Port Choice Problem and its applications.

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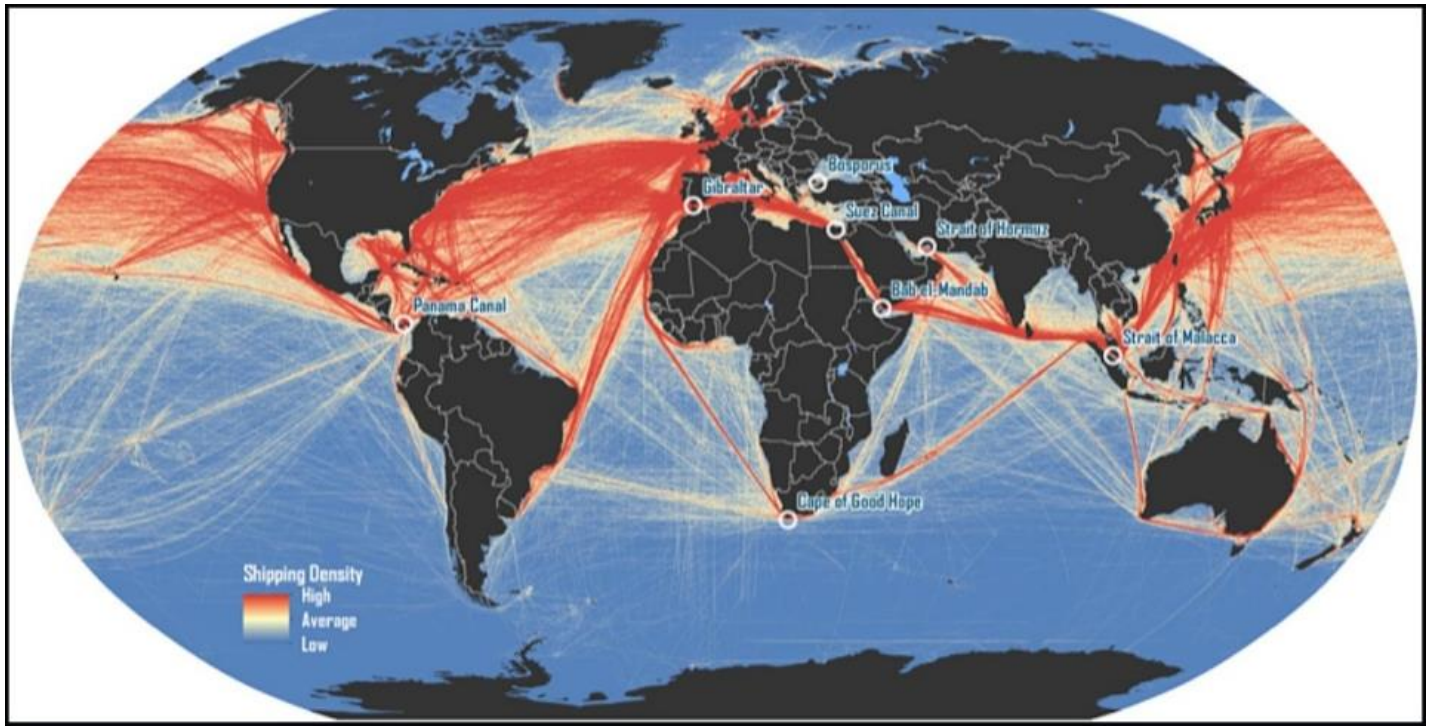
CONTAINER SHIPPING ROUTES



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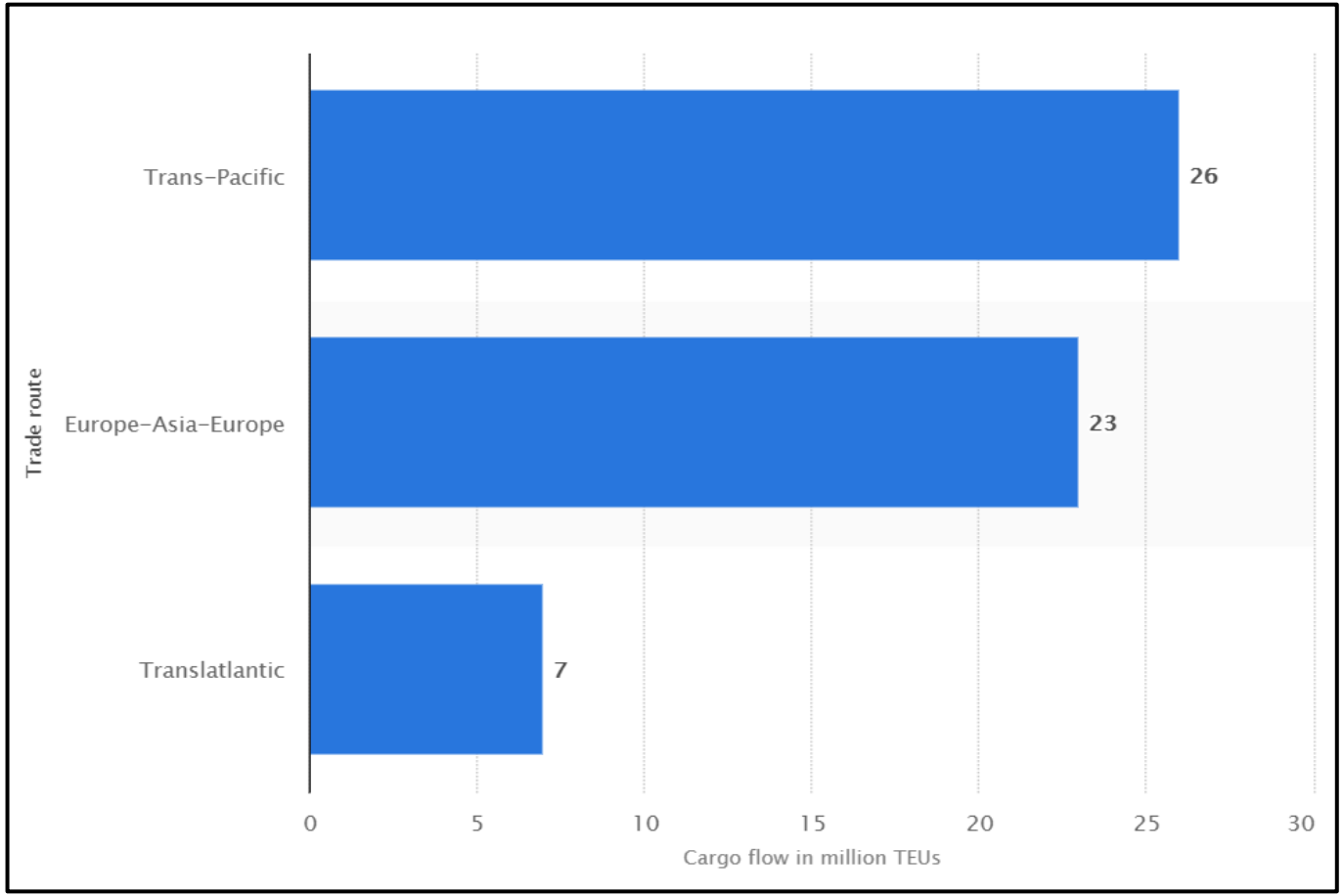
CONTAINERIZED CARGO FLOWS ON MAJOR CONTAINER TRADE ROUTES IN 2017 (in million TEUs)



Source: www.statista.com

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PORT CHOICE PROBLEM

- Generally the decision to route cargo through a port lies with shippers, although there are cases where freight forwarders and receivers can influence choice.
- Cargo source, port facilities, delivery distance, port location and operating cost have emerged in previous studies as major determinants of port choice.
- Much of the prior work implicitly assumes this choice involves minimizing total operation costs, or is made from a hinterland perspective.
- We widen this out to embrace more complex, less tangible objectives

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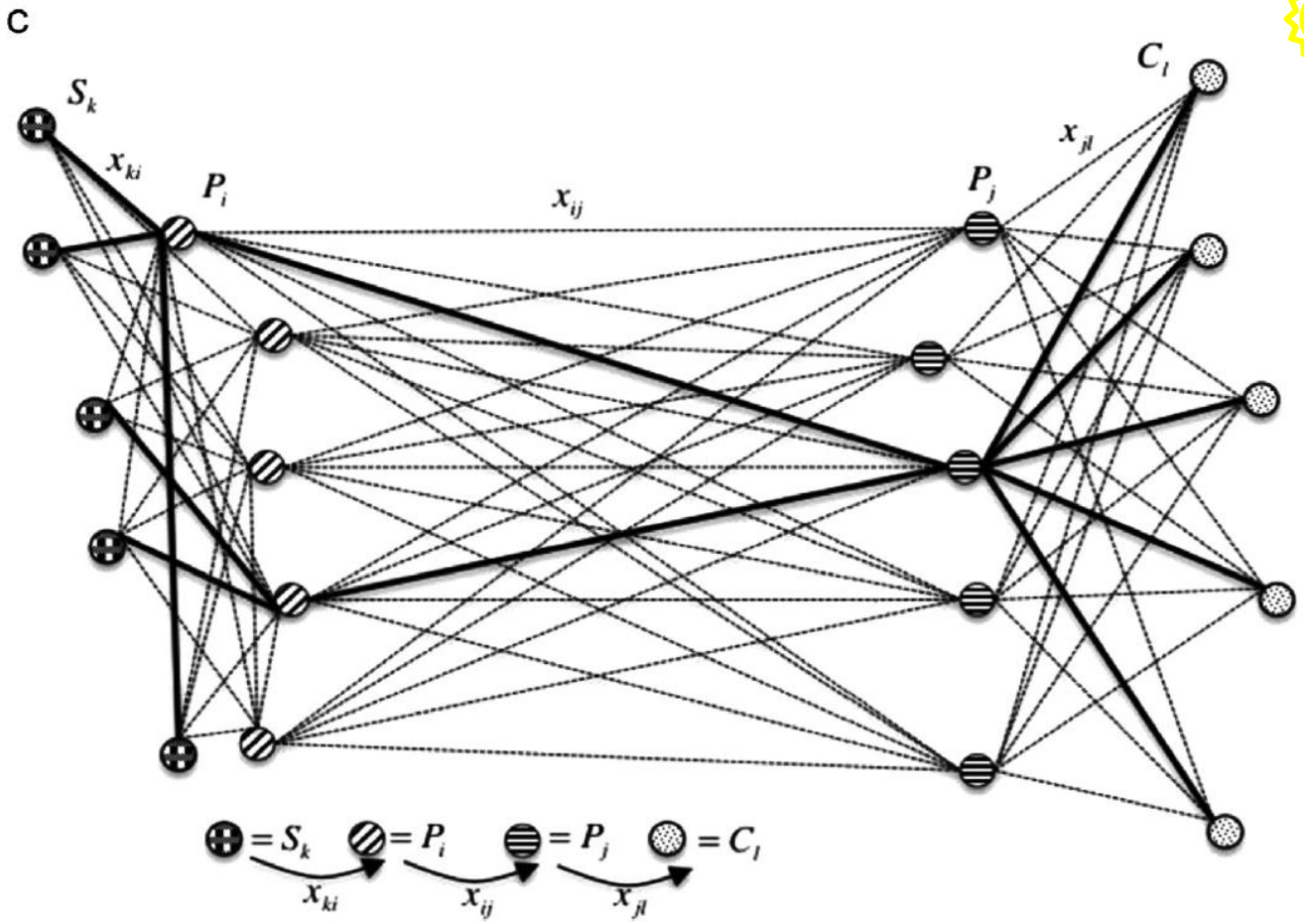
THE DEFINITON OF THE PROBLEM



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THE SOLUTION

Let's say:

PR_{Pj} is the preference rate for the j-th destination port obtained by AHP method.

We can write:

$$\omega_{\grave{P}_i P_j} \rightarrow \frac{1}{PR_{P_j}} \cdot \omega_{P_i P_j}$$

Now

weights are influenced by the preference rate.

- *Bigger the PR → Lower the Weight*
- *Lower the Weight → more chance to be in the final solution*

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THE PORTS


Hamburg
Rotterdam
Koper
Rijeka
Barcelona
Busan
Kaohsiung
Hong Kong
Port klang
Singapore

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STATED PREFERENCE

“AHP"

Surwey

- Questionare was sent to number of decision makers, mostly logistics providers…
- On both sides..

AHP

- The method was performed for both sides.

Preference rates of the ports.

Koper 0.199	Rijeka 0.199	Barcelona 0.201	Rotterdam 0.202	Hamburg 0.199
Singapore 0.211	Hong Kong 0.211	Busan 0.202	Kaohsiung 0.196	Port Klang 0.180

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THE DATA

Considered data

- PR
- Port cost
- Sailing time
- Land transport cost

Costs for production points ($/TEU).
Source: Slovenske (2012)

	Production points				
	A	B	C	D	E
Singapore	1316	931	2436	2033	3541
Hong Kong	1404	1136	2202	1901	3806
Busan	4573	4540	3091	3947	7233
Kaohsiung	1890	2454	970	530	4729
Port Klang	1279	1932	1937	923	3760
	Consumption points				
	Prague	Vienna	Paris	Cologne	Kiev
Koper	1316	931	2436	2033	3541
Rijeka	1373	918	2571	2174	3448
Barcelona	4459	4753	2785	3546	7925
Rotterdam	1890	2454	970	530	4729
Hamburg	1279	1932	1937	923	3760

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THE RESULTS

Programming results.

Port choice					
	Koper	Rijeka	Barcelona	Rotterdam	Hamburg
Port charges	34,033	35,855	30,898	43,052	32,900
Preference rate	0.199	0.199	0.201	0.202	0.199
$\Sigma P_j C_i$ for all I	3945	4032	8994	4067	3781
Σ sailing times $P_i P_j$ for all i	73.13	73.03	76.88	92.71	95.11
Final weight	78,958.9	79,592.2	118,241.4	81,985.0	80,513.9

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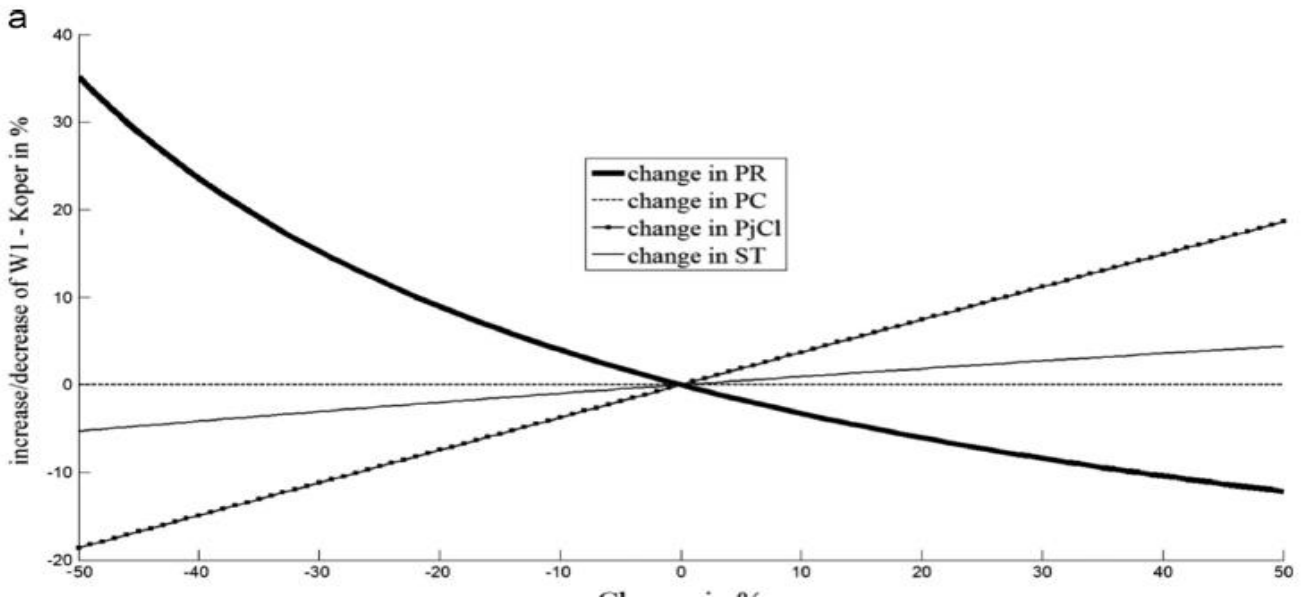
SENSITIVITY ANALYSES

Considered data

For sensitivity analysis we focus on four input factors and allow changes between -50% and +50% from the initial solution.



Source: www.porteconomics.eu

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- Kramberger, Tomaž, Rupnik, Bojan, Štrubelj, Gregor, Prah, Klemen. **Port hinterland modelling based on port choice**. *Promet*,. [Print ed.], 2015.
- Button, Kenneth John, **KRAMBERGER, Tomaž**, Vizinger, Tea, Intihar, Marko. **Economic implications for Adriatic seaport regions of further opening of the Northern Sea Route**. *Maritime economics & logistics*, ISSN 1479-294X. [Spletna izd.], Mar. 2017
- **Kramberger, Tomaž**, Monios, Jason, Strubelj, Gregor and Rupnik, Bojan. **Using dry ports for port co-opetition: the case of Adriatic ports**, Int. J. Shipping and Transport Logistics, Vol. 10, No. 1, 2018.
- **Kramberger, Tomaž**, Intihar, Marko, Vanelslander, Thierry and Vizinger, Tea. **On Distance Decay in Port Choice.** Technical Gazette, Vol. 25, No. 5, 2018.

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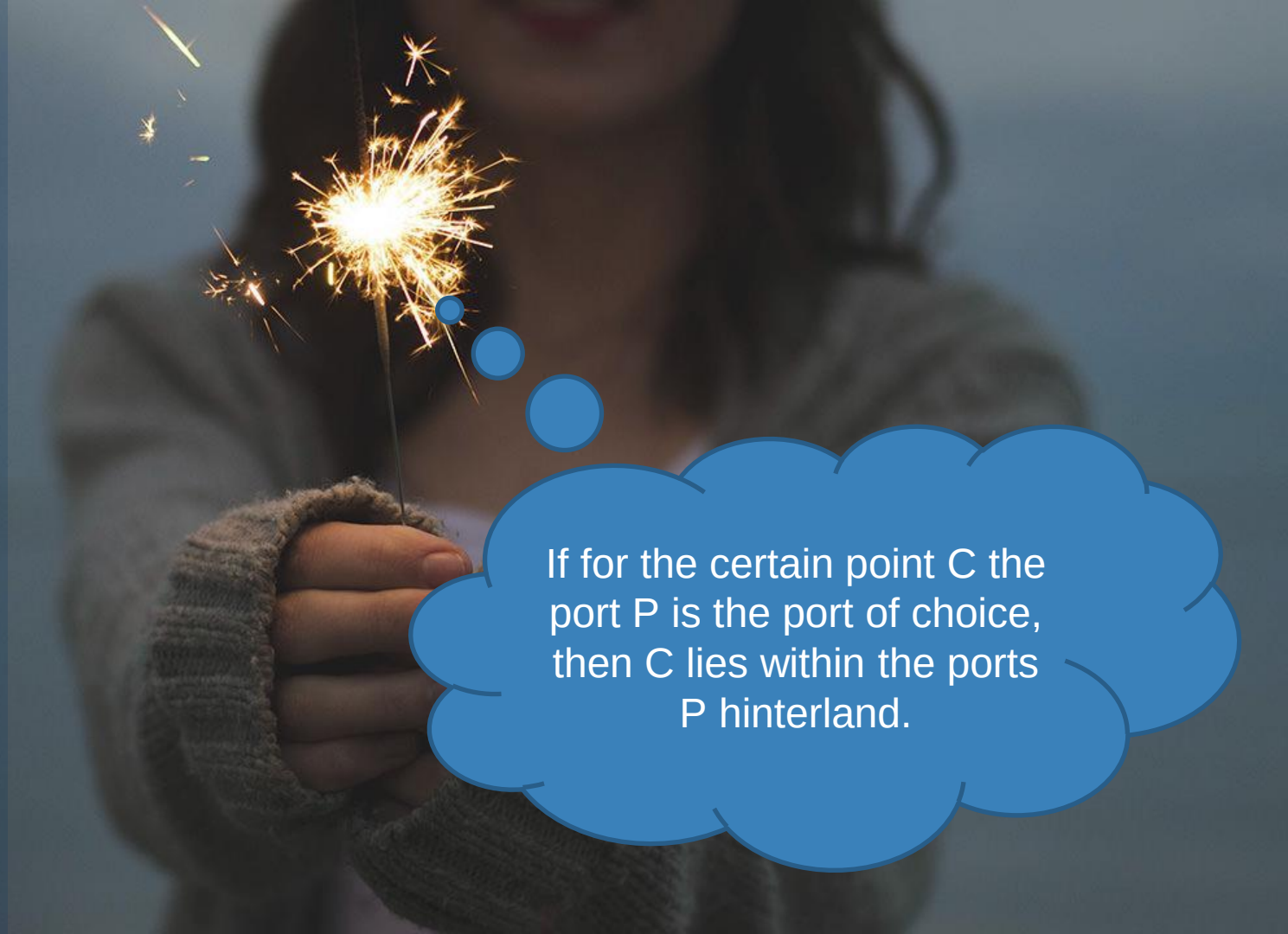
Application No. 1: HINTERLAND MODELLING



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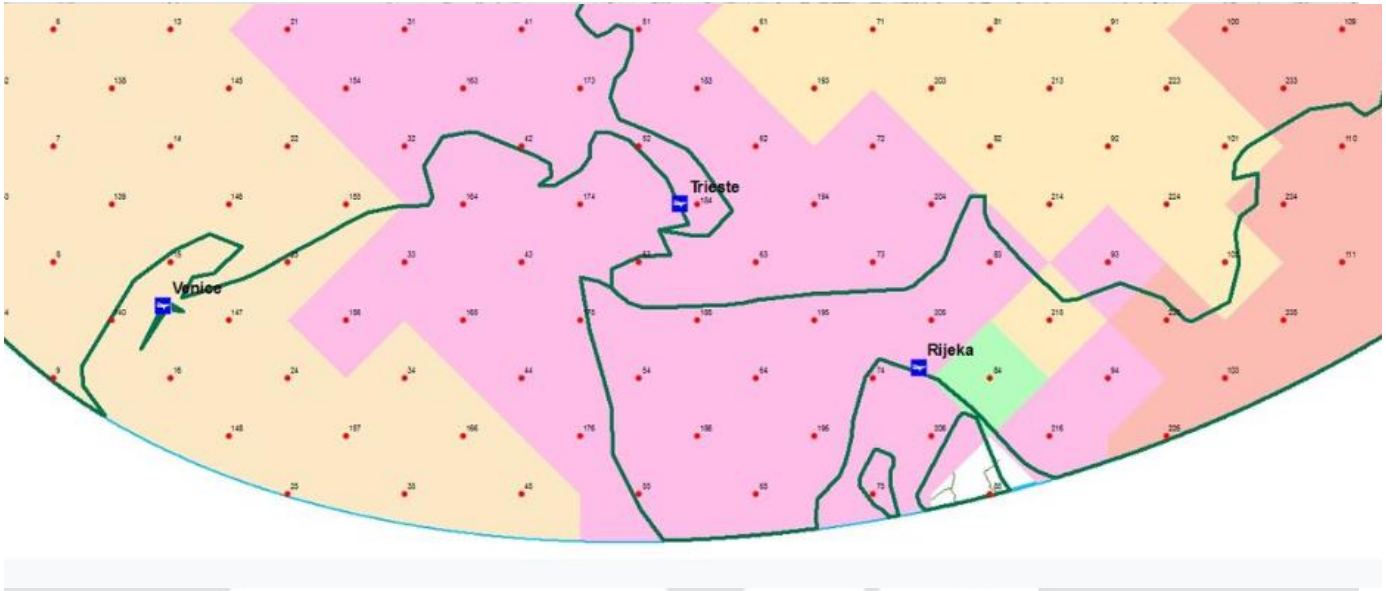
HINTERLAND MODEL

- Uniformly distributed points ower the selected area
- Calculation of „Port of choice“ for each point
- Connecting points with the same “ Port of choice“
- Creation of Voronoi diagrams



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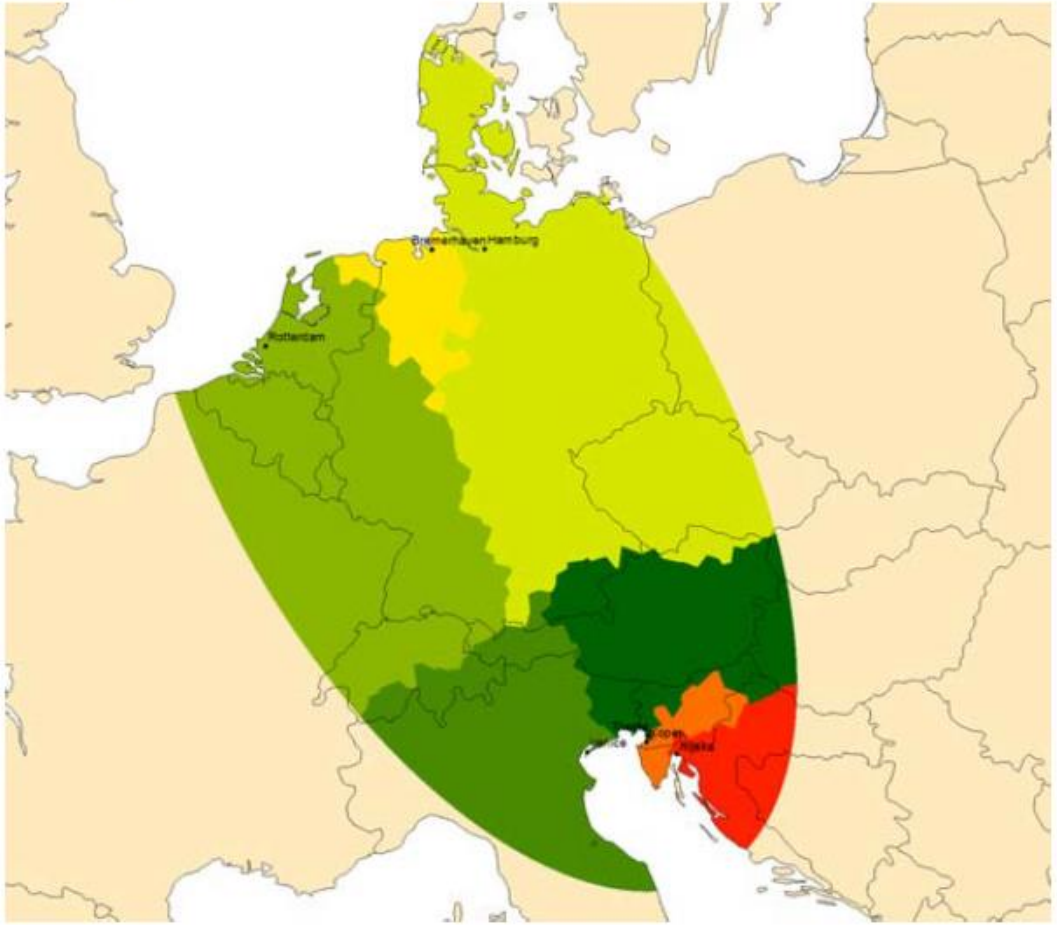
THE CASE OF ADRIATIC PORTS

Figure 2 Initial port hinterlands (see online version for colours)



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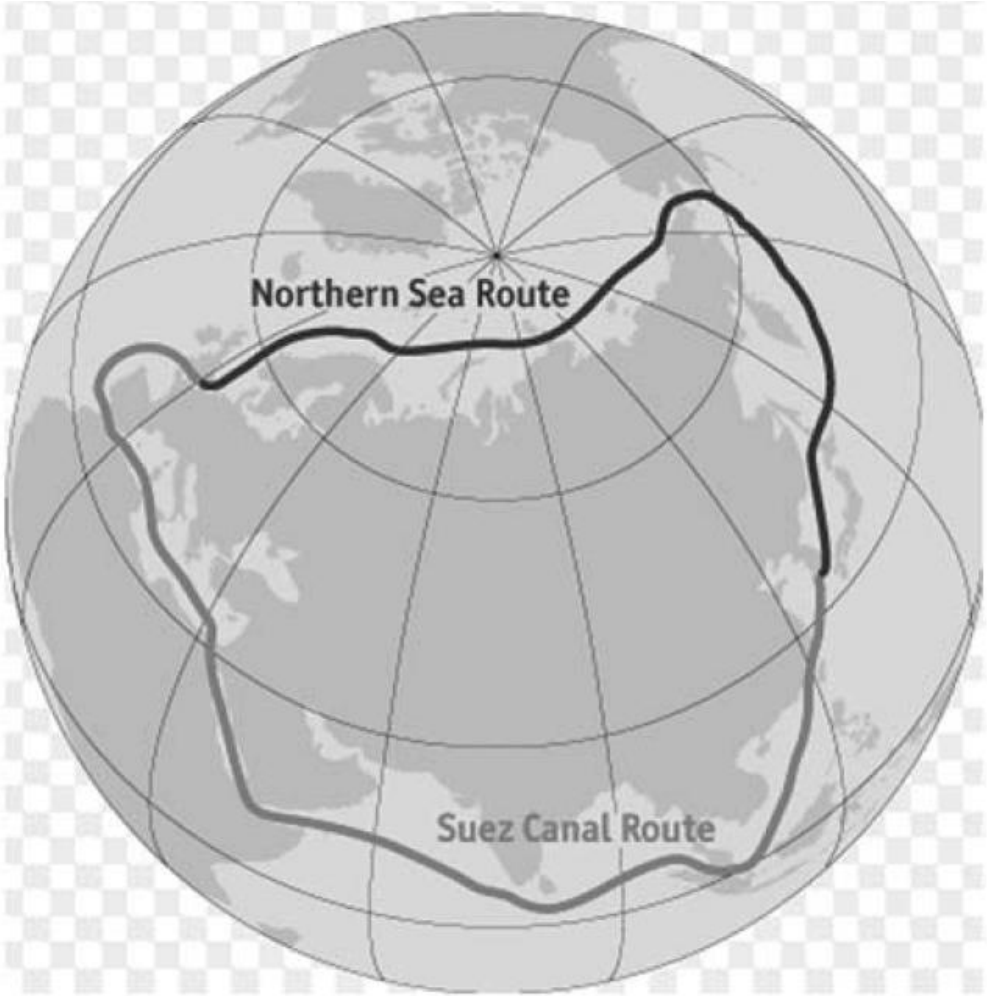
Application No. 2: Opening of the Northern Sea Route



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Opening of the Northern Sea Route

Table 4: Relative port attractiveness

	Suez Canal route			*NSR*			
	Cost US ($/TEU)	*Port rank*	*Attractiveness*	*Cost ($/TEU)*	*Port rank*	*Attractiveness*	*Δ (%) Attractiveness*
Koper	5271.3	5	0.1187	5731.3	5	0.1095	−8
Rijeka	5577.7	7	0.1121	5854.7	7	0.1072	−4
Trieste	4898.1	4	0.1277	5391.5	4	0.1164	−9
Venezia	5378.9	6	0.1163	5764.9	6	0.1088	−6
Ravenna	6257.9	8	0.0999	6308.3	8	0.0995	0
Rotterdam	4464.1	3	0.1401	4206.3	3	0.1492	+6
Hamburg	4359.6	1	0.1435	4008.0	1	0.1565	+9
Bremerhaven	4413.9	2	0.1417	4099.0	2	0.1531	+8

Note: The estimated sailing costs make no adjustment for probable slower sailing speeds on the NSR.

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Application No. 3: MODELLING CO-OPETITION

Captive and competitive hinterland

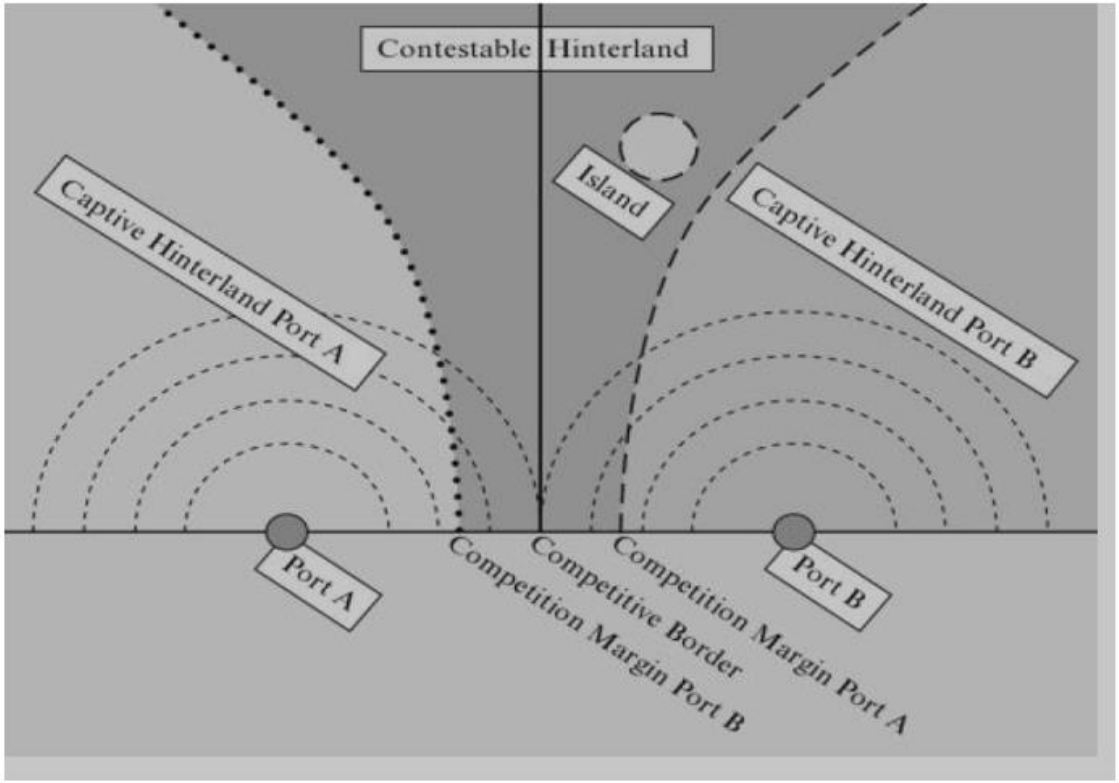

Figure 1: Captive and contestable hinterlands.

Source: Kronbak & Cullinane (2011)

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COMPETITIVE BORDER AND MARGIN

Captive and competitive hinterland

Table 3 Increase of hinterland size in % as a result of PR increases

Area	*Index when Increasing PR in % (no combined dry port)*					
	+5	*+10*	*+15*	*+20*	*+25*	*+30*
Adriatic	1.00	1.00	1.00	1.01	1.03	1.06
Northern	1.00	1.00	1.00	1.00	0.99	0.97
	Index when Increasing PR in % (with combined dry port)					
Adriatic	1.02	1.04	1.06	1.11	1.14	1.18
Northern	0.99	0.98	0.97	0.95	0.94	0.92

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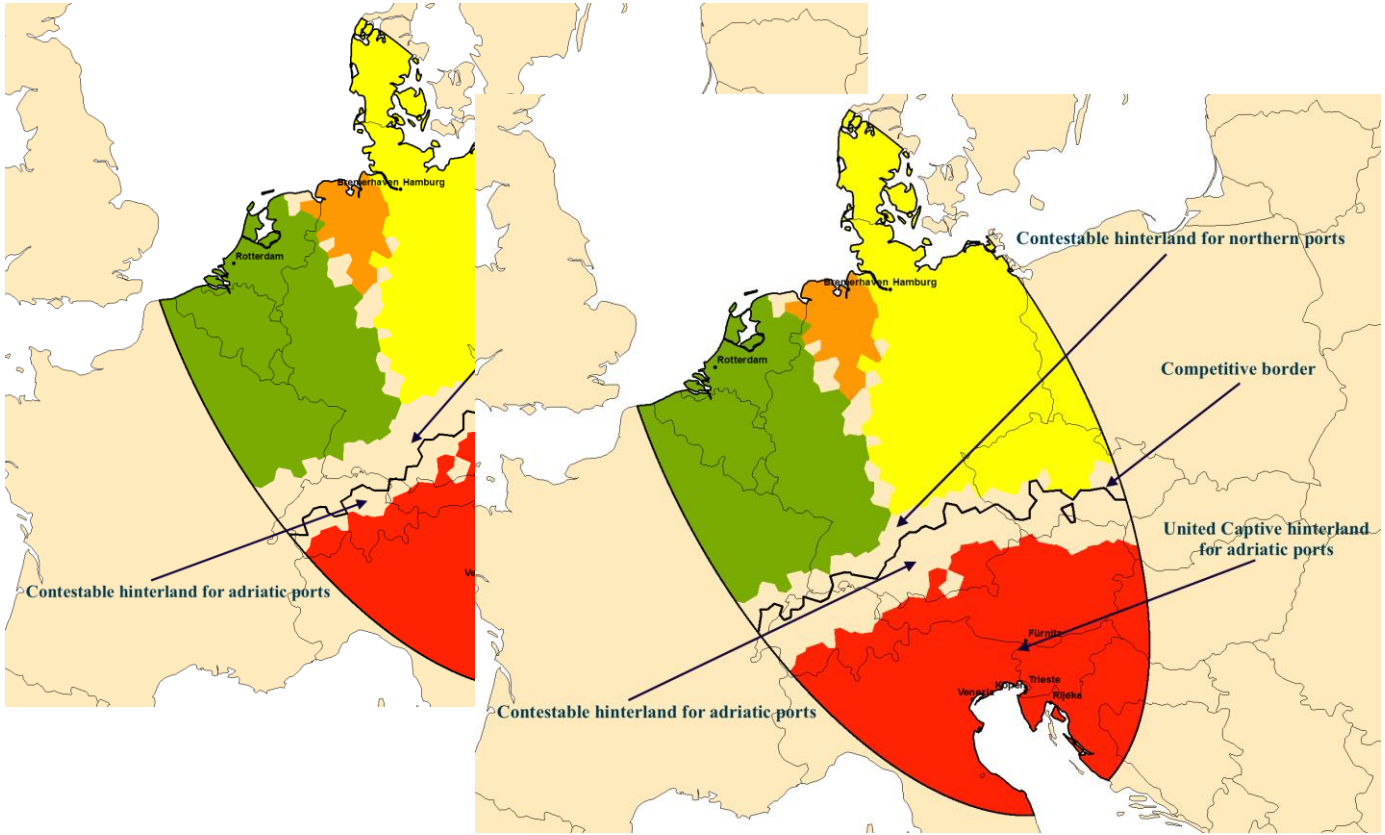
COMPETITIVE BORDER AND MARGIN

Captive and competitive hinterland combined dryport for Adriatic ports PR 15, 30%



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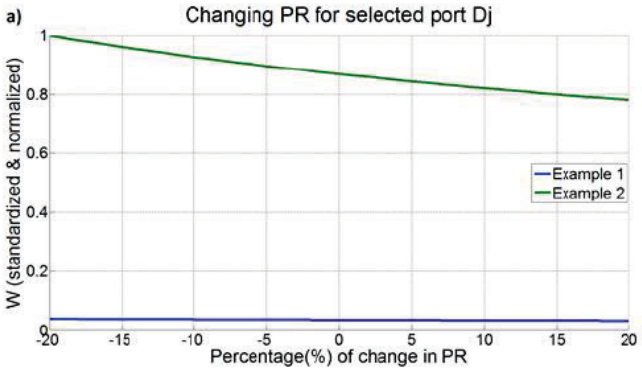
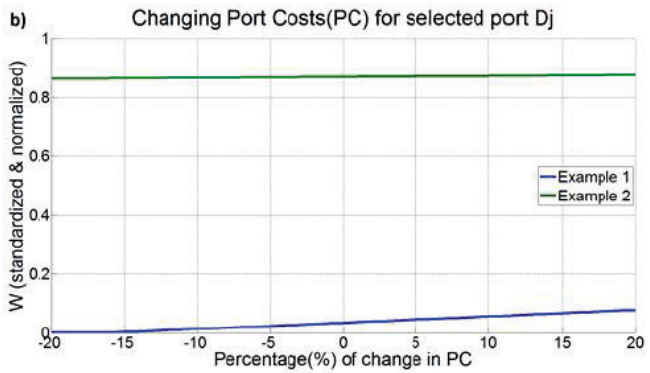
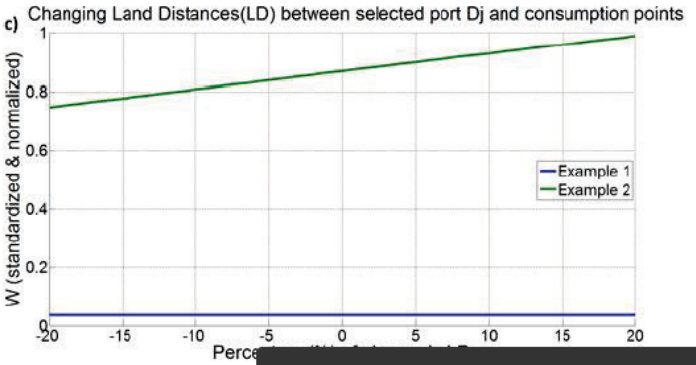
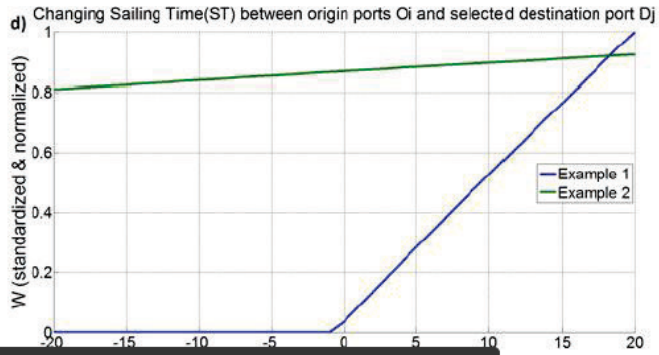
Application No. 4: On distance decay









THANKS!

Any questions?

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