"Trade Integration, Market Size, and Industrialization"
Discussion of Faber, ReStud 2014

Nathan Schiff
Shanghai University of Finance and Economics

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Faber ReStud 2014: Main Question

What is the main question?

Main question: what is effect of being connected (new highways) to large cities on small city industrial output?

Two possible effects: 1) production is shifted from large city to connected small city 2) production further concentrates in large city

Additional questions and issues:

1. What happens to population of small city?
2. How are neighboring, unconnected cities affected?

Innovations and Contributions

Novel “engineering IV”: cleverly used geography as a source of exogenous variation in road placement

Big question with no theoretical prediction: effect of trade could increase or decrease concentration depending on parameters (Krugman papers) and context (urbanization)

Quite thorough: results are robust to many specifications, falsification tests, and seem to tell a consistent story

Note: Appendix is a nicely written description of exactly how the estimation was done (data issues, necessary choices, etc..); well worth reading if interested in doing Trade-style projects on China

Why study this question in China?

China's National Trunk Highway System was built recently and rapidly

China has many cities and high industrial output, makes identification strategy feasible

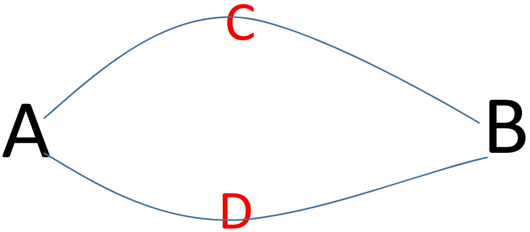
Data on city/region output available, geocoded roads, high precision land cover data

General importance of China as a large country

Krugman 2010: "...approaches of the new economic geography aren't backward-looking after all. They're utterly relevant to understanding developments in the world's fastest-growing economies. Localization in America has become a subtle affair, but in China and other emerging economies, it's anything but subtle, and there's wide scope for the use of [first principles] models to make sense of what we see."

Theoretical Effects of Connecting Regions

Basic Setup



New road policy is to connect large cities A and B

Road could go through peripheral county (city) C or D

What is effect on peripheral economy of new road?

Trade Models of Integration

Very influential literature in trade studies theoretical effects of connecting regions, especially “New Economic Geography” work by Paul Krugman (Nobel Prize 2008)

Krugman set-up: CES consumers, IRS manufacturing, iceberg transport cost

Krugman 1980 studies trade with immobile workers and mobile firms

Krugman 1991 allows for both mobile firms and worker migration (with a fixed agricultural population)

More recent literature builds on Krugman, including important models by Eaton-Kortum (Econometrica 2002) and Melitz (Econometrica 2003)

Krugman 1980

Say we connect a big (more workers) metropolitan area *A* with a small peripheral county *C*, and we have positive transportation costs, what happens?

Before connecting, *A* will have more firms, consumers will have higher utility through gains from variety (CES), firms in both regions will have the same mark-up p/w

After connecting: number of firms is the same, output per firm is the same, mark-up is the same, *but* wages will be higher in city *A* and consumer utility will rise, why?

Key: firms want to be in the larger market because they can sell to a larger population without paying shipping costs; consumers also benefit by being able to purchase more goods without shipping costs

This is known as the home-market effect

Rough Intuition for Home Market Effect

Firms in the smaller region have a smaller local market; they can sell to the larger region but there are shipping costs.

Since firms are mobile and thus spatial equilibrium condition implies that they are indifferent between the two locations: why would any firms locate in the smaller region?

If labor supply is not perfectly elastic, then higher demand leads to higher wages, which offsets the market advantage of the larger region

Thus firms are indifferent in equilibrium, but workers (consumers) benefit from being in the larger city due to a higher wage. This makes imports from C cheaper for consumers in A compared to imports from A for consumers in C.

Consumers in A also benefit from greater variety, but this not an effect of integration (count of firms is same as in autarky)

Krugman 1991

Allows manufacturing workers to move across regions, but keeps some population (farmers) fixed.

Agglomeration forces: home-market effect is now reinforced because there are increasing returns to population (increases in population lead to more varieties, which raise consumer utility)

Dispersion force: firms compete with each other for expenditure from fixed population, thus more firms means less expenditure for each firm

Results are complicated and quite interesting, depend greatly on strength of parameters

Dispersion: high transportation cost, low manufacturing consumption share, weak economies of scale

Concentration: low transporation cost, high manufacturing consumption share, large economies of scale

Theory for Faber 2014

Faber uses model similar to Krugman and Helpman (1985); firm counts can change with integration, but there is no worker migration

Agglomeration force: access to consumers without transportation costs; dispersion force is increased competition among firms

When connecting two regions, the smaller region benefits from access to the larger market but is also hurt from greater competition

Similarly, the home-market advantage of the larger market declines with greater integration (lower transportation costs) but is less affected by the increased competition from the smaller market

The key parameter is how asymmetric the two regions are before integration: if one region is much larger than the other then it is more likely manufacturing activity will move from the smaller region to the larger one

Identifying Effects of Connecting Regions

National Trunk Highway System

Faber writes that policy aim was “to connect all provincial capitals and cities with an urban registered population above 500,000 on a single expressway network, and to construct routes between targeted centres and the border in border provinces as part of the Asian Highway Network.”

- Policy approved in 1992: “7-5” network, 7 horizontal axes, 5 vertical axes
- Constructed between 1992 and 2007 at cost of US$ 120 bn
- 10% open by 1997, additional 81% by 2003,l final 9% after 2003

Note: no official list of targeted cities, Faber uses stated aim to classify these, finding 54 cities

National Trunk Highway System map

FIGURE 1
China's National Trunk Highway System. The figure shows Chinese county boundaries in 1999 in combination with the targeted city nodes and the completed expressway routes of the NTHS in the year 2007.

Endogeneity

$$ln(y_{ip}^{2006}) - ln(y_{ip}^{1997}) = \gamma_p + \beta * Connect_{ip} + \eta * X_{ip} + \epsilon_{ip} \quad (1)$$

County i, province p, $Connect_{ip}$ indicates if any part of county i within 10km of NTHS highway before end of 2003, cluster ϵ_{ip} by province

What is the endogeneity issue here?

What is his identification strategy?

Creates two IV road plans:

1. Least cost path spanning network: minimize total network cost given cost of building along different land cover types (slope/elevation, developed land, wetland, water)
2. Euclidean path network: minimize total network cost using straight line connections

Connected vs Non-Connected Regions

TABLE 1
Descriptive statistics for 1997

	Targeted city centres	Connected periphery	Non-connected periphery	National share of targeted city centres
Population (10,000)	233.24	56.96	38.48	0.17
Urban population (10,000)	179.69	10.77	5.83	0.5
GDP (100 Million Yuan)	517.86	32.58	15.09	0.5
GDP per capita (Yuan)	21435.06	5142.16	3637.09	–
Local government revenue (100 Million Yuan)	38.23	1.23	0.57	0.67
Industrial gross value added (100 Million Yuan)	194.61	14.93	5.58	0.48
Nonagricultural gross value added (100 Million Yuan)	505.75	24.42	9.74	0.59
Agricultural output share	0.04	0.34	0.42	–
Land area (km^2)	1543.09	3057.47	4513.4	0.015
Number of counties	54	424	943	54

Notes: The first three columns present mean 1997 levels, and the fourth column presents national shares by county groups. Targeted city centres refer to the central city county units (shixiaqu) of targeted metropolitan regions. Peripheral counties are counties outside a 50 km commuting buffer around the targeted city centres.

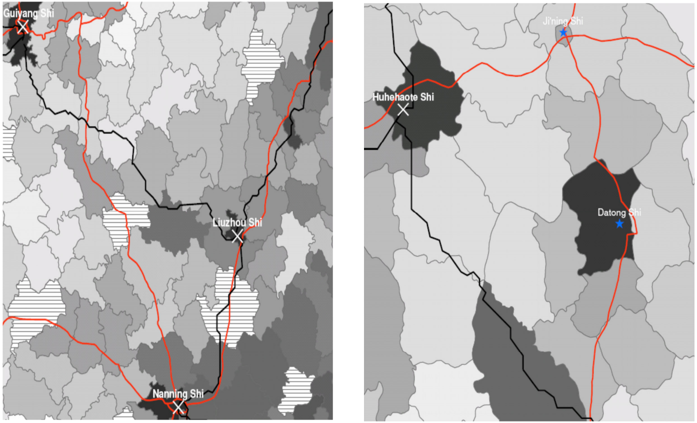
Connected peripheral regions look larger and richer.

Creating Least Cost Path Spanning IV

How does he do this?

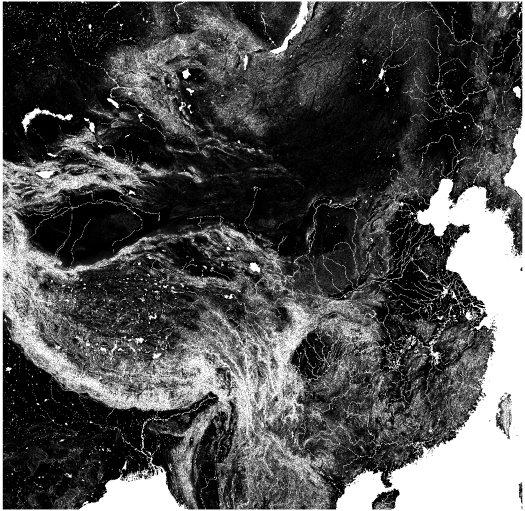
- Uses US and Chinese government data on characteristics of land parcels (GIS raster data is basically a grid of cells with values)
- Uses ArcGIS to run algorithms that minimize construction cost of entire road network based on requirement of connecting 54 cities and given costs of land types
- Output of process is a network of bi-lateral curves between 54 cities

Least Cost Path Spanning IV Example



The network in red color depicts actual NTHS expressway routes. The network in black color depicts the least cost path spanning tree network. Crosses indicate targeted metropolitan nodes. Counties are color coded according to their nominal levels of GDP in 1997, where darker colors represent higher values. Striped areas indicate missing 1997 GDP data.

Construction Cost Map



The figure depicts the construction cost raster used as input into the least cost path algorithm. The color scale ranges from white (very high cost of crossing a parcel of land) to black (very low cost of crossing a square km parcel of land). The cost assignment is based on land gradient (slope) as well as land cover (water, wetlands, and developed land), and described in more detail in the text.

Least Cost Path Spanning IV Map

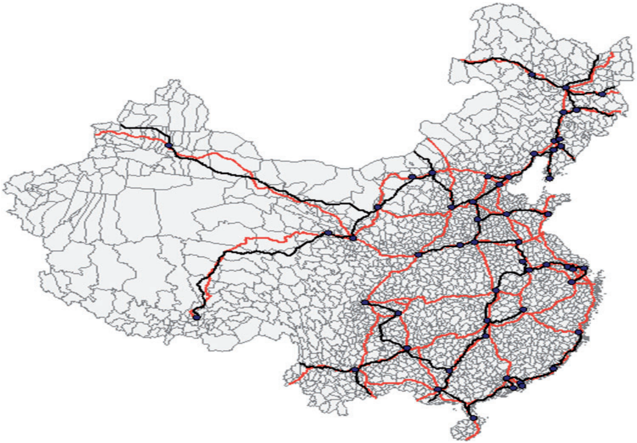


FIGURE 2

Least cost path spanning tree network. The network in red colour depicts the completed NTHS network in 2007. The network in black colour depicts the least cost path spanning tree network. The black routes are the result of a combination of least cost path and minimum spanning tree algorithms. In the first step Dijkstra's (1959) optimal route algorithm is applied to land cover and elevation data in order to construct least costly paths between each bilateral pair of the targeted destination. In the second step, these bilateral cost parameters are fed into Kruskal's (1956) minimum spanning tree algorithm. This algorithm identifies the subset of routes that connect all targeted nodes on a single continuous network subject to global construction cost minimization.

Euclidean IV

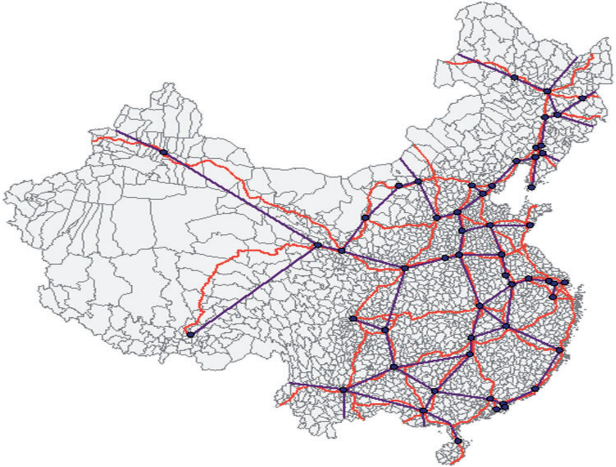


FIGURE 3

Euclidean spanning tree network. The network in red colour depicts the completed NTHS network in 2007. The network in darker colour depicts the Euclidean spanning tree network. The routes are the result of applying Kruskal's (1956) minimum spanning tree algorithm to bilateral Euclidean distances between targeted destinations. This algorithm is first run for the all-China network, and then repeated within North-Centre-South and East-Centre-West divisions of China. These regional repetitions add 9 routes to the original minimum spanning tree.

Discussion of IV

What is the relevance requirement and exclusion restriction for this IV?

Relevance: must be able to predict placement of road network, *controlling* for other variables (distance to node cities, capital status, urban status, demographics)

Exclusion restriction: instrument must be uncorrelated with error term; any problems in this context?

Controls are important; author notes:

- peripheral counties closer to targeted cities are "mechanically more likely to lie on a least cost [path]"
- least cost paths could also be correlated with "political and economic county characteristics due to historical trade routes"
- includes controls for pre-existing political status and 1990 economic conditions, including schooling and agricultural employment

Evaluation of IV

Author is very careful and pre-empts readers concerns by directly stating and address possible identification issues

Online appendix: discusses testing for whether land cover features could be endogenous (also includes as controls)

Appendix also discusses interpretation of estimated coefficients relative to population

Thoughts?

Results

Main Results

What does he find?

Output of connected peripheral counties grows more slowly than non-connected counties

Note: it's a little unclear how he defines peripheral counties; he excludes counties within 50km of targeted cities (worried about commuting) but does not explain remaining selection criteria

Effects are stronger when including additional controls, suggesting correlation of IV roads and controls

NTHS connections reduced GDP growth by 9% to 18% from 1997-2006; this comes from decrease in industrial output growth (no effect on agriculture)

No effect on county population growth

Table 2: First Stage

TABLE 2
First stage regressions

Dependent variable:	(1) Connect	(2) Connect	(3) Connect	(4) lnDistHwy	(5) lnDistHwy	(6) lnDistHwy
Least cost path IV	0.323***		0.254***	0.317***		0.245***
	(0.0574)		(0.0635)	(0.0645)		(0.0635)
Euclidean IV		0.243***	0.144**		0.280***	0.193***
		(0.0529)	(0.0560)		(0.0599)	(0.0657)
lnDistNode	−0.130***	−0.127***	−0.104***	0.588***	0.635***	0.426***
	(0.0376)	(0.0295)	(0.0323)	(0.130)	(0.112)	(0.122)
Prefect capital	−0.124*	−0.129*	−0.120*	0.437**	0.429*	0.413*
	(0.0648)	(0.0736)	(0.0658)	(0.209)	(0.229)	(0.215)
City Status	0.0891**	0.0929**	0.0847**	−0.297***	−0.296***	−0.270***
	(0.0403)	(0.0437)	(0.0399)	(0.0946)	(0.103)	(0.0951)
lnUrbPop90	0.106***	0.115***	0.107***	−0.228***	−0.244***	−0.227***
	(0.0225)	(0.0217)	(0.0209)	(0.0691)	(0.0640)	(0.0636)
Educ90	−0.273	−0.303	−0.302	−1.671	−1.747	−1.626
	(0.598)	(0.656)	(0.601)	(1.697)	(1.804)	(1.666)
AgShare90	−0.170	−0.216	−0.167	0.0238	−0.00173	−0.0160
	(0.182)	(0.189)	(0.179)	(0.537)	(0.555)	(0.533)
Obs	1342	1342	1342	1342	1342	1342
R^2	0.222	0.204	0.233	0.401	0.394	0.414
First stage F-Stat	31.61	21.07	20.31	24.09	21.82	15

Notes: All regressions include province fixed effects. Columns 1–3 report results for binary NTHS connection indicators among peripheral counties. Columns 4–6 report results for the log distance to the nearest NTHS segment among peripheral counties. lnDistNode is log county distance to the nearest targeted city node. Prefect Capital and City Status are binary indicators for respective county status in 1990. lnUrbPop90 is log 1990 county urban population. Educ90 is the 1990 county share of above compulsory schooling in 20+ population. AgShare90 is the 1990 county share of agricultural employment. Standard errors are clustered at the province level and stated in parentheses below point estimates. ***1%, **5%, and *10% significance levels.

Table 3: Main Specification

TABLE 3

Network connection effects among peripheral counties

Dependent variables		(1) OLS No controls	(2) OLS With controls	(3) LCP IV No controls	(4) LCP IV With controls	(5) Euclid IV No controls	(6) Euclid IV With controls	(7) Both IVs No controls	(8) Both IVs With controls	(9) Both IVs With controls
Change ln(IndGVA) 1997–2006	Connect	−0.0529	−0.0356	−0.284**	−0.304**	−0.246*	−0.287*	−0.272***	−0.297***	−0.297**
		(0.0418)	(0.0499)	(0.118)	(0.145)	(0.148)	(0.154)	(0.0965)	(0.108)	(0.121)
	Obs	1302	1280	1302	1280	1302	1280	1302	1280	1280
	R^2	0.242	0.255							
Change ln(NonAgGVA) 1997–2006	Connect	−0.0411	−0.0266	−0.243**	−0.252**	−0.270**	−0.296**	−0.251***	−0.268***	−0.268***
		(0.0335)	(0.0375)	(0.0983)	(0.117)	(0.122)	(0.131)	(0.0877)	(0.0969)	(0.0946)
	Obs	1285	1262	1285	1262	1285	1262	1285	1262	1262
	R^2	0.27	0.284							
Change ln(GovRevenue) 1997–2006	Connect	−0.0497*	−0.0914***	−0.0542	−0.223*	−0.175	−0.315**	−0.0926	−0.257***	−0.257***
		(0.0285)	(0.0295)	(0.109)	(0.120)	(0.117)	(0.132)	(0.0893)	(0.0996)	(0.100)
	Obs	1290	1285	1290	1285	1290	1285	1290	1285	1285
	R^2	0.275	0.334							
Change ln(GDP) 1997–2006	Connect	−0.00204	−0.0144	−0.106	−0.177*	−0.178	−0.254**	−0.127	−0.203**	−0.203**
		(0.0245)	(0.0276)	(0.0830)	(0.0942)	(0.112)	(0.116)	(0.0824)	(0.0886)	(0.080)
	Obs	1297	1272	1297	1272	1297	1272	1297	1272	1272
	R^2	0.228	0.264							
Change ln(AgGVA) 1997–2006	Connect	−0.00344	−0.00790	0.000194	−0.0252	−0.0305	−0.0597	−0.00865	−0.0371	−0.0371
		(0.0210)	(0.0220)	(0.0631)	(0.0789)	(0.0672)	(0.0728)	(0.0545)	(0.0630)	(0.0654)
	Obs	1335	1313	1335	1313	1335	1313	1335	1313	1313
	R^2	0.202	0.208							
Change ln(Population) 1997–2006	Connect	0.00488	−0.00217	0.0395**	0.0264	0.0183	0.0104	0.0333*	0.0207	0.0207
		(0.00456)	(0.00568)	(0.0188)	(0.0234)	(0.0242)	(0.0262)	(0.0183)	(0.0215)	(0.0225)
	Obs	1337	1314	1337	1314	1337	1314	1337	1314	1314
	R^2	0.234	0.271							

Interpreting Magnitudes

Using column 9 estimates, Faber notes that connecting a county reduced GDP growth—relative to non-connected counties—by exp(-0.203), or 18%

Local government revenue declines by 23 (row 3)%

Faber notes that decreases likely caused by decline in industrial output growth of 26% (row 1)

Concern: Instrument Correlated with Pre-existing Differences

IV coefs in Table 3 differ depending on inclusion of controls

Raises concern that there are other differences between *predicted* connected and non-connected counties that are not controlled

Similarly, predicted connected counties could have been on different pre-existing growth trends

How does Faber deal with this issue?

Falsification test: regress pre-period (1990-97; before roads built) revenue growth on instrument and controls

Table 4: Falsification Test

TABLE 4
Falsification test before and after the network was built

Dependent variable: Change ln(LocGovRev)	(1) OLS 1990–97	(2) OLS 1997–06	(3) LCP IV 1990–97	(4) LCP IV 1997–06	(5) Euclid IV 1990–97	(6) Euclid IV 1997–06	(7) Both IVs 1990–97	(8) Both IVs 1997–06
Panel A: Binary								
Connect	0.0154	−0.0848**	0.0143	−0.151	0.117	−0.282**	0.0563	−0.204***
	(0.0410)	(0.0360)	(0.0853)	(0.0974)	(0.107)	(0.129)	(0.0647)	(0.0467)
Obs	894	894	894	894	894	894	894	894
R^2	0.274	0.339						
First stage F-Stat			19.635	19.635	19.091	19.091	14.93	14.93
Panel B: log Distance								
ln(DistHwy)	−0.0114	0.0160	−0.0409	0.0854*	−0.00442	0.185**	−0.0274	0.122***
	(0.0142)	(0.0190)	(0.0350)	(0.0470)	(0.0573)	(0.0783)	(0.0329)	(0.0430)
Obs	894	894	894	894	894	894	894	894
R^2	0.275	0.336						
First stage F-Stat			18.696	18.696	17.306	17.306	11.259	11.259

Notes: Each point estimate stems from a separate regression. All regressions include province fixed effects and a full set of county controls. LCP IV stands for the least cost path spanning tree instrument. Euclid IV stands for the straight line spanning tree instrument. Panel A presents results for binary NTHS connection indicators (for both OLS and instruments) and Panel B presents results for log distance to the nearest NTHS segment (again for both OLS and instruments). Standard errors are clustered at the province level and stated in parentheses below point estimates. ***1%, **5%, and *10% significance levels.

Local Average vs Population Average Treatment Effects

An important concern about interpretation is that LATE could be quite different from ATE, why?

Brief review of LATE and ATE:

- Instruments capture effect on compliers–what is a complier in an experiment?
- Here compliers are counties whose connection status follows instruments prediction
- However, there are some counties that would always be connected, regardless of road construction cost; “always-takers”
- In theory there could also be some counties that would never be connected (“never-takers”), although it’s hard to think of a reason for this
- If connection effect is different for these counties, then ATE will be different from LATE

IV estimate is LATE

Let Y_i be the outcome for county i (ex: GDP), W_i indicates whether i is actually connected to highway system, Z_i indicates whether i is *predicted* to be connected based on cost instruments

$$\beta^{IV} = \frac{\mathbb{E}[Y_i|Z_i=1]-E[Y_i|Z_i=0]}{\mathbb{E}[W_i|Z_i=1]-E[W_i|Z_i=0]}$$

Faber notes that instrument may capture remote counties with poor economies (compliers) while counties that would always be connected (always-takers) may be both economically and politically important (administrative capitals, etc...)

If always-takers have better economies, then effect of instrument on connection status should be different for counties with better observable characteristics (ex: GDP, population)

In appendix, author separates sample by pre-connection (1997) observables (ex: above median GDP) and then estimates first stage. Similar coefficient suggests compliers and always-takers not systematically different in these variables.

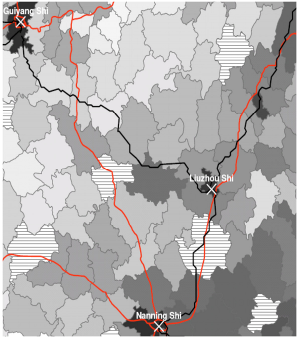
Appendix Table 2.1: LATE and First Stage

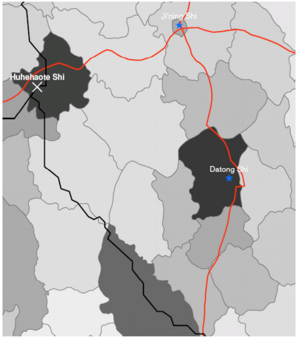
Table 2.1: Estimated Proportion of Compliers and Relative Likelihoods of Observable Characteristics

	(1) Full Sample	(2) Pop 97	(3) Urban Pop 97	(4) %Urban Pop 97	(5) GDP 97	(6) GDP Cap 97
Panel A: LCP IV						
Connect 1st Stage Point Estimate	0.418***	0.383***	0.432***	0.494***	0.399***	0.433***
	(0.0601)	(0.0821)	(0.0704)	(0.0599)	(0.0873)	(0.0869)
F-Statistic p-value [Coef=0.418]		0.677	0.839	0.214	0.832	0.864
Obs	1367	650	662	633	673	664
Estimated Proportion of Compliers Among Treated Counties	0.222					
Panel B: Euclid IV						
Connect 1st Stage Point Estimate	0.314***	0.354***	0.375***	0.328***	0.365***	0.337***
	(0.0492)	(0.0690)	(0.0822)	(0.0776)	(0.0784)	(0.0712)
F-Statistic p-value [Coef=0.314]		0.567	0.462	0.860	0.521	0.750
Obs	1367	650	662	633	673	664
Estimated Proportion of Compliers Among Treated Counties	0.221					

Each point estimate stems from a separate regression. The table presents first stage point estimates for regressions of binary NTHS connections on spanning tree connections and province fixed effects across different county samples. All regressions include province fixed effects. LCP IV stands for the least cost path spanning tree instrument. Euclid IV stands for the straight line spanning tree instrument. The first column presents the full sample first stage estimate. The following columns (in stated order) present this estimate for counties with above median 1997 levels of population, urban population, shares of urban population, GDP, and GDP per capita. Standard errors are clustered at the province level and stated in parentheses below point estimates. ***1%, **5%, and *10% significance levels.

Deviations from LCP affect rich and poor counties





The network in red color depicts actual NTHS expressway routes. The network in black color depicts the least cost path spanning tree network. Crosses indicate targeted metropolitan nodes. Counties are color coded according to their nominal levels of GDP in 1997, where darker colors represent higher values. Striped areas indicate missing 1997 GDP data.

Left plot shows counties missed by instrument have high and low GDP; Right plot shows that when planners deviated from LCP and chose to go through an important county (Datong), it affected counties along the way with both high and low GDP

Interpretation and Discussion of Mechanisms

Two Possible Explanations

What are the two explanations for his results that he tests?

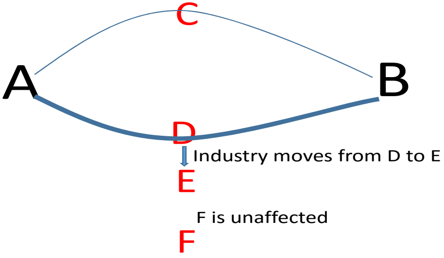
1) Trade effect: bigger market with IRS production leads to concentration of production in core, periphery loses (home market effect)

This effect can be reinforced when workers move to core area

2) Urbanization effect: connected counties lose industry to nearby unconnected counties (decentralization)

Also implies population growth should differ in connected counties compared to nearby unconnected (but how exactly? not a good fit for monocentric city model)

Effect of Distance to NTHS Road



Decentralization implies non-monotonic effect of distance to road on output; trade implies effect decreases with distance

D should be negatively affected, E positive, F unchanged

To test this estimates effect of distance using high-order polynomial (effect can vary greatly with distance)

Urbanization vs Trade

TABLE 5

Are NTHS connections associated to urbanization and industrial decentralization among peripheral counties?

Dependent variable:	Change ln(UrbPop) 1997–06	Change ln(Urb/Pop) 1997–06		Change ln(IndGVA) 1997–06			Change ln(GDP) 1997–06			Change ln(GovRevenue) 1997–06	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Connect	0.0350	0.0137	−0.297***	−0.262**		−0.203**	−0.193**		−0.257***	−0.253***	
	(0.0953)	(0.0925)	(0.108)	(0.113)		(0.0886)	(0.0919)		(0.0996)	(0.0961)	
Neighbour				0.153			0.0907			0.0535	
				(0.214)			(0.132)			(0.195)	
lnDistHwy					0.113*			0.0845*			0.177***
					(0.0615)			(0.0480)			(0.0667)
First Stage F-Stat	13.374	13.374	18.886	5.016	13.852	17.425	4.84	12.989	19.055	5.383	13.879
Obs	1,072	1,072	1,280	1,280	1,280	1,272	1,272	1,272	1,285	1,285	1,285

Notes: All regressions include province fixed effects and a full set of county controls. Reported results are 2nd stage estimates using the least cost path and the Euclidean spanning tree networks to instrument for NTHS connections, neighbouring peripheral counties, or distance to the nearest NTHS segment. Columns 1 and 2 report connection effects on peripheral county changes in log urban population and urbanization, respectively. Neighbour indicates peripheral counties neighbouring a connected peripheral county. Standard errors are clustered at the province level and stated in parentheses below point estimates. ***1%, **5%, and *10% significance levels.

No effect on population growth; baseline coefficients unchanged when adding neighbor dummy (no evidence for industry moving outwards)

Fitted Effect of Distance

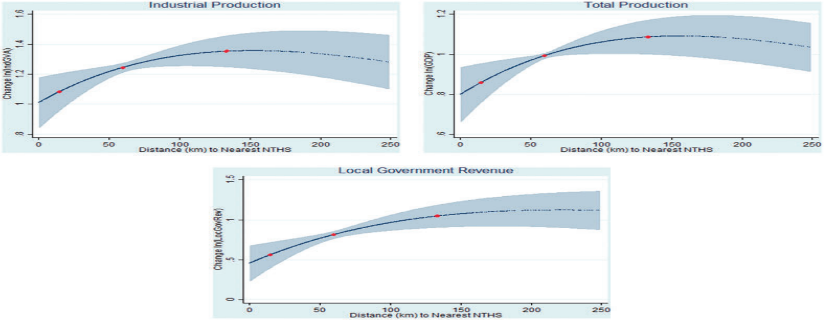


FIGURE 4

Estimated effect of peripheral connections over distance to the nearest NTHS route. The graphs depict the flexibly estimated relationships between distance to the nearest NTHS route and peripheral county growth in industrial value added, total GDP, and local government revenue. The plots correspond to the best fitting polynomial functional form according to the Akaike Information Criterion (AIC). The functions and confidence intervals are based on IV estimates holding covariates at their mean. County distance to the NTHS and its polynomial terms are instrumented with distances to the LCP and Euclidean spanning trees and their polynomials. The red dots indicate median county distances to the nearest NTHS route among connected peripheral counties (left), peripheral counties neighbouring a connected county (centre), and the remaining peripheral counties farther away (right). The shaded areas indicate 90% confidence intervals. Standard errors are clustered at the province level.

Heterogeneity: Larger Connected Regions Less Affected

TABLE 6
Testing the heterogeneity of peripheral connection effects

Dependent variable:	Change ln(IndGVA) 1997–2006 (1)	Change ln(IndGVA) 1997–2006 (2)	Change ln(GDP) 1997–2006 (1)	Change ln(GDP) 1997–2006 (2)
Panel A: Binary				
Connect	−0.304**	−4.281***	−0.177*	−3.571***
	(0.145)	(1.569)	(0.0942)	(1.011)
Connect*ln(DistNode)		0.748***		0.636***
		(0.270)		(0.172)
Connect*Emp90Dum		0.450*		0.404**
		(0.255)		(0.196)
Obs	1280	1280	1272	1272
First stage F-Stat	29.966	3.462	27.972	4.724
Panel B: log Distance				
lnDistHwy	0.0954	1.465***	0.0639	1.105***
	(0.0674)	(0.455)	(0.0434)	(0.318)
lnDistHwy*ln(DistNode)		−0.236***		−0.181***
		(0.0748)		(0.0494)
lnDistHwy*Emp90Dum		−0.266***		−0.192***
		(0.0823)		(0.0693)
Obs	1280	1280	1272	1272
First stage F-Stat	22.367	4.649	21.698	4.842

Notes: All regressions include province fixed effects and a full set of county controls. Reported results are 2nd stage estimates using the LCP spanning tree to instrument for NTHS connections as well as their reported interaction terms. lnDistNode is log county distance to the nearest targeted city node. Emp90Dum is a dummy for counties with above mean levels of county employment in 1990. Standard errors are clustered at the province level and stated in parentheses below point estimates. ***1%, **5%, and *10% significance levels.

Discussion

Do you find results convincing? Surprising?

Are you satisfied with the instruments?

Anything you would do differently?

Any important details of Chinese context ignored?