

Document of  
The World Bank

Report No.: ICR3434

IMPLEMENTATION COMPLETION AND RESULTS REPORT

(IBRD-76780)

ON A

LOAN

IN THE AMOUNT OF US\$300 MILLION

TO

CHINA

FOR A

GUIGUANG RAILWAY PROJECT

June 15, 2017

Transport and ICT Global Practice  
East Asia and Pacific Region

## CURRENCY EQUIVALENTS

(Exchange Rate Effective December 30, 2016)

Currency Unit = Yuan (CNY)

CNY 1.00 = US\$0.144

US\$1.00 = CNY 6.95

FISCAL YEAR

January 1 – December 31

## ABBREVIATIONS AND ACRONYMS

CBA	Cost-benefit Analysis
CPS	Country Partnership Strategy
CR	China Railways
CRC	China Railway Corporation
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMP	Environmental Management Plan
EMU	Electric Multiple Unit
FCTIC	Foreign Capital and Technical Import Center
FM	Financial Management
GHG	Greenhouse Gas
HSR	High-speed Railway
ICR	Implementation Completion and Results Report
IP	Implementation Progress
ISR	Implementation Status and Results Report
IUFR	Interim Unaudited Financial Report
M&E	Monitoring and Evaluation
MLTRDP	Mid- and Long-term Railway Development Plan
MOR	Ministry of Railways
MTR	Midterm Review
NPV	Net Present Value
O&M	Operations and Maintenance
PAD	Project Appraisal Document
PDL	Passenger-dedicated Line
PDO	Project Development Objective
RA	Regional Administration
RAP	Resettlement Action Plan
SIP	Supplemental Income Program

Senior Global Practice Director: Jose Luis Irigoyen

Practice Manager: Binyam Reja

Project Team Leaders: Martha B. Lawrence, Gerald Paul Ollivier

ICR Team Leader: Romain Pison

**CHINA  
GUIGUANG RAILWAY PROJECT**

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<b>A. Basic Information</b>			
Country:	China	Project Name:	Guiyang Guangzhou Railway
Project ID:	P107559	L/C/TF Number(s):	IBRD-76780
ICR Date:	05/23/2017	ICR Type:	Core ICR
Lending Instrument:	SIL	Borrower:	MINISTRY OF FINANCE
Original Total Commitment:	USD 300.00M	Disbursed Amount:	USD 299.49M
Revised Amount:	USD 300.00M		
<b>Environmental Category: A</b>			
<b>Implementing Agencies:</b> China Railway Corporation			
<b>Cofinanciers and Other External Partners:</b>			

<b>B. Key Dates</b>				
Process	Date	Process	Original Date	Revised / Actual Date(s)
Concept Review:	02/28/2008	Effectiveness:		08/26/2009
Appraisal:	12/29/2008	Restructuring(s):		08/02/2013 12/24/2015
Approval:	04/16/2009	Mid-term Review:		
		Closing:	12/31/2015	12/31/2016

<b>C. Ratings Summary</b>	
<b>C.1 Performance Rating by ICR</b>	
Outcomes:	Highly Satisfactory
Risk to Development Outcome:	Low or Negligible
Bank Performance:	Satisfactory
Borrower Performance:	Satisfactory

<b>C.2 Detailed Ratings of Bank and Borrower Performance (by ICR)</b>			
Bank	Ratings	Borrower	Ratings
Quality at Entry:	Satisfactory	Government:	Highly Satisfactory
Quality of Supervision:	Satisfactory	Implementing Agency/Agencies:	Satisfactory
<b>Overall Bank Performance:</b>	Satisfactory	<b>Overall Borrower Performance:</b>	Satisfactory

**C.3 Quality at Entry and Implementation Performance Indicators**

Implementation Performance	Indicators	QAG Assessments (if any)	Rating
Potential Problem Project at any time (Yes/No):	No	Quality at Entry (QEA):	None
Problem Project at any time (Yes/No):	Yes	Quality of Supervision (QSA):	None
DO rating before Closing/Inactive status:	Satisfactory		

**D. Sector and Theme Codes**

	Original	Actual
<b>Major Sector/Sector</b>		
Transportation		
Railways	100	100
<b>Major Theme/Theme/Sub Theme</b>		
Private Sector Development		
ICT	5	5
ICT Solutions	5	5
Public Sector Management		
Public Administration	48	48
Transparency, Accountability and Good Governance	48	48
Public Finance Management	48	48
Public Expenditure Management	48	48

**E. Bank Staff**

Positions	At ICR	At Approval
Vice President:	Victoria Kwakwa	James W. Adams
Country Director:	Bert Hofman	David R. Dollar
Practice Manager/Manager:	Binyam Reja	Ede Jorge Ijjasz-Vasquez
Project Team Leader:	Martha B. Lawrence	John Carter Scales
ICR Team Leader:	Romain Pison	
ICR Primary Author:	Romain Pison	
	Fatima Arroyo Arroyo	
	Laure Elisabeth Anne Fran Albinet	

## F. Results Framework Analysis

### Project Development Objectives (from Project Appraisal Document)

The development objective of the project is to provide additional transport capacity and reduce transport time between the less developed western region in southwest China and the relatively more developed Pearl River delta region.

### Revised Project Development Objectives (as approved by original approving authority)

The development objective was not revised.

#### (a) PDO Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
<b>Indicator 1</b>	Average number of pairs of express passenger trains operated per day (number)			
Value quantitative or Qualitative)	3	15	20	36 Guilin-Guangzhou; 25 Guiyang-Guilin; 2 Guiyang-Guangzhou
Date achieved	12/31/2008	12/31/2015	12/31/2016	12/31/2016
Comments (incl. % achievement)	Target achieved. The actual value exceeds on average the target of 20 pairs per day.			
<b>Indicator 2</b>	Average number of pairs of freight trains operated per day between Guiyang and Guangzhou (number)			
Value quantitative or Qualitative)	na	10	Dropped	
Date achieved	12/31/2008	12/31/2015	12/31/2015	
Comments (incl. % achievement)	As part of its unified network strategy, China Railway decided to make this line a passenger dedicated line and use other lines for freight. Therefore, the freight indicator for this line was dropped.			
<b>Indicator 3</b>	Average travel time of express passengers trains (minutes)			
Value quantitative or Qualitative)	1500	330	250	251
Date achieved	12/31/2008	12/31/2015	12/31/2016	12/31/2016

Comments (incl. % achievement)	Target Achieved. Travel time between Guiyang and Gangzhou has been reduced from 1,500 minutes to 251 minutes, reducing travel time by 83% from the baseline.
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**(b) Intermediate Outcome Indicator(s)**

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
<b>Indicator 1</b>	% of civil works completed (physical % complete)			
Value (quantitative or Qualitative)	0	100%		100%
Date achieved	12/31/2008	12/31/2014		12/31/2014
Comments (incl. % achievement)	Achieved			
<b>Indicator 2</b>	% of Bank-financed goods contracted (by value) (%)			
Value (quantitative or Qualitative)	0	100%	100%	100%
Date achieved	01/31/2008	12/31/2014	12/31/2014	12/31/2014
Comments (incl. % achievement)	Achieved			

**G. Ratings of Project Performance in ISRs**

No.	Date ISR Archived	DO	IP	Actual Disbursements (USD millions)
1	06/28/2010	Satisfactory	Satisfactory	0.00
2	06/28/2011	Moderately Satisfactory	Moderately Satisfactory	0.00
3	04/10/2012	Moderately Satisfactory	Moderately Satisfactory	0.00
4	11/18/2012	Moderately Satisfactory	Moderately Unsatisfactory	0.00
5	06/08/2013	Moderately Satisfactory	Moderately Satisfactory	14.51
6	12/24/2013	Moderately Satisfactory	Moderately Satisfactory	12.45
7	04/27/2014	Satisfactory	Moderately Satisfactory	22.57
8	11/26/2014	Satisfactory	Moderately Satisfactory	239.08
9	06/19/2015	Satisfactory	Moderately Satisfactory	263.05
10	12/22/2015	Satisfactory	Satisfactory	288.55
11	06/18/2016	Satisfactory	Moderately Satisfactory	298.74
12	12/27/2016	Satisfactory	Moderately Satisfactory	298.74

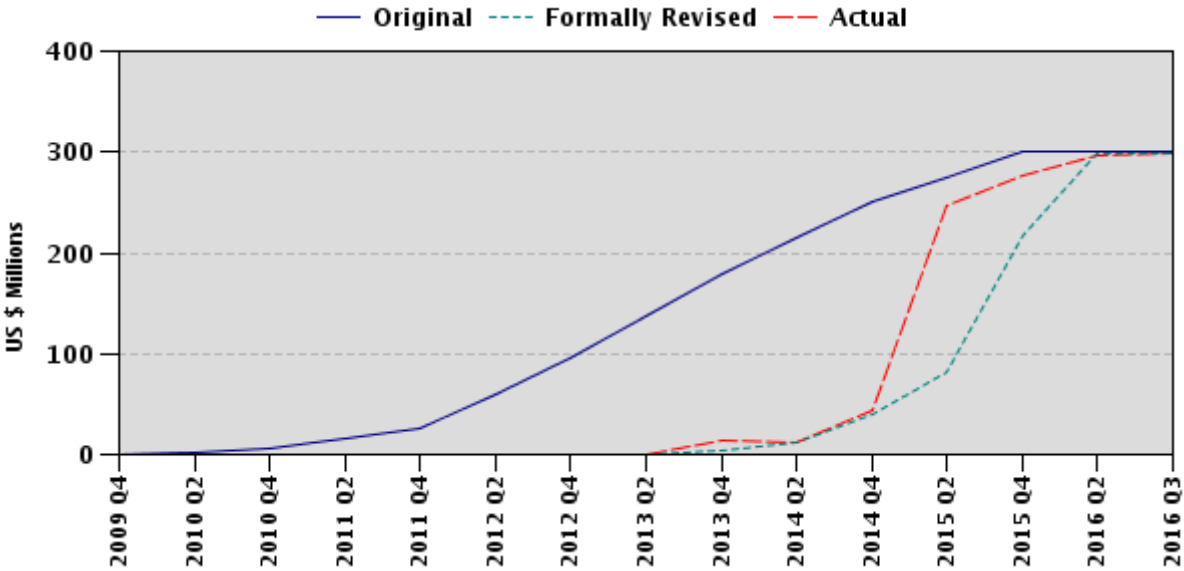


## H. Restructuring (if any)

Restructuring Date(s)	Board Approved PDO Change	ISR Ratings at Restructuring		Amount Disbursed at Restructuring in USD millions	Reason for Restructuring & Key Changes Made
		DO	IP		
08/02/2013	N	MS	MS	14.51	The key changes include (a) building the GuiGuang Railway as a passenger-dedicated line (PDL), instead of a mixed-use (freight and passenger) railways; the speed of passenger trains was increased from 200 to 250 km/h, which included a review of the Results Framework (review of target values and drop of indicator on freight trains); (b) reflecting the incorporation of the GuiGuang Railway Company Preparation Group as the Guiyang-Guangzhou Railway Co Ltd in the project documents; and (c) combining disbursement categories for enhanced flexibility. The first change reflects adjustments made to the Medium and Long-term Railway Network Plan. The second change, anticipated in the original Project Appraisal Document, reflects the creation of a new legal entity, as part of the project implementation structure, in line with the practice in other recent railway projects in China.
12/24/2015	N	S	S	288.55	The key change was extension of the closing date by one year from December 31, 2015 to December 31, 2016 to allow for implementation of the supplemental income programs related to land acquisition.

Restructuring Date(s)	Board Approved PDO Change	ISR Ratings at Restructuring		Amount Disbursed at Restructuring in USD millions	Reason for Restructuring & Key Changes Made
		DO	IP		

**I. Disbursement Profile**



# 1. Project Context, Development Objectives and Design

## 1.1 Context at Appraisal

1. The railway sector was considered vital to China's economic and social development and its international trade, continued economic growth, and ability to extend the benefits of development to people living in the central and western regions of the country. China is a vast country where people and goods move over long distances. Rail was considered the most economic means of transport over the distance range supported by the project. Railways are also more energy-efficient, are environment-friendly, and require less land than highways of comparable capacity.

2. Between 2000 and 2008, traffic on the China Railways (CR) network grew rapidly. Passenger traffic (measured in passenger-km) grew by 70 percent and freight (in ton-km) grew by 82 percent. Even the economic downturn had comparatively little impact, with passenger traffic in the first two months of 2009 up by 10 percent compared to the previous year and freight traffic down by only 6 percent. The network had been expanded by 11 percent since 2000, but had been unable to keep pace with traffic demand. As a result, much of the system, already intensively used a decade earlier, operated close to, or at, capacity. Some traffic on these routes was diverted to transport modes with higher economic and social costs. To avoid railway congestion slowing sustainable economic growth in China, the railway network and services needed to be both expanded and improved.

3. To tackle the increase in demand, in 2004 the State Council approved the Mid- and Long-term Railway Development Plan (MLTRDP) of the Ministry of Railways (MOR), which set out the investment required at the rate of about US\$12–15 billion per year till 2020 to keep pace with demand. An element of the Bank's strategy for China was to support this Government initiative to bring the various parts of the country closer with regard to personal mobility and the movement of goods through railway development, especially between the central and western regions of the country.

4. Following State Council approval of the 11th Five-Year Plan (2006–2010), the annual rate of investment in railways had increased significantly above the level originally envisaged in the MLTRDP, and in 2008 it had reached approximately US\$45 billion. Bank financing for this project contributed to achieving the overall investment target. An equally important reason for China to seek Bank participation was access to technical advice, especially on the application of appropriate safeguard policies, and international practice in project preparation, procurement, and implementation.

5. At the time of appraisal, the Bank had initiated engagement for the construction of 2,660 km of rail lines through a program of six projects. The choice of a multi-project engagement enabled the Bank to provide holistic support to the sector. In addition, and in parallel to the program support, the World Bank also fostered a railway sector-based policy dialogue and institutional support, nurtured by multiple railway policy notes (see Annex 8 for more details), which eventually facilitated and enriched the railway sector in China.

## **1.2 Original Project Development Objectives (PDOs) and Key Indicators**

6. The Project Development Objective (PDO), as indicated in the Project Appraisal Document (PAD) and the Loan Agreement, was to provide additional transport capacity and reduce transport time between the less developed western region in southwest China and the relatively more developed Pearl River delta region.

7. The key PDO indicators as indicated in the PAD were:

- Average number of pairs of passenger trains of maximum speed of 200 km/h operated per day between Guiyang and Guangzhou;
- Average number of pairs of freight trains operated per day between Guiyang and Guangzhou; and
- Average travel time of passenger trains of maximum speed of 200 km/h achieved between Guiyang and Guangzhou.

## **1.3 Revised PDO (as approved by original approving authority) and Key Indicators, and Reasons/justification**

8. The development objective was not revised, as the provision of “additional transport capacity” and reduction of “transport time” was inclusive of both freight and passenger services.

9. The key indicators were adjusted during the restructuring to reflect the change in the purpose of the line. This includes increased passenger train services and reduced transit time. The indicator on freight train service was removed since the line would no longer carry freight trains.

10. The PDO indicators as indicated in the Restructuring Paper were:

- Average number of pairs of express passenger trains operated per day; and
- Average travel time of express passenger trains.

## **1.4 Main Beneficiaries**

11. The project was expected to benefit both current and potential passengers who traveled between Guangzhou and southwest China as well as freight shippers, as the capacity and the level of service for both were anticipated to improve significantly. The population of the poorer autonomous region of Guangxi Zhuang was also expected to be a core beneficiary by becoming connected to the economically developed Pearl River Delta and thus enjoying wider economic opportunities. The project was expected to not only benefit the railways as a business but also the country overall, by encouraging the use of the more economically and environmentally efficient railways. Approximately 40 percent of the forecast rail patronage on the new railway was expected to either transfer from other modes or be generated.

## 1.5 Original Components

12. As described in the Loan Agreement, the project consisted of a single component in three parts:

A.1 Construction of a new two track electrified rail line of about 857 km for freight and passenger service connecting Guiyang in Guizhou Province and Guangzhou in Guangdong Province, including construction of sub-grades, tunnels, bridges, culverts and buildings, acquisition and installation of goods (including communications, signaling, mechanical and electrification equipment, and concrete beams), and provision of related technical assistance.

A.2. Construction of new railway stations along the rail line referred to in Part A.1 of the Project.

A.3. Resettlement and rehabilitation of Displaced Persons in connection with the carrying out of Parts A.1 and A.2 of the Project.

13. By international standards, this was a technically complex megaproject. This line crosses a mountainous area through a karst landscape. Over 23 percent of the line consists of bridges and viaducts, and about 54.5 percent is in tunnels. The new line, as designed at appraisal, was expected to be capable of maximum train speeds of 200 km/h for passenger trains and 120 km/h for freight trains. It was expected that the travel time for passengers between Guiyang and Guangzhou would be reduced from 19 hours (express) or 27 hours (ordinary) to a little over five hours (for express trains). It would also reduce the travel time between Guilin and Guangzhou from 11–12 hours (express) to less than three hours. In addition, the capacity provided on the new line would enable the transfer of traffic from the existing routes and thus provide additional train paths necessary to handle growing demand in those corridors.

## 1.6 Revised Components

14. The project design was revised for building the GuiGuang Railway as a passenger-dedicated line (PDL), instead of a mixed-use (freight and passenger) line. The GuiGuang railway was originally designed as a mixed-use railway on which 200 km/h speed express trains as well as fast container trains and normal freight would operate.

15. In October 2008, a revision to the Medium- and Long-term Railway Development Plan (MLTRDP) was approved under which several PDL and mixed-use railways would be built around the GuiGuang railway by 2020. With these dramatic changes in the railway network, the MOR re-analyzed traffic flows and the corresponding network allocation. The MOR determined that it would be necessary to modify the technical parameters of the GuiGuang railway accordingly. In 2013, the project was restructured to build the railway as a PDL with a design speed of 250 km/h. This would not only reduce transit time but also provide additional capacity required to match the expected improved connectivity of Guiyang with western China.

## **1.7 Other Significant Changes**

16. The project underwent two Level II restructurings in February 8, 2013, and December 24, 2015. Refer to Section H of the Data Sheet for details.

17. Project design did not include a Midterm Review (MTR). When the Bank mandated that an MTR should be conducted for all projects, all contracts had been awarded and project implementation was well under way. Part of the core World Bank team was located in the country office and met CR frequently to follow up on implementation of the railway program and provided constant support to the client. The MTR was therefore deemed unnecessary.

## **2. Key Factors Affecting Implementation and Outcomes**

### **2.1 Project Preparation, Design and Quality at Entry**

18. The project quality at entry is Satisfactory based on the analysis detailed in the following paragraphs.

#### *Soundness of Background Analysis*

19. From 1995 to 2010, CR had been pursuing two key objectives: 1) to reform the industry to become more responsive to the market economy; and 2) to achieve an order-of-magnitude change in the capacity and quality of infrastructure and services in a network that was already the busiest railway system in the world by a wide margin and was still facing rapidly growing demand. The GuiGuang Railway Project documentation clearly described the sector background and challenges, including the step-by-step approach chosen by the Government towards reform, concentrating on reforms within the existing framework.

#### *Assessment of Project Design*

20. The selection of the final route was based on a diligent multi-criteria selection, including economic, environmental, social, and technical factors. Several alternatives were considered, with the final choice based on multiple criteria that included: connections with the existing rail network; minimizing cost and land acquisition/resettlement; and connecting potential areas of economic development. Further efforts were made to avoid forest reserves, places with cultural relics, scenic and historic spots, and areas with poor geological conditions. The design institutes consulted officials responsible for urban development planning in the various cities in selecting sites for proposed railway stations and railway facilities. Environmental and social aspects were considered during feasibility engineering and environmental assessment (EA), including preparation of Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP).

21. Two project companies were planned to be created for project implementation, based on lessons learned from Bank railway projects in China. This project and the two previous World Bank-financed projects (ShiZheng Railway Project and NanGuang Railway Project) differed from previous World Bank-financed railway projects in China in that a project company was to be created and MOR was to transfer assets created by the project to the project company. This arrangement was considered to strengthen ownership of the project for both implementation and future operations. Additionally, this arrangement creates provincial accountability (provinces

finance, in part or in full, resettlement and land acquisition) for the appropriate application of social and resettlement practices.

22. The project was designed with Bank financing covering only 10 percent of costs, which is a relatively low compared to most Bank projects in China. Such an approach enabled the Bank to support a much wider program of railway projects (2,660 km of rail lines over six projects during the period) within the overall lending volume. The choice of a multi-project Bank engagement enabled the Bank to engage in policy dialogue and to provide support for institutional change, including multiple railway policy notes (see Annex 8 for more details). It also leveraged Bank resources effectively by extending the application of Bank requirements, especially safeguards, over a much larger project.

### *Assessment of Risks*

23. Risks were assessed diligently, taking into account the Bank's previous engagement in the railway sector in China. The following main risks were identified and risk management measures were taken:

- (a) **Resettlement and land acquisition.** This risk was rated High at appraisal, and this rating is justified because the project was designed as a green field project and required the acquisition of a large extent of land and affected a large number of people. The final alignment affected 226 villages in 87 townships of 26 counties in Guizhou, Guangxi, and Guangdong. More than 60,000 farmers were affected and around 8,000 people were relocated. There was a risk that land acquisition and resettlement would not be carried out according to the Resettlement Action Plan (RAP). The risk created by the formation of project companies (see Paragraph 22) for the implementation of Resettlement and Land Acquisition was identified at appraisal, but no mitigation measures were defined.
- (b) **Environmental risk.** Most of the GuiGuang line alignment goes through mountainous areas (via tunnels and bridges) with rich native vegetation and potentially high biodiversity. The following mitigation measures were developed: (i) diligent use of alternative analysis, leading to the avoidance of 40 of the 48 potentially environmentally sensitive areas; (ii) use of state-of-the art engineering digital mapping and design programs and tunnel-bridge-tunnel schemes to avoid or greatly limit impacts to most of the sensitive environmental locations; and (iii) preparation of detailed environmental design plans and EMPs, to minimize unavoidable impacts. There was, however, a high risk that the EMP would not be implemented satisfactorily. The arrangements for implementing the EMP turned out to be appropriate and the EMP was implemented satisfactorily.
- (c) **Complexity and large size of the project.** The technical complexity and size of the project justified the implementation risk being rated substantial. The risk was mitigated by MOR's substantial experience in railway construction in difficult terrain and the employment of proven technology for track, bridges, tunnels, signaling, and rolling stock.

- (d) **Traffic estimates.** The estimation of traffic demand is especially complex in green field projects. At appraisal, a network model was developed by the Bank to predict traffic demand and compare the results with the projections of the Design Institute.
- (e) **Creation of the special purpose Guiyang-Guangzhou Railway Company Limited.** At appraisal, the preparatory group of GuiGuang Railway Company was appointed as the implementing agency. However, the institutional and financial framework linking the company with the MOR and the Bank loan was not fully defined, but it was to be clarified before the transfer of project assets.
- (f) **Sustainability.** The risk that this high-cost project would not be economically and financially sustainable was considered Substantial. Results of the economic and financial analysis, which were based on conservative assumptions, have been confirmed by preliminary updates of the analyses after the beginning of operations.

## 2.2 Implementation

24. After Board approval, the function of the line was upgraded to a 250 km/h PDL with options for a higher speed in some sections (referred to as 250+ km/h). The project was redesigned with the following main changes: (i) modification of the layout of curves and maximum gradient; (ii) adopting PDL standards; and (iii) changing from a ballasted to a ballast-less track structure to meet the high-reliability and low-maintenance requirements for the operation of high-speed trains.

25. The complex megaproject was completed satisfactorily, with higher infrastructure standards (250 km/h versus 200 km/h at appraisal), on schedule, in line with the quality standards agreed at appraisal, albeit at a slightly above estimated cost. The project was completed and the line started operation in December 2014, i.e., prior to the estimated start of operation in 2015. The project had a slight cost overrun of 9% (in Chinese yuan), which is justified by the higher infrastructure standards needed for a 250 km/h line.

26. The administrative efficiency of the GuiGuang Railway Company during project implementation contributed substantially to on time and on budget delivery. GuiGuang Railway Company Limited was incorporated as a successor of the GuiGuang Railway Company Preparation Group. Project implementation proceeded in line with expectations and with high administrative efficiency despite the scale of this megaproject.

27. Project Implementation Progress (IP) was rated either Moderately Satisfactory or Satisfactory, except in November 2012, when it was downgraded to Moderately Unsatisfactory. By the end of 2012, the Bank team judged that project implementation would be completed satisfactorily, although with a delay. Nevertheless, by then, disbursement had not started and there were delays in the request for the restructuring from the Ministry of Finance. The performance rating was then downgraded to Moderately Unsatisfactory. The rating was revised when the restructuring was completed.

28. The IP was rated Moderately Satisfactory at loan closing as the implementation of the Supplemental Income Programs had not been completed. The revised RAP included three Supplemental Income Programs (SIPs, one in each province). Only the Guangxi Province SIP was completed by the time the ICR was prepared. The SIP of Guangdong and Guizhou provinces are



expected to be completed by May 2017 and March 2018, respectively. The Government and the Bank discussed the possibility of extending the loan closing date beyond December 31, 2016 but decided instead to continue to monitor SIP implementation after loan closing. China Railway Corporation (CRC) agreed to employ an external monitoring consultant to oversee the remaining distribution of funds from the SIP. The Bank and CRC have periodic video-conferences to evaluate the progress on the implementation of the SIP.

### **2.3 Monitoring and Evaluation (M&E) Design, Implementation, and Utilization**

29. Overall, monitoring and evaluation (M&E) is rated Substantial. The M&E system, as designed and implemented, was generally sufficient to assess the achievement of the objectives and to test the links in the results chain.

30. **M&E design.** The M&E framework had three PDO indicators and two intermediate indicators to measure the achievement of the PDO and intermediate outcomes/outputs. These indicators were specific, measurable, adequate, realistic, and targeted. The first two PDO indicators (average number of pairs of passenger trains and average number of pairs of freight trains) measure achievement of the first part of the PDO: to provide additional transport capacity between the southwest of China and the Pearl River delta region. The third PDO indicator, which measures reduction in transport time between the less-developed western region of southwest China and the relatively more developed Pearl River delta region, is appropriate to measure the achievement of the second part of the PDO: to reduce transport time between the less-developed western region southwest China and the Pearl River delta region.

31. Indicators related to the number of passengers on high-speed trains (Indicators 1 and 2), did not fully capture how passenger demand was met at the corridor level; the indicators measure the supply side of the equation, but not the demand side. In addition, these indicators do not measure the operation's impact or effectiveness in the long run, since such measurements can only take place after a few years of operation.

32. The PDO indicator on number of freight trains operating was dropped in the first project restructuring in 2013 to reflect the decision to operate only passenger trains in the line. Additionally, the indicator on the average number of pairs of passenger trains was revised to reflect the change in plans for the use of the new line. This change in the M&E framework is appropriate in the context of the revised project design.

33. The two intermediate indicators clearly assess progress in equipment procured (percentage of Bank-financed goods contracted, by value) and progress of works (percentage of civil works completed, physical percentage [completed]).

34. **M&E implementation and utilization.** MOR, through the Foreign Capital and Technical Import Center (FCTIC) and CRC, reported on project progress, including achievement of performance monitoring indicators. Data on baselines, target values, and intermediate values were provided by MOR through FCTIC. Overall progress was reviewed as part of annual audit reports, with progress compared to targets. CRC supplemented the M&E framework with other tools to serve as a basis for evaluation and to inform decision making and resource allocation.

### **2.4 Safeguard and Fiduciary Compliance**

35. **Procurement** under the project complied with World Bank policies. Procurement has been mostly carried out by the Department of Materials Management of China Railway Corporation (before the institutional reform, procurement was carried out by FCTIC), with the assistance of a tendering company. The Bank's assessment of FCTIC's capacity to implement procurement actions for the project during project preparation had confirmed that FCTIC would be able to manage project procurement in compliance with Bank Procurement Guidelines. Since the team responsible for procurement in the FCTIC and the Department of Materials Management of China Railway Corporation are the same, a separate assessment for the latter entity was not carried out. This assessment proved valid and the project did not face any procurement issues or delays, despite its large size. The Bank financed procurement of 23 International Competitive Bidding (ICB) goods contracts. All civil works and consultancy services contracts were procured through non-Bank financing. These arrangements were made so that the Borrower can procure large civil works in advance. Overall procurement under the project complied with the Bank policies. Procurement of non-Bank financed works, consultancy services and goods were carried out in accordance with China Tender and Bidding Law.

36. **Financial management** (FM) of the project complied with Bank policies, although there were some minor delays. The project FM system provided, with reasonable assurance, accurate and timely information that Bank loan proceeds were used for intended purposes. Counterpart funds were provided as planned. Bank loan proceeds were outside the budgetary and accounting system, but were included as a separate line item reported to the National Peoples' Congress. Project accounts were consistently audited by the National Audit Office with results generally publicly available, except for national security or commercial secrecy aspects. The auditors issued unmodified/clean opinions on project audit reports and interim unaudited financial reports (IUFs), and any minor issues identified were addressed by the implementing agency. In June 2015, the FM rating was downgraded from Satisfactory to Moderately Satisfactory because of a delay in providing the most recent IUFs. In December 2015, the FM rating was upgraded to Satisfactory, and this rating was maintained at loan closing.

37. The project complied with the Bank Environmental Safeguards Policies triggered (OP/BP 4.01 - Environmental Assessment, OP/BP 4.04 - Natural Habitats, and OP/BP 4.11 - Physical Cultural Resources). A number of environmentally sensitive areas (nature reserve, forest areas, tourist areas, cultural relics) were identified at appraisal and the EMP included specific actions to address them. The final EA documents (EIA Report, EMP, and EA Executive Summary) complied with Bank requirements. The EMP was implemented satisfactorily. Most sensitive areas were either avoided through proper alignment selection or crossed by tunnel or tunnel-bridge-tunnel systems to minimize negative impacts. Spoil sites and worker camps near the tunnel were well-designed, maintained, and removed.

38. The project complied with the Bank Social Safeguards Policy triggered (OP/BP 4.12 - Involuntary Resettlement). An RAP was prepared, reviewed, and disclosed in compliance with OP/BP 4.12. Active public consultations took place with affected villages and households from early 2008 on the selection of railway alignment, the locations of railway stations, compensation rates, relocation arrangements, and livelihood restoration approaches and measures; these helped optimize project design and reduce project impacts. In all, permanently acquired land along the railway affected 26,696 families, including 64,030 people; and temporary land acquisition affected

21,643 households, including 81,324 people. Affected people were consulted and the compensation rates applied meet both approved provincial and national policies.

39. When the project changed from a mixed-use line to a PDL, the RAP was updated to reflect the new alignment, adding Supplemental Income Programs (SIPs). Between the first and second RAP the resettlement policies changed in China so the new RAP included three SIPs, one for each province: (i) Multiple Livelihood Funds and scheme in Guizhou; (ii) project-related social security program in Guangxi; and (iii) reserved land or fees in Guangdong. The local government were to carry out these programs by 2014, and were to be reimbursed by CRC, GuiGuang Company and the three provinces. The programs account for about three percent of total support to the project affected people and about half of it had not disbursed at loan closing.

40. At the end of 2015 the loan closing date was extended because the three SIPs had not been completed. This extension, through a second restructuring of the project, extended the loan closing date by one year, to December 31, 2016.

41. By the end of 2016, the SIPs had made progress, but had not been completed. An agreement between CRC and the three provinces, signed on September 23, 2016, paved the way for implementation of the programs to start and the funds (CNY 337 million) were transferred to the provincial implementing agencies.

42. The Government and the Bank agreed that the Bank would continue to monitor the implementation of the SIPs after the loan closed on December 31, 2016. CRC and the GuiGuang Railway Company agreed to employ an external monitoring agent to prepare external monitoring reports on implementation status and the Bank continues to monitor implementation of the program regularly.

43. As of May 2017, there has been significant progress in the implementation of the remainder of the SIPs and the current status is as follows:

- (a) *Guangxi Province*. The SIP was completed in March 2017.
- (b) *Guangdong Province*. The SIP is expected to be completed by May 2017.
- (c) *Guizhou Province*. GuiGuang Company has disbursed the funds to Guizhou government and the SIP is expected to be completed by March 2018.
- (d) The M&E contract with an external monitoring agency has been signed, and CRC and the Bank have already received the first monitoring report from the consultant.

## **2.5 Post-completion Operation/Next Phase**

44. As discussed above, the Bank is monitoring the implementation of the balance of the SIPs. Given the Bank's continuing relationship with CRC on the Zhanghu and Hajia railway projects and the Logistics and High-speed Railway (HSR) Technical Assistance, there is continued Bank engagement with CRC, which would facilitate monitoring the completion of the SIP.

45. **Operations and maintenance.** Appropriate technical, financial, commercial, and institutional arrangements have been put in place to ensure effective project operation and maintenance (O&M). CR has now been operating HSRs successfully for over seven years, with over 19,000 route km of high-speed rail operational. CR has developed and operationalized robust and effective maintenance systems for infrastructure and rolling stock for these very intensively used high-speed rail systems. The ballast-less track structure meets the high-reliability and low-maintenance requirements for the operation of high-speed trains and allows higher speeds of trains. An appropriate number of technicians have been trained to carry out the maintenance of infrastructure and rolling stock.

46. **Financial sustainability.** The project line generates positive cash flows from operation and its financial sustainability is not at risk. GuiGuang can cover its operating costs of around CNY0.20 per seat-km from its average yield of CNY0.31 per seat-km. However, even though it has a load factor (passenger-km/seat-km) of over 80 percent, to cover its expected maintenance cost of around CNY1 million per route-km, it requires a passenger density of about 15 million per route-km. GuiGuang has not achieved this density so far, but will almost certainly do so once the Guiyang-Chongqing section is opened in 2018. GuiGuang line was not alone in this. Almost all the HSR lines, except Tokyo – Osaka, Paris – Lyon and a couple of lines in China have been financial viable, faced similar problems and CRC undertook a major debt restructuring, extending the tenors and restructuring principal repayments to gradually increasing over time to reflect the growth in traffic and revenue. With the restructuring, the long-term outlook for the company looks promising as the company will have adequate cash flows to cover interest charges, although in the short-term it will continue requiring support to absorb the infrastructure maintenance cost.

47. **Social sustainability** is ensured owing to a gradual and adjusted tariff policy. The Government of China considers public transport to be a social good and the affordability of rail transport including by poor, migrant workers and students is important as the railway system plays vital role in regional and cohesion in China. Therefore, rail passenger fares are regulated and set below cost recovery levels in China. HSR prices in the country range are RMB 0.14 to RMB 0.21 per passenger-km for conventional trains, about RMB 0.35 for the 250 kph high speed trains and about RMB 0.55 for the 350 kph trains. This pricing has proven very competitive with bus, air and even private automobile. MOR has carried out detailed passenger surveys, which show a strong willingness on the part of passengers to pay a surcharge of 50 percent for high-speed services, compared to conventional rail. It used to take 17 hours by bus and 21 hours by conventional train (on a different, circuitous rail route) with similar levels of fares, compared with the HSL travel time of 4–5.4 hours.

### 3. Assessment of Outcomes

#### 3.1 Relevance of Objectives, Design, and Implementation

48. **Relevance of objectives - High.** Project objectives were and remain highly relevant to the development priorities of China. In 2004, the State Council approved the Ministry of Railways (MOR) "Mid and Long Term Railway Development Plan (MLTRDP)" which articulated the construction priorities of China Railways and set the annual national investment needs for railways to keep pace with growing demand through 2020. The project contributed directly to the Bank Group's China Country Partnership Strategy (CPS) 2006–2010, especially on the dimensions of

integrating China into the world economy; reducing poverty, inequality, and social exclusion through affordable transport; and improving public and market institutions. The project contributes to the reduction in the poverty gap between the less developed western region of southwest China and the relatively more developed Pearl River delta region. The railway sector is vital to China, especially to its continued economic growth and development and to international trade. Railways also enhance China's ability to extend the benefits of development more widely in society and to people living in remote regions. The project continues to be aligned with the Bank Group's China CPS 2013–2016, especially on the dimension of the improvement of transport connectivity for more balanced regional development. The project is also aligned with the China's 13<sup>th</sup> Five-Year Plan (2016-2020), especially under the pillar "Establishing a new model of coordinated regional development". The 13<sup>th</sup> FYP informs the latest China CPS, which is currently under preparation.

49. **Relevance of design and implementation - Substantial.** Project design and implementation were and remain highly relevant in achieving the PDO. The relatively low Bank contribution (10 percent of the total project cost) allowed to Bank to support a much wider and unified program of railway projects (2,660 km over six projects during the period). This broad-based Bank support for the program, as well as the overall commitment of the Government and the implementing agencies, enabled the project to be a technical and environmental success despite the relatively marginal financial contribution of the Bank. Project components and expected outputs are consistent with the stated objectives, as outputs and outcomes are a direct result of the causal chain of the project. The change of design from mixed-use to passenger-dedicated line, a direct result of a re-evaluation of China Rail's network policy, could not be envisaged at appraisal. The Results Framework was appropriate, despite some minor shortcomings. The Results Framework includes relatively simple indicators, and was supplemented by the already sophisticated Monitoring and Evaluating framework in CR, which was provided monthly to the Bank. (Section 2.3). Additionally, a passenger-on-board survey was conducted along the railway line in 2015 to complement the Results Framework. Despite its massive size and technical challenges, project implementation was timely and consistent with on-going Government programs.

### **3.2 Achievement of Project Development Objectives**

50. The achievement of each of the elements of the PDO is discussed in the following paragraphs.

#### **Providing additional transport capacity between the less developed western region of southwest China and the relatively more developed Pearl River delta region - High**

51. The project achieved a significant increase in transport capacity between the western region of southwest China and the Pearl River delta region, and it has improved resilience of the railway network. The number of passenger train pairs operated on the line has significantly exceeded the target value. The project targeted 20 pairs of express passenger trains operated per day between Guiyang and Guangzhou and achieved 25 pairs of trains between Guiyang and Guilin, and 36 pairs of trains from Guilin to Guangzhou. In addition, two pairs of express trains are operated daily between Guiyang and Guanzhou. Freight demand is currently accommodated on the original line, which benefits from the reduction in passenger trains that now use GuiGuang and as such has some

spare capacity. The conversion of the project line as a PDL also triggered a reduction in maintenance costs for the line compared to a mixed-use line.

52. Since the start of the operation in December 2014, passenger traffic has grown strongly. The estimated density (passenger-km/route-km) in 2015 was 10 million, which was estimated to increase to about 12.5 million in 2016. The total number of passengers using the line in 2015 was 19 million. Patronage between Guiyang and Guangzhou, and particularly between Guilin and Guangzhou, is considerably higher than forecast. It is also higher than the traffic forecast between some of the local stations around Guilin. Additionally, two million passengers are on through trains from Nanning and Liuzhou, which was not anticipated. The efficient utilization of the line is demonstrated by the provision of train service in line with passenger demand. As of February 2017, there are 38 pairs of trains between Guangzhou and Guilin, of which 18 continue to Guiyang. In addition, there are five non-stop trains between Guangzhou and Guiyang, three of which (since January 2017) continue to Kunming and a further seven pairs between Guilin and Guiyang.

53. At appraisal, the project envisaged that the HSL would operate both passenger trains and freight trains. CR decided not to run freight trains on the HSL as part of its unified network strategy and instead runs freight trains on the existing conventional lines via either Zhuzhou or Nanning. The PDO indicator relating to freight trains was therefore dropped in the first restructuring. Overall, additional rail capacity has been provided as planned and capacity utilization in terms of pairs of trains operated on the HSL exceeds targets, although the passenger-freight composition is different.

### **Reducing transport time between the less developed western region of southwest China and the relatively more developed Pearl River delta region - High**

54. The project achieved a very significant reduction in the average travel time between the western region of southwest China and the Pearl River delta region. The average travel time came down dramatically from 1,500 minutes to 251 minutes. The reduction in travel time benefits an average of 53,000 passengers per day (i.e., around 19 million per year, according to data from the 2015 survey). Passenger surveys carried out by the Bank found that most trains are completely full all the way and, in many cases, there were standing passengers for up to 10 percent of seating capacity. The significant reduction of travel time and the competitive fares facilitate labor migration, and more frequent visit of migrants to family and friends. High-speed train fares are priced competitively against bus services and train travel provides significant time savings; hence it is used by passengers with a wide range of income levels, including the bottom 40 percent.

### **Additional Outcomes Achieved by the project**

55. Impacts are best assessed about five years after the HSL is operational; nevertheless, it appears that the GuiGuang Rail Project has contributed to the economic transformation of the region and has been a driver of poverty reduction in the less developed western region of southwest China as well as the more developed Pearl River delta region. Between 2007 and 2014, both rural and urban households in the provinces of Guizhou, Guangxi, and Guangdong enjoyed increases in average income because of jobs related to construction and the increased attractiveness of the region once the line developed. These increases were far more important in the project areas on the one hand and within rural households on the other. For instance, in Guizhou the average income

of rural households in the project area increased by 226 percent, while it increased by 174 percent in the entire province.

56. To stimulate job creation, cities along the GuiGuang line have started to develop new urban development strategies associated with the introduction of the high-speed rail service. Local governments have been developing urban plans for new development districts that include access to roads and highways to center city, logistics, industry zone designs, and promotion of ecotourism in remote tourism villages. Local authorities believe that such new development could provide more job opportunities for poor people and the bottom 40 percent of the population. Local Development and Reform Commissions and poverty offices have already set up multiple job training programs (for example, planting skills and auto repair technicians) for the local poor (including the extreme poor and the bottom 40 percent of the population). Tourism has developed a lot in all three provinces owing to the railway, and tourism has become a considerable source of job creation. For instance, Congjiang Tourism bureau estimates that more than 1,000 new service jobs have been created in the tourist industry since the GuiGuang line opened. The 2015 passenger survey found that 67 percent of the passengers were traveling for tourism. Travel agencies in Guiyang reported a 200 percent increase in business on average, after the opening of the HSR compared to the same period in 2014. During the seven-day Spring Festival Holiday in 2016, there were 11.89 million tourists in Guizhou Province, an increase of 21.3 percent compared to 2014.

57. In parallel with project activities, the Bank engaged in policy dialogue with the MOR and CRC on sector reforms and cutting-edge analytical work in railway network management and financing. The Bank documented the experience of China in developing its high-speed rail network, including notes on traffic, costs, success factors in project implementation, good practice in environmental management, and wider economic impact evaluation.<sup>1</sup>

### 3.3 Efficiency – Substantial

58. **Ex-post economic analysis.** The ex post economic analysis indicates that project investments were economically viable for all regions and provinces, with an overall economic internal rate of return (EIRR) of 18 percent, compared with an estimated EIRR of 16 percent at appraisal.<sup>2</sup> The reevaluation estimates a net present value (NPV) of CNY128 billion (2015 prices discounted at 12 percent). The impacts used in the analysis can be classified as (a) cost-benefit analysis (CBA) of passenger traffic (for example, through travel time savings); (b) externalities (impacts on third parties such as accidents, noise and GHG); and (c) agglomeration effects. The principal contributors to the improved economic result are the increase in the net passenger-related benefits associated with the higher value of time, together with net operating benefits across all modes and the improved greenhouse gas (GHG) contribution. The increase in GHG benefits is primarily caused by the changed Chinese policy regarding coal-based generation. The use of non-coal generated energy and improved efficiency in the remaining coal-fired plants will result in the reduction of electricity-related emissions by over 60 percent over time, increasing the savings from electric traction. This is offset to some extent by the greater proportion of generated passengers

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<sup>1</sup> Regional Economic Impact Analysis of High Speed Rail in China (P143907) (<http://operationsportal2.worldbank.org/wb/opsportal/ttw/about?projId=P143907>).

<sup>2</sup> This estimate takes into account the actual opening date, which was ahead of schedule.

compared to appraisal, who in the ‘without project’ case do not travel and hence do not create any GHG emissions.

59. **Agglomeration effects.** As transport improves, companies become more closely connected (creating what is known as a cluster) and this is known to generate agglomeration economies. Such agglomeration brings benefits to all companies in the cluster. The CBA captures the benefits to the companies which experience direct cost and time savings (e.g. as a result of relocation) but does not, however, include potential efficiency gains which accrue to other companies in the cluster as a result of these closer interactions. The agglomeration benefits in this project reflect the impact of the high-speed line on these other companies. The estimated agglomeration effects identified three geographic areas within Guizhou Province (Guiyang, southern Guizhou, and southeastern Guizhou). Of these, Guiyang contributed about 70 percent of the total benefits.

60. **Cost-effectiveness.** Project costs at completion were about US\$12,049 billion (CNY 87,124 billion) compared to appraisal estimates of US\$11,653 billion (CNY 79,829 billion), that is, an increase of 9 percent in Chinese yuan terms. This is highly satisfactory for a rail project of this scale, and given the fact that the line speed was increased to 250 km/h from the original design speed of 200 km/h. This results in a unit cost of US\$14 million per km, which is among the lowest cost per kilometer in the world,<sup>3</sup> especially as about 23 percent of the line consists of bridges and viaducts, and about 54.5 percent is in tunnels. The estimated unit costs of three other railway projects in China (with a maximum speed of 250 km/h) that are partly funded by the Bank are between US\$17–19 million per km, while that of another 200 km/h mixed-use line (with about 48 percent track on bridges/viaducts and in tunnels) is US\$15.5 million per km.

61. **Administrative efficiency.** The administrative efficiency of the project is high, as project activities were completed ahead of time in a cost-effective manner. The line was opened in December 2014, one year ahead of the original loan closing date, which improved the Economic Rate of Return by 0.7% (17.4% instead of 16.7%). The project was restructured in December 2015 only to allow time to implement the SIPs issues. Provincial government negotiations delayed the resolution of these issues, although by closing date, these negotiations had been completed and the SIPs had been implemented in two of the three provinces. The project was completed on December 2016 with loan funds almost fully disbursed.

### **3.4 Justification of Overall Outcome Rating**

**Rating: Highly Satisfactory**

62. Based on the ratings for relevance, efficacy, and efficiency the overall outcome of the project is rated Highly Satisfactory.

### **3.5 Overarching Themes, Other Outcomes, and Impacts**

#### **(a) Poverty Impacts, Gender Aspects, and Social Development**

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<sup>3</sup> Ollivier, Gerald Paul, Jitendra Sondhi, and Nanyan Zhou. 2014. *High-speed Railways in China: A Look at Construction Costs*. China transport topics; no. 9. Washington, DC; World Bank Group.  
<http://documents.worldbank.org/curated/en/2014/07/19761655/high-speed-railways-china-look-construction-costs>.



63. GuiGuang Rail Project has contributed to the economic transformation of the region, has been a driver of poverty reduction and a catalyzer of job creation. Rural and urban households in the provinces of Guizhou, Guangxi, and Guangdong have enjoyed increases in average income because of jobs related to construction and the increased attractiveness of the region once the line developed.

64. The operation of the GuiGuang Railway Project benefitted the bottom 40 percent and the train service is considered affordable compared to any equivalent transport services that were available previously, facilitating labor migration. See Section 3.2 for more details. A wide range of people (farmers, entrepreneurs, retirees, migrant workers, children, old couples, men, and women) across income levels were using the new line to access job opportunities, meet their families, or visit other parts of China. Guilin and Guiyang have numerous scenic spots, which the high-speed rail makes more accessible.

65. The GuiGuang Railway Project has directly improved accessibility for local people. Since this project was in a remote, hilly area, about 2,800 km of service roads and 4,686 km of bridges were built or rebuilt to facilitate the construction of the railway. Local communities are now using these roads and bridges on a daily basis.

66. **Impact on women.** The construction of this megaproject had a positive impact on women's inclusion, including access to jobs and services. According to the survey results, female passengers tend to have lower income than male passengers. The railway increases women's accessibility to jobs and has resulted in affordable transportation to support the reduction of the gender gap in income.

#### **(b) Institutional Change/Strengthening**

67. Through the program of six projects the Bank has been able to engage in policy dialogue and has supported institutional change through multiple railway policy notes (see Annex 8 for more details). These have contributed to sector reforms, including corporatization, financing options, optimization of O&M, and the balancing of demand and supply on the railway network based on traffic forecasts.

#### **(c) Other Unintended Outcome and Impact (positive or negative)**

Not applicable.

### **3.6 Summary of Findings of Beneficiary Survey and/or Stakeholder Workshops**

68. In 2015, a passenger-on-board survey was organized by the Bank along the railway line. Results detailed in Annex 5 show that 39 percent of the interviewed travelers chose the train because of the shorter travel time, while 22 percent chose it because of the comfort, and 17 percent because of the affordable price. About 17 percent of those surveyed were poor people with no monthly income. More details are provided in Annex 5.

#### 4. Assessment of Risk to Development Outcome

##### Rating: Low or Negligible

69. **The financial risk to the PDO is Low.** Results of the first months of operation show that the appraisal estimate of the number of passengers was slightly above the number of passengers in 2015 (appraisal forecast an average density<sup>4</sup> of 11 million in 2015, the density in 2015 was 10 million). GuiGuang can, like most 250 km/h lines, cover its operating costs of around CNY 0.20 per seat-km from its average yield of CNY 0.31 per seat-km. However, even though it has a load factor (passenger-km/seat-km) of over 80 percent, to cover its expected maintenance cost of around CNY 1 million per route-km, it requires a passenger density of about 15 million per route-km. Although GuiGuang has not achieved that to date, it is well on the way and will almost certainly do so once the Guiyang-Chongqing section is opened in 2018. The next target is to be able to repay interest charges. The GuiGuang Company, in common with other smaller HSR lines, is likely to pay interest on the debt and then negotiate any payment for infrastructure maintenance with the local Regional Administrations (RAs), who are also shareholders in the GuiGuang company. When repayment of the principal begins in 2017, GuiGuang will restructure its debt.

70. **The technical risk is Low.** Similar train systems have been operated and maintained at very high levels of reliability and safety in China since 2007. They have also been in operation in Japan, Germany, Italy, the United Kingdom, and France for many years.

71. **The social risk is Low.** A survey of passengers referred to earlier found that the high-speed train is relatively affordable, so it is used by passengers from a wide range of income levels, including the bottom 40 percent of incomes. A wide range of people (farmers, entrepreneurs, retirees, migrant workers, children, old couples, men, and women) use the new line to access job opportunities, meet their families, or visit other parts of China. By the loan closing date, compensation for permanent land acquisition and provision of replacement housing had been completed. By May 2017, SIPs to support project-affected people in Guangxi Province and Guangdong Province had been completed, while the program is expected to be completed in Guizhou Province by March 2018. CRC and the GuiGuang Railway Company will employ an external monitoring agent and the Bank will continue to monitor progress until the program is completed.

72. **The risk of reduced Government ownership and commitment and institutional support risk is Low or Negligible.** China has the world's longest HSR network and the railway sector benefits from strong Government commitment and institutional support. The State Council-approved 2004 MOR MLTRDP sets out the investment required to keep pace with demand at about US\$12-15 billion per year till 2020. This has increased substantially to over US\$90 billion per year post 2009.

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<sup>4</sup> Density measured in passenger-km/route-km.

## **5. Assessment of Bank and Borrower Performance**

### **5.1 Bank Performance**

#### **(a) Bank Performance in Ensuring Quality at Entry**

##### **Rating: Satisfactory**

73. The Bank ensured quality at entry through an adequate alignment of the project objectives with the CPS and national and World Bank transport strategies, combined with components designed to achieve the PDO, as well as appropriate implementation arrangements. Bank inputs and processes before Board approval were appropriate. The Bank provided guidance and support to ensure that technical and environmental specifications and feasibility studies were prepared within a short time to meet high quality standards. Project preparation included a screening to identify the poorest cities and the impact of the line on poverty issues. The Results Framework was well-focused and straightforward. The Bank assessed agglomeration effects as part of the economic analysis, which is considered a good practice for the railway sector. The risk assessment was comprehensive and proved robust during the implementation of a very large and complex project.

#### **(b) Quality of Supervision**

##### **Rating: Satisfactory**

74. The Bank worked closely with the Government and the implementing agencies to support the implementation of this complex mega railway project on time and to high quality standards, in compliance with Bank policies (especially safeguards and fiduciary policies). The Bank supervised the project diligently with the required expertise. Implementation Status and Results Reports (ISRs) were prepared on a six-monthly basis and the ratings were candid and appropriate. The task team has been commended by management for using the risk framework to update risk ratings in all the ISRs and in the management of identified project risks.

75. The Bank team was proactive in analyzing the needs for restructuring, given the adjustments in rail design and use. The Bank responded on time to the delays in the request for restructuring of the project, downgrading the IP rating by the end of 2011. The Bank approved a first restructuring of the project in early 2013, when the project description and indicators were adapted to the new design.

76. The Bank team monitored the social and environmental safeguards aspects of the project diligently. The Bank approved a second restructuring of the project in December 2015 to provide additional time to complete implementation of the supplemental income programs. The Bank supervised this issue closely during 2016. At the end of 2016 the Bank agreed with CRC and the GuiGuang Railway Company that while the loan would close, the Bank would continue to monitor the implementation of the SIP until it is completed.

77. The Bank team responded to delays in the delivery of the FM interim report in mid-2015 by downgrading the FM rating (see Section 2.4, on Financial Management for further information).

78. The Bank drew extensively on lessons learned from this project to document China's experience in developing its high-speed rail network, including notes on traffic, costs, success

factors in project implementation, good practice in environmental management, and wider economic impact evaluation.<sup>5</sup> In parallel with project activities, the World Bank engaged in policy dialogue with the MOR and CRC on sector reforms and cutting-edge analytical work in railway network management and financing (see Annex 8 for the list of Railway Policy Briefs and Notes prepared by the Bank).

### **(c) Justification of Rating for Overall Bank Performance**

#### **Rating: Satisfactory**

79. Overall, Bank performance is rated Satisfactory, based on the ratings for Bank performance in ensuring quality at entry and quality of supervision.

## **5.2 Borrower Performance**

### **(a) Government Performance**

#### **Rating: Highly Satisfactory**

80. The Government ensured that the project was prepared and implemented in record time with good quality and also complied with loan covenants, including fiduciary and safeguards aspects. MOR delegated responsibility and provided the needed resources to ensure timely project implementation. MOR demonstrated strong ownership of the project and changed the use of the line from mixed-use to PDL based on comprehensive network planning. MOR also actively participated in Bank supervision missions and wrap-up meetings and ensured that the implementing agency executed the project in accordance with the agreements reached with the Bank. MOR engaged in a dialogue with the World Bank on railway sector reform and took Bank inputs into account while finalizing policy decisions.

### **(b) Implementing Agency or Agencies Performance**

#### **Rating: Satisfactory**

81. Project implementing agencies deserve major credit for successfully implementing this massive infrastructure project. FCTIC, CRC, and the GuiGuang Railway Company responded efficiently on all project issues, adhered to project implementation requirements, engaged with Bank missions, and contributed to the timely completion of the project. They furnished progress and other reports on time, monitored environmental and social aspects, and suggested good practices for environmental methodologies. FCTIC managed procurement activities efficiently. CRC ensured that testing and commissioning went well. The GuiGuang Railway Company monitored resettlement and processed payment of compensation to project-affected persons, coordinated with local governments to review options to improve connectivity between urban areas and the new stations, and provided data on performance indicators as soon as the service was operational. Project agencies are working closely in ensuring that the SIPs are implemented in the three provinces as soon as possible.

### **(c) Justification of Rating for Overall Borrower Performance**

#### **Rating: Satisfactory**

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<sup>5</sup> Regional Economic Impact Analysis of High Speed Rail in China (P143907) (<http://operationsportal2.worldbank.org/wb/opsportal/ttw/about?projId=P143907>).

82. Borrower performance is rated Satisfactory based on the ratings for Government performance and implementing agency performance.

## 6. Lessons Learned

83. The main lessons learned from the project are highlighted below:

- (a) **The government played the key role in putting an eco-system in place to enable the impressive creation, galvanization and implementation of the railway program development.** China Railway Corporation (CRC) has single point responsibility for planning, financing and implementation of individual projects, for the creation of delivery mechanisms (such as the joint venture companies with provincial governments), and for administration of China's national railway services. This, combined with legal and institutional power, strong technical capacity, access to the operating cash flows of the railways and the ability to borrow, gave CRC the agility to plan and deliver projects very quickly. Cooperation between national and local authorities, with a timely availability of counterpart funds, made the project a success. This unified control over the project, as well as the overall commitment of the Government and the implementing agencies, enabled the project to be a technical and environmental success despite the relatively marginal financial contribution of the Bank.
- (b) **The development of a large scale HSR network, rather than construction of an isolated line can lead to lower costs.** China has built a network of about 10,000 route-km of high-speed railways rapidly and at a relatively low unit cost, compared with similar projects in other countries<sup>6</sup>. Based on experience with World Bank supported projects in China, the cost of railway construction is about 82 percent of the total project costs<sup>7</sup>. China HSRs with a maximum speed of 350 km/h and with a high ratio of viaducts and tunnels have a typical infrastructure unit cost of about US\$17-21 million (RMB100-125 million) per km. The cost of HSR construction in Europe with a design speed of 300 km/h or above is estimated to be of the order of US\$25-39 million per km, and HSR construction cost (excluding land, rolling stock and interest during construction) is estimated to be as high as US\$52 million per km in California. Several factors influence the cost of HSR. Some of the key factors contributing to China achieving lower costs without compromising the quality, include: (i) lower labor costs; (ii) support for the medium-term plan for the construction of a large HSR network encouraged the development of innovative and competitive capacity for equipment manufacturing and the amortization of the capital cost of construction equipment over a number of projects. It has also resulted in the standardization of designs for embankments, track, viaducts, electrification, signaling and communication systems, which enabled contractors to spread the costs of specialized equipment over multiple projects.

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<sup>6</sup> China Transport Topics No. 9, High-Speed Railways in China: A Look at Construction Costs, July 2014 by Gerald Ollivier, Jitendra Sondhi and Nanyan Zhou

<sup>7</sup> Including civil works, track works, regular stations, yards, signaling, control and communication, power supply and other superstructure components; excluding the cost of planning, land, some of the mega stations, rolling stock and interest during construction.

- (c) **Quantification of agglomeration benefits is important in evaluating the benefits of passenger railway projects.** Such agglomeration brought benefits to all companies in the cluster, and the agglomeration benefit model could be applied to other corridors in China and in other countries. As this rail project made companies locate or expand in a given area, the CBA captured the benefits to companies from direct cost and time savings. In China, agglomeration effects have been recognized at a theoretical level, although to date there are only a few quantitative studies on the topic. A Bank study in 2006 found that firms in more populated cities and city regions tend to be more productive, and this was tentatively attributed to greater competition and agglomeration benefits. The results from this project's economic analysis confirm the earlier results on the benefits of agglomeration. The ICR recommends undertaking an ex post analysis in five to ten years to confirm the long-term agglomeration effects.
- (d) **Large and linear infrastructure investment projects call for: (i) good preliminary designs; (ii) strict control over compliance with standards and specifications; (iii) reliable and responsible contractors; (iv) meticulous planning of activities; and (v) timely land acquisition.** An early and good preliminary project design was the basis of the Feasibility Report and initial cost estimates. The subsequent detailed design did not deviate significantly from the preliminary design. In addition, applicable standards and technical specifications for railway construction and material inputs were formulated and adhered to strictly. An effective quality control system was functional with contractors as well as with project management and as a result no significant problems were noted during testing and commissioning of the railway. A project of this dimension and complexity requires linking and control of thousands of activities that are carried out by diverse agencies. All construction and supply activities were identified and their inter-dependence was established. Meticulous planning and control of critical activities prevented hold ups during construction. Red flags on lagging activities were acted on quickly. Qualifications and experience of contractors were defined carefully, so that only those with credible past performance and with adequate resources were able to bid for contracts. On time availability of materials was ensured by efficient procurement. Timely land acquisition was another critical factor, since for a linear project any break in land availability is very disruptive.
- (e) **The choice of a multi-project engagement enabled the Bank to engage in a broader policy dialogue and to support effective institutional change.** Limited Bank financing for the project allowed the Bank to support a much wider and unified program of railway projects and enabled the Bank to provide holistic support through policy dialogue with the MOR and CRC on sector reforms and cutting-edge analytical work, documented through policy notes on railway network management and financing (Annex 10). The papers on Governance and Structure and Railway Price Regulation informed Chinese officials' thinking in the reform of corporatization of CRC and pricing liberalization. Prospective Bank support to the Chinese railway sector will likely focus on multi-modal and comprehensive projects that promote synergies with rural roads, logistics and trade to facilitate comprehensive solutions.
- (f) **The creation of project companies at the province level to help finance and implement railway projects bolsters provincial accountability but can make the execution of**

**resettlement compensation mechanism more cumbersome.** Beginning with the ShiZheng Railway Project and continuing with this project, MOR formed project companies with provinces to help finance and implement railway projects. This increased the provincial accountability for the appropriate application of social and resettlement practices. However, the division of fiduciary responsibilities between different provinces could delay resettlement compensation, as was the case with SIPs in this project.

## **7. Comments on Issues Raised by Borrower/Implementing Agencies/Partners**

### **(a) Borrower/Implementing Agencies**

84. Both the borrower and the implementing agency consider that the project can be evaluated as successful. This project is, according to their completion report, meeting the development objectives and priority of the Government for the economic growth of China. They emphasize that results are showing the effectiveness and relevance of the project and that the Borrower, with Bank support, managed the Project regarding efficiency, effectiveness, quality of inputs, quality of supervision, and M&E. The project also complied with national and Bank social and environmental requirements. A summary of the Borrower's ICR is provided in Annex 7.

### **(b) Cofinanciers**

Not applicable.

## Annex 1. Project Costs and Financing

(a) Project Cost by Component (in US\$, millions equivalent)

Components <sup>a</sup>	Appraisal Estimate <sup>b</sup> (US\$, millions)	Actual/Latest Estimate (US\$, millions)	Percentage of Appraisal
Construction of the electrified railway line	8,677.42	9,299.75	107
Acquisition and installation of goods	927.33	314.96	34
Land acquisition and resettlement	708.77	1,178.94	166
Other	664.07	1,241.95	187
Consulting Services	0.30	13.34	4,436
<b>Total Baseline Cost</b>	<b>10,977.89</b>	<b>12,048.94</b>	<b>110</b>
Physical Contingencies	675.94	487.24	72
<b>Total Project Costs</b>	<b>11,653.83</b>	<b>12,536.17</b>	<b>108</b>
Interest during construction	805.68	518.14	64
Rolling stock	66.30	0.00	0
Front-end fee IBRD	0.75	0.66	88
<b>Total Financing Required</b>	<b>12,526.56</b>	<b>13,054.98</b>	<b>104</b>

a. Spending categories.

b. Exchange rate at appraisal: US\$1=CNY6.85, and US\$1=CNY6.95 at completion.

c. The component Consulting Services includes studies of geological conditions of the tunnel and construction techniques of super bridge when unexpected circumstance occurred. These studies, per their nature of being unexpected, were not considered for financing at appraisal. This is the reason for the increase compared to the appraisal estimate.

(b) Project Cost by Component (in CNY, millions equivalent)

Components	Appraisal Estimate (CNY, millions)	Actual/Latest Estimate (CNY, millions)	Percentage of Appraisal
Construction of the electrified railway line	59,440.35	64,631.38	109
Acquisition and installation of goods	6,352.23	2,188.94	34
Land acquisition and resettlement	4,855.08	8,193.37	169
Other	4,548.91	8,631.29	190
Consulting Services	2.06	92.71	4,500
<b>Total Baseline Cost</b>	<b>75,198.63</b>	<b>83,737.69</b>	<b>111</b>
Physical Contingencies	4,630.16	3,386.20	73
<b>Total Project Costs</b>	<b>79,828.79</b>	<b>87,123.89</b>	<b>109</b>
Interest during construction	5,518.91	3,601.00	65
Rolling stock	454.16	0.00	0
Front-end fee IBRD	5.14	4.59	89
<b>Total Financing Required</b>	<b>85,807.00</b>	<b>90,729.48</b>	<b>106</b>



(c) Financing

Source of Funds	Type of Cofinancing	Appraisal Estimate (US\$, millions)	Actual/Latest Estimate (US\$, millions)	Percentage of Appraisal
Borrower	n.a.	12,226.56	12,755.49	104.33
IBRD	Counterpart funding	300.00	299.49	99.83
Total Funding	n.a.	12,526.56	13,054.98	104.22

## Annex 2. Outputs by Component<sup>8</sup>

1. The project comprised a single component with three parts. The outputs of each part are described below.

2. **Infrastructure Construction.** The major part of the project is the construction of the double-track electrified railway line from Guiyang in Guizhou Province to Guangzhou in Guangdong Province. This component also included the construction of subgrades, tunnels, bridges, culverts, and buildings related to the railway line. Table 2.1 summarizes the outputs of this part of the project.

Table 2.1. Achievements under Infrastructure Construction

Component	Outputs at Completion	Planned at appraisal, but not implemented
<b>Subcomponent 1.1: The double track electrified rail line</b>	<ul style="list-style-type: none"> <li>• Double-track electrified railway Passenger Dedicate Line of 847 km from Guiyang to Guangzhou (via Guilin in Guangxi Province)</li> <li>• Passenger rail line of 250 km/h</li> </ul>	<ul style="list-style-type: none"> <li>• Mixed-use (passenger and freight) railway line</li> </ul>
<b>Subcomponent 1.2: Subgrades, tunnels, bridges, culverts</b>	<ul style="list-style-type: none"> <li>• 342 bridges and viaducts (length: 191 km; 22% of the line)</li> <li>• 233 tunnels (length: 472 km; 55% of the line)</li> </ul>	—
<b>Subcomponent 1.3: Buildings</b>	<ul style="list-style-type: none"> <li>• 21 stations: Construction of 16 new stations and upgrading of three existing stations; the two final stations were developed outside the scope of the project (Foshan West and Guiyang North)</li> </ul>	<ul style="list-style-type: none"> <li>• 30 stations (of which 12 were overtaking stations)</li> </ul>

3. **Acquisition and installation of goods.** This part of the project is related to the acquisition and installation of goods, including communications, signaling, and electrification equipment, as well as maintenance vehicles. Table 2.2 summarizes the outputs achievements under this part of the project.

Table 2.2. Outputs Under Achievements under Component 2

Component	Outputs at Completion	Planned at appraisal, but not implemented
<b>Communication</b>	<ul style="list-style-type: none"> <li>• 20 core optical fiber cable</li> <li>• Global System for Mobile Communications-Railway digital mobile communication system</li> </ul>	—
<b>Signaling and electrification equipment</b>	<ul style="list-style-type: none"> <li>• Cab-signaling</li> <li>• Infrared hot box detectors</li> </ul>	—
<b>Maintenance vehicles</b>	<ul style="list-style-type: none"> <li>• Catenary maintenance cars, test vehicle, and wagons for carrying rail and other materials to the construction site</li> </ul>	—

<sup>8</sup> As defined in the Loan Agreement, the project consists in one Part A: Railway Line between Guiyang and Guangzhou. In this annex, each of the components represents sub-parts of Part A.

4. **Provision of related consulting services.** Based on MOR request, consulting services were provided during project implementation, including training and study tours. The significant increase in costs under this part of the project (US\$13.3 million at completion compared to appraisal estimates of US\$0.3 million) is due to the financing of geotechnical studies and other technical studies for the project; these studies were not envisaged at appraisal. (See Annex 1)

## **Annex 3. Economic and Financial Analysis**

### **Introduction**

1. This annex documents the economic re-evaluation of the GuiGuang HSR, constructed between Guangzhou and Guiyang North and fully opened to traffic in December 2014. It is based on data collected during a mission in March 2015 and updated in November 2016, supplemented by data obtained from a survey of passengers conducted at around the same time. The estimated economic return is about 18 percent, compared to 16 percent in the original evaluation, due to the significantly different pattern of demand, increase in real value of time compared to the forecast at appraisal, and the savings in construction costs.

### **Project Summary**

2. The line does not parallel existing conventional lines, except at the very northern end and provides a much more direct route between Guiyang North and Guangzhou South, with a distance at appraisal of 864 km, compared to 1,519 km on the existing lines. Several options for the line were considered, including a mixed-passenger freight line and a mixed electric multiple unit (EMU)/loco-hauled operation but the final objective was that by 2015 a new medium-speed (250 km/h) PDL would be constructed for this traffic. Services would consist solely of EMUs. The average travel time between Guiyang and Guangzhou for passengers would reduce from 24 hours to around 4.3 hours.

3. At the time of appraisal, it was expected that the adjacent Guiyang-Chongqing HSR would open shortly afterwards. The forecasts thus included traffic not only between Guiyang and Guangzhou but also to and from Chongqing, Chengdu, and Lanzhou, as well as some traffic from the Guiyang-Kunming corridor. In all, Guiyang traffic only represented about 15 percent of the total passenger traffic forecast on the line.

4. In practice, the new line opened before the onward connection to Chongqing has been completed and there will thus be no through traffic until 2018. All services are currently operated by EMUs and, with overnight sleeping trains now running on many high-speed lines, it seems unlikely that loco-hauled services will be introduced in future.

### **Traffic**

5. The appraisal forecast an average passenger density<sup>9</sup> of 11 million in 2015, increasing to 20 million in 2030.

6. The estimated density on the line in 2015 was 10 million, which is estimated to increase to about 12.5 million in 2016, in spite of the fact there are no passengers as yet to and from locations beyond Guiyang. The total number of passengers using the line in 2015 was 19 million. Patronage between Guiyang and Guangzhou, and particularly between Guilin and Guangzhou, is considerably higher than forecast, as is traffic between some of the local stations around Guilin. About two million passengers are on through trains from Nanning and Liuzhou, which was not anticipated at appraisal. After six months of operation, services were increased to 30 pairs of trains

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<sup>9</sup> Passenger-km/route-km.

on the section between Guilin and Guangzhou; with 10–15 pairs north of Guilin. In February 2017 there were 38 pairs of trains between Guangzhou and Guilin, of which 18 continue to Guiyang. In addition, there are five non-stop trains between Guangzhou and Guiyang, three of which (since January 2017) continue to Kunming and a further 7 pairs (25 in total) between Guilin and Guiyang. Patronage figures for 2016 are not yet available, but it is estimated that the passenger traffic density was about 12.5 million, with an average of 15 million south of Guilin and nine million north of Guilin. Table 3.1 compares the sources of the 2016 traffic (based on on-board surveys undertaken in March 2015) with the appraisal forecast.

Table 3.1. Forecast and Estimated Traffic Density in 2015  
(Passenger-km, millions per year)

Source	Appraisal		Estimated Actual	
	Million	%	Million	%
Conventional rail	8.5	77	1.6	13
Air	0.8	7	3.3	26
Bus	1.2	11	2.4	19
Car			0.7	6
Generated	0.6	5	4.5	36
Total	11.1	100	12.5	100

7. Rail passengers transferring are about 15 percent of those forecast; however, they still represent most of the previous end-to-end conventional rail passengers between Guiyang and Guangzhou. At appraisal, there were about 600,000 passengers per year each way between Guiyang, Guilin, and Guangzhou; the forecasts assumed that this volume would grow in line with general demand, at 6–8 percent per year. In practice, volume on this route instead has remained relatively static, probably due to increased competition from bus and air, and by 2013 had only increased to about 1.35 million. The new line thus appears to have captured almost all the conventional end-to-end rail traffic. In 2017, the conventional service from Guiyang to Guangzhou takes 21–24 hours and costs CNY174 for a hard seat while most high-speed services take about 5.3 hours and cost CNY268; the high-speed service from Guilin to Guangzhou takes about 2.7 hours and costs CNY138; all conventional services have been withdrawn, except one overnight train which costs CNY117 and takes 10 hours.

8. Rail has captured much of the air market: flights between Guiyang and Guangzhou have halved from about 11 return services daily in 2013 to 5 at present, while those between Guilin and Guangzhou have reduced from 5 to a single return trip every other day; air services between Guilin and Guiyang have ceased) and most of the bus market. It has also captured a share of the ‘car’ market, although this is probably from minibuses<sup>10</sup> than from sedans.

9. The total number of passengers claiming to have transferred from air is larger than the number of air passengers previously travelling on the two routes to Guilin and Guangzhou; this appears to be a result of what is claimed to be a much higher frequency of travel, as discussed in the following sections.

10. Generated passengers are 36 percent of the total, a bit higher than many other new lines. However, these are passengers who would not previously have made the trip by any mode. HSR

<sup>10</sup> In China, minibuses with up to 10 seats are conventionally classified as cars rather than as buses.

also seems to be increasing the frequency at which existing travelers make trips, with passengers typically quoting a 50–100 percent increase in trips, compared to the situation before the line opened. This increase (which results from the combined effects of the reduced travel time for all except air passengers, the competitive cost for bus and car travelers, and the much improved frequency, capacity, and reliability of the rail service) was not envisaged in the appraisal forecasts and will have been a significant factor in the underestimation.

### **Project Investment**

11. The estimated cost of the project infrastructure at appraisal was CNY 82.2 billion (US\$12.3 billion) at 2007 prices (net of EMU trainsets and excluding interest during construction). The final cost of the project is estimated at CNY 90.7 billion, CNY 8.5 billion more than at appraisal (in current prices). Considering the estimated time profile of disbursement, this is equivalent to a cost at 2007 prices of CNY 82.6 billion.

12. The initial cost of the train-sets is not explicitly included in the evaluation but is incorporated in the above-rail train operating cost as an equivalent annual cost.

### **Project Benefits**

13. Three main groups of potential benefits were considered at appraisal:

- A major reduction in travel time and distance for the traffic diverted to the new line, thereby generating significant operating cost savings to the railway and time savings for passengers and freight. Service frequency would also be greatly improved, with services operating at least hourly as opposed to the existing services which effectively were twice each day.
- Freeing up capacity on the existing lines would allow them to handle the projected increase in freight traffic, which would otherwise travel by road or not at all.
- Wider economic, social, and environmental benefits. Although some of these benefits are included as part of the CBA, a significant component is not. For example, the GuiGuang line would provide a quantum improvement in accessibility between its catchment and the Pearl River delta region and thus increase the competitiveness of the regional economy, accelerate the adoption of innovative practices, and stimulate its economic growth, all of which fall outside the conventional benefits directly linked to transport operations.

### *Time Savings*

14. At appraisal, the new line was expected to save the average rail passenger more than 20 hours compared to the existing timetable. The equivalent of a further 2.5 hours was included to represent benefits due to the much improved service frequency, based on the U.K. Passenger Demand Forecasting Handbook assumptions for intercity passengers. This time saving was valued at appraisal using a weighted average income per head of forecast passengers of CNY 1,600/month or CNY 10/hour (2007 prices), based on 2002 onboard surveys of rail services in the region, adjusted for subsequent income growth. Business and non-business travelers were valued at 100

percent and 35 percent, respectively, of this average income and the business/non-business mix was taken at 35:65, again based on the onboard surveys.<sup>11</sup> This gave an average value of time savings in 2007 of CNY 5.78 per hour (US\$0.84), which was forecast to increase in line with the expected growth in average income per head.

15. The improved level of service was expected to attract passengers from other modes, especially from Guilin which only had a circuitous rail service to Guangzhou, as well as generating additional trips by providing greater opportunities for potential passengers to travel (for example, it would be easily possible to make a day return trip between Guangzhou and Guilin, something which at appraisal was impossible to achieve by any mode other than air). This trip transfer would create user benefits as well as, in most cases, reducing both operating costs and externalities.

16. Diverted and generated traffic, calculated as part of the demand forecast, was allowed benefits calculated at 50 percent of the increase in user surplus to base traffic, as provided by the ‘rule-of-a-half’. The associated operating cost savings for traffic diverted from other modes was calculated using average operating costs derived from user surveys and highway cost studies (for road) and from the assumed operating cost component of air fares of 85 percent.

17. The forecast time saving has been borne out in practice, with the all-EMU services saving about 15 hours for the trip between Guiyang and Guangzhou. Frequency benefits are estimated as equivalent to a further two hours of travel time. The average income of passengers, based on the March 2015 onboard survey is CNY 6,070/month or CNY 37.94/hour. The business/non-business mix from the survey was 40:60, with travel to and from work (including migrant labor) being treated as business,<sup>12</sup> giving an average value of time savings of CNY 21.91/hour (US\$3.50).

#### *Distance Savings*

18. The value of distance savings at appraisal was based on the estimated resources (loco-km, carriage-km) saved, combined with 2007 unit costs. Savings for passengers transferring from air and road (estimated as 7 percent and 12 percent respectively of the opening volume) were based on the estimated operating costs of buses and air. At appraisal, the project was part of a general improvement of the link between Sichuan/Chongqing and Guangzhou and therefore contributed to benefits for trips made over much longer distances (for example, Pearl River delta region to Chengdu). For such trips, the project was credited with a share of such benefits in proportion to its distance relative to that of the total trip.

19. The re-evaluation has adopted the same approach, using estimated 2015 unit costs. Table 3.2 compares these with the appraisal unit costs adjusted for inflation.

Table 3.2. Estimated Unit Costs - Appraisal and Current (CNY/Passenger-km 2015)

Mode	Appraisal	Current
Conventional rail	0.07	0.20
EMU	0.07	0.20
Air	1.04	0.70

<sup>11</sup> On-board surveys in 2002 gave a mix of 44:56; this was assumed to reduce to 35:65 by 2015.

<sup>12</sup> Based on interviews with passengers, who stated that the train enabled them to return to work faster and thus earn more.

Mode	Appraisal	Current
Bus	0.47	0.35
Car		0.50

20. The large increase in estimated rail operating costs reflects the general increase of costs in the sector; between 2007 and 2014, the cost per traffic unit<sup>13</sup> increased from CNY 0.095 to CNY 0.178, an increase of 90 per cent over a period when inflation was 17 percent. This evaluation was also initially undertaken before there had been any significant experience with operating EMUs under Chinese conditions and the operating cost in retrospect was underestimated by about 25 percent. However, this did not have a major impact on the evaluation as the key input is the difference between EMU costs and other modal costs, and this was overstated to a much lesser degree, by about 10 percent at most. Aviation costs have reduced with the growth of budget airlines, while bus and car costs have been reasonably stable (although the appraisal road cost was weighted toward bus).

### *Freeing Up Capacity*

21. At appraisal, transferring passenger operations to the new line from the existing network was expected to provide additional capacity for freight (which would otherwise have slower transit times or, if a route is saturated, be forced to be transported by road or not travel at all). The most heavily used alternative route was from GuiGuang to Zhuzhou. At appraisal, this route was expected to be paralleled by a high-speed line from Changsha to Kunming, but only after the GuiGuang line had been in operation for 10 years. The potential reduction in congestion on this line was originally allowed for in the economic analysis by including a benefit, on a per train basis, that was credited to the project.

22. In practice, the Changsha-Guiyang line was completed and opened at end-2016. It is currently carrying 44 pairs of passenger trains daily. Although exact figures will not be available until the end of 2017, previous experience suggests that at least one-third of the passengers on the new line will have transferred from the conventional line, probably equivalent to 15 pairs of trains. This capacity is now available for freight trains. As the potential capacity provided by passengers from Guiyang transferring to the GuiGuang line is only about one pair of trains daily, this potential benefit has thus been overtaken by events and has been excluded from the reevaluation.

### *External and Environmental Benefits*

23. The external benefits calculated at appraisal include the reduction in road construction cost, accidents and congestion, vehicle emissions (net of the change in rail emissions), and changes in GHGs. These were all valued using standard unit costs adjusted to Chinese conditions. GHG emissions were valued at US\$29 per ton.

24. The reevaluation adopted the same values for these benefits, updated to 2015 prices, except for GHG benefits. The economic value put on CO<sub>2</sub> avoided is taken as US\$30/ton (2015 prices) in 2015, increasing over time to US\$80/ton, consistent with values used in World Bank project evaluations.

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<sup>13</sup> The sum of passenger-kilometers and net ton-kilometers.



### *Wider Economic Benefits*

25. A transport project that makes a step change in travel costs and times between regional economic centers (such as the GuiGuang Railway) is expected to yield significant impacts through bringing companies closer together in travel time and distance. Broadly speaking, the impacts can be classified as the following:

- Direct impacts on companies as they make their individual decisions based on considerations of profits and costs. These are already largely accounted for in the CBA of passenger and freight traffic (for example, through travel time savings).
- Externalities. The reductions in distances and travel times enable the companies to share input and output markets and to enjoy knowledge spillovers; this produces positive externalities in the form of agglomeration. However, infrastructure building and traffic produce negative environmental effects. The CBA usually includes the environmental effects but excludes agglomeration effects.

26. Agglomeration effects are excluded from conventional CBA as most companies decide where to locate/expand on the basis of their own profits and costs rather than the impact of their location upon profits/costs of others. However, in areas with improved transport, an increasing number of companies become more closely connected and this is known to generate agglomeration economies. Such agglomeration brings benefits to all companies in the cluster. Therefore, if a transport project makes a company locate or expand in a given area, the CBA will capture the benefits to the company through direct cost and time savings but will not include potential efficiency gains which arise from that decision but which accrue to other companies in the cluster.

27. Interviews with planners and businesses in March 2015 showed that many local businesses along the GuiGuang corridor had already formulated their commercial plans to exploit the complementarity of local industrial activities to those in the Pearl River Delta and Guangdong businesses had already made many linkages with GuiGuang businesses, bringing expertise as well as financial support for expanding and new business activities. The gains and losses of each region to a significant extent depend on local circumstances, such as industry clustering, local resources, labor supply, entrepreneurship, and governance, but the field work indicated significant potential benefits arising from the agglomeration effects.

28. Although these benefits are intrinsically difficult to quantify, at appraisal they were estimated using an approach developed by the United Kingdom Department for Transport for use in a number of road and rail projects in the United Kingdom, based on the concept of economic mass. This was applied to the GuiGuang Railway Project to demonstrate the potential magnitudes of the effects. At the time, there were no specific Chinese parameters which could be used and the analysis instead used parameter values imported from the U.K. studies. Subsequent work, however, on the impact of expressways on regional development in Guangdong has confirmed the general reasonableness of these values.

29. The estimated agglomeration effects included three geographic areas within Guizhou Province (Guiyang, southern Guizhou, and southeastern Guizhou [Guilin]). Of these, Guiyang

contributed about 70 percent of the total benefits even though it had an air service but its road and rail links remained poor in the absence of the project.

30. As rail services had only been operating for six months at the time of the interviews in 2015, and only for two years even now, these benefits cannot be quantified at present and it will take three to four years before their impact becomes fully apparent. Nevertheless, the interviews which were conducted with local authorities along the line during supervision missions in 2015 indicated a strong belief that the improved service and strengthened economic linkages with the Pearl River Delta and that these linkages were having significant flow-on effects throughout the local economy.<sup>14</sup> For the reevaluation, the benefits estimated at appraisal have been retained, updated for inflation. However, the comparison of the reevaluation with the appraisal considers the return both including and excluding these wider benefits.

### Economic Rate of Return

31. At appraisal, the project was expected to yield, during 30 years of operation, an NPV of CNY 90 billion<sup>15</sup> (2007 prices discounted at 12 percent to the first full year of operation in 2015) and to achieve an EIRR of 16 percent.

32. The reevaluation estimates an NPV of CNY 128 billion (2015 prices discounted at 12 percent to 2015) and an EIRR of 17 percent. The corrected appraisal NPV on the same basis is CNY 108 billion.

33. Table 3.3 compares the distribution of costs and benefits in the appraisal evaluation and ICR reevaluation.

Table 3.3. Comparison of Costs and Benefits at Appraisal and at ICR (CNY, billions 2015)  
(Discounted to 2015 at 12 percent per year)

		ICR	Appraisal	Difference
Construction		-138.9	-138.9	0.0
Train operations		6.3	4.0	2.3
Infrastructure maintenance		-7.7	-5.7	-2.0
Time savings	Passengers on existing rail	34.2	52.0	-17.8
	Other passengers (induced and generated)	32.1	7.8	24.3
Other mode operations	Air	12.5	7.2	5.3
	Bus	3.6	3.1	0.5
	Car	2.2	0.0	2.2
Road construction		0.1	0.2	-0.1
Avoided delays		0.0	0.0	0.0
Road accidents		0.1	0.2	-0.1
GHG		6.0	0.5	5.5
Agglomeration		177.9	177.9	0.0

<sup>14</sup> Some of these are summarized in <http://www.worldbank.org/en/news/feature/2015/05/19/a-look-at-the-impact-of-chinas-guiguang-and-nanguang-rail-lines-through-the-media-lens>.

<sup>15</sup> Reexamination of the appraisal calculations has shown an error in the NPV, which should have been CNY 92 billion at 2007 prices, but with the EIRR remaining at 16 percent. The corrected benefit, updated to 2015 prices, has been used in the comparison tables.

		ICR	Appraisal	Difference
Total		127.8	108.1	19.7

34. The principal contributors to the improved economic result are the increase in the net passenger-related benefits associated with the higher value of time (CNY 6 billion), together with net operating benefits across all modes of CNY 8 billion and the improved GHG contribution (CNY 5 billion).

35. The passenger-related benefits are due to the 90 percent increase in the value of time.<sup>16</sup> In retrospect, the value of time used at appraisal was clearly too low, by at least 30 percent, being a casualty of the extended project preparation, with successive iterations extending over a three-year period.

36. The differences in operating costs are caused by the changes in the modes previously used by passengers now using the new line. The increase in train operating savings is due to the general increase in real rail operating cost, which translates into absolute cost savings because of the saving in distance on the new line.

37. The increase in GHG benefits is primarily caused by the changed Chinese policy regarding coal-based generation, which reduces electricity-related emissions by over 60 percent as the result of more non coal-generation and improved efficiency in the remaining coal-fired plants. This is offset to some extent by the greater proportion of generated passengers compared to appraisal, who in the ‘without project’ case do not travel and hence do not create any GHG emissions.

38. If agglomeration benefits are excluded, the EIRR at appraisal becomes 9 percent with an NPV of CNY –70 billion. The reevaluation also gives an EIRR of 9 percent but with a lower NPV discounted at 12 percent per year of CNY –50 billion.

**Financial Analysis**

39. The line is owned by a project company, although the former MOR (now CRC) was formally responsible for implementing the project, mobilizing the financing, and repaying all borrowed funds. The project was financed using 50 percent of equity obtained from the project company partners, loans obtained from domestic banks (China Development Bank) and from the World Bank, and bonds raised in China, amounting to CNY 40 billion (US\$7 billion) in total (2015 prices). Of this, US\$300 million was funded by the World Bank loan.

40. At appraisal, it was expected that the project company would be ultimately responsible for the maintenance and operation of the line, although in practice the actual functions would be subcontracted, with the RAs operating the trains under contract with infrastructure maintenance also contracted to them or to third parties. It was expected that the RAs would own the train-sets and receive all revenue earned on the services.

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<sup>16</sup> This is balanced to a considerable extent by the shift in passenger mix from those diverted from existing rail services, whose time savings are valued at their full value, and those diverting from other modes as well as those generated, whose time savings are valued using the ‘rule-of-a-half’.

41. This model has been implemented on several of the new HSR lines but in the case of GuiGuang, an alternative business model has been implemented in which the project company is essentially an infrastructure manager, receiving access fees for use of its network and stations by third parties and contracting third parties for infrastructure maintenance and operation.

42. The access fees are set on a national basis and cover both usage of the infrastructure (currently CNY 70 per train-km for an 8-car set on a 250 km/h line such as GuiGuang) and the use of railway stations (currently CNY 5 per departing passenger at a major station). The train operating company also has to pay for the traction electricity at a rate (on GuiGuang) of CNY 53,000 gross ton-km.

43. Against this, the company is responsible for the maintenance and operation of the infrastructure and stations, which in the case of GuiGuang is contracted to the local RAs. As the line has only been open for two years, maintenance to date has largely consisted of inspections. There is little experience of what lifetime average costs might be but estimates for this type of line of CNY 1 million per route-km are generally considered to be reasonable.

44. At appraisal, the general expectation was that existing services would be withdrawn once the high-speed services commenced, with the conventional services only serving intermediate towns by-passed by the high-speed lines. Unit revenues were assumed to be CNY 0.22 (CNY 2007) per passenger-km in 2015, increasing to CNY 0.32 (CNY 2007) per passenger-km in 2020, compared to the 2007 average level of CNY 0.13<sup>17</sup> (US\$0.016) per passenger-km.

45. In practice, CR found it difficult to withdraw as many conventional services as it wished and these have in general been retained, although generally at lower frequencies than previously. However, they are now able to charge around CNY 0.30 (CNY 2015) per passenger-km on the GuiGuang services, equivalent to about CNY 0.25 per passenger-km (CNY 2007). The current tariff undercuts bus tariffs by about 15 percent and is typically under half the cost of competing air services.

#### *Financial Analysis of the Line as a Whole*

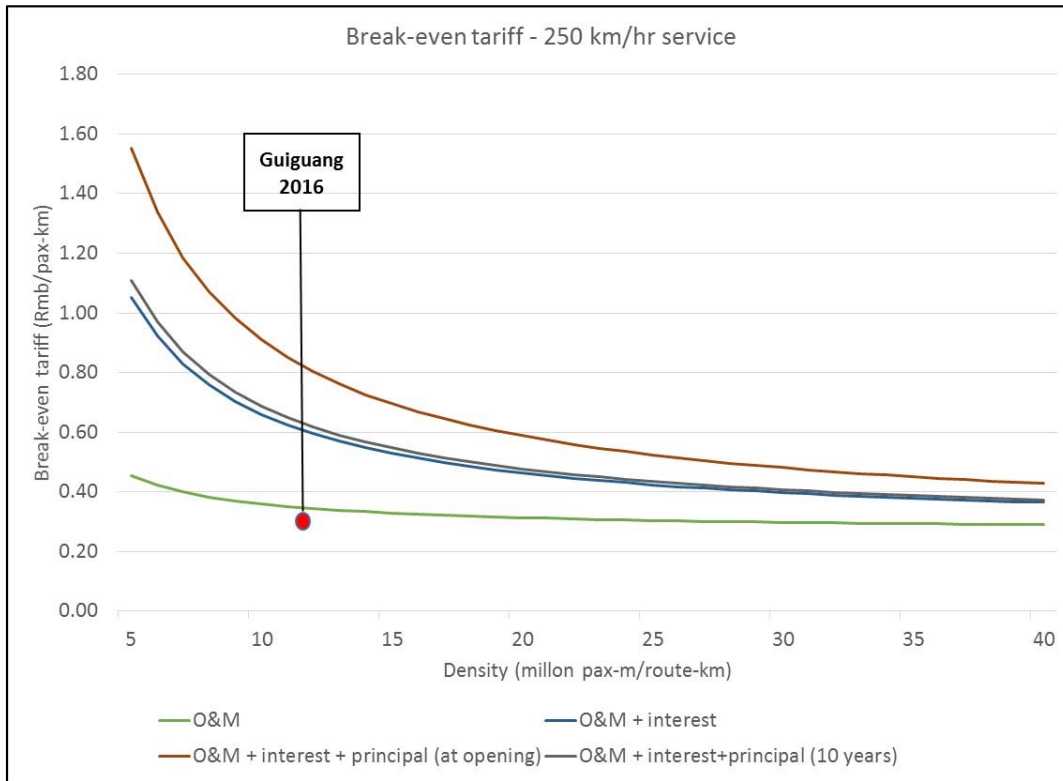
46. GuiGuang (or the RA operating its services) can, like most 250 km/h lines, cover its operating costs of around CNY 0.20 per seat-km from its average yield of CNY 0.31 per passenger-km. However, even though it has a load factor (passenger-km/seat-km) of over 80 percent, to cover its expected maintenance cost of around CNY 1 million per route-km, it requires a passenger density of about 15 million per route-km. Although GuiGuang has not achieved that to date, it is well on the way and will almost certainly do so once the Guiyang-Chongqing section is opened in 2018. The next target is to be able to repay interest charges. GuiGuang had about CNY 40 billion of debt at end-2015, on which it is paying interest at 5.4 percent; the annual interest bill is thus about CNY 2.21 billion. This can be paid as long as it is paid before considering any payment for infrastructure maintenance. The GuiGuang Company, in common with other smaller HSR lines, is likely to pay the interest on the debt and then negotiate any payment for infrastructure maintenance between itself and the local RAs, who are also shareholders in the GuiGuang

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<sup>17</sup> Although tariffs were up to double this rate for the higher-standard accommodation.

companies. When repayment of the principal begins in 2017, GuiGuang will have no option but to restructure its debt.

Figure 3.1. Breakeven Tariff for the GuiGuang Line as a Whole

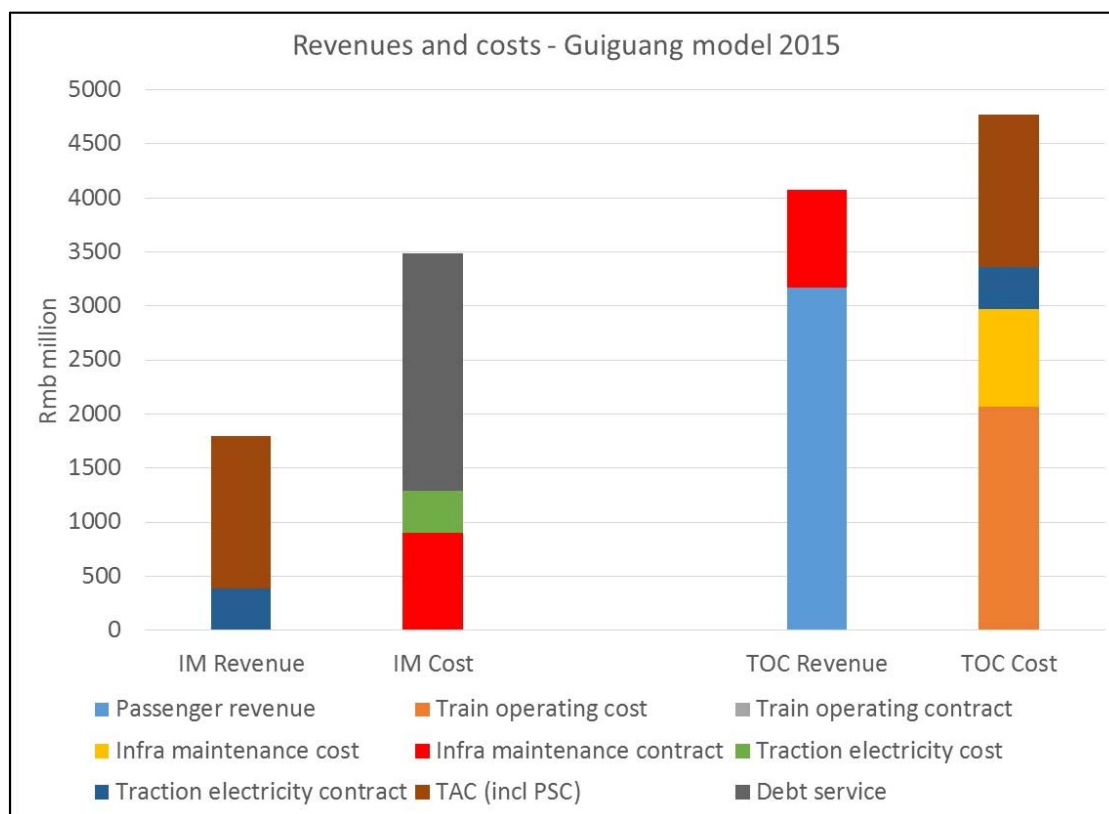


47. At its current volume, GuiGuang can pay for the operation of the services and maintenance of the infrastructure. However, it is only likely to be able to also finance debt service by 2025–2030, by which time volume will have increased and thus its gross margin over operating costs also increased. In the meantime, the shareholding RAs will probably have to absorb the cost of maintaining the GuiGuang infrastructure from their other operations.

*Financial Analysis of the GuiGuang Company*

48. The financial positions of the GuiGuang Company and the train operating companies using the infrastructure is summarized in Figure 3.2.

Figure 3.2. Financial Position of GuiGuang Company and Train Operating Companies (2015)



Note: IM = Infra Maintenance; PSC = Passenger Cost; TAC = Track Access Cost; TOC = Train Operating Company.

49. The company has two sources of income—track access fees and payment for traction electricity—which it uses to pay the electricity company. The access charges will be more than enough to pay the cost of maintaining the infrastructure after the initial years but nowhere near enough to pay the debt charges when they begin in full.

50. The RAs, as the train operating companies, earn revenue from passengers which covers train operating and traction electricity costs but is not enough to cover the cost of the track access charges. The RAs, as maintenance and train control contractors, earn revenue from this activity but it is balanced by the corresponding expenditure that they incur. As demand increases, the balance between revenue and expenditure will improve, as the access charge for a 16-car train is about 50 percent greater than for an 8-car train, while the passenger capacity is double.

51. While the long-term outlook for the GuiGuang company is promising, given its strong initial demand which will increase as the feeder routes to/from Sichuan, Chongqing, and toward Kunming are expanded, its short-term outlook will require renegotiation of the principal repayments of its loans as well as cross-subsidy by the local RAs of the maintenance and train control that they perform.

## Appendix. Assessment of GHG Benefits

1. A full analysis of GHG emissions in transport needs to consider emissions during construction of both the infrastructure and rolling stock, emissions during operation (mostly traction power), and emissions during disposal of the replaced equipment and infrastructure. This section assessment concentrates on emissions during operation, which are principally concerned with emissions related to the relative consumption of fuel and energy by HSR services compared to that of the modes from which passengers have been diverted (conventional rail, air, bus, car, and so on). Rail can be one of the most energy-efficient passenger modes but this depends on a range of factors such as the speed of the train, the weight of the rolling stock, and the passenger occupancy.

2. The analysis concentrates on CO<sub>2</sub> emissions. Although there are other gases contributing to GHG, these are not significant in analyzing rail operations, typically adjusting the impact of CO<sub>2</sub> alone by only 0.5 percent, and have not been considered in this table. The only exception is water vapor associated with radiative forcing in the upper atmosphere, associated with aviation and this has been allowed for in the analysis.

3. As both the conventional and high-speed rail services are powered by electricity, an essential first step is to establish the CO<sub>2</sub> emissions per kilowatt-hour for electricity generated in China. These have been derived from the fuel mix at power stations and the coal burn required per kWh (table A1.1; this table also gives an estimate for 2045 allowing for possible changes in fuel mix and efficiency).

Table A1.1. Estimated CO<sub>2</sub> Emissions per kWh from Electricity Generation 2015–2045

	2013		2045	
	% generation	Kg CO <sub>2</sub> /kWh	% generation	Kg CO <sub>2</sub> /kWh
Coal	74	1.39 <sup>(1)</sup>	35	1.00
Hydro	17	0.00	15	0.00
Nuclear	2	0.00	6	0.00
Solar/wind	3	0.00	30	0.00
Other (oil/gas)	4	0.50	14	0.50
Average	—	1.05	—	0.42

*Note:* Chinese coal assumed as 5,000 BTU/ton; includes transmission losses assumed at 7 percent.

4. The energy consumption for each mode has been taken from standard sources. The basic fuel consumption by rail mode has been derived from operational data and the road-based fuel consumption and occupancies per vehicle-km from local data and surveys. Rail energy consumption considers the terrain and operating speed of the two types of operation. Air fuel consumption is based on a 150-seat aircraft operating at 80 percent load factor for a flight of 750 km. The weighting factor of 2 applied to air travel is to allow for radiative forcing caused by water vapor in the upper atmosphere. The GHG emissions per liter of fuel are standard numbers (Table A1.2).

Table A1.2. Emissions per Passenger-km by Mode, 2015

	Fuel consumption	Gtk/pkm	Energy/km	Kgs CO <sub>2</sub>		Factor	Weighted kg/pkm
	kWh/1,000 gtk		Wh	Per kWh	Pkm		
HSR	40	0.80	0.032	1.05 <sup>(1)</sup>	0.033		0.033
Conventional rail	16.5	1.22	0.020	1.05	0.021		0.021
	Lt/vkm	Pkm/vkm	Liter	Per liter			
Bus	0.30	35	0.009	2.63	0.023	1	0.023
Air	3.75	128	0.030	2.52	0.076	2	0.153
Car	0.08	2	0.040	2.30	0.095	1	0.095

5. Over time, power station emissions per kWh will reduce as the less-efficient power stations are phased out and as the energy mix becomes more broad-based. Fuel efficiency for petroleum-based modes will continue to improve; a reduction of 20 percent in unit fuel consumption for these modes over the period has been assumed. Table A1.3 gives parallel figures for 2045 based on these assumptions.

Table A1.3. Emissions per Passenger-km by Mode 2015 and 2045

	Weighted kg/pkm	
	2015	2045
HSR	0.033	0.013
Conventional rail	0.021	0.008
Bus	0.023	0.019
Air	0.153	0.118
Car	0.095	0.076

6. The sources of the 'with project' passenger demand are given in Table 1. The impact of these changes is summarized in table A1.4.

Table A1.4. Estimated Change in GHG Emissions 2015 (1,000 tons)

Mode	Kg eCO <sub>2</sub> /pkm	2015		Kg eCO <sub>2</sub> /pkm	2045	
		Pkm (billions)	Thousand tons eCO <sub>2</sub> per year		Pkm (US\$, billions)	1,000 tons eCO <sub>2</sub> per year
Conventional rail	0.021	1.2	26	0.008	3.8	33
Bus	0.023	2.4	367	0.019	7.4	906
Air	0.153	1.9	45	0.118	5.9	111
Car	0.095	0.6	55	0.076	1.8	136
Generated	—	3.5	—		10.7	—
Total			493			1,185
CRH 250	0.033	9.6	322	0.013	29.6	787
Difference			171			398

7. These tonnages have been converted into money terms in the economic evaluation using an economic price for GHG in 2015 of US\$30 per ton, increasing to US\$80 per ton (in real terms) by 2050.



## Annex 4. Bank Lending and Implementation Support/Supervision Processes

### (a) Task Team Members

Names	Title	Unit	Responsibility/Specialty
Lending			
John Scales	Senior Transport Specialist (Task Team Leader)	EASCS	Team Leader
Lei Wu	Program Assistant (Beijing)	EACCF	
Malou Juico	Program Assistant (Washington)	EASTE	
Juan Quintero	Senior Environmental Specialist	EASRE	
Ning Yang	Environmental Specialist	EASCS	
Peishen Wang	Environmental Specialist	Consultant	
Chaohua Zhang	Senior Social Sector Specialist	SASDI	
Songling Yao	Social Sector Specialist	EASCS	
Jianjun Guo	Procurement Specialist	EAPCO	
Yi Geng	FM Specialist	EAPCO	
Jit Sondhi	Railways Engineering and Management Advisor	Consultant	
Richard Bullock	Railway Economic & Financial Evaluation Advisor	Consultant	
Paul Amos	Transport Policy Advisor/Railway Specialist	Consultant	
Syed Ahmed	Legal Counsel	LEGES	
Jorge Rebelo	Peer Reviewer - Railway economics	LCSTR	
Martha B. Lawrence	Peer Reviewer - Railways	ECSSD	
Supervision/ICR			
Martha B. Lawrence	Task Team Leader	GTI06	Team Leader
Gerald Paul Ollivier	Co-Task Team Leader	GTI02	Co-Team Leader
Jianjun Guo	Senior Procurement Specialist	GGO08	
Yi Geng	Senior FM Specialist	GGO20	
Songling Yao	Senior Social Development Specialist	GSU02	
Ruifeng Yuan	Program Assistant	EACCF	
Lei Wu	Program Assistant	EACCF	
Maria Luisa G. Juico	Program Assistant	GTI02	
Nanyan Zhou	Consultant		
Ning Yang	Senior Environmental Engineer	GEN2A	
Shaojun Chen	Consultant		
Jit Sondhi	Engineer-Consultant		
Peshan Wang	Environmental Specialist		
Romain Pison	Transport Specialist	GTI02	
Fatima Arroyo Arroyo	Urban Transport Specialist	GTI07	

Names	Title	Unit	Responsibility/Specialty
Laure Elisabeth Anne Fran Albinet	Temporary	GTI02	

(b) Staff Time and Cost

Stage of Project Cycle	Number of Staff Weeks	US\$, thousands (Including Travel and Consultant Costs)
<b>Lending</b>		
FY08	17.41	163.99
FY09	36.22	316.03
<b>Implementation/ICR</b>		
FY10	13.18	109.97
FY11	13.69	83.74
FY12	10.17	107.40
FY13	10.90	91.05
FY14	4.81	69.21
FY15	5.88	70.68
FY16	4.59	58.52
FY17	2.40	23.14

## **Annex 5. Beneficiary Survey Results**

### **Introduction**

1. Two HSR projects, supported by World Bank loans, were completed and went into operation at the end of 2014: the GuiGuang line between Guangzhou and Guiyang, a PDL with a top speed of 250 km/h, and the NanGuang Railway between Guangzhou and Nanning, a mixed-traffic line for passenger services (top speed 200 km/h), and freight trains (at speeds of up to 100 km/h).

2. Onboard passenger surveys were conducted on these two services about three months into their operations. The surveys provide a first picture of the passenger profiles and the findings are summarized here under three main headings: (a) socioeconomic characteristics of the passengers and their purposes of travel, (b) access to and from the stations, and (c) impacts on travel patterns. The results are compared with two similar surveys undertaken in 2013 on high-speed lines between Changchun and Jilin and between Tianjin and Jinan.

### **Line Description**

3. GuiGuang HSR has 857 km of double-track from Guiyang North Station to Guangzhou South via Guilin in Guangxi Province. This line crosses a mountainous area through a karst landscape. Over 23 percent of the line consists of bridges and viaducts, and about 54.5 percent is in tunnels. There are eight stations in Guizhou Province, eight in Guangxi, and six in Guangdong. The line opened on December 26, 2014. There were on average 10 pairs of trains between Guiyang and Guangzhou every day, and 24 pairs between Guilin and Guangzhou from March 2015. Only one pair of non-stop trains travel between Guiyang and Guangzhou with the quickest travel time of 249 minutes. The others stop at three to eight stations in between, with an average travel time of 322 minutes. The planned station for Yangshuo (which is one of the most popular tourist destinations in China) was not yet open when the survey was conducted. Neither were the smaller Wutong and GuilinXi Stations. Demand for January–March 2015, as estimated by the GuiGuang Rail Company, was an average of 53,000 passengers per day (which implies around 19 million per year). Most trains were completely full all the way and in many cases there were standing passengers for up to 10 percent of seating capacity.

4. The ticket fare between Guiyang and Guangzhou is CNY 313 for first class and CNY 261 for second class. It used to take 17 hours by bus and 21 hours by conventional train (on a different, circuitous rail route) with similar levels of fares, compared with the travel time now by HSR train of 4–5.4 hours. Bus services between Guilin and the cities along the corridor have been reduced sharply, with most long-distance services being canceled. Air fares have been discounted significantly, with the air fare now becoming lower than train tickets. Moreover, direct flights from Guiyang to Guilin (420 km) have been canceled.

### **The Onboard Surveys**

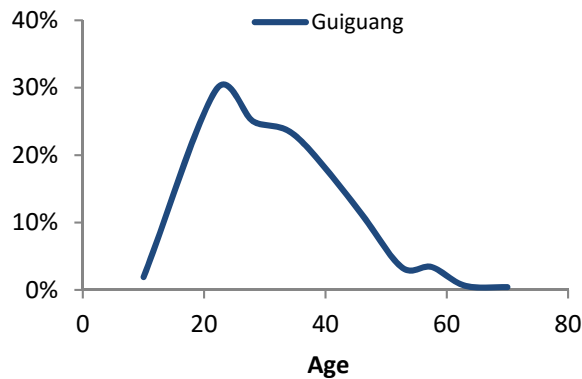
5. On the GuiGuang line, 467 interviews were carried out on 12 trains: this includes the earliest train from Guangzhou on both weekend and weekdays and return trains from Guiyang in the afternoon or evening. The same applied for Guiyang to Guangzhou services. Surveys were also conducted on the first and last trains from Guilin to Guangzhou.

6. Surveys were undertaken on Mondays and Fridays, together with another weekday. Interviews were also undertaken on Saturdays. The following sections show the 12 trains selected and interviews obtained on each train.

### Socioeconomic Characteristics and Trip Purpose

7. The predominant group of passengers was between the ages of 19 and 40 years, accounting for about 80 percent of the total passengers. Men accounted for approximately 64 percent of passengers and women 36 percent.

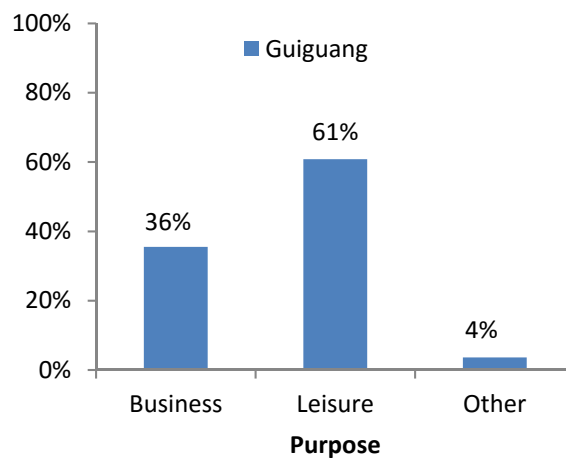
Figure 5.1. Age Distribution of Passengers



8. From the results of the passenger survey, the female passengers tend to be younger and with lower income. Travelling for leisure accounts for a larger proportion for women’s trip purpose (76 percent) than men’s (55 percent).

9. The GuiGuang line is famous for its attractive tourist destinations along the corridor, so it is not surprising that a large portion (61 percent) of passengers were travelling for tourism and leisure. Business trips thus only accounted for 36 percent on GuiGuang HSR.

Figure 5.2. Trip Purpose



10. The survey results indicated that the high-speed rail services were used by a broad range of income levels, with over 40 percent of travelers with an average monthly income of CNY 4,000 or lower (figure 5.4). On the line, the average self-reported monthly personal income was around CNY 5,900. As expected, people in the 30–55 age group have the highest average income.

Figure 5.3. Monthly Income (CNY) (Income by Line)

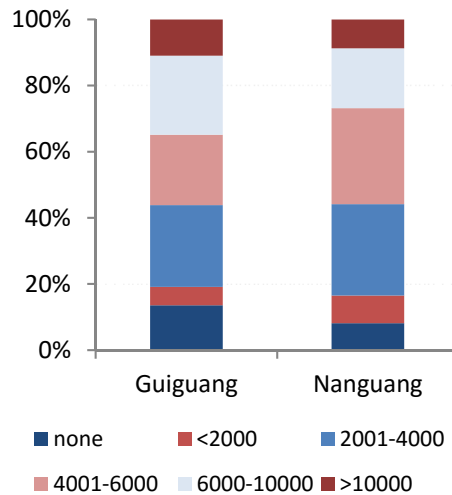
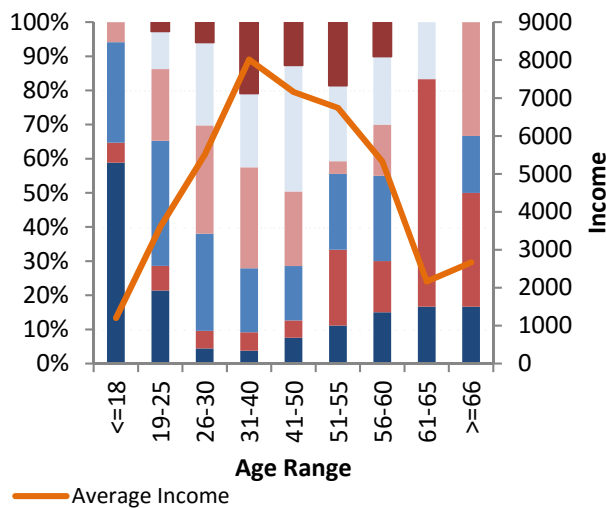
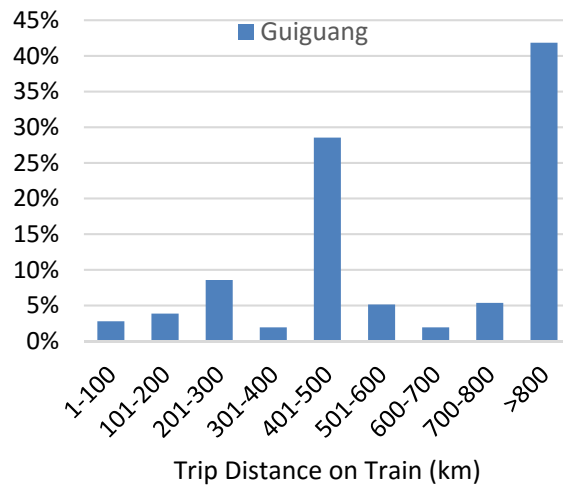


Figure 5.4. Monthly Income (CNY) (Income by Age)



11. Many of the passengers are travelling between the main centers. On GuiGuang, 41 percent of those interviewed were travelling all the way between Guiyang and Guangzhou, possibly influenced by the high proportion of tourists to Guiyang, the limited number of trains stopping at intermediate stations, and the difficulty of obtaining tickets for impromptu travel (Figure 5.5).

Figure 5.5. Travel Distance Distribution



### Impact on Travel Patterns

12. The survey asked passengers if they would still have undertaken the trip if the HSR service had not been there. About 36 percent of the passengers on GuiGuang said that they would not have undertaken the trip. Most of these passengers were on personal travel, with tourism as the main trip purpose on GuiGuang line (Figure 5.7). HSR also stimulated new business travel, in line with discussions with cities along the line. One reason business trips were low on the GuiGuang line was the shortage of tickets. The travel agencies had to book tickets well in advance, while businessmen could not get tickets when they needed them.

Figure 5.6. Trip Purpose for Generated Traffic

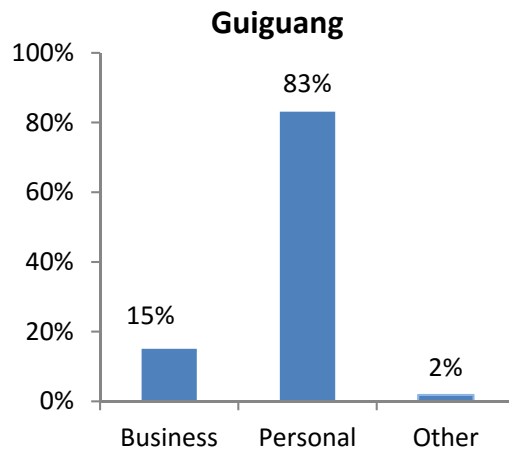
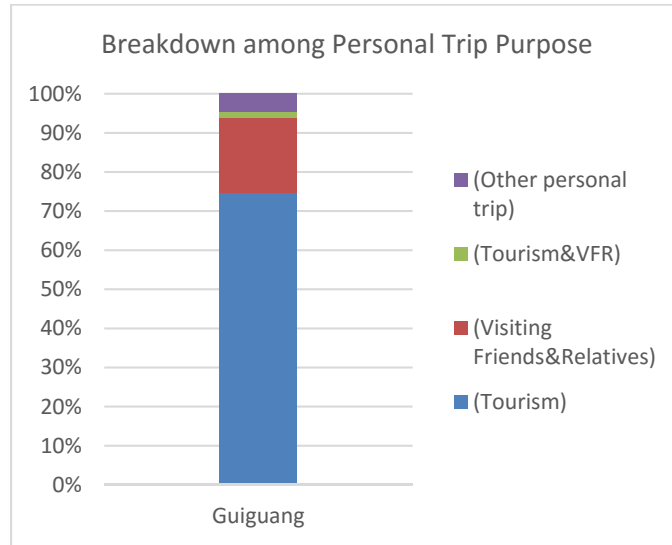


Figure 5.7. Trip Purpose for Generated Traffic (Breakdown among Personal Trip Purpose)

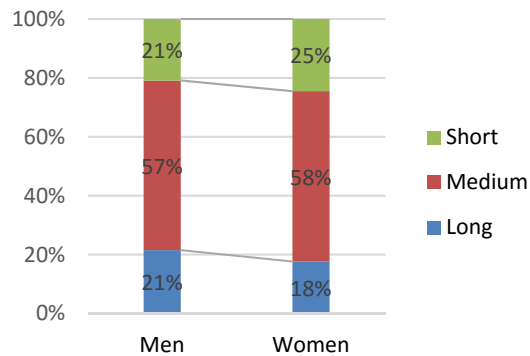


13. Women are more likely to be new travelers than men. On the GuiGuang Railway survey, 45 percent of female interviewees were new travelers, while only 30 percent males were new travelers who would not travel without the GuiGuang Railway.

14. Though, in general, men account for approximately 64 percent of passengers and women 36 percent of this survey, the gender difference is less for generated traffic, with 55 percent men and 45 percent women. For all transferred business travelers who would travel by another mode if there were no HSR, men are the dominant group (about 73 percent).

15. The results also show that men tend to take longer trips (figure 5.8).

Figure 5.8. Trip Distance by Gender

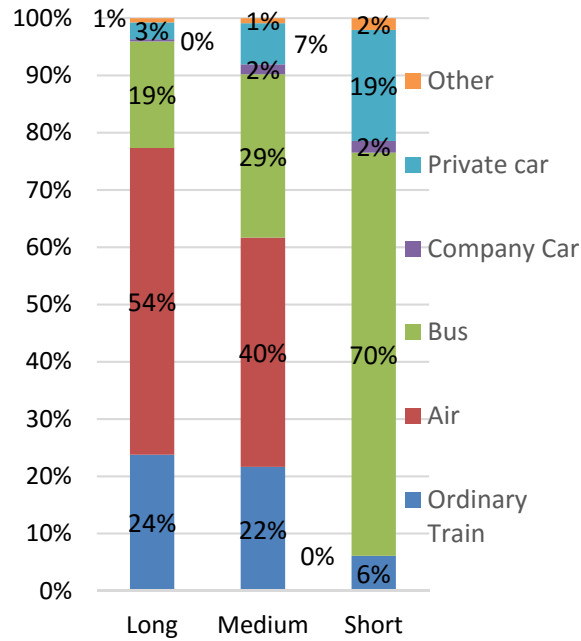


16. If HSR did not exist, 64 percent of the passengers on GuiGuang and 82 percent on NanGuang would still have travelled. On the Guiyang-Guangzhou corridor, over 70 percent of short-distance passengers would use the bus, and 19 percent would choose private car; air was the main alternative mode for medium- and long-distance trips.

17. The survey also asked if the passenger had increased their travel frequency with HSR service by comparing travel frequencies on the route in 2014 with the planned trip frequency in

2015. Over three-quarters (76 percent) of passengers reported that more such trips will be taken in 2015 with an overall increase of 40–50 percent. While such statements of future intent are often unreliable, the responses indicate that the large increase in overall trip-making that has accompanied many HSR services is due to a combination of existing travelers making trips more frequently as well as completely new travelers.

Figure 5.9. Alternative Modes if the HSR Services Were to Stop Running for Nanning Guangzhou (top chart) and Guiyang Guangzhou (bottom)





## **Annex 6. Stakeholder Workshop Report and Results**

Not applicable.

## **Annex 7. Summary of Borrower's ICR and/or Comments on Draft ICR**

### **Project Background**

1. The project consists of the construction of a double-track electrified railway line from Guiyang in Guizhou Province to Guangzhou in Guangdong Province. The line is subdivided into two traffic lines: the line from Guiyang to Guilin (Guangxi Province) and the line from Guilin to Guangzhou. The loan also financed the acquisition and installation of goods (including communications, signaling and electrification equipment, and maintenance vehicles) and provision of related consulting services. Previously thought to ensure both freight and passenger traffic, the line was finally devoted for passenger traffic in 2013.

2. During the work period, the railway line was divided into three sections: from Guiyang North to Guilin, from Guilin to Zhaoqing East, and from Zhaoqing East to Guangzhou.

### **Route Overview**

3. CRC is responsible for the construction of the double-track electrified railway through all the sections in addition to the construction of 16 stations and the upgrading of 3 stations. There was no existing direct railway line from Guiyang to Guangzhou but three existing stations that were upgraded (Guyun, Guilin, Hezhou) as well as two stations constructed through independent projects. The first section, starting from Guiyang North (excluded), passes by Longli North station, Changming station, Duyun East station, Sandu station, Rongjiang station, Congjiang station, Sanjiang station, and Wutong station before arriving at Guilin West station. From Guilin West station, the second section of the line passes by Yangshuo station, Gongcheng station, Zhongshan West station, Hezhou station, Huaiji station, and Guangning station before arriving at Zhaoqing station where the third section starts. From there to Guangzhou station, the line passes by two stations—Sanshui South station and Foshan station.

4. The line is 847 km and contains 342 bridges and viaducts (length: 191 km; 22 percent of the line) as well as 233 tunnels (length: 472 km; 55 percent of the line). The railway was built as a PDL with a design speed of 250 km/h. The line serves 21 stations, of which 12 are overtaking stations.

### **Operation Goals, Design, and Implementation**

5. The project facilitated the development of the Pearl River delta region, improved its influence and coverage, and dramatically shortened distances among the region (travel time was divided by 6). The GuiGuang Railway line provides high-quality and relatively low-cost transportation service, enabling a much better connectivity to the inhabitants of the relatively poor provinces of Guizhou, Guangxi, Yunnan, and Sichuan with the Pearl River delta region.

6. From the kick-off operation of GuiGuang Railway, the units implemented the policies, regulations, rules, and mandatory standards relevant to the MOR. The main function and physical quality of specialty systems satisfied the design requirement and the safety and stability of the running of passenger trains met relevant standards.

## **Operation Goal**

7. Twenty-five- pairs of stopping trains operate daily between Guiyang and Guilin, and 36 pairs of trains operate daily between Guilin and Guangzhou. Besides, two pairs of trains operate between Guiyang and Guangzhou. Travel time has decreased from over 24 hours by conventional train to just over four hours.

8. The project was originally appraised as a 200 km/h mixed-use (passenger and rail traffic) line. While the line was being built for both passenger and freight traffic, the MOR made a decision to postpone the use of the line for freight transport. The reason why the MOR decided to change it to a passenger line only was the growing demand of passenger traffic. The MOR decided freight demand could accommodate on the original line a bit longer whereas the demand for passenger traffic was high enough to upgrade the line to a 250 km/h. Freight traffic was not, however, abandoned and should be introduced in the line as soon as the supply and demand for passenger traffic is more adequate.

## **Land Acquisition, Demolition, and Management**

9. As far as land acquisition and resettlement are concerned, the project differs from past World Bank-financed railway projects. Indeed, the MOR used to finance them indirectly through agreements reached with provincial authorities. In this project, the three provinces, Guizhou, Guangxi, and Guangdong, were principal shareholders in the project company, GuiGuang Railway Company, which is being established to eventually own the assets. Their equity contribution included a portion of the cost of land acquisition and resettlement. Hence, as opposed to an indirect relation to the project, as was the case in earlier World Bank-financed projects, the provinces are direct stakeholders, thereby increasing the incentive for appropriate performance and allowing closer M&E.

10. The project required substantial acquisition of land and structures and resettlement, including some in the congested urban areas of Guangzhou and Foshan. Land acquisition was achieved on time but implementation programs took one more year than was expected to be completed, and that is the reason why the closing date was extended by one year. Three implementation programs were led: Multiple Livelihood Funds and scheme in Guizhou, the project-related social security program in Guangxi, and reserved land or fees in Guangdong.

## **Evaluation of the World Bank Team**

11. The World Bank team provided a conscientious, flexible, and efficient support during the preparation and the implementation of the project. World Bank experts actively advised on technical issues in preparation and on construction challenges during the implementation.

## Annex 8. List of Railway Policy Briefs and Notes

The following Railway Policy Briefs and Notes are published by the Bank on China Railways. Also available at the [ImageBank](#) and [OpenKnowledge](#).

- High-Speed Rail: The Fast Track to Economic Development? 2010, by Paul Amos, Richard Bullock, and Jitendra Sondhi
- Railway price regulation in China: time for a rethink?, 2011, By John Scales, Gerald Ollivier and Paul Amos
- Governance and structure of the railway industry: three pillars, 2011, by Paul Amos and Richard Bullock
- China Rail Financial Futures Model, 2012
- Fast and Focused - Building China's Railways, 2012, by John Scales, Jitendra Sondhi and Paul Amos
- High-Speed Rail: the first three years taking the pulse of China's emerging program, 2012, by Richard Bullock, Ying Jin, Andrew Salzberg
- China: The environmental challenger of railway development, 2012, by Ning Yang, Juan D. Quintero and Peishen Wang
- High-Speed Rail, Regional Economics, and Urban Development in China, 2013, by Andrew Salzberg, Richard Bullock, Ying Jin, and Wanli Fang
- High-Speed Railways in China: A Look at Construction Costs, 2014, by Gerald Ollivier, Jitendra Sondhi and Nanyan Zhou
- High-Speed Railways in China: A Look at Traffic, 2014, by Gerald Ollivier, Richard Bullock, Ying Jin and Nanyan Zhou
- Regional Economic Impact Analysis of High Speed Rail in China, June 2014, Report No. ACS9734, the World Bank
- Attracting Capital for Railway Development in China, 2015, by Martha B. Lawrence, Gerald Ollivier
- High-Speed Railways in China: an update on passenger profiles, 2016, by Gerald Ollivier, Nanyan Zhou, Richard Bullock, Ying Jin, Martha B. Lawrence

## Annex 9. Summary of the Implementation of Supplemental Income Programs

As of May 2017, the implementation progress of the Supplemental Income Programs is as follows based on the report of the independent consultant hired by CRC:

### Guangxi Province

The social security funds for Guiguang Project in Guangxi are intended to be used for social security for the qualified affected. The funds were allocated to the municipal (prefecture) level by Guiyang-Guangzhou Railway Co., Ltd. on December 12, 2016, and to the fiscal and social security accounts of the counties by the end of 2017. The government is presently establishing accounts for the affected farmers, who are now in a position to complete the social security as soon as possible according to their choices and arrangement. See Table 2 for the implementation progress of all the counties in Guangxi.

Table 2 Implementation Schedule of Social Security Funds of the Counties in Guangxi

S/ N	Administrative region	Total social security funds (RMB million)	Availability date of social security funds	
			Municipal competent authority	Social security account of finance bureau
1	Sanjiang County, Liuzhou	20.75	Allocated to the account of the municipal land and resources bureau on December 12, 2016	January 20, 2017
2	Longsheng County, Guilin	9.25	Funds were allocated to the special account of the railway construction office of Guilin on December 12, 2016	March 28, 2017
3	Lingui County, Guilin	6.74		March 28, 2017
4	Lingchuan County, Guilin	3.7		March 28, 2017
5	Yangshuo County, Guilin	8.89		March 29, 2017
6	Gongcheng County, Guilin	11.00		March 28, 2017
7	Zhongshan County, Hezhou	12.07		Funds were allocated to the special account of the land and resources bureau of Guilin on December 12, 2016
8	Pinggui District, Hezhou	9.01	March 27, 2017	
9	Babu District, Hezhou	9.05	March 27, 2017	
	Total	90.46		

## Guangdong Province

The government of Guangdong requires that 10% of the area to be acquisitioned should be used for the production and development of affected villages. The total expenses required for the land reservation resettlement of Guiguang Railway Project have been approved by the Development and Reform Commission of Guangdong Province, which have been totally paid to the account of the land and resources bureau of all counties. All counties are performing a series of administrative procedures in related to the funds allocation. It is estimated that the expenses will be paid to villages by the end of May 2017. Refer to Table 3 for details.

Table 3 Schedule of Reserved Land Resettlement in Guangdong Province

City	County	Area of reserved land	Amount to be allocated (RMB billion)	Progress
Zhaoqing	HuaijiLand County	351	33.67	Already paid to the account of the county land and resources bureau; expected to be paid to villages by the end of May 2017
	Guangning County	238	22	Already paid to the account of the county land and resources bureau; expected to be paid to villages by the end of May 2017
	Sihui City	163	12.84	Already paid to the account of the county land and resources bureau; expected to be paid to villages by the end of May 2017
	Dinghu District	339	58.62	Already paid to the account of the district land and resources bureau; expected to be paid to villages by the end of May 2017
Foshan City	Sanshui District	127.5	22.48	Already paid to the account of the district land and resources bureau; expected to be paid to villages by the end of May 2017
	Nanhai District	197	25.77	Already paid to the account of the district land and resources bureau; expected to be paid to villages by the end of May 2017
Total		1064.5	175.38	

## Guizhou Province

In addition to the basic compensation for the land compensation in the Project, Guizhou is required to provide livelihood funds by various means to support the people affected by the land acquisition in the Project. The multi-channel compensation schemes for the concerned counties and cities have been approved and adopted by the superior government. The land and resources bureau of project counties have received the multi-channel compensation funds in November 2016. Since the use of the funds involved various departments in the project, the implementation of the scheme will take some time. From the view of the current arrangement of these projects, such work can be completed by the scheduled date.

Table 1 Schedule of Implementation of Multi-channel Compensation Funds in Counties of Guizhou Province

County (district)	Responsible authorities	Implementation scheme	Scheduled completion date	Progress
Longli County	People's government, bureau of land and resources, housing and construction bureau, water conservancy bureau, railway construction office	Road rerouting, construction of irrigation tanks and channels, and handling of leftover issues in affected towns and townships	Before March 2018	In progress as scheduled
Guiding County	People's government, bureau of land and resources, housing and construction bureau, railway construction office	Road rerouting and handling of leftover issues in affected towns and townships	End of 2017	
Duyun County	People's government, bureau of land and resources, housing and construction bureau, water conservancy bureau, railway construction office	Road rerouting, construction of irrigation tanks and channels, and handling of leftover issues in affected towns and townships	Before March 2018	
Sandu County	People's government, bureau of land and resources, railway construction office	Handling of leftover issues in affected towns and township	End of 2017	
Rongjiang County	People's government, bureau of land and resources, housing and construction bureau, water conservancy bureau, railway construction office	Road rerouting, construction of irrigation tanks and channels, and handling of leftover issues in affected towns and townships	Before March 2018	
Congjiang County	People's government, bureau of land and resources, housing and construction bureau, railway construction office	Road rerouting and handling of leftover issues in affected towns and townships	Before March 2018	
Liping County	People's government, bureau of land and resources, railway construction office	Handling of leftover issues in affected towns and township	End of 2017	