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Modeling and analysis the competition dynamics among container transshipment ports: in case of East-Asian ports

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Abstract : *This paper studies the competitiveness and complementary among the major container ports in East Asia by analyzing their extensive and intensive dynamics in recent 8 years (2008-2015). Time series data on container throughput dividing into O-D and transshipment for the ports of Hong Kong, Kaohsiung, Shanghai, Busan, Ningbo-Zhoushan, and Shenzhen are calculated based on VAR and VECM model.*

Keywords : *Container throughput, Transshipment competition, Cointegration test, VAR and VECM model.*

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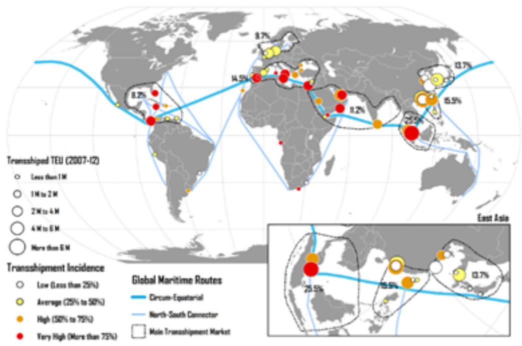
Outline

- Introduction
- Literature Review
- Problem Statement
- Methodology
- Results
- Conclusions

1. Introduction

- Port Competitiveness
  - ✓ Origin & Destination (O/D) port
  - ✓ Transshipment (T/S) port
- Container port competition
  - ✓ Intra port competition
  - ✓ Inter-port competition
- East Asia: Three main T/S markets

Global Transshipment Markets



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2. Literature Review

Author	Method	Highlight
Lee & Lam (2015)	DEA and SFA methods	Competition among Fifth Generation Ports in East Asia
Notteboom & Lam (2012)	Annualized slot capacity	Inter- & Intra-port competition in Europe & East Asia
Notteboom et al (2000)	Stochastic frontier analysis	Container terminals in hub ports should be technically more efficiently than ones in feeder ports.
Song et al (2016)	A non-cooperative game model	The centralized management model achieves a higher suppl y chain profit than the decentralized non-cooperative model
Ishii et al. (2013)	A non-cooperative game model	Nash equilibrium: Port charges to influence port competition.
Song (2002)	A non-cooperative game model	A co-operative alliance can strengthen both partners Hong-Kong and China
Fan et al (2015)	A stochastic network-flow model	Stochastic distribution of container shipments is acceptable at US ports and routes
Park (2009)	VAR & VECM model, Cointegration test	Busan & Kaohsiung are complementary relationship for China, Japan & US O/D cargoes
Tian et al (2015)	Granger causality	Competitive environment between Shenzhen and Hong Kong ports
Yap &Lam (2006b)	Cointegration test and error correction model	Hong Kong and Busan are beneficiaries from inter-port competition; Cargo volume shifts to China

3. Problem Statement

- Need to analyze the competition among major ports in East Asia in focusing on transshipment and O-D container dynamics
- Need to check robustness the model
- Need to evaluate recent trends

- Time series period: 2008 – 2015 (monthly)
- Method: Cointegration test, Granger causality, VAR & VECM models

4. Methodology

$$WTT_t = WOD_t + WTS_t$$

$$WTT - World\ Total\ Container$$

$$WOD - World\ Total\ O/D$$

$$WTS - World\ Total\ T/S$$

$$\Delta WOD_1 = WOD_1 - WOD_0$$

$$TS_{1,T-1} = \alpha_{1,T-1}\Delta WOD_{T-1} + \alpha_{1,T-1}\Delta WOD_{T-2}$$

$$TS_{1,T} = \alpha_{1,T}\Delta WOD_{T} + \alpha_{1,T}\Delta WOD_{T-1}$$

$$TS_{1,t} = \beta_{1,t}\Delta WOD_t + \gamma_{1,t}\Delta WOD_{t-1}$$

4. Methodology

$$TS_{k,t} = \sum_{j=1}^{n}\lambda_{kj,t}TS_{j,t-1} + \sum_{j=1}^{n}\beta_{kj,t}\Delta OD_{j,t}$$

$$TS_{k,t} = \sum_{j=1}^{m}\lambda_{kj,t}TS_{j,t-1} + \sum_{j=m+1}^{n}\lambda_{kj,t}TS_{j,t-1} + \sum_{j=1}^{l}\beta_{kj,t}\Delta OD_{j,t} + \sum_{j=l+1}^{n}\beta_{kj,t}\Delta OD_{j,t}$$

$$TS_{k,t} = \sum_{j=1}^{m}\lambda_{kj,t}TS_{j,t-1} + \sum_{j=1}^{l}\beta_{kj,t}\Delta OD_{j,t}$$

$$Here: j = \{1,2\ldots,m,m+1,\ldots,n-1,n\},\ 2 \le m \le n,\ 2 \le l \le n$$

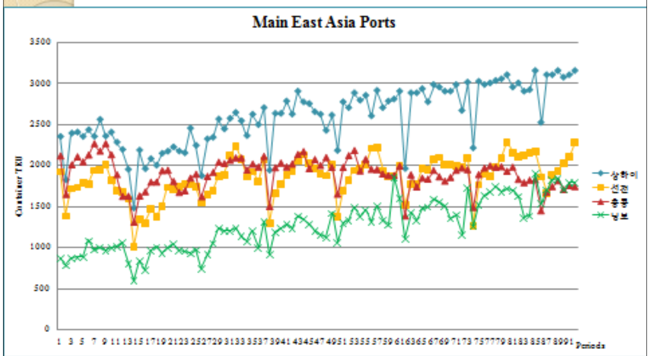
$$TS_{1,t} = \lambda_{11,t}TS_{1,t-1} + \lambda_{12,t}TS_{2,t-1} + \theta_{11,t}\Delta NOD_{1,t} + \theta_{12,t}\Delta NOD_{2,t} + \theta_{13,t}\Delta NOD_{3,t}$$

$$TS_{2,t} = \lambda_{21,t}TS_{1,t-1} + \lambda_{22,t}TS_{2,t-1} + \theta_{21,t}\Delta NOD_{1,t} + \theta_{22,t}\Delta NOD_{2,t} + \theta_{23,t}\Delta NOD_{3,t}$$

$$Here: TS_{i,t} = \text{Transshipment of } i \text{ port in } t \text{ period}$$

$$\Delta NOD_{i,t} = NOD_{i,t} - NOD_{i,t-1}$$

5. Results



5. Results

Johansen Cointegration test

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.339923	111.2141	95.75366	0.0028
At most 1 *	0.300976	75.07437	69.81889	0.0179
At most 2	0.219573	43.92229	47.85613	0.1116
At most 3	0.167699	22.35380	29.79707	0.2792
At most 4	0.070120	6.383935	15.49471	0.6501
At most 5	0.000679	0.059073	3.841466	0.8079

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

1 Cointegrating Equation(s): Log likelihood -2931.204

Normalized cointegrating coefficients (standard error in parentheses)

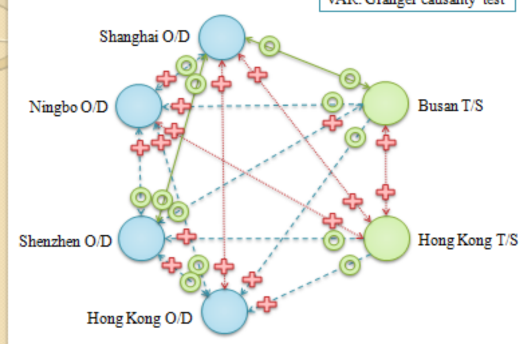
BS	HK	HKT	NB	SH	SZ
1.000000	-0.923759	0.310256	-1.426316	0.378911	0.725947
	(0.29060)	(0.38301)	(0.33988)	(0.34625)	(0.23419)

5. Results

VAR: Granger causality test

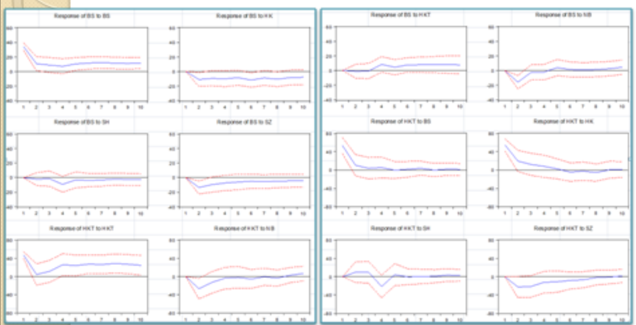
Null Hypothesis:		Obs	F-Statistic	Prob.
HK does not Granger Cause BS	Rejected	88	2.67564	0.0378
BS does not Granger Cause HK			0.18924	0.9434
HKT does not Granger Cause BS		88	1.69675	0.1591
BS does not Granger Cause HKT			0.29939	0.8775
NB does not Granger Cause BS	Rejected	88	5.45665	0.0006
BS does not Granger Cause NB			7.59528	3.E-05
SH does not Granger Cause BS	Rejected	88	4.01901	0.0051
BS does not Granger Cause SH	Rejected		4.23231	0.0037
SZ does not Granger Cause BS		88	8.18924	1.E-05
BS does not Granger Cause SZ	Rejected		2.92344	0.0261
HKT does not Granger Cause HK		88	0.62789	0.6440
HK does not Granger Cause HKT	Rejected		2.01955	0.0997
NB does not Granger Cause HK	Rejected	88	2.45043	0.0528
HK does not Granger Cause NB			1.87744	0.1228
SH does not Granger Cause HK		88	0.62600	0.6453
HK does not Granger Cause SH			1.45488	0.2239
SZ does not Granger Cause HK	Rejected	88	2.08871	0.0901
HK does not Granger Cause SZ			0.40804	0.8023
NB does not Granger Cause HKT		88	0.91738	0.4581
HKT does not Granger Cause NB			1.28245	0.2840
SH does not Granger Cause HKT		88	0.96510	0.4314
HKT does not Granger Cause SH			0.55020	0.6994
SZ does not Granger Cause HKT	Rejected	88	2.75130	0.0338
HKT does not Granger Cause SZ			0.94302	0.4438
SH does not Granger Cause NB		88	1.22370	0.3075
NB does not Granger Cause SH	Rejected		3.05074	0.0216
SZ does not Granger Cause NB		88	1.25116	0.2963
NB does not Granger Cause SZ	Rejected		3.95388	0.0056
SZ does not Granger Cause SH	Rejected	88	3.83934	0.0067
SH does not Granger Cause SZ	Rejected		3.66004	0.0087

5. Results

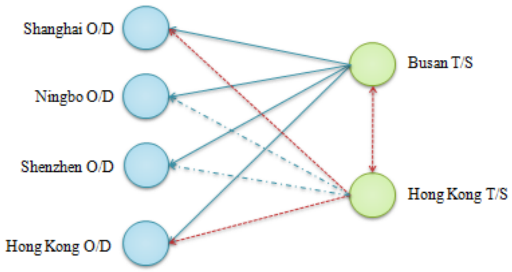


5. Results

VAR: Impulse response function



6. Conclusion



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