD, and even less evidence for convergence. This discrepancy is probably due to the fact that we focus on a large and heterogeneous area, while previous studies are confined to a relatively small and homogeneous area or to the Chinese cities that have similar socio-economic conditions. Furthermore, a distinct house price diffusion pattern is confirmed; the generalized impulse response function (GIRF) shows that shocks to a city first spread to the nearby cities and then gradually to the distant cities.

The remainder of this paper is organised as follows. Section 2 briefly reviews the related literature, followed by the data description in Section 3. The empirical examination of the leading-lag relationships, long-run integration and house price dynamic pattern are shown in Sections 4, 5 and 6, respectively. Finally, Section 7 concludes the findings and derives certain implications.

2. Previous literature

The focus on regional housing markets interaction dates to the observation of UK housing markets: house price disparities between South and North tended to increase in the 1980s, but tended to narrow again in the 1990s (Giussani and Hadjimatheou, 1991). This behaviour inspires the discussion on regional market integration and the 'ripple effect' hypothesis.

The long-run properties of regional house prices are usually examined under the cointegration framework. MacDonald and Taylor (1993) and Alexander and Barrow (1994) found general evidence for cointegration relationships between regions within either the South or the North of the UK, although the South/North segmentation still appears to exist. In the U.S. housing markets, Yunus and Swanson (2013) documented systematic cointegration among 9 census regions, the degree of which has further intensified after the subprime crisis.

Certain researchers take the idea of cointegration one step further and are interested in the long-run *convergence*, which describes a situation in which local house prices converge towards a constant equilibrium relationship in the long-run (Meen, 1996)[3]; that is a more stringent concept than *cointegration*. Cointegration is necessary but not sufficient for long-run convergence of regional markets. House price *convergence* necessitates that two house price series are cointegrated with a cointegrating vector following the form $(1, -1)$, as well as that they are co-trending, which means no deterministic trend in the cointegrating vector (Abbott and Vita, 2013; Holly et al., 2011). In accordance with this tradition, Meen (1996) tentatively suggested three groups (namely the South, the North and the Midlands) in the UK within which house prices may be converged. However, a later study by Abbott and Vita (2013), using the pairwise approach, offered no evidence in support of

[2] The "*Hukou*" (household registration) system in China was initially designed as a mechanism of monitoring population movements in early 1950s. Afterwards, it became a strong tool to restrain the rural-urban migration and the labour mobility between cities. Since 1980s, the power of "*Hukou*" system has been weakened through a series of reforms, but it remains in place to this day.

[3] The convergence here is commonly referred to as stochastic convergence from the time-series point of view. It does not imply that all the local house prices are equalized across regions. However, another notion of convergence that house prices will ultimately converge to the common level in the long run is also investigated by, for example, Kim and Rous (2012) and Blanco et al. (2016).