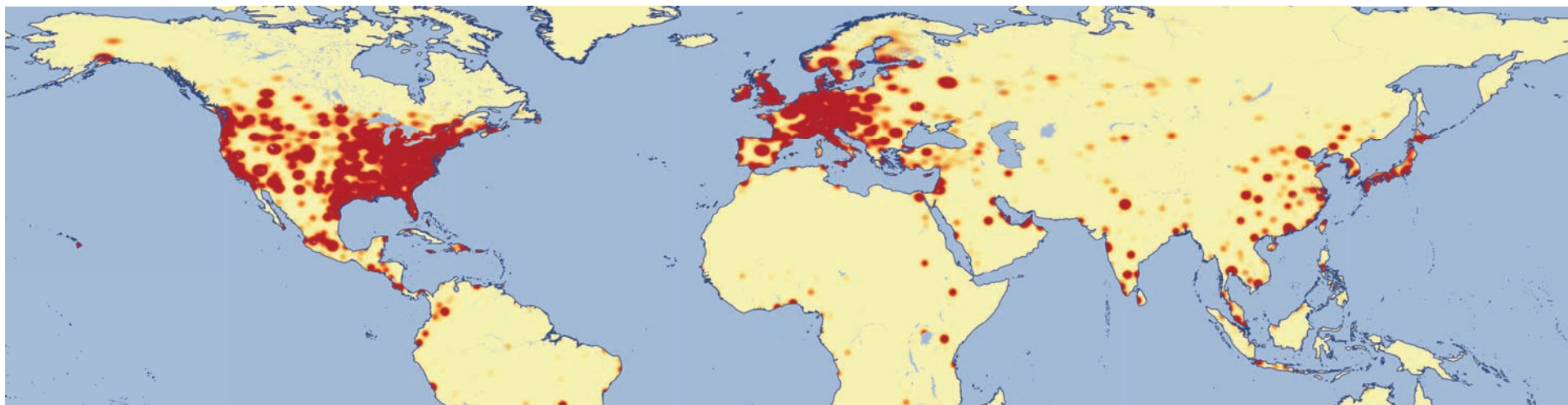




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and the Environment

Massachusetts Institute of Technology



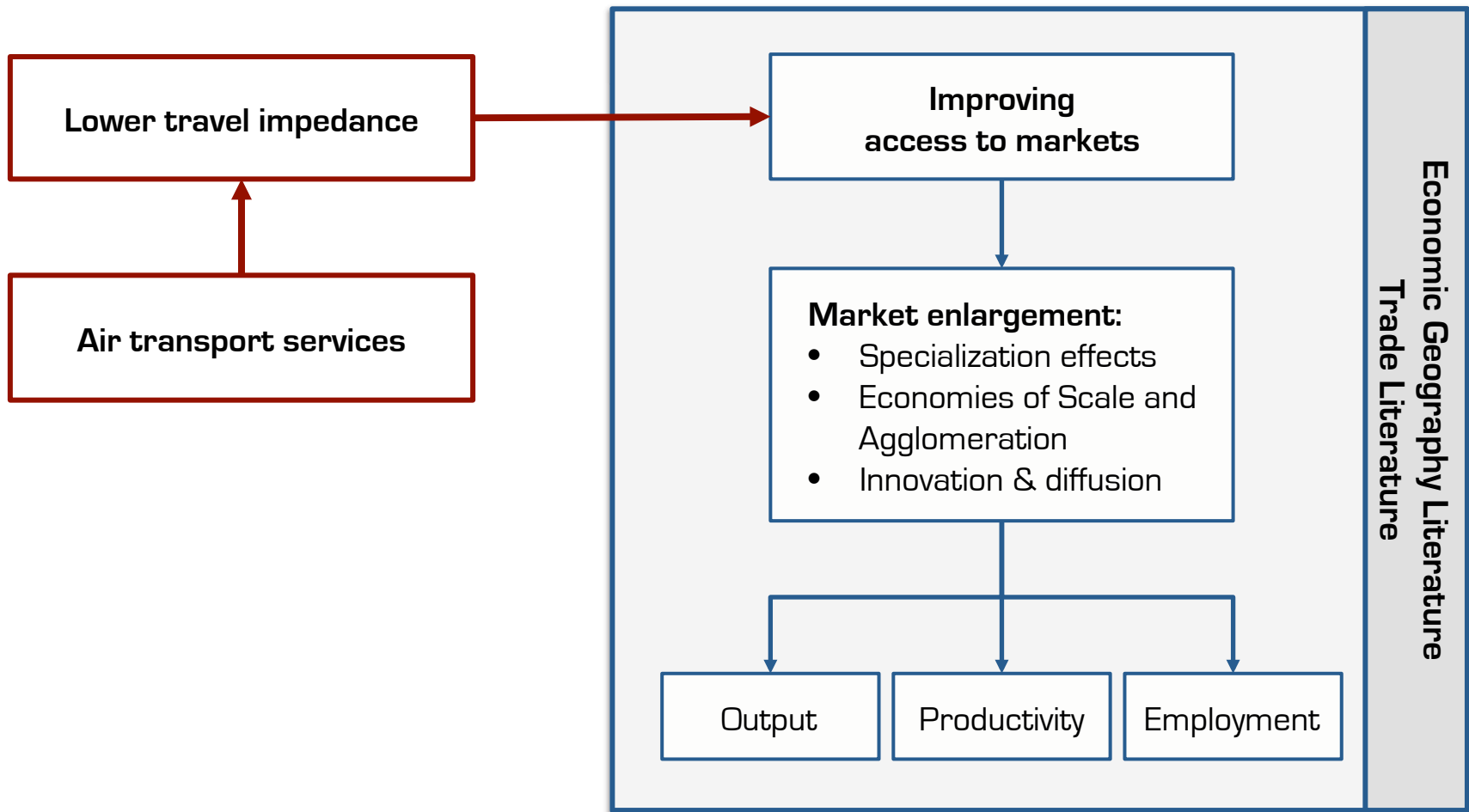
How air transport connects the world - A New Model of Global Air Connectivity

Robert Malina, Florian Allroggen, Michael Wittman

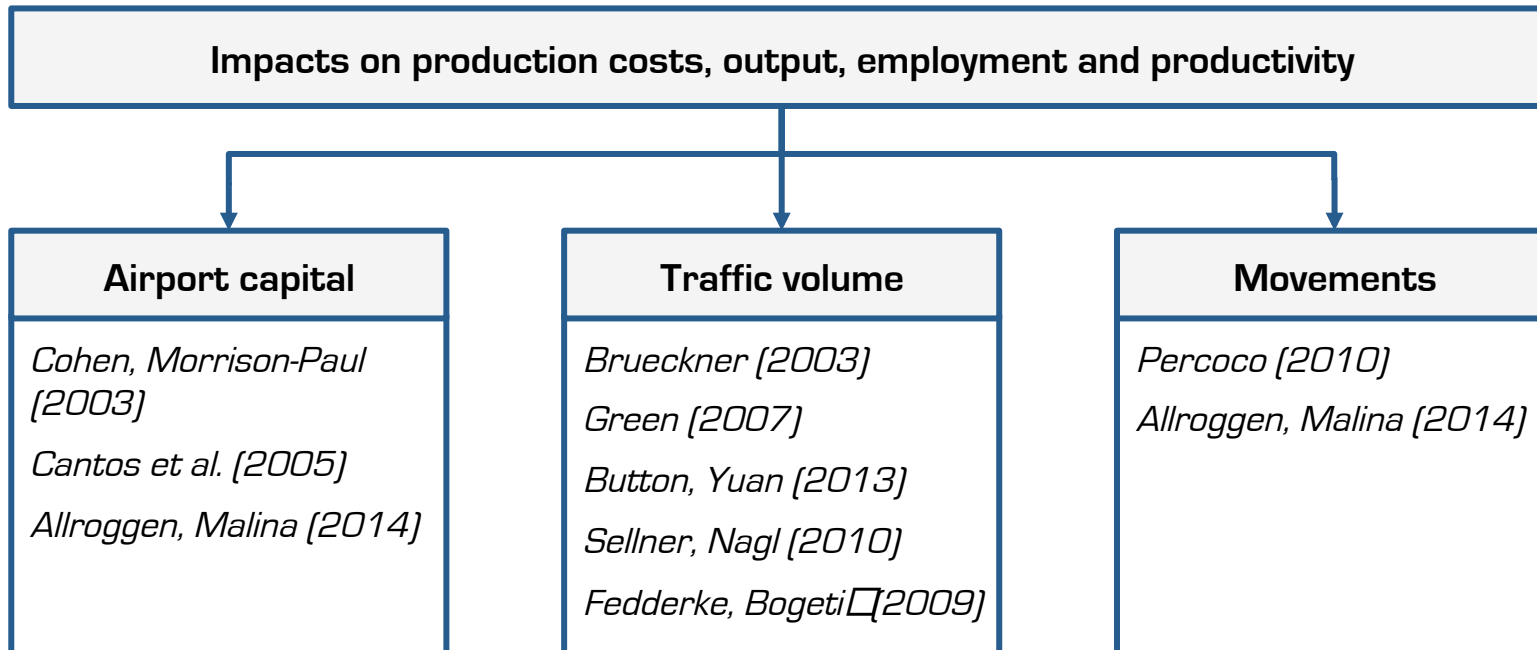
Konferenz Verkehrsökonomik und -politik
Berlin, June 12th, 2015

Causal links

Generation of economic effects through air transportation:



Existing empirical work



- No destination markets / destination quality
- No direct or indirect links



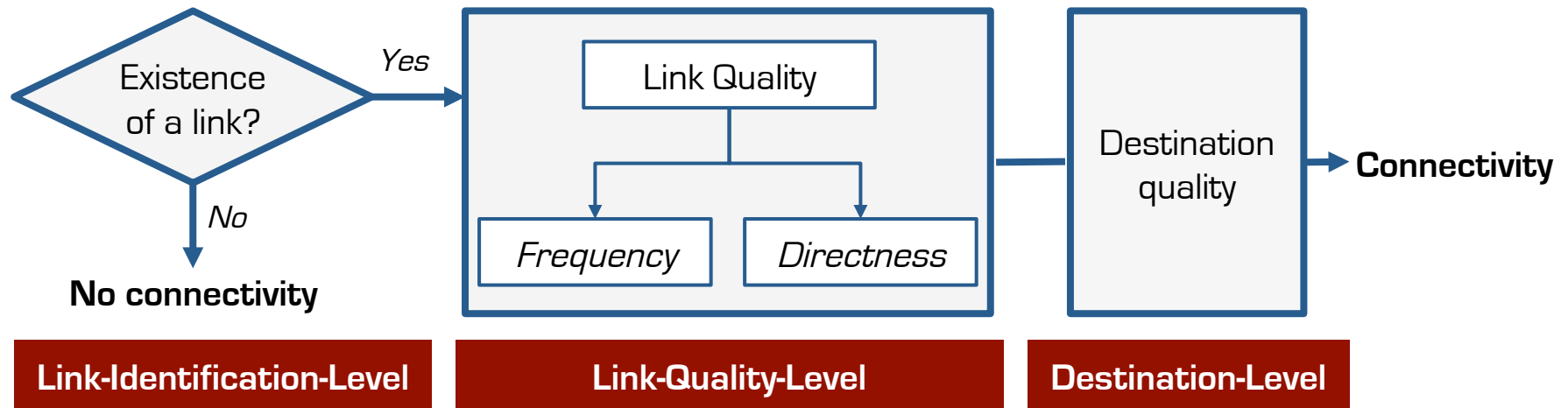
Metric of market access as generated through air transportation needed

Agenda

- 1. The connectivity model**
2. Implications from the connectivity model
 - a. The significance of indirect connectivity
 - b. Generation of indirect connectivity
 - c. The significance of destination weights
- 3. Conclusions**

Outlining the connectivity model

The Global Connectivity Index is computed through the following steps:



- Data source: OAG schedules
- Identify nonstop flights
- Onestop itinerary generator:
 - Minimum connecting time
 - Feasible airline combinations

- **Frequency:** Counter of Ops.
- **Directness:** Value of a onestop route as compared to a nonstop flight:
 - Additional flight time
 - Layover time

- Global grid of wealth-adjusted population
- Distance-decay

The Metric

Two core metrics are used in this presentation:

GCI

Global Connectivity
Index

$$GCI_{A,t} = \sum_{r \in R_{A,t}} f_{r,t} \alpha_{r,t} w_{d,t}$$

Destination-Invariant
GCI

Global Connectivity
Index without
destination weights

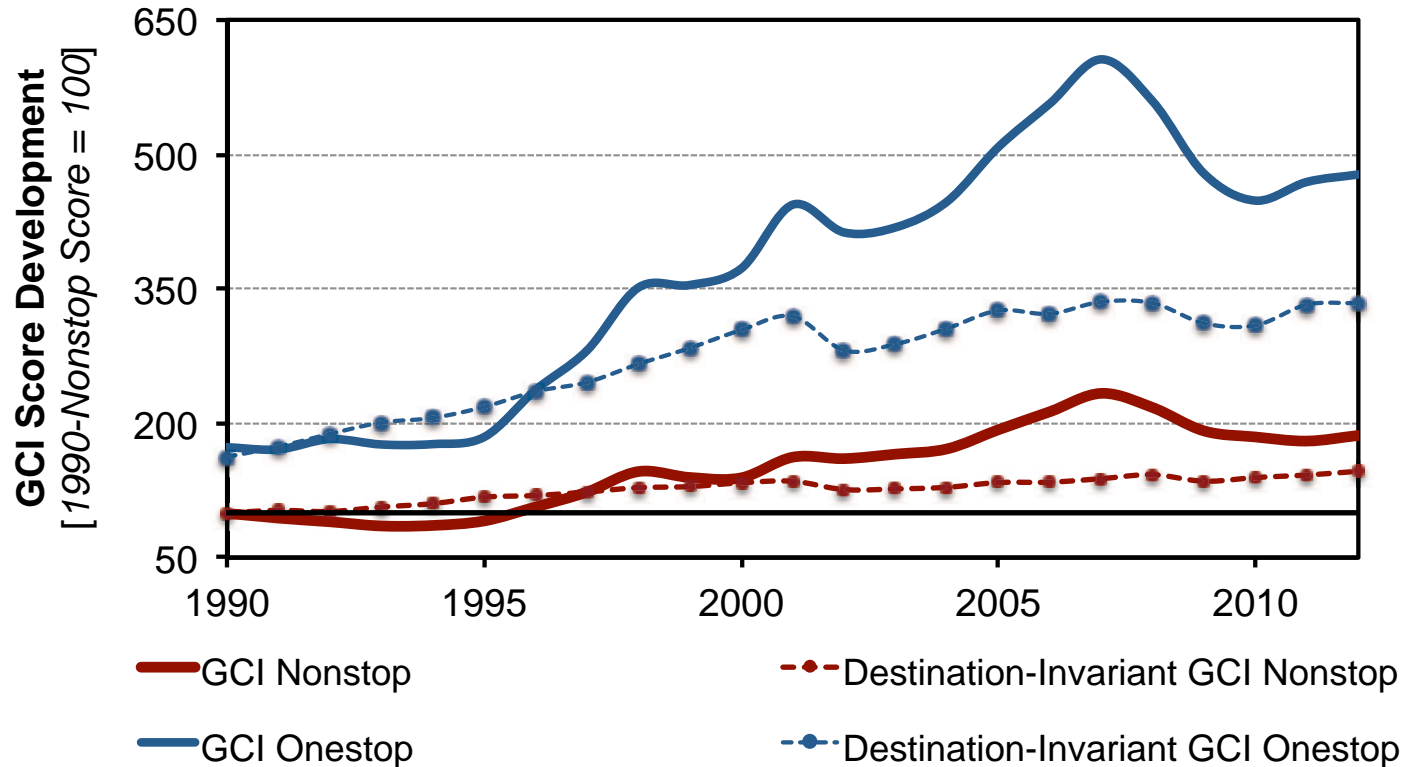
$$GCI_{A,t}^{cw_one} = \sum_{r \in R_{A,t}} f_{r,t} \alpha_{r,t}$$

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Nonstop and onestop GCI

Global nonstop and onestop GCI trends:

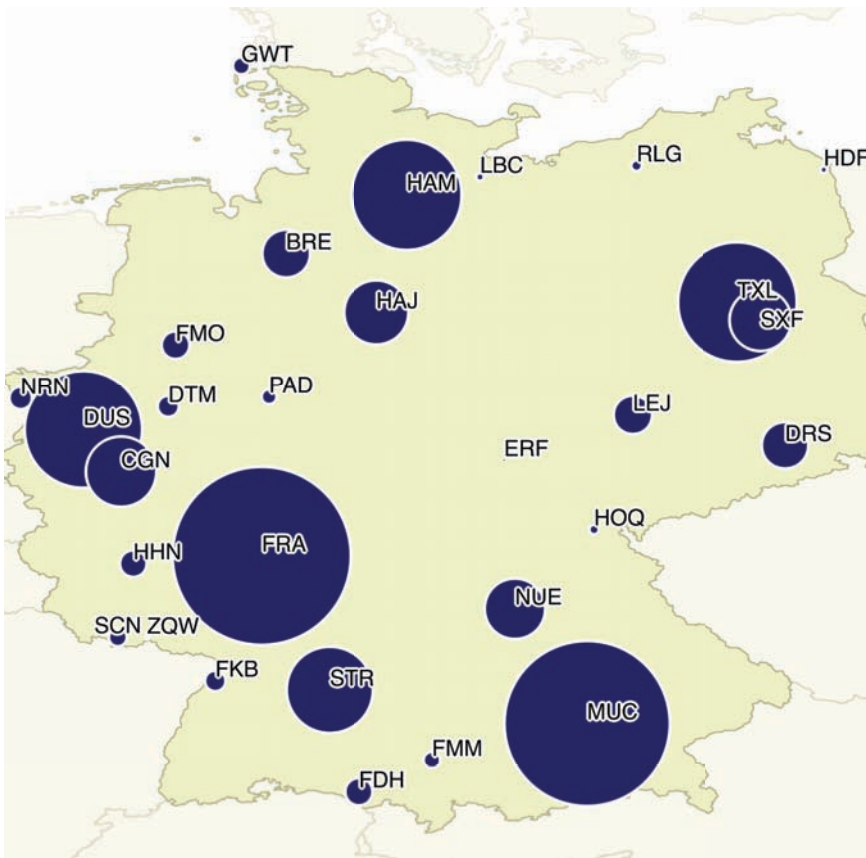


Onestop GCI growth (CAGR: 4.7 %) higher than nonstop GCI growth (CAGR: 2.9 %).

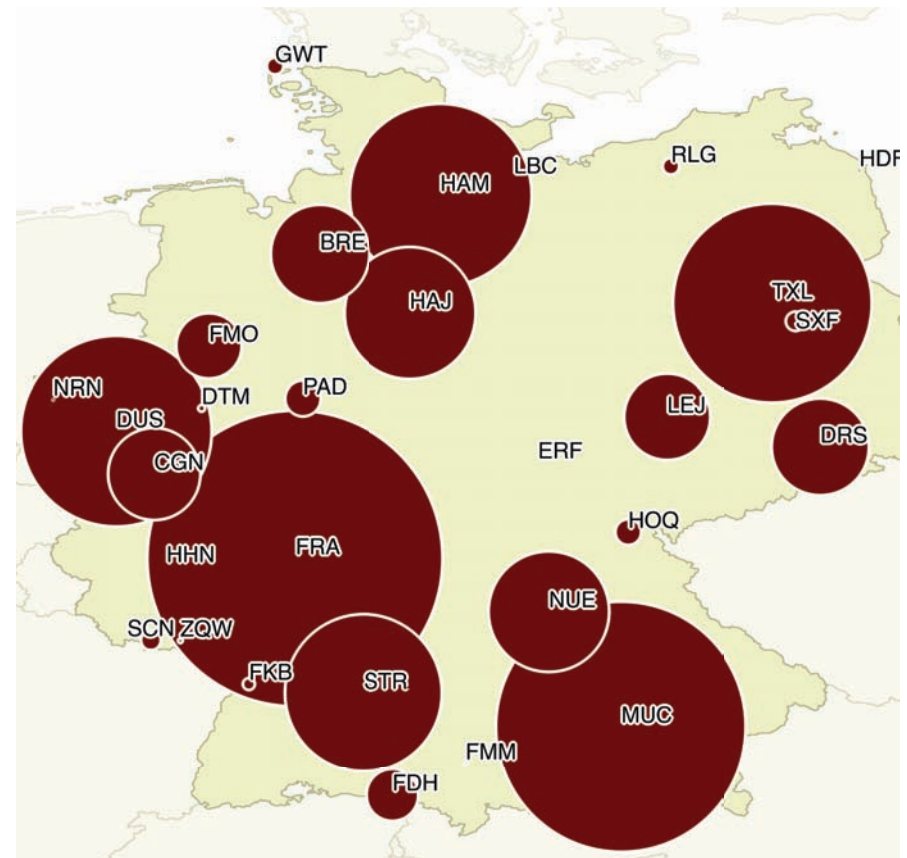
Nonstop and onestop GCI

Heterogeneity in distribution of nonstop and onestop GCI among German airports:

Nonstop GCI, year 2012

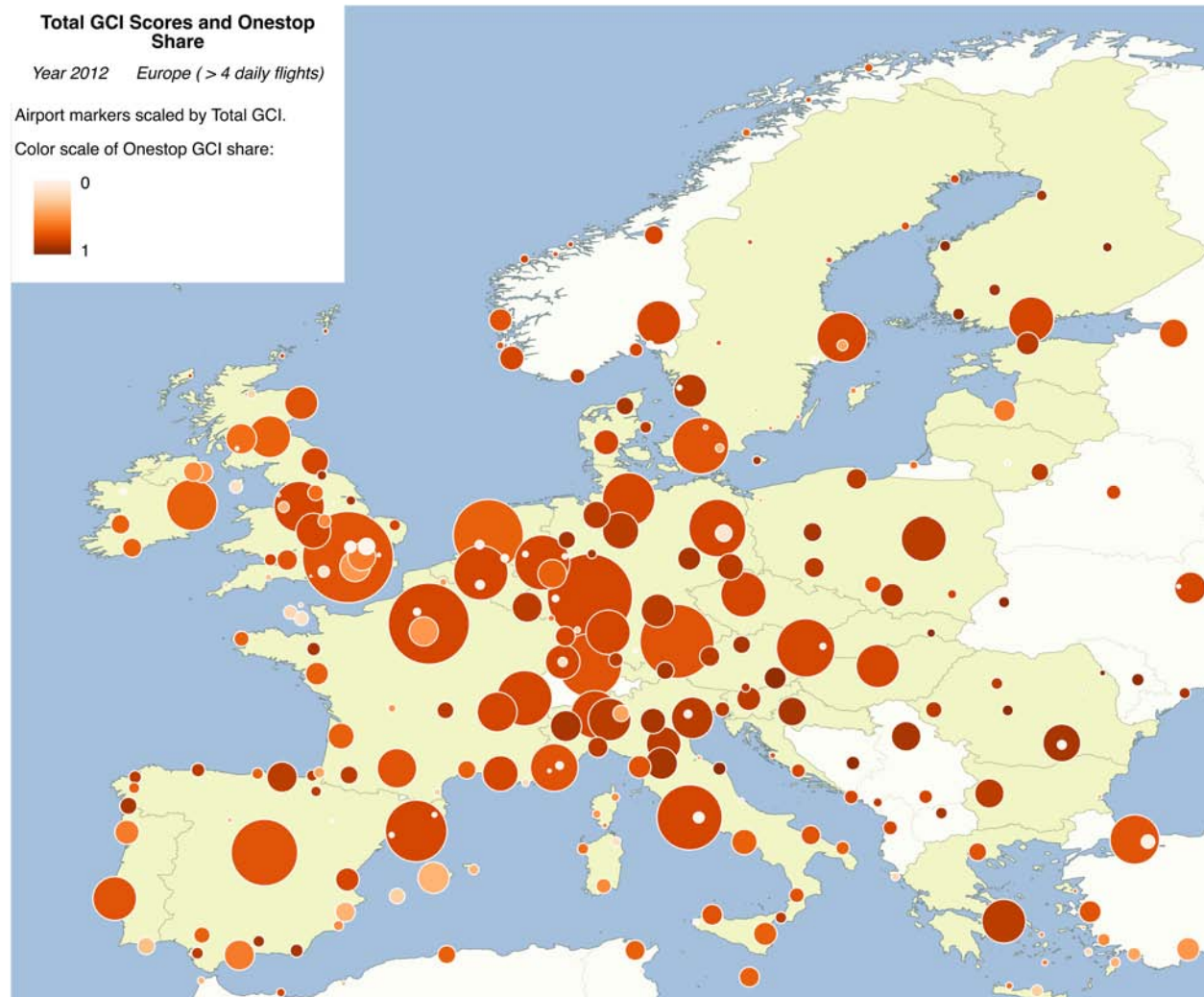


Onestop GCI, year 2012



Nonstop and onestop GCI

Total connectivity and share of onestop connectivity at European airports:



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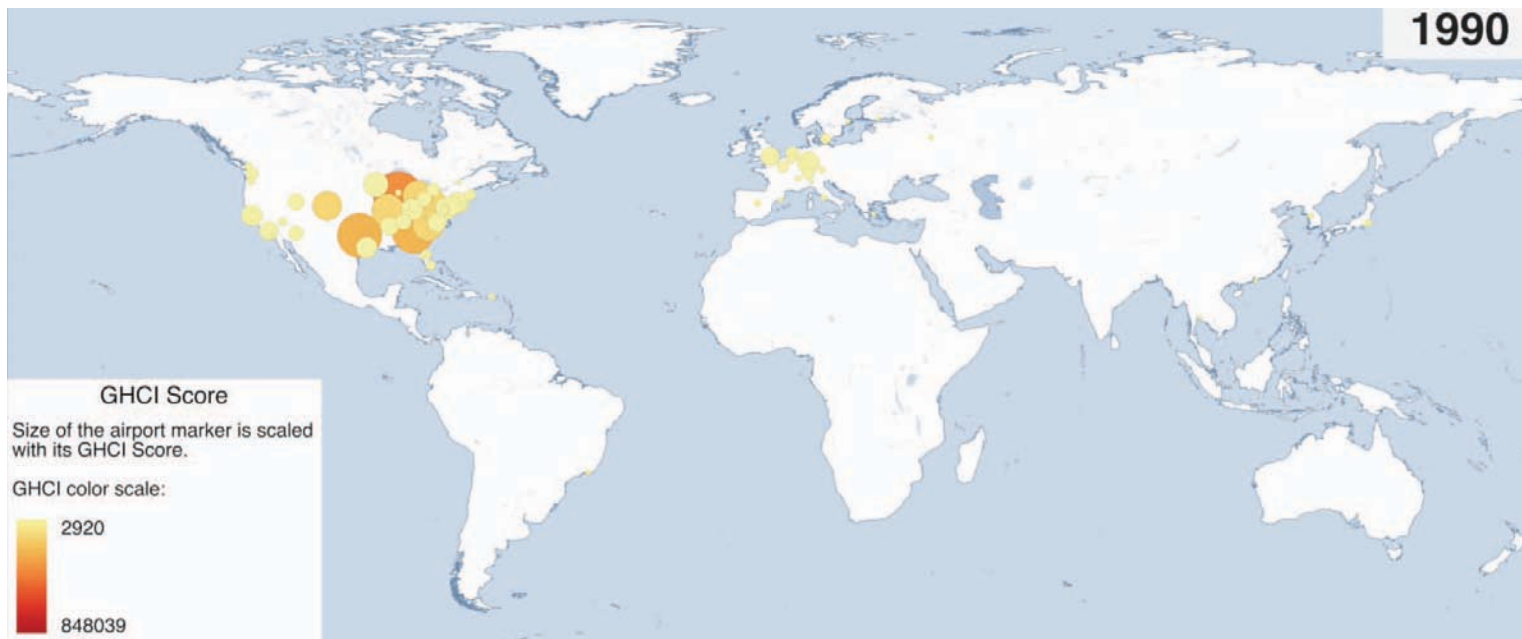
Hub centrality

Hub centrality measures the significance of transfer points in forming onestop connections.

Metric: Global Hub Centrality Index (GHCI)

$$GHCI_{l,t} = \sum_{r \in R_{l,t}^{onestop}} f_{r,t} \alpha_{r,t} w_{d,r,t}$$

Trends:

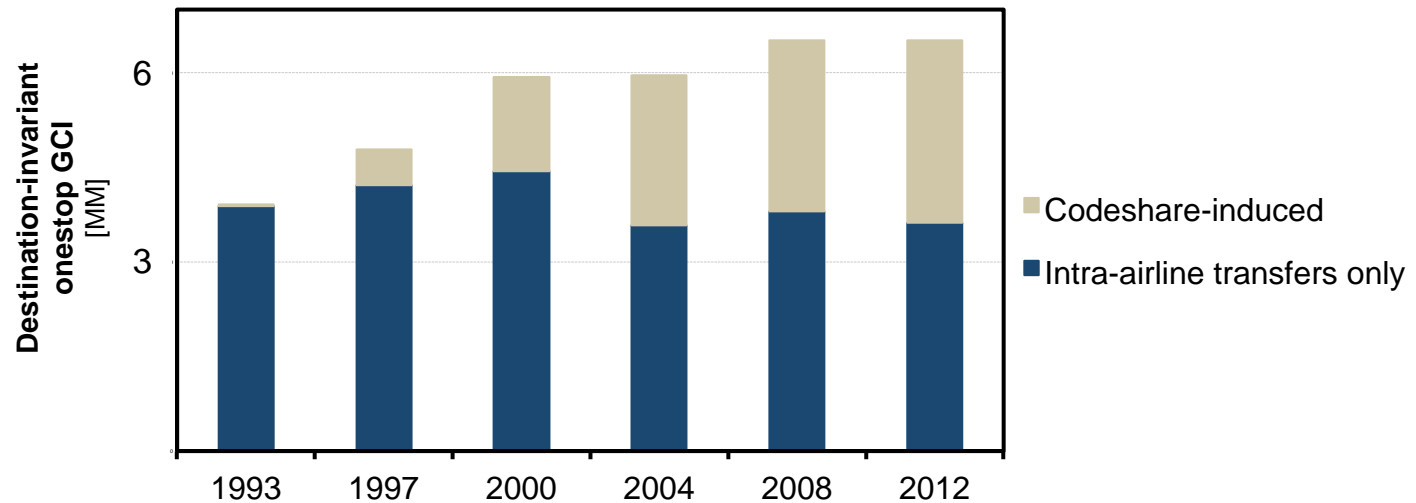


Indirect connectivity: Codeshares

Example: BOS-ARL



Significance of codeshare-induced GCI

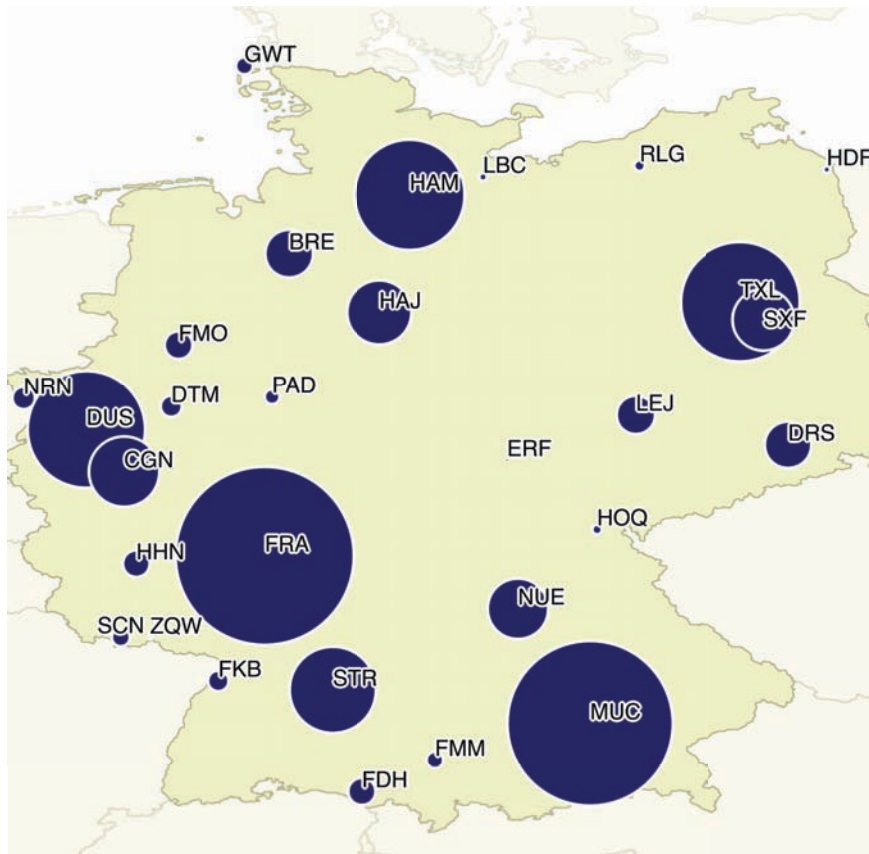


Agenda

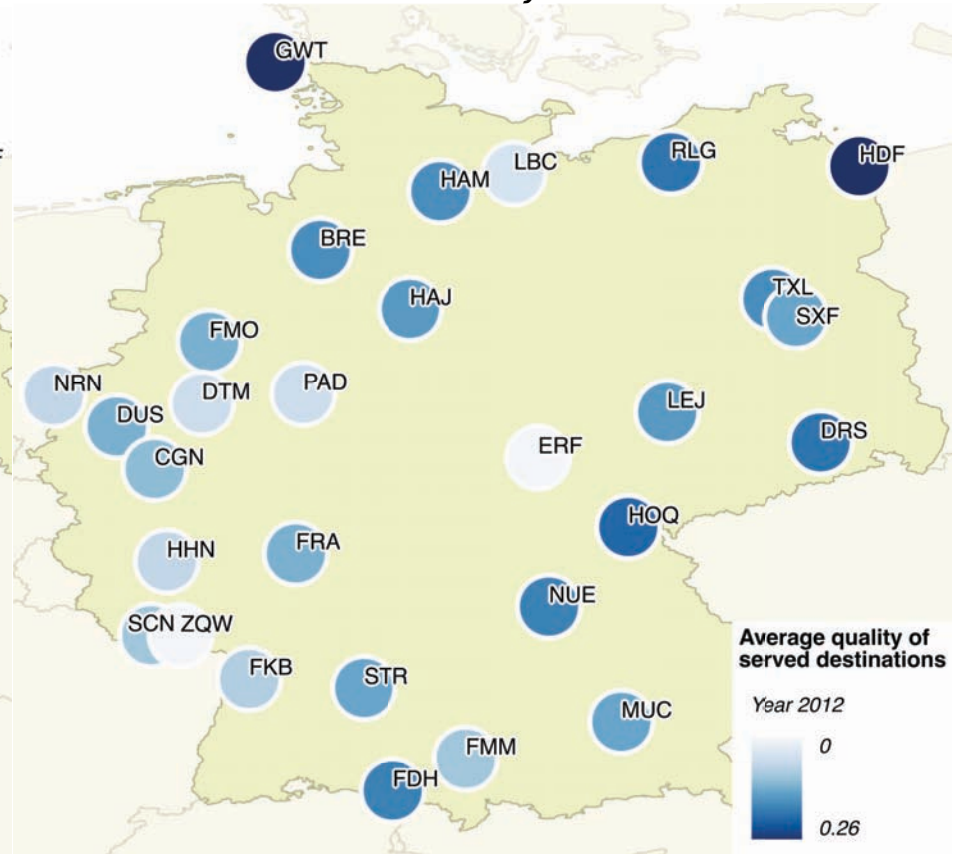
1. The connectivity model
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Destination-weights: Germany

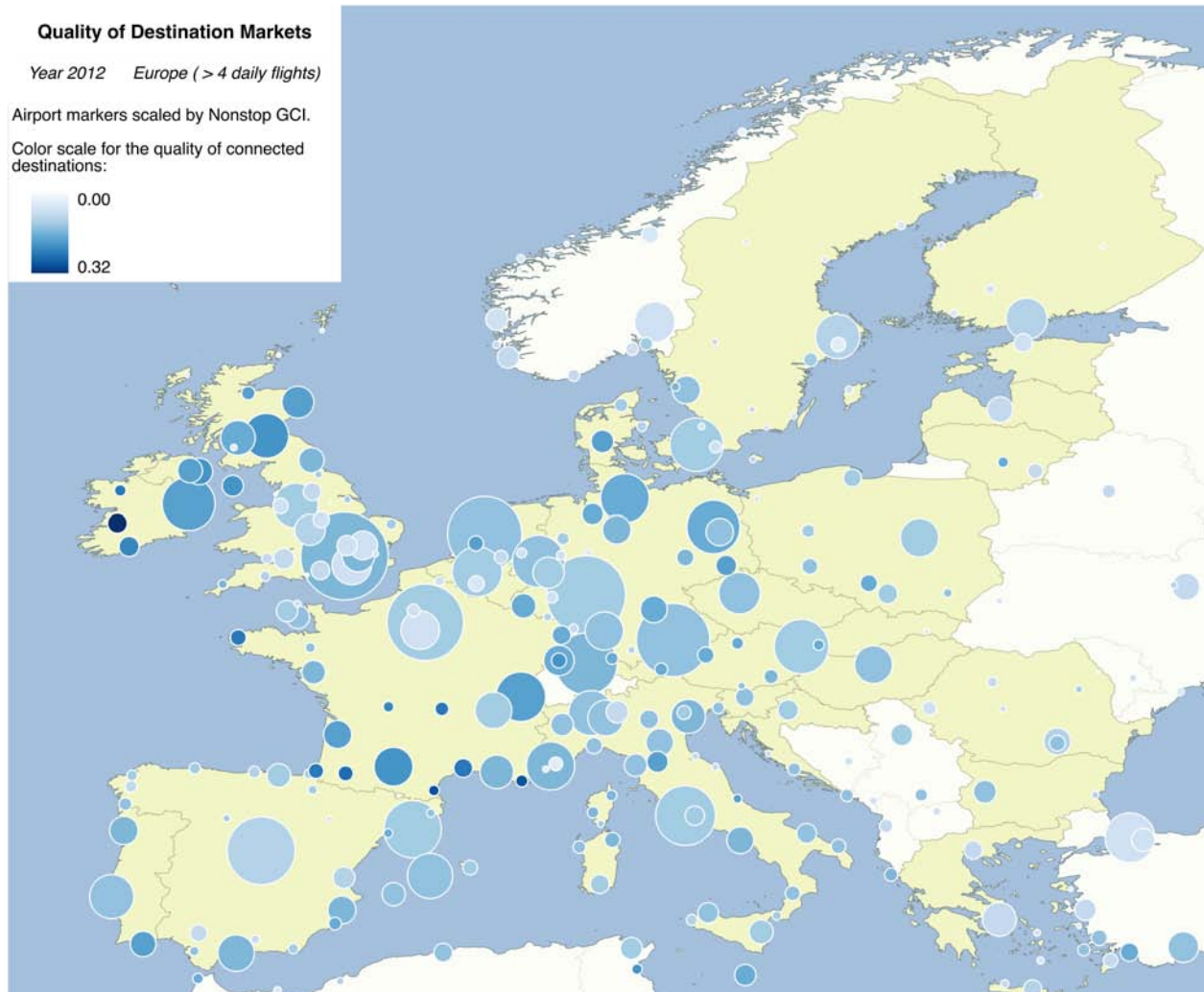
Nonstop GCI, year 2012



Average weight of served nonstop destinations, year 2012

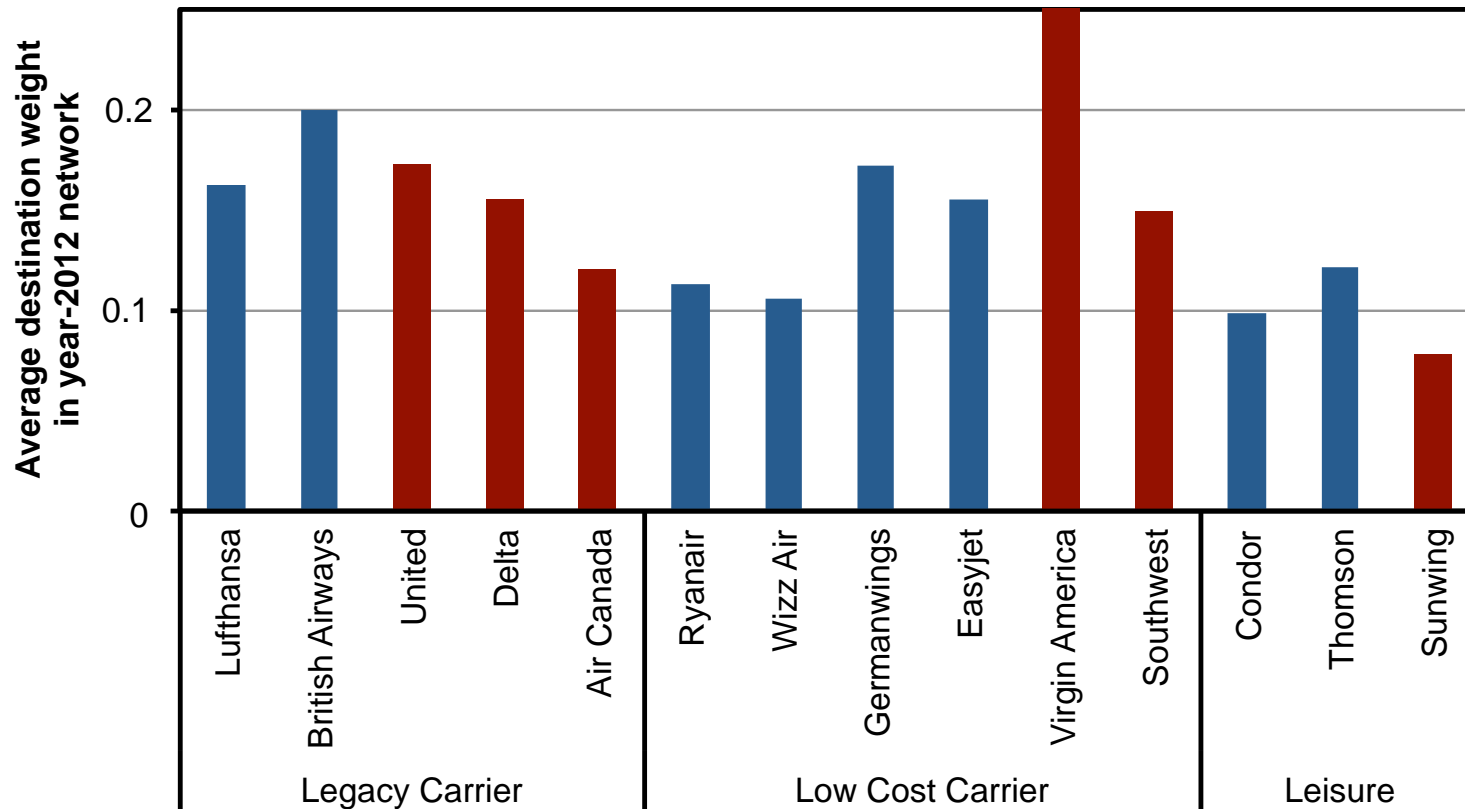


Destination-weights: Europe



Airline strategy and destination weights

The average quality of (nonstop) destinations in airline networks:



Red: North American carriers
Blue: European carriers

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Conclusions

- Many metrics of air transportation cause bias when used to assess the economic effects of air transportation:
 - No transfer connections.
 - No assessment of link quality in terms of detour, temporal schedule coordination or feasible airline combinations.
 - No destination market quality.
- The Global Connectivity Index
 - considers **all available** nonstop and onestop **connections**;
 - **values each link** in terms of frequency and directness;
 - models the **quality of markets to which links provide access**.
- Yearly global GCI results are available for 1990-2012.

Potential applications

Societal Benefits	Evaluation of the societal benefits of aviation
Network Evolution	Historic patterns in the evolution of today's airline networks
Airline Strategies	Impacts of airline business on network configuration: <ul style="list-style-type: none">• Airline alliances, codeshares and joint ventures• Contribution of LCC• ME 3• ...
Governmental Intervention	Network changes due to <ul style="list-style-type: none">• Liberalization (ASAs)• EAP, PSO• Airport incentive schemes• ...

For more details

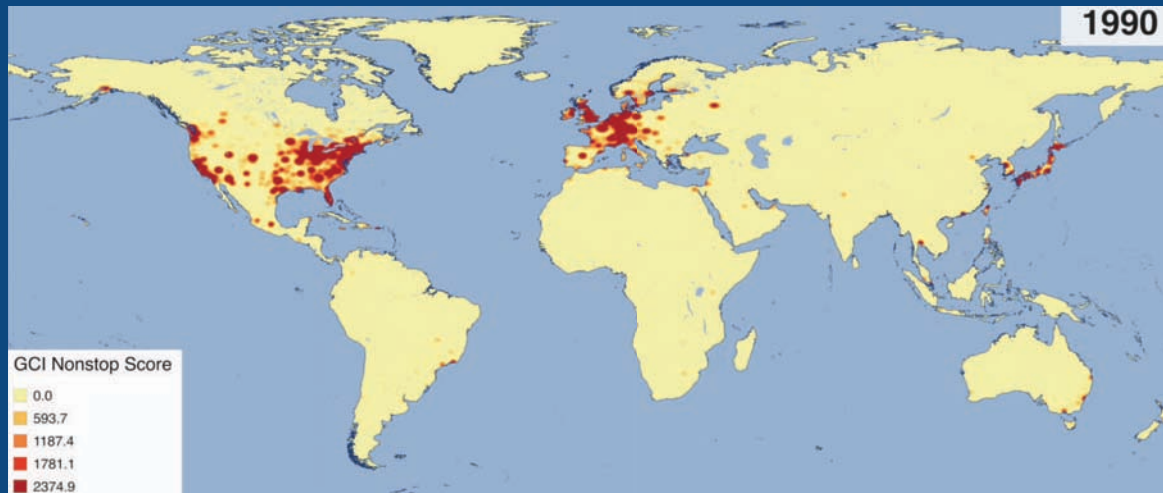
Paper on methodology & global trends

is accepted for publication in *Transportation Research Part E*.

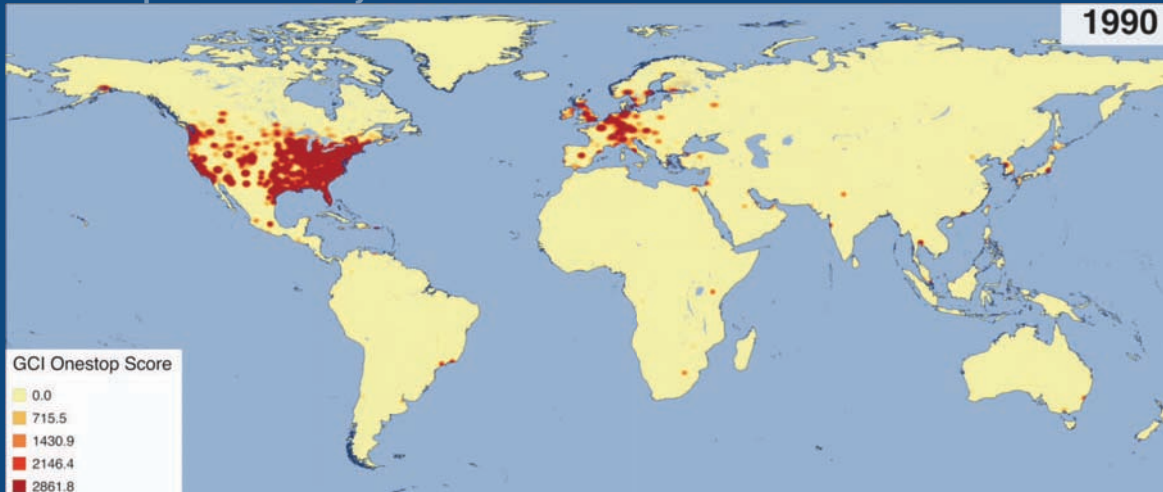
Longer report on methodology & trends by world-region

is available in the report series of the
MIT International Center of Air Transportation
<http://hdl.handle.net/1721.1/95968>

Nonstop Connectivity



Onestop Connectivity



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Florian Allroggen acknowledges funding by the **German Research Foundation (DFG)**.
Mike Wittman acknowledges financial support by the **MIT Airline Consortium**.