ECONOMIC AND FINANCIAL ANALYSIS

A. Introduction

1. The project consists of the reconstruction and rehabilitation of two sections of the Bishkek–Osh road: Bishkek to Kara-Balta (52.5 kilometers [km]) and Madaniyat to Jalal-Abad (67 km). These are the last two sections needed to complete the rehabilitation of the Bishkek–Osh road, which forms part of Central Asia Regional Economic Cooperation (CAREC) Corridor 3 linking Kazakhstan in the north with Uzbekistan and Tajikistan in the south. The Bishkek–Osh road links the country's two largest cities and is one of the busiest parts of the road network.

2. The economic analysis was conducted in accordance with the Guidelines for Economic Analysis of Projects of the Asian Development Bank (ADB).[1] Project investments yield savings in vehicle operating costs, operations and maintenance costs, and travel time. The economic evaluation was undertaken using the Highway Development and Management Model (HDM-4).[2] The primary analysis involved (i) estimating the demand for travel, (ii) identifying options for analysis, (iii) establishing the economic costs and benefits of the proposed project, and (iv) calculating the internal rate of return and its sensitivity to changes in key input parameters.

B. Economic Rationale of the Project

3. Reconstruction of the road will provide for an increasing volume of road traffic, reduce the transit time for goods and passengers, and improve road safety. The main goal of the project is to reduce vehicle operating costs and travel time for domestic and regional travel. This will facilitate national and regional trade and reduce poverty by improving access of rural communities to markets and health and education facilities.

C. Project Alternatives

4. The Bishkek–Kara-Balta section was divided into four subsections for analysis and two options were considered for each subsection: a six-lane divided carriageway or a four-lane divided carriageway. Based on the HDM-4 analysis, it is proposed that the first two subsections and one intermediate section will be six lanes, while the remainder of the road will be four lanes. For the Madaniyat–Jalal-Abad section, the analysis was undertaken for each of five subsections and alternative pavement treatments were tested in each subsection. The least-cost option (based on the agency cost) was to use a 20-year pavement design on all sections.

D. Forecast Traffic

5. Traffic forecasts for the two project road segments were based on a combination of historical data, traffic counts, and origin–destination surveys. The historical counts vary significantly from year to year. A logarithmic curve was fitted to the data to estimate the historical growth rate and calculate a base (2013) traffic level. In cases where the calculated 2013 base estimate exceeded the observed 2013 count data, the 2013 count data was used as a starting point for future forecasts. This approach effectively averages the available data, smoothing observed outliers. The traffic estimates for 2013 for the project road sections are shown in Table 1.

[1] ADB. 1997. *Guidelines for Economic Analysis of Projects.* Manila.
[2] World Road Association. 2002. *HDM-4 Version 2.* Paris.

Table 1: Project Road Traffic 2013

Km	End Point	Car	Mini-Bus/Van	Bus	Small Truck	Medium Truck	Large Truck	Artic Truck	Tractor	Total
Bishkek–Kara-Balta										
8–17	Bypass jn.	29,769	9,382	1,472	552	183	490	137	12	**41,996**
17–29	Sokuluk	34,429	10,850	1,702	638	209	559	156	14	**48,558**
29–40	Belovodskoe	16,567	4,480	177	275	268	620	427	18	**22,832**
40–61	Kara-Balta	8,472	2,403	24	275	268	620	427	18	**12,507**
Madaniyat–Jalal-Abad										
507–520	Kochkor-Ata	4,567	455	24	137	72	101	142	17	**5,516**
520–528	Massy	4,567	455	24	137	72	101	142	17	**5,516**
528–539	Bazarkorgon	8,095	807	43	243	128	179	252	30	**9,776**
539–557	Suzak pass	8,095	807	43	243	128	179	252	30	**9,776**
557–574	Uzgen fork	7,205	718	38	216	114	159	224	27	**8,702**

Km= kilometer marker.
Source: Asian Development Bank estimates.

6. Assumed growth rates were based on historical growth as well as forecast gross domestic product (GDP) growth. Traffic counts provided by the Ministry of Transport and Communications (MOTC) show growth in the total traffic volume, but truck traffic has been largely static or in some cases even declining. Traffic is normally closely correlated with GDP for freight and GDP per head for passengers, but has been tracking below GDP growth in recent years. Historic growth in GDP has been around 4%–5% per year and is expected to continue at this level. The rate of growth in demand for travel was set at 3.3% based on the growth in the last 2 years. There is a proposal for a bypass road between Bishkek and Kara-Balta and it is assumed that this proposal will be brought forward if the project road approaches capacity. Since most traffic is local, construction of the bypass will not significantly reduce demand for the project road but will provide a relief route. Consequently, traffic growth on the Bishkek–Kara-Balta section was capped beyond 2025.

7. The road carries some international traffic. Completion of the CAREC corridors together with associated transport and trade facilitation initiatives are expected to result in significant increases in international traffic, but the benefits from these developments are contingent on activities other than the project road itself and thus have not been included. Table 2 shows the forecast traffic on each subsection of the project road assuming that the works commence in September 2015 and are completed in late 2018. There is no diverted traffic because there is no viable alternative route. Generated traffic is assumed to be 5% of normal traffic based on the reduced vehicle operation costs (VOC).

Table 2: Forecast Traffic by Subsection
(average annual daily traffic)

	Bishkek–Kara-Balta (Km)				**Madaniyat–Jalal-Abad** (Km)				
Year	**08–17**	**17–29**	**29–40**	**40–61**	**507–520**	**520–528**	**528–539**	**539–557**	**557–574**
2013	41,996	48,558	22,832	12,507	5,516	5,516	9,776	9,776	8,702
2018	49,398	57,117	26,856	14,711	6,488	6,488	11,499	11,499	10,236
2020	55,348	63,996	30,091	16,483	7,270	7,270	12,884	12,884	11,469
2030	65,103	75,276	35,395	19,389	10,058	10,058	17,826	17,826	15,868
2038	65,103	75,276	35,395	19,389	13,916	13,916	24,664	24,664	21,954

Km = kilometer marker.
Source: Asian Development Bank estimates.

E. Cost–Benefit Analysis

8. The project reconstruction and rehabilitation period was considered to be from September 2015 to October 2018, and the completed Project would operate until 2038. Project cost and benefits have been estimated in constant 2013 prices using an international numeraire. Capital costs considered in the economic evaluation include project material and construction costs, physical contingencies, but exclude taxes, price contingencies and financial charges during reconstruction and rehabilitation. A standard conversion factor (SCF) 0.95 was used to convert domestic market prices (less taxes) of non-tradable goods to economic prices.

9. The economic capital cost estimated for the Bishkek–Kara-Balta section is $83.9 million and for the Madaniyat–Jalal-Abad section $53.9 million. Maintenance costs have been estimated at $3,000/km for routine and winter maintenance, in addition to $16 per square meter for patching potholes and cracks. These levels of expenditure are compatible with the current budgets allocated for maintenance and are sufficient to sustain the improved road conditions for the project's period of analysis.

10. The key benefits of the project considered in the economic evaluation were savings in VOC, time, and annual maintenance costs. Road improvements are expected to create benefits in lower accident rates by making the road environment more predictable. However, for purposes of this study, accident costs were not included because of lack of realistic data.

11. Savings in VOC (Table 3) comprise the largest category of benefits and arise from the improved road conditions resulting from the civil works carried out under the project. The VOC are calculated for each vehicle type based on regional vehicle cost and utilization data. Unit economic VOC for passenger and freight vehicles were estimated and aggregated using the highway development and management model (HDM-IV). VOC savings will accrue primarily from improvements to the road surface. The International Roughness Index (IRI) for the project road in the without-project scenario is predicted to rise from a range of 6.0–8.0 in subsections to a range of 10.0–16.0, whereas the with-project scenario assumes a post-construction IRI of 3.0 in 2017, gradually rising to over 6.0 by 2036. The analysis assumes a reasonable level of maintenance, including condition-responsive periodic resurfacing.

Table 3: Representative Vehicle Operating Costs by Vehicle Type

($ per '000 vehicle-km)

Item	Car	Bus	Light Truck	Heavy Truck	Artic. Truck
Without Project	139	580	424	846	1,114
With Project	132	571	380	827	1,046
VOC saving	7	9	44	19	68

Artic = articulated, km = kilometer, VOC = vehicle operating costs.
Source: Asian Development Bank estimates.

12. The rehabilitation of the road also results in time savings due to the improved road conditions. The value of time savings was derived from the travelers' average income, taking into account the work traveling ratio per car occupancy. The values used for work time were $0.84 for bus passengers and $1.00 for car passengers. This compares with a rate based on the average gross national income per person of $990, implying an average wage of $1.20 per hour. Nonworking trips were valued at 25% of the value of working trips. The occupancy rates and the proportion of work-related passenger travel were based on data obtained from origin–destination surveys carried out for other recent studies in the Kyrgyz Republic. There would also be some time value benefits for freight traffic but, given the relatively short length of the project sections, in isolation these benefits would not be of great magnitude.

F. Findings

13. The economic evaluation is based on a comparison of cost and benefits of the reconstruction and rehabilitation of the Bishkek–Osh road. The economic internal rate of return (EIRR) for the total project is estimated at 25.7% (Table 4). This is well above the 12.0% threshold normally applied, indicating the project's viability. Considering the two sections of the project road separately, the EIRR is 26.8% for the Bishkek–Kara-Balta section (Table 5) and 23.6% for Madaniyat–Jalal-Abad (Table 6). Residual values are based on the ratio of the nonpavement cost to the total cost on the assumption that the pavement will be exhausted.

Table 4: Cost and Benefit Flow, Total Project
($ million)

	Road Agency Costs			Savings in Road User Costs				
	Capital Works	Recurrent Works	Savings in Existing	Normal (+ Diverted) Traffic		Generated Traffic		Total
Year				VOC	Time	VOC	Time	
2016	34.4	0.6	3.1	0.0	0.0	0.0	0.0	**(31.92)**
2017	57.8	0.6	0.9	2.4	1.7	0.0	0.0	**(53.36)**
2018	45.5	0.6	1.6	3.8	2.8	0.1	0.1	**(37.66)**
2019	0.0	0.6	1.2	18.1	9.5	0.4	0.2	**28.77**
2020	0.0	1.0	1.2	19.4	10.9	0.5	0.2	**31.14**
2021	0.0	1.2	4.0	21.5	12.9	0.5	0.2	**38.02**
2022	0.0	1.3	2.7	23.4	15.1	0.5	0.3	**40.73**
2023	0.0	1.3	1.2	24.9	16.8	0.6	0.3	**42.43**
2024	0.0	1.5	0.7	26.0	18.0	0.6	0.3	**44.17**
2025	0.0	1.8	0.6	27.8	20.0	0.6	0.4	**47.60**
2026	0.0	2.0	3.6	30.1	22.3	0.7	0.4	**55.03**
2027	17.4	1.6	2.7	30.6	23.7	0.7	0.4	**39.05**
2028	0.0	1.7	1.2	33.1	24.9	0.7	0.5	**58.67**
2029	17.0	1.3	0.7	34.7	26.7	0.7	0.5	**44.93**
2030	10.5	1.1	0.6	40.0	29.5	0.9	0.6	**59.83**
2031	12.9	0.8	3.6	45.4	32.6	1.0	0.6	**69.55**
2032	0.0	0.8	2.7	48.5	34.2	1.1	0.7	**86.43**
2033	0.0	0.8	1.2	50.2	35.4	1.1	0.7	**87.79**
2034	2.4	0.7	0.7	51.3	35.1	1.1	0.7	**85.66**
2035	10.8	0.7	0.0	55.2	4.2	1.2	0.7	**49.81**
2036	11.4	0.8	0.0	60.7	0.0	1.3	0.8	**50.54**
2037	5.8	0.8	0.0	64.8	0.0	1.4	0.8	**60.40**
2038	(26.2)	0.8	0.0	67.7	0.0	1.5	0.8	**95.39**
							EIRR	**25.72%**
							NPV	**168.86**

( ) = negative, EIRR = economic internal rate of return, NPV = net present value, VOC = vehicle operating cost.
Source: Asian Development Bank estimates.

Table 5: Cost and Benefit Flow, Bishkek–Kara-Balta Section
($ million)

	Road Agency Costs			Savings in Road User Costs				
				Normal (+ Diverted) Traffic		Generated Traffic		
Year	Capital Works	Recurrent Works	Savings in Existing	VOC	Time	VOC	Time	Total
2016	21.0	0.3	0.57	0.0	0.0	0.0	0.0	**(20.67)**
2017	33.6	0.3	0.59	1.3	1.1	0.0	0.0	**(30.93)**
2018	29.4	0.3	1.24	2.3	2.0	0.0	0.0	**(23.90)**
2019	0.0	0.3	0.77	9.7	5.7	0.2	0.1	**16.16**
2020	0.0	0.3	0.70	10.4	6.8	0.2	0.1	**17.97**
2021	0.0	0.3	0.93	12.0	8.4	0.3	0.1	**21.48**
2022	0.0	0.3	2.40	14.4	10.9	0.3	0.2	**27.92**
2023	0.0	0.3	0.89	15.4	12.2	0.3	0.2	**28.79**
2024	0.0	0.4	0.37	16.0	13.1	0.3	0.2	**29.67**
2025	0.0	0.7	0.27	17.4	14.8	0.3	0.2	**32.36**
2026	0.0	0.9	0.54	19.4	16.7	0.4	0.3	**36.39**
2027	0.0	1.0	2.40	21.1	18.6	0.4	0.3	**41.78**
2028	0.0	1.1	0.89	21.6	19.2	0.4	0.3	**41.30**
2029	6.9	1.0	0.37	22.4	20.5	0.4	0.3	**36.22**
2030	10.5	0.8	0.27	26.4	22.7	0.5	0.4	**39.03**
2031	12.9	0.4	0.54	30.9	25.3	0.6	0.4	**44.55**
2032	0.0	0.4	2.40	34.9	27.4	0.7	0.5	**65.47**
2033	0.0	0.4	0.89	35.7	28.0	0.7	0.5	**65.36**
2034	2.4	0.4	0.37	35.8	27.2	0.7	0.5	**61.68**
2035	3.7	0.3	0.04	38.7	4.2	0.8	0.5	**40.13**
2036	6.9	0.4	0.00	42.1	0.0	0.8	0.5	**36.25**
2037	0.0	0.5	0.00	46.7	0.0	0.9	0.6	**47.80**
2038	(18.5)	0.4	0.00	47.6	0.0	1.0	0.6	**67.26**
							EIRR	**26.81%**
							NPV	**123.97**

( ) = negative, EIRR = economic internal rate of return, NPV = net present value, VOC = vehicle operating cost.
Source: Asian Development Bank estimates.

14. **Sensitivity analysis.** Sensitivity analysis was carried out to test the effects of negative changes in the key parameters that determine the benefits and costs for the project road. The switching value is the percentage change necessary to result in the EIRR falling below 12%. The sensitivity analysis (Table 7) indicates that total costs would have to increase by 200% or traffic decrease by 47% for the EIRR to be reduced to the viability threshold level of 12%. Even in the worst case, which combines 40% increasing capital cost and 40% traffic reduction, the EIRR would only decrease to 17.2%, which still exceeds the hurdle rate of 12.0%. Assuming no travel time benefits also reduces the return to 17.2%. Based on these results, the investment analysis and conclusions are robust.

15. **Financial sustainability.** Incremental recurrent costs associated with the project are estimated to be 0.63% of the current maintenance budget of the MOTC and 0.16% of the overall budget on an annual basis. The allocation for road maintenance was on average around Som1,071.1 million until financial year (FY)2010 and has been increased to Som1,397.6 million in FY2012 and Som1,836.4 million in FY2013. The budget allocation for road maintenance in FY2013 was assessed to meet the maintenance needs for the international roads maintained by the MOTC, and the government is committed to maintaining a similar level of budget for road maintenance works. Thus, it is reasonable to expect that funds will be available to meet the maintenance costs of the project road.

Table 6: Cost and Benefit Flow, Madaniyat–Jalal-Abad Section

($ million)

	Road Agency Costs			Savings in Road User Costs				
				Normal (+ Diverted) Traffic		Generated Traffic		
Year	Capital Works	Recurrent Works	Savings in Existing	VOC	Time	VOC	Time	Total
2016	13.5	0.3	2.56	0.0	0.0	0.0	0.0	**(11.25)**
2017	24.2	0.3	0.35	1.2	0.6	0.0	0.0	**(22.43)**
2018	16.2	0.3	0.41	1.5	0.8	0.0	0.0	**(13.75)**
2019	0.0	0.3	0.44	8.4	3.8	0.2	0.1	**12.61**
2020	0.0	0.7	0.46	9.0	4.1	0.2	0.1	**13.17**
2021	0.0	0.9	3.05	9.6	4.5	0.2	0.1	**16.54**
2022	0.0	1.0	0.35	9.0	4.2	0.2	0.1	**12.82**
2023	0.0	1.1	0.35	9.5	4.5	0.2	0.1	**13.64**
2024	0.0	1.1	0.35	10.0	4.9	0.3	0.1	**14.50**
2025	0.0	1.1	0.35	10.4	5.2	0.3	0.1	**15.24**
2026	0.0	1.1	3.05	10.7	5.6	0.3	0.1	**18.65**
2027	17.4	0.6	0.35	9.5	5.1	0.2	0.1	**(2.73)**
2028	0.0	0.6	0.35	11.5	5.7	0.3	0.1	**17.37**
2029	10.1	0.3	0.35	12.2	6.2	0.3	0.2	**8.72**
2030	0.0	0.3	0.35	13.5	6.7	0.3	0.2	**20.80**
2031	0.0	0.3	3.05	14.5	7.3	0.4	0.2	**25.00**
2032	0.0	0.3	0.35	13.6	6.8	0.3	0.2	**20.96**
2033	0.0	0.3	0.35	14.5	7.4	0.4	0.2	**22.42**
2034	0.0	0.3	0.35	15.5	7.9	0.4	0.2	**23.98**
2035	7.1	0.3	0.00	16.5	0.0	0.4	0.2	**9.68**
2036	4.5	0.4	0.00	18.5	0.0	0.5	0.2	**14.30**
2037	5.8	0.3	0.00	18.0	0.0	0.5	0.2	**12.60**
2038	(7.7)	0.3	0.00	20.1	0.0	0.5	0.2	**28.13**
							EIRR	**23.56%**
							NPV	**44.90**

( ) = negative, EIRR = economic internal rate of return, NPV = net present value, VOC = vehicle operating cost.
Source: Asian Development Bank estimates.

Table 7: Sensitivity Analysis

Scenario	EIRR (%)	NPV ($)	Switching Value (%)
Base case	25.72	168.86	
Increase total cost 40%	19.91	135.74	204%
Decrease VOC savings 40%	20.84	110.74	116%
Exclude time savings	17.20	59.74	155%
Reduce traffic 40%	14.17	24.97	47%
No traffic growth	20.74	97.39	NA
Cost +40%, benefit –40%	17.20	60.53	62%

EIRR = economic internal rate of return, NA = not available, NPV = net present value, VOC = vehicle operating cost.
Source: Asian Development Bank estimates.