From lock-in to efficiency:
Evolution of Japan's port choice after the Hanshin earthquake

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1. Research Outline

- **Research motivation**: to test the existence of a **third-degree lock-in** for shippers' port choice considering the exogenous shock by Kobe earthquake in 1995, Japan.
- **Targeted area**: 47 prefectures in Japan.
- **Methodology**: panel-data analysis with the dummy variables for prefectures (shippers) and years.
- **Database**: Container cargo flow survey data from 1985 to 2013 at five-year intervals (cross section and time series).
- **Main findings**: 1) NO third-degree lock-in; 2) Kobe lost port market shares permanently; 3) more efficient port market in terms of inland freight distance in Japan after 1995.
- **Notes**: Asian container terminal developments in late 1980s, and global shipping services expanding, e.g. Busan port.

“Lock-in”, multiple-equiliblia

Types	Description
1st-degree	A and B are actually not different in terms of efficiency and A is selected historically, then there is no incentive to switch from A to B.
2nd-degree	B is better than A in terms of efficiency and A is selected historically, but to switch from A to B requires a switch cost which is greater than the potential benefits obtained from the switch from A to B. Then there is no incentive to switch from A to B.
3rd-degree	B is better than A in terms of efficiency and A is selected historically, further, to switch from A to B requires a switch cost which is less than the potential benefits obtained from the switch from A to B. However, there is still no incentive to switch from A to B, due to (to some extent) irrational behavior.

(source) Khalil (2013)

2. Structure of Presentation

1. Research Outline (introduction)
2. Structure of Presentation
3. Research Background
4. Empirical analysis and results
5. Conclusion

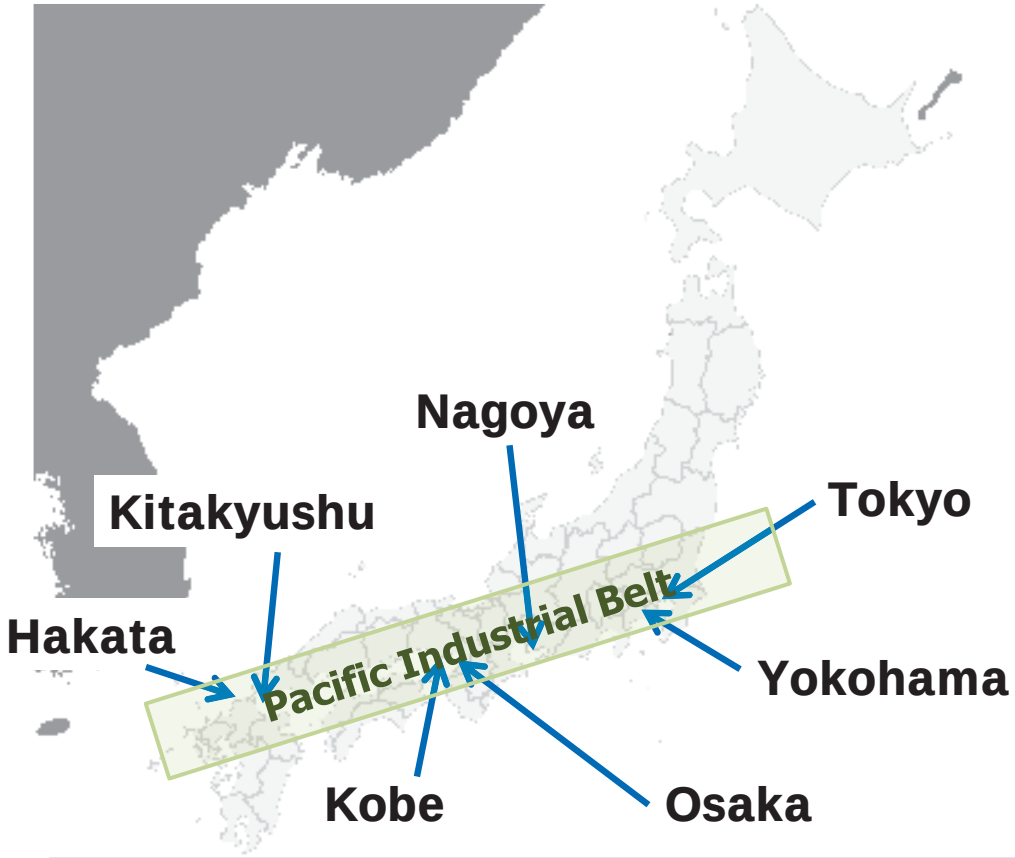
3. Research Background

- **Hinterland / foreland analysis**
  - Anyport model (classic model), Bird (1963)
  - Collaboration with regional economy, Itoh (2002, Ph.D. thesis)
  - Port regionalization, Notteboom and Rodrigue (2005) and Rodrigue and Notteboom (2010)
  - Hinterland spatial patterns, Lee et al. (2008)
- **Empirical analysis**
  - Simple counting in Japan, Inamura et al. (1997)
  - Discrete choice analysis in Japan, Itoh et al. (2003)
  - Fuzzy clustering analysis in Japan, Itoh (2013) ➔ main idea!!
  - French foreign trade, Guerrero (2014) ➔ extended!!
  - Port regions' classification, Ducruet et al. (2015, Japan EU US), Ducruet and Itoh (forthcoming, 41 countries)

Historical Background at Kobe Port

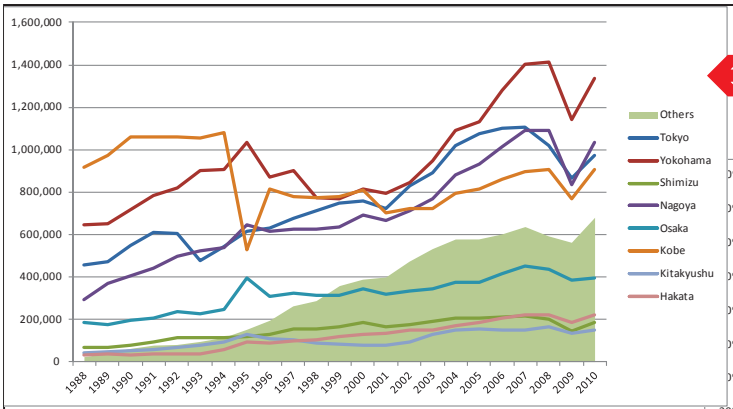
- One of first (five) international "open" ports in 1868.
- Before WW2, supporting (light) industries, general merchants and traders (*Sogo-Shosha* in Japanese).
- After WW2, connecting with Japanese industrial zones "Pacific Industrial Belt" for efficient domestic networks.
- During containerization, the first container port with high standard container berths, or over-Panamax, in 1967.
- After bubble economy (early 1990s), losing transshipment cargo by the developments in Asian ports, e.g. Busan port.
- In 17th January 1995, Hanshi (southern Hyogo prefecture) earthquake, not reach the handling level in 1994.
- In October 2014, the management of container terminals at the ports of Kobe and Osaka was integrated.

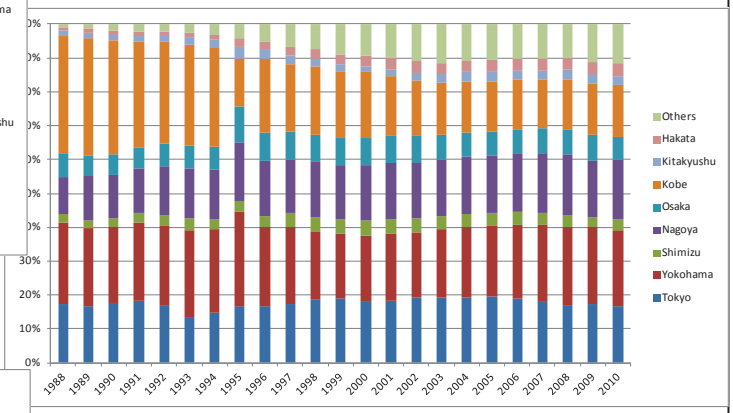
Japanese major ports' locations



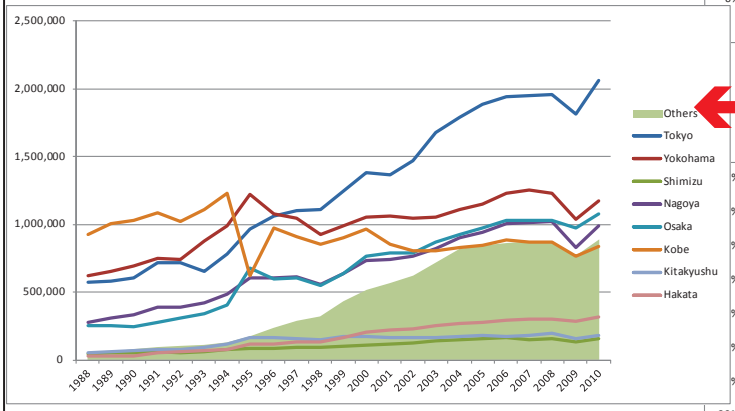
Note) During income doubling plan in 1960s, Japanese gov. constructed this belt for connecting four industrial zones.

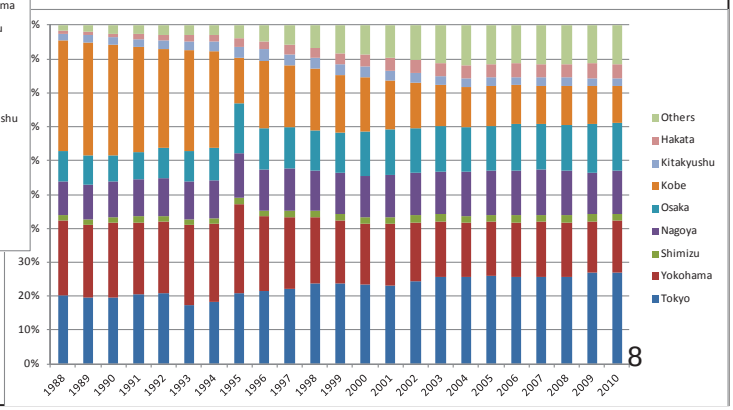
Export container cargo





Import container cargo





4. Empirical analysis

- Panela-data analysis; 47 prefectures and 7 time points between 1985 and 2013, the reference is in the year 1985
- Dependent variables; relative port handling shares of ports for the level in the year 1985 at each prefecture (major 7 and 11 ports, export and import)
- Independent variables; (only) port and year dummies

$$\frac{(volume_{ijt}/volume_{it})}{(volume_{ij1985}/volume_{i1985})} = \alpha + \sum_t \sum_j \beta_{jt} \cdot dummy_j \cdot dummy_t$$

i: prefecture (shipper), *j*: port, *t*: year

$Volume_{ijt}$ / $Volume_{it}$	(1) export	(2) import	(3) export	(4) import
Reference year: 1985				
kobe*y88	-0.03 (0.07)	-0.05 (0.06)	-0.08 (0.09)	-0.08 (0.10)
kobe*y93	-0.08 (0.06)	-0.07 (0.06)	-0.09 (0.09)	-0.08 (0.10)
kobe*y98	-0.14** (0.06)	-0.17*** (0.05)	-0.15* (0.09)	-0.22** (0.09)
kobe*y03	-0.20*** (0.06)	-0.22*** (0.05)	-0.22*** (0.08)	-0.26*** (0.09)
kobe*y08	-0.19*** (0.06)	-0.22*** (0.05)	-0.17* (0.09)	-0.22** (0.09)
kobe*y13	**-0.22*** (0.06)**	**-0.24*** (0.05)**	**-0.29*** (0.07)**	**-0.29*** (0.09)**
tokyo*y88	-0.01 (0.04)	-0.04 (0.04)	-0.06 (0.07)	-0.06 (0.10)
tokyo*y93	-0.04 (0.04)	-0.04 (0.04)	-0.05 (0.08)	-0.05 (0.10)
tokyo*y98	-0.01 (0.05)	-0.04 (0.05)	-0.02 (0.09)	-0.09 (0.09)
tokyo*y03	-0.03 (0.04)	-0.03 (0.05)	-0.04 (0.07)	-0.07 (0.09)
tokyo*y08	-0.03 (0.04)	-0.02 (0.05)	-0.01 (0.09)	-0.02 (0.10)
tokyo*y13	-0.04 (0.04)	-0.01 (0.05)	-0.11 (0.07)	-0.06 (0.09)
yokohama*y88	0.18*** (0.03)	0.19*** (0.04)	0.12* (0.07)	0.16* (0.09)
yokohama*y93	**0.20*** (0.04)**	**0.19*** (0.04)**	**0.20*** (0.08)**	**0.18** (0.09)**
yokohama*y98	0.12*** (0.02)	0.13*** (0.03)	0.11 (0.08)	0.07 (0.08)
yokohama*y03	0.13*** (0.03)	0.09*** (0.02)	0.11* (0.06)	0.05 (0.08)
yokohama*y08	0.14*** (0.03)	0.09*** (0.02)	0.17** (0.08)	0.08 (0.08)
yokohama*y13	0.13*** (0.03)	0.07*** (0.02)	0.06 (0.05)	0.02 (0.08)
osaka*y88	-0.01 (0.02)	-0.00 (0.03)	-0.06 (0.06)	-0.03 (0.09)
osaka*y93	-0.00 (0.02)	0.00 (0.03)	-0.01 (0.07)	-0.01 (0.09)
osaka*y98	0.01 (0.03)	0.01 (0.03)	-0.00 (0.08)	-0.05 (0.08)
osaka*y03	-0.01 (0.02)	0.02 (0.04)	-0.03 (0.06)	-0.02 (0.08)
osaka*y08	-0.02 (0.03)	0.01 (0.04)	0.00 (0.08)	0.01 (0.09)
osaka*y13	-0.02 (0.03)	0.01 (0.04)	-0.09* (0.05)	-0.04 (0.08)
nagoya*y88	0.02 (0.03)	0.02 (0.03)	-0.03 (0.07)	-0.00 (0.09)
nagoya*y93	0.03 (0.04)	0.01 (0.04)	0.03 (0.08)	0.00 (0.09)
nagoya*y98	0.03 (0.04)	0.02 (0.04)	0.02 (0.08)	-0.03 (0.08)
nagoya*y03	0.03 (0.04)	0.02 (0.04)	0.02 (0.06)	-0.02 (0.08)
nagoya*y08	0.04 (0.04)	0.02 (0.04)	0.06 (0.08)	0.02 (0.09)
nagoya*y13	0.05 (0.04)	0.02 (0.04)	-0.02 (0.06)	-0.03 (0.08)
kitakyushu*y88	0.01 (0.02)	0.02 (0.03)	-0.04 (0.06)	-0.01 (0.09)
kitakyushu*y93	0.03 (0.02)	0.02 (0.03)	0.02 (0.07)	0.01 (0.09)
kitakyushu*y98	0.01 (0.02)	0.03 (0.03)	0.00 (0.07)	-0.03 (0.08)
kitakyushu*y03	0.02 (0.02)	0.00 (0.02)	-0.00 (0.06)	-0.04 (0.08)
kitakyushu*y08	0.00 (0.02)	-0.00 (0.03)	0.03 (0.08)	-0.00 (0.08)
kitakyushu*y13	-0.00 (0.01)	-0.01 (0.02)	-0.07 (0.05)	-0.06 (0.08)
hakata*y88	-0.00 (0.01)	0.02 (0.01)	-0.05 (0.06)	-0.01 (0.09)
hakata*y93	0.02 (0.02)	0.04** (0.02)	0.01 (0.07)	0.03 (0.09)
hakata*y98	0.04 (0.03)	0.04* (0.02)	0.03 (0.08)	-0.01 (0.08)
hakata*y03	0.04 (0.03)	0.04* (0.02)	0.02 (0.06)	-0.00 (0.08)
hakata*y08	**0.07* (0.04)**	0.04* (0.02)	0.09 (0.08)	0.04 (0.08)
hakata*y13	0.05* (0.03)	**0.05* (0.03)**	-0.02 (0.06)	-0.00 (0.08)
Constant	0.18*** (0.03)	0.18*** (0.03)	0.15*** (0.06)	0.14* (0.08)
Samples	**Full sample**	**Full sample**	**7 major ports**	**7 major ports**
Port dummies	Y	Y	Y	Y
Pref.*Year dummies	N	N	Y	Y
N	3,948	3,948	2,303	2,303
adj. R^2	0.211	0.149	0.198	0.142

Kobe

Yokohama

Hakata

After 1995, Sig. Negative, Still expanding

After 1988, Sig. Positive, But 1993 Max.

Export: After 2008, Sig. Positive, But 2008 Max.

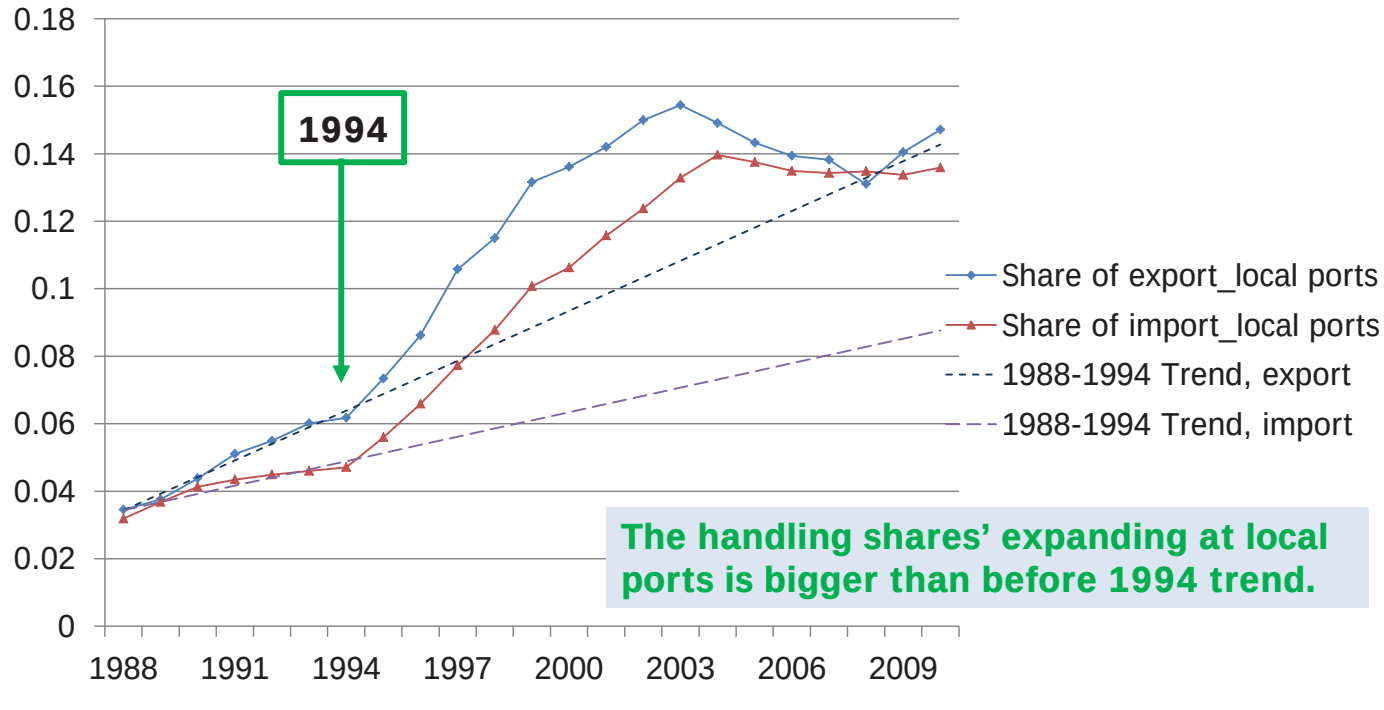
Import: After 1993, Sig. Positive Still expanding

4. Empirical results

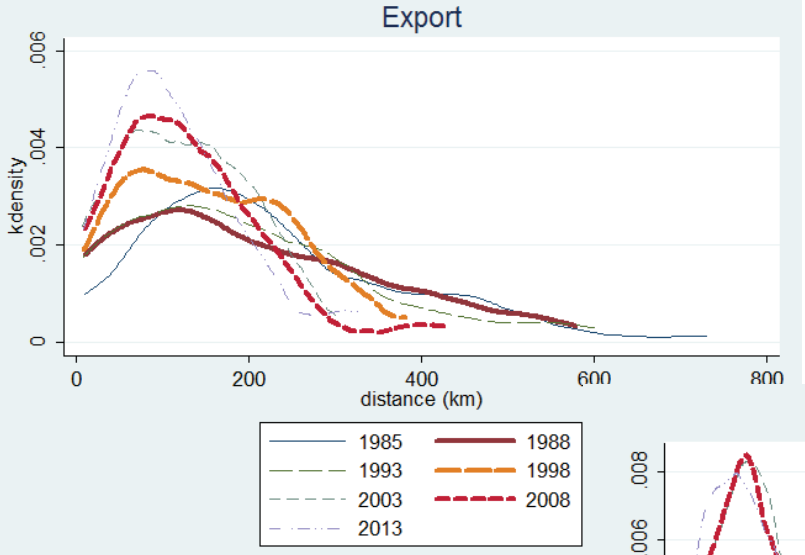
1. No significant differences before the earthquake at Kobe.
2. Kobe port has significantly shrunk after the earthquake in 1995, and the parameters for Kobe is still expanding.
3. But, No significant winner from the earthquake in 1995.

- ➢ The handling shrinking at Kobe port was mainly due to the earthquake but not a pre-quake trend.
- ➢ In addition, the rest Japanese major ports are mainly following their pre-earthquake trend.
- ➢ The prosperity of Kobe port was due to historical reasons.
- ➢ Once the lock-in of Kobe was collapsed, the port market will shift from "lock-in" to more "efficiency" structure, but not to another “new lock-in".

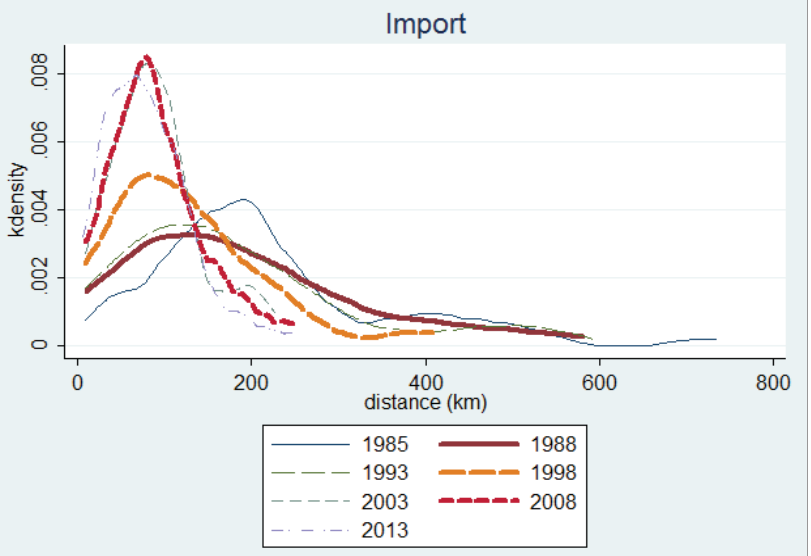
The share gaps between actual local ports and the average trend before 1994



The distribution of port users to their ports



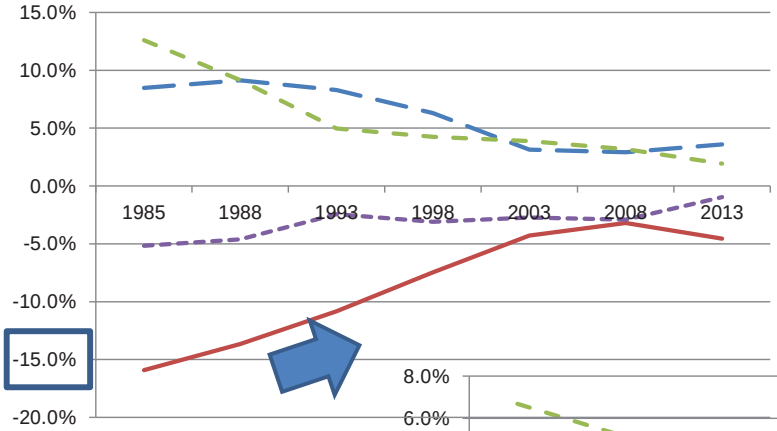
Inland transport distance is shorter than before.

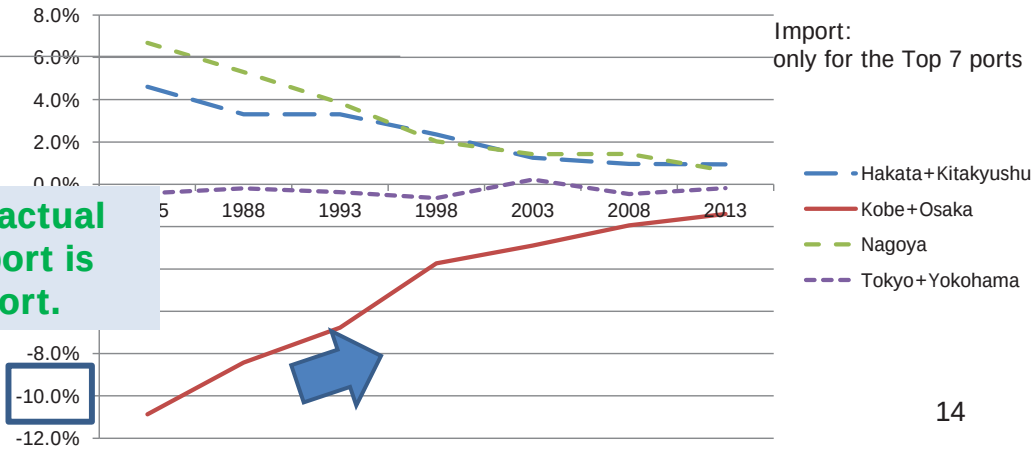


Inland transport distance on Import is shorter than the case on Export

The efficiency gaps between the actual and optimal port organization

Note) if shipper uses the nearest one in top 7 ports and local ports.





The gaps between actual and optimal on export is bigger than on import.

5. Conclusions

- Empirical analysis revealed that:

1. the third-degree lock-in does not appear in the case of Kobe port.
2. the market share of Kobe port was permanently lost due to the partly dissipation of lock-in effect on shippers' port choice for Kobe port.
3. the exogenous shock leads to a more efficient port market in terms of inland freight distance from prefectures (shippers) to their handling ports.

- After the damage of Kobe port, Japanese port users moved to alternative ports (local ports and other major ports) which are geographically close to them, leading to "efficient" inland transport.

Thank you !

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Recent shifts on French hinterlands

Just a matter of economies of scale?

David Guerrero
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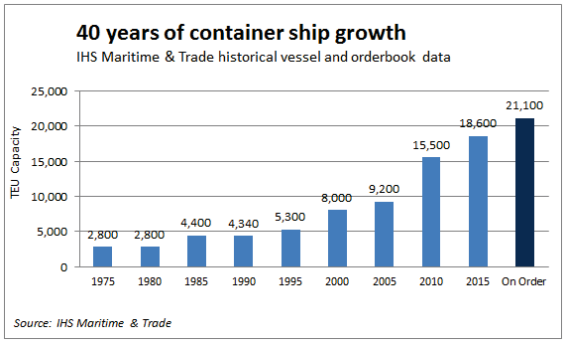
The argument

- Under the influence of containerization, hinterlands have become increasingly competitive.
- However in France hinterlands have remained quite path dependent (distance-constrained) over the past decades.
- During the last years (since 2008) French hinterlands have become much less distance-constrained.

The « mainstream » explanation

- Economies of scale in shipping (larger ships) and in handling activities have become much more important in the last decade.



- This predisposes the concentration of freight flows at a few "global ports", implying larger hinterlands and increasing competition.

…but does it really explain the <u>whole</u> story?

Data and method

- Customs data (2005-2012)

  countries(trade partners)*ports*NUTS3 regions(FR)

  Time-distance (by truck) between ports and NUTS3

- Method: doubly-constrained spatial interaction model.

$$I_{ij} = A_i \cdot O_i \cdot B_j \cdot D_j \cdot d_{ij}^{-\alpha}$$

Friction of inland distance

where O_i is the total maritime traffic of the *département* or the port called i, D_j is the total maritime traffic of the *département* or the port called j (see table 1); d_{ij} is the distance between i and j; α is the friction parameter; and A_i and B_j are the balancing factors ensuring that the origin i and destination j constraints are satisfied.

Inland friction of different types of cargo

Type of cargo (2012)	α	r^2	$r^{2'}$
Automobiles & transport material	-0.6	74%	15%
Glass & construction materials	-0.9	68%	30%
Other manufactured products	-1.2	85%	55%
Raw food & animal food	-1.3	87%	56%
Pharmaceuticals & para-chemical	-1.3	91%	60%
Processed foodstuffs	-1.3	81%	54%
Electrical goods	-1.4	86%	57%
Textiles & clothing	-1.7	87%	66%
Forestry products	-1.7	79%	53%
Metal products	-2.0	80%	66%
Chemicals, plastics, nuclear products	-2.3	93%	82%
Raw minerals and metals	-6.6	99%	97%
Petroleum products*	-9.4	99%	99%
Total without petroleum products	-1.7	93%	81%

Logically, the highest is the value (per ton) the lowest is the friction!

Evolution of friction (2005-2012)

	2005	2008	2010	2012
Import	-2.2	-1.6	-1.6	-1.7
Export	-2.0	-1.9	-1.8	-1.8
Total	-2.1	-1.6	-1.6	-1.7

Friction has been considerably relaxed between 2005 and 2008, and has remained almost unchanged.

Evolution of friction by trading region

	2008	2010	2012	Δ
North America	-2.1	-1.7	-1.8	↘
Central America	-3.6	-2.9	-2.4	↘
South America	-1.8	-2.0	-1.8	→
East Asia	-1.7	-1.6	-1.6	↘
South-East Asia	-1.4	-1.8	-2.0	↗
Southern Asia	-1.0	-1.7	-1.9	↗
Southern Africa	-2.9	-1.5	-2.1	↘
Rest of Africa	-1.9	-1.9	-2.0	↗
Europe (non-EU)	-2.6	-2.5	-2.4	↘
Middle-East	-1.5	-1.4	-1.9	↗
World (non-EU)	-1.6	-1.6	-1.7	↗

Main Container regions

Low Friction, but higher than East Asia

Low friction

High friction

The mainstream explanation (cascading)

Capacity deployment by trade route (Alphaliner, 2015)

Trade			2011				2013				2015	
route	S	M	L	XL	S	M	L	XL	S	M	L	XL
Europe-East Asia	0%	7%	28%	65%	0%	1%	12%	87%	0%	2%	7%	92%
Europe North America	2%	88%	10%	0%	2%	84%	14%	0%	1%	73%	19%	6%
Africa related	37%	56%	5%	2%	21%	64%	8%	7%	12%	64%	20%	4%
Latin America related	19%	65%	16%	0%	14%	41%	34%	11%	9%	32%	23%	37%
Intra Europe	71%	29%	0%	0%	66%	34%	0%	0%	61%	30%	9%	0%

But the increase of vessel size,

does it explain the whole picture?

Some alternative explanations

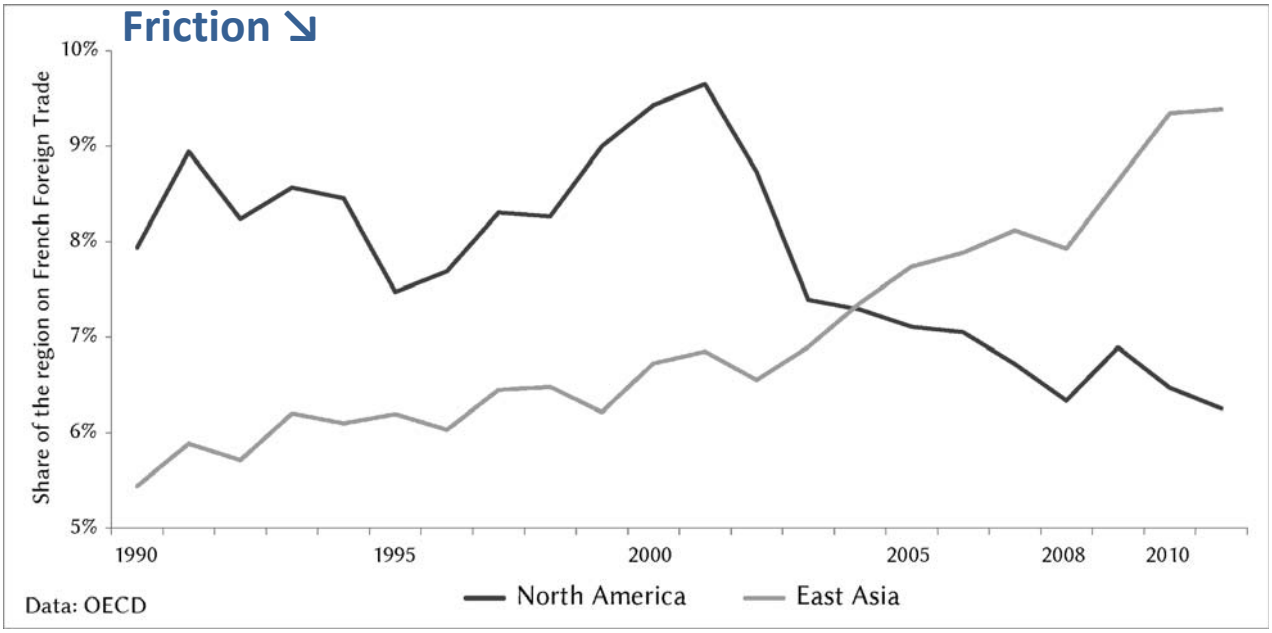
- A) Shift of the centre of gravity of French foreign trade.
- B) Change in the cargo mix of French intl. Trade
- C) Changes in the location of shippers in France

A) Shits on French foreign trade

The center of gravity of French trade has moved Eastwards

East-Asian trade is less distance constrained

Friction ↘



B) Changes in the cargo mix of French maritime trade

Less bulk, more containerized cargo

Friction ↘

Table 6 Evolution of the cargo mix of French ports (excluding ro-ro)

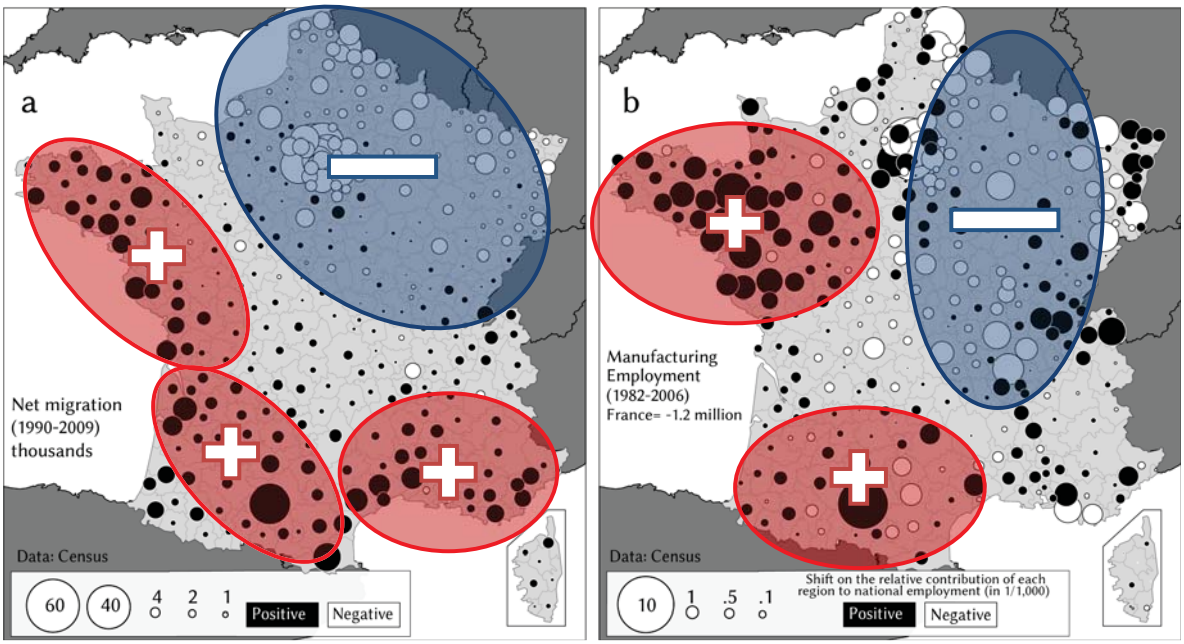
	2000	2002	2003	2005	2007	2009	2011
Petroleum products	53%	55%	53%	55%	53%	55%	52%
Other liquid bulk	4%	4%	4%	3%	4%	4%	5%
Solid bulk	29%	27%	28%	26%	26%	23%	26%
Containers	10%	10%	12%	13%	15%	15%	15%
General cargo	5%	4%	4%	3%	3%	3%	3%
Total	100%	100%	100%	100%	100%	100%	100%
Total (Mt)	303	292	302	311	317	280	284

Source: French Ministry of Transport

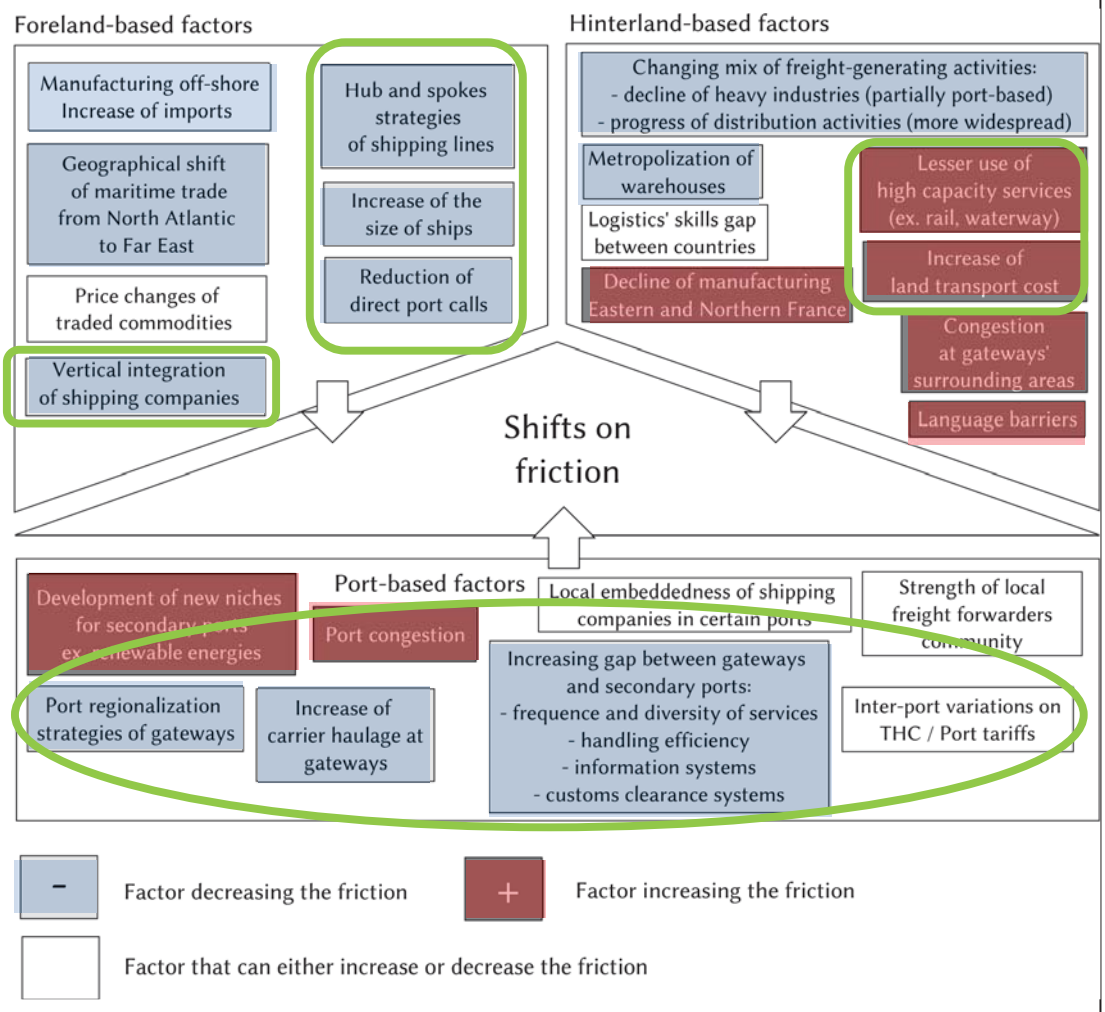
C) Long-term changes in the location of shippers

The center of gravity has moved towards the shore

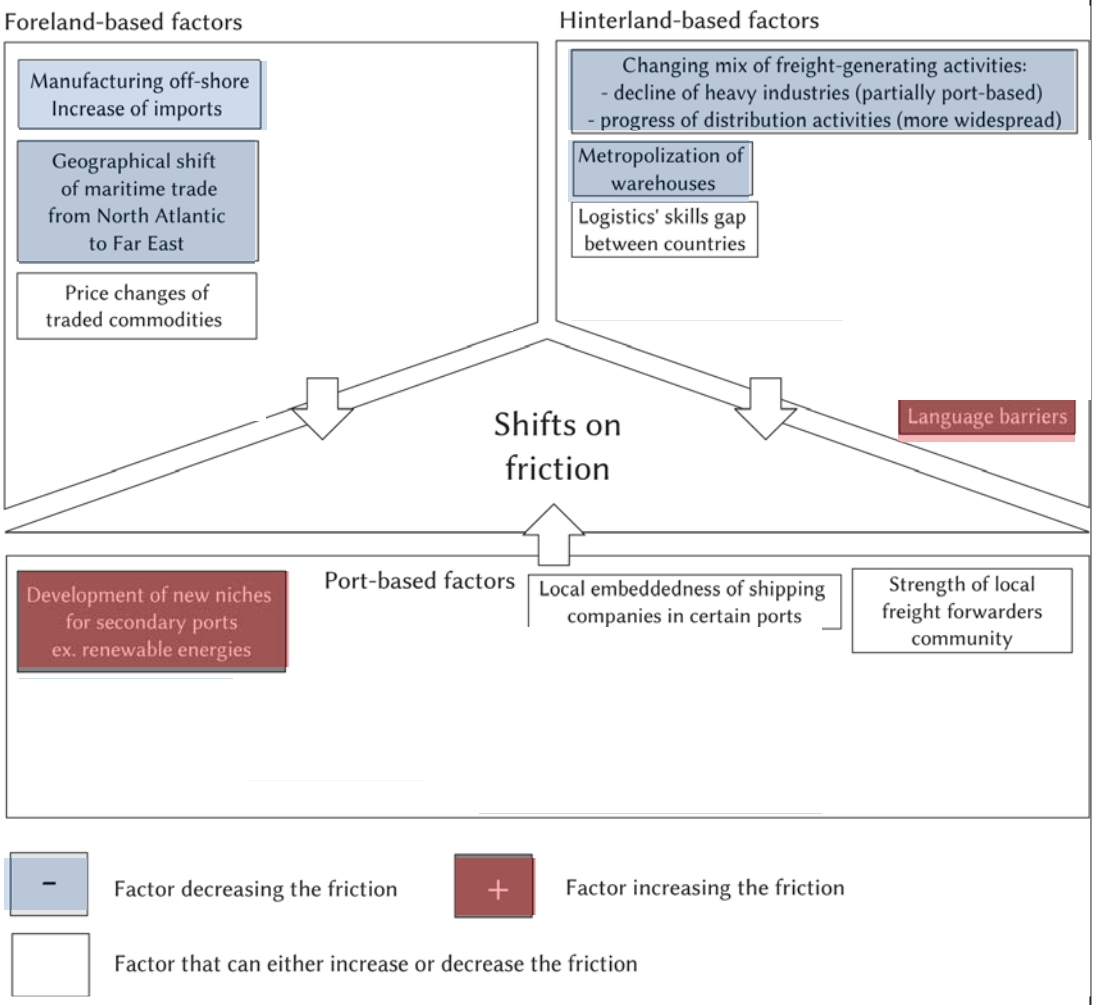
Friction ↗



Factors related to economies of scale



Alternative explanations



Conclusion

- The friction associated to inland distance has been relaxed in the recent years.
- Increasing economies of scale (specially vessel size increase) explain a part of the story.
- But the understanding of recent changes in French hinterlands requires taking in account other factors (ex. shifts in French foreign trade, changes in the location of shippers…)

Thank you!

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