Long-range growth: economic development in the global network of air links

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Introduction

Motivation

- Era of ultra long-haul
  - Faster and cheaper transportation
  - World as a global network : constant flow of people between countries
  - Made possible by innovation : "Jet Age" (50's), Boeing 747 (1970), Boeing 747-400 (1989), Airbus A330 and A340 (1993-1994)
- Airports matter for firms :
  - Businesses tend to locate disproportionately near airports (Bel and Fageda 2008)
  - New airline routes between headquarters and plants increase plant-level investment & productivity (Giroud 2013)
- Face-to-face contact : key driver of the transmission of knowledge and information $\rightarrow$ productivity growth

Introduction

Research question

What is the impact of long-distance flights on the spatial allocation of economic activity ?

- Assess the impact of air-connections on local growth, firm links and FDI
- Use regulatory and technological constraints to identify causal effects
  - Cities that are just under 6,000 miles apart are more likely to have direct air links, compared with cities slightly above that threshold.

Introduction

Literature

- **Transportation infrastructures and growth** : steamships (Pascali 2017), railroads (Donaldson and Hornbeck 2016 ; Donaldson 2018), and airplanes (Feyrer 2009)

- **Impact of air travel and proximity on** : businesses (Giroud 2013 ; Bernstein, Giroud, and Townsend 2016), science (Catalini, Fons-Rosen, and Gaule 2016) and trade (Cristea 2011 ; Poole 2013 ; Yilmazkuday and Yilmazkuday 2014).

- Debate on **globalization and inequality** (Dollar 2005 ; Bourguignon 2015) : inequality decreasing between countries while increasing within

Data

This paper combines three datasets :

- **"Traffic by Flight Stage"** (International Civil Aviation Organization)
  - Annual traffic, international flights (1989-2014)
  - Information on : aircraft used, number of flights operated, traffic (passengers, freight, mail)
  - 819 cities with major international airports, from 200 different countries.
- **Satellite-measured night lights** (NCEI-NOOA)
  - proxy for local economic activity
  - data aggregated into grid cells of size 0.25×0.25 degrees
  - available for 1992 and 2010
- **Orbis** (Bureau van Dijk)
  - Detailed information on firm ownership
  - 195 million firms in 229 countries

  $\rightarrow$ construct the network of foreign ownership links at the city pair level
  - Complement Orbis with the GDELT database GDELT

Empirical strategy

Identification

- **Main threat to identification** : perhaps "investment goes to cities that are attractive in their own right, rather than because they are easy to get to" (The Economist 2015)

- **Discontinuity** in connectedness between cities at a distance of **6,000 miles**
  - Cost strongly increases after 12 hours ($\approx$ 6,000 miles)
  - Very long flights impose requirements on the availability of pilots and crew
    - ⋆ U.S. Federal Aviation Authority (FAA) : a two-pilot crew can fly at most 12 hours within a 24-hour period. Flights above that limit require at least three pilots and an additional flight crew member
  - Trade-off between payload (passenger + cargo weight) and fuel

- **Identification assumption** : economic fundamentals of city pairs evolve continuously around 6,000 miles of distance
  - the assignment below/above the threshold is as good as random

Graph

Empirical strategy

Specification

- **City pair analysis**

  "Fuzzy" RD approach :

$$Y_{ij} = \alpha + \beta \times \text{Below6K}_{ij} + g(d_{ij}) \times \gamma + \epsilon_{ij}$$

  - d_{ij} : distance between the two cities
  - Below6K_{ij} : dummy equal to 1 if d_{ij} is less than 6,000 miles
  - $g(d_{ij})$: polynomial function of d_{ij}

- **Grid-Cell Analysis**

  2SLS :

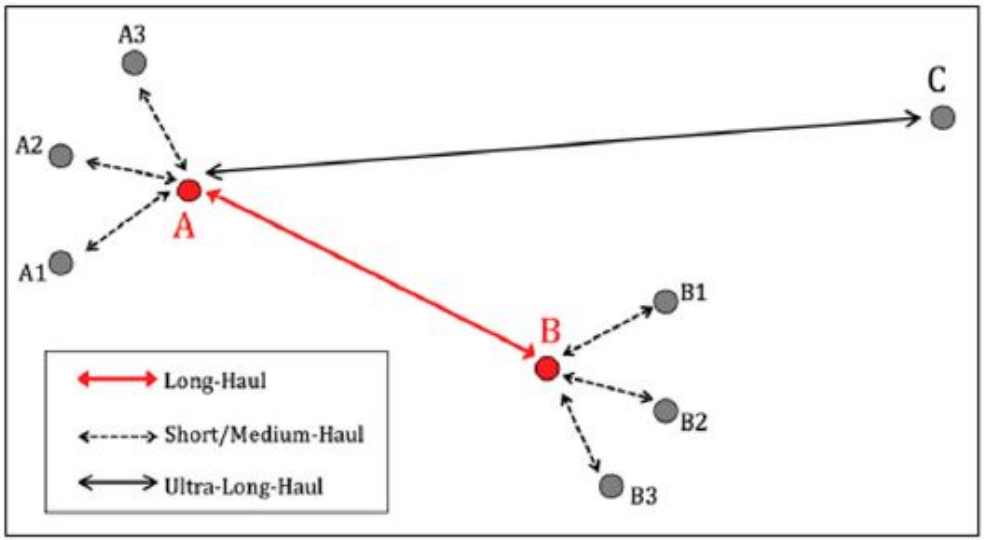
$$\text{Connections}_{ic} = \alpha_1 + \beta_1 \times \text{ShareBelow6K}_{ic} + X_{ic} \times \gamma_1 + \epsilon_{ic}$$
$$Y_{ic} = \alpha_2 + \beta_1 \times \widehat{\text{Connections}}_{ic} + X_{ic} \times \gamma_2 + \eta_{ic}$$

  Controlling for : total number of airports between 5,500 and 6,500 miles away, network centrality, region FE.

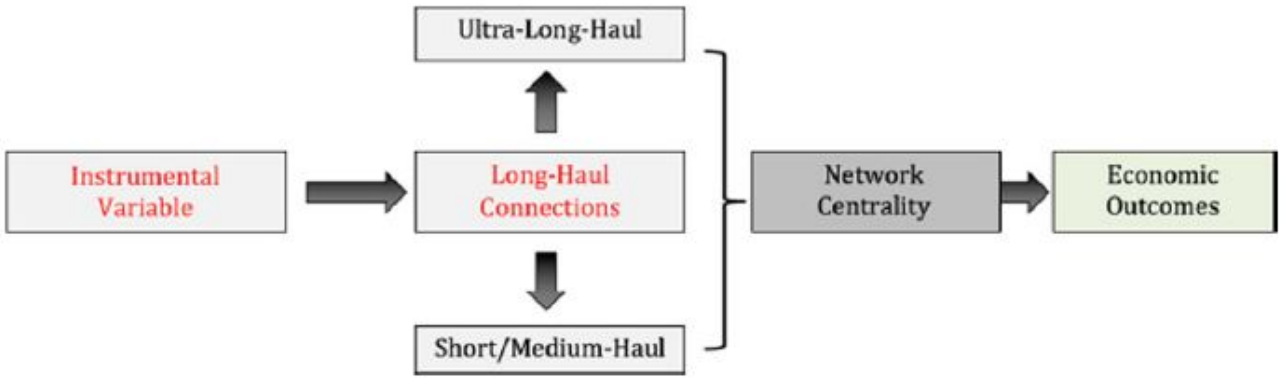
Empirical strategy

Instrumenting for network centrality

(A) Air Links



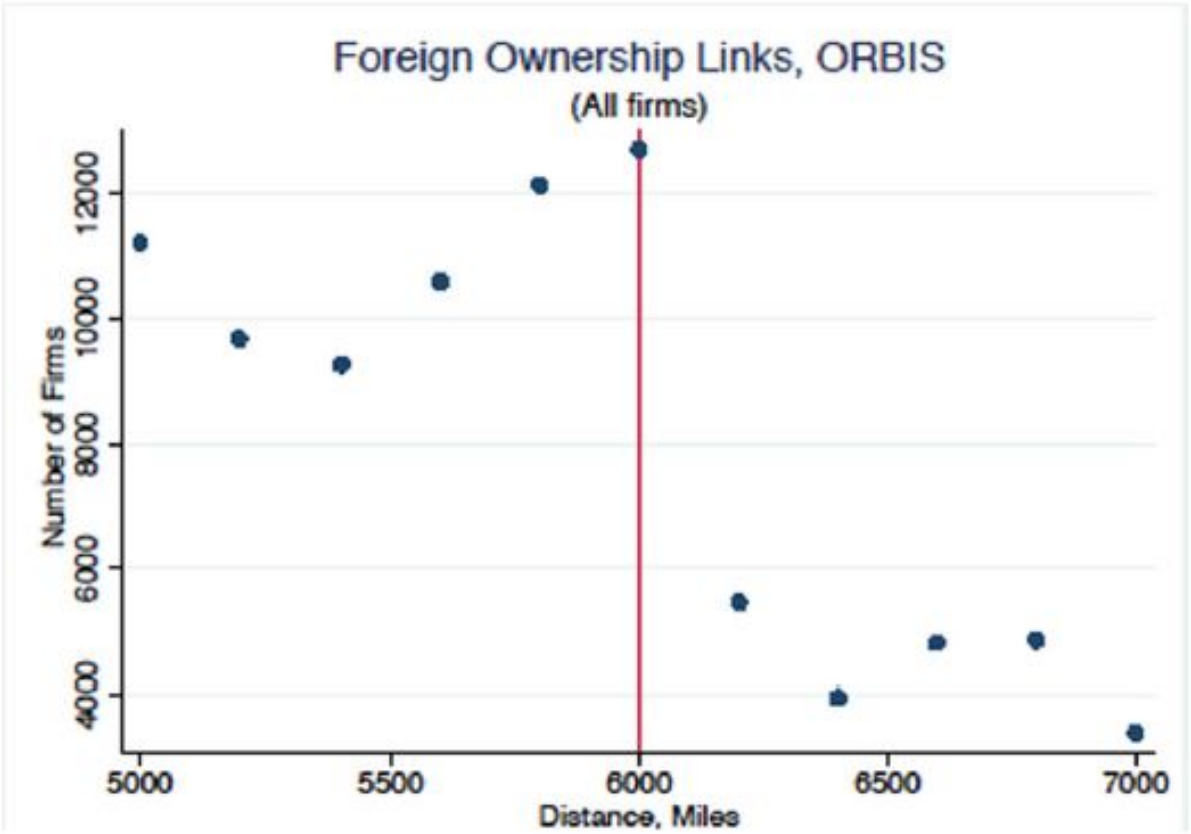
(B) Causal Framework



Results

FDI

(A) **All Firms**



Results

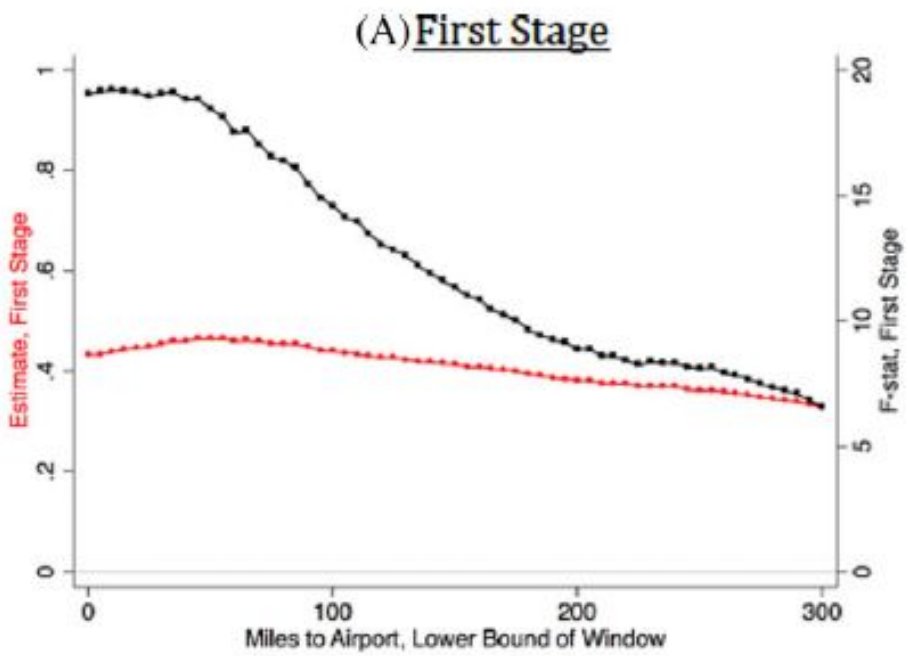
Growth

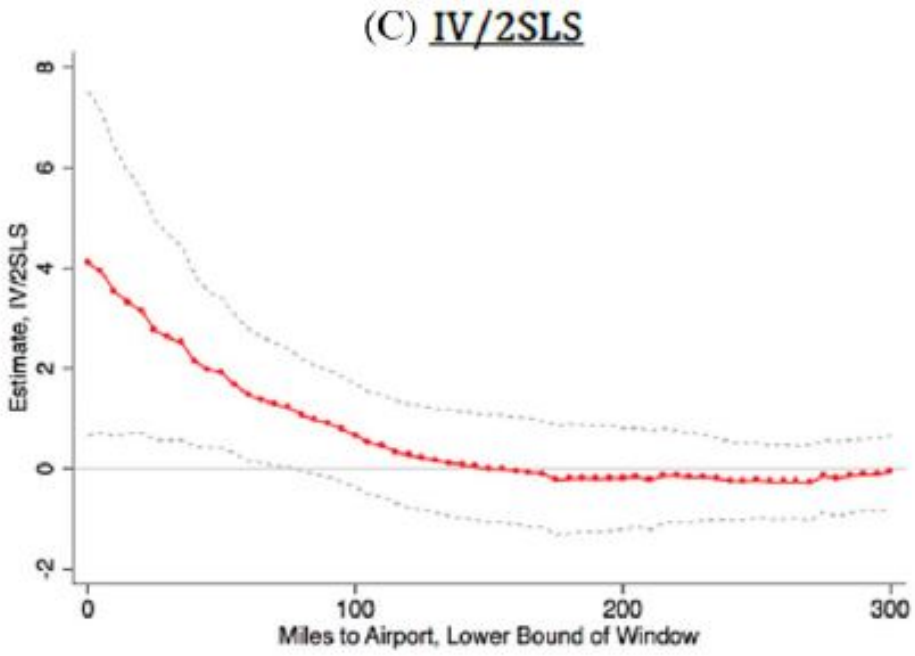
	Dependent variable: Night lights			
	92-2010 change (2SLS)	92-2010 change (std. 2SLS)	92-2010 growth (2SLS)	92-2010 growth (std. 2SLS)
Network centrality 1990–2010	4.1 **	0.81 **	0.525 **	1.01 **
	(1.75)	(0.34)	(0.236)	(0.46)
Anderson-Rubin p-value	0.012	0.012	0.022	0.022
Sanderson-Windmeijer F-stat	12.98	12.98	12.98	12.98
Airports	734	734	734	734
Observations	37766	37766	37766	37766
Controls	Yes	Yes	Yes	Yes

- improving an airport's position in the network has a + effect on local economic activity
- elasticity around 0.3 between night lights and GDP growth
- driven mostly by capital flows from H-I to M-I (but not L-I) countries

Results

Heterogeneous effect (wrt distance)





Results

Spillovers across airports

- Links in one city may displace those would have been formed with other cities
- **What happens to the business links around a given airport when the closest major airports receive a shock to their position in the network ?**
- Extended specification :

$$Y_{ic} = \alpha + \beta_1 \times \text{Centrality}_{ic} + \beta_2 \times \text{Centrality Closest 10}_{ic} + X_{ic} \times \gamma + \eta_{ic}$$

- Instrument "Centrality Closest 10" using "ShareBelow6K_Closest10"
  - "Centrality Closest 10" :
  - "ShareBelow6K Closest10" : the average "ShareBelow6K" for the 10 closest airports, while at least 300 miles away.

Results

Spillovers across airports (2)

	Number of firms owned by foreigners 2SLS	Night lights growth 92-2010 2SLS
Network centrality	1.909 *** (0.641)	1.561 ** (0.696)
Network centrality, 10 nearest airports	-0.279 (0.274)	-0.086 (0.305)
SW F-stat Network centrality	10.08	10.08
SW F-stat Network centrality 10 nearest	17.20	17.20
Observations	777	777
Controls	Yes	Yes

The impact of shocks to the centrality of other airports nearby is :

- Negative, smaller in magnitude, statistically insignificant

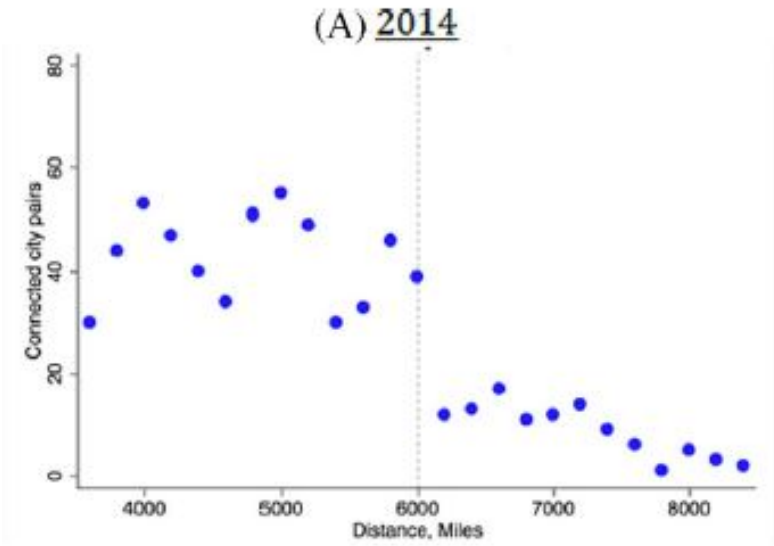
Conclusion

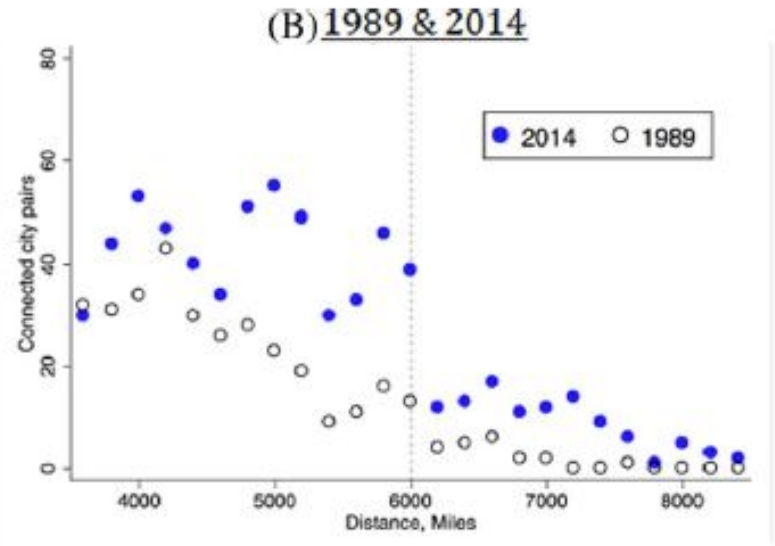
- Study the impact of international long-distance flights on local economic activity
- Exploit the discontinuity at 6000 miles linked to technology / regulation
- Causal estimation using RDD / instrumental variable approaches
- Main results
  - Better connected areas grow faster
  - Decreasing effect with distance
  - Relocation from the hinterland cannot entirely explain the effect
  - Air links increase business links
  - Air links increase FDI

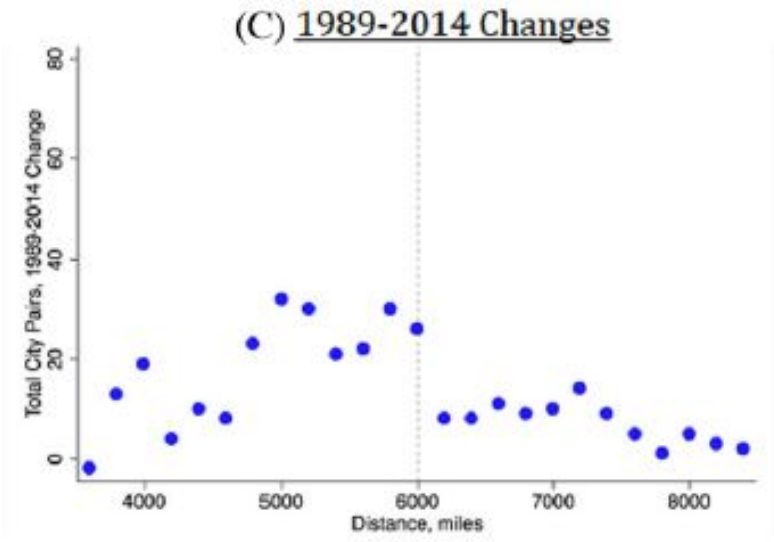
6 Appendix

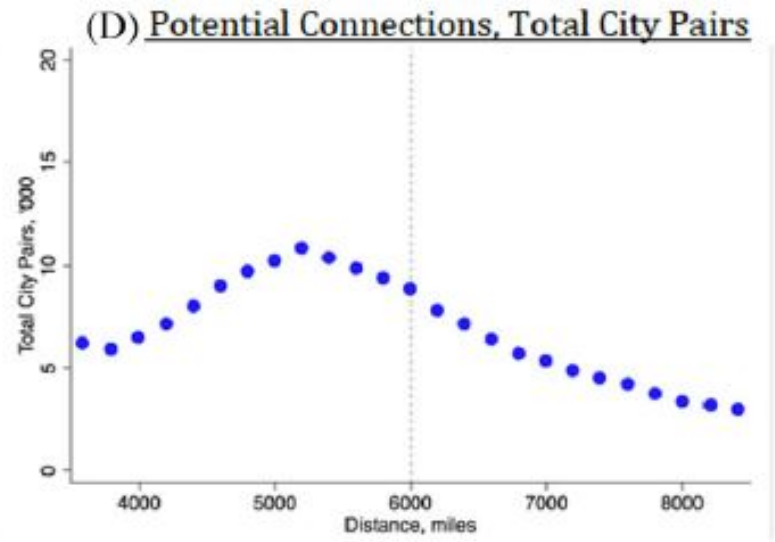
Connections between city pairs, by distance

Back









GDELT project

Back

https ://www.gdeltproject.org