Public Service Obligations for Air Transport in the United States and Europe: Connectivity Effects and Value for Money

Michael D. Wittman[A] / Florian Allroggen[B] / **Robert Malina**[B,C]

[A] *MIT International Center for Air Transportation, Cambridge, MA*
[B] *MIT Laboratory for Aviation and the Environment, Cambridge, MA*
[C] Center *for Environmental Sciences, Hasselt University, Belgium*

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Laboratory for Aviation and the Environment
Massachusetts Institute of Technology

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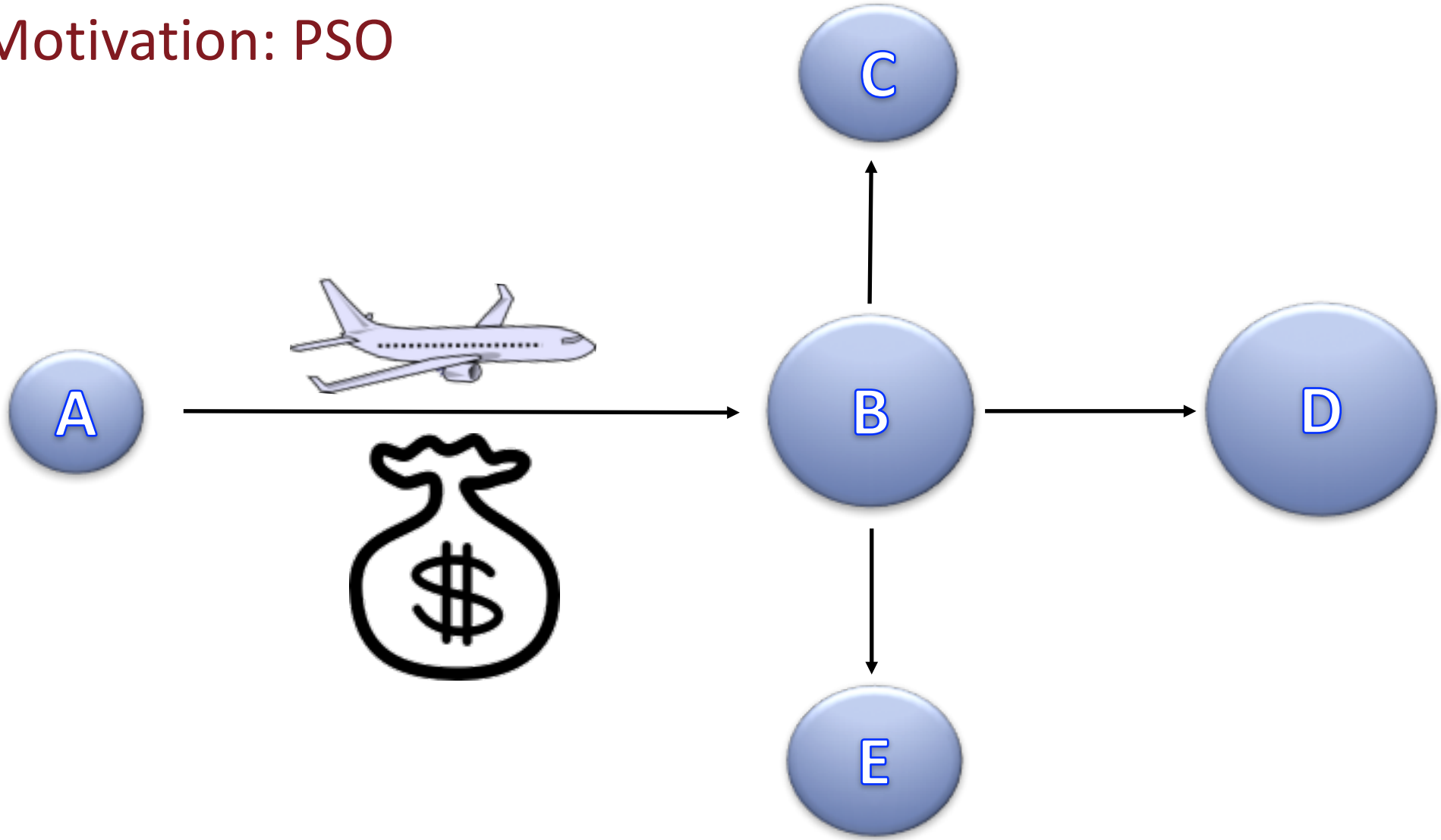
Outline

What are **Public Service Obligations** (PSOs)?

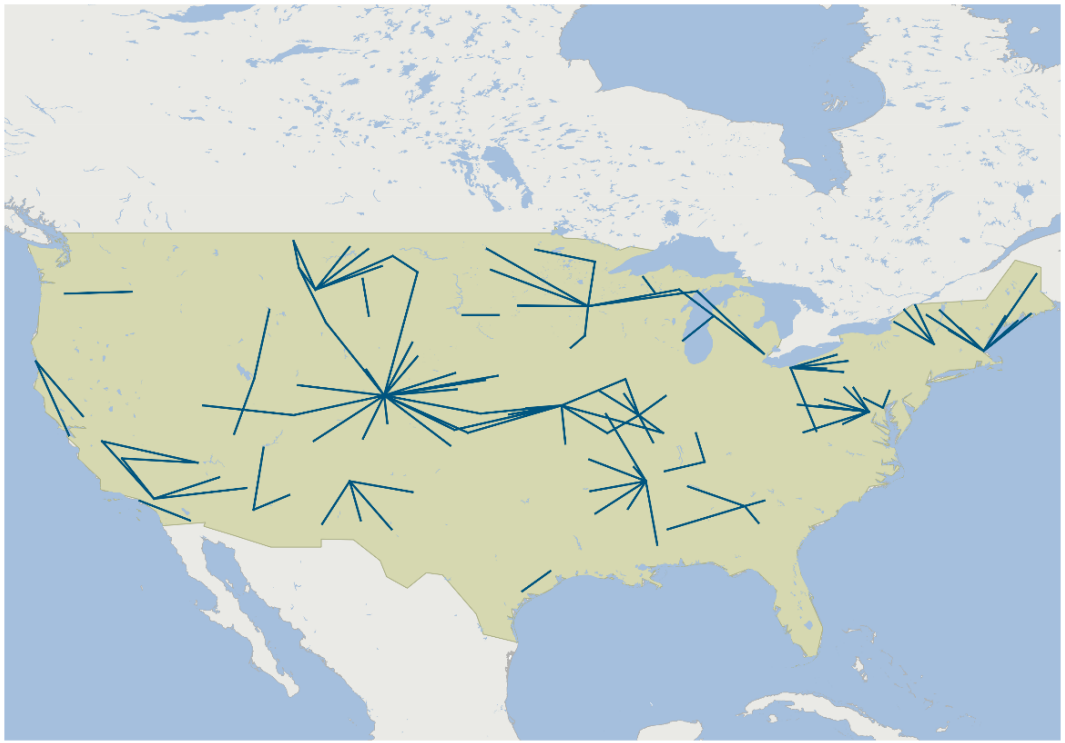
To what extent do specific PSO's contribute to **connectivity**?

How much **public money** is being spent on PSO's and how does this **compare** to the connectivity impacts of those routes?

Motivation: PSO

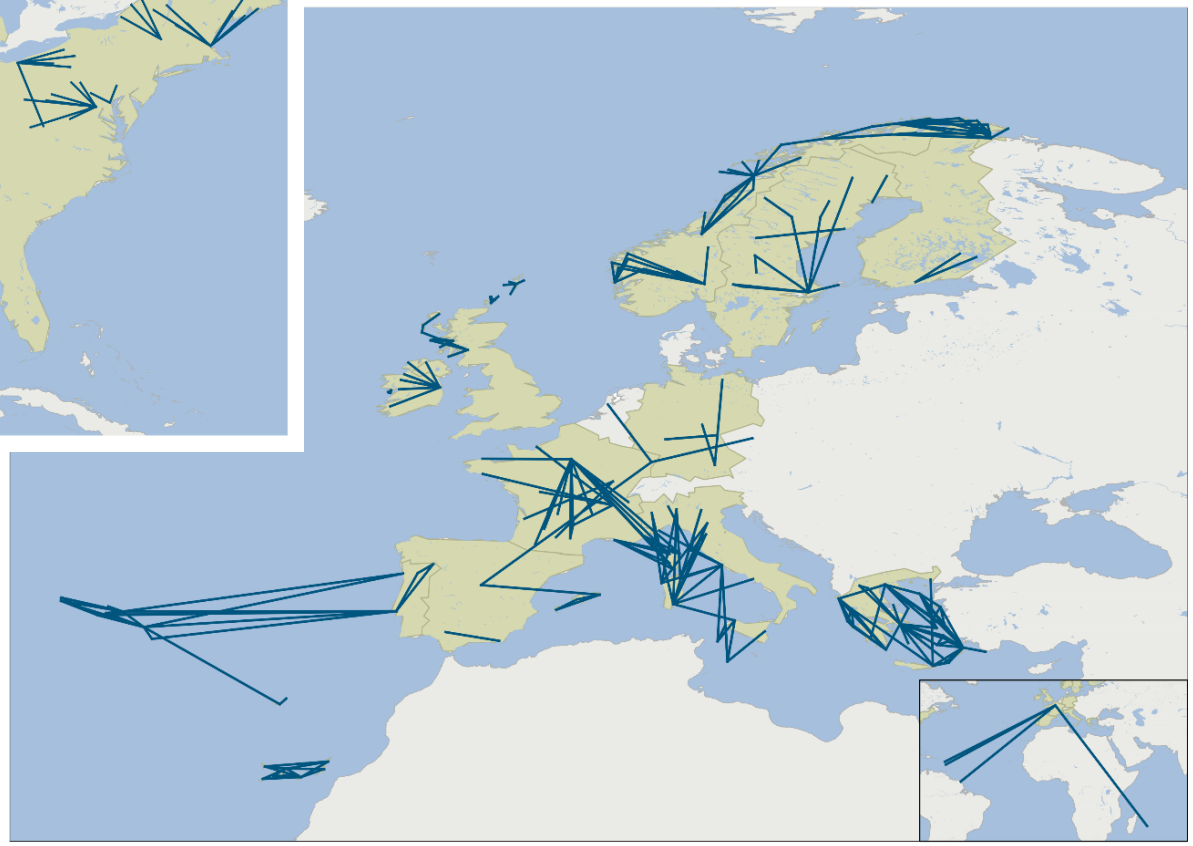


Geographical scope



U.S.

11 European Countries



Source: Analysis of OAG Schedule Data; U.S. DOT; European Commission, year 2010 data

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PSOs Represent about 2.5% of Scheduled Movements in the 12 Countries Analyzed

Summary Statistics for PSO Movements in the U.S. and Europe, 2010

Country	Airports with PSO Flights	Thousands of Scheduled Movements (2010)			Millions of Scheduled Seats (2010)		
		PSO	Total	PSO % of Total	PSO	Total	PSO % of Total
Finland	4	2	181	0.9%	0.1	20	0.4%
France	38	43	1,074	4.0%	6.7	155	4.3%
Germany	5	3	1,583	0.2%	0.1	226	<0.1%
Greece	31	15	256	5.9%	0.8	34	2.5%
Ireland	11	10	194	5.1%	0.8	31	2.6%
Italy	13	32	1,018	3.1%	5.6	153	3.7%
Norway	37	58	392	14.8%	2.2	44	5.0%
Portugal	15	21	234	8.8%	1.9	33	5.8%
Spain	14	90	1,231	7.3%	6.4	191	3.3%
Sweden	13	7	304	2.3%	0.3	34	1.0%
U.K.	27	9	1,662	0.5%	0.1	252	0.1%
U.S. (mainland)	135	164	10,073	1.6%	3.1	1,041	0.3%
Total	**343**	**453**	**18,202**	**2.5%**	**28.2**	**2,214**	**1.3%**

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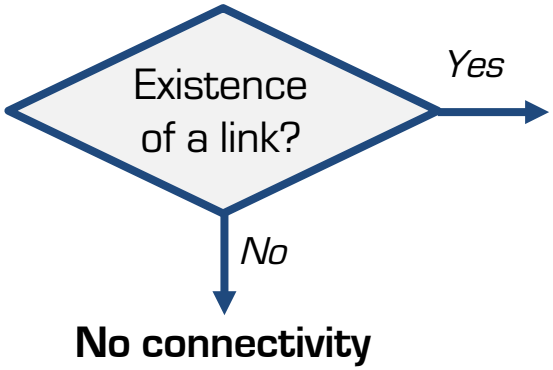
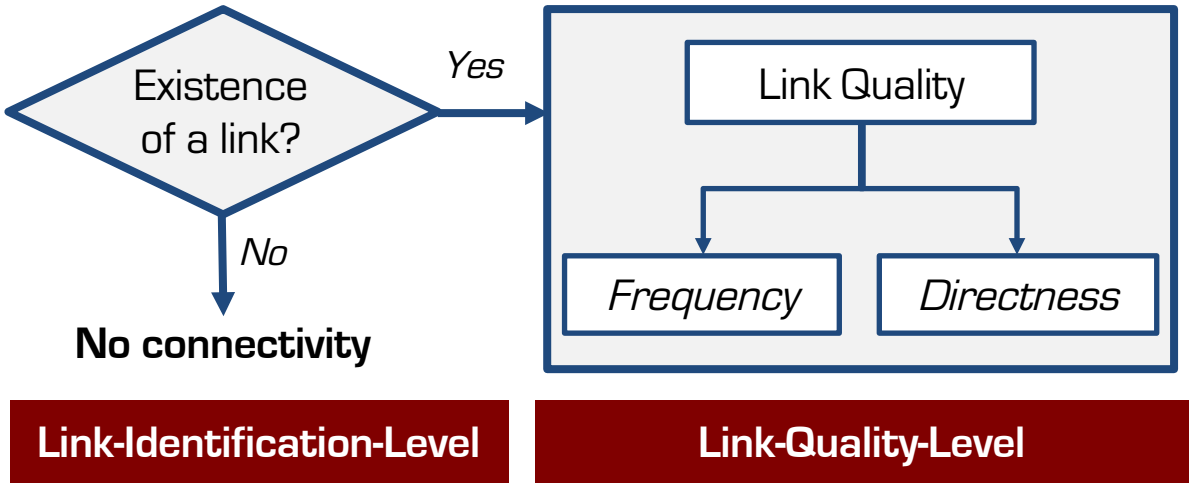
The Global Connectivity Index (Allroggen, Wittman, Malina 2015)



Link-Identification-Level

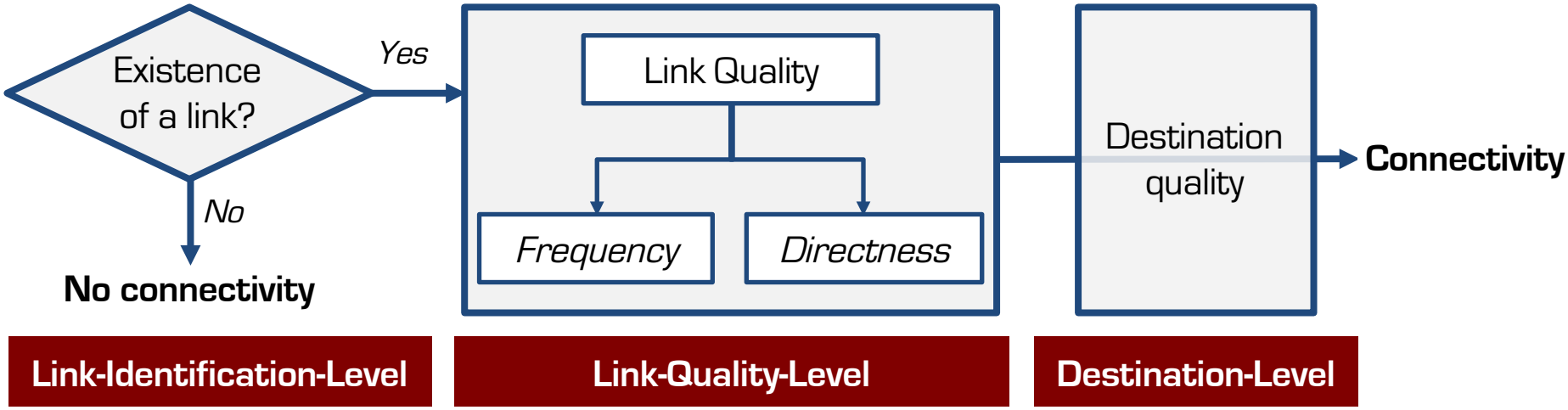
- Data source: OAG schedules 1990-2012
- Identify nonstop flights
- Onestop itinerary generator:
  - Minimum connecting time
  - Feasible airline combinations

The Global Connectivity Index



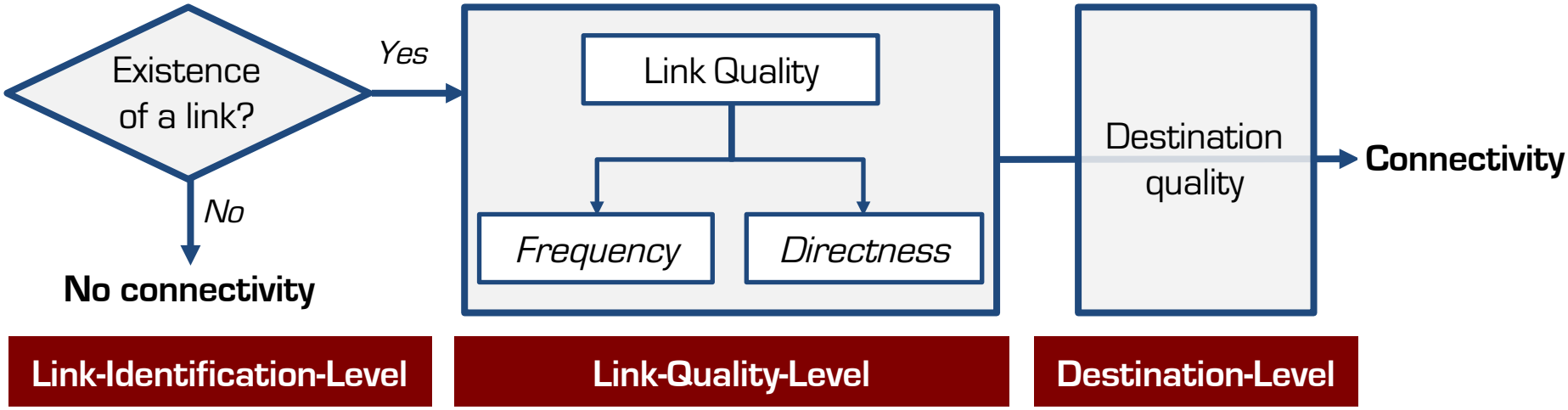
- **Frequency:** Counter of ops.
- **Directness**: Valuation of detours: The higher the relative mark-up of travel time compared to a (hypothetical) non-stop routing, the lower the link quality

The Global Connectivity Index



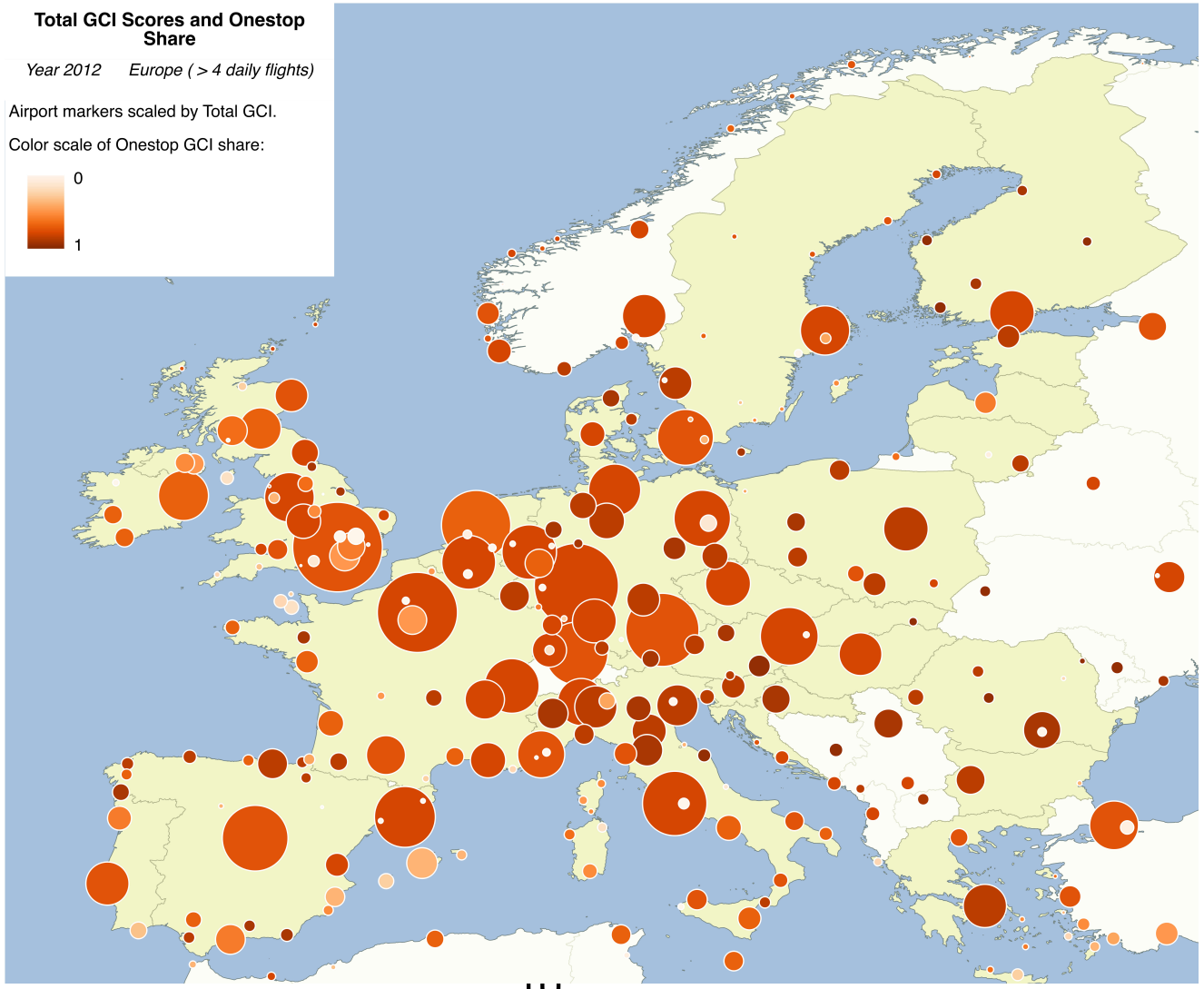
- **Define and calculate** metric for interaction potential: GDP
- **Define geographical market** of airport: distance decay modeling

The Global Connectivity Index



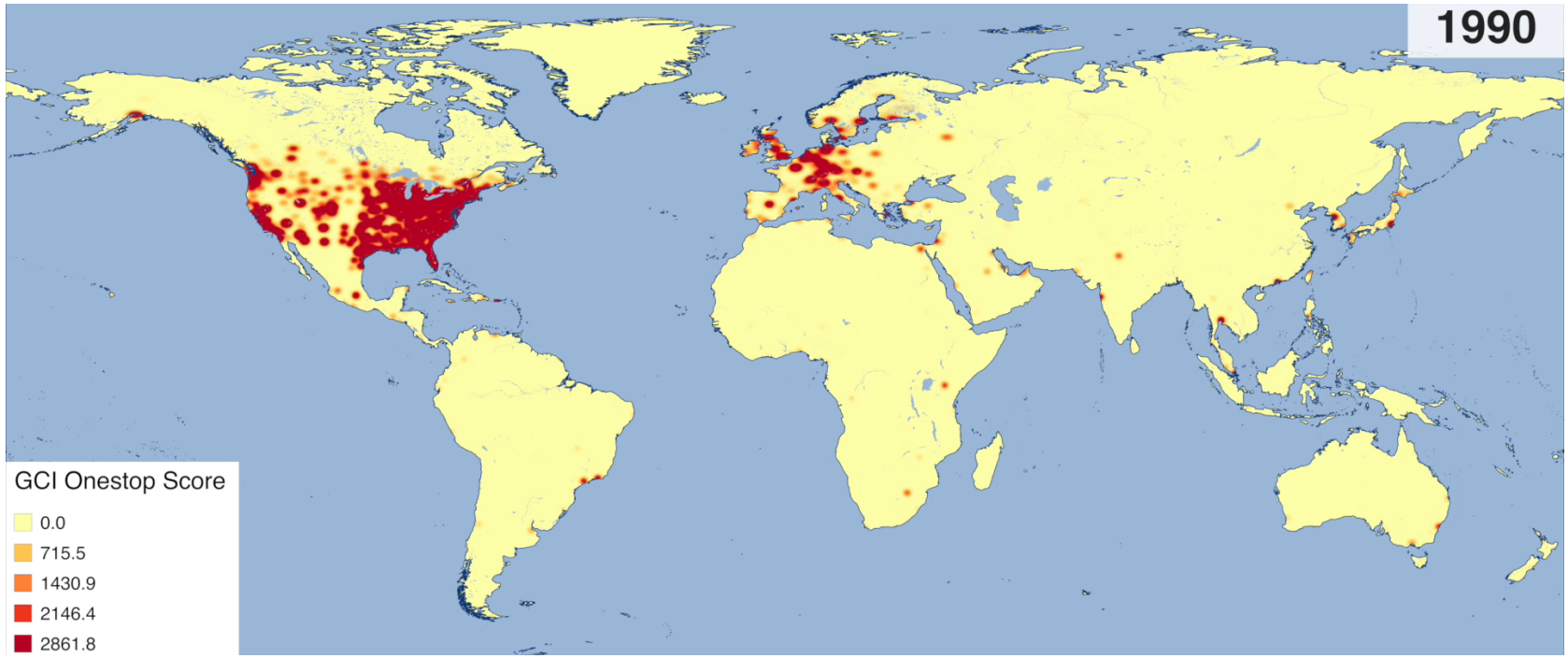
Connectivity metric: Sample visualizations

Total connectivity and share of onestop connectivity at European airports:

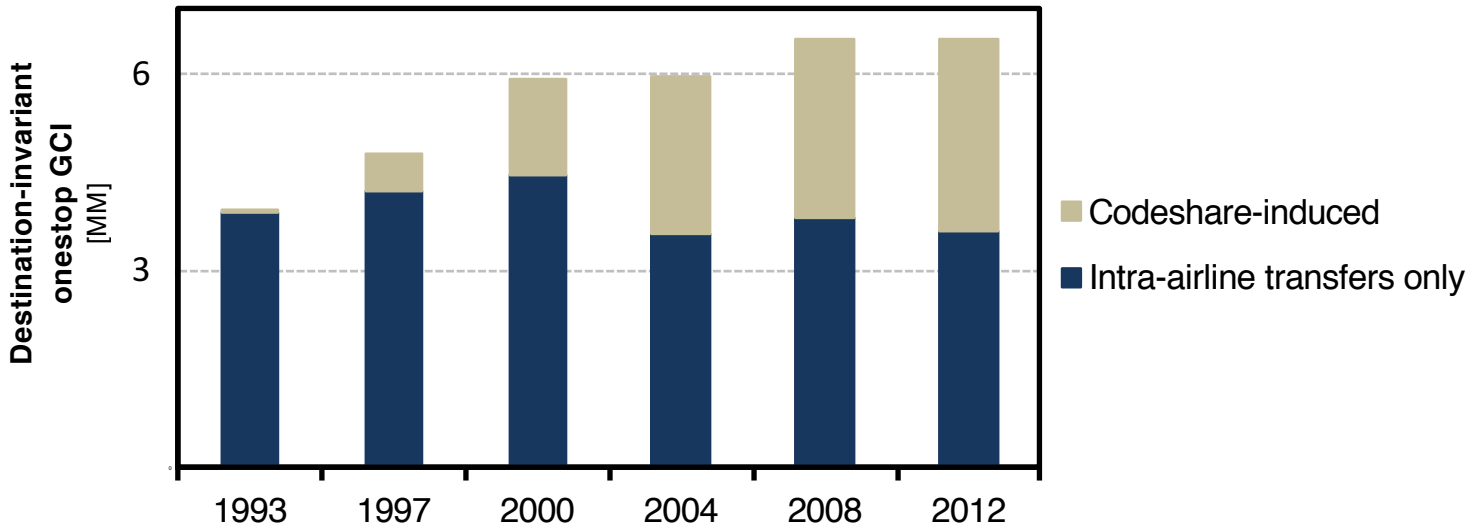


Connectivity metric: Sample visualizations

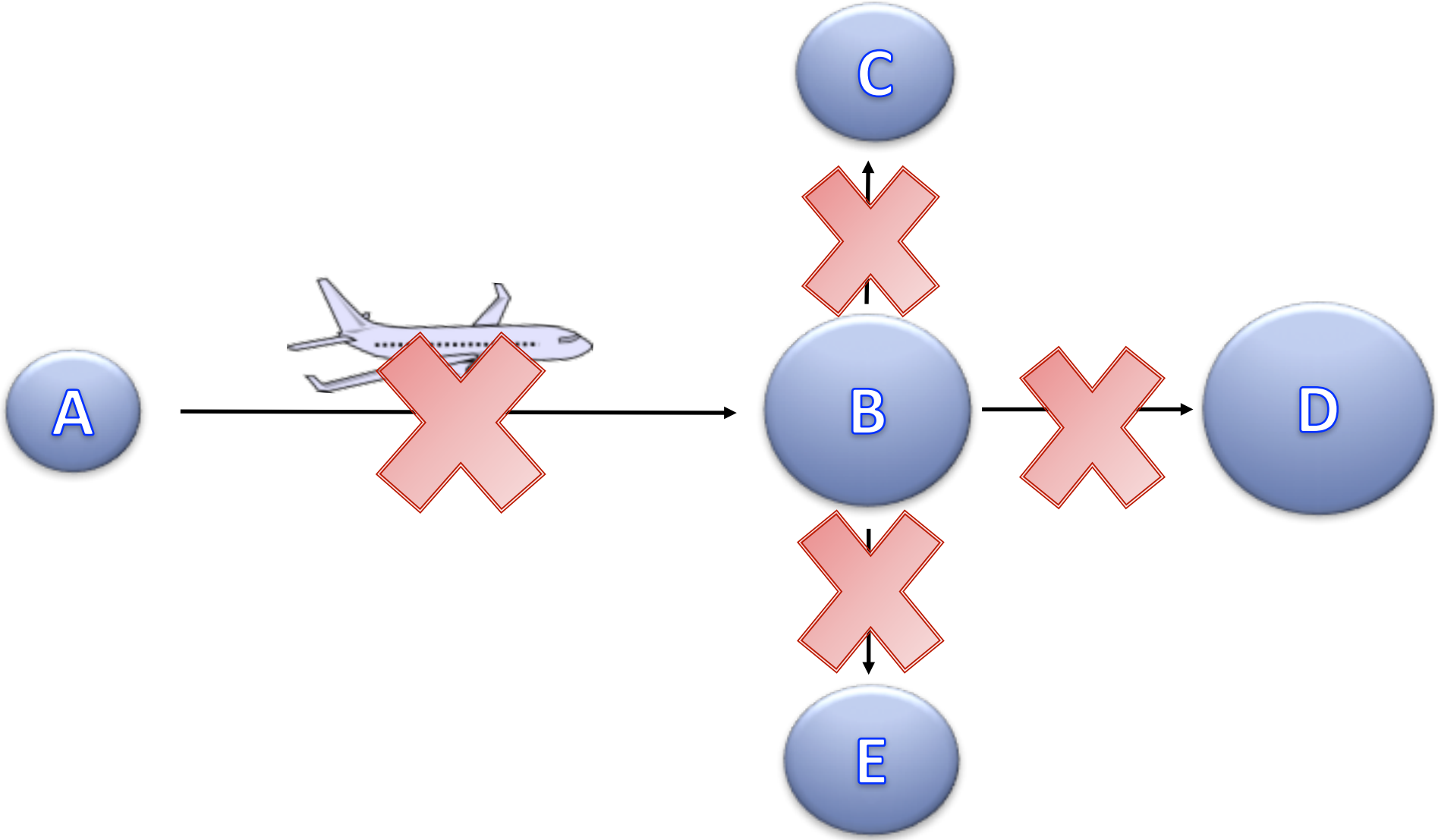
The global onestop connectivity landscape



Connectivity metric: Sample visualizations

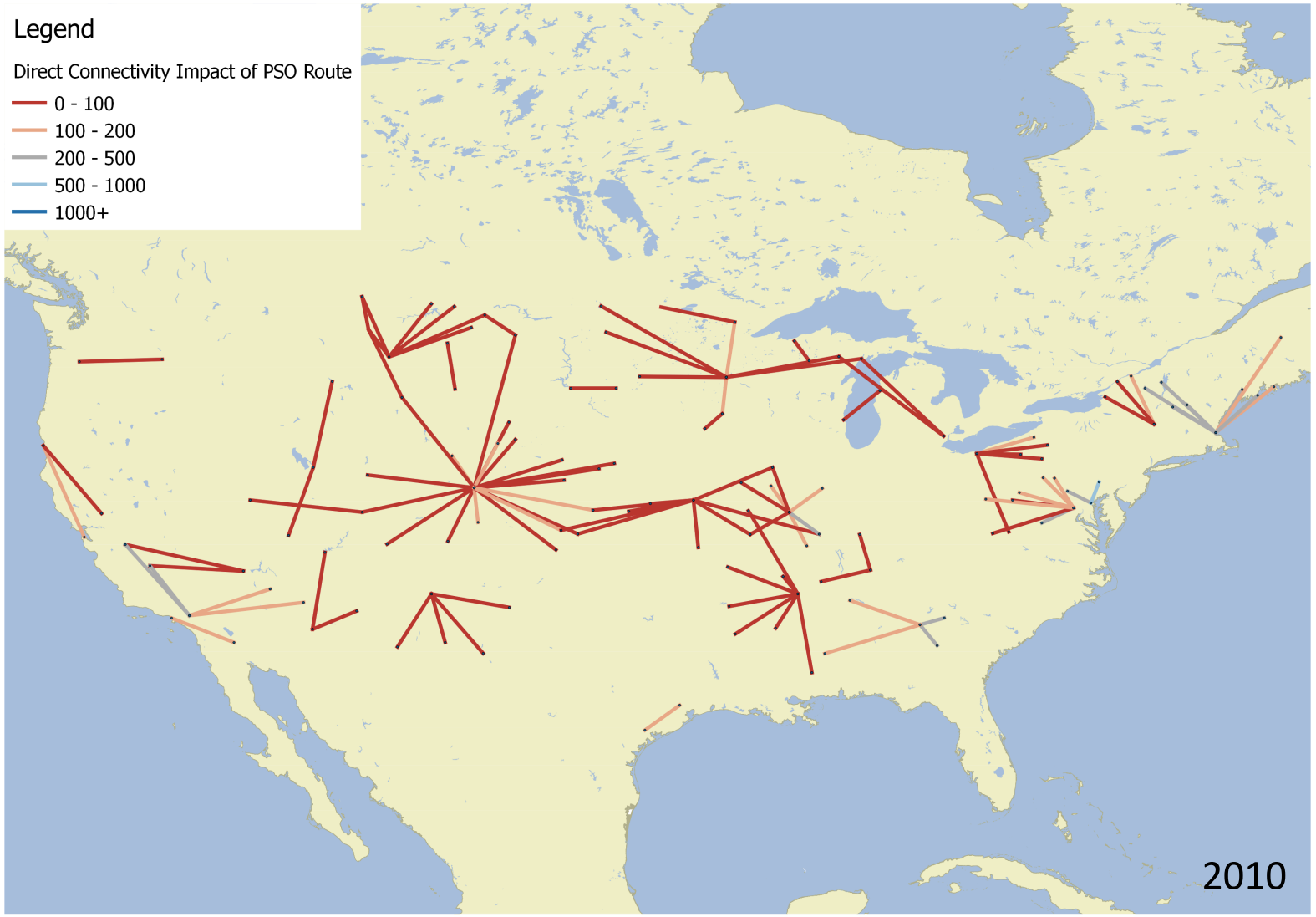


Calculation of the connectivity impacts of PSOs

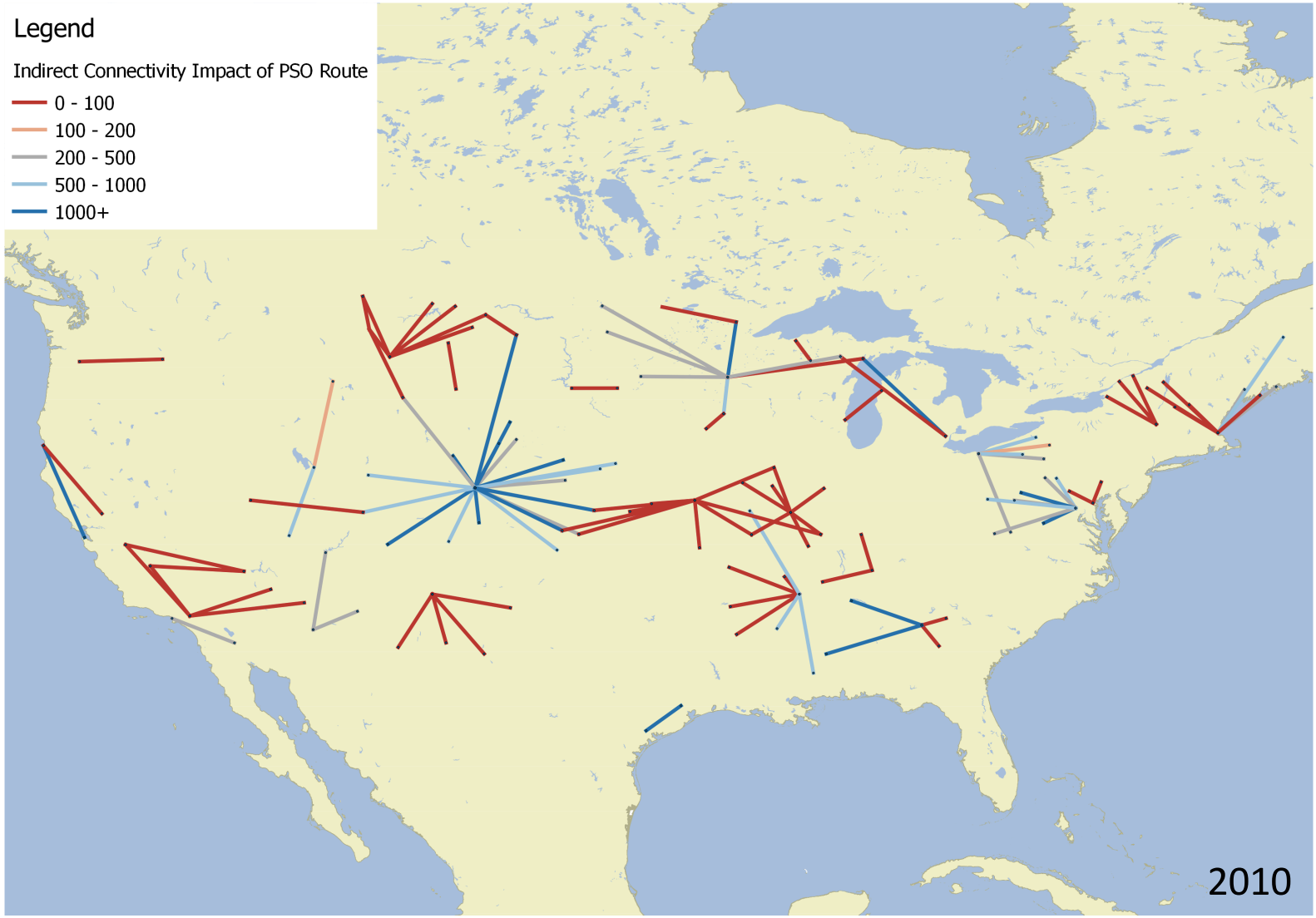


Calculations ONLY done for the year 2010

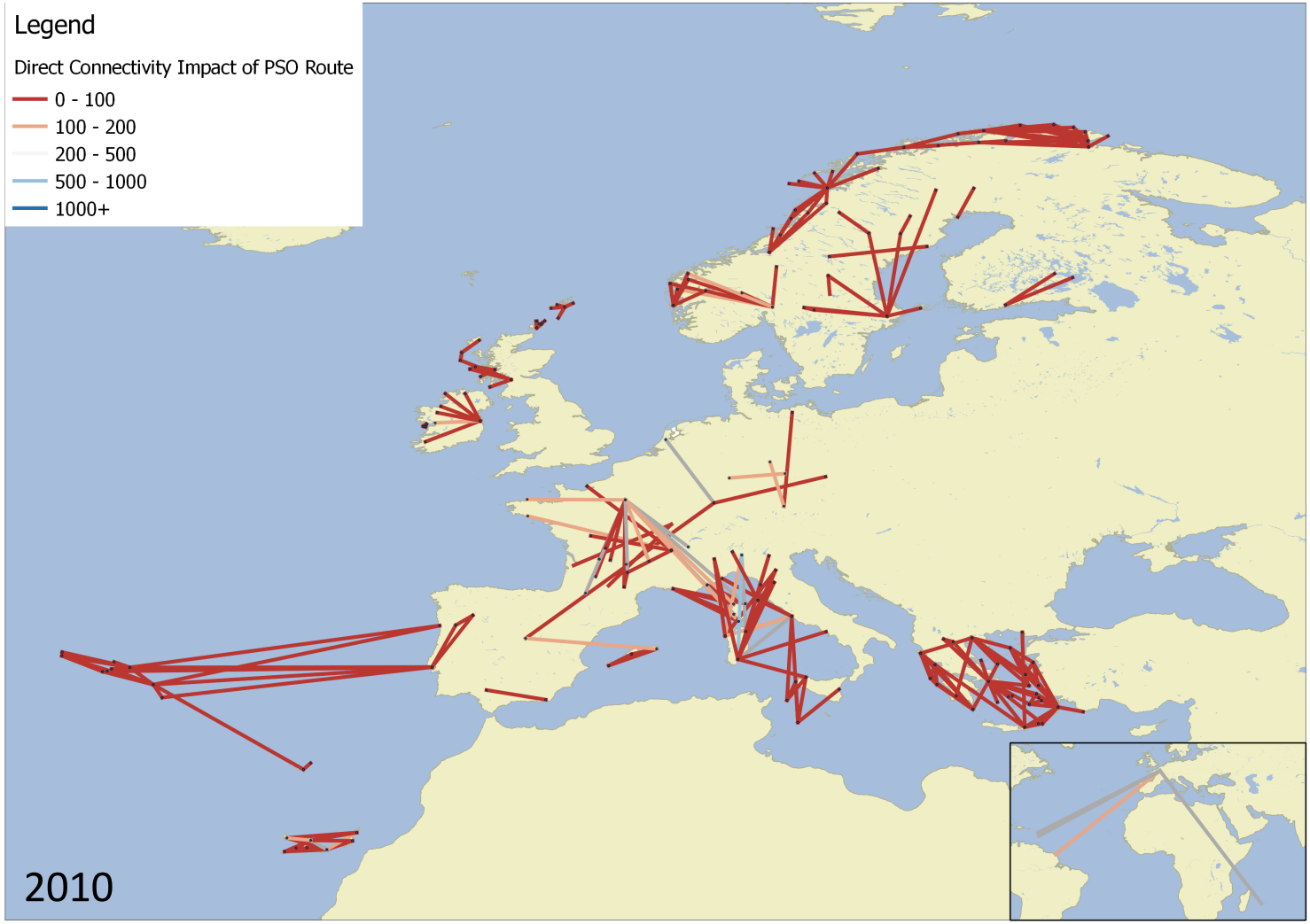
In the U.S., PSO Routes Provide Limited Amounts of Direct Connectivity



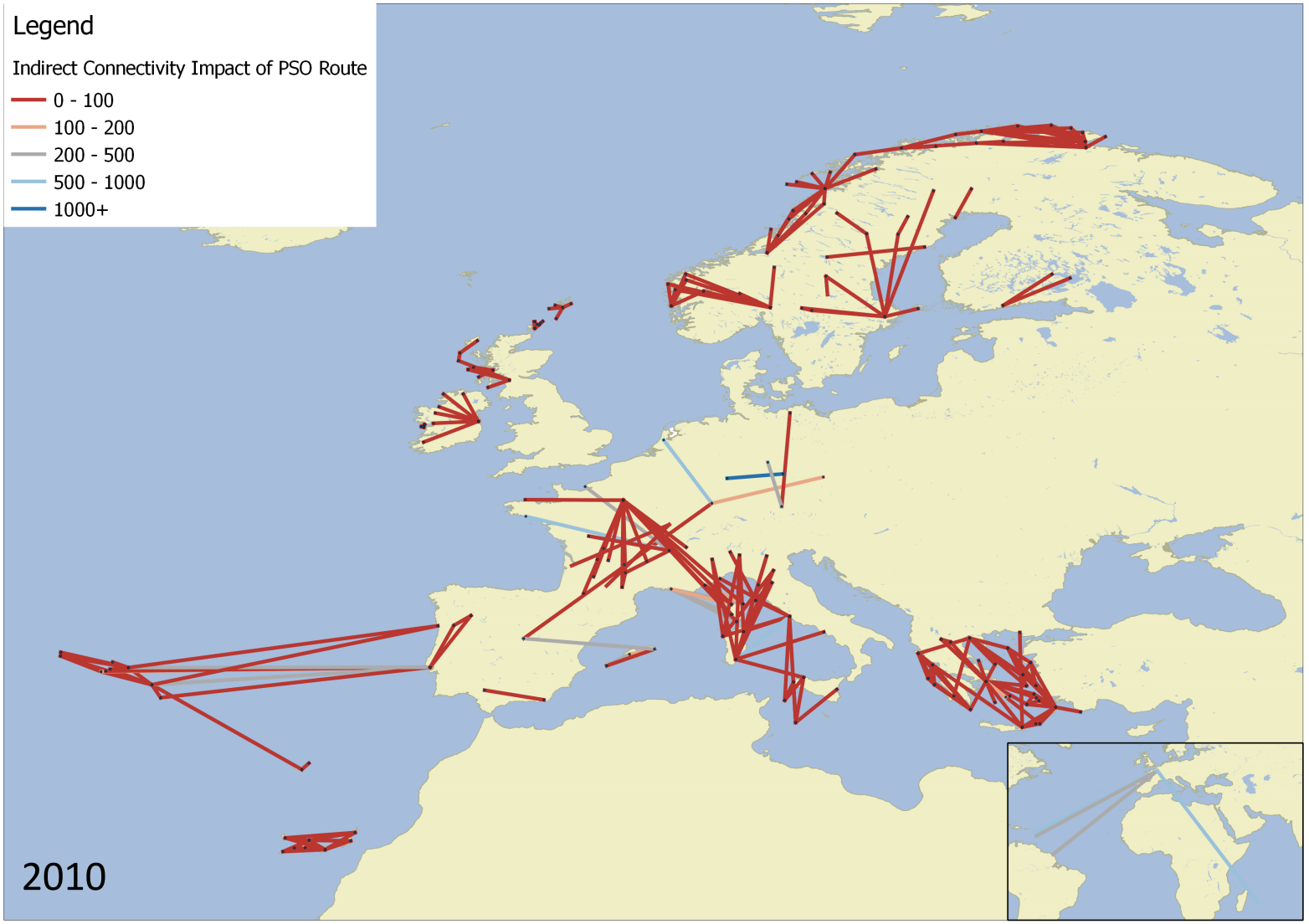
But PSOs Serving Network Carrier Hubs Can Generate Significant Indirect Connectivity



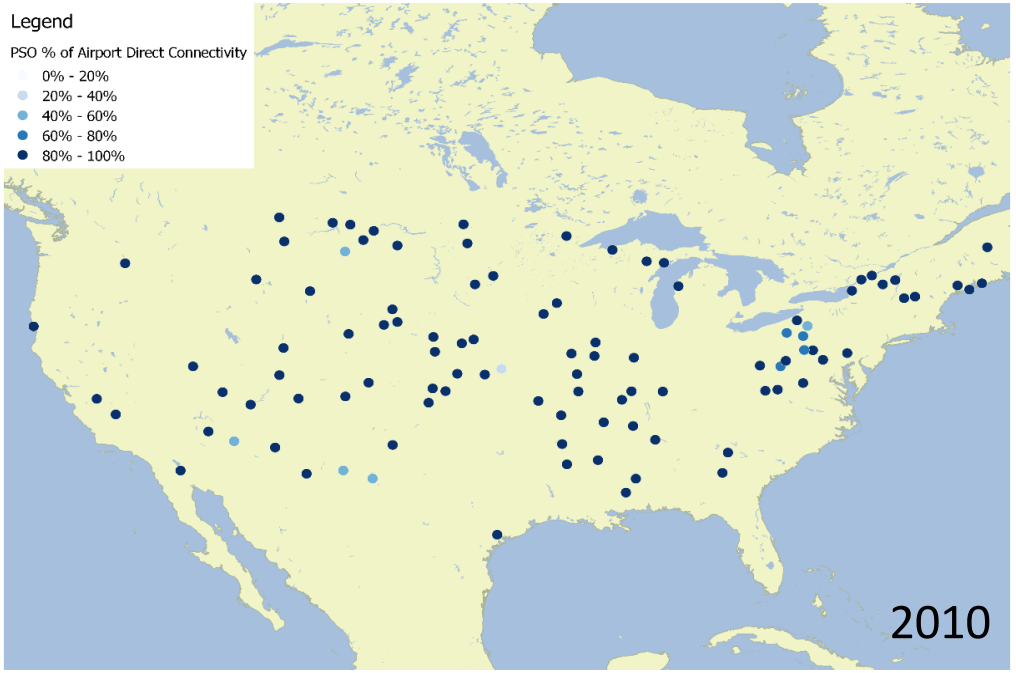
Most European PSOs Provide Limited Direct Connectivity

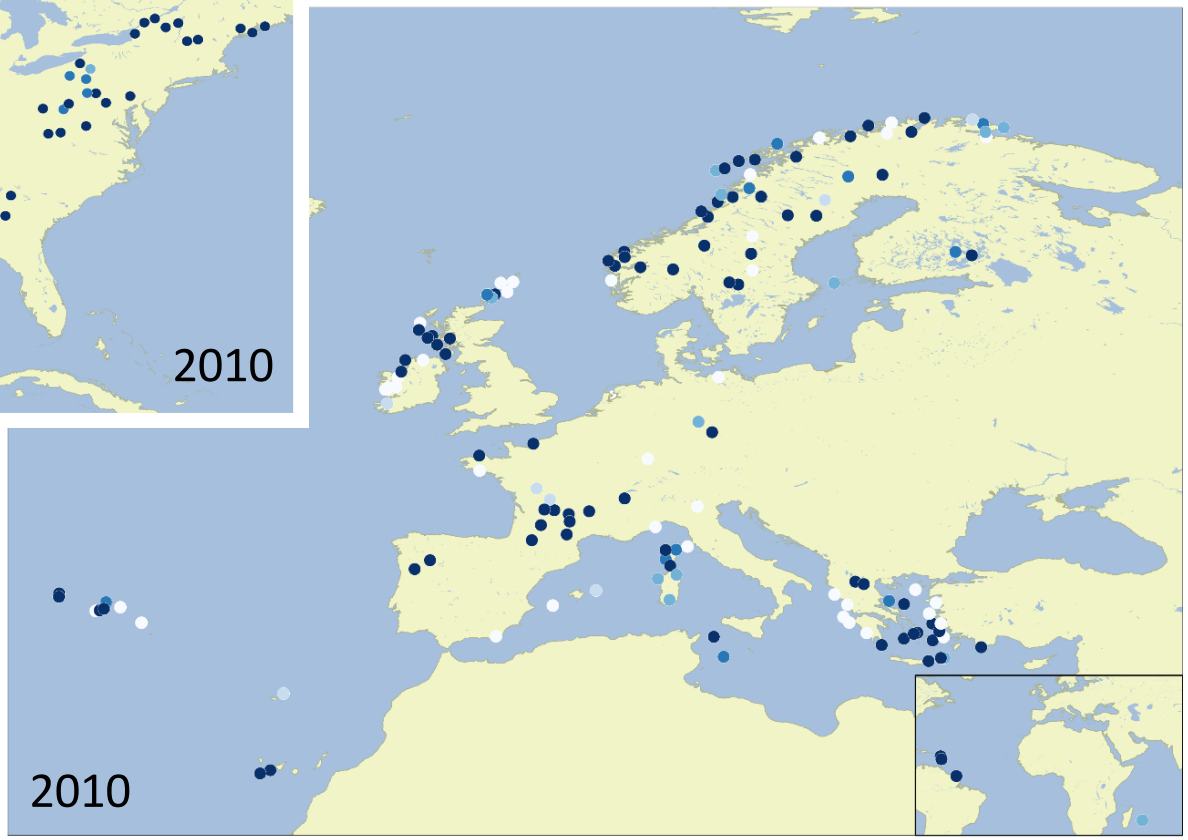


Indirect Connectivity Limited for Many “Lifeline” PSO Routes, Even Those Serving Large Airports



Yet PSOs are Still Critically Important; PSOs Provided All Connectivity at 142 Airports





A New Subsidy Dataset Provides Additional Insight into PSO Performance

- Our PSO subsidy data set, covering 90% of all PSO movements in 2010, was collected from different sources:

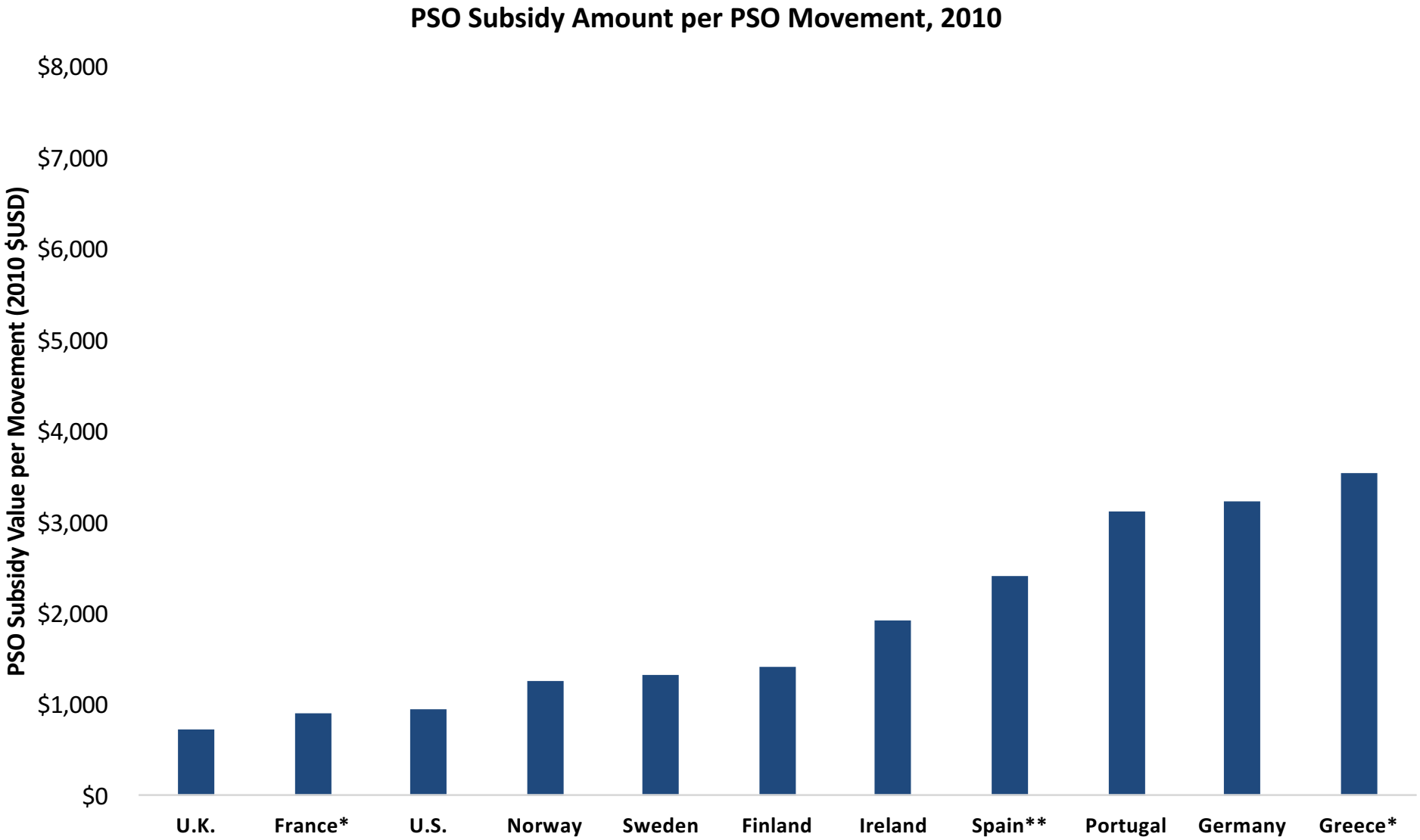
Governments Earmarked Over $900 Million for Subsidies in 2010

Country	Total Annual Subsidy (Millions of USD, 2010 PPP)	Thousands of PSO Movements (2010)		% of PSO Movements Covered by Subsidy Data
		Subsidy data available	All PSO movements	
Finland	$2.3	2	2	100%
France*	$19.6	22	43	51%
Germany	$8.3	3	3	100%
Greece*	$49.8	14	15	92%
Ireland	$19.1	10	10	100%
Italy	Not Available	0	32	0%
Norway	$73.3	58	58	100%
Portugal	$64.7	21	21	100%
Spain**	$495.2	206	206	100%
Sweden	$9.1	7	7	100%
U.K.	$6.2	9	9	100%
United States	$155.6	164	164	100%
Total	**$903.2**	**515**	**569**	**90%**

* Only routes with subsidy data available are included

** Spain data includes air discount scheme routes between the mainland and the Canary and Balearic Islands. Caution should be used when comparing Spanish results to other countries, in which air discount schemes are not included.

Average Subsidies per Movement Were of the Same Order of Magnitude Across Countries



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Note: Local currencies converted to USD PPP via World Bank data

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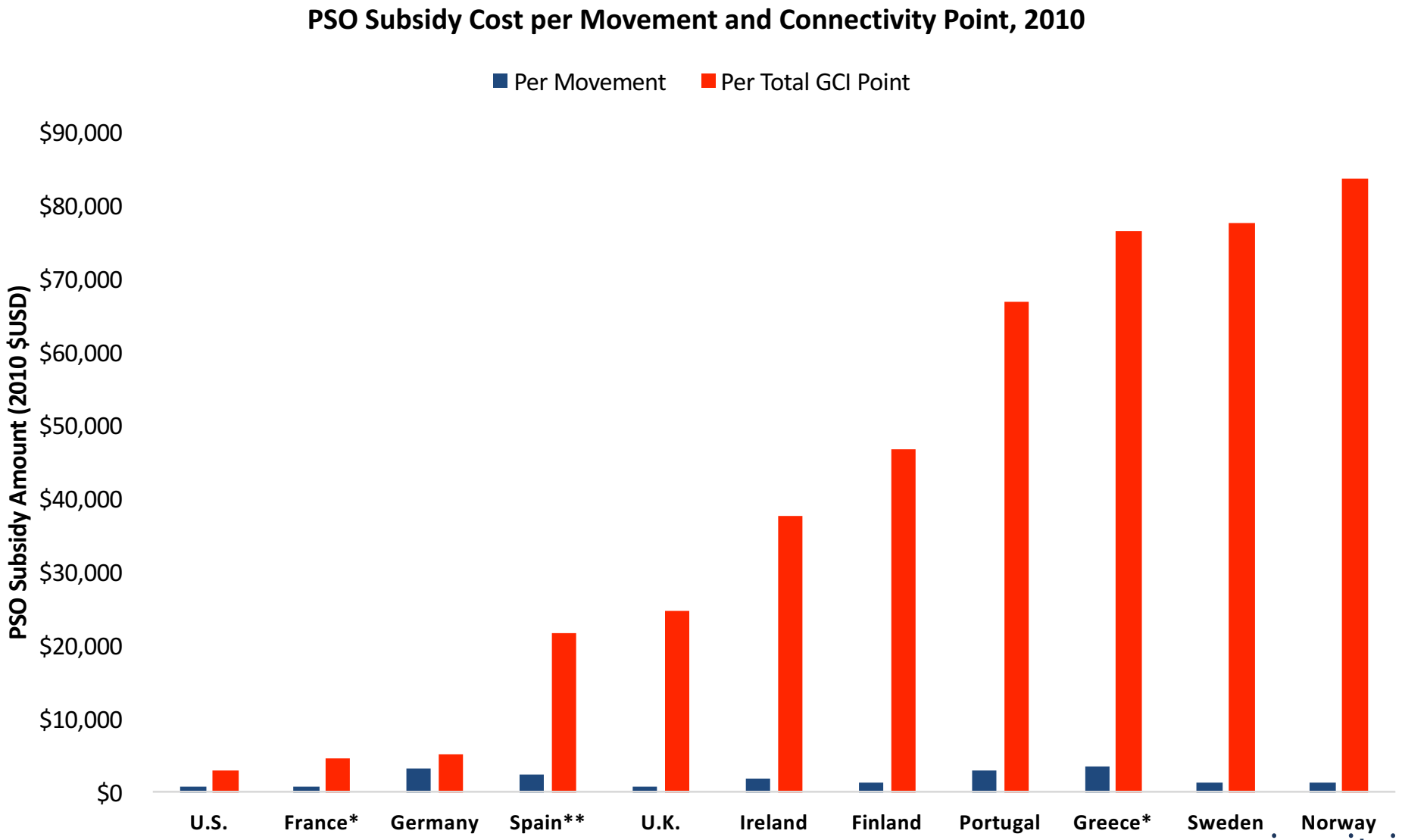
Yet Programs that Focused on Indirect Connectivity Provided the Best "Bang-for-Buck"



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Conclusions

- Our analysis of PSO connectivity and subsidy data revealed various regional trends:

A majority of PSOs are lifelines for the communities they serve, often providing the only direct (and indirect) connections to local & global markets

PSOs that focus on increasing indirect market access, such as those in the U.S. and Germany, provide the best connectivity "bang for buck"

- A GCI-based analysis could be used by policymakers when choosing between different tenders for the same PSO route to determine which offer provides the best market access value for money.

For details

The manuscript discussed in this presentation

is accepted for publication in *Transportation Research Part A*
DOI: 10.1016/j.tra.2016.08.029

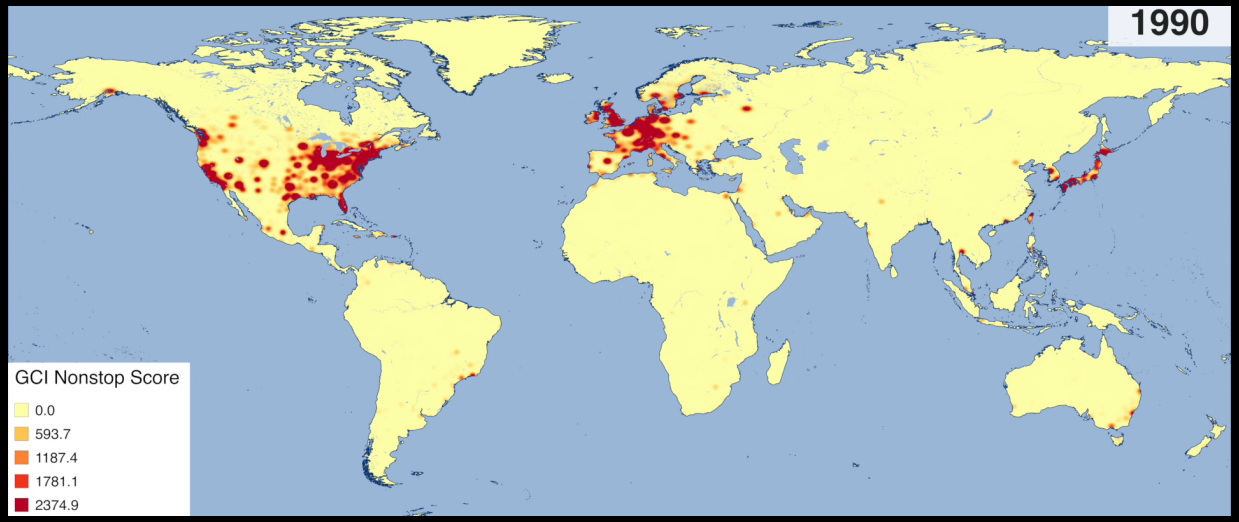
A method paper on the Global Connectivity Index

was published in 2015 in *Transportation Research Part E:*
How air transport connects the world: A new metric for global air connectivity:
DOI: 10.1016/j.tre2015.06.001

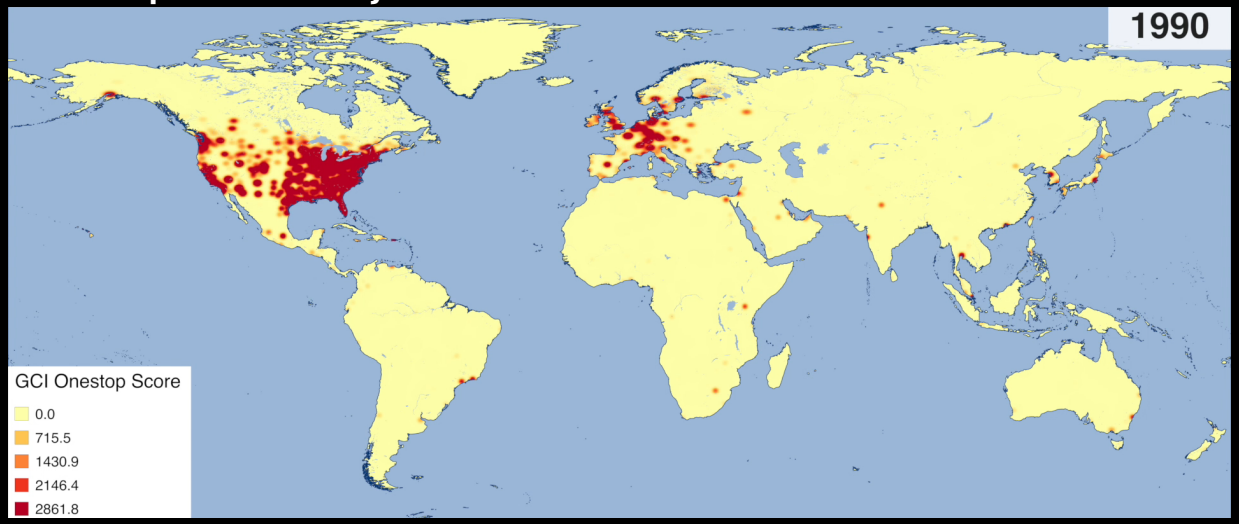
Longer report on methodology & connectivity trends by world-region

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



Thank you!

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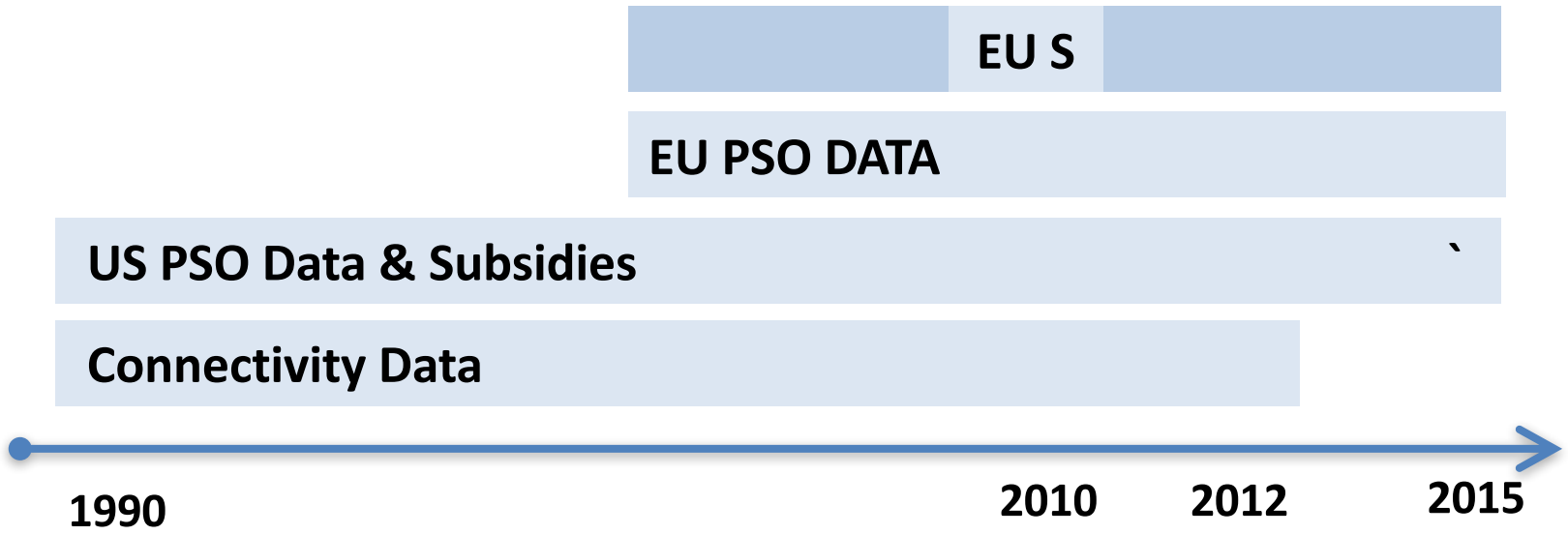
Email:
robert.malina@uhasselt.be

Florian Allroggen acknowledges funding by the **German Research Foundation (DFG).**

Mike Wittman acknowledges financial support by the **MIT Airline Consortium.**

Potential extension



Classification of PSO Countries into Three General Archetypes

Indirect Connectivity

- PSOs serve large network carrier hubs with indirect connections available
- **United States and Germany**

Lifeline-Focused

- PSOs connect rural regions to economic centers, with limited focus on connectivity
- **UK, Ireland, Sweden, Norway, Finland**

Service to Remote Territories

- PSOs serve primarily to connect remote territories to the mainland, providing both direct and indirect connectivity
- **Portugal, Spain, France**

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Literature comparison

Study	European PSOs	US PSOs	Subsidy Data	Multinational Subsidy Data	Connectivity Focused
Halpern and Bråthen (2011)	✅				
Di Francesco & Pagliari (2012)	✅				
Williams (2012)	✅				
Merkert and O'Fee (2013)	✅				
Merkert and Williams (2013)	✅				
Matisziw and Wei (2012)		✅			
Reynolds-Feighan (1999)	✅	✅			
Santana (2009)	✅	✅			
Metrass-Mendes et al. (2013)	✅	✅			
Lian et al. (2010)	✅		✅		
Anger et al. (2012)	✅		✅		
Williams and Pagliari (2004)	✅		✅	✅ (7)	
This work	✅	✅	✅	✅ (11)	✅

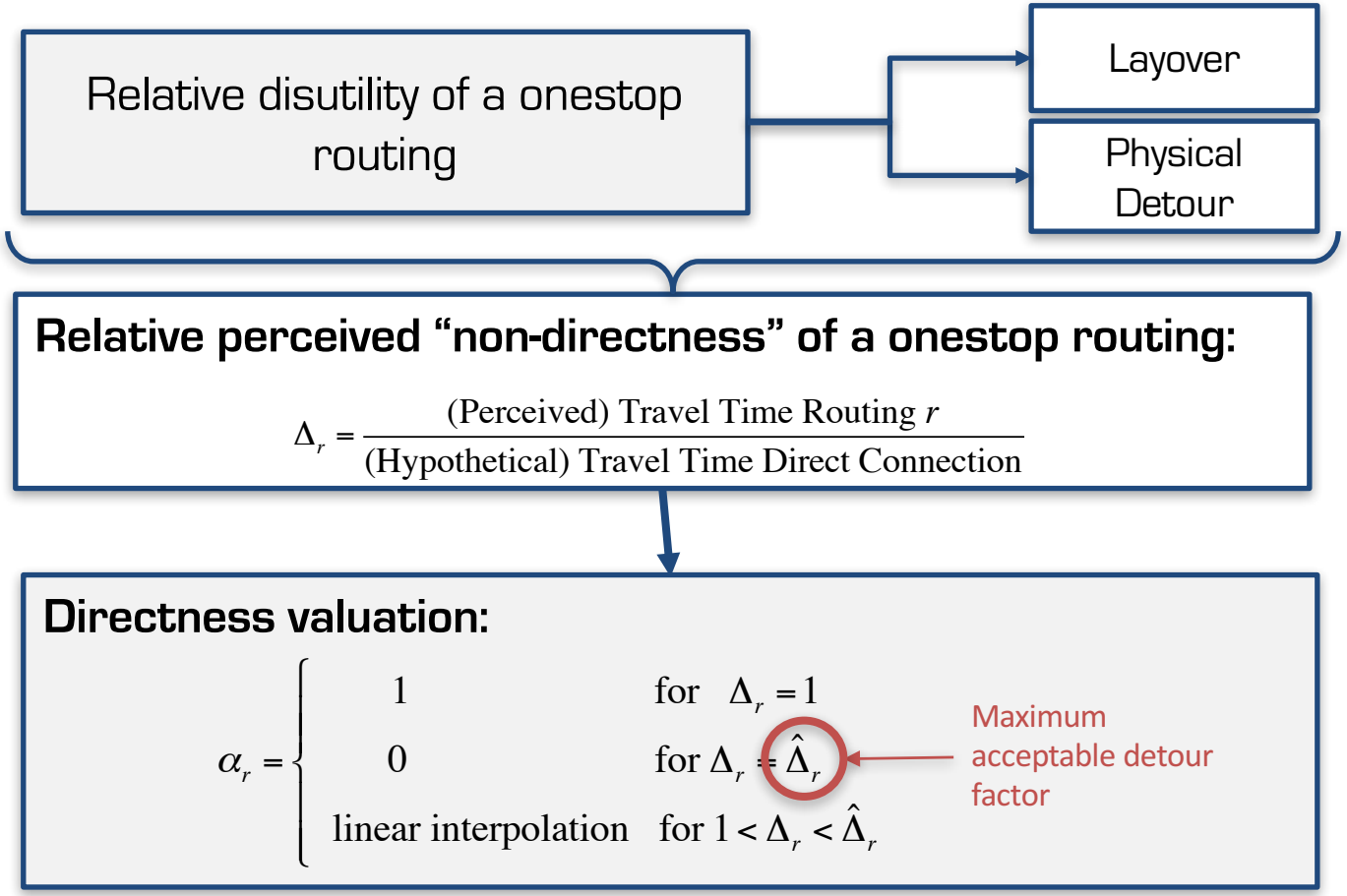
Destination quality

Airport	City	Country	IATA Code	$w_{d_r,t}$	Percentile in Dataset
Tokyo Intl.	Tokyo	Japan	HND	0.949	0.0%
Newark Liberty Intl.	Newark	United States	EWR	0.730	0.2%
John F. Kennedy Intl.	New York	United States	JFK	0.705	0.2%
Heathrow	London	United Kingdom	LHR	0.594	0.5%
Los Angeles Intl.	Los Angeles	United States	LAX	0.512	0.7%
Düsseldorf	Düsseldorf	Germany	DUS	0.501	0.8%
Manchester	Manchester	United Kingdom	MAN	0.445	1.2%
Charles De Gaulle	Paris	France	CDG	0.409	1.6%
Schiphol	Amsterdam	Netherlands	AMS	0.360	2.1%
Chicago O'Hare Intl.	Chicago	United States	ORD	0.360	2.1%
Brussels	Brussels	Belgium	BRU	0.359	2.2%
Incheon Intl.	Seoul	South Korea	ICN	0.340	2.5%
Ronald Reagan Washington Natl.	Washington	United States	DCA	0.276	3.2%
Washington Dulles Intl.	Washington	United States	IAD	0.246	4.1%
Hong Kong Intl.	Hong Kong	Hong Kong	HKG	0.221	4.6%
...					
Bahrain Intl.	Bahrain	Bahrain	BAH	0.036	24.9%
Lourdes	Tarbes	France	LDE	0.035	25.1%
...					
Lanzarote	Las Palmas	Spain	ACE	0.006	50.0%
Luxor Intl.	Luxor	Egypt	LXR	0.005	50.2%
...					
Strahan Airport	Strahan	Australia	SRN	0.001	74.9%
Teniente Vidal	Coyhaique	Chile	GXQ	0.001	75.2%
...					

The link quality level: Route directness

Idea:

Valuation of route directness as compared to a (hypothetical) nonstop routing between an origin airport and a destination airport.



The destination level

The global market grid

Wealth-adjusted population at a 30" resolution

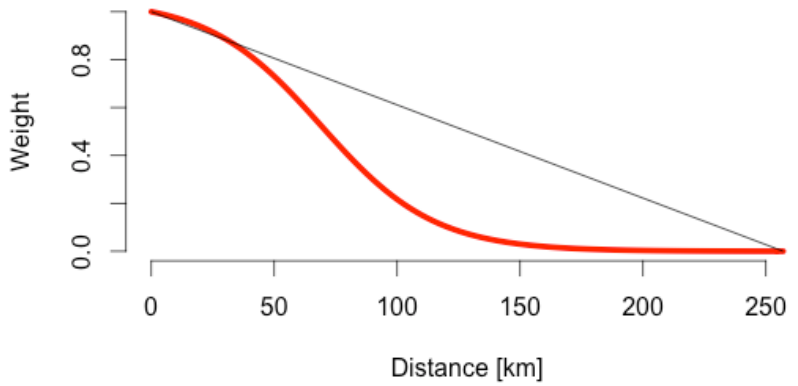
Data Sources: Landscan (Population) & Worldbank (GDP p.c.)

Geography of airport market

Distance decay modeling

Calibration:

Airport choice data



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PSOs Represented About 1% of Total Connectivity Across the 12 Countries in our Dataset

Connectivity Impact of PSO Movements in the U.S. and Europe, 2010

Country	*GCI Scores*			*% of Total PSO GCI*		*GCI Per PSO*	*PSO % of*
	Direct	*Indirect*	*Total*	*Direct*	*Indirect*	*Movement*	*County Total*
Finland	46	4	50	92%	8%	0.03	0.1%
France	5,170	5,416	10,586	49%	51%	0.25	4.1%
Germany	334	1,294	1,628	21%	79%	0.63	0.4%
Greece	340	363	703	48%	52%	0.05	1.5%
Ireland	436	70	506	86%	14%	0.05	1.0%
Italy	2,156	1,110	3,266	66%	34%	0.10	1.2%
Norway	778	96	874	89%	11%	0.02	1.5%
Portugal	218	748	966	23%	77%	0.05	2.5%
Spain	1,218	1,082	2,300	53%	47%	0.03	1.0%
Sweden	118	0	118	100%	0%	0.02	0.2%
U.K.	108	143	251	43%	57%	0.01	0.1%
U.S.	11,336	41,448	52,785	21%	79%	0.32	1.0%
Total	**22,212**	**51,770**	**73,983**	**30%**	**70%**	**0.16**	**1.0%**

Future applications of connectivity metric

Network Evolution

Historic patterns in the evolution of today's airline networks

Airline Strategies

Impacts of airline business on network configuration:

- Airline alliances, codeshares and joint ventures
- Contribution of LCC
- ME 3

...

Governmental Intervention

Network changes due to

- Liberalization (ASAs)
- Airport incentive schemes

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Economic impacts

Connectivity impacts on:

- Economic growth
- Employment
- Trade
- Foreign Direct Investment

...