Intercity Traffic and Regional Economic Development: Analysis of Spatial Spillovers in Greater Bay Area in Guangdong Province

Introduction

Recently, the development of Guangdong-Hong Kong-Macao Greater Bay Area and the transport infrastructures inside are at the beginning level. It is said that an efficient and well-established transportation system will improve the whole economy's productivity due to the spillover effect (externality).

This research investigates spatial spillover effects under Guangdong in city level in terms of economic strength under the effect of transport network, discovering how transportation investment in Guangdong Province will affect the regional economic growth.

(Spatial spillover effect is assumed that one region could benefit or suffer from an infrastructure investment located in another region in which the impact is directly and normally happens between regions which have strong transport connectivity, economic linkage and with geographical proximity)

Model & Findings

Moran's I Index

$$\text{Moran's I Index} = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(Y_i-\bar{Y})(Y_j-\bar{Y})}{S^2 \sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}}$$

$$\text{where } S^2 = \frac{\sum_{i=1}^{n}(xi-\bar{x})^2}{n} \quad \text{and} \quad \bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

- Displays spatial correlation between nearby cities (Ranging from -1 to 1)
- The greater the value of index = The greater the spatial correlation between cities

Table 1 – Value of the Moran's I Index (I) of ln *GDP* from 2009-2018

Year	I	z	p	Year	I	z	p
2009	0.434***	4.351	0.000	2014	0.414***	4.173	0.000
2010	0.431***	4.338	0.000	2015	0.403***	4.062	0.000
2011	0.426***	4.296	0.000	2016	0.405***	4.076	0.001
2012	0.418***	4.22	0.000	2017	0.406***	4.091	0.001
2013	0.416***	4.184	0.000	2018	0.411***	4.124	0.001

*** the value is significant at 99% confidence level

Table 1 shows GDP of cities in the Greater Bay Area in Guangdong Province positively correlated due to spatial reasons

Accessibility index

The index is formulated as follows (Allen et.al., 1993):

$$A_i = \frac{1}{N-1}\sum_{j=1}^{N} d_{ij}$$

Where, N_i = *Number of zones*

d_{ij} = *relative accessibility of point j with respect to point i (minutes)*

If d_{ij} is defined as the travel time between cities i and j, then A_i is the average travel time between city i and another location within the targeted cities. A_i is called the median point of the network (Allen et.al., 1993). The higher the index is, the lower the accessibility.

- Displays transport accessibility of each targeted city by the weighted average of travel time of different vehicles between cities
- The smaller the value of index = The greater the accessibility of cities

Table 2 – Accessibility Index for different cities

SZ	GZ	Dongguan	Huizhou	Foshan	Zhongshan	Qingyuan	Zhuhai	Maoming	Shantou
99.25	76.875	125.125	131.25	114.5	126.875	139.25	152.625	232.375	273.375

- Table 2 shows GZ and SZ are the most accessible; ST and MZ are the least accessible

The Regression Model

The research uses four independent variables to determine economics growth and transportation efficiency:

1.Capital supply in transport sector (K)
2.Capital supply other than transport sector (O)
3.Labor participation number (L)
4.Transportation infrastructure (C)

Bases on the Production Function of Y =g (K) f (L , O) and the independent variables,

we derived the **OLS Model:**

$$\ln GDP_{it} = \alpha_0 + \beta_1 \ln K_{it} + \beta_2 \ln O_{it} + \beta_3 \ln L_{it} + \beta_4 \ln C_{it} + \delta_{it}$$

To determine spatial spillover effects, two spatial econometric models are applied.

1.The spatial lag model (SAR):

$$\ln GDP_{it} = \alpha_0 + \beta_j X_{it} + \rho \sum_{j=1}^{N} W_{ij} X_{jt} + \delta_{it}$$

2.The spatial error model (SEM):

$$\ln GDP_{it} = \alpha_0 + \beta_j X_{it} + \rho \sum_{j=1}^{N} W_{ij} \ln Y_{it} + \delta_{it}$$

Table 3 – Results of Spatial Econometric Models from 2009 to 2018

Variables	OLS panel	The SAR model			The SEM model		
		Spatial Fixation	Time-Period Fixation	Double Fixation	Spatial Fixation	Time-Period Fixation	Double Fixation
K_{it}	0.116**	0.043	-0.011***	0.074**	0.0772	-0.23***	-0.048
	(4.86)***	(1.76)***	(-0.47)***	(3.21)***	(3.46)***	(-11.13)***	(-2.33)***
O_{it}	0.433	0.196	0.073	0.133	0.203	0.064	0.129
	(28.27)***	(16.78)***	(4.81)***	(8.82)***	(17.21)***	(4.25)***	(8.37)***
L_{it}	0.184	0.093	0.031	0.087	0.106	0.022	0.084
	(16.15)***	(7.72)***	(2.53)***	(6.78)***	(8.11)***	(1.86)***	(6.42)***
C_{it}	0.093	-0.0159	-0.141	0.069	0.064	-0.176	-0.06
	(6.43)***	(-0.98)***	(-8.92)***	(4.87)***	(4.22)***	(-12.12)***	(-3.56)***
cons	4.342						
	(32.34)***						
Wln *GDP*		0.387	0.084	0.314			
		(9.21)***	(2.54)***	(7.43)***			
$W\delta_{it}$					0.512	0.062	0.28
					(12.54)***	(0.83)***	(5.76)
Adjusted R^2	0.9442	0.9918	0.9267	0.9921	0.9834	0.9387	0.9923

Noted that** and *** are significant at the significance level of 5% and 1% respectively and number in bracket is a t statistic

- **From the regression results of OLS Model**

Labor & capital supply other than transportation are the main contributors for promoting economic growth of the Greater Bay Area's cities independently and internally

Transportation factors can promote economic growth of cities internally in a less extent

- **From the regression results of the SAR model & SEM model**

Transportation factors have greater importance in promoting regional economic growth, narrowing the gap between O, L and K, C when talking about regional growth

Adjacent cities/ cities with strong economic connections will have greater spillover effect to each other under efficient and accessible transportation system

- **Conclusion**

1.Economic Growth of a city depends mostly on labor & capital supply other than transportation
2.An efficient and accessible transportation system attaches greater importance on

Growth when referring to regional economic development:
3.Cities adjacent each other/ with strong economic links will be more likely benefited under better transportation system