Regional Impacts of High Speed Rail in China

Working Paper 1

Baseline report for a case study of Yunfu in Guangdong Province

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Preface

This Report has been prepared for the World Bank and for the China Rail Corporation (CRC), by Dr. Ying Jin, Mr. Richard Bullock, and Dr. Wanli Fang. This Bank Team was first led by John Scales (Transport Sector Coordinator), then by Gerald Ollivier (Sr. Infrastructure Specialist).

This report has been drafted as part of evaluation of the NanGuang Railway Project (P112359) and completed as part of the Technical Assistance activity called “Impact of High Speed Rail on Regional Economic Development” (P143907). This activity aims at developing a standard approach to identify and quantify regional economic impact of High Speed Rail (HSR) projects, extending beyond traditional economic benefits associated with reduction of transportation costs.

The paper presents the results of a reconnaissance field trip to Yunfu in April 2010 to help establish the baseline for designing follow-up ’before and after’ studies, in the context of the NanGuang Project. It is expected that this baseline data will be compared with the situation in 2013 and 2015, as part of the NanGuang project, before and after the opening of the NanGuang line.

Acknowledgement

We acknowledge the help, cooperation and information provided to the Bank team by the municipal government of Yunfu during the field trip in April 2010. We are grateful to Mr. Paul Amos for his pertinent comments on this study.

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1818 H Street NW
Washington DC 20433
Telephone: (202) 473-1000
Internet: www.worldbank.org E-mail: feedback@worldbank.org/gollivier@worldbank.org
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Summary

The theories of New Economic Geography (NEG) emphasize the importance of transport costs to economic development, alongside increasing returns to scale and preference for product varieties. Compared with neoclassical spatial economic models, the NEG theories provide many further insights into the role of transport infrastructure investment in facilitating growth and change of regional economies. A growing body of empirical literature that builds on the NEG theories shows that, in the OECD countries, improved spatial proximity through transport improvements is generally associated with higher levels of business productivity. The econometric analysis carried out in Guangdong Province by the World Bank in parallel with this case study (see accompanying Working Paper 2) suggests that this association in Guangdong may be even stronger than what is usually the case in the OECD countries. The empirical results fit well the theoretical predictions about the benefits of agglomeration to productivity, although they are not of course a direct proof of a causal relationship.

The NEG theories also throw a new light upon the relative rates of development between a prosperous centre and undeveloped periphery regions. Transport costs play a significant role, but the outcome can go in either direction depending upon the local circumstances: a reduction in transport cost can help the undeveloped periphery to grow through increased trading, or it could strengthen the centre at the expense of the periphery.

This means that the NEG theories and econometrical results can only provide part of the picture in our attempt to explore the impacts of transport improvements. They must be complemented by an understanding of the actual business practices that translate transport changes into different typologies of regional development. Case studies thus provide a richness that is sacrificed in the development of abstract theories, and more importantly, they shed light on the causal mechanisms that are either beneficial or detrimental to the economic growth of peripheral regions. Given the level of income disparity that exists in China and the policy objective to ameliorate it, it is important to monitor the actual impacts of major transport investments. This provides the motive for initiating the Yunfu case study that we report in this paper.

The Yunfu municipality has long been isolated from the economic centers in the Pearl River Delta. At present, a trip from the main urban area of Yunfu to the center of the provincial capital, Guangzhou, takes 2.5 hours on road at non-peak hours; the main urban areas are not connected by rail. The current construction of the Nanning-Guangzhou (NanGuang) High Speed Rail is expected to reduce the equivalent travel time to 40 minutes by 2013. Currently, Yunfu is at the bottom of the GDP ranking in Guangdong, and the annual average GDP growth rate during 2000-2008, at 9.8%, is the second slowest among the Guangdong municipalities. The local businesses believe that efforts to attract skills, investment and development opportunities are hampered by poor transport access.
The development context of Yunfu thus provides critical case\(^1\) for piloting a methodology for monitoring the development impacts of transport through a ‘before and after’ study. On the one hand, the high speed rail service may facilitate local innovation thanks to exposure to new ideas and the ingress of or access to highly skilled workers; net capital flow and labor flow to Yunfu; growth of export-oriented secondary industries due to productivity improvements, as well as some special subsectors of service industry, such as tourism and recreation. On the other hand, improved accessibility may attract local talents and investors to the bright lights of the Guangzhou and Shenzhen, thus weakening the local businesses. There may be differential impacts within the municipality, i.e. between counties in Yunfu due to highly localized access to the new high-speed railway. The outcome can thus be uncertain and heterogeneous, depending upon the extent to which the local communities anticipate and take advantage of the transport improvements through continuously adapting business planning and operations, the patterns and intensities of urban land use, social and entrepreneurial networks, and government policies.

In a nutshell, what we found overwhelmingly confirms that access to new knowledge and knowhow is of crucial importance to the initiation and continued success of businesses in Yunfu, and the industry leaders have been ingenious in overcoming the current lack of good transport accessibility. The insights gained from the Yunfu case could be informative to the regional development effects of major transport investments in China and other developing countries where the institutions and business culture are similar. The findings can also be used to verify the extent of the productivity benefits suggested by the econometric studies.

This paper contains an initial reconnaissance of the situation in Yunfu, prior to the NanGuang project construction. It provides a brief overview of the trajectory of economic development in Yunfu from an economy that was dominated by primary industries to that by secondary industries. The development of local transport infrastructure is reviewed, as is the more detailed structure of local industries, with special emphasis on dominant industrial sectors and the planned industrial parks. The experience of high speed rail development impact elsewhere was drawn upon to reflect on the possible regional economic outcomes that might emerge following the opening of the Nanning-Guangzhou high speed rail. The structure of and the approach to a ‘before and after’ monitoring study is considered.

\(^1\) In the sense of Flyvberg (2006).
1 Background

Railway construction in China has attracted worldwide attention especially the expansion of high-speed railways. More than 9,300 km of high-speed railways are in operation in China (December 31, 2012), and an additional 8,700 km is expected to be completed by 2015.

The World Bank’s China Transport team in Beijing is initiating research into the regional economic impacts of improvements of high-speed rail. While there have been several attempts to project the regional economic impacts of planned high-speed rail schemes (some are summarized in Annex 4), nearly all have been made by scheme promoters or their consultants, rather than independent assessors. There has also been limited ex-post investigation of what regional impacts have actually occurred, either because schemes are not yet built, or because there was little or no study of beforehand thus making it difficult to assess the impact through any comparisons.

The 2014 opening of the Nanning - Guangzhou (NanGuang) high-speed railway will bring dramatic improvements in the railway travel times between the municipalities along this transport corridor. The expectations are that such large improvements in travel would engender significant regional economic impacts. This Report describes 2010 conditions in one of those municipalities, the city of Yunfu. The Report is intended to be the starting point for a long-term program of trying to identify and monitor the regional development impact, in practical and tangible terms, as it affects a specific city. The overall program is subject to securing the necessary resources and the continuing co-operation and support of the Yunfu authorities.

Yunfu in Guangdong Province was selected because the city is currently a rather remote city from a transport viewpoint and the high-speed railway that is expected to open in early 2013 will shorten the travel time to Guangzhou from more than 2 hours to only 40 minutes, thus drawing it well into the core economic area of the Pearl River Delta (Figure 1-1). If there are regional economic development impacts they should be more discernable in such a case.

The Yunfu case study is being carried out in parallel with an econometric analysis of regional agglomeration effects that covers the whole of Guangdong province, which tries to identify the relationship between spatial proximity to economic centers and the productivity of municipalities/counties in Guangdong Province. This case study is expected to add the insight and context of economic geography to the purely econometric analysis.

The remainder of the paper is divided into six parts. Part 2 gives a brief overview of the economic development in Yunfu municipality since its establishment in 1994. Part 3 describes

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local transport links and infrastructure. Part 4 provides a description of the internal structure of local industries, with special emphasis on the dominant industrial sectors and the planned industrial parks. Part 5 discusses possible regional economic impacts associated with the forthcoming high-speed rail line and Part 6 summarizes a proposal for the next steps.

Figure 1-1 Travel time Yunfu-Guangzhou: before and after the opening of high-speed rail

(Source: Transport Bureau of Yunfu and Bank estimates)

2 Overview of Economic Development

2.1 Development Path

The municipality of Yunfu was established in April 1994. It is the newest municipality in Guangdong Province. Its jurisdiction includes: Yuncheng District which is the capital and downtown area of Yunfu county; Yun’an County; Xinjing County; Yunan County; and a county-level city named Luoding. All were previously part of Zhaoqing Municipality. Yun’an County was added later in 1996. (Figure 2-1). At end-2008, the total registered population of Yunfu was 2.72 million, among which about 10% live in the Yuncheng District.

In 1994, when the municipality was first established, the Gross Regional Product (GRP) of Yunfu was under 10 billion yuan (CNY) (CNY 4,340/ capita), with an industrial structure dominated by agriculture. After 14 years of economic development, the total GRP of Yunfu has more than tripled in real terms to about 30 CNY billion (in constant prices of 1994). Meanwhile, the industrial structure has changed significantly: primary industry has remained pretty stable during this period in absolute terms (with minor peaks in year 2005 and 2008); secondary industry has grown to be the dominant economic sector; tertiary industry experienced moderate expansion and is now 28% of GRP, about the same as primary industry (Figure 2-2).
Figure 2-1 Administrative Units of Yunfu

Data Source: China National Fundamental Geo-information System.

Figure 2-2 Gross Regional Product by Sector (1994-2008) in 1994 prices

2.2 Recent Economic Performance

From 2008, the global financial crisis slowed down the general growth rate of China. The aggressive fiscal policy and stimulus package of central and local governments in China partly offset the shock from financial crisis and the general growth trend in Yunfu has been maintained. The GRP of Yunfu in 2009 reached CNY 34.7 billion, up by 10.5%\(^3\); the per capita GRP is CNY 14,397 /person, up by 9%; average disposable income of urban residents is CNY 13,211, up by 7.1% and the average net income of rural residents is CNY 6,128, up by 11.6%; total government budgetary income is CNY 1.8 billion, up by 12.9%.

However, export-oriented sectors suffered from losses due to reduced overseas demand. The total general export value is USD 200 million, down by 1.6%, and the manufacturing trade value is USD 415 million, down 17.7%.

2.3 Economy ranking

Despite its achievements, Yunfu is still considered to be among the most underdeveloped areas in Guangdong Province. The Gross Regional Product (GRP) of Yunfu is less than 1% of the 21 municipalities in the whole Province, whilst its population is 2.5% of the Province. Yunfu’s per capita GRP in 2008, at CNY13,400, is among the lowest in the province, a third of the provincial average and a mere 15% of the per capita GDP of the richest municipality, Shenzhen.

In Guangdong Province, cities generally fall into 3 tiers according to their GRPs: with Guangzhou and Shenzhen in the first tier; Foshan and Dongguan in the second tier and others in the third tier (Figure 2-3). There is an increasing divergence in economic performance between the tiers. The first and second tier cities are growing faster, at annual growth rate of 14% to18% over the period 2000-2008. Even within the group of the third tier cities, Qingyuan and Heyuan excel with annualized nominal growth rates at about 19% yearly between 2000-2008. Yunfu, with an annualized nominal growth rate of 9.8%, is second slowest. (Figure 2-4).

\(^3\) All growth rates mentioned here are relative to 2008, with inflation adjusted.

Figure 2-3 Gross Regional Product of All Cities in Guangdong (2000-2008)

First Tier
Second Tier
Third Tier

Figure 2-4 Annualised Nominal Growth Rate of GRP 2000-2008

3 Transport Infrastructure and Plans

Local officials and business owners believe that poor transport accessibility has long been a bottleneck to local economic development.

Highways
There are 6,937 kms of highways in operation in Yunfu (2009), of which only 18.5 kms are expressway, 251.3kms are Class I highway, and over 70% of the total length is of Class IV and below.

The Guangzhou-Wuzhou expressway is the main fast transportation route for Yunfu. The section from Guangzhou to Hekou (Yunfu) opened at the end of 2004 and reduced the inter-city travel time between Guangzhou and Yunfu from 3 - 4 hours to 2.5 hours. The section from Hekou (Yunfu) to Pingtai opened in June, 2010. This expressway is considered to be a major improvement of transport infrastructure in recent years. Its possible impacts are described in Annex 3.

Four additional expressways have been approved by provincial Development and Reform Commission (DRC) to improve the trunk highway system; they are Yunfu - Cengxi (63.4kms), Luoding - Jiangmen (147.4kms), Yunfu - Yangjiang (85.8kms), and Shantou - Zhanjiang (43.2kms).

Inland waterways
In 2009, the total navigable inland waterway in Yunfu is about 235 kms, of which 109 kms are on the Xijiang River (a major tributary of the Pearl River), 91 kms on Nanjiang River and 35 kms on the Xinxingjiang River. The inland waterway of Xijiang is a Class 1 waterway and can serve 3000 DWT vessels all year round.

The total volume of incoming and outgoing freight by inland waterways was 8.77 million tons in 2009. There are four major port areas, and the newly constructed Yunfu New Port is a Class II port with seven 2000 DWT berths. It is designed to have an annual throughput capacity of 400,000 TEUs and a maximum annual throughput of 10 million tons.

Railways
Yunfu had only 151 kms of railway lines in 2009, about 2 % of the municipality road length. The lines form part of the Sanshui-Maoming railway and its branches. It takes about three hours to travel from Guangzhou to Xinxing County with only three pair of trains daily. There is no railway station in the downtown area of Yunfu at all. The high-speed NanGuang railway is under construction and is expected to be in full operation by 2014. The expected travel time from Yunfu to Guangzhou South station by NanGuang will be 40 minutes. Another new rail connecting Luoding to Cengxi (total 75.5kms), the first railway project funded by private capital, is expected to be completed by 2012.
4 Industrial Structure

4.1 Overview
In 2008, manufacturing industries constituted the largest proportion (44%) of Yunfu’s GRP, and are also the major sources of tax income for the local government. The industrial structure of Yunfu is characterized by specialization in certain dominant industrial sectors, as shown in Table 4-1 and Table 4-2. This feature is also reflected in the Location Quotients (LQ) based on the sectoral output value in Yunfu as compared with the average in Guangdong.

Table 4-1 indicates the dominant industries in terms of the number of employees, major business income and total profit. Table 4-2 shows the products that each subsector produces. Most workers are hired in four major sectors: metal products (mainly stainless steel utensils); communication equipment (cell-phone chargers, etc); non-metal mineral products (stone processing); and garment manufacturing. Non-metal mineral mining and dressing (pyrite and stone mining) exports a huge proportion of products to areas beyond its own administrative boundary, as represented by the location quotient as high as 24.9. So does stone processing with a location quotient of 5. Among the dominant industries, the stone processing and stainless steel utensil production have the biggest turnover.

The industrial structure of Yunfu reflects the primary stage of economic development. A large proportion of GRP comes from extracting natural resources or providing low-end manufacturing services, while high value-added industries are only slowly emerging. However, some high value-added industries are increasing in importance and exporting to other areas, for instance, medical and pharmaceutical products, especially veterinary drugs.

Structural change is taking place within the traditional sectors, which helps local firms to move upwards in the value chain. For example, within the stone processing industry the primary manufacturing of slate is being replaced by fine processing of stone artworks (Box 4-1).

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4 Location quotient > 1 means specialization in that industry is greater than the average in the parent region, in this case, Guangdong Province. For more details about the calculation of location quotients, see Annex 1.
### Table 4-1 Dominant industries in Yunfu (2008)

<table>
<thead>
<tr>
<th>Industrial Sector</th>
<th>Total Employment (person)</th>
<th>Location Quotient</th>
<th>Main Business Gross income (CNY million)</th>
<th>Total Profit (CNY million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-metal Minerals Mining &amp; Dressing</td>
<td>5,744</td>
<td>24.9</td>
<td>1,572</td>
<td>35</td>
</tr>
<tr>
<td>Raw Chemical Materials &amp; Chemical Products</td>
<td>3,352</td>
<td>1.2</td>
<td>1,518</td>
<td>15</td>
</tr>
<tr>
<td>Non-metal Mineral Products</td>
<td>15,924</td>
<td>5.0</td>
<td>4,505</td>
<td>44</td>
</tr>
<tr>
<td>Farm &amp; Sideline Products Processing</td>
<td>2,656</td>
<td>2.1</td>
<td>135</td>
<td>11</td>
</tr>
<tr>
<td>Garments, Shoes &amp; Accessories Manufacturing</td>
<td>16,044</td>
<td>2.2</td>
<td>1,556</td>
<td>55</td>
</tr>
<tr>
<td>Medical &amp; Pharmaceutical Products</td>
<td>1,395</td>
<td>2.8</td>
<td>577</td>
<td>18</td>
</tr>
<tr>
<td>Metal Products</td>
<td>20,619</td>
<td>3.3</td>
<td>4,329</td>
<td>86</td>
</tr>
<tr>
<td>Communication Equipment, Computer &amp; Other Electronic Equipment Manufacturing</td>
<td>18,869</td>
<td>0.5</td>
<td>2,992</td>
<td>52</td>
</tr>
<tr>
<td>Production &amp; Supply of Electric Power</td>
<td>4,258</td>
<td>2.4</td>
<td>2,875</td>
<td>-251</td>
</tr>
</tbody>
</table>

Source: Major data bulletin of the 2nd Economic Census in Yunfu, Issue No.2, Table 5

### Table 4-2 Total output of major industrial products (2008)

<table>
<thead>
<tr>
<th>Industrial Products</th>
<th>Unit</th>
<th>Total Output Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pyrites</td>
<td>thousand ton</td>
<td>2067.8</td>
</tr>
<tr>
<td>Artificial slate</td>
<td>thousand m2</td>
<td>151.8</td>
</tr>
<tr>
<td>Sulphur acid</td>
<td>thousand tons</td>
<td>503.4</td>
</tr>
<tr>
<td>Cement</td>
<td>thousand tons</td>
<td>5879.7</td>
</tr>
<tr>
<td>Ceramic tiles</td>
<td>thousand m2</td>
<td>43327.1</td>
</tr>
<tr>
<td>Natural marble slate</td>
<td>thousand m2</td>
<td>2300.2</td>
</tr>
<tr>
<td>Natural granite slate</td>
<td>thousand m2</td>
<td>6908.9</td>
</tr>
<tr>
<td>Stainless steel household utensils</td>
<td>thousand ton</td>
<td>103.8</td>
</tr>
<tr>
<td>Electronic component</td>
<td>million piece</td>
<td>223</td>
</tr>
<tr>
<td>Power supply</td>
<td>billion KWH</td>
<td>4.57</td>
</tr>
</tbody>
</table>

Source: Major data bulletin of the 2nd Economic Census in Yunfu, Issue No.2, Table 3
4.2 Industry Clusters
The main industry clusters observed in Yunfu are intra-sectoral clusters, that is manufacturing enterprises clustered with similar firms within the sector.

Stone Processing Cluster
The city of Yunfu has been known for its stone processing for over two hundred years. The cluster contains over 3,000 firms, which together employ about 150,000 people including seasonal workers. The industry has evolved from mining and preliminary processing to fine processing and handicrafts with higher value-added. Even the exhaustion of local resources has not held back development. The industry, which spreads along a stretch of the national highway (G324, Silao – Hekou section) now imports stone from Turkey, Italy and India, etc, and supplies products to domestic and international market.

This thriving stone processing cluster is at first sight anomalous to classic industrial location theory. Both its raw materials and final products generate massive payload for transportation and the theoretically ideal location would be either close to raw material or to major market. In Yunfu, specialist labor skills and brand effect --- not necessarily for a single product brand, but for this “Stone Capital” as a whole --- dominate other factors in sustaining the historic location choice.

Nevertheless, the benefits from clustering are at the cost of relatively higher transport expenditures. Currently, most of the raw stones are shipped to Yunfu via the Liudu Port on Xijiang River, and then delivered to each factory by road. According to the Stone Industry Association of Yunfu (SIAY), the shipping rate per thousand square meters of stone slab is CNY 20,000 by road, 10,000 by waterway and 7,000 by rail respectively. It was indicated that it is relatively easy to find containers to ship stone products to provinces which also export goods to Guangdong, such as Shandong and Liaoning; but very hard to find containers to go to Xinjiang and Sichuan as no logistics company would like to send containers there which will be empty on the return leg.

As the stone industry in Yunfu gradually moves upwards in the value chain, business trips gain increasing importance for individual firms and the whole cluster. It was indicated by the SIAY that each day about 50 industry employees travel internationally on business trips, and an average of 500 people visit to select and purchase stone products.

Although the thousands of stone processing firms look alike, they are not the same. They differentiate in product category and style, with some specializing in high-end handicrafts while others stick with slab manufacturing. The local government’s strategy is to encourage advanced technology and equipment to replace out-of-date production capacity and develop new, energy-efficient product lines.
Box 4-1  Art Brings Life to Stone

Founded in 1989, the Continental Stone Artwork Co. Ltd is a privately-owned company that produces artworks made of marble and granite. Its products include a wide variety of fireplaces, Roman columns, sculptures of figures, animals and flower pots, hotel floors, desktop puzzles, toiletries, and stone ornaments. Originally their business was limited to pure processing, with the style requirement and design of final products specified in the customer orders. Now they have an in-house department to provide personalized design to satisfy different tastes of costumers. The “one-stop service” mode makes the Continental group attractive especially to foreign clients. According to Ms. Lu Qiong, the deputy general manager of Continental Stone Artwork Co. Ltd, this company is the largest exporter of stone artwork in Yunfu, with four oversea sales agencies in North America and EU countries.

In the exhibition hall of the Continental Group, are found not only delicate statues, but also reproductions of masterpieces made of stone mastics, (Pictured below)

Source: Photos by Bank staff.
Stainless Steel Household Utensils

Xinxing County in Yunfu is known as the largest centre of stainless steel tableware and kitchenware production and export in China. The origin of the industry was based on investment from Hong Kong in 1984, through family connections, but once the industry was there, it has attracted more investment and expanded rapidly. There are now more than 30 firms in the industry and 90% of the production is exported to overseas markets. There are about 30 major categories and 1,000 kinds of products, and the total value of exports reached CNY 4.3 billion in 2008.

<table>
<thead>
<tr>
<th>Box 4-2</th>
<th>A Kingdom of Stainless Steel Kitchenware and Tableware</th>
</tr>
</thead>
<tbody>
<tr>
<td>The leading enterprise in the stainless steel utensils business is LINKFAIR Group Co. Ltd. LINKFAIR is a private, family owned company engaging in the design, production and sales of stainless steel tableware and kitchenware. Established in 1993, it now employs over 3,500 staff, who work in four specialized tableware or kitchenware producing plants, one high-tech company producing stainless steel fingerprint lock and coded locks, three overseas sales companies and one domestic sales company. Most staff are hired locally---this is something LINKFAIR is proud of and also worried about. The industry is faced with difficulties in attracting and keeping skilled staff, such as product developers, designers, and professional managers. Mr. Ceng Jiansheng, the Deputy CEO of LINKFAIR Group said that even for a leading enterprise it is hard to recruit people they need most with comparable salary. Since it takes more than 3 hours to go to Guangzhou, most potential recruits simply turn down their job offers. As compensation, they need to double the local market salary to attract outside skilled staff. He believes that convenient access to Guangzhou would mean that the highly-skilled professional workers can reside in Guangzhou to provide their family with access to better urban amenities. The company expects the opening of high-speed rail to alleviate the constraints on accessing good labor market. Besides the trips for marketing and business development, as a company with many branches, LINKFAIR also generates many internal business trips, due to regular meetings and staff training programs. The major destinations are Guangzhou, Shenzhen, Shanghai and Hong Kong, and currently these trips are served by over 50 company-owned cars, at a high cost of gas, toll and time. The forthcoming opening of NanGuang high-speed rail is expected to reduce such cost, but only if convenient local access to high-speed rail station is provided accordingly.</td>
<td></td>
</tr>
</tbody>
</table>

Sulphur Chemicals

Yun’an County and Yuncheng District contain a cluster of firms in the sulphur-based chemicals industry. Yunfu has the second-largest known reserve (208 million tons) of opencast high quality pyrites in China and it could be mined for another 40 years at the current mining rate. The designed production capacity for pyrites is 3 million tons, which makes it the major export base in China.

The production of sulphuric acid in Yunfu in 2009 was 600,000 tons, and was planned to be increased to 800,000 tons in 2010. The residuals of production, rich in iron, are shipped to
nearby cities in Guangdong for iron and steel refining. Other downstream products include electrolytic manganese (200,000 tons) and titanium dioxide (50,000 tons). A new factory for electrolytic manganese with design production capacity of 2.5 million tons is under construction.

In 2010 over 80% of the final products were shipped out by waterways. According to the industry development plan, in the year 2015 there will be over 6.5 million tons of sulphur chemicals, which will challenge the existing capacity of freight transportation.

Cement
Yunfu is one of three planned cement production bases in Guangdong Province, which has total limestone reserves of more than 7.2 billion tons. Shipping via the Xijiang River provides a convenient and economic way of distributing the cement. Cement companies in Yunfu include the Qingzhou Cement Group (Hong Kong) and the China National Material Group (Sinoma). In 2010 the total production capacity of cement was 9 million tons/year, and another 6 million tons will be added on the completion of facilities currently being commissioned.

In order to enhance competitiveness of the cement industry cluster, the local government has a strategy of phasing out the older production capacity and promoting the acquisition and merging of small plants. The City is encouraging the development of a new dry-process cement clinker project with a daily output of at least 4,000 tons, supports big major cement enterprise in seeking financing through listing on the stock market, and advocates the aims of energy-saving and environmental-protection.

A leading cement manufacture stated that the company had difficulty in recruiting people to fill local positions and expected the major benefit to his company of high-speed rail to be the accessibility to more highly skilled labor and larger markets rather in the than the shipping cost of final products.

Power Supply
Yunfu City is an emerging production base of electric power supply. Currently, Yunfu has installed generating capacity of around 1.57 million kilowatts, including the 6.0 × 105KW Yunfu Power Plant No. C which is under construction. In 2008, the total power supply has reached 4.57 billion KWH with a value of CNY 2.28 billion.

All the electric power is generated by coal-fired units. No local reserves within Guangdong Province could support such huge demand for raw coal. Almost all the coal is shipped from the mountainous areas in Guizhou Province to Yunfu via Xijiang River. A new thermal power plant, financed by the Huarun Group, has been proposed on the south bank of Xijiang River. The total demand of raw coal by this new power plant is estimated to be 2 million tons per year, which will generate additional demand on both inland waterway and railway freight transport.

Although high-speed rail is obviously not used for coal, other benefits are expected by the industry by the NanGuang line. Mr. Huang Hanrong from the preparatory committee informed
that the opening of NanGuan will improve the communication with people from the headquarters of Huarun Group in Shenzhen. He expected that the high-speed rail will also facilitate routine management after the new power plan is in service.

With concerns about sustainable energy supply, the local government of Yunfu tried to explore alternatives such as nuclear power and wind power. Several key projects are listed on the 12th FYP provided by the municipal DRC. The potential switch in the power supply structure may generate labor demand for technical staff, which it is expected will be easier to attract to Yunfu when its accessibility by rail is improved.

**Bio-pharmaceuticals**
Production of bio-pharmaceuticals in Yunfu is quite recent but the industry is expanding rapidly. The original idea of establishing bio-pharmaceutical firms stems from the local market for veterinary drugs. Xinxing County is the major exporting base of pork and chicken to Hong Kong. In recent years, the threat of bird flu epidemic has greatly increased the nation-wide demand for vaccines for bird flu. The bio-pharmaceutical firms in Xinxing County have been authorized to supply vaccine for general domestic market.

| Box 4-3  From Agriculture to Biopharmaceutical |

The Wen’s Group in Xinxing, which started business in the1980s, has become a leading enterprise whose major business is animal farming and associated products, and the R&D and production of bio-pharmaceuticals. In 2009, the total sales income of Wen’s Group exceeded CNY 20 billion. It has established over a hundred branches in 16 Provinces in China. As a result, Wen’s Group attracts many well-educated employees: there are more than 3,300 people with university and college degrees, 185 people with a master’s degree and 30 Ph.D.s in the Wen’s Research Institute in Xinxing.

The Deputy party secretary of Wen’s Group, Mr. Chen Zhelun told us that they have to offer a strong salary and benefits package to keep the high-end employees, because people soon find Yunfu to be too isolated. According to Mr. Chen, the lack of high-speed transport has also raised the time and monetary cost of management of such a huge multi-regional company. Meetings and various training programs require convenient access to the headquarters in Xinxing County. To satisfy the demand for business travel, they have over 1,000 company-owned cars.

### 4.3 Planned Industrial Parks
Four industrial parks have been planned either to accommodate new industries that it is hoped might be attracted from the Pearl River Delta, or to integrate and optimize existing industries. The Foshan (Yunfu) Industrial Transfer Park, with a planned total area of 39.6 kms², has been laid out jointly by the municipality governments of Foshan and Yunfu since 2009 with provincial support. This industrial park is part of the riverside new city located to the north of the planned Yunfu railway station. It aims to focus on the development of specialized machinery, new material production and metallic material production (Figure 4-3).
In Yun’an County, where there are contaminating heavy industries, a new industry park which takes up a total area of 30.46 kms$^2$ has been proposed to recycle the raw materials, intermediate products and energy in the process of stone manufacturing, sulphur chemicals, cement and port-based logistics. By co-locating in the same industrial parks, these firms could share the facilities of Yunfu New Port. More importantly, the intermediate products, waste materials, and surplus energy could be recycled.

Two other industrial parks are located in Xinxing County and Luoding City respectively, which are further away from the NanGuang line.

5 Possible Impacts of High-Speed Rail

Faster transport generally brings better accessibility, but it does not follow that all impacts associated with the high-speed rail will be positive for any particular city, since better accessibility also creates competition among cities. Although knowledge, labor and technology are expected to spread from Guangzhou to Yunfu, the flows of business could run in both directions.

Knowledge spillover from Guangzhou to is expected to improve by better accessibility, though this is not a sufficient condition to foster innovation. With better accessibility, Yunfu will have a
better chance to attract inward capital investment, although the local investors may also find it easier to take their investment elsewhere.

More people may be expected to be attracted to work in Yunfu, too. Among them there are several different groups: managerial-level staff who would probably live in Guangzhou and might commute by the high-speed rail to work in Yunfu; well-educated professional workers who might relocate to Yunfu with families due to the high housing price in Guangzhou but still have convenient access to the pleasures of city life; low-end, unskilled workers who migrate to work at the new plants.

Firms in different industries sectors are not likely to be affected equally by the high-speed rail. A large proportion of secondary industry in Yunfu is export-oriented - as revealed by the location quotient analysis, and time is essential to business negotiations and order acquisition. The high-speed rail not only facilitates firms from Yunfu to reach wider markets, but also helps to bring in clients from all over the world. Firms with multiple branches outside the Province and China will be among the expected major beneficiaries.

Local firms that aim to move upwards the value chain are faced with shortage of professional staff in research, new product development and design, sales and marketing. Better accessibility will alleviate the difficulties of recruiting people to fill the high-end positions. High-speed rail should stimulate some special subsectors of service industry, such as tourism and recreation. High-speed rail makes weekend trips easier and more attractive to people from Guangzhou and other large cities in the Pearl River Delta.

The impacts of NanGuang high-speed rail are likely to be unevenly distributed among different counties. The main beneficiary is expected to be the Yuncheng District, the main urban area of Yunfu. Yun’an County and Yunan County are currently less developed, but since Yun’an County is close to the new station of Yunfu, and Yunan has its own station on this high-speed rail, it is possible that they will see obvious stimulus effects during the following couple of years. Xinxing County and Luoding County have better economic performances and industrial foundations; however, they do not get direct access to the high-speed rail. It may take them more time to get to the Yunfu high-speed rail station than to travel from Yunfu to Guangzhou on the fast train. (Figure 5-1). This does raise challenges for the municipal government to provide fast and convenient local connecting transportation, such as express public transit.
Figure 5-1 Travel time to Counties within Yunfu from Guangzhou: before and after the opening of high-speed rail

(Note: Counties within Yunfu Municipality that do not have direct access to the Nanning-Guangzhou high speed rail are assumed to access Yunfu high-speed rail station by road at a speed of 60 km/hour.)

The government of Yunfu has high expectations of the NanGuang railway and highlights its imminence in the city’s promotion materials to encourage inward investments. It has also adapted its land-use Masterplan to take advantage of the high-speed rail stations in Yunfu. A riverside New Town of Yunfu is proposed to be built on the north side of the high-speed rail stations (Annex 2) with planned business and trade areas and warehousing and logistics parks (this may be based on an assumption that the NanGuang Railway will carry a significant proportion of freight transport after operation, which is not yet determined). As a result, the spatial structure of Yunfu City is likely to be reshaped due to the opening of high-speed rail.

6 Conclusions and Possible Next Steps

Past experience in Guangdong suggests that improved spatial proximity to a large economic mass is likely to trigger significant economic growth. It is perhaps no coincidence that out of the three nationally designated Special Economic Zones in Guangdong in the early 1980s (Shenzhen, Zhuhai and Shantou), Shenzhen being close to Hong Kong and Guangzhou has experienced strongest growth and in 30 years transformed itself from a township to a first tier city in Guangdong. Similarly, Zhuhai being close to Macau has also grown considerably. By contrast, Shantou being a port city with strong overseas links through historic emigration but with distant transport connections to the core Pearl River Delta, has experienced the slowest GDP growth among all municipalities during 2000-2008.
Of course such casual comparisons cannot pinpoint the role of spatial proximity or transport costs. An in-depth case study would be required to understand the actual mechanisms at work, and provide underpinnings for econometric modeling. Yunfu being a peripheral city that is going to be connected by high-speed rail services in 1 year appears to be a suitable location for such a future case study. Findings from the 2010 field trip suggested that the local business community is highly enterprising and the urban development plans and policies have already started to adapt themselves to the future high-speed rail connections. It seems that Yunfu may be able to provide many positive lessons on what should be done to secure the benefits of transport improvements.

A possible ‘before and after’ case study would comprise two main elements: (a) a desk-top data collection exercise, and (b) two field trips to Yunfu for interviewing businesses, households and the relevant government departments once before opening and once after opening as part of the NanGuang project monitoring.

6.1 Desk-top Annual Data Collection
Some of the economic performance indicators are already reported in the provincial and municipal statistic yearbooks, such as:

- Gross Regional Product by city in Guangdong and by county in Yunfu
- Output by 2-digit industrial sector in Yunfu
- Employment by 2-digit industrial sector in Yunfu
- Employment by educational background in Yunfu
- Wage rate of fully employed workers by city in Guangdong and by county in Yunfu
- Investment in fixed assets by 2-digit sector and by county in Yunfu
- Foreign direct investment in Yunfu
- Investment in real estate sector by city in Guangdong
- Area of commercial buildings sold by city in Guangdong
- Average price of commercial buildings by city in Guangdong
- Number of tourists in Yunfu by origins (i.e. domestic vs. foreign)
- Gross income from tourism in Yunfu
- Total value of exports from Yunfu
- Fiscal revenue and public spending in Yunfu
- Household disposable income by city in Guangdong and by county in Yunfu

The above aggregate economic data is in fact supplemented by a firm-level Economic Census that was carried out for the first time in 2004, and then in 2008. The 3rd and 4th Economic Census will be due in 2013 and 2018 respectively. This firm level data, though very useful for analytical purposes, is not generally published. The published Economic Census tables (either by municipality or by city) are still useful in providing the details of production, consumption, investment, structure of local industries, educational background and sectoral composition of labor force that are beyond what is available from the statistics yearbooks. In other words, a
fairly detailed picture of the local economy is available every 5 years or so, not only for Yunfu but also for other municipalities of Guangdong. This provides an overall picture of the provincial and local economy.

Data collection can also include changes in the extent of urban land use development, e.g. from remote sensing images (i.e. Landsat TM images) as well as land use maps that may be available from the Municipal Bureau of Urban Planning and the Municipal Bureau of Natural Resource and Land.

In addition, government policy documents may be reviewed to provide an initial understanding of the development policies and regulations. This is to inform the field interviews which will provide a more precise understanding of the implementation of the policies (See below).

6.2 Field Work

To fully understand how the high-speed rail might actually influence the way people do business in Yunfu, and how these influences vary in different industrial sectors and strata of the population, interviews of local businesses, households and relevant government departments would be required. The first round of the interviews should be carried out before the high speed rail services open in 2013. This could be followed by subsequent interviews ideally 1 year, 3 year and 5 year after the opening of rail services.

The business interviews should ideally focus on the 10-20 key industries in Yunfu, both existing and emerging (e.g. in the technology transfer park in the Yuncheng District). An eclectic methodology will be applied that covers three different aspects of agglomeration and clustering:

- the impedance of transport related costs in reaching labor, capital, suppliers of raw/intermediate materials and product markets;
- the importance of face to face contacts and the value of efficient communication of tacit knowledge, developing trust and incentives, screening, and prioritization of marketing;
- development of the social and entrepreneurial networks and the creation of the milieu for local innovation. Semi-structured interviews are carried out with the businesses’ operational and financial directors and key operational managers to identify attitudinal as well as operational changes in response to transport improvements.

The main focus is placed on understanding how these factors affect Yunfu’s ability to attract skilled labor and capital, adoption of technology, pace of innovation, changes in the organization of production and business performance.

The interviews of a small number of households (possibly in focus group format with representation from a wide range of socio-economic backgrounds) will aim to understand the
perception of labor market catchment before and after the high speed rail, livelihoods, incomes life styles, and choices of housing and travel modes.

The interviews with the transport, planning, and land resources bureaux as well as the Mayor’s office to understand the intention and implementation of urban development plans, institution building, incentives and regulations of investment.

In addition, there are a number of statistical items that may need to be either collected or discussed with the municipal statistics bureau during the field trips. For instance, the Economic Census data, capital flows and labor migration from within and outside the Province and the municipality, etc.

From the discussion above, it would seem that the ideal case study period would be 2013 – 2018, subject to budget availability and the continued cooperation of the Yunfu government.

Although data from any other Guangdong municipalities can be collected, the question of a control observation (e.g. a municipality that is currently in a similar economic backwater but does not benefit from connections to high speed rail services, thus can be used to compare with Yunfu in the ‘After’ part of the study) is still a fairly difficult one to answer. Strict, clinical control experiments are not feasible in this context. However, a number of peripheral Guangdong municipalities that are not expected to connect onto the high speed network in the foreseeable future may provide informative comparisons. A research methodology can be developed for such comparisons if and when required.
References


Masson, S. and R. Petiot (2009). "Can the high-speed rail reinforce tourism attractiveness? The case of the high-speed rail between Perpignan (France) and Barcelona (Spain)." Technovation (29): 611–617

Annex 1  Location Quotient of Yunfu’s Industries

The index location quotient (LQ) could be constructed as follows:

\[ LQ_{ik} = \frac{Y_{ik}}{Y_k} / \frac{Y_i}{Y} \]

Where \( LQ_{ik} \) is the location quotient of sector I in county/district k;

\( Y_{ik} \) is the output of sector i in region k;

\( Y_i \) is the total output of county/district k;

\( Y_i \) is the output of sector i in the whole Province;

\( Y \) is the total employment of the whole Province.

Note: Location quotient > 1 means this region is exporting such product/service to other regions. The larger the number, the more intensive such industry is clustering in home region.
<table>
<thead>
<tr>
<th>Industrial Sectors</th>
<th>Location Quotient</th>
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<tbody>
<tr>
<td>Nonmetallic Minerals Mining &amp; Dressing</td>
<td>24.9</td>
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<tr>
<td>Ferrous Metals Mining &amp; Dressing</td>
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<td>Nonmetallic Mineral Products</td>
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<td>Metal Products</td>
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<tr>
<td>Medical &amp; Pharmaceutical Products</td>
<td>2.8</td>
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<tr>
<td>Production &amp; Supply of Electric Power, Steam &amp; Hot Water</td>
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</tr>
<tr>
<td>Garments, Shoes &amp; Accessories Manufacturing</td>
<td>2.2</td>
</tr>
<tr>
<td>Farm &amp; Sideline Products Processing</td>
<td>2.1</td>
</tr>
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<tr>
<td>Textile Industry</td>
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<tr>
<td>Raw Chemical Materials &amp; Chemical Products</td>
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<tr>
<td>Papermaking &amp; Paper Products</td>
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<td>Production &amp; Supply of Water</td>
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<tr>
<td>Timber Processing, Bamboo, Cane, Palm Fiber &amp; Straw Products</td>
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<tr>
<td>Smelting &amp; Pressing of Nonferrous Metals</td>
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<tr>
<td>Fine Arts and other Manufacturing</td>
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<tr>
<td>Cultural, Educational &amp; Sports Goods</td>
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<tr>
<td>Smelting &amp; Pressing of Ferrous Metals</td>
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<td>Equipment Manufacturing for Special Purposes</td>
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<tr>
<td>Printing &amp; Record Duplicating</td>
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<td>Nonferrous Metals Mining &amp; Dressing</td>
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<td>Oil Processing, Coking &amp; Nuclear Fuel Processing</td>
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<td>Rubber Products</td>
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<td>Transportation Equipment Manufacturing</td>
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<td>Recycling of Wasted Resources and Materials</td>
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Annex 2  Detailed Plan of Yunfu Riverside New City
Annex 3  Impact of Guangzhou-Wuzhou Expressway

The opening of the Guangzhou – Hekou (Yunfu) expressway in 2004 ago was a significant milestone in Yunfu’s transport accessibility. It is naturally too late to do the in-depth before and after surveys that give a more rigorous inference of its impacts, but it useful to try to capture some of the development events that followed its opening as this may provide some lessons for the future methodological design of this case study.

Industrial Production

Before the expressway, Yunfu was isolated from the provincial trunk highway system. It cut the travel time from Yunfu to Guangzhou by as much as half and effectively enlarged the potential market areas for Yunfu’s industries. Figure A3-1 shows the growth rates of GRP by sectors in Yunfu in real terms. The general growth rate of GRP jumped by two digits right after 2004, and reached as high as 15% in 2007. It is of course not statistically valid to assert a direct link between the opening of the expressway and changes in GRP. But the results are consistent with such a link. The opening was followed by a spike in the growth rate of export-oriented secondary industry to 28% in 2005 and around 25% in following years. But no dramatic change in growth of primary industry (which depends largely on railways and waterways) or tertiary industry (which serves a predominantly local market) occurred. (The reduced growth rate in all sectors in 2008 is attributed by the Yunfu business community to the global financial crisis and reductions in foreign orders).

![Figure A3-1 Growth Rate of GRP by Primary, Secondary & Tertiary Sector 1999-2008](image-url)
Data source: Yunfu Statistics Yearbook.

In terms of individual sub-sectors of secondary industry, data by 2-digit industrial sector is only available from the economic censuses of 2004 and 2008. The average annual growth rate in income by major business sector was calculated by comparing 2008 and 2004 in constant prices using a deflator calculated from data in the municipal statistics yearbook. Figure A3-2 show that those industrial sectors that export products to outside the region had the highest income growth. While the expressway would probably not on its own have caused their higher growth, it would not be unreasonable to expect that improved transport have helped facilitate it.

**Figure A3-2 Average Annual Growth Rate in Business Income 2004-2008**

Investment

A second area of comparison is investment trends. To broaden the analysis, the city of Meizhou, which is in a similar economic development condition to Yunfu was also investigated. Meizhou is still among the more remote areas. Figures A3-3 to A3-6 compare trends in Yunfu and Meizhou for a number of variables.

The total investment in fixed assets in Yunfu saw a sharp increase in the period 2003 – 2005 compared to Meizhou. This might indicate a concentration of capital investment before and right after the opening of the expressway (Figure A3-3). Investment in the real estate sector accelerated in 2006, a year after the opening of the expressway (Figure A3-4) as it did in Meizhou, but at a slower rate. Correspondingly, the total area of real property sold goes up quickly from 2005 to 2007 (Figure A3-5), and the average sales price grows up rapidly after 2005 (Figure A3-6). Since the sales and average price of real property have long been considered to be an indicator of economic prosperity, the abovementioned tendency to some extent reflects the enhanced economic performance and increased attractiveness of Yunfu City.
Tourism

Among tertiary industries, tourism largely relies on the condition of passenger transportation. Yunfu has rich tourism resources that were not easily accessible to visitors before the opening of expressway. Time series data is rather limited but the number of tourists and tourist income more than doubled in 2007 when compared to that of 2004 (Figure A3-7 and A3-8).


Conclusions

The directions of change indicated suggest there may be a link between transport accessibility and economic development in Yunfu, whether of a causal or facilitating nature. The completion of the NanGuang high-speed railway in 2014 will represent, nearly ten years after the opening of the expressway, the opportunity to undertake a more rigorous analysis of trends, compared to control conditions to be defined, and through industry surveys to try to obtain micro-economic insight and explanation of the trends observed.
Annex 4 Some previous projections of regional economic impact

Projections by Cambridge Systematics (2007) and Orange County Business Council (2008) found that a California high-speed rail system with stops in Orange County promise significant positive economic impact for residents and businesses, including 23,000 more jobs by 2030.

Colin Buchanan and Volterra (2009) found that against a total cost of 7.3 billion pounds, High-speed 1, the UK’s first high-speed rail, will generate benefit of more than double that cost. Besides the direct positive impact on economic growth and regeneration, the environment and tourism, the HS1 was projected to result in a positive trickledown effect on deprivation, house prices, consumer spending, accessibility and jobs.

A prospective analysis by Sophie Masson and Romain Petiot (2009) investigating the case of the forthcoming South European high-speed rail lines between Perpignan and Barcelona shows that the resulting increased spatial competition may reinforce the tourism activities agglomeration around Barcelona (but to the detriment of Perpignan).

Kwang Sik Kim (2000) examined how high-speed rail developments between Seoul and Pusan may affect changes in spatial structures in the Capital region in South Korea. The projections indicate that spatial structures would lead to continued concentration towards Seoul and its fringe, whereas spatial structures relating to employment would be more broadly dispersed over time.

See main report for an updated review of the regional impact analysis of high speed railway.