

Urban Transportation, Land Use, and Growth

Evidence from China 1990-2010



In brief

- Major cities undergo a transformation as countries develop. Population and manufacturing moves to new suburbs from the central city, where new service industries grow to employ a more mobile, affluent and suburban workforce.
- This relocation of production and population involves a reconstruction of cities, driven primarily by market forces. However, public investment in transport infrastructure can play an important role in this process.
- China has undergone a major transport investment campaign in recent years, with spending on transport infrastructure growing at roughly 15% a year since 1990 to reach \$200 billion in 2007, with a large portion of this in urban environments
- This study investigates what the impact of this transport infrastructure spending is on “sprawl” and whether improvements in central city public transport help forestall sprawl in the context of China.
- Key findings:
 - The construction of radial highways and ring-roads outside central cities reduces population density. More precisely, each additional radial highway displaces more than 4% of central city population to suburban regions.
 - Each additional radial railroad line displaced about 26% of central city industrial sector GDP to surrounding regions and ring roads built outside of central cities displaced additional central city manufacturing to outlying areas.
- Our results will allow planners to formulate infrastructure plans that are consistent with their objectives regarding the spatial form of a city.

Motivation

“Highway construction, both of radial highways connecting the centre to the suburbs and of ring roads circling the city, is particularly important”

As countries develop, their major cities undergo a remarkable transformation. Population shifts to new suburbs and central city population density falls. Manufacturing activity also moves from the central cities to the suburbs, and in its place, service industries grow to employ a workforce that is increasingly affluent, mobile and suburban. This relocation of production and population involves massive reconstruction of cities, and while market forces drive this process, public sector investments in transportation infrastructure play an important role. Highway construction, both of radial highways connecting the centre to the suburbs and of ring roads circling the city, is particularly important. In the early 1990s, China embarked on an ambitious initiative to build and upgrade its transportation infrastructure, particularly its highways. From a low level, spending on transportation infrastructure has grown at about 15% a year since 1990 to reach \$200 billion in 2007.

Much of the associated construction has occurred in cities. What will be the impact of these new roads on “sprawl”, on the conversion of farm land to suburbs and on economic competitiveness? Do improvements in central city public transportation help forestall sprawl? We investigate these questions in the context of China. The answers provide important guidance to city planners and mayors in China and other developing countries as they try to develop infrastructure plans to meet their particular policy objectives.

Policy Impact and Audience

“Construction of radial roads and ring roads makes commuting by car or bus to jobs in the city centre easier. This facilitates population suburbanisation”

We investigate the effects of transportation infrastructure investments on urban form and on the location of people and employment in cities. We estimate the magnitude of the effect on population suburbanisation of radial highways, ring-roads, overall kilometers of highways and bus based public transit. We also estimate the corresponding effects of transportation infrastructure on the location of employment. These estimates inform transportation planners as they try to devise transportation plans to achieve particular policy objectives. Thus, our results are useful to anyone with an interest in transportation planning: urban planners, mayors and national ministries responsible for land management, infrastructure investment and urban construction.

Policy Implications

Our data show that construction of radial and ring- roads outside central cities reduces population density. More precisely, each additional radial highway displaces more than 4 percent of central city population to suburban regions

Construction of radial roads and ring roads makes commuting by car or bus to jobs in the city centre easier. This facilitates population suburbanisation, expansion of the urban area, increased consumption of land or residential open space, and declining floor-to-area ratios. The role of highway construction on

“In China the effect of highway construction is to slow centralisation, rather than to cause decentralisation”

population decentralisation in the USA has been established. The last century saw the development of the US interstate highway system, and as a consequence, the population of Manhattan declined by over 30% even as metropolitan area population tripled. Unlike the USA, China experienced very rapid highway construction during a period when population is centralising because of the movement of rural migrants to cities. Between 1990 and 2010 aggregate population growth was 55% in central cities relative to just 5% in city hinterlands. In China the effect of highway construction is to slow centralisation, rather than to cause decentralisation. We also find some evidence that central city buses and trolleys increase central city population density. Together these findings provide support for the conventional wisdom that urban compactness is reduced by radial and ring road construction and enhanced by public transportation.

We find that each additional radial railroad line displaced about 26 percent of central city industrial sector GDP to surrounding regions from 1990- 2005 and ring roads built outside of central cities displaced additional central city manufacturing to outlying areas. This partly reflects China’s heavy historical reliance on rails to move goods

In 1910 New York was the USA’s leading manufacturing centre. Today it is the leading service centre. In China in the early 1980’s most manufacturing was in central cities, although rural manufacturing developed in the 1980’s. Between 1990 and 2005, industrial GDP grew by about 400% in China’s central cities but by 800% in the urban peripheries, as industry relatively decentralised. City case studies for Brazil, Korea and Indonesia suggest decentralisation of industry and the subsequent development of business and financial services in central cities all depend substantially on transportation infrastructure investments.

Economists since Alfred Marshall have recognised that denser cities provide richer information environments, which in turn improve productivity and increase innovation, but central city environments come with much higher land and labor costs. In the early stages of industrialisation, manufacturing facilities in developing countries often locate in central cities. However, as technologies mature and economic growth proceeds, central city environments become too expensive for standardised manufacturing and manufacturing activity decentralises to find cheaper land and labor. Thereafter, central cities typically specialise in business and financial services, which derive greater benefit from the denser central city environments. Such transformation improves efficiency in production through better use of the rich information environments in central cities, thus promoting local economic growth. Ours is the first project to investigate the extent to which different highway and railroad network configurations contribute to this transformation.

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Implementation

Urban infrastructure policy requires the choice of location, mode and extent of infrastructure investments in cities: all decisions which affect cities for many decades and which involve fiscal allocations. Planners need first to formulate objectives involving city spatial form. How compact versus responsive to consumer demand

for land and open space in residential areas, how well suited and competitive in attracting manufacturing (to the urban periphery) versus services (in the city centre). With these objectives settled, our results allow planners to formulate infrastructure plans that are consistent with the objectives.

Dissemination

Our work has been widely presented not just in academic contexts but in contexts with policy makers present at conferences and symposia in China (including Hong Kong separately), Spain, Colombia, Hong Kong and the United Kingdom. Dissemination to city planners and policy makers would be useful but we have no specific suggestions as to actual individuals.

About the authors

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