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Spatial Diffusion of Housing Prices and Relocation of the Administrative Capital in South Korea*

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Abstract

We investigate the effect of relocation of administrative capital in South Korea on the spatial diffusion of housing prices using a long-run equilibrium time series analysis. To mitigate the population density in Seoul city and to improve the regional balance of economic development, South Korea began relocating its administrative capital to Sejong city, 120 km south of Seoul, in 2003 and recently finished the relocation in 2015. By applying the cointegration method of a vector autoregressive model to two periods, before and after the start of the relocation of the administrative capital in 2003, we find that the housing prices in Seoul prominently affected regional housing prices before relocation of the administrative capital, but did not affect regional housing prices in the period after 2003. Given the unique setting of relocation of the administrative capital in South Korea, the results will not only help policy makers evaluate the relocation of a focal region, but also provide insights to the spatial diffusion of housing prices.

Keywords : Spatial Diffusion, Housing Price, Relocation of the Administrative Capital, Cointegration

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1. Introduction

One of the distinct behaviors in housing markets is the spatial diffusion of housing prices in which the housing prices in a dominant region first affect geometrically close regions and then other regions that are further away with decreasing spillover effects. The spatial diffusion of housing prices has serious implications for policy makers: they are able to set optimal timing housing policies by predicting a spatial diffusion pattern while closely monitoring core regions. The spatial diffusion of housing prices generally leads to a stable housing price relation between a dominant region and other regions, showing a long-run equilibrium across regions. On the economic importance of housing prices, Kim and Chung (2016) argue that housing prices have an effect on the U.S. business cycle with increased consumption due to the wealth effect and the collateral effect. While the wealth effect hypothesis predicts that housing price appreciation will increase homeowners' wealth and then increase their consumption, the collateral effect hypothesis posits that housing price increases help reduce the constraints of borrowing of homeowners and in turn increase their consumption.

Given the substantial impact of a housing market on a national economy as well as on households, the pattern of spatial diffusion has garnered much focus. In the U.K. housing market, Montagnoli and Nagayasu (2015) find a high degree of spillover across regions arising from London housing prices. Other studies also find evidence in favor of spatial diffusion by considering asymmetric adjustment (Cook, 2005), the first principal component (Holmes and Grimes 2008), and the spatio-temporal impulse response function (Holly et al., 2011). In the U.S. housing market, DeFusco et al., (2017) find evidence of a spillover effect during a boom in the housing cycle. Cohen et al., (2016) find that the effect of spatial diffusion in recent years is greater than after the 2007-2008 housing crash. Although many prior studies argue a spatial diffusion effect in real estate markets, the studies are silent regarding its effect for the relocation of a dominant region such as the relocation of the capital city.

The purpose of this study is to investigate the effect of relocation of the administrative capital in South Korea on the spatial diffusion of housing prices using a long-run equilibrium time series analysis. As the capital of South Korea, Seoul, including close regions, was home to 19 million of the 46 million total South Korean residents in 2000 (KOSIS, 2016). The high population in Seoul can lead to high housing prices there and in other regions. To alleviate soaring housing prices and improve balanced developments across regions, the former president Moo-Hyun Roh proposed a plan to relocate all central government agencies, including the Blue House and the National Assembly, to Sejong city, 120 km south of Seoul, in 2003. Against this unique backdrop, we investigate the spatial diffusion pattern in two periods, 1993-2002 and 2003-2015, using the quarterly housing price indexes across five metropolitan cities, including Seoul, Daejeon, Daegu, Busan, and Gwangju. By applying a vector error correction model (VECM) to the housing price indexes, we find that the housing prices in Seoul had a dominant impact on other cities from 1993-2002; however, that influence disappeared from 2003-2015. The result suggests that the spatial diffusion effect can be alleviated through the relocation of the administrative capital. Given the unique setting of the relocation of the administrative capital, the results will not only help policy makers of other countries such as Japan and China that take into account to relocate a focal region, but also provide insights into the spatial diffusion of housing prices. In particular, the successful relocation of the administrative capital can lead to the long-term sustainability of a country.

This paper is organized as follows: The next section discusses the relocation of South Korea as well as Japan and China with prior studies on the diffusion effect of housing prices. We limit the discussion of the relocation of capital to the countries of East Asia including South Korea, and two other countries, Japan and China, that consider relocating their capital cities. Section 3 discusses the methodology. Section 4 presents the empirical results, and the last section provides conclusions and implications.

2. Relocation of the Administrative Capital

2.1. South Korea

The relocation of the administrative capital in South Korea was accomplished over the course of about 13 years, from 2003 to 2015, and over the last three presidents. <Table 1> reports the history of the administrative capital relocation of South Korea. First, the former president Moo-Hyun Roh proposed an election pledge to relocate the capital city to the central region of the country in 2002. After elected, he carried forward the plan with a special law for a new capital city enacted by the National Assembly in 2004, but the Constitutional Court ruled that the special law was unconstitutional. Thus, the plan was changed to the relocation of the administrative capital that would relocate governmental agencies excluding the Blue House and the National Assembly to Sejong city. However, the next present, Myung-Bak Lee, tried to overturn the original plan with an amendment proposal that reduced the range of the administrative capital and turned it into an industrial, science, and education hub in 2010. In this time, the National Assembly rejected the amendment proposal, and the next president, Geun-Hyu Park, carried out the plan, relocating the governmental agencies to the new administrative capital. The relocation of the administrative capital was accompanied by the relocation of 115 public institutions in 10 different regions. Given the long-term history of the relocation, it is necessary to analyze the spatial diffusion of housing prices with a time series model.

The primary reason for the relocation of the administrative capital was to balance the development of the country and to mitigate the problem of overconcentrated population and economic resources in Seoul (Rossman, 2018; Lee, 2009). When relocation was proposed, more than forty percent of the total population resided in the capital and in the immediate vicinity. In addition, 95 percent of the largest firms and 20 of the best universities were located in the capital (Lee and Pelizzon, 1991). Moreover, the growth rate of housing prices in Seoul is 22.5 percent, which was higher than the growth rate of other regions 13.2 percent, deteriorating the standard of living due to excessive spending on housing. When the relocation of the administrative capital was successful, the old capital lost its role as a focal region, and the spatial diffusion effect emanating from the city dissipated. Therefore, we are able to examine one of the aspects of the relocation of the administrative capital by investigating the diffusion of housing prices.

<Table 1> The Brief History of Relocation of the Administrative Capital City of South Korea

Presidency	Date	Main contents
The Moo-Hyun Roh Presidency (2003-2008)	2002.09	As a presidential candidate, he proposed an election pledge to relocate the capital city to the central region of Korea.
	2004.01	The National Assembly enacted a special law for the capital city relocation construction.
	2004.10	The Constitutional Court ruled that the special law for capital city relocation was unconstitutional.
	2005.03	The plan was changed to constructing an administrative city named Sejong city.
	2006.01	The master plan for Sejong city was announced.
The Myung-Bak Lee Presidency (2008-2013)	2010.01	The amendment proposal that reduced the administrative city into an industrial, science, and education hub was announced.
	2010.06	The National Assembly rejected the amendment proposal, and then the original plan was resumed.
	2012.12	Sejong city was launched, and the relocation of the main governmental agencies was completed.
The Geun-Hye Park Presidency (2013-2015)	2013 - 2015	The remaining governmental agencies were relocated to a new administrative city, Sejong city. Along with the administrative city, the innovation city project started from the beginning of the relocation of the governmental agencies and completed the relocation of public institutions to eight regional areas.

2.2. Japan and China

The discussion regarding the relocation of the capital, Tokyo, in Japan started in the late 1980s when the economy enjoyed a boom. The ample funds from a booming economy flowed into the real estate market, and thus the housing prices in Tokyo soared so high that people could not afford the homes they wanted (Rossman, 2018). Consequently, the law makers in Japan decided to relocate governmental agencies and ministries to a new city in the 1990s.

However, when the economic bubble burst in the 2000s, the project of relocation of the capital was postponed. More recently, discussion regarding the relocation of the capital started again after the Fukushima Daiichi nuclear disaster. The two primary reasons for relocation of the capital in Japan are now the problem of overconcentration of resources and seismic threats (Rossman, 2018; Vogel, 2001). More than 13 million people, or about 11% of Japan's total population, reside in Tokyo, and the National Diet (Japan's bicameral legislature, which is composed of a lower house and an upper house) and best universities are concentrated in the capital. However, the idea of moving the capital still remains under discussion in 2018.

Since the mid 2000s, China has discussed the relocation of its capital, Beijing, because of two reasons: bad environmental conditions and imbalanced regional development (Rossman, 2018). Sandstorms blow in from Inner Mongolia and often cover an area of 1.5 million square kilometers over the capital, threatening the normal life of citizens (ChinaDaily, 2018). The frequent sandstorms have gradually desertified large areas of northern parts of Beijing, which has forced the government to move people from arid lands to the southern area. Combined with the sandstorms from the Gobi desert, the pollution from Beijing's industries are leading to health problems such as lung cancer and heart attacks. The western development strategy in China increased the gap between the developed coastal east region and the underdeveloped west region (Sun, 2013). The eastern provinces occupy only 17 percent of the area but comprise 62 percent of the GDP (Dijk, 2011). Therefore, the threats to sustainability from the inequality of the economic development and environmental conditions call for a discussion regarding the relocation of the capital in China.

2.3. The Diffusion Effect of Housing Prices

The behavior of regional housing prices has attracted considerable attention among researchers because housing prices lead to economic fluctuations and labor mobility (Kim and Chung, 2016; Alexander and Barrow, 1994; Leamer, 2007). Kim and Chung (2016) find that house prices significantly affect the transition of the U.S. economy between the boom and bust phases. DeFusco et al., (2017) finds that housing price spillover is one of the important factors to draw a U.S. housing boom. Also, the increase in housing prices can reduce labor mobility and in turn impair the efficient function of the economy (Alexander and Barrow, 1994). Because of the substantial impact of a housing market on a national economy, many researchers investigate the characteristics of a housing market and find that unlike a financial market, it is an inefficient market where housing prices do not reflect all available information immediately. They also find that housing prices in one region affect the housing prices in other regions, and the diffusion effect diminishes in inverse proportion to the distance between one region and another region. The diffusion of housing prices is mainly investigated in the U.K. housing market with housing price convergence and the ripple effect of housing prices. The convergence of housing prices implies that the ratio of housing prices between one region and anther region is stable or housing prices among regions are moving together in the same direction. Meen (1999) proposes four channels of the diffusion of housing prices, including migration, equity transfer, spatial arbitrage, and spatial pattern. Thus, studies on the diffusion of housing prices have employed the indirect method of the convergence of housing prices or the direct method of the ripple effect of housing prices.

The results of the diffusion of housing prices in the U.K. are mixed. Using the mixed adjusted house price with a pair-wise approach, Abbott and De Vita (Abbott and De Vita, 2013) find no evidence of convergence among regional housing prices. Tasi (2014) finds unfavorable evidence of the convergence of regional-national housing price ratios using the unit root tests. In contrast, other studies support the existence of price convergence and the spatial diffusion effect. Cook (2005) argues that a drawback of prior studies is the assumption that the adjustment process to equilibrium of regional housing prices is symmetric. The threshold autoregressive method relaxing the assumption of symmetry results in a number of long-run relationships, and the adjustment speed is faster when house prices in the South East off England decrease compared to other regions. Instead of employing regional housing prices, Holmes and Grimes (2008) test the convergence of housing prices using the first principal component that incorporates the maximum variation of original housing prices in a linearly combined price. The unit root test for the first principal component has a stationary result, indicating the convergence of regional housing prices to the national housing price. Further estimation with the differentials between each region and London provides evidence of the diffusion effect that regional housing price adjustment is inversely related to the distance to the London price shock. Holly et al., (2011) also find that the housing price in London propagated slowly along the geographical dimension to other regions and further to New York, and then the increased prices in New York in turn echoed back to London through the link between financial centers and international development.

In the U.S., because of the large size of housing markets, studies of the diffusion effect show mixed results according to the different aggregation levels such as the state level, census level, metropolitan statistical area, or county level. First, on the state level, Brady (2014) presents evidence of the spatial diffusion of regional housing prices using impulse response functions. Holly et al., (2010) examine the diffusion of regional housing prices across states and identify a significant spatial effect. Second, on the census level, Pollakowski and Ray (1997) examine the diffusion pattern of housing prices using a vector autoregressive model from nine U.S. census divisions and do not identify the diffusion pattern. Nneji et al., (2015) investigate whether the speculative bubble is diffused across regional housing markets, and their empirical analysis shows that speculative bubbles do not depend on contiguity or distance. Third, on the metropolitan statistical areas, Cohen et al., (2016) and Kang (2011) find evidence of diffusion patterns, while Kang (2011) argues that the effect of spatial shocks is instantaneous but short-lived, even though the high-tech industry effect is persistent. Holmes et al., (2011) examine the housing price convergence across states and metropolitan statistical areas, and their pair-wise analysis displays evidence of long-run equilibrium between regional housing prices.

Finally, on the county level, Clapp and Tirtiroglu (1994) utilize data from single-family house prices for 19 towns in the Hartford, Connecticut area and find evidence of the diffusion of housing prices. Using dynamic panel data of California counties, Brady (2011) reveals evidence of the diffusion of housing prices. These mixed results indicate that the housing market may be a heterogeneous market, but underlying economic characteristics affect the regional housing market differently (Yunus and Swanson, 2013). Indeed, if housing markets are efficient, housing prices in one region do not cause housing prices in other regions because housing shocks are either confined to one region or dissipate along other regions simultaneously (Pollakowski and Ray, 1997). However, recent research has presented that the housing market is often inefficient and adjusts slowly to changes in market conditions (Case and Shiller, 1989; Riddel, 2004), and it takes several years to fully incorporate information into housing prices (DiPasquale and Wheaton, 1992). We examine the effect of relocation of the administrative capital in South Korea on the diffusion of housing prices by expecting housing prices to show different patterns before and after the event.

3. Methodology

To investigate the long-run spatial diffusion pattern, we use a vector error correction model (VECM) (Lutkepohl, 2005) for two periods, 1993-2002 and 2003-2015. Overall, we first identify long-run equilibrium relations across the housing prices of metropolitan cities and investigate the spatial diffusion pattern within the equilibrium. The housing price indexes of regions may not generally be stationary in the short run; however, they can move together in the same manner and form a long-run relationship. Thus, we conduct unit root tests with level data and differenced data. If the level data are not stationary but the differenced data are stationary, and then integrated of order 1, denoted as $I(1)$, it is possible to form a cointegrating relationship in the long run (Lutkepohl, 2005). The vector autoregressive model with k variables and p lags has the following form,

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \cdots + A_p Y_{t-p} + u_t \quad (1)$$

Where y_t is a set of housing price indexes, A_i are $(k \times k)$ coefficient matrices, and u_t are independent stochastic vectors with u_t ~ (0, Σ_u). To use the Johansen cointegration test, model (1) needs to be converted to VECM as follows,

$$\Delta y_t = \Pi y_{t-1} + \Gamma_1 \Delta y_{t-1} + \cdots + \Gamma_{p-1} \Delta y_{t-p+1} + u_t \quad (2)$$

Where Π = -($I_k - A_1 - \cdots - A_p$) and Γ_i = -($A_{i+1} + \cdots + A_p$) for i = $1, \cdots, p-1$. By subtracting y_{t-1} from both sides and rearranging terms in model (1), model (2) is obtained. If housing prices are a vector of I(1) variables, then Δy_t, Δ_{t-i}, and u_t are stationary. As a result, due to the equality of the left-hand side and the right-hand side in model (2), Πy_{t-1} should be stationary, indicating a long-run relationship where housing prices are no longer changing. In model (2), the Π coefficient matrix represents a long-run coefficient matrix. If there are r cointegrating vectors in housing prices, Π can be represented as $\alpha\beta'$ with ($k \times r$) and ($r \times k$) dimensions, where β represents the cointegrating vectors and α represents the adjustment parameters. After determining the rank of Π, a Granger causality test is applied to the framework of VECM to identify the spatial diffusion pattern among housing prices. In addition, variance decompositions are performed to assess the proportion of effects in the dependent housing prices between their own housing prices and other regions' housing prices (Lutkepohl, 2005).

4. Methodology

To determine the spatial diffusion of housing prices, we use the quarterly housing price index (HPI) of five metropolitan cities, Seoul, Daejeon, Daegu, Busan, and Gwangju, from 1986Q1 to 2006Q4. Among the cities, Seoul has the largest population with approximately 10 million in 2002; the next is Busan with more than three million. All other cities have a population of over one million. Because the regional housing price indexes are calculated using 2015Q4 as a base year with 100, all HPIs can unconditionally lead to convergence in the long run, producing a base year bias. In accordance with the remedy provided by Phillips and Sul (2007), we first move the base year from 2005Q4 to 1986Q1 and recalculate HPIs with $\log(y_t/y_0) \times 100$, where y_t is the housing price index at time t and y_0 is the first housing price index in 1986Q1. We then discard portions of regional HPIs from 1986Q1 to 1992Q4 and use data after 1993Q1 because housing price indexes in the former period are virtually all the same.

<Table 2> Unit Root Tests for Housing Prices of Five Cities

Variables	1993-2002			2003-2015		
	Deterministic terms	Lags	t-statistics (p-value)	Deterministic terms	Lags	t-statics (p-value)
Seoul	Intercept, Trend	2	-2.982 (0.91)	Intercept, Trend	8	-0.673 (0.96)
⊿Seoul	Intercept	1	-4.735** (0.02)	Intercept	7	-3.280** (0.02)
Busan	Intercept, Trend	1	-2.748 (0.96)	Intercept, Trend	4	-3.184 (0.10)
⊿Busan	Intercept	0	-4.710** (0.02)	Intercept	4	-2.63* (0.09)
Daejeon	Intercept, Trend	1	-3.437 (0.72)	Intercept, Trend	9	-2.712 (0.23)
⊿Deajeon	Intercept	0	-4.615** (0.03)	Intercept	0	-3.34*** (0.01)
Daegu	Intercept, Trend	5	-2.885 (0.94)	Intercept, Trend	7	-0.842 (0.95)
⊿Daegu	Intercept	3	-5.47*** (0.01)	Intercept, Trend	0	-3.188* (0.09)
Gwangju	Intercept	2	-4.028 (0.14)	Intercept, Trend	1	-2.947 (0.15)
⊿Gwangju	Intercept	2	-4.028* (0.05)	Intercept	1	-3.434*** (0.01)

Note: * $p < .05$, ** $p < .01$, *** $p < .001$. Each value in parenthesis denotes the p-values. The null hypothesis of non-stationary is rejected in favor of the stationary alternative. The Augmented Dickey-Fuller (ADF) unit root test with a structural break for the year 1998 is applied to the 1993-2002 because of the Asian financial crisis called the IMF crisis.

Moreover, because the plan for a new administrative capital materialized in 2003, we divide our sample into two periods, 1993-2002 and 2003-2015. For each sample, we conduct the Augmented Dickey-Fuller (ADF) unit root test as the first step and find that all HPIs are integrated at the first order. <Table 2> presents the results of the ADF unit root test. To test the ADF unit root, we include an intercept and trend term in the level data due to the upward behaviors of the HPIs, except for Gwangju, which does not shown any trend, and determine appropriate lags with Schwarz Information Criteria. In particular, the unit root test with a structural break for the year 1998 is applied to the former period because of the Asian financial crisis called the IMF crisis. For the differential data, we include only a constant term since the difference of the HPI time series removes a trend. Given the test result of each city, the unit roots cannot be rejected in the level of HPIs, suggesting that all the time series are not stationary. However, the unit root tests of the lagged differences of the level data for the former period are rejected at the 5% level, and the unit root tests for the later period are rejected at the 5% level too although Daegu and Busan are rejected at the 10% level. The overall results of the unit root tests suggest that all HPIs are integrated at the first order, I(1), so that the non-stationary time series of HPIs becomes stationary at the first difference.

The characteristics of *I(1)* time series of HPIs suggest that there is a possibility for them to move together over time and to form a cointegrating relationship in the long run. Thus, we conduct Johansen cointegration tests for the two periods, and the result is shown in 〈Table 3〉. To test for cointegration, we use three lag specification for both periods suggested with Akaike information criterion (AIC) as the optimal lag length. In the former period, the Johansen cointegration test with a constant and a trend term rejects the null hypothesis of one cointegration at the 1% level. In contrast, in the later period, the Johansen test with a constant and a trend term rejects the null hypothesis of three cointegrations at the 1% level. Overall, two Johansen tests indicate that the former period has two cointegration relations and the later period has four cointegration relations.

With two and four cointegrations for each period, we estimate a vector error correction model for each period using the Johansen Maximum likelihood method. 〈Table 4〉 presents the estimates of the cointegration relations. We normalize the coefficients of Seoul and Busan as one for the 1993-2002 period, and Seoul, Busan, Daejon, and Daegu for the 2003-2015 period in order of the population of each city. The cointegration vector β for each period shows a long-term stationary relation with the normalized cities. For example, during the 1993-2002 periods, the first long-run relation gives Seoul = -0.220Deajeon + 1.902Daegu - 1.477Gwangju and the second long-run relation gives Busan = 0.122Daejeon + 0.980Daegu - 0.278Gwangju. Therefore, during the 1993-2002 periods, Daegu and Gwangju respond to Seoul and Busan in the same way, but Daejeon responds to Seoul and Busan in a different way. In the later period, Gwangju responds to Seoul, Busan, Daejeon, and Daegu in the same way. The loading matrix, α, shows the average speed of convergence to a long-run equilibrium. For the both period, the large coefficients of the adjustment speed of Seoul suggests that housing prices of Seoul is corrected quickly to the equilibrium.

<Table 3> Johansen Cointegration Tests for Housing Prices

Rank	1993-2002		2003-2015	
	Trace test statistics	Critical value at 99%	Trace test statistics	Critical value at 99%
r = 0	165.57*	77.81	194.75*	77.81
r = 1	73.46*	54.68	112.80*	54.68
r = 2	31.01	35.45	54.78*	35.45
r = 3	12.72	19.93	24.82*	19.93
r = 4	1.56	6.63	0.69	6.63

Note: The * symbol along with test statistics denotes the rejection of the null hypothesis at each rank. Johansen cointegration tests are taken with three lags and linear deterministic trend, and the results suggest two and four cointegrations before and after the start of discussion of the relocation of administrative capital, respectively

<Table 4> Cointegration Vector and Loading Parameters for VECM

Period	Parameters	Seoul	Busan	Daejeon	Daegu	Gwangju
1993 - 2002	β1	1	0	0.220 (0.93)	-1.902 (-7.01)	1.477 (5.688)
	β2	0	1	-0.122 (-1.80)	-0.980 (-12.59)	0.278 (3.74)
	α1	-6.654 (-2.55)	-0.265 (-2.32)	-0.244 (-1.32)	-0.738 (-4.98)	-0.510 (-4.72)
	α2	1.454 (2.03)	0.661 (2.07)	1.737 (3.36)	2.000 (4.82)	0.671 (2.223)
2003 - 2015	β1	1	0	0	0	-0.138 (-0.73)
	β2	0	1	0	0	-0.863 (-11.73)
	β3	0	0	1	0	-0.219 (-1.87)
	β4	0	0	0	1	-1.577 (-8.99)
	α1	-0.353 (-4.66)	0.001 (0.03)	-0.088 (-1.73)	-0.149 (-3.58)	-0.026 (-0.61)
	α2	-0.732 (-4.81)	0.055 (0.59)	0.121 (1.18)	-0.132 (-1.57)	0.084 (0.96)
	α3	0.375 (3.85)	0.026 (0.45)	-0.199 (-3.04)	0.115 (2.14)	0.099 (1.76)
	α4	-0.139 (-2.21)	0.069 (1.79)	-0.135 (-3.19)	-0.091 (-2.62)	0.094 (2.59)

Note: Each value in parenthesis denotes the t-statistics. Seoul is the capital of South Korea and Busan is the second largest city.

<Table 5> Vector Error Correction (VEC) Granger Causality Tests of Housing Prices

A. 1993-2002	Dependent Variables				
	Seoul	Busan	Daejeon	Daegu	Gwangju
Seoul	-	7.80 (0.05)	9.46 (0.02)	28.64 (0.00)	13.83 (0.00)
Busan	5.61 (0.13)	-	9.61 (0.02)	26.79 (0.00)	7.53 (0.05)
Daejeon	0.39 (0.94)	2.00 (0.57)	-	2.26 (0.51)	13.64 (0.00)
Daegu	2.41 (0.49)	4.14 (0.24)	9.63 (0.02)	-	9.44 (0.02)
Gwangju	3.28 (0.34)	6.34 (0.09)	19.70 (0.00)	12.85 (0.00)	-
B. 2003-2015	Dependent Variables				
	Seoul	Busan	Daejeon	Daegu	Gwangju
Seoul	-	3.98 (0.26)	1.83 (0.60)	3.12 (0.37)	1.05 (0.78)
Busan	20.79 (0.00)	-	33.64 (0.00)	28.04 (0.00)	13.96 (0.00)
Daejeon	9.28 (0.02)	20.19 (0.00)	-	11.28 (0.01)	14.61 (0.00)
Daegu	13.26 (0.00)	3.75 (0.28)	1.07 (0.78)	-	5.56 (0.13)
Gwangju	11.03 (0.01)	9.08 (0.02)	15.11 (0.00)	11.59 (0.00)	-

Note: Each value denotes the chi-square test-statistics with the p-value in brackets. Vector Error Correction Granger causality tests show the response of column city to each row city. For example, the response of Seoul to Busan shock from 1993-2002 is 5.61 (0.13).

<Table 5> shows the results of Vector Error Correction (VEC) Granger causality tests that describe the response of a column city to a row city. During the 1993-2002 period, Seoul has a positive and significant influence on Busan, Daejeon, Daegu, and Gwangju of 7.80, 9.46, 28.64, and 13.83, respectively. In contrast, all four cities do not affect Seoul, and all estimates are not significant at the 5% level. This result indicates that Seoul housing prices affect the housing prices of other cities, but not vice versa, from 1993-2002. The behavior of HPIs, however, is reversed for the 2003-2015 period. In this period, while Seoul does not affect other cities, all other cities have a positive and significant

influence on Seoul. Therefore, the results imply that the housing price spatial diffusion pattern changes following relocation of the administrative capital.

<Table 6> Variance Decomposition of the Effect of Seoul on Four Other Cities

1993-2002 period				
Quarter	Busan	Daejeon	Daegu	Gwangju
1	60.95	75.74	66.72	25.47
4	20.79	52.53	13.04	47.71
8	3.00	24.35	4.34	30.69
2003-2015 period				
Quarter	Busan	Daejeon	Daegu	Gwangju
1	26.98	18.95	16.02	14.04
4	11.80	12.14	4.03	19.93
8	5.39	5.34	1.22	6.65

We assess the relative importance of Seoul housing prices on the other four cities using a variance decomposition shown in <Table 6>. During the 1993-2002 period, the Seoul housing prices have a dominant impact on other cities. In the first quarter, 61% of the variation of the housing prices in Busan can be attributed to the Seoul housing price shocks. In the other cities, the Seoul housing prices are important too. As time horizons increase, the influence of Seoul housing prices decrease, although 24% and 30% of Daejeon and Gwangju, respectively, continue to be explained by Seoul housing prices. However, the impact of the Seoul housing prices declines in the 2003-2015 period. In the first quarter, 27%, 19%, 16%, and 14% of Busan, Daejeon, Daegu, and Gwangju, respectively, are attributed to the Seoul housing prices. Compared to the first quarter of the 1993-2002 period, Seoul's later period influence weakens considerably. After 8 quarters, the Seoul housing prices explain less than 7% of the variance of each city. This result thus provides evidence that Seoul is a dominant influential source of the housing price of other cities in the 1993-2002 period; however, Seoul's tremendous impact disappears over the 2003-2015 period.

5. Conclusions

The purpose of this paper is to investigate the long-term effect of the relocation of the administrative capital in South Korea in terms of the spatial diffusion of housing prices. As the capital city of South Korea, Seoul, including its metropolitan area, is home to more than forty percent of the South Korean population. The high population density has led to economic and social problems such as an imbalance of improvements among regional cities and soaring housing prices. In particular, Seoul housing prices are the main source of price explosions in other cities. To mitigate these problems, the former president, Moo-Hyun Roh, proposed a new capital city plan in 2003 to relocate all central government agencies, including the Blue House and the National Assembly. The subsequent former president tried to derail the plan; however, the new president that followed salvaged the plan by excluding the Blue House and the National Assembly from the relocation list.

Because it took approximately 13 years from 2003 to relocate the administrative capital, we compare the spatial pattern of housing prices between two periods, 1993-2002 and 2003-2015, using a long-run equilibrium time series analysis. By applying the cointegration method of a vector error correction model to the two periods, we find that Seoul housing prices prominently affected regional housing prices in the former period; however, the influence disappeared in later periods. We conjecture that the results support the positive effect of the relocation of the administrative capital. Given the unique setting of the capital relocation, the results not only help policy makers evaluate the relocation of a focal region but also provide insights on the spatial diffusion of housing prices.

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주택가격 공간적 파급효과와 행정수도 이전*

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요 약

본 연구는 장기균형 시계열 분석을 통해 한국의 행정수도 이전에 따른 주택가격의 공간적 지역간 확산효과를 살펴보기 위한 것이다. 한국은 서울 인구 과밀화와 지역균형발전을 위해 서울에서 남쪽으로 120km 떨어진 세종에 2003년부터 행정수도를 건설하기 시작하여 2015년에 완공하였다. 벡터자기회귀모형의 공적분 관계 분석을 2012년 행정수도 이전과 이후로 나누어 분석하였을 때, 행정수도 이전에는 서울의 주택가격이 지방의 주택가격에 상당한 파급효과를 미치는 것으로 나타났으나, 행정수도 이전 이후에는 그러한 효과가 나타나지 않았다. 한국의 유일한 행정수도 이전 사례에 따른 주택가격 파급효과 연구는 정책 결정자들이 행정수도 이전에 대한 평가를 하는데 도움을 줄 수 있을 뿐만 아니라, 이에 따른 주택가격의 공간적 파급효과에 대한 시사점을 제공해준다.

핵심주제어 : 공간적 파급효과, 주택가격, 행정수도이전, 공적분관계

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