Rail Transportation Lead to Urban Form Changes:
Case Study of Beijing-Tianjin-Hebei Region

夏海山, 张纯, 沈忱
Haishan Xia,
Chun Zhang,
Chen Shen

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Outline

1. National Level: HSR in China
2. Regional Level: JJJ Region on the Rail
3. City Level: Synergy Development—Integration between Urban Space and Rail Transportation
Urbanization and Railway Construction

Railway is a critical transportation infrastructure that impacts regional and economic development.

Railway is firmly associated with urbanization and the development of metropolitan areas.

The Development History between Rail Construction and Urbanization

- “First Five Year Plan”, begin construction era
- Cultural revolution period: stopped and stagnated
- After economic Reform and Open-Up: Adjustment and Development

- 21st century: Golden time for High-speed Railway

Before 2000: Miles issues
After 2000: Speed issues
1. Present Situation

High Speed Rail in China

Figure. Railway development in China
China high-speed railway has achieved several No.1 in the world.

1. The longest operating length—20,000 km
2. The highest operating speed—486.1 km/h
3. The world’s highest level—Beijing-Shanghai HSR
4. The world’s first newly built in alpine region—Harbin-Dalian HSR
5. The longest operating length—Beijing - Guangzhou HSR 2298km
6. The world’s first one-time completed high speed railway with the longest operating length—Lanzhou-Xinjiang HSR 1776
HSR in China

Operating length in China: 20000km
China in 21st Century: Golden Age for High Speed Railway and Metropolitan Regions

HSR and Mega-region

On national level, HSR promotes mega-region development

- Population Density
  Improve Mobility: connection intra mega-regions
  500,000 people per day on Jing-Hu line
  Lan-Xin line on the silk road as 2nd Euro Asia Land Bridge

- Improve Accessibility: connection inter mega-regions
  • Current Character:
    Fragmentation High-density region oriented

Figure High Speed Railway in China and Metropolitan Areas

1. Present Situation
On national level, HSR promotes mega-region development.

- **Per Capita GDP Perspective**
  - Connectivity of the rich cities and regions
    - Cities along Jing-Hu line accounts for 32.8% of the total national gross income, connecting the richest regions in China.
- **Regional gap might be larger due to un-balanced spatial distribution of HSR**
  - Developed areas become better, while undeveloped areas enjoy little benefit.
On national level, HSR promote the regional un-equilibrium:

1) **Double effect on national and regional development.** It changes from equilibrium to uneven. The agglomeration for big cities and mega-regions are more obvious due to time-spatial compression effect.

2) **Change of city-region relationship—benefits from pass-by to nodes.**

Conventionally, the allocation of railway stations benefits city development. However, in high-speed railway era, the benefits requires good connection of high-speed railway stations and urban space.
## Location of Beijing-Tianjin-Hebei

A table showing data on the Beijing-Tianjin-Hebei region, including Mega-Regions, Population (2009), Land Area, Built-up Area, GDP, Central City, and Secondary Central City. The table also lists the Other Cities and Total No. of cities. The map illustrates the region's geographical layout and includes a legend indicating different cities and provinces.
Regional Transportation Planning of Beijing-Tianjin-Hebei:

Three center: Beijing, Tianjin, and Shijiazhuang

Travel Mode: Rail transportation and urban metro, forming 1 hour commuting zones

Rail transportation plays an important role on regional development
Beijing Tianjin Hebei region -- the development of high speed railway on the remodeling of regional space

2 JJJ Region on the Rail

- Two issues with the development of HSR
- Connectivity between HSR and Urban Metro network
- Synergy and integration of HSR and surrounding region area
Accessibility of county level cities

Using GIS network analysis, calculate average commute time from county-level cities to 13 regional-level cities.

Characteristics of accessibility

accessibility is high when county level cities are along the major rail lines

There will be benefits as soon as railway goes through.
Beijing Tianjin Hebei region -- the development of high speed railway on the remodeling of regional space

2 JJJ Region on the HSR

Synergy Development

One-hour commuting circle under high-speed rail system scenario

One-hour commute circle expands 5 times, which covers Beijing, Tianjin, Shijiazhuang, and most 9 cities

The difference of Accessibility in regional Space

County level unit with stations will have better accessibility node effect bring benefits, which should be the major consideration on allocation of stations.
Connectivity between networks:

- Service Area within 30 min and 60 min, from Beijing South Station, Beijing North Station and Changping Station
- Travel times are longer intra-city and inter-city
- Transfer efficiency among different travel mode becomes critical issued to improve connectivity
The impact of high-speed railway stations on city space is not only at individual points, but a connection joint to network to the whole region. In Beijing- Tianjin-Hebei Region, the connection of high-speed railway network and city space supports the idea of regional integration.
Comparison of population change before / after high-speed railway construction

- Although the accessibility of fringe of metropolitan increases, connectivity is strengthened, however, population is moving out of the remote cities

Better transportation draws more population concentration, especially in Beijing and Tianjin areas

Figure Comparison of population change after high-speed railway is completed
Beijing-Tianjin-Hebei region -- HSR and commuting across cities

- Population Mobility
  90 pair HSR trains carry 50,000 commuters

- Spatial Mismatch across cities
  Daily Commuting across the administrative boundary
Case Study: Intra-city level of Beijing

3 Synergy Development

1) City rail transit and city inner population space change

Simultaneously, Suburbanization and concentration happens

Trend of Scattering: suburbanization happened because rail transit system connected center and suburb areas. (Typical regions: Tongzhou Guanzhuang, Changping Huilongguan, Tiantongyuan, Daxing)

Trend of Concentration: Population density increased at rail transit system nodes, especially at the areas where rail transit system is with high density

Simultaneously, Scattering and clustering happens

Figure: Evolution of Beijing job population distribution 2000 (up) and 2010 (bottom).
Homogenization: since using rail transit system saves time, population distribute along subway lines, which embodies the homogenization of city rail transit system (Line 4 and Line Tongzhou)

Polarization: some nodes have evident advantages, bigger differences in population distribution

population distribution: Polarization plays a dominant role than Homogenization
2) Job Density Change

Urban transit system construction and city job space change
• Scattering and concentration

A very strong trend of concentration. Compared with population distribution, the construction of city transit system enhanced the accessibility and concentrated the economic elements. CBD is at the nodes of rail transit system

A weak trend of scattering. While rail transit system provides better transportation, very few job space appears in suburb areas. Two expectations are Shangdi and Dashanzi areas.

——The effect of concentration is bigger than that of scattering.

Figure. Evolution of Beijing job spatial distribution 2000(up) and 2010 (bottom).
Homogenization and Polarization

- Compared with population change, polarization is more dominant in job distribution.
- Regional differences are more evident. City job space is not Homogenized.

Job density: Polarization plays a dominant role.
From perspective of Job/Housing Ratio, High-speed railway stations have good connectivity with city rail transit system, which brings more regional economic impact.

City rail transit Passenger traffic shows the volume on the commute oriented city.
1) On metropolitan scale, HSR provides more than transportation infrastructure. Accessibility brings double effects, inducing population and economic elements polarization. Connectivity between and within rail network both matter.

2) On urban scale, urban metro increase urban mobility, while restructuring job/housing spatial distribution. Function adjustment and coordination becomes important.
Suggestions

(1) Strengthen the connection between High Speed Rail and Urban Metro system

**Suggestion:** to further development of Suburban Railway

(2) Land use should be integrated with surrounding urban metro station

(3) Synergy of rail transportation with urban functions
Thanks