From Public Housing to Private Housing:

Spatial Pattern of Public Housing Purchase in Transitional China

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Abstract

China's housing reform has led to in a wide-spread "renting-to-owning" switch, as well as a rise in the purchase of public housing. The paper uses the China 2000 Population Census Data to examine how the spatial pattern of aggregate housing tenure choice is influenced by market-related and institutional characteristics at the county level. The OLS model shows that the organizational patronage helps to translate the home-purchase impulse into homeownership, and the transitional public housing sector particularly rewards employees of high human capital. Besides the effect of spatial variability in demographic and structural terms, the spatial regime analysis further illustrates that factors like low-income prevalence and industrial employment act differently from the southeastern regime to the northwestern regime. Such a difference is moderated after introducing a spatially-autocorrelated error term, which implies that the dynamics of "homeownership boom" varies by localized economic and policy settings, and needs to be contextualized in larger social processes.

Issue

The two decades of China's housing reform have brought out the complex housing tenure composition as well as an increasing proportion of owner-occupiers. In the pre-reform China, housing in China had approximated a welfare item, particularly in urban areas. People had relied heavily on work units for access to public rental housing,

until the housing reform was initiated in 1979. Since then, many residents experienced a "renting-to-owning" switch, though which previous renters of public apartments became homeowners. In particular, the purchase of public housing has become one of the most important ways of moving into homeownership, since the welfare housing provision was first terminated in Beijing in 1998.

The privatization of the previous socialist housing system results from both policy change and household choice. Based on the data of public housing purchase by county, the study examines how its spatial distribution is influenced by population density, age composition, economic and employment structure, income level, and the rural-urban divide. Both demographic and economic structural predictors are incorporated in the models in order to model the spatial heterogeneity and spatial dependence in the housing tenure pattern.

Literature Review

Housing tenure choice is often taken as a function of household and personal characteristics. Assuming well-defined market mechanisms, household economics suggest that homeownership involves both consumption decision and investment consideration. With income as an important predictor, homeownership usually involves affordability considerations (Clark et al., 1994). Moreover, many demographers add that housing tenure change is strongly influenced by the life cycle effect. For example, transition models suggest that households develop a sense of permanence as their members pass through a series of life cycle milestones (Cichocki, 1996). Interrelated events such as family formation, family compositional change, and occupational

mobility, are translated into variation in housing consumption, so forming a "housing career" (Champion & Fielding, 1992; Fielding, 1992).

However, in the transitional China, the tenure choice is neither merely a market processing of rational decisions, nor simply a life course event timed by individual experience. Instead, the rising homeownership involves changes in household preference and state policy. Both institutional persistence and market penetration are evident in the reform process. On the one hand, market-centered theory suggests the devalued material privilege connected with administrative control and the increasing rewards to human capital, such as education, experience and entrepreneurship (Nee, 1996). On the other hand, the persistence of political advance and official power is observed in a post-socialist era (Bian & Logan, 1996). In the early phase of market transition in Hungary, access to housing continued to illustrate the cadre privilege (Szelenyi & Manchin, 1987). Similarly, Walder (1995) found that party membership and being an administrator were significantly associated with apartment size in the city of Tianjin in 1986. Furthermore, the characteristics of work units (Logan et al., 1999) continue to influence the access to publicly subsidized housing. According to Fu, the lack of public subsidy discourages private homeownership (Fu et al., 2000), while such aids are usually provided though work units.

In addition to human capital and organizational links, other institutional factors also play a crucial role in determining access to housing, such as the urban-rural divide in the household registration system. The public housing system, mostly established in urban areas, is available only for people with the urban "hukou" (registration) in principle. Though the dichotomous status of urban or rural "hukou" is less important due

to the development of the housing market, the urban population has more chance in buying "affordable" housing that is publicly subsidized.

Because of the parallel mechanisms of the subsidized and non-subsidized housing purchase (Li, 2003), the expected effects of class position and life cycle position might be distorted. According to Huang and Clark (2002: 7), given the complicated institutional relationships among the state, work units, and households, the effects of individual characteristics (such as employment and marital status) on tenure choice are different from those in the West.

There are three empirical reasons to examine the influences of life cycle position, class position, and institutional factors as a whole on the nation-wide pattern of public housing purchase. First of all, demographic and structural factors may have a distinct pattern of influence on public housing purchase different from other housing tenure choices. On one hand, the aid from state or local agencies involved in public housing purchase is likely to be directed to the economically disadvantaged families. On the other hand, public housing purchase provides a chance for work units to do favor certain privileged groups. Previous studies tend to see human capital and organizational links as dichotomous categories of personal characteristics, one favored by the socialist system and the other is oriented towards the market. Nevertheless, some of their elements can be consistently rewarding regardless of the institutional context. In the case of technicians, it is hard to employ dichotomous measures to evaluate the advantage of employment and that of education. As such, there will be a group of "dual advantage," who can benefit from both organizational links and human capital, and the public housing purchase could

be a specific way that they show such a dual advantage in either the public or the private housing sector.

Second, previous researches do not pay enough attention to the dynamics of public housing purchase. In the gradualist housing reform, the privatization process does not occur over a night. Though confronted with the emerging housing market, the public rental housing still remains to be attractive to some extent for many renters until the privatization trend becomes seemingly irresistible. A large proportion of previous renters chose to enter the "internal" market rather than a fledgling "open" market (Logan and Fang, 2006: 5), and moved into the homeownership in a sponsored way. Their strategies "first involve a change from renting a work unit or housing bureau dwelling to owning a flat with partial property rights, and then to owning with full property rights (Li & Li, 667)." In other words, households' expressed consumption desire is conditioned by the periodized social and economic changes at the macro level, and the advantageous personal characteristics do not necessarily lead to the ownership of commodity housing.

Third, previous studies fail to employ spatial analysis to look at the nation-wide housing tenure dynamics, as well as how the demographic, economic, and institutional determinants adds to the complication of housing tenure structure and the diversification of landscape. The spatial analysis will examine not only the spatial viability of aggregate housing tenure choice, but also the varied influences of demographic and structural predictors, which could convey information about the localized institutional context.

Model

The study starts with the classic OLS model. Furthermore, the trend surface model and geographically weighted regression are employed to detect the pattern of

spatial heterogeneity and the geographical variation of the relation between the outcome variable and predictors. Informed by the diagnostics on spatial heterogeneity and spatial dependence, the study expands the standard spatial regime analysis to recruit the spatial autoregressive error term. The demographic, economic, and institutional effects on the spatial pattern of housing tenure are modeled at the county level.

There are two reasons why county is an appropriate unit of analysis. First, county (and district) compose the baseline level of administrative governance that is nationally coordinated. Its administrative integrity can result in the relative consistency of the policy implementation. Second, there is considerable geographical heterogeneity at the county level. For example, counties as city centers, suburban areas, or migrant enclaves differ sharply in terms of landscape and institutional context. As such, the county-level analysis helps to effectively detect the meaningful clustering and barriers of housing tenure pattern.

The study builds the definition of "neighboring" counties using the contiguity-based weights matrix of the queen first order because of four reasons. First, the areas and shapes of counties are highly irregular. "Neighbors" of a county can hardly be defined by setting a distance within which each observation is guaranteed to have at least one neighbor, as the distance-based matrix does, because this minimum threshold may be too large for many counties, resulting in too many "neighbors." Second, compared with the k nearest neighbor matrix that forces all observations to have the same amount of neighbors, the contiguity-based matrix takes into consideration the effect of shared boundaries, which plays an important role in policy implementation and socioeconomic processes. Third, a greater degree of the positive spatial autocorrelation of the outcome

variable is captured when using the first-order neighbors instead of the second-order ones. It adds to the reason to differentiate the direct and indirect neighborhoods, possibly due to the distance-decay effects, or because the coverage of large-scale processes puts a limit on the definition of neighborhood. Finally, the weights matrix of the rook first order is not employed because as there is no evident suggesting corner neighbors are less important and should be excluded. In sum, all the directly adjacent counties surrounding the focal county are defined as its "neighbors."

The hypotheses to be tested are as follows.

1) Population density is positively associated with the proportion of households who bought public housing.
2) The proportion of public housing purchase is higher in urban areas.
3) The county's age composition influences the composition of housing tenure types. People tend to buy rather than rent housing as they age.
4) The proportion of people who are employed in nonagricultural sectors or retired is anticipated to have a positive connection with the percentage of public housing purchase.
5) The higher proportion of professional and technicians leads to the higher percentage of the public housing purchase.
6) Greater purchased public housing is expected in counties where low-income households are more prevalent, because these families are both attracted by and provided with access to the subsidized public housing purchase.

Data and Variables

This study uses the China 2000 County (District) Population Census Data. The dependent variable is the logarithm of the percentage of purchased public housing, which is measured for each county (district) as the proportion of family households that bought the original publicly-owned housing. The independent variables include:

Area/person: county area per person on average.

Age65+: the percent of population aged 65 and over.

Low income: the percent of family households with income below 10,000 Yuan.

Rural: the percent of rural population.

Industrial employment: the percent of employed population in the second industry.

Professional: the percent of employed population for professional/ technical.

Unemployment: the percent of unemployed population in total population.

Retired: the percent of retired population in total population.

Results

Regardless of the spatial effect, demographic and economic structural factors explain 57% of the variation in the aggregate tenure choice of public housing purchase (OLS model). Population density has a positive though insignificant effect on the proportion of public housing purchase, while the proportion of rural population works as a negative predictor. The percentages of aged population and industrial employment are negatively associated the outcome variable. But among them, people who retired and who are professionals and technicians tend to contribute to the public housing purchase. Another beneficiary group in the privatization of the socialist housing system is those

with low income and those who are unemployed, which confirms with the fact that public housing are mostly affordable instead of luxurious ones. By contrast, the more high-income households the county has, the less likely there will be public housing purchase, which could be partly explained by the alternative choice of commodity housing.

Given the slightly negative effect of the aged population and the strong positive effect of the retired population, counties with larger retired proportions among old people will have higher percentages of public housing purchase. As such, a county can benefit from its aged population in promoting public housing purchase only if these people have an organizational link. If the aged population hardly had a formal job in their working ages (as in rural areas), they are not likely to contribute to the public housing purchase. As such, the life cycle effect is contingent on institutional factors.

Similarly, the negative effect of the industrial employees could be outweighed by the positive effect of professionals, if there is a high overlap between the two. In other words, the employment per se does not guarantee the housing benefits, and work units would give its patronage disproportionately to those with high human capital. In the transitional period, it is the combination of organizational links and market-oriented values that are most rewarded.

The spatial variability of demographic and structural characteristics explains part of the remaining spatial autocorrelation of public housing purchase (with a Moran's I of 0.3197, as shown by the residual map). Most of the "hot" counties (underestimated observations) of public housing purchase turn out to be metropolises, urban centers, or previous state industrial bases (Figure 1). By contrast, the "cold" spots (low-low clusters) scatter in rural inland areas or the south coast (Figure 2). The later region used to be the

vanguard area of market reform, and has little socialist housing system to privatize. Furthermore, the northwestern part of China has more heteroskedasticity, where the predicting power of the OLS model may be undermined by the concentration of lower income households and underdevelopment (Figure 3). These patterns suggest that the exploration of spatial heterogeneity and spatial dependence should be situated in economic structure and reform process.

Figure 1 . Quantile map of OLS residuals.

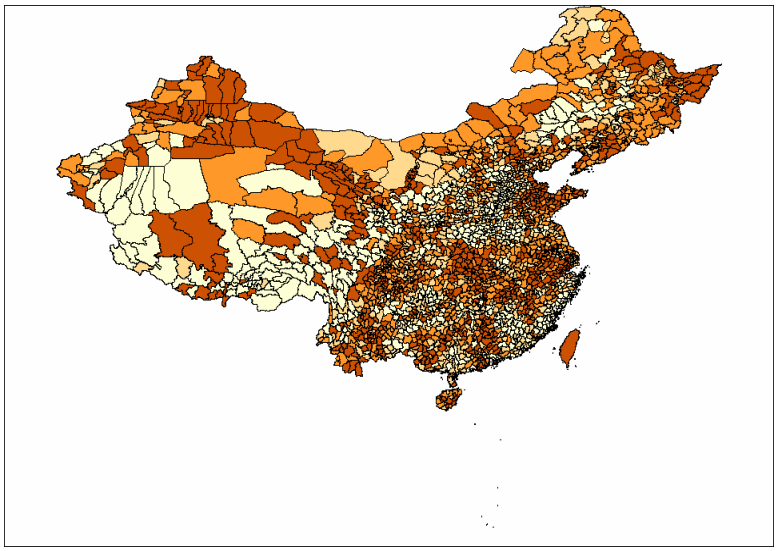


Figure 2. LISA map of OLS residuals.

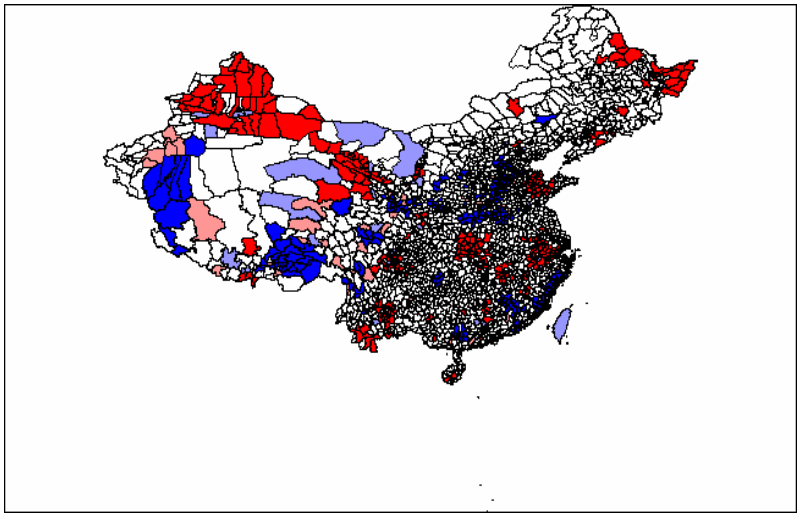
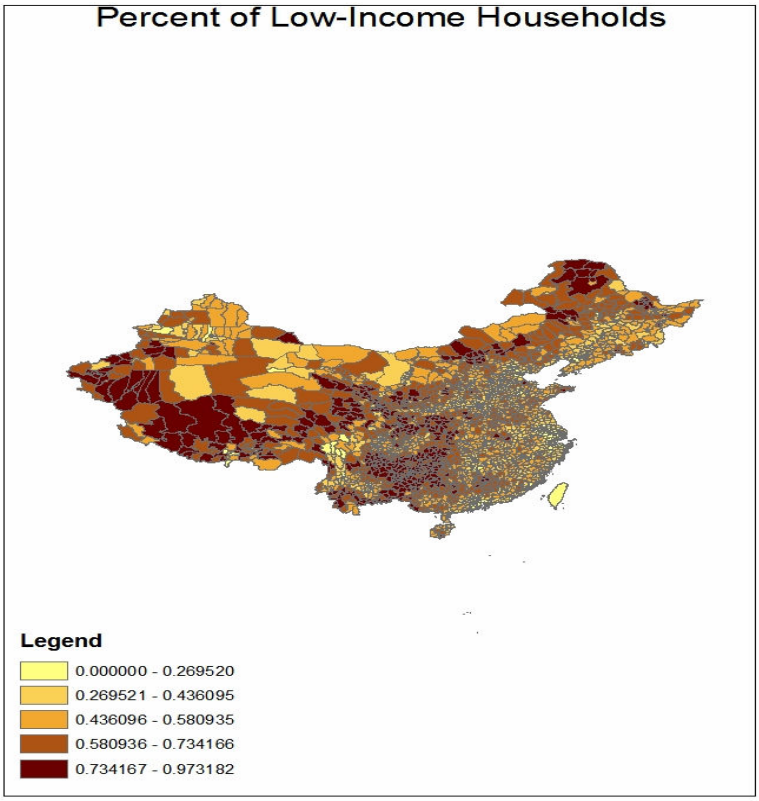


Figure 3. Quantile map of the percent of low-income households (logged).



The trend surface model and the geographically weighted regression help to address spatial heterogeneity. The quadratic trend surface model[1] suggests a semi bowl-like shape for the trend surface, with the lower value in the middle and increasing to the outside (Figure 4). The smoothed-out distribution of public housing purchase confirms with some information conveyed by the OLS model. "Cold" areas mostly correspond to less populated areas, and "hot" spots are mainly urban and populated regions surrounded by vast rural areas. Related with the pattern of heteroskedasticity (Figure 5), we can

[1] The linear trend surface model turns to be crude with an adjusted R-squared of 6%, but both the latitude and the longitude are strongly significant, suggesting an increasing trend from West to East, and an increase from South to North. The quadratic trend surface model improves the adjusted R-squared to 10%.

detect that the western areas that are predicted to have low rates of public housing purchase in fact have larger variation in residuals.

Figure 4. Quantile map of predicted values by the quadratic trend surface model.

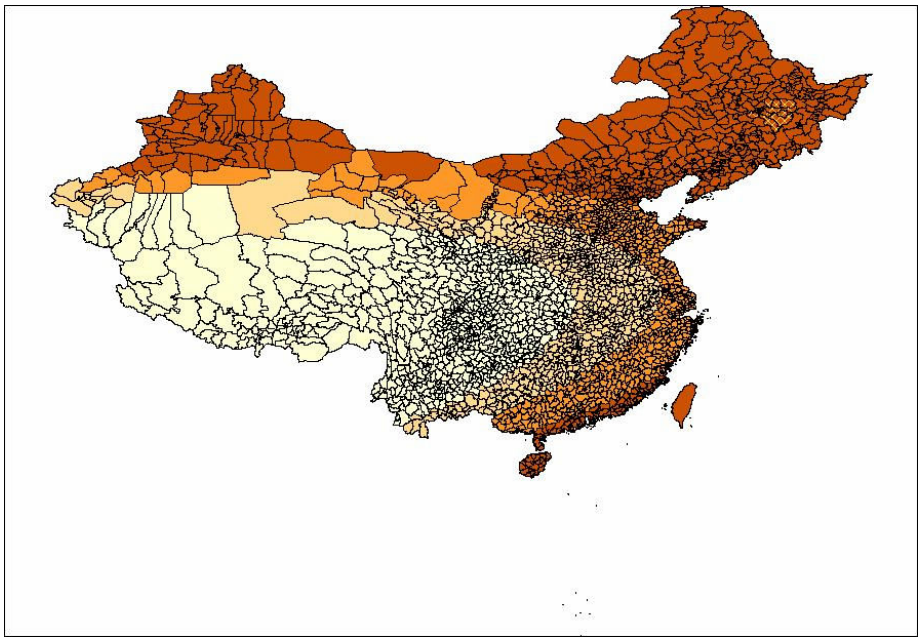
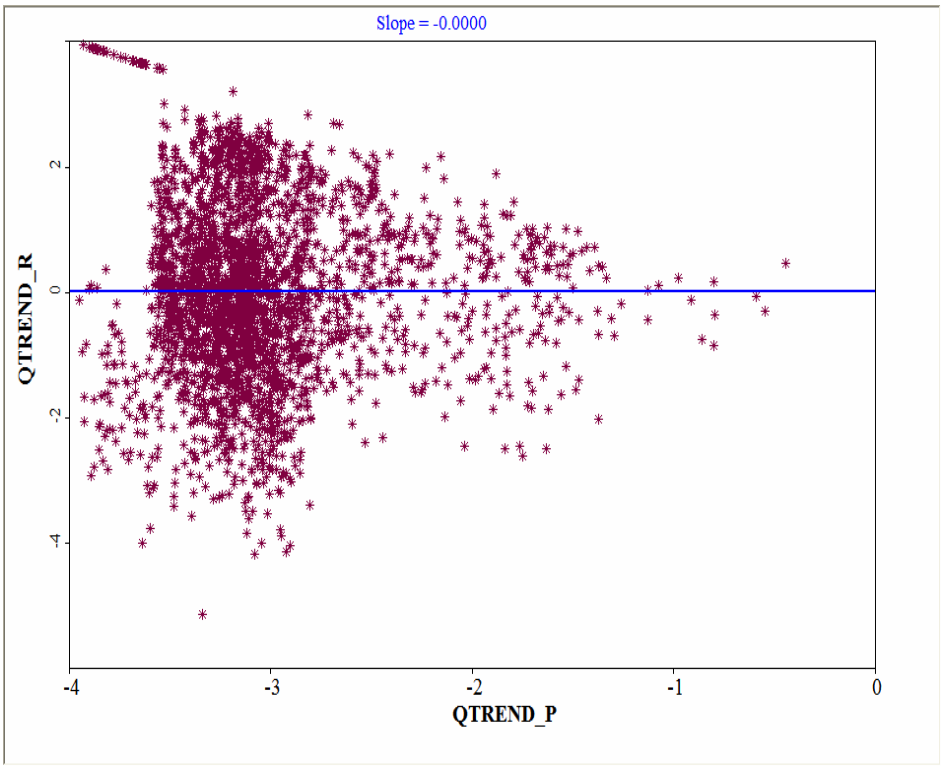
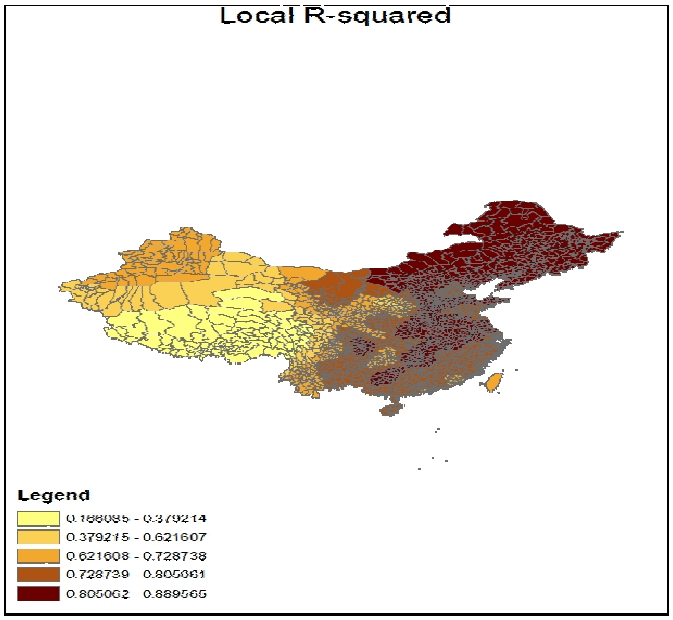


Figure 5. Plot of residuals against predicted values in the quadratic trend surface model.



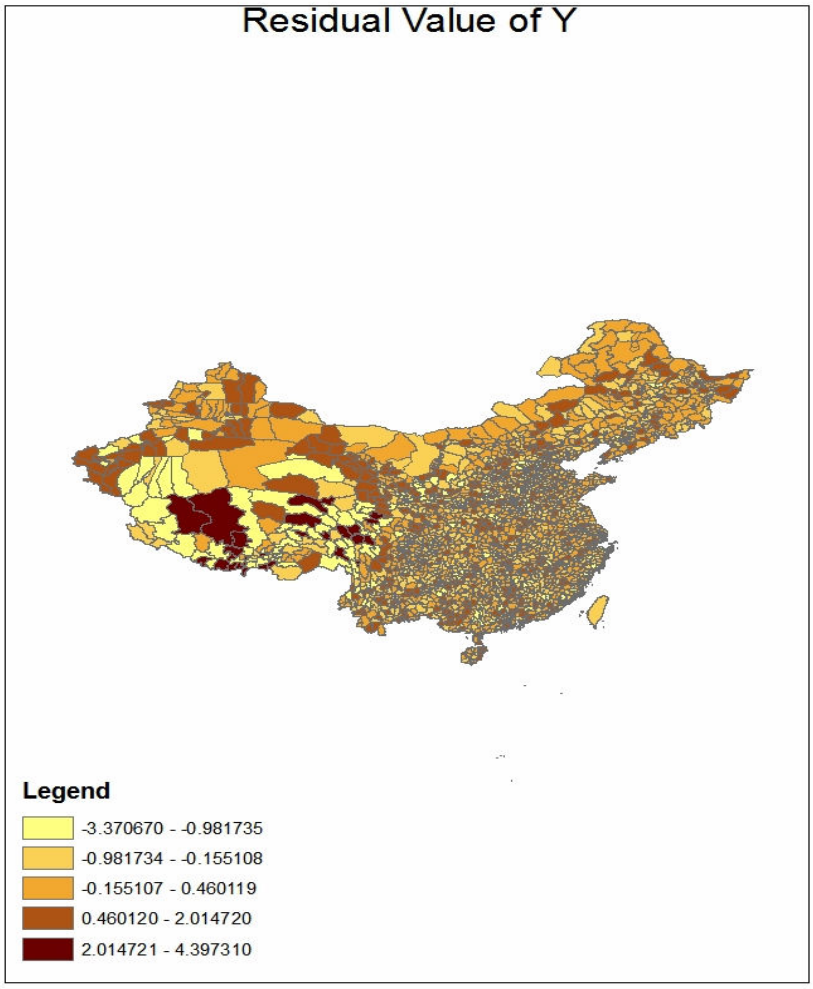
The spatial heterogeneity is also illustrated by geographically weighted regression. The spatial distribution of the local R-squared indicates that the model has more explanatory power in the eastern part of China. Among the independent variables, the effects of most factors vary greatly in terms of direction, magnitude, or significance across areas, except that of "rural population." In general, the eastern part of China has closer coefficients to those in the original OLS model, and the local R-squared is higher in these areas. For example, the positive effect of the "low-income prevalence" is most significant in the eastern China, which becomes negative in some western areas. In other words, such irregularities undermine the model efficacy in the western region.

Figure 6. Quantile map of local R-squared by GWR.[2]



[2] The eastern areas are usually the overlapping place where predictors are more significant. For example, the t-value distributions of "industry" and "professional," as well as those of "aged population" and "retired population," collectively contribute to the local R-squared pattern.

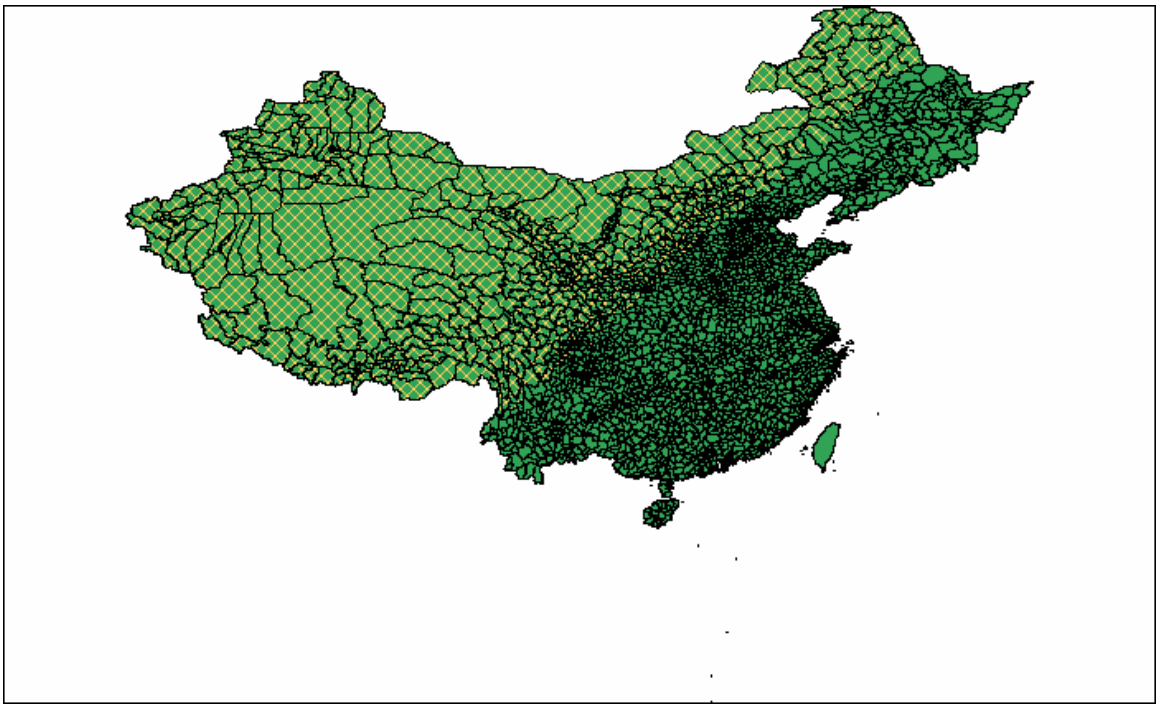
Figure 7. Quantile map of residuals by GWR.



The map of residuals (Figure 7) confirms with the pattern of heterogeneity and heteroskedasticity informed by the trend surface model (yellow tones correspond to over-prediction, and under-prediction is implied by brown tones). The remaining spatial autocorrelation has been reduced to a level with a Moran's I of 0.0571, while most irregular observations still concentrate in the western China.

Based on these findings, the model divides China into the northwestern and southeastern regimes using the "Heihe-Tengchong line" (Hu, 1935) to model spatial heterogeneity (Figure 8)[3]. The two areas differ sharply in elevation, land use and land cover, population density, productivity, and city patterns.

Figure 8. Spatial regimes: the northeastern and the southeastern part of China.



There are some important differences between the two regimes in terms of the direction, magnitude, and significance of coefficients, though the major pattern remains

[3] The Heihe-Tengchong line refers to the line connects Aihui District in Heilongjiang Province and Tengchong County in Yunnan Province. The line is geographically important, because the southeastern part of the line occupies 43% of the total area in China, but more than 90% of the total population of China resides in this area. A model for simulating population distribution (MSPD) of China (Yue, Wang, Chen, Liu, Qiu, Deng, Liu, and Tian, 2003) shows that the ratio of population on the northwestern side has been increasing since 1935, but there were still 90.8% of the population distributed on the southeast part in 2000.

the same (Table 1). Both the population pressure and the institutional barrier stand out in the southeastern regime. These areas have a more developed metropolitan system, with the matured public housing system and the established privilege towards urban "hukou." As such, compared with in the northwestern regime, population density has a stronger positive effect on the proportion of public housing purchase, and the rural population is more significantly disadvantaged. In the northwestern regime, the aged, retired, or unemployed population is more likely to buy public housing, but professionals and technicians have a lower likelihood of public housing purchase. On one hand, housing market is more mature in the southeast regime, which provides an alternative way of home purchase. On the other, professionals and technicians become the group that show a path dependence to rely on the public housing sector because of they are persistently rewarded by their employers who are dominant in the economy of the southeastern regime.

In particular, there are two factors that act in strikingly different ways. The first one is the prevalence of low-income households. It promotes the public housing purchase in the southeastern regime but illustrates its prohibiting effect in the northwestern regime. The possible reason is that public housing purchase is more affordable for low-income households in the southeastern areas due to its overall level of household income and governmental subsidy. In the northwestern regime, the policy bias towards low-income households may confront severe constraints of local budgets. The second factor is the industrial employment, which works as a negative predictor in the southeastern regime but a positive one in the northwestern regime. In other words, the industrial employment is more meaningful in the northwestern regime to better people's life chance, because of

its importance stands out given the lower level in general in terms of industrialization and economic development.

Table 1. Spatial regime model and spatial regime model with error.

Variable	HETEROSKEDASTIC ERROR MODEL (GROUPWISE)		SPATIAL ERROR MODEL WITH STRUCTURAL CHANGE OF DIFERENT SLOPES	
	northwest	southeast	Northwest	southeast
AREA/PERSON	584.82	128110*	1329.35*	48602.7
AGE65+	-0.0710925	-0.0971964***	-0.0119414	-0.12407***
RETIRED	12.798***	7.53876***	9.02219***	9.70602***
INDUSTRIAL	**0.01126**	**-0.0069878*** **	**0.0103121***	**-0.00457811**
EMPLOYMENT				
PROFESSIONAL	0.146042	2.68928**	2.61161	2.5377**
LOW INCOME	**-0.226586**	**0.716242*** **	**-0.216787**	**0.3342**
UNEMPLOYMENT	2.17441***	0.878332***	1.59426***	0.419626
RURAL	-1.3712**	-2.36237***	-1.39276***	-2.05332***
CONSTANT	-2.6053***	-1.82278***	-2.82808***	-1.63388***
HETEROSKEDASTIC COEFFICIENT				
EAST	1.70305***	0.629397***		
DIAGNOSTICS FOR SPATIAL DEPENDENCE IN SPATIAL REGIMES				
Lagrange Multiplier (error)		996.899460***		
Lagrange Multiplier (lag)		554.249473***		
LAMBDA			0.543275***	

*p<0.05**p<0.01***p<0.001

The spatial regime analysis is further expanded to include the spatial autoregressive error term according to the diagnostics for spatial dependence (Table 1). In the spatial regime model with error, most coefficients keep to be in the same directions

and at similar levels of significance.[4] However, the difference between the two regimes in most coefficients is reduced after allowing the error term to be spatially autocorrelated. Tests on structural stability lend evidence to the reduced instability between the two regimes. The Chow-Wald test shows a reduced difference between joint equality of coefficients, though it is still statistically significant. For the individual coefficients, most of them illustrate less instability except the ones for the aged population and the industrial employment.

Nevertheless, the difference between the two spatial regimes remains. After including the error term, the coefficients of the industrial employment and the low income prevalence remain to be the two that have opposite signs in the two regimes. According to the test of spatial stability, the effect of industrial employment still behave differently in the northwestern and the southeastern areas, but the difference between the low income effects in the two regimes becomes insignificant. To conclude, the influence of industrial employment contributes significantly to the difference between the two regimes, while the contribution of low income prevalence can be explained by the autocorrelation of err terms.

Discussion and Conclusion

The study adopts the combination of spatial regression and spatial regime analysis to examine the dynamics of housing tenure change driven by the privatization process of the socialist housing system. Both market-related and institutional characteristics

[4] The spatial autoregressive coefficient (0.543) is highly significant. In both regimes, the effects of industry employment, unemployment, and low income prevalence are less significant, which are partly taken care of by including in the spatially autoregressive error term. The error model also reports larger standard errors for most coefficients, which are underestimated by the standard OLS model. Consequently, the corresponding coefficients' significance is deflated.

influence the chance of public housing purchase, and such access varies with the economic and policy setting of counties.

The results show that public housing purchase tends to occur in urban and populated areas. The proportion is also greater in counties where low-income households and unemployment are more prevalent, because of the policy bias in the process of housing privatization towards these economically vulnerable groups. It is worth noticing that the effects of the age composition and the employment structure do not illustrated the expected direction. In other words, either the life cycle position or the organizational links cannot guarantee a better chance of public housing purchase. There can be two reasons: the public housing sector rewards people with further selectivity, or people who tend to become homeowners are granted alternative choices to buy commodity housing.

Related with other coefficients, we can have a more comprehensive picture of the contingent demographic and employment effects. Given the partial overlapping of the aged and the retired population, we can expect the organizational patronage to be the condition of translating the home-purchase impulse driven by the aging process into homeownership. On the one hand, in a county where both the retired and the aged portion of the population are high, the positive "retired" effect will outweigh the negative "aged" effect. On the other, the proportion of aged population remains to be a negative predictor net of other variables: by controlling the effect of organizational link, the "left-over" aged people is economically disadvantaged and less likely to contribute to the public housing purchase. By the same token, if professionals and technicians occupy a large portion of the industrial employees in the county, its positive effect is very likely to outweigh the negative effect of the later. To sum, the influence of the county's industrial employment,

being negative per se, is contingent on the human capital of employees. In the housing reform, the public sector does not reward all the employees blindly; those of high human capital would benefit the most from their connection with work units.

However, the influence of demographic and economic predictors varies geographically. In general, the model has more explanatory power in counties in the southeastern part of China. By contrast, the northwestern regime illustrates more overestimation and underestimation. Two factors could have particularly contributed to the spatial heterogeneity. First, the northwestern counties are less populated but larger in size. The low population density makes the individual variations more influential in the aggregate choice of housing tenure, and the "irregular" households are more likely to result in "abnormal" countries. Second, the northwestern counties are economically less developed, and are less typical concerning either the previous socialist housing provision or the current privatization process. In these areas, the policy bias in the privatization of public housing is more likely to be hold back by poverty or the lack of governmental sponsorship.

As such, the structural instability between the two regimes is informed by fundamental differences in the structural characteristics, and how they are contextualized in larger social processes. The southeastern regime is characterized by the established socialist housing system and an emerging housing market, where personal and household advantages are likely to illustrate the expected effects. In the northwestern regime, given the higher poverty rates and the underdevelopment of housing market, the governmental discretion is more consequential, which adds additional variations to the pattern of housing tenure mix.

Appendix

Figure a. Quantile map of the percent of public housing purchase (logged). [5]

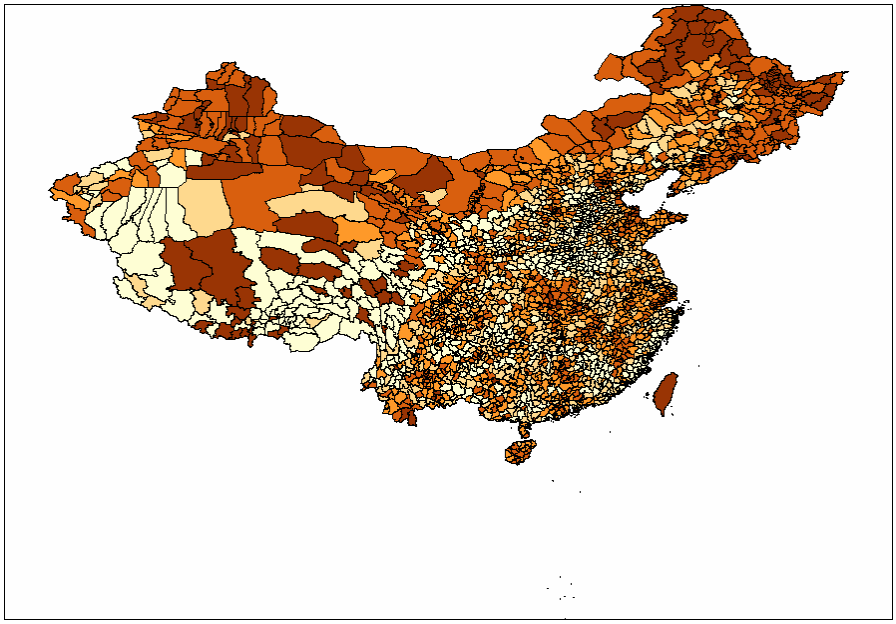
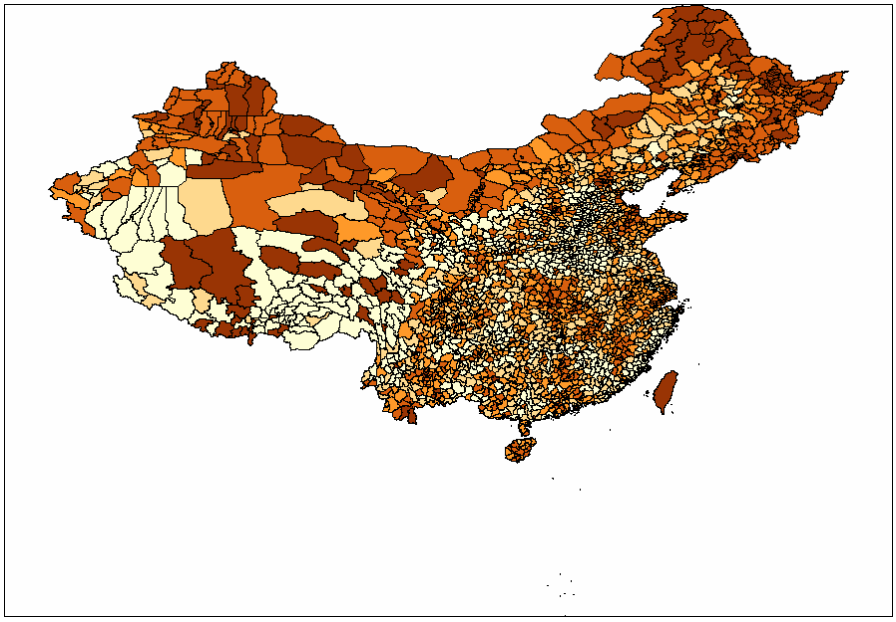


Figure b. Predicted values by OLS model.



[5] The spatial distribution of the outcome variable (Figure a) shows the pattern of public housing purchase, with darker areas corresponding to higher percents, and lighter areas to lower percents. There is a relative high spatial autocorrelation, with a Moran's I of 0.4490.

Figure c. Standardized map of residuals in the quadratic trend surface model.[6]

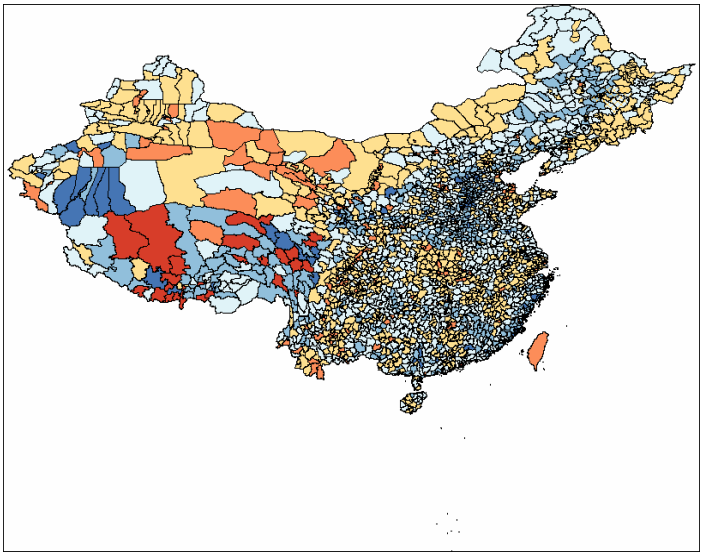
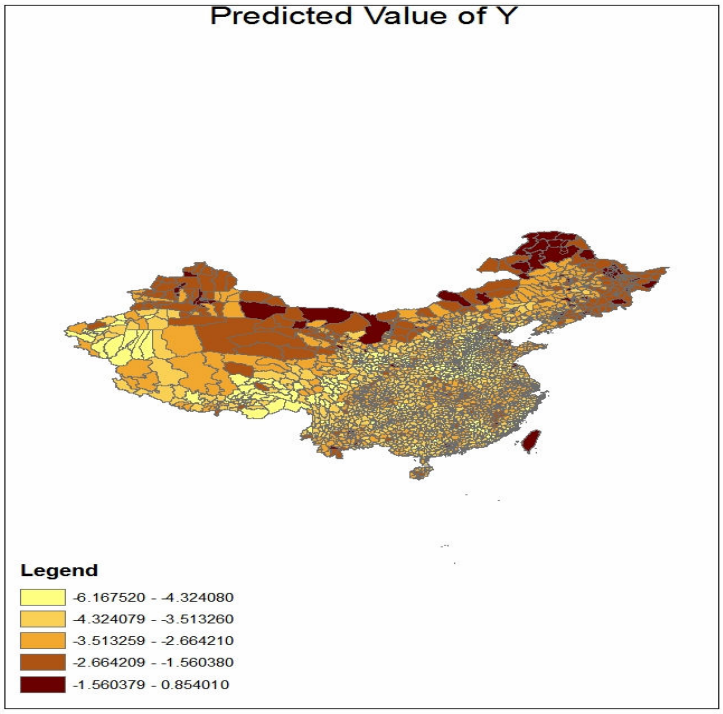


Figure d. Quantile map of predicted values by GWR.



[6] The unaddressed spatial autocorrelation by the trend surface model is evident in the residual map (Figure c) with a Moran's I of 0.3922. The areas with blue tones correspond to over-prediction, and those with red tones suggest the presence of under-prediction.

Table a. OLS regression model.

Variable	Coefficient
CONSTANT	-1.892991***
AREA/PERSON	135.2241
AGE65+	-0.0944154***
INDUSTRIAL EMPLOYMENT	-0.005847585**
LOW INCOME	0.4968673***
UNEMPLOYMENT	1.463671***
RETIRED	8.131153***
PROFESSIONAL	1.596224*
RURAL	-2.26731***

*p<0.05**p<0.01***p<0.001

Table b. Linear trend surface and quadratic trend surface model results

	Linear trend surface	Quadratic trend surface
Variable	Coefficient	Coefficient
XDD	0.0201949***	0.0156085
YDD	0.03657108***	-0.2177024***
X-squared		0.0002277282
Y-squared		0.005836357***
X*Y		-0.001294852**
CONSTANT	-6.52346***	-2.306985

*p<0.05**p<0.01***p<0.001

Table c. The results of OLS, spatial lag, and spatial error model.

Variable	OLS	Spatial lag	Spatial error
AREA/PERSON	135.2241	232.3816	1348.053*
AGE65+	-0.0944154***	-0.07607965***	-0.1054702***
RETIRED	8.131153***	5.318693***	9.173857***
INDUSTRIAL EMPLOYMENT	-0.005847585**	-0.004404226*	-0.002689092
PROFESSIONAL	1.596224*	2.438672**	2.323489**
LOW INCOME	0.4968673***	0.4825646***	0.156569
UNEMPLOYMENT	1.463671***	0.6584257***	0.9506895***
RURAL	-2.26731***	-1.979439***	-1.955786***
W_LBUY_P		0.358878***	
LAMBDA			0.5518248***
CONSTANT	-1.892991***	-0.8508667***	-1.851352***

*p<0.05**p<0.01***p<0.001

Table d. Test on structural stability.

Variable	HETEROSKEDASTIC ERROR MODEL (GROUPWISE)	SPATIAL ERROR MODEL WITH STRUCTURAL CHANGE OF DIFERENT SLOPES
STABILITY OF INDIVIDUAL COEFFICIENTS		
AREA/PERSON_0	4.673186*	0.604175
AGE65+_0	0.453698	8.286014**
RETIRED_0	2.618142	0.067878
INDUSTRIAL	6.414445*	7.827430**
EMPLOYMENT_0		
PROFESSIONAL_0	1.321763	0.001924
LOW INCOME_0	6.916243**	3.159783
UNEMPLOYMENT_0	7.503520**	4.909669*
RURAL_0	4.894723*	3.918617*
CONSTANT_0	1.975799	7.809950**
TEST ON STRUCTURAL INSTABILITY FOR 2 REGIMES		
Chow - Wald	43.211098***	29.410294***

*p<0.05**p<0.01***p<0.001

Table e. Model diagnostics of OLS, lag model, error model and spatial regime model.

	OLS	Lag	Error	regime	Regime-error
LIK	-3923.2	-3739.5	-3633.3	-3802.31	-3618.73
AIC	7864.3	7468.9	7284.5	7640.63	7273.47
SC	7920.0	7558.5	7338.2	7747.98	7380.82
DIAGNOSTICS FOR HETEROSKEDASTICITY					
B-P test	476.9	513.5 ***	726.3***		701.694306***
Spatial B-P test					-1046605172381
Wald test				125.8482***	
DIAGNOSTICS FOR SPATIAL DEPENDENCE					
M's I(error)	27.907***				
LM (ERROR)	764.31***			996.8995***	
Robust LM (error)	304.95***				
LM (LAG)	460.52***			554.2495***	
Robust LM (lag)	1.15626				
LM(SARMA)	765.47***				
LR test		367.39 ***	579.75***	174.4250***	541.5871***
LAGRANGE MULTIPLIER TEST ON SPATIAL LAG DEPENDENCE					7.538746**

*p<0.05**p<0.01***p<0.001

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