Do bigger cities contribute to economic growth in surrounding areas? Evidence from county-level data in China

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Abstract: This paper focuses on the role of city interaction in influencing local economic growth using county-level data in China. According to literature on urban and regional economics, the impacts of a high-tier city on its surrounding areas depend on the interaction of growth spillover effect and agglomeration shadow effect. The empirical evidence in this paper illustrates that higher-tier cities have positive effects on economic growth for nearby counties, suggesting the dominant growth spillover effect over agglomeration shadow effect. This analysis also reveals the negative effect of institutional barriers associated with spatial deprivation and local protectionism on the interrelationship between a higher-tiered city and its neighboring counties. The positive effect of a higher-tiered city on economic growth for the surrounding county under its jurisdiction is found to be weaker, providing empirical evidence of spatial deprivation. On the other hand, the positive link between higher-tiered city and the county nearby is found to be thinner as they belong to different provinces. This finding is consistent with local protectionism argument.

Key words: Spatial Interaction, Growth Spillover Effect, Agglomeration Shadow Effect, Local Protectionism, Spatial Deprivation

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1. Introduction

The demand from neighboring agglomeration economies on local economic growth has attracted considerable interest among economists. The growing demand in urban centers leads to non-negligible interregional spread effects on their fringe areas, which could be positive and negative: on the one hand, it may increase the market and transfer capital or knowledge in favor of neighboring areas, generating positive spillover effect (North 1955, Glaeser and Khan 2004, Rosenthal and Strange 2001). On the other hand, it may empty its neighboring areas through its strengthened competitiveness in product and labor markets, leading to agglomeration shadow effect (Krugman 1991, 1993). Thus, the impact of bigger cities on economic growth for surrounding regions depends on these two aforementioned offsetting effects. The (net) effect will be positive if the growth spillover effect domains and it will be negative if agglomeration shadow effect prevails.

Given the importance of demand from urbanized economies, we examine the impacts of higher-tiered cities on economic growth for counties in China[1]. Besides economic fundamentals, we also consider the importance of institutional barriers associated with interregional trade linkages in explaining economic growth across counties. One of these institutional barriers is local protectionism. Some studies found significant cross-provincial border effects in China (Poncent 2003, Amiti and Javorcik 2008). The border effect is partly led by protection behaviors of local governments. Different from radical reform in Eastern Europe, China's economic reform has been spread gradually across space and over time. The uneven path of economic reform provides the incentives for local governments to expand their fiscal revenue and raise their political profile through anti-market behaviors when facing fierce interregional competition. Thus, we assume that local protectionism gives rise to distortions, which prohibit growth spillover effect of higher-tiered cities on their surrounding areas. The other is spatial deprivation. China's bureaucratic control is featured as a vertical control of hierarchical system, in which the appointment, promotion and dismissal of local carders is steered by top-level government. Thus, the urban government has exerted considerable influence over county-level cadres

[1] In China, there are three different levels of administrational and jurisdictional entities: municipalities (provincial-level cities), prefecture-level cities and county-level cities. In this paper, we focus on above-county-level cities and the effects of their growth performance on surrounding areas.

under its jurisdiction. To favor residents in urban centers, they may seek for rent-seeking opportunities and deprive resources from counties towards urban areas using anti-market tools (Fang and Liu 2007). Spatial deprivation behaviors derail trade linkages between urban centers and its surrounding area by strengthening agglomeration shadow effect.

Using county-level data in China between 2000 and 2008, we construct a panel data structure to test the hypotheses above. Our analysis shows that higher-tiered cities have (net) positive impacts on economic growth for their surrounding counties, indicating the growth spillover effect prevails over agglomeration shadow effect. The result is consistent with the findings using U.S. data (Partridge et al. 2008, 2009). We also find that both local protectionism and spatial deprivation have weakened the positive (net) effect of higher-tiered cities, providing evidence of the negative role of institutional barriers identified in trade literature (Bai et al. 2004, Lu and Tao 2009).

The remainders of this paper are organized as follows: Section 2 discusses the theories and related hypotheses. In Section 3, we describe the empirical framework. In section 4, we document the data. Section 5 presents the econometric testing of the hypotheses and assesses the significance of bigger cities in determining county growth. Section 6 concludes.

2. Theories and hypotheses

Following a large literature on urban and regional economics this paper views demand from neighboring urban centers as an important determinant of local economic growth. The effect of higher-tiered cities on their surrounding areas arises from two competing forces related to interregional trade linkage. One the one hand, the trade linkage may enlarge the market and stimulate capital and knowledge transfer in favor of the neighbors. Growth in urban centers generates increase in local income, and a consequent demand for goods, involving goods producing and exported from neighboring areas. According to export-growth theory by North (1955), this may generate positive income multiplicative effects on the income of these neighbors. In addition, technical knowledge and managerial skills in urban areas can diffuse to surrounding areas when they are embodied in capital goods. For example, congestion costs, such as higher land rent, pollutions and crime, may cause some firms to relocate part of their production process to surrounding areas, which leads to positive growth spillovers to these places (Glaeser and Khan 2004). Rosenthal and Strange (2001) also find that labor market pooling in large urban centers provides benefits for firms in proximate areas. Thus, there is growth spillover effect of urban centers on its neighboring areas.

On the other hand, new economic geography theory predicts that close proximity to higher-tiered cities may give rise to agglomeration shadow effect on surrounding counties. According to Krugman (1991,1993), in the presence of trade costs, market interaction draw firms subject to increasing returns to scale towards places such that larger urban center. Workers are also attracted to the urban center with large market potential as it offers better access to final products. Eventually the cumulative process of concentration in urban center empties surroundings of industrial activities. In line with these arguments, the growth in urban areas may negatively affect their surrounding areas.

By summarizing the discussions above, we have:

Hypothesis 1: The role of higher-tiered cities on their surrounding areas is the result of the interaction of positive growth spillover effect and negative agglomeration shadow effect.

Implicit in the above hypothesis is the presence of free market and competition, in which the location choice of firms is in response to market incentives. However, in the context of China, there are some trade barriers that affect the interrelationship between urban centers and their surrounding counties. Economic reform has begun since the end of 1970s but the processes have been developed in an incremental way. The uneven path of reform processes has created some distortions which prohibit free flow of goods, services and factors across regions. Specifically, we discuss two concerns associated with regional integration: one is local protectionism, and the other spatial deprivation.

Current studies have extensively documented local protectionism at the provincial level in China. Under the fiscal decentralization reform and its consequent interregional competition, local governments seek to invest in local industries to increase their fiscal revenue and raise their political profile. They were likely to protect local enterprises from outside competition by erecting interregional barriers to trade and factor mobility. Young (2000) documented varieties forms of local protectionism in China. Poncent (2003) found amounts of cross-province border effects when she examined interregional trade data in China. Other studies provided evidence of local protectionism by investigating the trends in industrial concentration (Bai et al. 2004, Amiti and Javorcik 2008, Lu and Tao 2009). All of them suggest that local protectionism prohibit the flow of economic activities across regions. Thus, we have the following hypothesis:

Hypothesis 2: The effect of higher-tiered cities on their neighboring counties is derailed by local protectionism, which weakens the growth spillover effects.

The interrelationship between urban centers and their surrounding areas are possibly affected by spatial deprivation. According to Ades and Glaeser (1995), politics is an important factor in determining the spatial allocation of resources because spatial proximity to power increases political influence. Thus, the political power of urban population may push the government to transfer more resources to the city instead of surrounding areas. These transfers attract migrants, thus promoting growth for urban centers. In the context of China, the hierarchical system of bureaucratic control is featured as the 'top-down' model, in which the top-level government steers lower-level cadres through its stranglehold over the appointment, promotion, and dismissal of local cardres[2]. Thus the urban government has exerted considerable influence over county-level cadres, which provides rent-seeking opportunities associated with resource allocation in favor of urban center. Fang and Liu (2007) documented how urban centers deprived spatial resources from surrounding areas under their administration using multiple anti-market behaviors in China. Thus, we can assume that spatial deprivation hurts the interregional trade between urban centers and the surrounding areas under its administration. Following the discussion above, we have:

Hypothesis 3: The effect of higher-tiered cities on their neighboring counties is derailed by spatial deprivation, which strengthens agglomeration shadow effect.

3. Empirical framework

The primary idea in this paper is that the dynamics of county economic growth is conditioned on the geographic position relative to higher-tiered cities nearby. In order to guide the empirical work, we construct a specification for industrial growth across areas. The profit function for industry *j* in area *i* at time *t* is defined as

$$\pi_{ijt} = \pi(p_{ijt}, w_{ijt}, A_{ijt}), \qquad (1)$$

where p_{ijt} is the price of output, w_{ijt} is the vector of input prices, and A_{ijt} is the state of technology. According to Hotelling Lemma, the output supply is $y^s = \frac{\partial \pi}{\partial p_{ij}(p_{ij}, w_{ij}, A_{ij})}$.

Assume that the inverse demand for output is $p_{ij} = p(y_{ij}^d, H_i)$, where y_{ij}^d is the quantity of output demanded, and H_i is a set of regional characteristics that affect local demand in area *i*, such as infrastructure, market access to neighboring economies. We have the reduce-form of output in area i as follows:

$$y_{ijt} = \pi(w_{ijt}, A_{ijt}, H_{it}) \qquad (2).$$

[2] For detailed discussions on political system in China, see Tsui and Wang (2008).

Specifically, the complete specification of economic growth process for county i is thus depicted as:

$$\Delta y_{it} = \alpha_0 + \alpha_1 y_{it-1} + \boldsymbol{\beta X}_{it} + \boldsymbol{\gamma Z}_{it} + \mu_{it}, \quad (3)$$

where y_{it-1} is per capita GDP for county i in time t-1, $\boldsymbol{X}_{it}$ is the vector of demand from neighboring economies, $\boldsymbol{Z}_{it}$ is the vector of local characteristics. The regression coefficients are $\alpha_0, \alpha_1, \beta,$and γ. μ_{it} is the residual term.

One of the biggest challenges in estimation is to identify the demand from neighboring economies. In this paper, we assume the effect of external demand on a specific county is sensitive to the geographic position and tier of the proximate urban areas. Following gravity model we construct the indictor of "neighboring city demand", which is economic size of neighboring city weighted by the spatial distance[3]. The farther away a higher-tiered city and its surrounding county are, the weaker their relationship is, other characteristics being equal. In this analysis, the demand from bigger cities for county i is the cumulative effects of neighboring cities across tiers in the urban hierarchy, which evolves as follows. First, we assume there are n tiers of cities in the urban hierarchy and each consecutive higher-tier of cities is j+1,…, j+n. Then the incremental distance is the difference in the distances between places in tiers j and j+1;j+1 and j+2;, j+2 and j+3; and so on. Third, we calculate the marginal impact for demand of greater incremental distance from the previous tier for each county i as follows: $\mathrm{MES} = \mathrm{SIZE} * \mathrm{e}^{-(\mathrm{Dist})^{1/2}}$, where MES is the marginal impact, SIZE is the economic size in following tiered city and Dist is the nearest spatial distance between two consecutive higher-tier of cities. For example, the marginal impact of economic growth of greater incremental distance between places in tier j and j+1 is calculated as follows: $\mathrm{MES}_{\mathrm{j,j+1}} = \mathrm{SIZE}_{\mathrm{j+1}} * \mathrm{e}^{-(\mathrm{Dist}_{\mathrm{j,j+1}})^{1/2}}$. Finally, the effect of demand from bigger cities for location i is the sum of the marginal impacts over all tiers. Figure 1 depicts the construction of the measurement of 'neighboring city demand' across tiers for one location. There are two advantages in considering such measurements. One is that the marginal effect of neighboring cities reflects the spatial interaction across tiers in the urban hierarchy, which is ignored in previous studies (Chen et al. 2008). Second, the marginal effect of higher-tier neighbor cities is assumed to be fully exogenous to county i, avoiding endogeneity problem in some studies associated with the impacts of market potential on local economic growth

[3] Different from market potential method, we consider the effect of demand from the nearest city across tiers on county growth.

(Hanson 2005). Besides the impacts of proximity to higher-tiered cities, we also consider the effects of neighboring same-tiered counties on local economic performance. The indicator for demand for nearest same-tiered county is constructed similar to MES.

/Insert Figure 1 about here/

We select a set of control variables associated with local characteristics considering their importance as growth determinants. The control variables include local population size (POP), fiscal revenue GDP share (FISGDP), and amenities in terms of the number of hospitals per capita (AMEN).

We extend the regression specification by allowing the effect of institutional barriers to vary with the proximity to nearest cities. We do this by interacting the institutional barriers measure with the weighted economic size of the nearest higher-tiered cities. The regression equation with an interaction term is presented as the follows:

$$\Delta y_{it} = \alpha_0 + \alpha_1 y_{it-1} + \boldsymbol{\beta X}_{it} + \boldsymbol{\theta x}_{it} * Inst_{it} + \gamma \boldsymbol{Z}_{it} + \mu_{it}, \quad (4)$$

where $\boldsymbol{x}_{it}$ represents the neighboring economic performance for nearest higher-tier city, $Inst_{it}$ is a set of dummy variables for institutional barrier. In this analysis, two measures in terms of institutional barriers are taken into account. One is local protectionism. For county i, if the nearest higher-tiered city is from different provinces, $Inst_{it}$ takes the value of one, otherwise, 0. The other is spatial deprivation. To estimate the impact of spatial deprivation, $Inst_{it}$ takes the value of one if county i is contained as part of higher-tiered city, otherwise, 0.

4. Data

To calculate the variables we discussed above, we employ varieties of data sources. County-level data for the economic and amenity variables are taken from the 2001 to 2009 (for data years 2000-2008) annual volumes of *China's County Statistical Yearbook*. GDP per capita and total GDP are not available in yearbooks. But we have data on value-added for two sectors, primary (agriculture) and secondary (manufacturing). We also have data on total population size across counties. Thus county-level GDP per capita is the summation of primary and secondary value added divided by total population size.

In this paper, higher-tiered city beyond county is defined as the urbanized area (called the 'city proper') of all prefecture region. Thus, higher-tiered city in our paper contains all contiguous agglomerated urban activities around the city center, which is regularly updated over time. The data for economic performance of cities of any tier is collected from *Urban Statistical Yearbook* in corresponding years. In each volume of urban statistical yearbook, data on GDP for both city proper and the whole prefecture region are available. Due to the changes in administrative boundaries in China and consequent size of city proper, we adjust the administrative area of city proper for each prefecture region in following years based on 2000 to make the data consistent over time. For example, we exclude *Daxing*, *Huairou*, and *Pinggu*, from Beijing city proper for years 2002-2008 since three of them were consolidated into city proper in 2001. In this analysis, we classify Chinese prefecture cities into six tiers based on their nonagricultural population, small-size tiered, medium-size tiered, large-size tiered, mega tiered, super tiered, and BJ-SH tiered(See Appendix).

The spatial distance across areas are calculated from *China Administrative Regions GIS Data: 1:400,000,000, County Level 2000*. This map is composed of boundary files convering the administrative regions of China, including national, provincial, prefecture, and county levels. The temporal coverage indicates the status of China as of 31 December 2000. The data include information on geographical locations, areas, provincial names, prefecture names, and county names, and codes for each administrative division. We determine the geographical location for various levels of regions using the coordinates of its geometric center ρ associated with its latitude and longitude: $\rho = (\rho_x, \rho_y)$. In two-dimension Euclidean space, we calculate the spatial distance between two places j and j+1 as following formula: $Dist_{j,j+1} = \sqrt{(\rho_x^j - \rho_x^{j+1})^2 + (\rho_y^j - \rho_y^{j+1})^2}$.

5. Estimation results

We estimate the growth specifications above by using a panel data structure in China for 1800 counties and three periods (2000-2002, 2003-2005, and 2006-2008). There are some challenges for estimation. The first is the presence of unobserved period- and county-specific effects. The inclusion of period-specific dummy variables can account for period-specific effects, but the common methods of dealing with county-specific effects are not appropriate given the dynamic nature of growth regression. The second challenge is that some explanatory variables are likely to be jointly endogenous with county economic growth. Among them is the effects of weighted economic size for the nearest tiered city and for the same-tiered surrounding county, both of which can affect county growth of interest. Thus we need control for the biases resulting from simultaneous or reverse causation.

In this paper, we use the generalized method of moments (GMM) estimators for dynamic models of panel data introduced by Arellano and Bond (1991) and Arellano and Bover (1995). Several features of GMM estimators can be summarized. First, these estimators are based on differencing regressions or instruments to control for unobserved effects. Second, the previous observations of explanatory and lagged dependent variables are employed as instruments to deal with the likely endogeneity of the explanatory variables and the problem that the error-term is correlated with the lagged dependent variables after first differencing. In our case, the instruments include all lagged observations.

Regression results using GMM are presented in Table 1 and Table 2. Table 1 shows the results of the regression with no interaction terms, in which different groups of higher-tier cities are considered. In Column (1), we look at the incremental impacts of proximity to six tiers of bigger cities, small-size-tiered, medium-size-tiered, large-size-tiered, mega-tiered, super-tiered, and BJ-SH-tiered. The basic regression (Table 1, Col 1) shows results consistent with the previous empirical studies. The coefficients of marginal effects of bigger cities across six tiers are positive and statistically significant. This suggests that the positive role played by the proximity to higher-tiered cities, in which that growth spillover effect overcomes agglomeration shadow effect. We also find positive and significant coefficients of the impacts of same-tiered county and nearest higher-tiered cities, implying the importance of demand from neighboring areas in influencing local economic growth.

In table 1, we successively test the robustness of the results to alternative tiers of cities. Column (2) presents the marginal effects of neighboring cities of three tiers, bottom-tiered, middle-tiered, and top-tiered. We find that all of the coefficients of these three groups are positive and significant, suggesting the net positive impact of bigger cities on surrounding cities. Column (3) reports the regression results, in which only the impact of close proximity to Beijing and Shanghai is considered. The coefficient of spatial proximity is found to be positive but not statistically significant. These results (Table 1, Column 2 and 3) suggest the stability of our key results across these varied classifications of tiers of bigger cities.

/Insert Table 1 about here/

Table 2 reports the regression results with interaction terms. In column (1), we consider the interaction coefficients of the nearest higher-tier city across six tiers with local protectionism and spatial deprivation dummies, respectively. An interesting pattern of institutional barriers emerges: the coefficients for the interaction are found to be negative and statistically significant. This indicates the negative effect of institutional barriers since they derail the positive impact of bigger cities on surrounding areas. The negative coefficient of the interaction with local protectionism dummy is consistent with the hypothesis that interregional trade barrier prohibits growth spillover effects of bigger cities on surrounding areas. At the same time, the negative coefficient of the interaction with spatial deprivation supports that argument that the resource allocation in favor of urban centers strengthens agglomeration shadow effect. We have got similar findings about the negative role played by local protectionism and spatial deprivation in column (2) and (3) of Table 2, in which we look at marginal effects of bigger cities of three tiers and Beijing-Shanghai tiers, respectively.

/Insert Table 2 about here/

6. Conclusion

The rapid urbanization process in China since the beginning of economic reform has generated agglomeration economies for the whole China. In this paper, we examine the effects of bigger cities on their surrounding areas. We found that the positive role played by bigger cities in explaining economic growth for counties in China, providing evidence of the dominant growth spillover effect of demand from neighboring cities over the agglomeration shadow effect. Another finding in our paper is that two institutional barriers, local protectionism and spatial deprivation, derail the positive effect of bigger cities on surrounding counties: the former precludes growth spillover effect and the latter strengthen agglomeration effect.

Our paper contributes to the empirical studies on the role of spatial interaction on local economic growth (for example, Dobkins and Ionnides 2001, Ioannides and Overman 2004). On the other hand, our analysis has some policy implications. Among them is that market integration not only helps enhance agglomeration economies but also improve efficiency of urban system in China.

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Tables and Figures

Figure 1 Marginal impact of proximity to bigger cities (three-tier case)

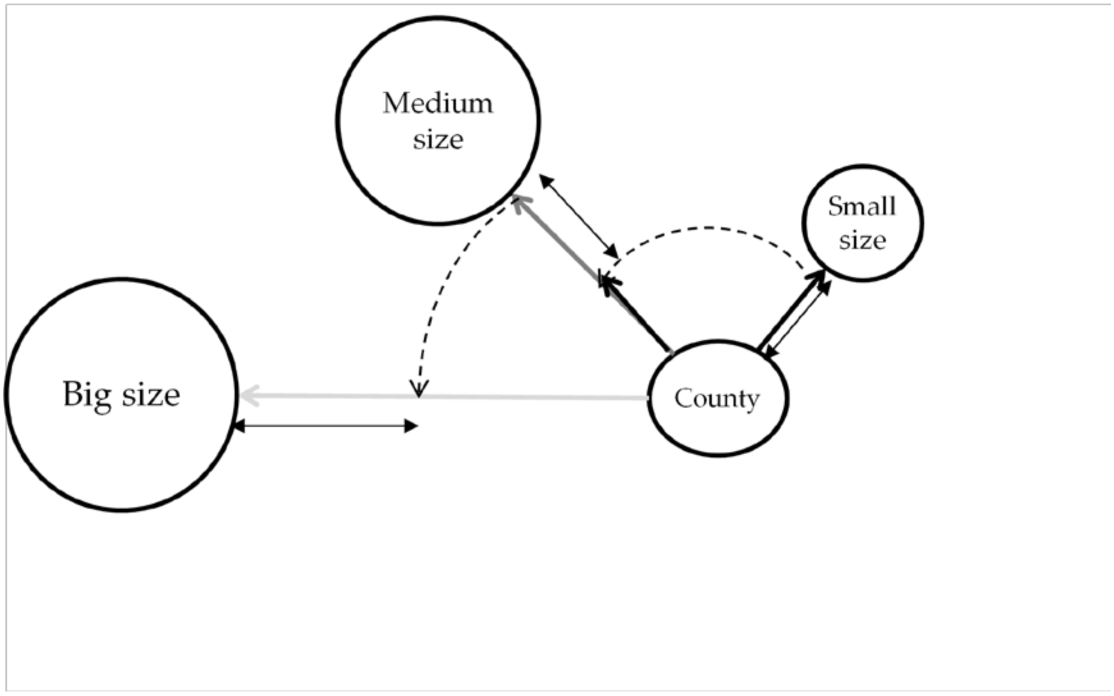

Table 1 Regression results without interaction terms

	(1)	(2)	(3)
MES_{SMALL}	666.48*		
	(358.30)		
MES_{MEDIUM}	668.36*		
	(358.35)		
MES_{LARGE}	672.25*		
	(358.16)		
MES_{MEGA}	670.06*		
	(358.28)		
MES_{SUPER}	668.03*		
	(358.37)		
MES_{BJ-SH}	622.41***		
	(348.93)		
MES_{BOTTOM}		668.46*	
		(405.38)	
MES_{MIDDLE}		670.40*	
		(405.45)	
MES_{TOP}		669.50*	
		(405.49)	
MES_{BJ-SH}			76.86
			(68.29)
MES_{COUNTY}	11.44***	11.52***	11.11***
	(8.98E-01)	(8.98E-01)	(8.88E-01)
$MES_{NEAREST}$	2.74**	2.90**	3.42**
	(1.26)	(1.31)	(1.38)
Sargan	0.49	0.53	0.54
AR(2)	0.18	0.18	0.48

***,**,* indicates significance at 1%, 5% and 10% level, respectively. Standard errors are in parentheses. Dependent variable: the change in per capita growth at the county level. The control variables, initial Log(PGDP), POP, FISGDP, AMEN are considered in the regression.

Table 2 Regression results with interaction terms

	（1）	（2）	（3）
MES_{SMALL}	722.58**		
	(348.05)		
MES_{MEDIUM}	724.37**		
	(348.07)		
MES_{LARGE}	728.64**		
	(347.59)		
MES_{MEGA}	726.30**		
	(347.88)		
MES_{SUPER}	724.21**		
	(347.98)		
$MES_{BJ\text{-}SH}$	676.55**		
	(340.88)		
MES_{BOTTOM}		730.60*	
		(400.21)	
MES_{MIDDLE}		732.44*	
		(400.25)	
MES_{TOP}		731.66*	
		(400.24)	
$MES_{BJ\text{-}SH}$			51.41
			(72.76)
MES_{COUNTY}	11.03***	11.09***	10.97***
	(8.47E-01)	(8.48E-01)	(8.45E-01)
$MES_{NEAREST}$	4.21***	4.37***	4.18***
	(1.22)	(1.24)	(1.18)
SPDEP*$MES_{NEAREST}$	-9.84E-02**	-9.71E-01*	-6.97E-01
	(4.95E-01)	(4.98E-01)	(4.85E-01)
LOPRO*$MES_{NEAREST}$	-1.52*	-1.57**	-1.12
	(7.84E-01)	(7.91E-01)	(7.56E-01)
Sargan	0.66	0.69	0.71
AR(2)	0.24	0.22	0.56

***,**,* indicates significance at 1%, 5% and 10% level, respectively. Standard errors are in parentheses. Dependent variable: the change in per capita growth at the county level. SPDEP is spatial deprivation dummy and LOPRO is local protectionism dummy. $MES_{NEAREST}$ is the weighted economic size for nearest higher-tiered city. The control variables, initial Log(PGDP), POP, FISGDP, AMEN are considered in the regression.

Appendix:

Definitions of categories of cities in China:

According to National Bureau of Statistics in China, the definitions of categories of cities in terms of the size are as follows:

BJ-SH-tiered city: Beijing and Shanghai.

Super-tiered city: a city with nonagricultural population in urban area larger than 2 million excluding Beijing and Shanghai;

Mega-tiered city: a city with nonagricultural population in urban area between 1 and 2 million;

Large-size-tiered city: a city with nonagricultural population in urban area between 0.5 and 1 million;

Medium-size-tiered city: a city with nonagricultural population in urban area smaller than 0.5 million but larger than 0.2 million;

Small-size-tiered city: a city with nonagricultural population in urban area below 0.2 million.