REAL ESTATE INVESTMENT AND REGIONAL ECONOMIC DEVELOPMENT IN CHINA--BY APPLYING THE SPATIAL ECONOMETRIC APPROACH

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ABSTRACT
After China's market-oriented reform for real estate from 1998, real estate investment has achieved rapid development. The real estate sector has also been becoming a critical approach that the government releases macro policy in China. But with the fast development of the real estate, there is a concern about that the overheated investment in real estate will harm economic growth. A considerable debate on whether the increasing real estate investment is boosting the economy or, in contrast, is hurting the economy is still going on. We are using the ESDA (Exploratory Spatial Data Analysis) to see the spatial dependence on real estate investment and economic development, to find whether they have some similar pattern. The result shows that in the initial year in 2000, the economy led a high in east and low in west pattern. However, real estate investment still had a relatively homogeneous spatial distribution. While in 2018, two of them show a vital characteristic that high in the east and slowly shrinking toward the west, indicating that the developed economy attracted the investment into those areas, which follows the rule of development of the economy. And next, compare the fitness of OLS, GWR, and MGWR to determine the impact of real estate investment on the regional economy. All those three models indicated that the effects from real estate investment to economic development are getting weak, evidence from the data in 2016, 2018 and 2019. In more detail, the result of MGWR is telling that the contribution of real estate investment to the regional economy is substantial in the east but slowly shrinking toward the west, and in overall, real estate investment has a positive correlation with regional economy.

Keywords: Real Estate Investment, Regional Economy, ESDA, GWR, MGWR

1. INTRODUCTION

The development in the real estate sector is always connecting with the growth in other sectors, such as the construction sector, banking sector, etc. As what Harris and Arku (2006) pointed out, the real estate investment may affect economic development through its impact on employment, savings, total investment, and labor productivity (Hirschman 1958, Wu & Zhang 2005). Thus, it is always taken as an essential policy tool by the central government or local government to accelerate growth and create employment in the short run (Polenske & Sivitanides,1990). Besides, purchasing land from the government can also increase the government's fiscal revenue and help economic development.

In 1998, the Chinese government decided to transform the real estate from the society planned-oriented real estate into market-oriented real estate, which led the rapid development of real estate become distinctive feature of economy in China. In recent years, the share of investment in the real estate sector is growing and even reached 15% of the GDP in China. In lots of the previous studies, they have figure out a positive impact of real estate investment on the economic development in the short term, whereas whether the investment in real estate, in the long run,

can contribute to the growth of the economy is still under debate (Wang and Liu 2004, Liu et al. 2002, Hong 2014).

But previous studies have two shortages. One is taking less eye on the spatial characteristic of real estate. The second one is the rough level data, province-level data, which is hard to tell the inner variety of province, for example the city variance.

To fill this gap, this paper will learn the spatial pattern of the real estate investment and regional economy by applying ESDA to test the city-level data from 2000 to 2018 and see whether they have similar characteristics. Next, to see how significant real estate investment contributes to the regional economy, we use OLS, GWR, and MGWR. Here GWR and MGWR are going to tell the variance of the coefficients across the regions. In addition, we use test data in 2016, 2018 and 2019 to see the tendency of the coefficients.

We organize the rest of the paper as below: In section 2, we will review some literature, and in Section3, we will tell the data selection and methodology and the result of them. Section 4 give the conclusion and policy implication.

2. LITERATURE REVIEW

The development of real estate investment in China has attracted tremendous research interest (Han, 1998; Lee, 2000; Ding, 2003; Zhao & Borassa, 2003; Fung et al., 2006; Tang et al., 2006; Guo, 2005; Zhao et al., 2006; Liu et al., 2002; Li et al., 2005; Yu et al., 2016; Hong, 2014). Some of these studies focus on the change of real estate policies. And some of them focus on analyzing the impact of real estate sector to economy development or the relationship between real estate investment and economy development.Liu et al. (2002) conduct a Granger causality analysis to tell that housing investment strongly affects economic growth in both short and long. Zhang et al,. (2012) also used the Granger causality but is using the panel data of 30 provinces from 1999 q1 to 2007 q4 to learn the relationship between real estate investment and economic growth in China, and get the result showing a strong two-way Granger causality relationship between real estate investment and GDP in the east part and at the whole country level, while only one-way Granger causality from the real estate investment to GDP in the mid part, but no Granger causality exit in the west part. Meanwhile, they use a threshold effect

Some of the studies show a correlation from a regional perspective. For the effect variation, Han (1998) finds a big difference between the coastal and the non-coastal regions but a more negligible difference in the term of the state-dominated sector. Other than that, those investments from Hong Kong, Macau, and Taiwan were the main factor that boosted the development of real estate in those areas located around the coast.

3. DATA DECLARATION AND VARIABLE SELECTION

The data for this analysis is from China City Statistical Yearbook, including 295 cities available among 344 in total and covering the period from 2000 to 2018, having the whole sample amount as 5605. All the missing values are leaving blank. Considering data limitation that the GRP data in 2017 has only data for the district under the city, in this paper, we get rid of the data for 2017.

In the ESDA part, this study will use data for real estate investment and GRP per capita from 2000 to 2018.

In the next session, we do the analysis by using OLS, GWR, MGWR model by testing the data from 2016, 2018, and 2019. Variables are showing below

Table 1: Variable definition

Variable	Notation	Definition
L	Labor force participation rate	Employed people/Population
U	Urbanization	Urban population/Population
T	Tax burden	Tax revenue/GRP
PD	Population density	Population/Area
ind_grp	Share of secondary industrial to GRP	Secondary industrial output/GRP

Source: (TNR 10pt., italics)

3.1 ESDA

3.1.1 Moran's I

ESDA is applied to visualize spatial patterns and should be considered as a descriptive step before suggesting dynamic factors to explain the spatial patterns understudy and before estimating and testing more sophisticated regression models (Anselin,1998). ESDA reveals the complicated spatial phenomenon not identified otherwise.

Moran's I statistic helps to assess the global spatial autocorrelation and learn the overall clustering. (Anselin et al 2007, Anselin 1995). The value of Moran's I should be in the range of -1 and 1. When it is positive, we say the variable is spatially dependent.

On the contrary, when it is negative, the excellent performance in a region will inversely harm its neighbors. And when Moran's I is 0. we say the distribution of this variable is random, doesn't have spatial autocorrelation.

The weight matrix is essential for the result of Moran's I, we are going to test it by using two weight matrices. One is the Queen contiguity (make the weight as 1 when the place share the same boundary or corner with this city) and the other one is inverse distance.

Figure 1: Moran's I for GRP per capita in 2000

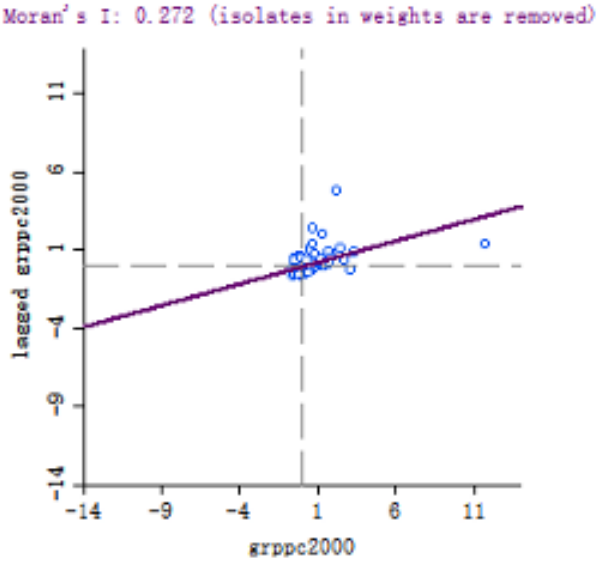


Figure 2: Moran's I for GRP per capita in 2018

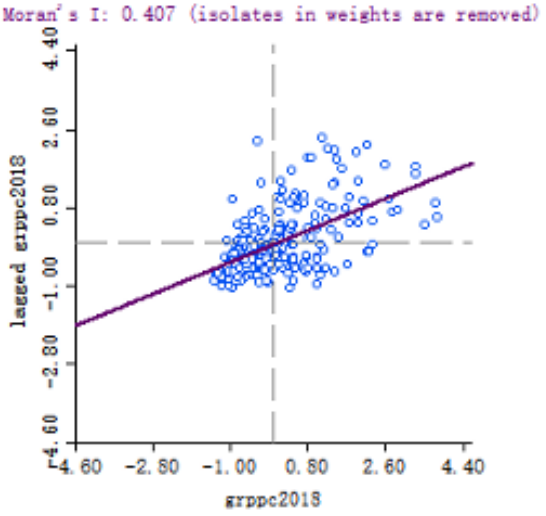


Figure 3: Moran's I for real estate investment in 2000

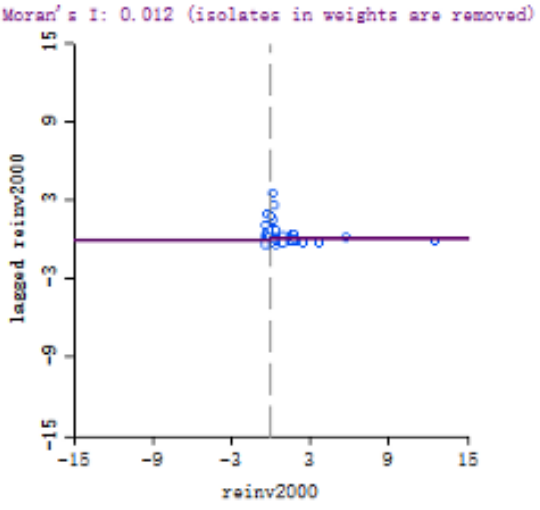
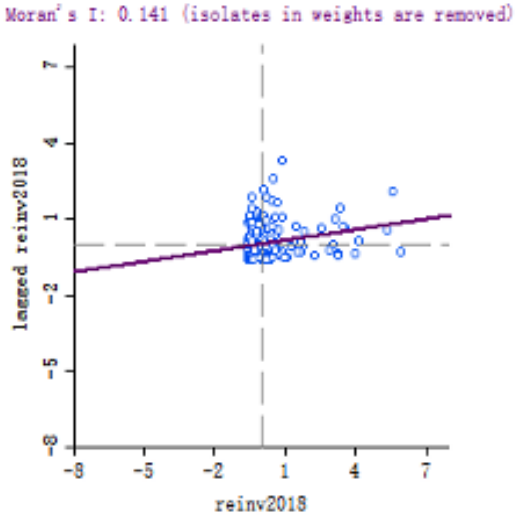


Figure 4: Moran's I for real estate investment in 2018



After comparing the p-value of each Moran's I, prioritizing low p-value, we decided to use the queen contiguity weight to conduct our Moran's I test, and then plot them, we have figure 1-4 showing the Moran's I. The graph of that is above. Take figure 1 as an example; we have GRP per capita as the X-axis, and the lag GRP per capita, which is the neighbors' average impact of that region as the Y-axis. When they locate in the first quantile, it means a positive performance of this region is associated with a positive performance of its neighbors, indicating that the spillover effect of this region is positive, high-high. When dots are in the second quantile, it means that the negative performance of this region is linked with the positive performance of its neighbors, which is the so-called low-high. And then the low-low dot in the third quantile, the high-low in the fourth quantile.

Figure1 and figure2 show the Moran's I of GRP per capita in 2000 and 2018, which increased from 0.272 to 0.407, meaning spatial dependence enhanced. Figure3 and figure4 show the Moran's I of real estate investment in 2000 and 2018, which is also growing, from 0.012 to 0.141. The initial number is 0.012, which means that there was almost no spatial autocorrelation in 2000, but with time going on, there is some correlation on space in the end year in 2018.
For the Moran's I of the rest of years for these two variables, below is a table involving their Moran's I value and P-value.

Table 2: Moran's I and P value

Variables	Queen	Inverse distance	variables	Queen	Inverse distance
GRPPC2000	0.275(0.001)	0.105(0.002)	REinv2000	0.02(0.16)	-0.004(0.47)
GRPPC2001	0.284(0.001)	0.107(0.002)	REinv2001	0.055(0.068)	0.009(0.15)
GRPPC2002	0.444(0.001)	0.197(0.001)	REinv2002	0.06(0.059)	0.012(0.097)
GRPPC2003	0.485(0.001)	0.227(0.001)	REinv2003	0.078(0.037)	0.018(0.051)
GRPPC2004	0.488(0.001)	0.228(0.001)	REinv2004	0.105(0.021)	0.024(0.034)
GRPPC2005	0.391(0.001)	0.227(0.001)	REinv2005	0.112(0.02)	0.023(0.037)
GRPPC2006	0.257(0.002)	0.136(0.002)	REinv2006	0.098(0.027)	0.02(0.047)

GRPPC2007	0.123(0.007)	0.078(0.006)	REinv2007	0.086(0.039)	0.014(0.093)
GRPPC2008	0.403(0.001)	0.218(0.001)	REinv2008	0.121(0.014)	0.024(0.034)
GRPPC2009	0.409(0.001)	0.197(0.001)	REinv2009	0.097(0.03)	0.021(0.055)
GRPPC2010	0.391(0.001)	0.175(0.001)	REinv2010	0.093(0.032)	0.024(0.038)
GRPPC2011	0.375(0.001)	0.176(0.001)	REinv2011	0.109(0.016)	0.032(0.024)
GRPPC2012	0.369(0.001)	0.171(0.002)	REinv2012	0.082(0.033)	0.028(0.035)
GRPPC2013	0.422(0.001)	0.13(0.003)	REinv2013	0.084(0.032)	0.029(0.034)
GRPPC2014	0.364(0.001)	0.162(0.001)	REinv2014	0.092(0.028)	0.032(0.026)
GRPPC2015	0.366(0.001)	0.163(0.001)	REinv2015	0.101(0.021)	0.034(0.022)
GRPPC2016	0.4(0.001)	0.179(0.001)	REinv2016	0.112(0.013)	0.036(0.019)
GRPPC2018	0.406(0.001)	0.199(0.001)	REinv2018	0.142(0.005)	0.051(0.009)

All the results above are larger than 0, indicating a positive spatial autocorrelation. In the term of GRP per capita, we have the value fluctuating up and down, but keeping a tendency of increasing in general. In the term of real estate investment, we have a relatively low value of Moran's I, but as the value goes up, the significance getting higher as well.

Table 3: Summarize statistics

Variable	Obs	Exp.	Mean	Std.Dev.	Min	Max
L16	289	+	0.1398629	0.1384582	0.0317087	1.185019
L18	293	+	0.1313018	0.1246649	0.0314262	1.069206
L19	292	+	0.1279512	0.1179566	0.031792	1.144731
U16	294	+	0.3749023	0.2389892	0.0468541	1
U18	291	+	0.3790759	0.2349597	0.0472335	1
U19	290	+	0.3799878	0.2320137	0.0474255	1
T16	289	NC	0.0811542	0.0288824	0.0307006	0.2273398
T18	294	NC	0.0771392	0.0272795	0.0242602	0.2175085
T19	293	NC	0.0756125	0.0251787	0.023432	0.1893862
PD16	279	NC	5.16269	3.947632	0.1890875	24.21154
PD18	278	NC	4.651726	3.427573	0.4246575	22.15385
PD19	274	NC	4.779631	3.742169	0.3401535	24.68421
ind_grp16	289	+	44.86727	9.472239	14.95	70.5
ind_grp18	294	+	42.91058	9.631419	15.75	72.9
ind_grp19	294	+	39.37313	10.26774	10.68	67.04
lnreinv16	287	+	14.26476	1.227173	10.545	17.51568
lnreinv18	263	+	14.31093	1.386013	8.987197	17.56472
lnreinv19	271	+	14.46338	1.390104	9.721066	17.60859

We run the multicollinearity test for the control variables. To do so, we calculate the variance inflation factors (VIFs) for each variable and get the results which are showing all the VIFs lower than 3, indicating no issues regarding multicollinearity in the models and six independent variables were not collinear. The detailed result of VIFs is in the table below.

Table 4: VIF result

year	lnreinv	L	U	T	PD	ind_grp
2016	1.216366	2.079286	1.717935	1.461656	1.173744	1.058664
2018	1.167665	2.381395	1.805841	1.499818	1.146162	1.047837
2019	1.163032	2.342195	1.955789	1.455581	1.152345	1.072556

Next, to examine the impact of real estate investment on the regional economy, we test Ordinary Least Squares (OLS), GWR model, and MGWR model. The R studio software runs the OLS model, and the MGWR 2.2 software application gives the result of GWR and MGWR model. (Oshan et al.,2019). The table below is showing the results of those three models.

Table 4 Fitness of three models

	OLS	GWR	MGWR
R2	0.687	0.867	0.872
Adjusted R2	0.680	0.829	0.843
AIC	480.210	353.367	321.885
AICc	482.745	391.177	347.161
Moran's I of residual	0.309	0.098	0.024
p-value of Moran's I	0.001	0.013	0.236

By comparing the data above, we learn that MGWR has the highest value on adjusted R^2, meaning that the most suitable model for this analysis is MGWR. And the lowest AICc from the result for MGWR is also emphasizing that. We test the Moran's I for each residual in each model and get the lowest one from MGWR (0.024), comparing with GWR (0.098) and OLS (0.309***), indicating that the MGWR model specification is more potent in filtering spatial autocorrelation. (Gu,2020)

Below is the result of coefficient and p-value of each variable by using MGWR in three years

Table 5 result of MGWR

Coefficients	16	18	19
Intercept	-0.020	-0.008	-0.031
lnreinv	0.303	0.282	0.315
L	0.320	0.344	0.328
U	0.323	0.398	0.301
T	-0.073	-0.227	-0.120
PD	-0.271	-0.257	-0.216
Ind_grp	0.349	0.320	0.386

The beta coefficient of each variable for each observation is mapping by GEODA software with natural breaks criteria to make it into five groups. We map the coefficient of real estate investment for every city in three years, the darker the color is, the higher the value is.

Figure 5 Coefficient of real estate investment in 2016

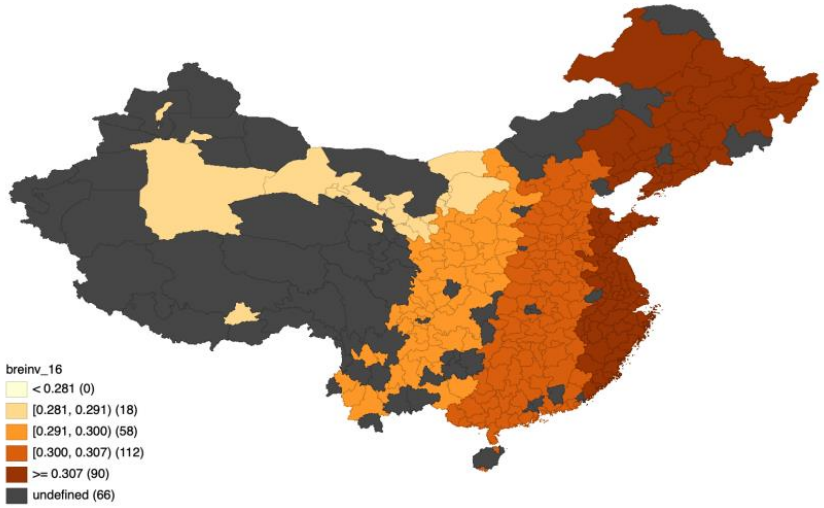


Figure 6 P-value of real estate investment in 2016

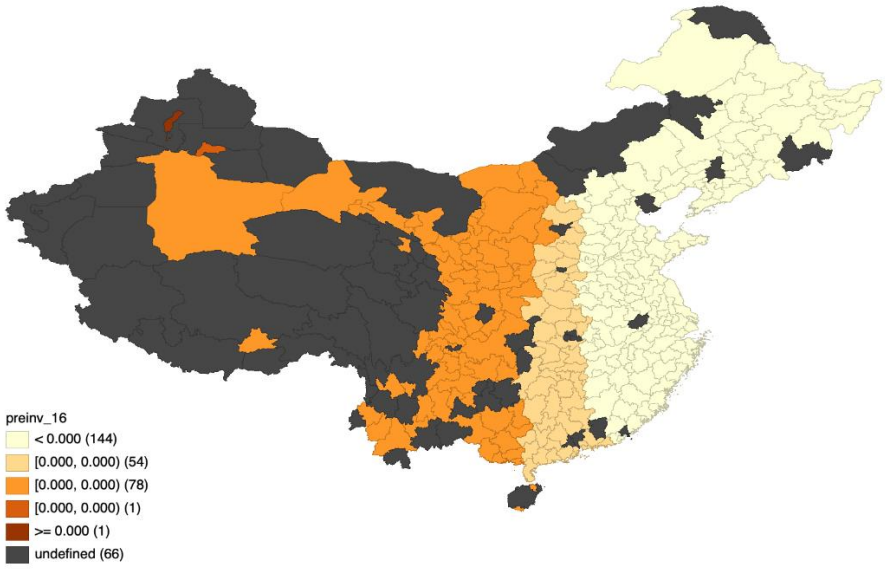


Figure 7 Coefficient of real estate investment in 2018

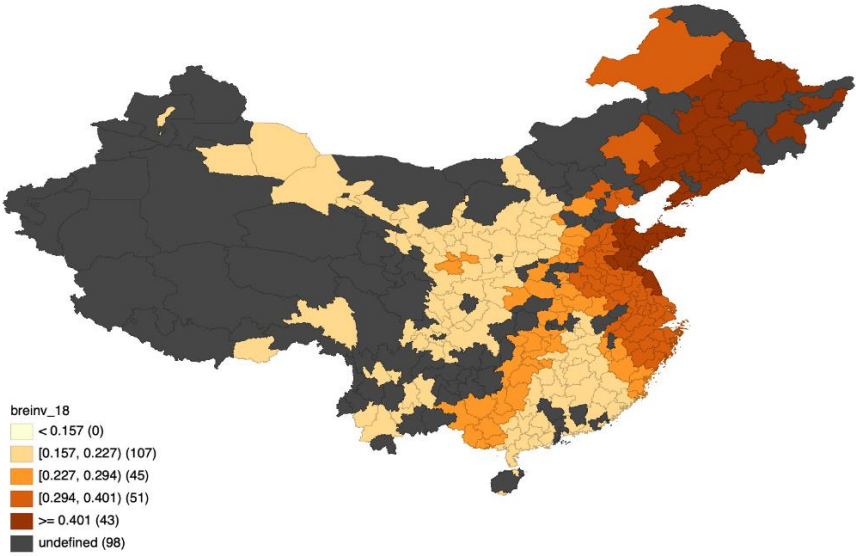


Figure 8 P-value of real estate investment in 2018

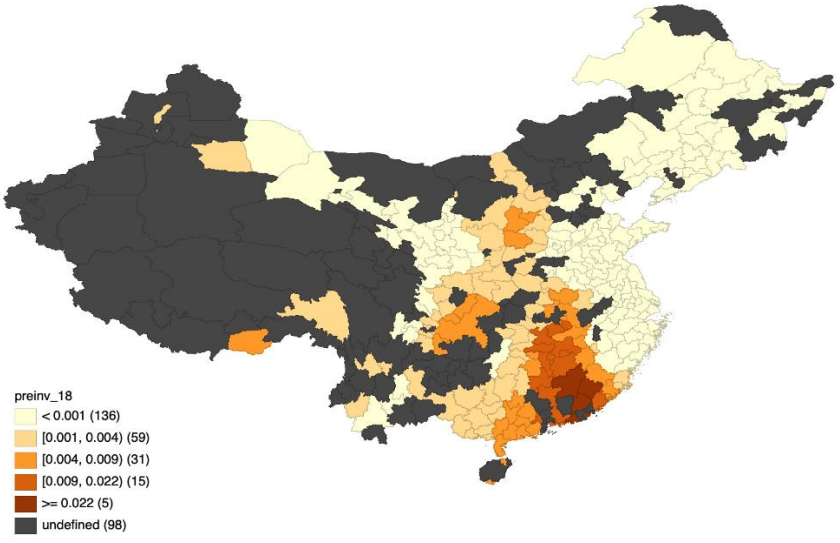


Figure 9 Coefficient of real estate investment in 2019

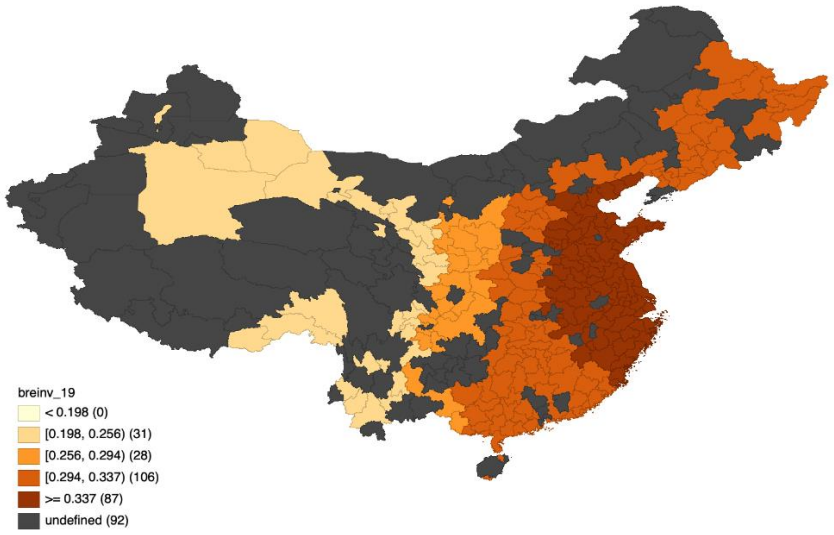


Figure 10 P-value of real estate investment in 2019

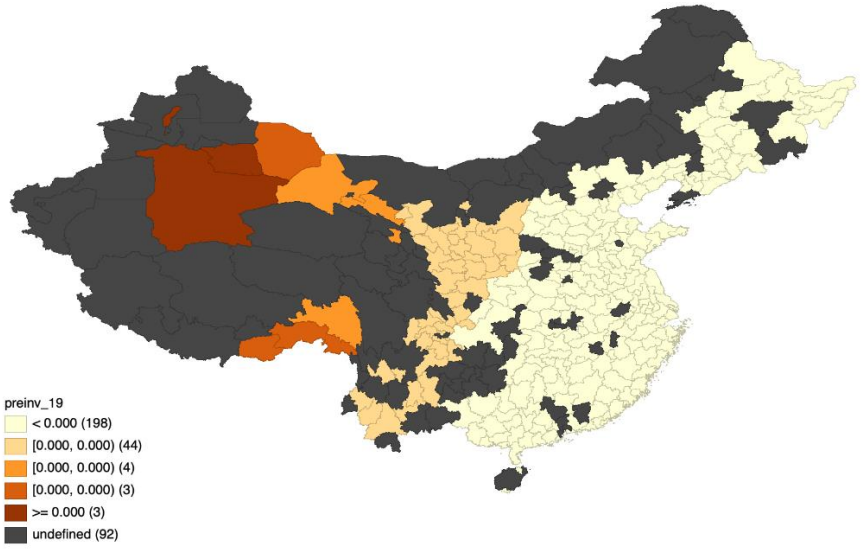


Figure 5 is showing the coefficient of real estate investment in 2016, a clear tendency increasing from the west toward the east is seen. Which means that the development in real estate investment in the east can contribute to the economy development better than that in the west. And the p-value is indicating that the value in the east is more trustable than that in the west. While figure 7 is showing that in 2018, we found a fundamental pattern which have significant performance in the east area and low in the west area. But comparing with that in 2016, a better

effect from real estate investment appeared in the north-east part of China rather the east costal area. In the figure 9 with the coefficient of real estate investment in 2019, the higher performance is in the east costal area, mainly in the Shandong peninsula and Yangzi River delta area.

Seeing the distribution for three years, we find real estate investment so far is continuously doing good for economy development not only in the eastern developed areas but also in the western lagging areas. But this kind of impact is getting weak from the east toward the west, which indicate that invest too much on real estate in the west has very limited effect on accelerating economy development. And throughout the year, this kind of effect fluctuated but with less difference, which means that in the coming few years, the impact from real estate investment to economy development is smooth and steady but still need more attention on the west areas, to control the fast development in real estate investment, because of its limited effect and the shrinking population.

4. CONCLUSION AND POLICY IMPLICATION

The result of this study first tells that the spatial pattern of regional economy and real estate investment is gradually becoming similar, both is developed in the east (especially near the Yangzi River delta), some of the capital cities of each province and key cities of China while doing a poor performance in most of the middle and west area. It also indicates an unbalanced development on real estate investment among China. The spatial dependence of real estate investment and regional economy is getting stronger from 2000 to 2018, which means that the performance of one city is more likely to influence its neighbors, or more likely to be influenced by its neighbors.

According to the result of MGWR, we know that real estate investment overall is contributing to the regional economy but differ by levels. Summarizing the result from three years, in the east area, a unit of real estate investment increased can lead to a higher development on regional economy than that in the west. For the coefficient of real estate investment, we noticed they don't have a clear tendency of increasing or decreasing. It is fluctuating up and down, but still very significant to regional economy.

The policy implications emerging from this study can be summarized as below:

- Set and support some of the leading cities among those cold dots, as the spatial dependence increasing, let the development of one city also contributes for its neighbors, in this way to deal with the unbalancing development between east and west.
- Encourage the real estate investment in the east, while control that in the west, and try to put more effort on industrial development or the development on other sectors.

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