# ECONOMIC AND FINANCIAL ANALYSIS

## A. Introduction

1. The Kyrgyz Republic is a landlocked mountainous country in Central Asia bordering Kazakhstan, the People's Republic of China (PRC), Tajikistan, and Uzbekistan. The economy relies heavily on such agricultural products as wool, meat, dairy products, wheat, and sugar beet; mineral extraction, including the mining of coal, gold, and uranium; and remittances from overseas workers. In 2013, gross domestic product (GDP) per capita was estimated at $1,280, the second lowest in Central Asia. GDP growth averaged 4.4% during 2000–2014, but performance in recent years has been volatile. For example, growth ranged from –0.9% in 2012 to 10.5% in 2013.[1]

2. In 2013, the country's exports and imports totaled $11.8 billion. The main trading partners were (i) the PRC ($5.6 billion), (ii) the Russian Federation ($2.1 billion), (iii) Kazakhstan ($1.1 billion), (iv) Uzbekistan ($0.5 billion), and (v) Turkey ($0.5 billion).

3. The road sector dominates transport in the Kyrgyz Republic and accounted for 52% of all freight ton-kilometers in 2012 and 82.6% of all passenger-kilometers.[2] Of the country's 34,000 kilometer (km) of roads, 4,163 km are international roads, 5,678 km are national roads, and 8,969 km are local roads. The rest are mainly municipal roads under the jurisdiction of city administrations and local authorities. Only 41% of the overall road network and 78% of the international roads are paved. Although international roads make up 22% of the national road network, they carry 75% of the traffic (footnote 2).

4. The most heavily used roads in the Kyrgyz Republic include the Bishkek–Osh Road, which links Bishkek in the northern part of the country with the southwest, and the Bishkek–Naryn–Torugart (BNT) corridor linking Bishkek with the southeast. The BNT corridor serves the populations of Bishkek city (about 870,000) and Naryn city (about 35,000) directly. It also provides a crucial route for the transport of goods, particularly between Xinjiang Province in the PRC, the Kyrgyz Republic, and other Central Asian countries. The BNT corridor forms part of Central Asia Regional Economic Cooperation (CAREC) corridor 1 linking Europe with the PRC and East Asia.

5. **Without-project scenario.** The without-project scenario used for the economic analysis for the CAREC Corridor 1 (Bishkek–Torugart Road) Project 3 (BNT-3) is based on continued use of the existing substandard 60 km stretch of road—kilometer 479–kilometer 539—which has two lanes and is 6–10 meters wide along different sections. The quality varies by section but the road is generally unpaved. The current average International Roughness Index (IRI) value over the route is about 12, and this is forecast to worsen to about 19 by 2036 without intervention.

6. **With-project scenario.** The with-project scenario is based on the reconstruction by the project of the above-mentioned 60 km of the BNT corridor. This stretch of road is the last section in the Kyrgyz Republic needing reconstruction to complete the rehabilitation of the highway that forms part of CAREC corridor 1 linking Europe and the PRC and East Asia. The road runs to and from the country's border with the PRC at Torugart and is an important route for goods vehicles moving between the PRC and Central Asia.

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[1] International Monetary Fund (IMF). World Economic Outlook Database. http://www.imf.org/external/data.htm (accessed 01 September 2014).

[2] ADB. Kyrgyz Republic Transport Sector Assessment, Strategy, and Road Map. Unpublished.

7. Under the project, the road is to be reconstructed to international standards, with 3.5-meter-wide lanes and 2.0-meter-wide shoulders on each side. The reconstruction will involve widening within the existing right-of-way. The new road will have an initial IRI value of 2, which will increase to about 5.

8. The rehabilitation of this stretch of road under BNT-3 for which the additional financing is now proposed was subject to an economic analysis undertaken as part of ADB due diligence during project preparation in 2011.[3] However, on 2 prior ADB-financed projects—BNT projects 1 and 2—the newly opened roads suffered surface cracking due to frost-heave phenomenon. The design of the project section of BNT-3 had to be revised to prevent similar issues occurring. The solution adopted—mainly an additional 30 centimeter sub-base with improved drainage and a reduction in fine materials—will ensure good surface quality but will result in additional costs. This economic analysis has been undertaken to confirm whether the project will remain economically viable despite these additional costs. The economic internal rate of return (EIRR) for the project road was previously estimated at 14.8%.

## B. Forecast Traffic

9. Traffic forecasts for the project road were derived from traffic counts undertaken in 2013 (see Table 1).

**Table 1: Project Road Traffic in 2013**

| Location | Car | Minibus/ Van | Bus | Light Truck | Medium Truck | Artic | Total (AADT) | PCU* |
|---|---|---|---|---|---|---|---|---|
| **Torugart** | 46 | 5 | 1 | 2 | 1 | 113 | 168 | 461 |

PCU = passenger car units, AADT = annual average daily traffic.
Source: Asian Development Bank estimates.

10. Real GDP growth forecasts for the Kyrgyz Republic for 2014–2020 were sourced from International Monetary Fund (footnote 1). Average annual GDP growth for 2020–2036 has been estimated at 5.5%. Demand for transport has been forecast based on projected changes in real GDP per capita, with an elasticity calculated based on recent correlation between economic growth and the size of the country's vehicle fleet. However, not enough reliable detailed traffic information was available to facilitate the calculation of country-specific elasticities.

11. The completion of the entire BNT corridor and the section to Karshi in the PRC by 2016 will substantially reduce transport costs on these roads. Exports from the PRC to the Kyrgyz Republic increased from $80.0 million in 2004 to $5.6 billion in 2013, and trade between the PRC and Central Asia was up about 40% per annum during the same period.[4] International traffic to and from the PRC makes up the majority of the truck traffic on the ADB project road section, much of it carrying freight from the PRC onward to other Central Asian countries. This appraisal applied an average annual traffic growth rate of about 7.7%, based on assumed GDP growth of 6.0%–6.5% in Central Asia during the period 2017–2036 and an income elasticity of demand of 1.2.

12. Table 2 shows the with-project traffic forecast on the project road. No traffic was assumed to be diverted from other routes because no viable alternative exists. The forecast included additional trips generated by the improved road due to reductions in vehicle operation

[3] *ADB. 2011. Report and Recommendation of the President to the Board of Directors: Proposed Loan to the Kyrgyz Republic for the Kyrgyz Republic: CAREC Corridor 1 (Bishkek–Torugart Road) Project 3 Project. Manila.*
[4] International Monetary Fund. Direction of Trade Statistics Database. http://www.imf.org/external/data.htm (accessed 02 September 2014).

costs (VOCs) and improved journey times. This was assumed to be 20% of the forecast demand in the without-project scenario.

**Table 2: Forecast traffic**
(passenger care units)

| Year | Without-Project Scenario | With-Project Scenario |
|---|---|---|
| **2017** | 556 | 668 |
| **2020** | 702 | 844 |
| **2030** | 1,477 | 1,773 |
| **2035** | 2,146 | 2,576 |

Source: Asian Development Bank estimates.

## C. Economic Costs

13. Project costs and benefits were estimated in constant 2014 prices. The project reconstruction and rehabilitation period considered was 2012 to 2016, and the project's benefits was appraised based on a 20-year period from 2017 to 2036.

14. The economic costs of the project comprise (i) capital investment, including civil works, land acquisition, construction supervision, and physical contingencies; and (ii) road maintenance. Table 3 provides details of the investment costs. Costs related to taxes, duties, and price contingencies were excluded from the economic analysis, as were financing charges during implementation. The contractor broke down construction costs into components—for example, costs for traded inputs, non-traded inputs, skilled and unskilled labor, and profits. Financial costs were then converted into economic costs by application of an appropriate conversion factor. Table 4 shows the parameter values and assumptions used for the economic analysis.

**Table 3: Financial Cost Estimate**
($ million)

| Item | Revised Cost Estimate | Original Cost Estimate |
|---|---|---|
| **Construction** | 69.0 | 55.0 |
| **Land acquisition** | 0.0 | 0.0 |
| **Physical contingencies** | 1.0 | 1.0 |
| **Consulting services** | 4.8 | 4.0 |
| **Project management** | 1.7 | 1.7 |
| **Total** | **76.5** | **61.7** |

Source: Asian Development Bank estimates

**Table 4: Parameter Values and Assumptions for Economic Analysis**

| Item | |
|---|---|
| Price Base Year: | 2014 |
| Currency of Analysis: | US dollars |
| Construction Start Year: | 2012 |
| Construction End Year: | 2016 |
| First Year of Benefits: | 2017 |
| Appraisal Period: | 20 years |
| Numeraire Used: | Domestic price numeraire |
| Income Elasticity of Demand: | 1.2 |
| Value of time (in work, 2013): | $2/h (increasing in line with real GDP per capita growth) |
| Value of time (goods vehicles, 2013): | $3/h (increasing in line with real GDP per capita growth) |
| Value of time (non-work, 2013): | $0.6/h (increasing in line with real GDP per capita growth) |
| GDP growth assumption: | Sourced from IMF (2014–2019), 5.5% (2020–onwards) |
| Shadow Price of Labor: | 0.75 |
| Shadow Exchange Rate Factor: | 1.11 |
| Conversion Factor applied to Supervision: | 1.0 |
| Conversion Factor applied to taxes, duties, profits, transfers: | 0.0 |

15. The project does not involve land acquisition. However, a number of trailers adjacent to the existing road near the customs facilities in Torugart will need to be relocated to make way for a parking facility for vehicles queueing at the border crossing point. The relocation costs have been included in the land acquisition and resettlement plan. They include (i) the cost of moving the trailers, (ii) installation of outdoor electric cable connections, (iii) compensation for net income lost during a resettlement period of an estimated 10 days, and (iv) vulnerability allowance. The cost of damage to trailers during relocation was included in the project's contingency allocation, and the cost of concreting the area to which the trailers are to be relocated was included in the overall construction cost estimate. In calculating the economic price of relocation, the cost of moving trailers and compensation for net income were adjusted in line with ADB guidelines.[5] The vulnerability allowance is considered a transfer payment and excluded from the economic analysis.

16. Unit rates have been estimated for routine and winter maintenance and patching potholes and cracks (Table 5). These levels of expenditure will be sufficient to sustain the new road conditions in a reasonable condition over the project appraisal period.

[5] ADB. 1997. *Guidelines for the Economic Analysis of Projects.* Manila.

**Table 5: Unit Rates for Maintenance[a]**

| Type | Paved Minimum Maintenance | Unpaved Minimum Maintenance |
|---|---|---|
| **Overlay** | 46.83 per $m^2$ | |
| **Reseal** | 6.34 per $m^2$ | |
| **Edge Break Repair** | 20.66 per $m^2$ | |
| **Patching Potholes** | 22.04 per $m^2$ | |
| **Crack Sealing** | 22.04 per $m^2$ | |
| **Blading** | | 68.87 per km |
| **Spot Regraveling** | | 13.77 per $m^2$ |
| **Winter Maintenance** | 173.77 per km per year | 125.35 per km per year |
| **Other Works** | 125.35 per km per year | 132.24 per km per year |

km = kilometer, m2 = square meter
[a] 2014 prices
Source: HDM-4 model.

## D. Economic Benefits

17. The length of the road in both the without- and with-project scenarios is about 60 km. The project will generate substantial savings in terms of value of time and VOCs.

18. Per-kilometer unit rates for VOCs were derived from an HDM-4 model and are shown in Table 6. VOC unit rates for the without-project scenario are substantially higher than for the with-project scenario, reflecting the fact that the project will make large improvements to surface quality and allow more fuel-efficient vehicle speeds.

**Table 6: Representative Vehicle Operating Costs by Vehicle Type**
($ per vehicle-km)

| Scenario | Car | Bus | Light Truck | Medium Truck | Articulated Truck |
|---|---|---|---|---|---|
| Without Project | 0.24 | 0.80 | 0.38 | 0.60 | 1.67 |
| With Project | 0.22 | 0.55 | 0.33 | 0.48 | 1.22 |
| VOC Savings | 0.02 | 0.25 | 0.05 | 0.12 | 0.45 |

Source: Consultant calculations based on Kyrgyz Republic HDM4 model.

19. The average speeds modelled in the economic analysis are shown in Table 7 below.

**Table 7: Projected Average Vehicle Speeds in 2017**

| Vehicle type | With Project (km/hour) | Without Project (km/hour) |
|---|---|---|
| Car | 87 | 41 |
| Bus | 80 | 36 |
| Light truck | 83 | 40 |
| Medium truck | 83 | 40 |
| Articulated truck | 80 | 32 |

Source: Consultant estimates based on HDM-4 model outputs

20. Benefits for existing traffic were calculated by estimating the difference in costs between the without- and with-project scenarios. For generated traffic, benefits from VOC and time savings were estimated at 50% of those of existing traffic.

21. The value of business travel time adopted for car passengers was $2 per hour. Leisure time was valued at 30% of business time. To estimate the value of time, 25% of occupants in

passenger vehicles were assumed to be in working time and the remainder to be travelling for leisure purposes. Crew wages for trucking were estimated at $3 per hour, based on typical monthly earnings in the sector. The value of time was calculated to increase during the appraisal period in real, inflation-adjusted terms in line with growth in GDP per capita. Crew costs were excluded from the VOC unit rates and hence included in calculating the value of time. Values of time have been adjusted in the economic analysis by applying a shadow wage rate factor.

## E. Results of Economic Analysis

22. The economic assessment was carried out in accordance with the ADB's Guidelines for the Economic Analysis of Investment Projects (footnote 5). The methodology used compared the benefits derived from reductions in VOCs and travel time arising from the project's construction with the up-front investment cost and any incremental changes in maintenance costs over the 20-year appraisal period.

23. A summary of the results of the economic analysis are in Table 8. The economic indicators provided are the EIRR, the benefit-to-cost ratio, and the net present value at a 12% discount rate. The results are presented in the domestic price numeraire for two scenarios. Scenario 1 is the baseline scenario and compares the incremental costs and benefits of implementing the revised design versus a without-project scenario based on not undertaking the project.

**Table 8: Project Economic Indicators**

| Scenarios | Benefit-to-Cost Ratio | NPV ($ million) | EIRR (%) |
|---|---|---|---|
| **Scenario 1 (baseline)** | 1.03:1 | 1.3 | 12.3 |
| **Scenario 2 (alternate scenario)** | 1.47:1 | 3.1 | 14.6 |

Source: Asian Development Bank estimates.

24. Scenario 2 was examined for the record to compare the incremental costs and benefits of implementing the revised design that will require additional ADB financing with a without-project scenario based on completing the project using the initial design, which would leave the road subject to cracking and damage from frost during winter. Scenario 2 therefore represents the incremental costs and benefits from going from the initial engineering design to the revised design that will prevent this cracking.

25. The economic analysis showed that the project is economically viable under both scenarios. This means that the project as a whole, with the additional financing, is economically viable with a benefit-to-cost ratio of 1.03:1; and that revisions to the design of the project are economically viable and have a benefit-to-cost ratio of 1.47:1.

26. The economic cost and benefit streams arising from the baseline scenario 1 are shown in Table 9.

**Table 9: Cost and benefit streams**
($ million)[a]

| Year | Capital Costs | Maintenance Costs | VOC | Value of Time | Net Benefits |
|---|---|---|---|---|---|
| 2012 | 7.1 | 0.0 | 0.0 | 0.0 | (7.1) |
| 2013 | 5.6 | 0.0 | 0.0 | 0.0 | (5.6) |
| 2014 | 9.5 | 0.0 | 0.0 | 0.0 | (9.5) |
| 2015 | 19.7 | 0.0 | 0.0 | 0.0 | (19.7) |
| 2016 | 13.3 | 0.0 | 0.0 | 0.0 | (13.3) |
| 2017 | 0.0 | (0.2) | 3.7 | 0.2 | 4.1 |
| 2018 | 0.0 | (0.2) | 4.1 | 0.2 | 4.5 |
| 2019 | 0.0 | (0.2) | 4.4 | 0.3 | 4.9 |
| 2020 | 0.0 | (0.2) | 4.8 | 0.3 | 5.4 |
| 2021 | 0.0 | (0.2) | 5.3 | 0.3 | 5.8 |
| 2022 | 0.0 | (0.2) | 7.3 | 0.4 | 8.0 |
| 2023 | 0.0 | (0.3) | 8.0 | 0.4 | 8.6 |
| 2024 | 0.0 | (0.3) | 8.7 | 0.5 | 9.4 |
| 2025 | 0.0 | (0.3) | 9.4 | 0.5 | 10.2 |
| 2026 | 0.0 | (0.3) | 10.2 | 0.6 | 11.1 |
| 2027 | 0.0 | (0.3) | 11.1 | 0.7 | 12.0 |
| 2028 | 0.0 | (0.3) | 12.0 | 0.7 | 13.0 |
| 2029 | 0.0 | (0.4) | 12.9 | 0.8 | 14.1 |
| 2030 | 0.0 | (0.4) | 13.9 | 0.9 | 15.2 |
| 2031 | 0.0 | (0.4) | 15.0 | 1.0 | 16.5 |
| 2032 | 0.0 | (0.4) | 16.2 | 1.2 | 17.8 |
| 2033 | 0.0 | (0.4) | 17.5 | 1.3 | 19.2 |
| 2034 | 0.0 | (0.4) | 18.9 | 1.5 | 20.8 |
| 2035 | 0.0 | (0.4) | 20.5 | 1.7 | 22.5 |
| 2036 | (19.9)[6] | (0.4) | 23.2 | 1.9 | 45.4 |
| | | | | EIRR | 12.3% |
| | | | | NPV | $1.3m |

VOC = vehicle operating costs, EIRR = economic internal rate of return, NPV = net present value.
[a] 2014 Domestic Prices, undiscounted
Source: Asian Development Bank estimates.

27. Sensitivity tests and calculations of switching values were carried out to determine the effect on the key economic indicators for scenario 1 by variations from the estimates of key input parameters. Four scenarios were studied: (i) an increase in annual average traffic growth rate of 1 percentage point; (ii) a reduction in annual average traffic growth of 1 percentage point; (iii) an increase of investment costs of 10%; and (iv) a decrease in investment costs of 10%. Table 10 provides details. The project is sensitive to reductions in annual traffic growth and increases in investment cost.

[6] A residual value was calculated by estimating the working life for each of the expenditure headings and applying straight-line depreciation, with the residual value of the project equal to the aggregate of the residual value of all of the project components.

**Table 10: Results of the Sensitivity Analysis**[a]

| Scenario | Benefit-to-Cost Ratio | NPV ($ million) | EIRR (%) | Switching Value (%) |
|---|---|---|---|---|
| Base case | 1.03 | 1.3 | 12.3 | |
| Annual traffic growth +1% | 1.17 | 6.6 | 13.3 | |
| Annual traffic growth -1% | 0.92 | -3.3 | 11.2 | -0.3% |
| Investment cost +10% | 0.93 | -2.9 | 11.4 | +3.0% |
| Investment cost -10% | 1.16 | 5.5 | 13.3 | |

a Domestic Price Numeraire
Source: Asian Development Bank estimates.

28. In summary, the economic analysis found the EIRR for the baseline scenario to slightly exceed the discount rate (12%). Considering that the project will also yield benefits in terms of economic development and in the comfort and reliability of travel that are not monetized in the economic analysis, the project can be deemed to be economically viable.

## F. Financial Analysis

29. The government has allocated about $30 million in annual funding has been allocated in 2013 for road maintenance. This is less than one-half of what is required to ensure that maintenance is adequate and that road assets can be sustainably maintained. The project will reduce maintenance costs by about $0.2 million per year initially, saving less than 1% of the currently inadequate maintenance budget of the Ministry of Transport and Communications.

30. In 2013, the total public debt of Kyrgyz Republic stood at 47.7% of GDP. The roughly $14.83 million in additional financing requested from ADB to complete the project would have a marginal effect on the public debt–GDP ratio, adding another 0.2%.