Strategic Interaction in Urban Infrastructure Finance: A Spatial Panel Econometric Analysis of Chinese Prefecture-Level Cities

Can Chen, Assistant Professor, Florida International University

Kenneth A. Kriz, Professor, University of Illinois at Springfield

Shuanglin Lin, Professor, University of Nebraska at Omaha and Peking University

Research Motivation I

- **Incorporate strategic interaction into the study of Chinese urban infrastructure finance**

- **Test the notion that cities respond strategically to the policy decisions of other cities in the policy context of urban infrastructure development**

  ▫ Strategic interaction among governments has been the focus of substantial research interests (tax setting, welfare spending)

  ▫ Few studies analyze the strategic interaction of infrastructure investment (Case et al. 1993; Bruce et al. 2007).

  ▫ Extant infrastructure finance literature tends to ignore infrastructure maintenance expenditures, which is also a key component of urban infrastructure spending (Chen 2016; Tong et al. 2018).

Research Motivation II

- **Disentangle the possible sources of strategic interaction in Chinese urban infrastructure spending**

  - Which mechanism drives the spatial interactions?
    - Expenditure Externality or Spillover
    - Expenditure Competition
    - Yardstick Competition
    - Common Unobserved Shock in the Error Terms?

Literature review I

- **Chinese Urban Infrastructure Finance**
  - Historical evolution of Chinese institutions and policies on urban infrastructure finance
    - Chan 1998; Wu 1999; Zhao and Cao 2011; Wang et al. 2011; Zhan, de Jong, and de Bruijn 2018
  - The level and development of urban infrastructure provision
    - Chan 1998; Wu 1999; Lin 2016
  - Models and revenue composition of urban infrastructure finance
    - Zhao & Cao 2011; Wang et al. 2011; Su and Zhao 2007
  - Determinants of urban infrastructure investment
    - **Yu et al. 2011**; Tong et al. 2018; Qiu, Xu, and Li 2018

Literature review II

- **Strategic Interaction in Public Finance (Brueckner 2003)**
  - Spillover Models
    - The first type models strategic interaction as a function of "spillovers" of decisions from other jurisdictions (Case et al. 1993)
    - A second type is the "yardstick competition" model. Voters in a jurisdiction look at public service and tax levels in other jurisdictions to help judge whether their government is using its resources efficiently (Besley and Case 1995)

  - Resource-Flow Models
    - Jurisdictions are not directly affected by the decisions of other jurisdictions but must compete for a mobile resource
    - Tax competition (Beck 1983; Wilson 1986; Ladd 1992)
    - Welfare competition (Saavedra 2000; Volden 2002)

Research Questions

- *Do Chinese city governments behave strategically in making both infrastructure capital and maintenance spending decisions?*

- *What are the potential sources of strategic interaction of urban infrastructure investment (e.g., expenditure competition, yardstick competition, or expenditure spillovers)?*

Model Specification

The reduced urban infrastructure spending function for city *i* is as follows:

$$I_i = R\left(I_{-i}, X_i\right)$$

The baseline spatial econometric is specified as follows:

$$Y_{it} = \rho \sum_{j=1}^{N} w_{ij}\, Y_{jt} + X_{it}\beta + \omega_i + \lambda_t + \varepsilon_{it}$$

$$\varepsilon_{it} = \gamma \sum_{j=1}^{N} W_{ij}\, v_{it} + u_{it}$$

The inverse distance-based weighting matrix is preferred weighting scheme

$$w_{ij} = \frac{1}{d_{ij}}$$

Unit of Analysis

- **Unit: Chinese 277 prefecture-level cities**

- **Time Period: 2001 and 2012 (twelve-year panel data).**
  - (1) ensuring the total investment covered the same municipal infrastructure sectors over time
  - (2) ensuring the availability of data.

- **Total Observations: 3324**

Data and Variables

Table 1. Variable Definition and Data Sources

Variables	Description	Mean	SD	Min	Max	Data Sources
Dependent Variables						
Total Urban Infrastructure Spending	Total annual fixed assets investment in urban infrastructure (real per capita) Chinese Yuan	331	743	0.66	19463	China's Urban Construction Statistical Yearbook
Infrastructure Capital Spending	Total annual fixed assets investment in urban infrastructure (real per capita) Chinese Yuan	199	529	0.5	19380	China's Urban Construction Statistical Yearbook
Infrastructure Maintenance Spending	Total annual maintenance expenditure in urban infrastructure (real per capita) Chinese Yuan	83	242	0.2	6155	China's Urban Construction Statistical Yearbook
Independent Variables						
Public Demand						
Population Density	Total city population divided by total land area (persons per square kilometer)	412	364	4	11564	China City Statistical Yearbook
Urbanization	The share of people living in urban area	0.11	0.03	0.09	0.43	China City Statistical Yearbook
Urban Household Income	Urban household income (real per capita) Chinese Yuan	12577	6675	1881	164741	China City Statistical Yearbook
Urban-Rural Income Disparity	Ratio of urban household income divided by rural household income	2.71	0.84	0.33	28.66	China City Statistical Yearbook
Government Supply						
Economic Development	Real GDP per capita (Chinese Yuan)	22069	19894	1394	183505	China City Statistical Yearbook
% Own-Source Revenue	Ratio of city own revenue sources in total city revenue	0.49	0.22	0.037	0.94	China City Statistical Yearbook
Fiscal Deficit	(General fiscal expenditure minus general fiscal revenues) divided by total population	-0.12	0.16	-4.8	0.15	China City Statistical Yearbook
Political Factors						
Party Secretary's Tenure	Prefectural party secretary's accumulated year in office by the end of that year	1.8	1.7	0.5	9	The Chinese Political Elite Database
Party Secretary's Distance to Retirement	60 minus a prefectural party secretary's age	8.5	3.79	0	21	The Chinese Political Elite Database

Descriptive Exploration of Spatial Autocorrealtion in Urban Infrastructure Spending I: The Global Moran's I Statistics

Table 2. Global Moran's I Statistics Based on the Cross-Sectional Data
(On Average 2001-2012)

	χ^2 test	p-Value for Model Test
Total Infrastructure Expenditure Per Capita	chi2(1) =48.11	Prob > chi2 =0.0000
Infrastructure Capital Expenditure Per Capita	chi2(1) =37.44	Prob > chi2 = 0.0000
Infrastructure Maintenance Expenditure Per Capita	chi2(1) =31.15	Prob > chi2 = 0.0000

Descriptive Exploration of Spatial Autocorrealtion in Urban Infrastructure Spending II: The Thematic Maps
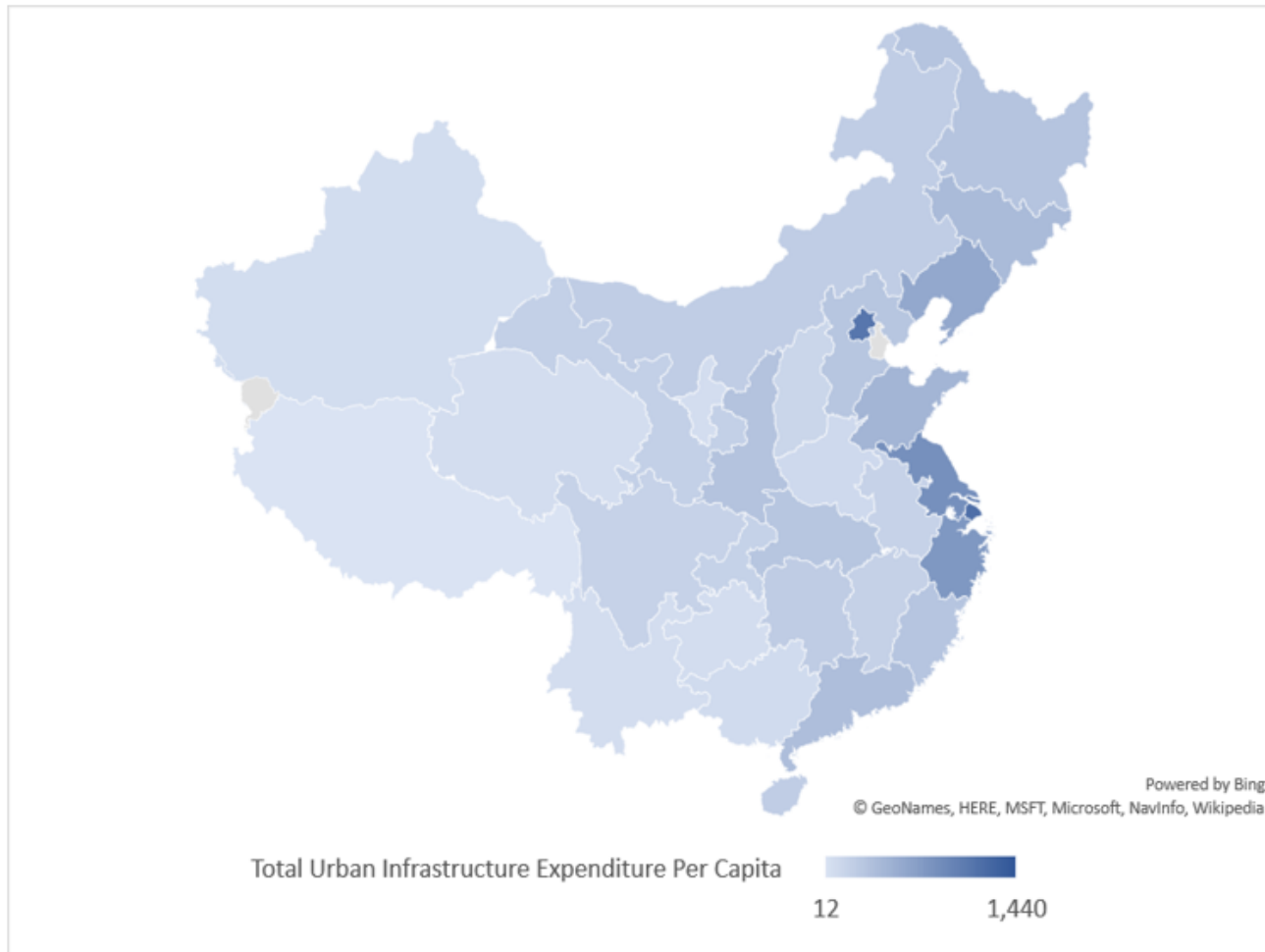

Figure 1. Average City Infrastructure Expenditure Per Capita During 2001-2012
Source: *China's Urban Construction Statistical Yearbook*

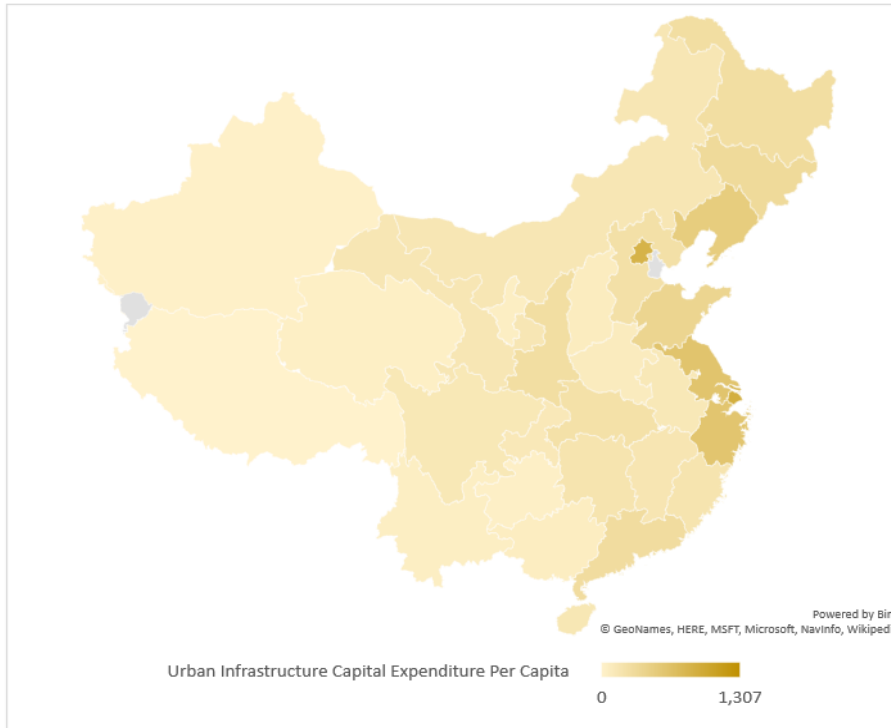## Descriptive Exploration of Spatial Autocorrealtion in Urban Infrastructure Spending II: The Thematic Maps

Figure 2. Average City Infrastructure Capital Expenditure Per Capita During 2001-201
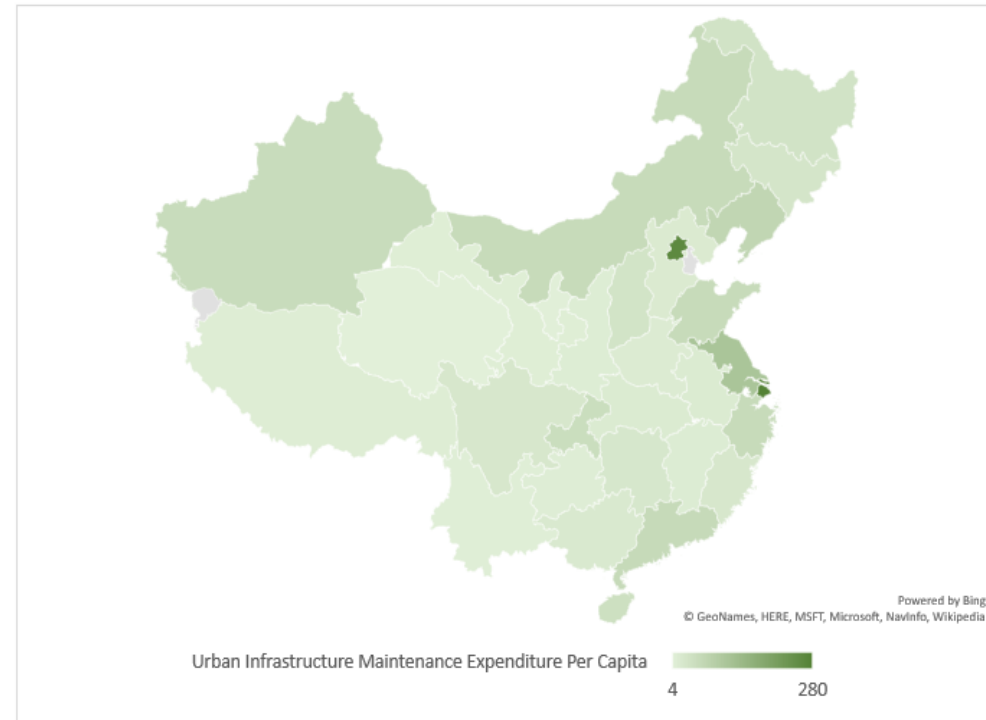Source: *China's Urban Construction Statistical Yearbook*

Figure 3. Average City Infrastructure Maintenance Expenditure Per Capita During 2001-2012
Source: *China's Urban Construction Statistical Yearbook*

Table 3. Baseline Spatial Panel Regression Results

Variables	Model 1	Model 2	Model 3
	Total Infra Exp PC	Capital Exp PC	Maintenance Exp PC
Ln Real GDP Per Capita	0.287***	0.549***	0.217*
	(0.088)	(0.119)	(0.117)
Ln Urban Household Income	0.310	0.340	0.639**
	(0.189)	(0.253)	(0.249)
Ln Pop Density	-0.321***	-0.438***	-0.206
	(0.123)	(0.166)	(0.162)
Urbanization	-1.841	1.971	-6.497***
	(1.354)	(1.823)	(1.777)
Urban and Rural Income Inequality	-0.042	-0.051	-0.092**
	(0.034)	(0.045)	(0.044)
Fiscal Deficit	-0.989***	-1.456***	-0.767***
	(0.124)	(0.168)	(0.165)
% of Own-Source Revenue	0.046	0.042	0.024
	(0.08)	(0.110)	(0.110)
Party Secretary's Tenure	0.004	0.001	0.020*
	(0.008)	(0.01)	(0.012)
Party Secretary's Time to Retirement	-0.002	-0.005	0.003
	(0.005)	(0.006)	(0.006)
Time Trend	-0.056**	-0.142***	-0.039
	(0.025)	(0.032)	(0.034)
W × Total Infra Exp Per Capita	0.535***		
	(0.190)		
Error_Total Infra Exp Per Capita	0.592***		
	(0.181)		
W × Ln Capital Exp Per Capita		0.766***	
		(0.113)	
Error_Capital Exp Per Capita		0.581***	
		(0.178)	
W × Ln Maintenance Exp Per Capita			0.285*
			(0.159)
Error_Ln Maintenance Exp Per Capita			0.852***
			(0.055)
Constant	0.756***	1.017***	0.994***
	(0.009)	(0.013)	(0.013)
R-Squares	0.2715	0.3668	0.3752
Observations	3,324	3,324	3,324
Number of groups	277	277	277

Table 4. Spatial Panel Regression Results for Different Regions of China

Variables	The Eastern Region			The Middle Region			The Western Region		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	Total Infra Exp PC	Capital Exp PC	Maintenance Exp PC	Total Infra Exp PC	Capital Exp PC	Maintenance Exp PC	Total Infra Exp PC	Capital Exp PC	Maintenance Exp PC
Ln Real GDP Per Capita	0.440***	0.703***	0.261	0.594***	0.569*	0.911***	-0.205	-0.122	-0.077
	(0.146)	(0.207)	(0.213)	(0.231)	(0.310)	(0.296)	(0.144)	(0.189)	(0.198)
Ln Urban Household Income	-0.738***	-1.007***	0.121	-0.195	0.0004	0.066	1.998***	2.480***	1.844***
	(0.261)	(0.363)	(0.420)	(0.367)	(0.495)	(0.473)	(0.428)	(0.564)	(0.594)
Ln Pop Density	-0.320**	-0.557***	-0.117	-0.300	-0.199	-0.239	-0.653**	-0.544	-0.599
	(0.132)	(0.188)	(0.182)	(0.450)	(0.601)	(0.575)	(0.316)	(0.414)	(0.435)
Urbanization	-0.222	4.507**	-6.097***	-13.88**	-9.582	-23.30***	-5.796	-11.43	-1.009
	(1.330)	(1.892)	(1.773)	(7.008)	(9.371)	(8.963)	(6.168)	(8.057)	(8.491)
Urban. Rural Income Inequality	0.253**	0.152	0.054	0.079	-0.011	-0.014	-0.184***	-0.229***	-0.189***
	(0.110)	(0.153)	(0.181)	(0.096)	(0.129)	(0.124)	(0.050)	(0.066)	(0.070)
Fiscal Deficit	-1.287***	-1.812***	-1.374**	-1.440***	-2.872***	0.655	-0.679***	-1.056***	-0.518**
	(0.419)	(0.591)	(0.643)	(0.520)	(0.705)	(0.681)	(0.156)	(0.205)	(0.215)
% Own-Source Revenue	0.401**	0.476*	0.586*	0.191	0.413*	-0.620***	-0.228*	-0.500***	0.083
	(0.189)	(0.264)	(0.320)	(0.162)	(0.219)	(0.209)	(0.136)	(0.179)	(0.187)
Secretary's Tenure	0.017	0.017	0.046**	-0.0001	0.002	-0.021	0.001	5.40e-05	0.032
	(0.013)	(0.019)	(0.018)	(0.015)	(0.020)	(0.019)	(0.018)	(0.023)	(0.024)
Secretary's Time to Retirement	-0.009	-0.016	-0.001	0.0003	-0.006	-0.004	0.0004	0.005	0.016
	(0.007)	(0.010)	(0.009)	(0.008)	(0.010)	(0.010)	(0.010)	(0.014)	(0.014)
Time Trend	0.012	-0.019	0.036	-0.017	-0.115	-0.035	-0.098*	-0.173**	-0.068
	(0.029)	(0.039)	(0.057)	(0.057)	(0.077)	(0.074)	(0.054)	(0.073)	(0.075)
W × Total Infra Exp	0.807***			0.502***			-0.363		
	(0.052)			(0.124)			(0.243)		
Error. Total Infra Exp	-0.296*			0.564***			0.743***		
	(0.179)			(0.118)			(0.079)		
W × Ln Capital Exp		0.886***			0.724***			-0.419**	
		(0.030)			(0.078)			(0.210)	
Error. Capital Exp		-0.396**			0.684***			0.881***	
					(0.090)			(0.033)	
W × Ln Maintenance Exp			-0.187			0.578***			-0.190
			(0.167)			(0.114)			(0.246)

Table 5. Basic Spatial Panel Regression Results (Alternative Dependent Variables)

Variables	Model 1	Model 2	Model 3
	Total Infra Exp Per km^2	Capital Exp Per km^2	Maintenance Exp Per km^2
Ln Real GDP Per Capita	0.323***	0.585***	0.250*
	(0.089)	(0.119)	(0.117)
Ln Urban Household Income	0.322*	0.374	0.664***
	(0.189)	(0.254)	(0.249)
Ln Pop Density	0.709***	0.556***	0.785***
	(0.124)	(0.166)	(0.162)
Urbanization	-1.900	1.968	-6.430***
	(1.365)	(1.825)	(1.776)
Urban and Rural Income Inequality	-0.046	-0.057	-0.097**
	(0.034)	(0.045)	(0.044)
Fiscal Deficit	-0.606***	-1.069***	-0.376**
	(0.126)	(0.169)	(0.165)
% of Own-Source Revenue	0.055	0.030	0.009
	(0.083)	(0.111)	(0.110)
Party Secretary's Tenure	0.005	0.001	0.020*
	(0.009)	(0.01)	(0.012)
Party Secretary's Time to Retirement	-0.002	-0.005	0.003
	(0.005)	(0.006)	(0.006)
Time Trend	-0.051**	-0.142***	-0.036
	(0.025)	(0.032)	(0.034)
W × Total Infra Exp Per Capita	0.483***		
	(0.172)		
Error_Total Infra Exp Per Capita	0.635***		
	(0.142)		
W × Ln Capital Exp Per Capita		0.737***	
		(0.144)	
Error_Capital Exp Per Capita		0.631***	
		(0.188)	
W × Ln Maintenance Exp Per Capita			0.295*
			(0.159)
Error_Ln Maintenance Exp Per Capita			0.844***
			(0.058)
Constant	0.762***	1.019***	0.994***
	(0.010)	(0.013)	(0.013)
R-Squares	0.1561	0.459	0.2058
Observations	3,324	3,324	3,324
Number of groups	277	277	277

Table 6. Spatial Panel Durbin Regression Results

Variables	Model 1	Model 2	Model 3
	Total Infra Exp	Capital Exp	Maintenance Exp
Ln Real GDP Per Capita	0.306***	0.571***	0.249**
	(0.089)	(0.120)	(0.117)
Ln Urban Household Income	0.396**	0.389	0.739***
	(0.185)	(0.251)	(0.243)
Ln Pop Density	-0.342***	-0.473***	-0.197
	(0.123)	(0.166)	(0.162)
Urbanization	-1.284	2.904	-6.781***
	(1.364)	(1.836)	(1.790)
Urban_Rural Income Inequality	-0.050	-0.048	-0.104**
	(0.033)	(0.045)	(0.044)
Fiscal Deficit	-1.001***	-1.412***	-0.836***
	(0.126)	(0.169)	(0.166)
% of Own-Source Revenue	0.040	0.010	-0.032
	(0.088)	(0.119)	(0.116)
Party Secretary's Tenure	0.003	0.0003	0.019
	(0.009)	(0.012)	(0.012)
Party Secretary's Time to Retirement	-0.002	-0.006	0.002
	(0.005)	(0.006)	(0.006)
W × Ln Real GDP Per Capita	0.212	-0.086	0.021
	(0.680)	(0.935)	(0.838)
W × Ln Urban Household Income	-1.267	-1.611	0.304
	(0.901)	(1.244)	(1.132)
W × Ln Pop Density	-0.720	0.845	0.147
	(1.677)	(2.359)	(2.106)
W × Urbanization	53.88***	73.94***	10.11
	(16.71)	(23.20)	(21.20)
W × Urban_Rural Income Inequality	0.587**	0.250	0.658*
	(0.285)	(0.394)	(0.364)
W × Fiscal Deficit	-2.178**	-4.841***	4.195***
	(1.020)	(1.521)	(1.329)
W × % Own-Source Revenue	-0.087	0.032	0.500
	(0.383)	(0.587)	(0.487)
W × Party Secretary's Tenure	0.008	-0.031	-0.014
	(0.062)	(0.089)	(0.077)
W × Party Secretary's Time to Retirement	-0.070*	-0.128**	-0.047
	(0.039)	(0.052)	(0.048)
W ×Total Infra Exp Per Capita	0.720***		
	(0.010)		
Error_Total Infra Exp Per Capita	0.244		
	(0.202)		
W × Ln Capital Exp Per Capita		0.803***	
		(0.062)	
Error_Capital Exp Per Capita		0.361**	
		(0.159)	
W × Ln Maintenance Exp Per Capita			0.791***
			(0.060)

Further Results Checks: Account for The Dynamic Effects of Infra Investment

Table 7. Dynamic Spatial Panel Regression Results

Variables	Model 1 Total Infra Exp PC	Model 2 Capital Exp PC	Model 3 Maintenance Exp PC
Ln Total Infra Exp Per Capita (One-Year Lag)	0.151*** (0.016)		
Ln Capital Exp Per Capita (One-Year Lag)		0.185*** (0.017)	
Ln Maintenance Exp Per Capita (One-Year Lag)			0.136*** (0.017)
Ln Real GDP Per Capita	0.260*** (0.087)	0.496*** (0.117)	0.192* (0.115)
Ln Urban Household Income	0.236 (0.186)	0.245 (0.248)	0.482* (0.247)
Ln Pop Density	-0.328*** (0.122)	-0.358** (0.163)	-0.213 (0.161)
Urbanization	-1.801 (1.331)	1.365 (1.785)	-6.339*** (1.759)
Urban_Rural Income Inequality	-0.025 (0.033)	-0.029 (0.044)	-0.066 (0.044)
Fiscal Deficit	-0.864*** (0.124)	-1.217*** (0.166)	-0.684*** (0.164)
% Own-Source Revenue	-0.010 (0.082)	-0.036 (0.110)	-0.032 (0.109)
Party Secretary's Tenure	0.003 (0.008)	-0.0006 (0.012)	0.017 (0.012)
Party Secretary's Time to Retirement	-0.001 (0.005)	-0.003 (0.006)	0.003 (0.006)
Time Trend	-0.031 (0.025)	-0.104*** (0.033)	-0.020 (0.034)
W × Total Infra Exp Per Capita	0.290** (0.145)		
Error_Total Infra Exp Per Capita	0.791*** (0.064)		
W × Ln Capital Exp Per Capita		0.603*** (0.144)	
Error_Capital Exp Per Capita		0.737*** (0.112)	
W × Ln Maintenance Exp Per Capita			0.272* (0.155)
Error_Ln Maintenance Exp Per Capita			0.848*** (0.054)

Disentangling the Sources of Strategic Interaction in Chinese Urban Infra Finance

Table 8. Spatial Panel Estimation Results for the Yardstick Competition Model
(The Political Cycle of The Provincial Communist Party Congress)

Variable	Model 1 Total Infra Exp PC	Model 2 Capital Exp PC	Model 3 Maintenance Exp PC
Pre-One-year Provincial Communist Party Congress	-0.499***	-0.486***	-0.185
	(0.192)	(0.192)	(0.193)
Pre-One-year Provincial Communist Party Congress × Wy	0.091***	0.083*	0.030
	(0.031)	(0.044)	(0.049)
Current year Provincial Communist Party Congress	-0.452***	-0.641***	0.006
	(0.125)	(0.173)	(0.190)
Current year Provincial Communist Party Congress × Wy	0.080***	0.123***	-0.012
	(0.030)	(0.043)	(0.050)
Post One-Year Provincial Communist Party Congress	-0.275**	-0.520***	0.347*
	(0.133)	(0.185)	(0.200)
Post One-year Provincial Communist Party Congress × Wy	0.050	0.089**	-0.077
	(0.031)	(0.044)	(0.051)
Ln Real GDP Per Capita	0.550	0.595	0.299
	(0.083)	(0.113)	(0.113)
Ln Pop Density	-0.290**	-0.403**	-0.180
	(0.123)	(0.165)	(0.162)
Urban and Rural Income Inequality	-0.004	-0.015	-0.019
	(0.026)	(0.035)	(0.034)
Fiscal Deficit	-1.038***	-1.529***	-0.789***
	(0.121)	(0.165)	(0.165)
Urbanization	-1.640	2.180	-6.333***
	(1.353)	(1.818)	(1.776)
Party Secretary's Tenure	0.005	0.001	0.0210*
	(0.009)	(0.012)	(0.012)
Party Sectary's Time to Retirement	-0.003	-0.006	0.003
	(0.005)	(0.006)	(0.006)
% Own-Source Revenue	0.111	0.120	0.060
	(0.078)	(0.108)	(0.111)
Time Trend	-0.044***	-0.120***	0.025
	(0.015)	(0.019)	(0.024)
W × Total Infra Exp Per Capita	0.719***		
	(0.065)		
Error, Total Infra Exp Per Capita	0.124		
	(0.162)		
W × Ln Capital Exp Per Capita		0.842***	
		(0.046)	
Error, Capital Exp Per Capita		0.308**	
		(0.148)	
W × Ln Maintenance Exp Per Capita			0.304*
			(0.171)
Error, Ln Maintenance Exp Per Capita			0.841***
			(0.063)
Constant	0.754***	1.014***	0.994***

Table 9. Spatial Panel Estimation Results for the Yardstick Competition Model
(The Political Cycle of City Party Secretary's Tenure in Office)

Variables	Model 1 Total Infra Exp PC	Model 2 Capital Exp PC	Model 3 Maintenance Exp PC
Party Secretary's Tenure First Year	-0.267** (0.133)	-0.0851 (0.173)	-0.158 (0.164)
Party Secretary's Tenure First Year × Wy	0.0519* (0.0279)	0.0212 (0.0356)	0.0252 (0.0332)
Party Secretary's Tenure Second Year	0.100 (0.147)	0.182 (0.195)	-0.0151 (0.186)
Party Secretary's Tenure Second Year × Wy	-0.0233 (0.0342)	-0.0364 (0.0447)	-0.00243 (0.0421)
Ln Real GDP Per Capita	0.326*** (0.0845)	0.593*** (0.115)	0.297*** (0.113)
Ln Pop Density	-0.310** (0.123)	-0.424** (0.166)	-0.190 (0.162)
Urban and Rural Income Inequality	-0.00443 (0.0261)	-0.0120 (0.0352)	-0.0183 (0.0345)
Fiscal Deficit	-1.726 (1.353)	2.085 (1.820)	-6.304*** (1.777)
Urbanization	-1.006*** (0.123)	-1.474*** (0.167)	-0.789*** (0.165)
Party Secretary's Tenure	-0.0101 (0.0190)	0.000650 (0.0256)	0.00745 (0.0251)
Party Sectary's Time to Retirement	-0.00248 (0.00471)	-0.00545 (0.00634)	0.00307 (0.00617)
% Own-Source Revenue	0.0533 (0.0798)	0.0550 (0.109)	0.0406 (0.110)
Time Trend	-0.0356** (0.0179)	-0.110*** (0.0207)	0.0230 (0.0242)
W × Total Infra Exp Per Capita	0.653*** (0.140)		
Error, Total Infra Exp Per Capita	0.424** (0.216)		
W × Ln Capital Exp Per Capita		0.792*** (0.0927)	
Error, Capital Exp Per Capita		0.532*** (0.175)	
W × Ln Maintenance Exp Per Capita			0.307* (0.164)
Error, Ln Maintenance Exp Per Capita			0.843*** (0.0599)

Table 10. Spatial Panel Estimation Results for the Resource-Flow Model
(Compete for the Mobile Resource—Foreign Direct Investment)

Variables	Model 1 Total Infra Exp PC	Model 2 Capital Exp PC	Model 3 Maintenance Exp PC
FDI Above Median × Wy	0.032**	0.025	0.049**
	(0.016)	(0.022)	(0.022)
Ln Real GDP Per Capita	0.312***	0.584***	0.277**
	(0.085)	(0.115)	(0.113)
Ln Pop Density	-0.312**	-0.428***	-0.189
	(0.123)	(0.166)	(0.162)
Urban_Rural Income Inequality	-0.007	-0.013	-0.019
	(0.026)	(0.035)	(0.034)
Fiscal Deficit	-1.838	1.986	-6.435***
	(1.354)	(1.822)	(1.778)
Urbanization	-1.025***	-1.485***	-0.807***
	(0.124)	(0.168)	(0.165)
Party Secretary's Tenure	0.004	0.0013	0.020*
	(0.009)	(0.012)	(0.012)
Party Secretary's Time to Retirement	-0.002	-0.005	0.003
	(0.005)	(0.006)	(0.006)
% Own-Source Revenue	0.055	0.053	0.040
	(0.081)	(0.110)	(0.110)
Time Trend	-0.031*	-0.109***	0.024
	(0.018)	(0.021)	(0.024)
W × Total Infra Exp Per Capita	0.608***		
	(0.168)		
Error_Total Infra Exp Per Capita	0.499**		
	(0.207)		
W × Ln Capital Exp Per Capita		0.774***	
		(0.111)	
Error_Capital Exp Per Capita		0.572***	
		(0.181)	
W × Ln Maintenance Exp Per Capita			0.332*
			(0.184)
Error_Ln Maintenance Exp Per Capita			0.825***
			(0.076)
Constant	0.756***	1.017***	0.005***

Table 11. Spatial Panel Estimation Results for the Resource-Flow Model
(Compete for the Mobile Resource—Industrial Firms)

Variables	Model 1 Total Infra Exp PC	Model 2 Capital Exp PC	Model 3 Maintenance Exp PC
Industry Outputs Above Median × Wy	-0.006 (0.013)	-0.003 (0.018)	0.020 (0.017)
Ln Real GDP Per Capita	0.330*** (0.086)	0.594*** (0.116)	0.283** (0.113)
Ln Pop Density	-0.313** (0.123)	-0.428*** (0.166)	-0.187 (0.162)
Urban_Rural Income Inequality	-0.007 (0.026)	-0.012 (0.035)	-0.020 (0.034)
Fiscal Deficit	-1.763 (1.354)	2.069 (1.822)	-6.231*** (1.777)
Urbanization	-1.008*** (0.124)	-1.475*** (0.167)	-0.783*** (0.165)
Party Secretary's Tenure	0.004 (0.009)	0.001 (0.012)	0.021* (0.012)
Party Secretary's Time to Retirement	-0.002 (0.005)	-0.005 (0.006)	0.003 (0.006)
% Own-Source Revenue	0.055 (0.081)	0.054 (0.109)	0.043 (0.110)
Time Trend	-0.029 (0.0183)	-0.109*** (0.021)	0.0261 (0.024)
W × Total Infra Exp Per Capita	0.574*** (0.181)		
Error_Total Infra Exp Per Capita	0.551*** (0.195)		
W × Ln Capital Exp Per Capita		0.782*** (0.102)	
Error_Capital Exp Per Capita		0.554*** (0.178)	
W × Ln Maintenance Exp Per Capita			0.299* (0.158)
Error_Ln Maintenance Exp Per Capita			0.849*** (0.056)

Conclusion

- **Chinese city infrastructure expenditures are significantly and positively affected by the action of neighboring cities**

- **Strategic interaction is stronger in infrastructure capital investment than maintenance expenditure**
  - Capital projects usually receive high levels of public visibility and attention (Chen, 2016; Walden and Eryuruk, 2012)

- **Regional difference of strategic interaction in urban infra finance**
  - Capital expenditures (stronger interaction in the eastern area)
  - Maintenance expenditure (occurs only in the middle area)

- **Strong evidence of Yardstick Competition**
  - During and one-year before the PCRC
  - The first year after the city party secretary taking office

- **Weak and limited evidence of Expenditure Competition**