

# Time zones matter: The impact of distance and time zones on services trade

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# Time zone differences



Figure: Do time zone differences matter?

# Nature of trade in services

- non-storable nature of services → proximity of supplier and consumer
- double coincidence in both time and space
- factors like distance place a cost burden of services delivery
- time zone differences add significantly to the costs of doing business abroad

# Motivation

- distance as a cost burden
- transactions costs that may affect the cost of doing business
- How do we account for transaction costs?
  - geographical characteristics
  - variables related to cultural and historical ties
- How can we capture transaction costs related to the need for frequent interaction in real time between parties?
- telephone, email and teleconference could be close substitutes to face-to-face interaction
  - North-South distance can be overcome more easily
- BUT: differences in time zones can matter
- frequent real-time communication important between headquarters and their foreign affiliates

# This paper

- offer alternative way to measure distance in terms of transaction cost
- decompose distance into a longitudinal (East-West) and latitudinal (North-South) component
- differences in time zones to account for difficulties in real time interaction
- examine the effect of "distance" on foreign affiliate sales
- panel of affiliate sales rather than FDI as proxy
- more sector detail - 5 service sectors
- **Results:** both measures of transaction cost appear empirically robust in explaining increased affiliate sales
  - increasing longitudinal or latitudinal distance by 100km raises affiliate sales by 2%

# Outline

- Related literature
- Decomposing distance
- Econometric Specification&Results
- Concluding Remarks

# Theoretical background

Proximity-concentration trade-off (Brainard 1993, Neary 2007, Helpman, Melitz, Yeaple 2003)

- higher fixed cost favor exporting over FDI, whereas higher trade costs favor FDI over exporting
- comparison across space: further away markets should be served by FDI
  - empirical evidence: negative effects of distance - both exports and FDI fall with distance
  - distance may proxies for other factors than trade costs (such as cost of communicating with subsidiaries)  
→ inconsistent with the proximity-concentration trade-off
- distance also affects marginal costs
  - with heterogenous firms: as distance increases more firms engage in FDI

# Empirical evidence wrt. time zone differences

- little attention with respect to economic effects
- Stein and Daude (2007)
  - bilateral OECD FDI stocks (cross-section)
  - significant negative impact of differences in time zones on FDI stock
  - longitudinal distance matters more (robustness check)
- Kamstra et al. (2000)
  - investigate the effect of daylight saving time on equity returns
  - returns are lower directly after the weekend the change occurred
- Portes and Rey (2005)
  - determinants of bilateral equity flows
  - significant negative impact of bilateral distance
  - overlapping stock market trading hours has a significant positive effect

# Time zone differences

- time zone differences in hours between the countries capitals
  - based on standard time zone, abstracting from daylight savings
  - ranges from 0 to 12 hours
- overlapping business hours between 9am and 5pm
  - ranges from 0 to 9 hours

# Longitudinal and latitudinal distance

- decompose distance between the U.S. and the partner countries in a longitudinal and latitudinal component
- capital of the U.S. located at  $(LA_{US}, LO_{US}) = (39.92N, 77.02W)$
- partner country's capital located at  $(LA_P, LO_P)$
- latitudinal distance (North-South)
  - great circle distance from  $(LA_{US}, LO_{US})$  to  $(LA_P, LO_{US})$
- longitudinal distance (East-West)
  - long distance if countries are close to equator, short if they are close to the pole
  - measure differs if we hold latitude constant at the U.S. or at the partner country
  - simply average the two measures

# An example

- longitudinal and latitudinal distance between USA and Finland
- Washington D.C. located at  $(LA_{US}, LO_{US}) = (39.92N, 77.02W)$
- Helsinki located at  $(LA_{FIN}, LO_{FIN}) = (60.15N, 25.03E)$
- longitudinal distance (fixing latitude of US): 8136km
- longitudinal distance (fixing latitude of FIN): 5059km
- average longitudinal distance: 6597.5km
- latitudinal distance: 2249km

- benchmark surveys from the Bureau of Economic Analysis (BEA)
- U.S. outward affiliate sales, disaggregated by country and industry of the affiliate
- in detail: sales by majority-owned foreign affiliates of U.S. multinationals
  - 5 service sectors , covering the years 1989, 1994, 1999 and 2004
  - observing 61 partner countries
- other sources: CEPII, IMF, World Bank

# Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Affiliate sales	735	1011.341	2711.454	0	31402
Log Affiliate sales	676	5.329065	2.042554	0	10.35463
Distance capitals	1016	7825.595	4021.269	737.0425	16371.12
Longitudinal distance	1016	6516	4516.826	2	15428.5
Latitudinal distance	1016	2583.14	2274.749	38	9012
Time zone differences	1016	5.621063	3.711334	0	12
Overlapping working hours	1016	3.795276	3.134021	0	9
Services value added (%GDP)	925	60.8109	11.70365	23.69907	90.85753
Trade in Services (%GDP)	938	18.59726	19.37309	2.126198	161.028
GDP	998	365803	692686.6	1501.5	4760168
GDP per capita	998	13597.97	13292.09	223.2644	74107.89
Log GDP	998	11.67979	1.652111	7.31422	15.37579
Log GDP per capita	998	8.842412	1.347682	5.408357	11.21328
Landlocked	1016	0.0728346	0.2599929	0	1
Common language	1016	0.2716535	0.4450313	0	1
Contiguity	1016	0.0354331	0.1849628	0	1
RTA	1016	0.0590551	0.2358439	0	1

# Affiliate sales and longitudinal distance

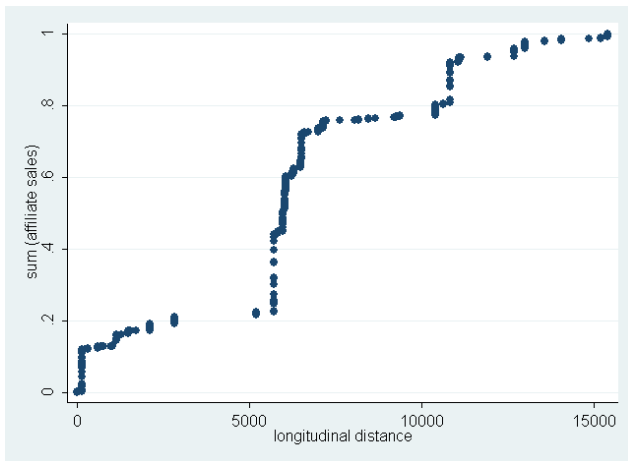


Figure: The development of affiliate sales over longitudinal distance

Standard gravity model:

$$\ln \text{Aff.Sales}_{jt}^k = \beta_0 + \beta_1 \mathbf{X}_{jt} + \beta_2 \mathbf{Z}_j + \alpha_t + \gamma_k + \mu_j + \varepsilon_{jt}^k \quad (1)$$

→ apply Hausman-Taylor model (HTM)

# Longitudinal and latitudinal distance components

Explanatory variables	(1)	Explanatory variables	(1)
Longitude	0.0002* (0.000)	y94	-0.0658 (0.152)
Latitude	0.0002** (0.000)	y99	0.2325 (0.179)
Log GDP	-0.0569 (0.502)	y04	0.3081 (0.238)
Log GDPpc	0.7410* (0.392)	I services	0.8966* (0.474)
Trade in Service	0.0121 (0.009)	FI services	0.6528 (0.453)
Service Value added	0.0638*** (0.014)	PST services	1.0399** (0.440)
Landlocked	-1.9341* (1.017)	Other services	0.6961 (0.483)
Contiguity	4.4047** (1.862)	Constant	-3.6676* (1.928)
Language	-3.6676* (1.928)	Observations	607
RTA	-0.0316 (0.321)	rho	0.867
		sigma e	0.864
		sigma u	2.206

# Pooled time zone differences

Explanatory variables	(1)	(2)
Latitude	0.0003*** (0.000)	0.0003*** (0.000)
1 to 2 hours	-0.3911 (0.617)	-0.4061 (0.561)
5 to 7 hours	1.7027* (0.931)	
8 to 9 hours	1.8696 (1.213)	
10 to 12 hours	3.1180** (1.368)	
5 to 6 hours		2.4493** (0.992)
7 to 8 hours		0.6960 (0.785)
9 to 10.5 hours		3.6313** (1.552)
11 to 12 hours		2.3616** (1.008)
Constant	-6.4380*** (2.497)	-5.4638** (2.550)

# Non-linear effect of time zones

Explanatory variables	(1)	Explanatory variables	(1)
Latitude	0.0003*** (0.000)	9 hours	2.9312* (1.580)
1 hour	-1.0065 (0.662)	10 hours	2.3480* (1.328)
2 hours	-0.0165 (1.108)	10.5 hours	4.9703* (2.736)
5 hours	5.6253*** (1.967)	11 hours	2.6899** (1.201)
6 hours	1.3626 (0.837)	12 hours	0.5068 (0.988)
7 hours	0.4068 (0.765)	Constant	-3.2059** (1.589)
8 hours	0.1829 (1.014)		

# Closing Comments

- offer alternative way to measure distance in terms of transaction cost
- increasing East-West or North-South distance raises affiliate sales substantially
- moving away in terms of time zones, our results show a significantly positive impact on affiliate sales for time zone differences of 5h and 9h or more
- Being further away matters!