UNCTAD
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Assessing Port Performance

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Principle Component Analysis As a tool to rank ports and track their relative evolution

by

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Principal Component Analysis

As a tool to rank ports and track their relative evolution

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The need

- All ports are different
- Most ports keep statistics but collection methods are diverse
- Compare the aggregated ports in the Flemish-Dutch Delta with other port regions

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The methodology

- Principal component analysis
- Reduces the number of variables
- Through rotation the new variable set will have as little correlation as possible
- The new set will approach the variation of the original set
- Scree analysis
- Orthogonal rotation

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Choice of data series

- Limited sets internationally available
- Missing :
  - Input : employees, investment, maintenance
  - Output : value added
  - Connectivity
  - Modal split
  - Sustainability
  - ….

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The data collection

- Data that are widely available and with analogue collection methods
- Data that are related to the topic
- Throughput data for the years 2001-2011
- Flemish-Dutch Delta: Antwerp, Ghent, Zeebruges, Zeeland, Rotterdam
- North-Germany: Hamburg, Bremen
- France-Atlantic: Le Havre, Dunkerque
- South-Europe: Marseille, Constanta
- Asia: Singapore

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Sources

- Annual reports
- National sectorial reports
- Websites
- Personal contact

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Principal Component Analysis

- **Model A**
  - Dry bulk, Liquid bulk, Containers, Roro, General Cargo
  - 84% explanatory power
  - 2 components
  - Component 1 : 49% : LB, Con, GenCar
  - Component 2 : 35% : LB, DB, Roro

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Model A

Rotated Component Matrix[a]

	Component	
	1	2
DryBulk		,815
LiqBulk	,731	,579
Contain	,952	
Roro		,873
ConvCargo	,931	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

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Principal Component Analysis

- **Model B**
  - Dry bulk, Liquid bulk, Containers, Roro, General Cargo + Gross Regional Product
  - 80% explanatory power
  - 2 components
  - Component 1 : 51% : LB, Con, GenCar + GrosRegProd
  - Component 2 : 29% : LB, DB, Roro

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Model B

Rotated Component Matrix[a]

	Component	
	1	2
GrosRegProd	,845	
DryBulk		,809
LiqBulk	,754	,569
Contain	,956	
Roro		,869
ConvCargo	,872	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

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The analysis

- Model B : LB, Con, GenCargo correlate with GrosRegProd
- Containers, General Cargo create Value added in the port region, Liquid bulk partially
- Model A : data available up to 2011

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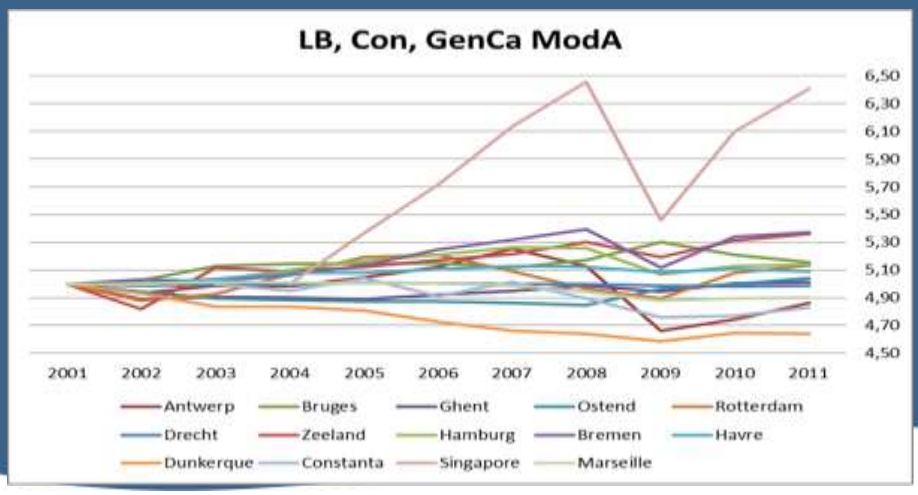
Model A – Component1



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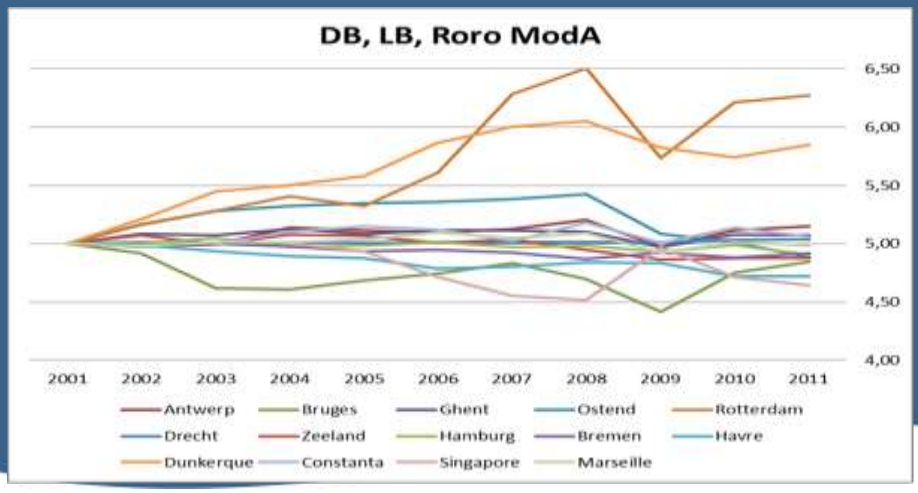
Model A – Component2



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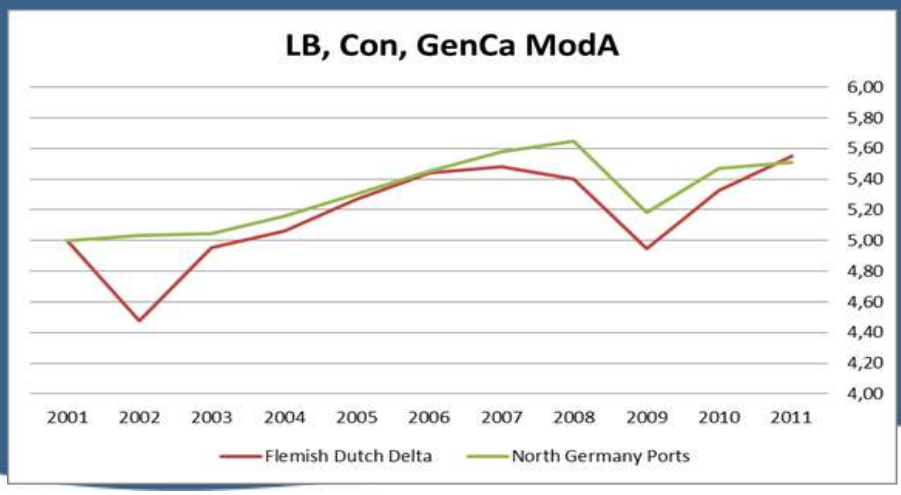
Comparing multi-port regions



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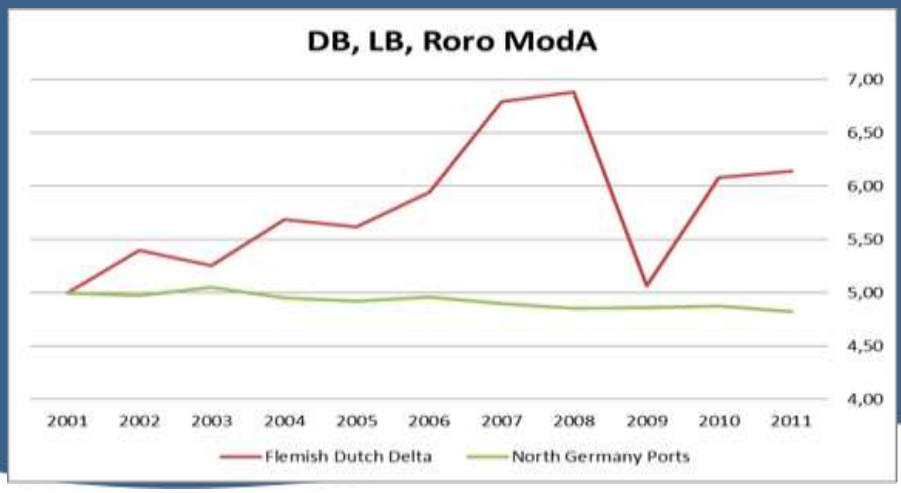
Comparing multi-port regions



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Remaining research questions

- Other parts of the triptych
  - Added value in port region
  - Connectivity hinterland
- Other ports

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Conclusion

- PCA as a tool to rank port evolution
  - Unbiased
  - Robust
  - Flexible

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