Major factors in the spatial-temporal evolution of a gateway's hinterland: A case study for Shanghai, China

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Outline

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1: Introduction

Gateway-port is important for:

1. International trade of its hinterland
   - For the traders, selecting a port almost implies the transportation cost and time of the shipment.
2. Economic development of the hosting community
   - Direct and indirect economic impacts, jobs, secondary benefits.

The changes

in the gateway-hinterland relationship

- Increasing demand in international trade
  - Enables economies-of-scale in maritime transportation
- More ports
  - More choices for the shippers in the hinterland
- Better land transportation facility
  - Decreases the land transportation cost for the same distance.
- Hinterland changes from EXCLUSIVE to OVERLAP

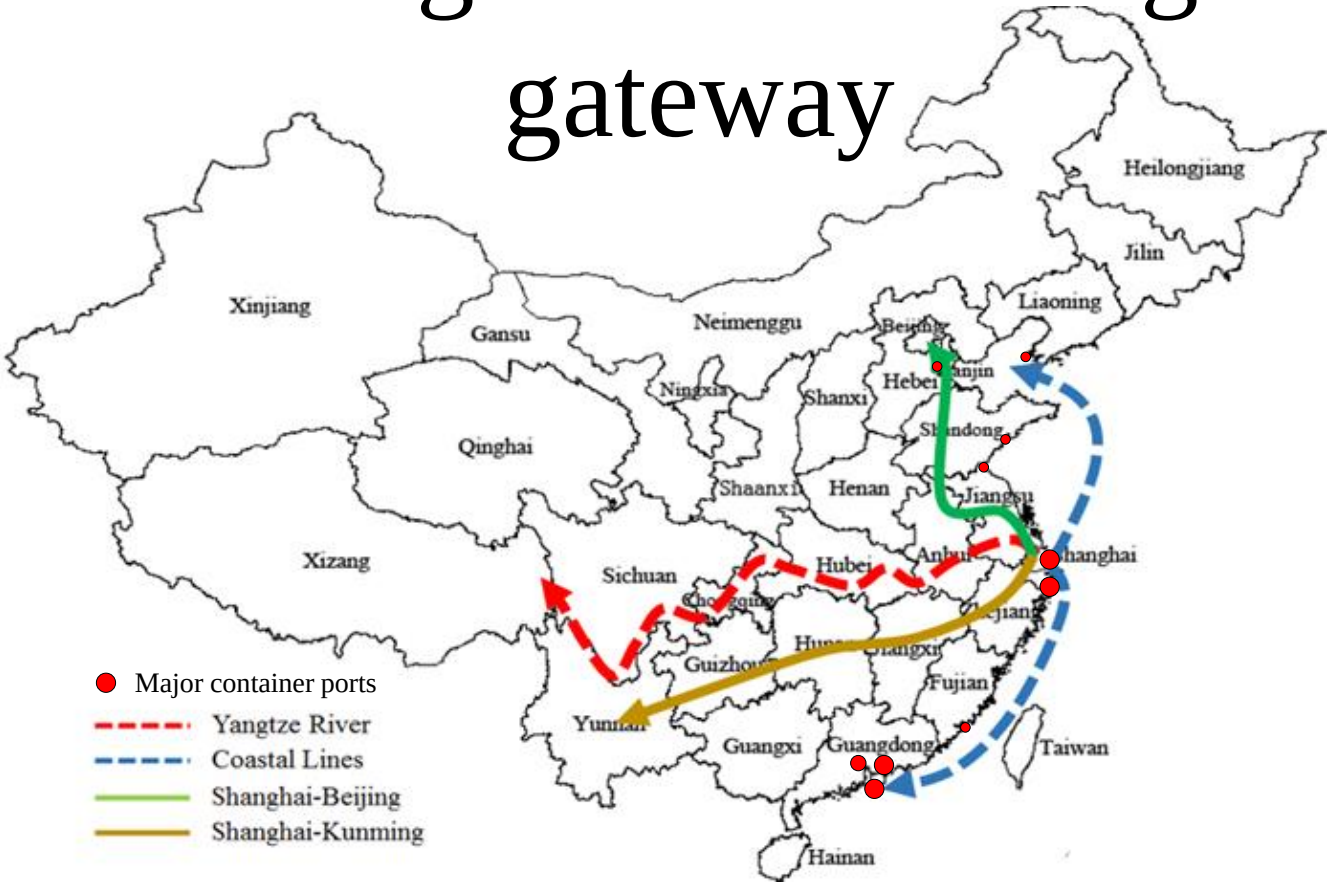
Problem

- How to maintain the attractiveness of a port to its hinterland?
  - Increasing rail connection to its hinterland?
  - Increasing road capacity?
  - Attract FDI?
  - ……?
- What are the important factors that determines the attractiveness of a port to its hinterland?

The research and its significance

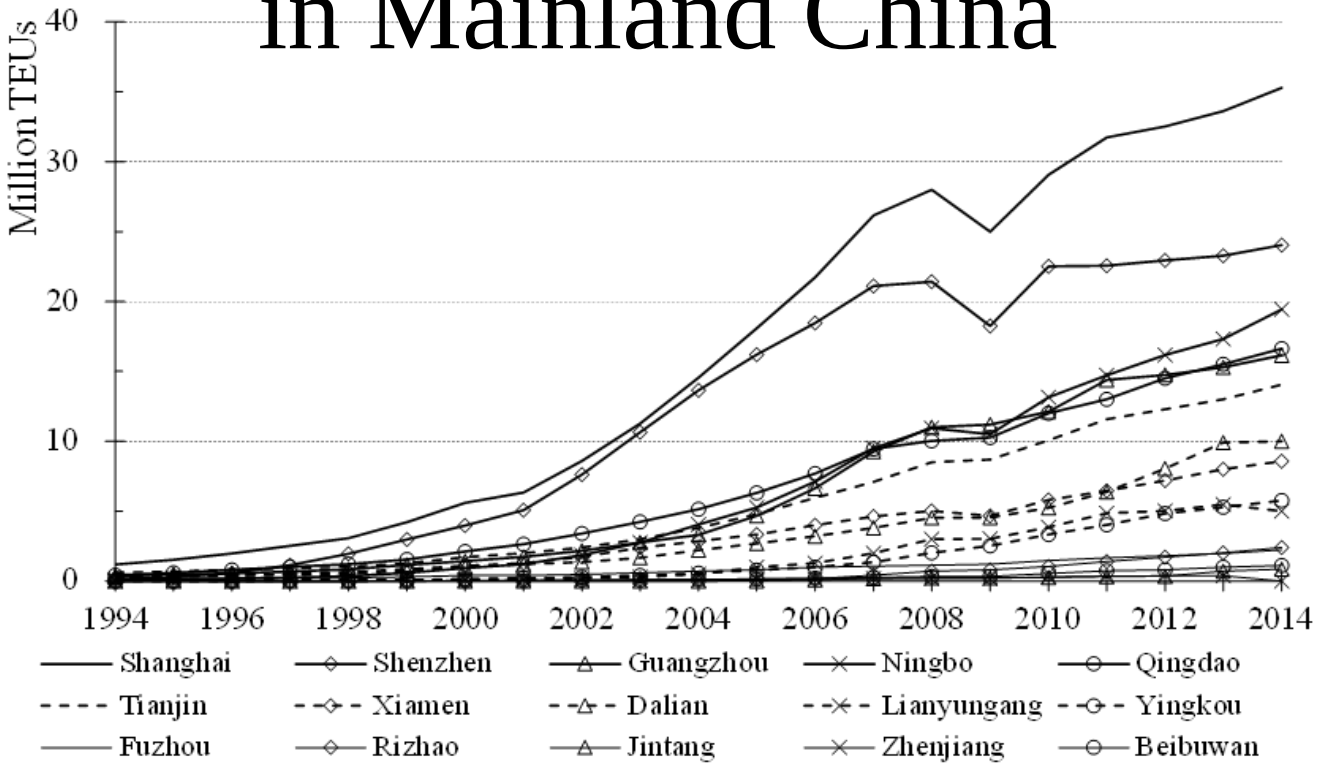
- Panel data for 31 provinces and municipalities in Mainland china from 1994-2012
  - Define attractiveness of a port, i.e., the port-hinterland relationship.
  - Analyze what are the leading factors for the evolution of port-hinterland relationship
- Extends the existing literature on the spatial development of gateway
- Contribute to the policies on the management of port development and transportation facilities

2. Background of Shanghai gateway



Shanghai is located at the center of the Chinese Coast, and at the ends of Yangtze River to East China Sea. In early 1930s, it is already known as “The Paris of the East, and New York of the West.”

Throughputs of major container ports in Mainland China



- The top 15 ports. Shanghai has much higher throughputs. Ningbo has a higher increasing rate in recent years.

Geographical classification of Shanghai's hinterland

In 2012:

- 88.25% of the cargoes use Shanghai port is from Jiangsu, Zhejiang and Shanghai.
- 4.4% is from 8 provinces/municipalities in Yangtze river system;
- 7.35% from 20 other provinces/municipalities

Current development in China

1. Development of Free Trade Zones and International Shipping Centers
   - After Shanghai FTZ, three other FTZs are developing in Tianjin, Xiamen and Guangzhou. Each is also developing ISC.
2. "*One Belt, One Road*"
   - The construction of Far East-Europe freight rail may take away some cargo.
   - The Maritime Silk Road will benefit more to the ports in the South and South-east in China.

One Belt One Road

3. Literature review

- Connectivity or accessibility (liner/port): Using the number of liner services as an index. Mostly focused on the foreland of a port. (Wilmsmeier & Hoffmann, 2008; Tang & Low, 2011; Jiang et al., 2015)
- Port-hinterland relationship: How hinterland changes when port competition increases. (Notteboom & Rodrigue, 2005, 2007; de Langen, 2007), when land bridge appears (Wang, 1998; Lee et al 2008).

The measure of gateway-hinterland relationship

Gateway Attractiveness Index (GAI):

$$s_{it} = \frac{SIO_{it}}{IO_{it}}$$

i: subscribe for geographical unit, a province or municipality.

s_{it}: The GAI for unit *i* at year *t*.

SIO_{it}: The total value of cargo in unit *i* at year *t* that uses Shanghai port for im- export.

IO_{it}: The total value of cargo import/exported.

Five hinterland categories

I. Captive hinterland: $s_{it}>0.9$;

II. Core hinterland: $0.9\geq s_{it}>0.4$;

III. Significant hinterland: $0.4\geq s_{it}>0.2$;

IV. Peripheral hinterland: $0.2\geq s_{it}>0.1$;

V. Nominal hinterland: $0.1\geq s_{it}>0$;

The evolution of Shanghai's hinterland

Year	I (90%-100%)	II (40%-90%)	III (20%-40%)	IV (10%-20%)
1994	Shanghai 97.37%	Jiangsu 42.49% Zhejiang 46.68% Anhui 44.60%	Jiangxi26.35% Hubei 24.51%	Beijing 15.88% Shanxi 12.90% Sichuan 2.35%
2001	Shanghai 94.23%	Jiangsu 56.71% Zhejiang 47.88% Anhui 45.28% Jiangxi 42.56%	Hubei 26.08% Beijing 20.51% Sichuan 28.32%	Henan 10.28% Hunan 17.72% Guizhou10.47% Shanxi 13.27%
2005	Shanghai 95.73%	Jiangsu 41.98% Sichuan 58.08%	Zhejiang 37.02% Anhui 39.39% Jiangxi 22.65% Hubei 25.61%	Beijing 18.92% Hunan 14.93% Shanxi 10.46%
2008	Shanghai 94.49%	Sichuan 56.88%	Jiangsu 39.95% Zhejiang 31.07% Anhui 34.84% Beijing 21.33% Hubei 21.43% Hunan 20.08%	Jiangxi 15.27% Shanxi 11.24%
2012	Shanghai 91.55%		Jiangsu 36.24% Zhejiang 27.67%	Jiangxi 15.28% Hubei 19.22%

1994

2001

2012

Above 90% Monopolistic hinterland

40%-90% Core hinterland

20%-40% Significant hinterland

10%-20% General hinterland

10%-20% Peripheral hinterland

Difference between import and export

Number of provinces in each category for export and import

	II		III		IV	
	Export	Import	Export	Import	Export	Import
1994	2	3	4	2	4	4
2001	5	1	3	4	4	3
2005	4	0	3	4	5	3
2008	3	0	4	3	4	4
2012	2	0	4	1	5	6

Shanghai has a larger export hinterland

5: Empirical analysis

- Key factors
  - Economic indicators
    - Does the relative economic development, measured by the percentage of GDP and FDI in national level, has anything to do with Shanghai's attractiveness?
  - Transportation Infrastructure
    - Does the development in transportation infrastructure, such as rail, road, inland waterway port, coastal port, has any impact on the attractiveness of Shanghai?

Percentage of GDP and FDI for 31 Provinces from 1994-2012(%)

Province	GDPR			FDIR		
	Mean	Max	Min	Mean	Max	Min
Beijing	3.1	2.4	3.6	3.6	2.0	4.6
Tianjin	1.8	1.6	2.2	4.6	0.3	6.4
Hebei	5.0	4.6	5.3	2.2	0.8	3.5
Shanxi	2.0	1.7	2.2	0.5	0.0	1.1
Neimenggu	1.9	1.4	2.8	0.9	0.1	1.9
Liaoning	4.5	4.0	5.4	6.6	2.1	11.5
Jilin	1.9	1.8	2.1	1.0	0.4	2.3
Heilongjiang	3.0	2.4	3.6	1.8	0.7	2.5
Shanghai	4.4	3.5	4.8	7.5	4.7	10.7
Jiangsu	9.1	8.7	9.5	14.9	6.1	20.8
Zhejiang	6.4	5.9	7.0	5.4	1.7	9.2
Anhui	3.0	2.6	3.5	1.4	0.5	3.5
Fujian	3.6	3.2	4.1	9.4	2.6	54.0
Jiangxi	2.1	2.0	2.3	1.8	0.4	2.9
Shandong	8.9	8.5	9.6	6.9	3.7	12.0
Henan	5.2	4.9	5.4	1.9	0.6	5.0
Hubei	3.8	3.3	4.6	2.5	1.4	4.1
Hunan	3.6	3.3	4.0	2.1	0.5	3.0
Guangdong	10.5	9.3	11.4	18.5	9.6	27.5
Guangxi	2.3	2.0	2.8	0.9	0.3	1.9
Hainan	0.5	0.4	0.7	1.1	0.6	2.7
Chongqing	1.7	1.5	2.0	1.9	0.6	4.8
Sichuan	4.2	3.7	6.1	1.4	0.4	4.4
Guizhou	1.1	1.0	1.2	0.2	0.1	0.4
Yunnan	1.9	1.7	2.2	0.4	0.1	0.9
Xizang	0.1	0.1	0.1	0.0	0.0	0.0
Shaanxi	2.0	1.7	2.5	0.8	0.5	1.3
Gansu	1.0	0.9	1.1	0.1	0.0	0.3
Qinghai	0.3	0.3	0.3	0.1	0.0	0.3
Ningxia	0.3	0.3	0.4	0.1	0.1	0.2
Xinjiang	1.3	1.2	1.5	0.1	0.0	0.2

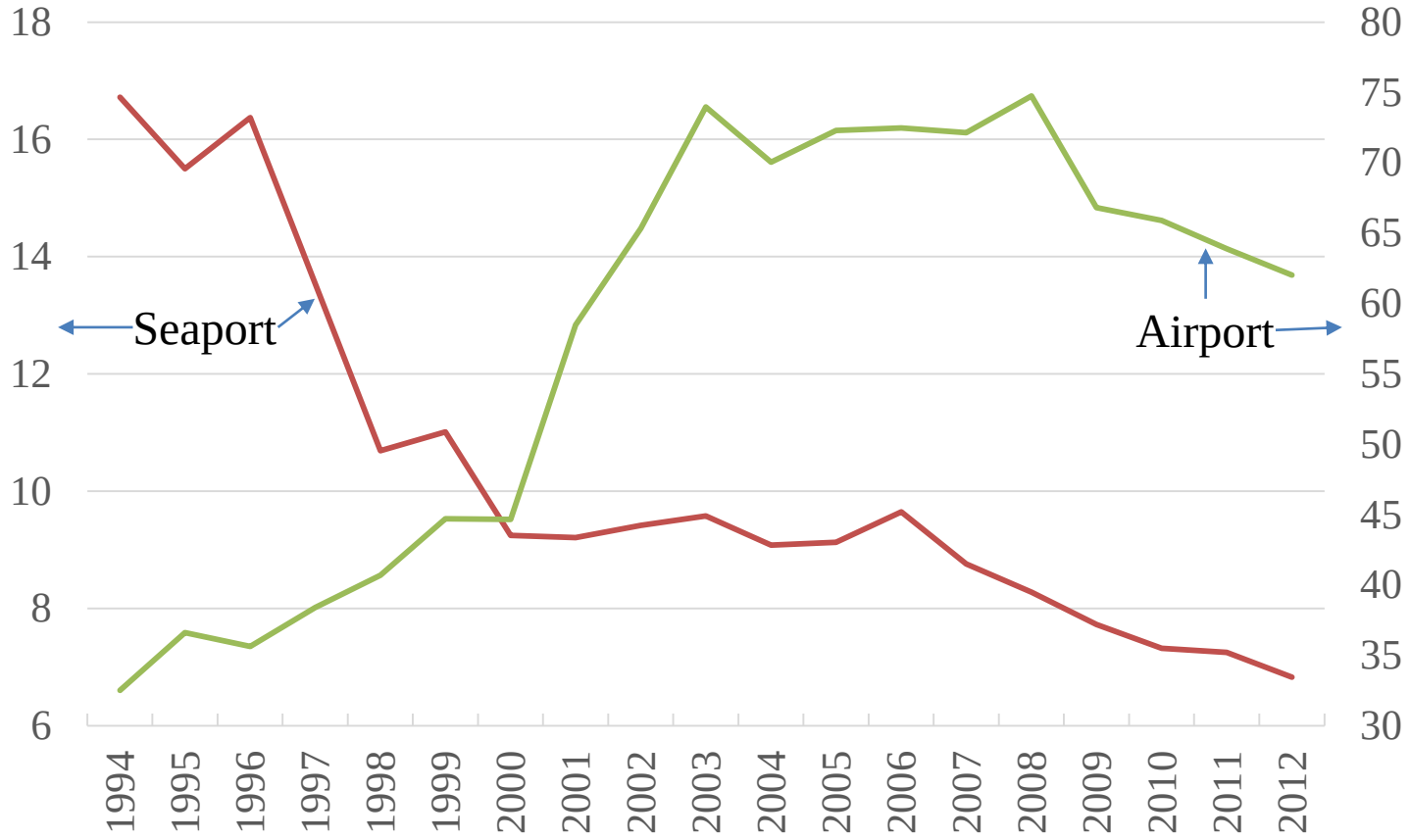
5: Empirical analysis

- Distance from Shanghai to each provinces
  - Does “being close” has any impact on Shanghai’s attractiveness?
- Port throughput change in competing ports
  - Is it really true that the attractiveness of Shanghai decreases with the market share of Shanghai port throughput?

The average density of Highway and Rail and the average number of sea berths, inland berths and airports of 31 provinces during 1994-2012, and their distance

Province	RailD(it) Unit: m/m²	RoadD(it) Unit: m/m²	SeaBerth(it) Unit: %	InlandBerth(it) Unit: %	Airport(it) Unit: %.	Distance(i) Unit: Km
Beijing	0.07	0.96	0.0	0.0	3.1	1500
Tianjin	0.06	0.86	7.6	0.0	3.1	1420
Hebei	0.02	0.50	3.3	0.0	3.1	1422
Shanxi	0.02	0.51	0.0	0.0	0.0	1580
Neimenggu	0.01	0.08	0.0	0.0	6.1	2000
Liaoning	0.03	0.46	13.5	0.0	6.1	2120
Jilin	0.02	0.30	0.0	0.0	3.1	2450
Heilongjiang	0.01	0.20	0.0	0.0	12.3	2750
Shanghai	0.05	1.20	18.3	0.0	3.1	0
Jiangsu	0.01	0.79	3.0	46.9	3.1	412
Zhejiang	0.01	0.64	14.1	0.0	3.1	203
Anhui	0.02	0.63	0.0	17.5	0.0	624
Fujian	0.01	0.54	0.0	0.0	6.1	1407
Jiangxi	0.01	0.48	0.0	2.3	0.0	928
Shandong	0.02	0.81	10.6	0.0	9.2	1150
Henan	0.02	0.77	0.0	0.0	0.0	1220
Hubei	0.01	0.62	0.0	19.1	0.0	1150
Hunan	0.01	0.56	0.0	0.0	3.1	1276
Guangdong	0.01	0.73	27.1	0.0	6.1	1840
Guangxi	0.01	0.29	0.0	0.0	6.1	2460
Hainan	0.01	0.55	2.6	0.0	3.1	2500
Chongqing	0.01	0.31	0.0	18.8	3.0	2750
Sichuan	0.01	0.83	0.0	2.4	0.0	2500
Guizhou	0.01	0.43	0.0	0.0	0.0	2450
Yunnan	0.01	0.39	0.0	0.0	6.1	3207
Xizang	0.00	0.03	0.0	0.0	3.1	4176
Shaanxi	0.01	0.39	0.0	0.0	3.1	2108
Gansu	0.01	0.14	0.0	0.0	0.0	2840
Qinghai	0.00	0.05	0.0	0.0	0.0	3040
Ningxia	0.01	0.22	0.0	0.0	0.0	2585
Xinjiang	0.00	0.05	0.0	0.0	6.1	4680

Market share of Shanghai seaport and Airport



5: Empirical analysis

- Dependent variable: $Y_{it}=s_{it}$
- Explanatory variables:

For each *it*: $\boldsymbol{X_{it}}$

- *RailD* & *RoadD*: rail and road length per unit area.
- *GDPR* and *FDIR*: national percentage in GDP and FDI
- *SeaberthR* & *InlandBerthR*: Share of inland berths and sea berths.
- *AirportR*: the percentage of national airport.

For each *i*: $\boldsymbol{X_i}$

- *Distance*.

For each *t*: $\boldsymbol{X_t}$

- *ShDGP* and ShFDI: Shanghai's share of national GDP and FDI
- *ShSeaPortR* & *ShAirportR*: Shanghai's container share and air cargo share.

Statistical Equation

$$Y_{it} = \alpha + \boldsymbol{X}_{it}\boldsymbol{\beta} + X_i\gamma + \boldsymbol{X}_t\boldsymbol{\delta} + \mu_i + \varepsilon_{it}$$

To capture the unique nature of individual geographical unit, we use dummy variable to indicate each *i*.

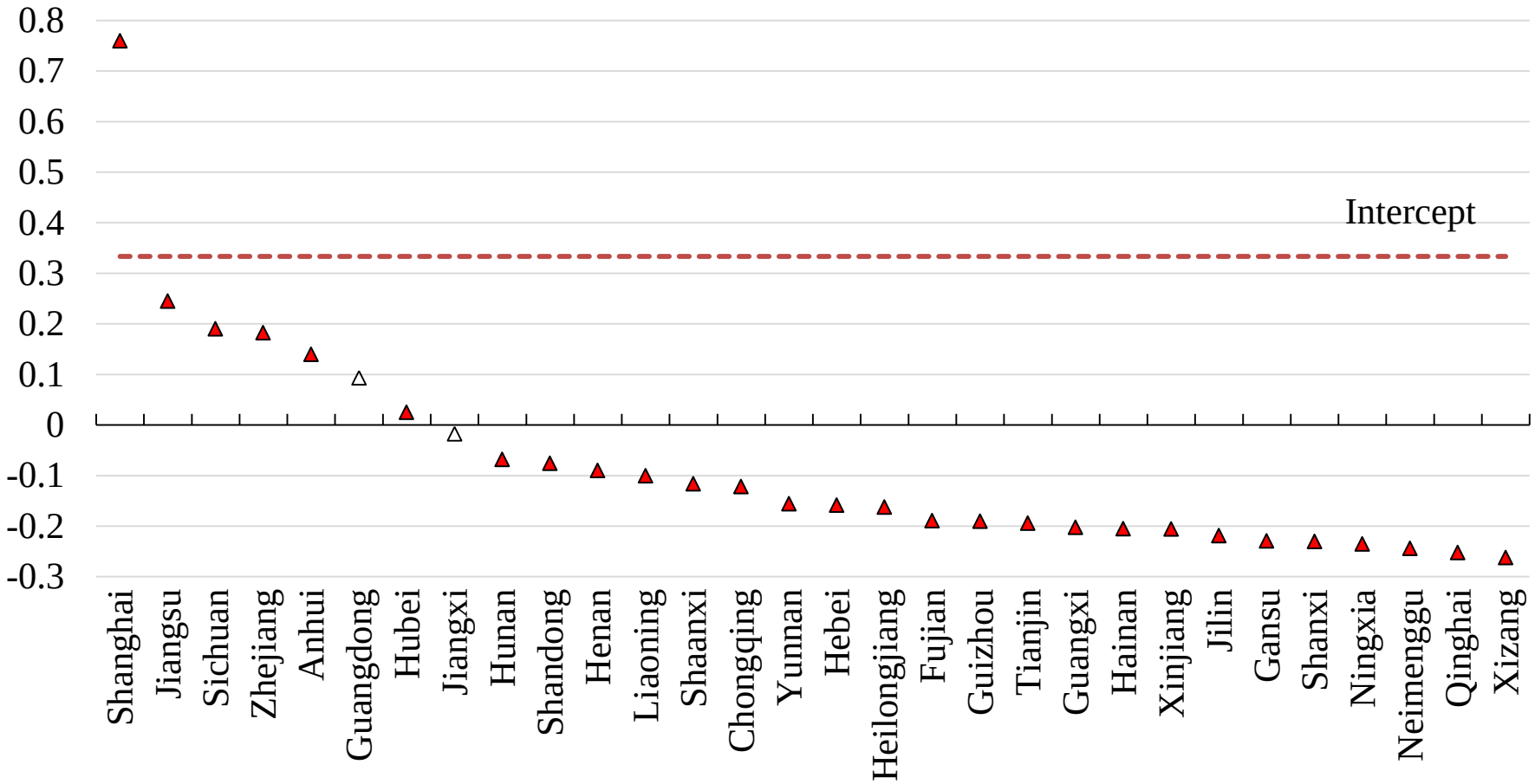
$$Y_{it} = \alpha_i + \boldsymbol{X}_{it}\boldsymbol{\beta} + X_i\gamma + \boldsymbol{X}_t\boldsymbol{\delta} + \varepsilon_{it}$$

Regression results

	Model 1	Model 2	Model 3	Model 4
_cons	0.21532178	0.23842219	.34848629***	.33334759***
RailD	-0.49150385	-0.49363192	-0.70529964	
RoadD	-.03803787***	-.03926081***	-.03912795***	-.05190998***
FDIiR	-0.1084958			
GDPiR	2.1896692	1.8477651		
ShFDIR	-0.00945387			
ShGDPR	0.75071406	0.71510254	0.74044398	
SeaBerthR	-.32335187***	-.32234566***	-.32709568***	-.32870162***
InlandBerthR	-0.01005913	-0.01436273	-0.03562733	
AirPortR	3.2585154	2.5346354		
ShSeaPortR	-0.20770588	-.21291777*	-.22765993*	-.17582461*
ShAirPortR	-0.00822846	-0.00908145	-0.01494271	
GDPiRDistance	-.00251133**	-.00231925**	-.0014038***	-.00143646***
R^2	0.95971164	0.95953171	0.9594	0.95913086

*Significance level: * 10% ** 5% *** 1%*

Specific effect of each Province



Summary and conclusion

For Shanghai gateway:

- Its natural condition is the main factors in the hinterland evolution.
- Sea port berth in other area is the main competitive factor
- The road construction reduces its attractiveness.
- Although its container throughput share increases, its attractive to its hinterland decreases.
  - Market deconcentration.
- Rail hasn't had any obvious impact to the increasing use of Shanghai port.

Implications

- The main factors prompting the hinterland to select Shanghai as the gateway for imports and exports is still its natural geographical condition and location. The main hinterland for Shanghai is still the region along the Yangtze River.
- To reverse the current decreasing trend in market share, Shanghai could strengthen its economic cooperation with other regions along the Yangtze River, and also increase the capacity of inland waterway transportation.

Implications

- Currently, multimodal container transportation is not very developed, accounting for less than 2% of the container port throughput in China. The multimodal containers in Shanghai only account for about 0.2% of the port throughput (Wang, 2012). Further development of the western part of China, and the initiative of “One Belt One Road”, will enhance the development of freight rail and multimodal transportation throughout China. Therefore, to benefit from this new development, Shanghai should have on-dock freight rail to Yang Shan port.

Thanks!

- Any question?