Dispersion of Agglomeration through Transport Infrastructure

A Case of China’s High-speed Rail

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High-speed rail: are the billion RMB investments worthwhile?

Political cartoon removed due to copyright restrictions.
Motivation of research

- **Pending policy inquiries**
  - Will high-speed rail bring growth opportunities?
  - For project appraisal, what is missing from the standard cost-benefit analysis?
  - How to quantify the claimed wider economic benefits (externalities), if they do exist?
  - A win-win situation or a zero-sum game?
Question & Hypothesis

- How do major transport infrastructure investment influence urban economic performance?
- By facilitating cities’ access to external resources, which are partial substitutes for their own endowment.
Redefine agglomeration

- **Economies of agglomeration** describes the benefits that firms derive by locating near each other.
- **Internal vs. external scale of production**

![Diagram with circles: Cluster of own resources + Access to external resources = Agglomeration effects]
Accessibility patterns

- **Key inquiries**
  - Evolution of accessibility patterns during 2001-2010
  - The role of HSRs in shaping accessibility

- **Method**
  - Spatial analysis using GIS tools
Railway network 2007

Legend
- Conventional Rail 2007
- Provinces
- Nationbound

0 250 500 1,000 Kilometers
National HSR plan 2008
Four vertical, four horizontal PDLs
Railway network 2010

Legend
- High-speed Rail 2010
- Conventional Rail 2007
- Provinces
- Nationbound

Kilometers
0 250 500 1,000
Facts about China’s HSR

- **Definition:** High-speed rail (HSR) in China refers to any commercial train service with average speed of **200 km/h** (124 mph) or higher.

- **Length:** China has the world's longest HSR network with about **9,300 km** (5,800 mi) of routes in service as of December 2012, including the world's longest line, the 2,298 km (1,428 mi) Beijing-Guangzhou HSR.

- **Ridership:** Since high-speed rail service in China was introduced on April 18, 2007, daily ridership has grown from 237,000 in 2007 to **1.33 million in 2012**, making the Chinese HSR network the most heavily used in the world.
Accessibility levels

Legend
- High-speed Rail 2010
- Economic potential 2001
- Economic potential 2010
- Provinces
- Nationbound

0 250 500 1,000 Kilometers
Change in accessibility

Legend
- High-speed Rail 2010
- Change of economic potential 2001-2010
- Provinces
- Nationbound

0 250 500 1,000 Kilometers
Findings

- Reduce disparities in accessibility

Coefficient of variation (CV) dropped by 50%
Findings

- The Role of HSR in shaping accessibility
  - Improve accessibility significantly compared to a no-HSR counterfactual scenario as of 2010:
    (average increase of 17%, maximum 157%)
  - Most affected cities: lower-tier cities in inland regions
Economic Impacts

- **Key inquiries**
  - How do accessibility influence urban economic activities:
    1) Beneficial or detrimental?
    2) Generative or distributive?
    3) Divergent or convergent?
    4) Decreasing return to accessibility?

- **Method**
  - Econometric modeling using panel data
Conceptual model

- Add accessibility to endogenous growth model

\[ Y_i = A(R_i, M_i) f[K(k_i, M_i), L(l_i, M_i)] \]

- Generative
- Redistributive

- \( M_i \) --- accessibility

- \( R_i \) --- level of local innovative activities

- \( K, L \) --- the effective inputs of capital and labor
# Estimation results

**Fixed-effect estimations using the whole sample**

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Dependent variables in logarithm form</th>
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<tbody>
<tr>
<td></td>
<td>GDP</td>
</tr>
<tr>
<td>Ln(accessibility)</td>
<td>0.013</td>
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<tr>
<td>(0.052)</td>
<td>(0.033)</td>
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<tr>
<td>Observations</td>
<td>2,595</td>
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<tr>
<td>R-squared</td>
<td>0.341</td>
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<th>VARIABLES</th>
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<tr>
<td></td>
<td>IT* employment</td>
</tr>
<tr>
<td>Ln(accessibility)</td>
<td>0.227**</td>
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<tr>
<td>(0.111)</td>
<td>(0.093)</td>
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<tr>
<td>Observations</td>
<td>2,059</td>
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<tr>
<td>R-squared</td>
<td>0.130</td>
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</table>

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

*Note: Consistent statistics for these indicators available for 2003-2010 due to redefinition of industrial sectors.
Regional + city size effects

- Elasticity coefficients by sub-groups: general indicators

Cities grouped by region and by size

- Western small
- Western medium
- Western large
- Middle small
- Middle medium
- Middle large
- Eastern small
- Eastern medium
- Eastern large

- GDP
- Population
- Per capita GDP
- Wage rate
- Total employment
- Agency employment
- Private employment
Regional + city size effects

- Elasticity coefficients by sub-groups: sectoral indicators

![Bar chart](image)
Recap the findings

- **Accessibility patterns**
  - HSR significantly reduced the gaps in intercity accessibility, particularly in low-tier cities

- **Economic impacts**
  - Positive and generative impacts on productivity
  - Redistributive impacts on employment and capital flows
  - Particularly positive impacts on travel-dependent services
  - No evidence of decreasing return to accessibility
Q & A
Policy implications

- How to choose from alternative transport projects?
  - Project prioritization based on accessibility improvement
  - Integrate sectoral investment plans, which requires institutional changes in current administrative structure
Policy implications

- How to include agglomeration in project appraisal?
  - Keep in mind that different impacts may offset each other
  1) Include **generative** impacts to calculate the economic internal rate of return (EIRR)
  2) Evaluate divergent or convergent trends of regional disparities with **redistributive** effects
  3) Avoid overbuilding through identification of **saturation** effects
Policy implications

- Should China invest in HSR?
  - Socio-economic reasons
    1) Reduce accessibility gaps at a massive scale
    2) Release capacity for freight transport on regular rails
    3) Reshape urban hierarchy
    4) Optimize allocation of production factors
  - Non-economic reasons
    1) Energy security (Gas to electricity)
    2) Reduce carbon emissions
    3) Technology development
Thank you!