Competition and Quality: Evidence from High-Speed Railways and Airlines

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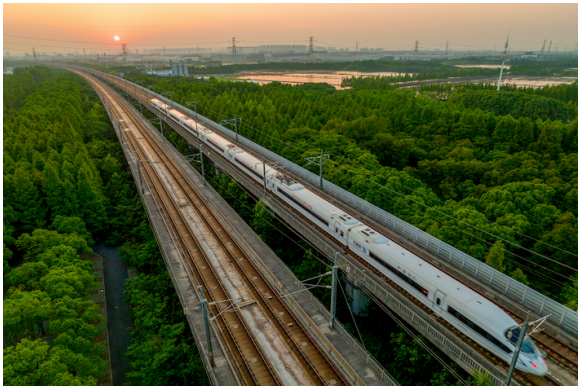
Contents

High-speed Rail in China

- The first long-distance High-speed rail (HSR) line in China, Beijing-Shanghai, opened in June 2011. It ran through 26 cities at opening.
- China's HSR system has seen dramatic expansion and is the largest in the world.
- China's domestic air travel market also saw explosive growth, with passenger numbers increasing by 90% between 2009 and 2015.
- The Beijing-Shanghai line provides significant competition to airlines in 11 cities, thanks to its nearly perfect on-time performance (OTP), better comfort, and potentially shorter travel times.
- Beijing Capital International Airport (BCIA) is one of the busiest airports on the Planet.

The Competitors



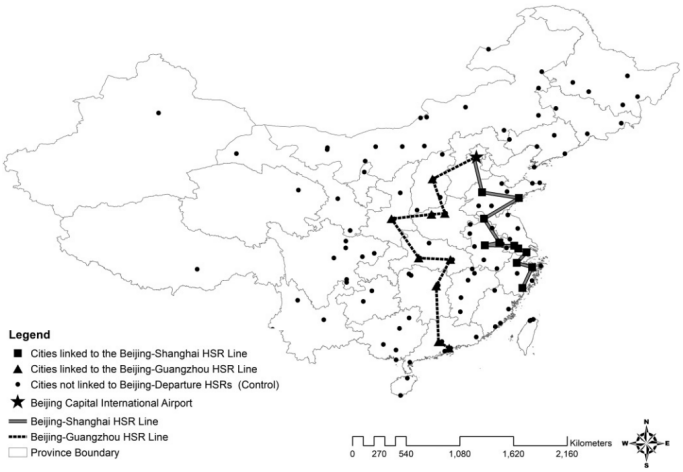
1. Intercity Transportation in China
2. Empirical Strategy
3. Results and Mechanisms
4. Conclusion

Research Question

- The paper aims to contribute to the literature on the effect of intensified competition on quality.
- Theoretically, the causal effect of increased competition on quality is ambiguous.
- The opening of the Beijing-Shanghai HSR line provides exogenous variation in competition intensity in the air travel market.
- Dataset containing 865,967 flights departing from BCIA to 113 destinations between January 2009 and December 2012 allows for comparison of OTP between flights to HSR-served and non-HSR cities.
- OTP is broadly considered the most important measure of quality for airlines.

Map

FIGURE 1.—GEOGRAPHIC DISTRIBUTION OF SAMPLE CITIES IN SEPTEMBER 2015



Identification

- Differences-in-differences specification will measure changes in OTP in treated flights compared to control flights (flights to cities not served by HSR).
- Identifying assumption is that, in the absence of the introduction of HSR, OTP of flights to the 11 cities would have followed the same trends as routes to cities not served by HSR.
- Threats to identification:
  - Contamination of control group
  - Composition effects (flight cancellations)
  - Capacity slack-induced OTP improvement
  - Non-random placement of HSR

Econometric Specification

$$Delay_{ijdt} = \alpha + \beta \cdot Treatment_{ijd} \cdot After_t + \mu_i + \delta_i + \zeta_t + \varepsilon_{ijdt}$$

Where:

- μ_i is a flight fixed effect
- δ_i is a departure hour fixed effect
- ζ_t is a date fixed effect
- $After_t$ is 1 after June 30th, 2011 and $Treatment_{ijd}$ is 1 for flights to the 11 treated cities.
- β is the parameter of interest

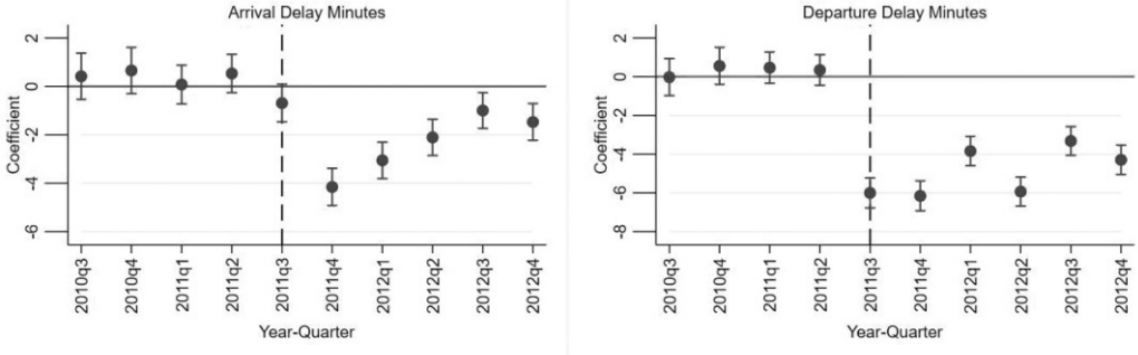
- An alternative event-study specification is also used.

Delay Measures

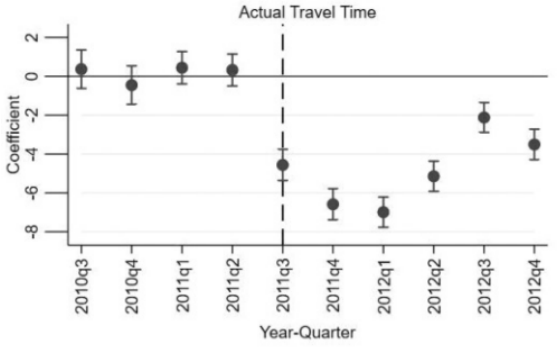
- Arrival/departure delay in minutes (ADM/DDM): Difference between scheduled and actual arrival/departure.
- Arrival/departure delay 15 minutes (ADD15/DDD15): Equal to 1 if delay is longer than 15 minutes.
- Actual travel time (ATT): Time between scheduled departure time and actual arrival time.
- Excessive travel time (ETT): Difference between ATT and minimum ATT for that flight in the same month.

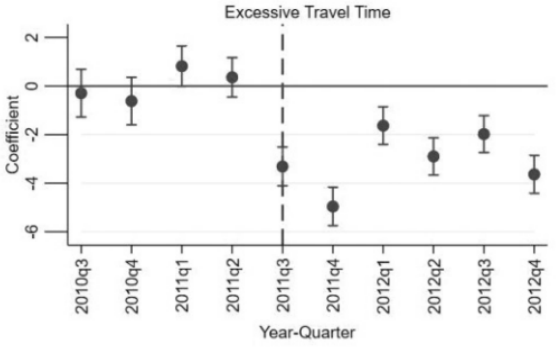
Testing Pre-trends

FIGURE 2.—DYNAMIC CHANGES OF THE FOUR OTP MEASURES



Testing Pre-trends





Main Results

TABLE 3.—EFFECT OF COMPETITION ON THE ON-TIME PERFORMANCE MEASURES: DEPARTURE LEVEL RESULTS

Dep. variables	ADM	ADD15	DDM	DDD15	ATT	ETT
Model	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Flight-level baseline results						
Treatment*After	−2.539***	−0.025***	−5.282***	−0.034***	−4.726***	−3.919***
	(0.230)	(0.002)	(0.224)	(0.002)	(0.236)	(0.240)
Observations	865,967	865,967	865,967	865,967	865,967	865,967
R-squared	0.266	0.196	0.254	0.209	0.636	0.208
Panel B: Beijing–Shanghai HSR (treatment) vs. Beijing–Guangzhou HSR (control)						
Treatment*After	−2.241***	−0.035***	−2.991***	−0.030***	−3.587***	−2.345***
	(0.284)	(0.003)	(0.277)	(0.011)	(0.285)	(0.283)
Observations	400,158	400,158	400,158	400,158	400,158	400,158
R-squared	0.296	0.212	0.274	0.213	0.577	0.238
Panel C: All HSR entries up to September 2015						
Treatment*After	−4.357***	−0.024***	−3.553***	−0.039***	−2.455***	−2.154***
	(0.274)	(0.001)	(0.116)	(0.001)	(0.130)	(0.128)
Observations	2,001,362	2,001,362	2,001,362	2,001,362	2,001,362	2,001,362
R-squared	0.231	0.196	0.246	0.220	0.564	0.197
Fixed Effects			Hour FE, Date FE, Flight FE			

Other explanations?

TABLE 8.—SUBSAMPLE ANALYSIS

Dep. Variables	ADM (1)	ADD15 (2)	DDM (3)	DDD15 (4)	ATT (5)	ETT (6)
Panel A: Only departures in the holiday periods						
Treatment*After	−1.628**	−0.017**	−2.505***	−0.024**	−3.558***	−2.001**
	(0.798)	(0.008)	(0.781)	(0.011)	(0.838)	(0.826)
Observations	54,719	54,719	54,719	54,719	54,719	54,719
R-squared	0.266	0.204	0.239	0.220	0.700	0.202
Panel B: Only flights that operated both before and after the HSR entry						
Treatment*After	−2.579***	−0.026***	−5.374***	−0.035***	−4.717***	−3.975***
	(0.230)	(0.003)	(0.229)	(0.003)	(0.234)	(0.362)
Observations	716,304	716,304	716,304	716,304	716,304	716,304
R-squared	0.262	0.193	0.253	0.206	0.637	0.237
Panel C: Only morning flights between 6 am and 9 am						
Treatment*After	−2.057***	−0.019***	−2.717***	−0.023***	−2.992***	−1.993***
	(0.419)	(0.004)	(0.401)	(0.005)	(0.425)	(0.417)
Observations	216,840	216,840	216,840	216,840	216,840	216,840
R-squared	0.318	0.246	0.330	0.257	0.692	0.268
Fixed effects			Hour FE, Date FE, Flight FE			

Main Results: Variance

TABLE 4.—EFFECT OF COMPETITION ON THE VARIANCE OF ON-TIME PERFORMANCE: FLIGHT-WEEKLY LEVEL RESULTS

Dep. Variables	Var. of ADM (1)	Var. of DDM (2)	Var. of ATT (3)	Var. of ETT (4)
Treatment*After	−475.113***	−487.390***	−509.221***	−507.734***
	(58.658)	(59.993)	(70.310)	(70.426)
Observations	150,019	150,019	150,019	150,019
R-squared	0.100	0.117	0.049	0.049
Fixed effects		Year-Week FE, Flight FE		

Where are the improvements coming from?

TABLE 5.—SOURCES OF QUALITY IMPROVEMENT FROM COMPETITION: DEPARTURE LEVEL RESULTS

			Components of actual duration			
Dep. variables	Departure delay	Actual duration	Taxi-out	Taxi-in	Air time	Scheduled duration
Model	(1)	(2)	(3)	(4)	(5)	(6)
Treatment*After	−5.282***	0.391	0.117	−1.389***	1.740***	−2.039***
	(0.224)	(0.541)	(0.086)	(0.055)	(0.124)	(0.061)
Observations	865,967	865,967	865,387	865,387	865,387	865,967
R-squared	0.254	0.929	0.097	0.141	0.813	0.962
Fixed effects			Hour FE, Date FE, Flight FE			

TABLE 6.—DOES THE AIRPORT GIVE TREATMENT FLIGHTS PRIORITY? DEPARTURE DELAY AT BUSY SLOTS

	Panel A: Full Sample		Panel B: Subsample excluding 2am–3am	
Sample	DDM	DDD15	DDM	DDD15
Dep. Variables	(1)	(2)	(3)	(4)
Treatment*After	−5.706**	−0.069**	−5.271**	−0.068**
	(2.594)	(0.030)	(2.630)	(0.030)
Treatment*After*BusySlot	0.466	0.049	0.288	0.048
	(2.507)	(0.033)	(2.570)	(0.033)
Observations	865,967	865,967	865,290	865,290
R-squared	0.258	0.198	0.259	0.199
Fixed effects		Hour FE, Date FE, Flight FE		

Who improves more?

TABLE 7.—HETEROGENEOUS EFFECTS OF THE COMPETITION ON THE ON-TIME PERFORMANCE MEASURES: DEPARTURE LEVEL RESULTS

	Panel A: Hub airlines heterogeneity				Panel B: Distance heterogeneity			
Dep. variable	ADM (1)	DDM (2)	ATT (3)	ETT (4)	ADM (5)	DDM (6)	ATT (7)	ETT (8)
Treatment*After	−6.793***	−3.780***	−3.079***	−1.433***	−2.696**	1.054	−0.889	−0.556
	(0.415)	(0.176)	(0.196)	(0.193)	(1.331)	(0.989)	(0.967)	(0.843)
Treatment*After*Hub	3.698***	0.344*	0.947***	0.422*				
	(0.473)	(0.200)	(0.224)	(0.227)				
Treatment*After*STM					−1.252***	−3.781***	−2.825**	−2.737***
					(0.068)	(0.759)	(1.425)	(0.891)
Observations	2,001,362	2,001,362	2,001,362	2,001,362	2,001,362	2,001,362	2,001,362	2,001,362
R-squared	0.231	0.246	0.564	0.197	0.346	0.517	0.890	0.363
Fixed effects	Hour FE, Date FE, Flight FE							

Economic Significance

- The results show an improvement of OTP in the intensive margin of between 2 and 5 minutes on average for treated routes.
- On the extensive margin, a 2-3 p.p. decrease in delays.
- Standard deviation of delay: Improvements of around 23-24 minutes.
- Results are mostly consistent across specifications and delay measures.

Mechanisms

- Capacity slack does not account for better OTP.
- Non-random placement of the HSR doesn't explain the results either.
- No evidence of schedule padding.
- Improvements aren't particularly acute during busy times compared to less busy times.
- Improvements stem mostly from on-time departure from the gate (in the airline's control) and some from faster taxi-in at destination.
- Hub airlines at BCIA (which have more market power) don't improve as much as non-hub airlines.
- Improvements are mainly on closer cities.