ECONOMIC ANALYSIS

A. Introduction and Macroeconomic Context

1. The economic analysis for the proposed Guangxi Regional Cooperation and Integration Promotion Investment Program–Tranche 2 was in accordance with Asian Development Bank (ADB)'s Guidelines, including *Guidelines for the Economic Analysis of Projects (2017)*. Standard cost-benefit analysis was applied to the individual subprojects and to the project as a whole to determine whether the minimum required economic internal rate of return (EIRR) and economic net present value (ENPV) were achieved. Least-cost analysis was not conducted since the subproject costs and scopes were predetermined based on detailed needs assessments.

2. The Guangxi Zhuang Autonomous Region (GZAR) attach great importance to regional cooperation and integration (RCI), and has mainstreamed RCI into its own development strategies. The border areas of GZAR and Viet Nam are key areas for development of RCI through trade. GZAR's international trade increased rapidly from $17.7 billion in 2010 to $51.3 billion in 2015, with Viet Nam as its biggest trade partner accounting for 48% of this trade. GZAR's border trade with Viet Nam, which goes mainly through the key border crossing points of Dongxing, Longbang and Pingxiang, grew rapidly from $3.3 billion in 2010 to $16.3 billion in 2015. Key imports from Viet Nam consist of agricultural products (including fresh and dry fruits, vegetables, grains, live animals and animal products, starch, and aquatic products) and minerals, while GZAR's main exports to Viet Nam are electrical, machinery, textile, and petroleum products. International trade conducted by the private sector, mostly small and medium-sized enterprises (SMEs), accounted for 52% of GZAR's total trade in 2015.

B. Economic Analyses of Subprojects

1. Economic Costs

3. The economic viability was assessed using the following assumptions: (i) all costs are based on 2017 prices; (ii) analysis period was 20 years including five years of implementation; (iii) economic costs are calculated based on financial capital works and recurrent operations and maintenance costs as presented in the feasibility study reports (price contingencies, financial charges, and taxes and duties are excluded from the analysis); (iv) economic opportunity cost of capital (EOCC) is assumed at 9%; and (v) all costs are valued using the domestic price numeraire; tradable inputs and unskilled labor costs are adjusted by the shadow exchange rate factor of 1.08 and the shadow wage rate factor for unskilled labor of 0.5, respectively (Table 1).

Table 1: Details of Project Cost (CNY million)

		Capital Cost [a]		O&M Cost [b]		Implementation
No	Subproject Title	Financial	Economic	Financial	Economic	Period
1	Chongzuo Sino–Viet Nam border economic cooperation zone demonstration	449.1	426.7	169.2	143.8	2019–2023
2	Dongxing Changhu road east section construction project	384.0	364.8	137.3	120.5	2018–2023
3	Road connectivity in Pingxiang (Guangxi)–Lang Son (Viet Nam) cross-border	121.8	115.7	47.4	40.33	2019–2023
4	Qinzhou bonded port cross-border trade e-commerce industrial park	138.0	131.1	140.3	136.7	2019–2023
5	Qinzhou international cold-chain logistics demonstration project	145.8	138.5	118.8	115.7	2018–2023

No	Subproject Title	Capital Cost [a] Financial	Capital Cost [a] Economic	O&M Cost [b] Financial	O&M Cost [b] Economic	Implementation Period
6	China–ASEAN SME synergy innovative development project	606.5	576.2	136.2	140.0	2018–2023
7	China–ASEAN educational medicare cooperation project	636.7	604.8	157.4	161.8	201–2023

ASEAN = Association of Southeast Asian Nations, O&M = operations and maintenance, SME = small and medium-sized enterprises.
[a] Financial capital costs include civil works, equipment, project preparation and management, and physical contingency; excludes financing charges, price contingency and taxes. Economic costs are adjusted to include effects of shadow exchange rate factor and shadow wage rate factor.
[b] Financial O&M costs include regular and periodic repairs and maintenance, utilities, salaries, office supplies and other operating costs; economic costs are adjusted to include effect of shadow exchange rate factor and shadow wage rate factor.
Source: Feasibility Study Reports.

2. Economic Benefits

4. Varying parameters and methods were used in quantifying economic benefits depending on the nature of the proposed subprojects.

5. Physical Connectivity. This involves improving physical connectivity in cross-border points or border economic zones to enhance trade and related economic activities. The following road subprojects are included: (i) Chongzuo Sino–Viet Nam Border Economic Cooperation Zone Demonstration Project; (ii) Dongxing Changhu Road East Section Construction Project; and (iii) Road Connectivity in Pingxiang (Guangxi)–Lang Son (Viet Nam) Cross-border. The road benefits were calculated by computing savings in vehicle operating cost (VOC), time savings or reduction in travel time, and avoided accident costs due to improved infrastructure. Diverted and generated traffic were considered for new road sections. Improvement and decongestion on the current routes (parallel roads) were likewise considered due to availability of alternate route. Projected traffic with and without project situations were considered for existing roads. Based on an estimated number of vehicles per section, the related user cost savings were calculated. Savings in VOC for all road sections were calculated at 1.2 to 1.4 passenger car unit (PCU) per kilometer (PCU/km) for new roads, while parallel roads (or roads in current routes) were calculated at 0.4 to 0.7 PCU/km. Total VOC savings for all road sections were valued at $173.5 million. Time savings for both project and parallel roads were valued at $28 million due to increased travel speed and shorter distance for select road sections. Avoided accident costs were assumed to be about 1.0% of gross domestic product of the city and further factored by 5% as reduction due to the subprojects. Total avoided accident costs were estimated at $0.9 million. Parameters used in the quantification of road economic benefits are presented below:

Table 2: Road Benefit Parameters

	Chongzuo						Changhu	Pingxiang
	#1	#2	#3	#4	#5	#6		
Construction type	New	New	New	Rehab	Rehab	Rehab	New	Rehab
Main function	Secondary	Secondary	Trunk	Trunk	Trunk	Trunk	Trunk	Highway
Length (km)	3.48	5.38	2.63	2.71	4.60	1.04	3.70	2.67
Number of lanes	2	2	4	4	4	4	6	4
Design speed (km/h)	30	30	40	40	40	40	60	40
Design capacity [pcu/(km*ln)]	1,300	1,300	1,300	1,300	1,300	1,300	1,400	1,400
Projected traffic (Year 1)	3,086	3,429	5,074	6,923	5,561	8,107	29,792	9,046
Projected traffic (Year 20)	8,151	9,057	12,483	17,034	13,371	19,494	34,284	15,537
City GDP 2015 (CNY mil)	68,282	68,282	68,282	68,282	68,282	68,282	62,071	68,282
VOC savings per pcu*km (proposed road)	1.3	1.3	1.4	1.4	1.4	1.4	1.2	1.4
VOC savings per pcu*km (parallel road)	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.7

	Chongzuo						Changhu	Pingxiang
	#1	#2	#3	#4	#5	#6		
Accident savings rate (%)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Accident savings due to project (%)	5	5	5	5	5	5	10	10

GDP = gross domestic product, km = kilometer, PCU = passenger car unit, VOC = vehicle operating cost.
Source: Feasibility Study Reports.

6. Qinzhou Bonded Port Cross-Border Trade E-commerce Industrial Park Project. The subproject involves construction of a building with a total of 50,000 square meters (m^2) of rentable space. Rentals will be made available for office spaces, warehouses, platforms, exhibition center, and apartments. Key informant interviews[1] of existing businessmen and local officials were undertaken to establish the level of indicative willingness to pay (WTP) of prospective beneficiaries for the various facilities that would be made available. On average, WTP is about CNY2/m^2/day. The value of benefit was calculated by multiplying the available rentable spaces with the assumed WTP.

7. Qinzhou International Cold-Chain Logistics Demonstration Project. The subproject will construct facilities for cold/frozen storage, constant temperature warehouse, ordinary warehouses, office and distribution areas, cold-chain inspection platform (including auxiliary facilities). Total construction area is about 45,000 m^2. It was assumed that the subproject will initially start with 60% of its operational capacity when the project is completed in 2023, and will grow by 10% annually to 90%. Maximum occupancy rate was conservatively retained at 90%. Like the previous subproject, key informant interviews were undertaken to establish the level of WTP of prospective beneficiaries for the various facilities that would be made available. With the available storage capacity, the value of benefit was calculated by multiplying the available rentable spaces with the WTP for the space per unit which was assumed to be CNY6/m^2/day for cold storage, CNY3/m^2/day for constant temperature, and CNY1.5/m^2/day for ordinary warehouse. This price is considered a low estimate of the economic value of cold storage services.

8. China–Association of Southeast Asian Nations (ASEAN) SME Synergy Innovative Development Project. This includes construction of SMEs' business development service information center, vocational training facilities, and improving program design of business management courses targeting SME managers and owners. The subproject benefits were measured using the income approach to measuring incremental flow of factor incomes, i.e., benefits that the university will provide over and above what was there before. The educational system will offer the graduates an opportunity to move up the employment ladder to improve their skills, productivity, and buying power, substantially.

9. The university will provide educational facilities for students recruited nationwide and overseas, and is expected to graduate 6,233 students in 2024, increasing annually by 6%. Wages of graduates are assumed to rise from the average annual wage for unskilled labor of CNY16,000 to the average for skilled labor of CNY52,800 estimated for 2017.

10. China–ASEAN Educational Medicare Cooperation Project. The Youjiang Medical College for Nationalities is located at the junction of Guangxi, Yunnan, and Guizhou. It receives students from these three provinces as well as students from ASEAN countries, such as Viet Nam, Laos and Thailand. Foreign students are currently limited to just about 2.5% of total student population.

[1] Key informant interviews were done during site visits to existing businessmen in the border economic zone, local officials of the municipality, and project implementing entity staff.

11. The subproject benefits are measured using the income approach to measuring incremental flow of factor incomes, i.e., the benefits that the university will provide over and above what was there before. The university will provide medical education for students recruited nationwide and overseas, and is expected to graduate 2,638 students in 2024, increasing annually by 6% to its maximum enrollment capacity of 10,550 which is expected to be achieved by 2030. Wages of graduates are assumed to rise from the average annual wage for unskilled labor of CNY16,000, to the average for medical graduates of CNY31,090.

3. Other Benefits

12. While it was not possible to quantify and value all the potentially diverse and often intangible benefits created by the subprojects with a degree of confidence to warrant inclusion in the computation of EIRR, these benefits were nevertheless identified. For road subprojects, there will be induced trade effects brought about by improved infrastructure, stimulating job creation. For the e-commerce subproject, in addition to expanding and diversifying trade, the subproject is expected to provide considerable efficiency gains in lower trading costs compared with conventional commercial transactions. The cold-chain facility will reduce product spoilage costs. The universities will enhance living standards of the beneficiaries and provide access to health care with the availability of medical graduates.

C. Results of Economic Analysis

13. The economic analysis shows the proposed subprojects to be economically viable, with a calculated EIRR exceeding the EOCC of 9% and a positive ENPV (Table 3). These estimated benefits are considered conservative because qualitative benefits were excluded from the analysis. Sensitivity tests were conducted to ensure that negative changes in key parameters would still provide an EIRR above the EOCC. The results show that the subprojects remain economically viable in the face of a 10% cost overrun, a 10% benefits reduction, a combination of cost overrun and benefits reduction and a 1-year delay in the program start-up.

Table 3: Summary of Economic Analysis Results

	Subproject	EIRR (%)	ENPV ($ million)
1	Chongzuo Sino–Viet Nam border economic cooperation zone demonstration project	13.4%	20.12
2	Dongxing Changhu road east section construction project	16.7%	29.72
3	Road connectivity in Pingxiang (Guangxi)–Lang Son (Viet Nam) cross-border	26.7%	28.05
4	Qinzhou bonded port cross-border trade e-commerce industrial park	13.0%	5.03
5	Qinzhou international cold-chain logistics demonstration project	14.6%	6.82
6	China–ASEAN small and medium enterprises synergy innovative development project	27.1%	432.98
7	China–ASEAN educational medicare cooperation project	21.2%	214.99

ASEAN = Association of Southeast Asian Nations, EBCR = economic benefit-cost ratio, EIRR = economic internal rate or return, ENPV = economic net present value.
Source: Asian Development Bank estimates.

14. Analysis of the overall economic costs and benefits indicates that the project is robust with EIRR of 22.2%, ENPV of $739 million, and benefit-cost ratio of 3.1 (Table 4). All sensitivity tests show positive results and over the EOCC of 9%.

Table 4: Overall Project Economic Analysis Result ($ million)

Year	Economic Costs			Economic Benefits						Net Economic Benefit	Sensitivity Analysis			
	Capital Investment	Operations & Maintenance	Total	Reduced VOC	Reduced Accident Costs	Time Savings	Employment/ Increased Income	Willingness to Pay	Total		Costs +10%	Benefits -10%	Costs +10% Benefits 10%	Delay in Operation
2018	209.8	-	209.8	-	-	-	-	-	-	(209.8)	(230.8)	(209.8)	(230.8)	(209.8)
2019	94.4	1.2	95.6	15.1	0.1	1.4	-	-	16.6	(79.0)	(88.6)	(80.7)	(90.2)	(95.6)
2020	48.3	1.5	49.8	15.9	0.1	1.6	-	-	17.6	(32.2)	(37.2)	(34.0)	(39.0)	(33.2)
2021	-	4.1	4.1	16.8	0.1	1.7	-	6.3	24.9	20.9	20.5	18.4	18.0	13.5
2022	-	4.1	4.1	17.8	0.1	1.9	-	7.6	27.4	23.3	22.9	20.5	20.1	20.8
2023	0.0	4.2	4.2	18.9	0.1	2.1	-	8.9	30.0	25.8	25.4	22.8	22.4	23.2
2024	0.0	4.3	4.3	19.7	0.1	2.3	17.5	9.4	49.0	44.7	44.3	39.8	39.4	25.7
2025	0.0	14.6	14.6	20.5	0.1	2.6	53.4	9.4	86.0	71.4	69.9	62.8	61.3	34.4
2026	-	4.3	4.3	21.4	0.1	2.8	96.7	9.4	130.5	126.2	125.8	113.1	112.7	81.7
2027	4.2	4.3	8.6	22.3	0.1	3.1	142.6	9.4	177.6	169.0	168.1	151.2	150.4	121.9
2028	-	4.4	4.4	23.3	0.1	3.5	191.2	9.4	227.6	223.1	222.7	200.4	199.9	173.2
2029	-	4.5	4.5	24.3	0.1	3.9	225.4	9.4	263.1	258.6	258.1	232.3	231.8	223.0
2030	-	4.6	4.6	25.4	0.1	4.4	244.0	9.4	283.3	278.7	278.2	250.3	249.9	258.5
2031	-	4.7	4.7	26.5	0.2	4.9	257.3	9.4	298.2	293.5	293.1	263.7	263.2	278.6
2032	-	15.1	15.1	27.7	0.2	5.6	268.9	9.4	311.7	296.7	295.2	265.5	264.0	283.2
2033	-	4.8	4.8	28.9	0.2	6.4	277.8	9.4	322.7	317.9	317.5	285.7	285.2	307.0
2034	4.2	4.9	9.1	29.5	0.2	7.2	283.8	9.4	330.1	321.0	320.0	288.0	287.0	313.6
2035	-	5.0	5.0	30.1	0.2	8.1	286.8	9.4	334.6	329.6	329.1	296.1	295.6	325.1
2036	-	5.1	5.1	30.5	0.2	9.3	287.7	9.4	337.1	332.0	331.5	298.3	297.8	329.5
2037	-	5.2	5.2	31.3	0.2	15.0	287.7	9.4	343.6	338.4	337.9	304.0	303.5	331.9
	312.0	139.4	351.4	173.5	0.9	28.1	829.4	58.4	1,090.3					
Economic Internal Rate of Return										**22.2%**	**20.9%**	**20.8%**	**19.5%**	**19.5%**
Economic Net Present Value ($ million)										**739**	**704**	**630**	**595**	**593**
Benefit-Cost Ratio										**3.1**	**2.8**	**2.8**	**2.5**	**2.1**
Switching Values											**175.3%**	**158.8%**		