ECONOMIC AND FINANCIAL ANALYSIS

A. Background and Introduction

1. Roads are the main mode of transport in Pakistan, accounting for 96% of inland freight and 92% of passenger traffic. According to the Pakistan Economic Survey, 2013–2014,[1] Pakistan has 263,755 kilometers (km) of public roads, of which 12,131 km are classified as motorways or national highways; the remainder is classified as either provincial highways or local roads. The motorway and highway network comprises less than 5% of the total road length, but caters to about 80% of total traffic. Despite the high levels of reliance on road transport, the quality of the infrastructure is still cause for concern. Although national highways attracted considerable investments since 2005, they need further improvement—only 7% are in good condition, and 26% are in *poor* or *very poor* condition.[2]

2. Project 1 of the investment program will finance the upgrading of 143 km of the N55 highway, specifically (i) building an additional two lanes of the Petaro–Sehwan section (66 km), (ii) building an additional two lanes of the Ratodero–Shikarpur section (43 km), and (iii) rehabilitating the existing four-lane Dara Adamkhel–Peshawar section (34 km). Subsequent projects will finance the upgrading of other sections, including Shikarpur–Rajanpur and DG Khan–DI Khan.

3. With the project, the N55 between Kotri and Shikarpur will be made a consistent, four-lane divided highway facility with asphalt concrete pavement. Improvements to the existing carriageway, including resurfacing and rehabilitation, will also be carried out where necessary. Without the project, the N55 will remain a mixture of two lanes and four lanes, limiting its overall capacity. The traffic demand consists of normal growth and generated traffic from infrastructure upgrade projects financed by the government and other development partners.

B. Traffic Studies

4. To study the viability of the investment program and the individual projects under it, a traffic demand forecasting model was developed, and the impact of the investment proposals upon the operation of the Pakistan highway network assessed. The model estimates current demand on the existing road network validated by means of field surveys, and forecasts future traffic for a 20-year project horizon to 2036 for both with- and without-project scenarios. Data on current traffic was sourced from surveys done by the National Highway Authority (NHA) from 2013 to 2016. This was augmented with new traffic counts, traffic interview surveys, and journey time surveys where required.

5. To estimate growth in normal traffic, general increases in population, economic activity, and vehicle ownership over time were considered. Traffic growth rates were then estimated using elasticity values derived from historical growth in vehicle registration and socioeconomic variables obtained from published World Bank data. Vehicle occupancy rates were assumed to remain constant throughout the assessment period at 2 per motorcycle, 3 per car, 12 per wagon, 15 per minibus, and 45 per bus. Growth rates were adjusted for the impact of rail investment and subsequent increase in the mode share for the overall commercial freight market. Table 1 shows the resultant growth factors with a rate decay applied every 5 years to reflect the slower growth with greater volume.

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[1] Government of Pakistan, Ministry of Finance. 2014. *Pakistan Economic Survey 2013–2014*. Islamabad.
[2] Data provided by NHA based on its road asset management system.

Table 1: Normal Traffic Growth Factors (%)

Type of vehicle	2016–2020	2021–2025	2026–2030	2031–2036
Motorcycle	5.6	5.0	3.9	2.3
Car	8.1	7.3	5.6	3.4
Wagon	3.5	3.1	2.4	1.5
Mini bus	3.8	3.2	2.9	2.7
Regular bus	3.8	3.2	2.9	2.7
Rigid truck	5.4	5.0	4.7	4.3
Articulated truck	7.5	7.0	6.5	5.9
Other	2.0	1.7	1.5	1.4

Source: ADB.

6. It is conservatively assumed that diverted and generated traffic will be 10% of the normal traffic. It is also assumed that this traffic will arise after project completion (year 3 of the project). The resulting traffic forecasts for the three sections are in Table 2.

Table 2: Traffic Forecasts of Project 1
(annual average daily traffic)

Year	1: Petaro–Sehwan	2: Ratodero–Shikarpur	3: Dara Adamkhel–Peshawar
2015	5,122	4,518	10,207
2020	6,719	6,193	13,992
2025	8,373	7,718	17,436
2030	10,434	9,618	21,729
2036	13,588	12,525	28,297

Source: ADB.

C. Economic Costs

7. Economic analysis considers real costs (exclusive of taxes, duties, and subsidies), which are transfer payments and do not represent use of any real resources. Therefore, taxes and duties are excluded from market prices to arrive at real costs. The financial costs estimated based on measured quantities of works and materials and schedule of rates of NHA were converted into economic costs by a series of conversion factors, computed with latest trade and tax data. Table 3 provides details on the conversion factors applied for civil works. Resettlement costs included some transfer payments and these have been excluded in line with ADB guidelines. Land prices were adjusted to reflect their opportunity cost, based on factors used in similar projects in Pakistan. The estimated opportunity cost of land is 90% of nominal prices.

Table 3: Conversion Factors

Item	Applicable Factor	Composition (%)	Conversion Factor	Adjustment Factor
Materials				
(i) Tradable	SERF	15	1.04	0.156
(ii) Nontradable		20	1.00	0.200
Equipment (nontradable)		25	1.00	0.250
Labor				
(i) Skilled	Skilled SWR	10	0.90	0.090
(ii) Unskilled	Unskilled SWR	15	0.75	0.113
Tax		15	0.00	0.000
Total		**100**		**0.809**

SERF = shadow exchange rate factor, SWR = shadow wage rate.
Source: ADB.

8. In terms of the maintenance regime for both with- and without-project scenarios, it was assumed that (i) patching of potholes would be conducted when the number of potholes is more than 10 per kilometer; (ii) sealing of cracks would take place when transverse thermal cracks are more than 10 per kilometer; (iii) edge repair would be made when the edge break area is more than 5 m^2 per kilometer. The with-project scenario assumes that an overlay of 25 mm is added when roughness reaches 4 on the international roughness index (IRI). The cost of maintenance operations is estimated based on the schedule of rates in Table 4.

Table 4: Cost of Maintenance Operations ($/$m^2$)

Activity	Unit	Economic	Financial
Overlay 25 cm	m^2	9.44	11.66
Surface dressing	m^2	1.89	2.33
Pothole patching	m^2	11.84	14.62
Crack sealing	m^2	3.42	4.21
Edge repair	m^2	17.72	21.50

cm = centimeters, m^2 = square meter.
Source: Asian Development Bank and National Highway Authority.

D. Economic Benefits

9. The benefits considered are (i) vehicle operating cost savings, and (ii) travel time savings.

10. **Vehicle operating cost savings.** Information on prices of vehicles and tires were obtained from dealer-advertised prices, while prices of fuels and lubricants controlled by the government were obtained from government notifications. Motor vehicles and fuel are common items of taxation, and their prices were adjusted for taxes and duties that are known.

11. **Travel time savings.** Travel time savings were calculated by comparing the time spent in travel (in both with- and without-project cases) multiplied by the value of time. The value of time was estimated based on the per capita gross national income (GNI) of $1,560.7 in 2015–2016, which is based on overall population including infants, children, and senior citizens.[3] It is, however, produced by the working population only. The labor force participation rate being 32.3%,[4] GNI per employed person works out to $4,832, resulting in working time valued at $1.73 per hour based on 350 working days and 8 hours a day. However, considering that not all bus passengers are of working age and that they are of less than average wage class, a lower figure of $1.50 has been taken as the value of working time of a bus passenger. The value of working time of wagon and motorcycle passengers is taken at 1.5 times that of a bus passenger and of car passenger twice that of a bus passenger. Nonworking time is valued at one-third of working time. Work-related trips were estimated to be 80% of all trips by motorcycle and car, and 85% of all trips by wagon and bus. Time savings accruing to freight trips were omitted from the analysis to ensure a conservative approach to benefit estimation.

E. Economic Analysis

12. Economic analysis has been carried out in accordance with ADB's Guidelines for the Economic Analysis of Projects by comparing life cycle costs of road agency and road users with the without-project scenario using discounted cash flow techniques, domestic price numeraire, and price base year of 2017.[5]

[3] Pakistan Economic Survey, 2015–16, Statistical Appendix, Table 1.5.5.
[4] Pakistan Economic Survey, 2015–16, Statistical Appendix, Table 12.1.
[5] ADB. 2017. *Guidelines for the Economic Analysis of Projects.* Manila.

13. The tool of analysis used was version 1.3 of the Highway Development and Management (HDM-4) model of the World Road Association and the World Bank. The model predicts road condition and estimates annual vehicle operation costs over the project life and provides net present value and economic internal rate of return (EIRR) as decision criteria. Table 5 shows that project 1 is highly economically feasible, with an EIRR of 24.3% against the discount rate of 9%.

Table 5: Key Economic Performance Indices

Item	**EIRR** (%)	**NPV** ($ million)
1: Petaro–Sehwan	18.3	95.0
2: Ratodero–Shikarpur	11.7	14.2
3: Dara Adamkhel–Peshawar	41.2	244.8
Project 1	**24.3**	**354.0**

EIRR = economic internal rate of return, NPV = net present value.
Source: National Highway Authority and Asian Development Bank.

F. Sensitivity Analysis

14. The results have been tested for increase in costs, decrease in benefits, and better maintenance strategy (Table 6). The test indicates that a 10% increase in costs and decrease in benefits will not reduce any of the sections to an EIRR below 9%. However, a change in maintenance strategy to one that defers maintenance up to when IRI reaches 8 will reduce EIRR to less than 9% for section 2, thus highlighting the importance of good maintenance.

Table 6: Sensitivity Analysis

	1: Petaro–Sehwan		**2: Ratodero–Shikarpur**		**3: Dara Adamkhel–Peshawar**	
Item	**EIRR** (%)	**SV** (%)	**EIRR** (%)	**SV** (%)	**EIRR** (%)	**SV** (%)
Base case	18.3	…	11.7	…	41.2	…
10% increase in cost	17.3	162.3	10.8	34.8	39.4	735.3
10% decrease in benefits	17.2	61.6	10.7	27.2	39.2	(88.0)
10% increase in cost and 10% decrease in benefits	16.3	…	9.9	…	37.4	…
Delay to project completion by 1 year	18.1	…	10.6	…	37.4	…
Alternative maintenance regime	9.8	…	2.8	…	21.4	…

… = not applicable, EIRR = economic internal rate of return, SV = switching value.
Source: ADB.

Table 7: Cost and Benefit Streams for Project 1
($ million, 2017 real prices, undiscounted)

	Capital Costs	**Incremental Cost of Maintenance**	**VOC Savings**	**Time Savings**	**Net Benefits**
2018	26.3	0.0	0.0	0.0	(26.3)
2019	37.2	0.0	0.0	0.0	(37.2)
2020	43.2	0.0	0.0	0.0	(43.2)
2021	31.1	0.0	0.0	0.0	(31.1)
2022	16.7	1.5	1.1	2.7	(14.4)
2023	0.0	0.0	3.6	8.3	11.9
2024	0.0	0.0	10.8	22.4	33.2
2025	0.0	0.0	18.6	35.9	54.6

	Capital Costs	Incremental Cost of Maintenance	VOC Savings	Time Savings	Net Benefits
2026	0.0	0.0	19.6	38.1	57.7
2027	0.0	0.0	23.0	41.8	64.8
2028	0.0	0.0	25.6	47.5	73.1
2029	0.0	0.0	29.3	55.9	85.2
2030	5.0	0.0	36.3	66.8	98.2
2031	0.0	(0.1)	47.3	83.8	131.2
2032	0.0	(0.1)	57.6	100.6	158.3
2033	17.6	(0.1)	62.4	109.3	154.1
2034	6.1	0.0	64.6	114.5	173.0
2035	0.0	0.0	69.6	120.4	190.0
2036	0.0	0.0	72.5	126.3	198.8
2037	5.0	0.0	76.8	132.2	204.0
				NPV =	354.0
				EIRR (%) =	24.3

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

G. Financial Analysis

15. Road investment and road maintenance are financed by different funding mechanisms. Road investment is funded by the annual budget allocation to the federal Public Sector Development Program. In contrast, road maintenance is funded by a dedicated road maintenance fund outside the federal fiscal budget envelope, the use of which is earmarked only for road maintenance.

16. Through lengthy policy dialogues led by key aid agencies, the government established the dedicated road maintenance fund in 2003, which is financed by toll revenue from the motorways and national highways, federal grants, and other road revenues. Securing a stable source for road maintenance expenditures (free from federal fiscal budget allocations that are usually influenced by political consideration) enabled NHA to adequately plan and effectively prioritize maintenance needs in accordance with the rankings of the road asset management system. In contrast, federal budget allocations for road investment have been erratic, unstable, and insufficient, preventing NHA from effectively planning and funding road development and resulting in the inefficient use of scarce resources.

17. With help from development partners including ADB, NHA established the Road Asset Management Directorate and installed a sophisticated road asset management system (RAMS) based on the HDM-4 model. The system monitors the road conditions of all national highways by regularly collecting pavement condition data, traffic data, falling weight deflectometer data, roughness data, road user and vehicle operating cost data, socioeconomic data, and revenue data from toll plazas. Fed by these data, the system generates the annual road maintenance plan based on the strategy and program analysis, focusing on preventive maintenance. This systematic way of prioritizing road maintenance prevents scarce resources from being misused.

18. The maintenance resources generated through the road maintenance fund have been consistently lower than the unconstrained maintenance requirement calculated by RAMS through

HDM-4 (55%–59% in 2009–2013 but abruptly plummeted to 46% in 2014 and 33% in 2015).[6] RAMS calculates the unconstrained maintenance requirement to upgrade all roads to the level of newly paved roads (IRI of 2.0 m/km). Hence, the unconstrained requirement envisages an ideal situation with no resource constraints. Constrained by scarce national resources, NHA aims to maintain the roads at an average IRI of 3.5 m/km (current average is 4.0 m/km), implying the vehicle operating cost of road users to be kept 30%–40% higher than the ideal situation (IRI of 2.0 m/km). It is a tradeoff between whether the federal government collects more taxes (or reprioritize fiscal resources) and spends them to maintain the roads at an IRI of 2.0 m/km or whether NHA maintains the roads at an IRI of 3.5 m/km with constrained resources while road users bear the cost in the form of higher vehicle operating costs.

19. The distribution of IRI of NHA roads takes a U-shape (not a typical bell-shaped normal curve), with the bottom of the U-shape centered on an IRI of 4.0–5.0 m/km. About a half of total roads have less than 3.0 m/km IRI, while about a quarter have an extremely high IRI of 6.0–7.0 m/km (also known as maintenance backlogs). While RAMS calculates the unconstrained maintenance requirements to upgrade all roads uniformly to the condition of newly paved roads regardless of their current conditions, reconstruction of maintenance backlogged roads should be financed separately by the road investment fund (not by road maintenance fund), because these are considered unmaintainable and their reconstruction goes beyond normal maintenance works. If the roads at the right tail of the U-shape distribution (i.e., maintenance backlogged roads) are reconstructed and moved to the left tail (IRI of 2.0m/km), the unconstrained maintenance requirements will be considerably reduced and NHA will achieve their aim to maintain the roads at an average IRI of 3.5 m/km with a minimal increase in the maintenance fund.

20. NHA plans to reconstruct 1,113 km of maintenance backlogged roads (with residual life less than 2 years) through the assistance of development partners. ADB will assist NHA to reconstruct 498 km through the Sustainable National Highway Maintenance Project, which will be submitted to the Board in 2019.

21. Since NHA was established as a corporate entity, the government budgetary support for road investment has been in the form of government loans to NHA despite NHA's no debt serviceability with its meager revenues hardly covering road maintenance expenditures. The practice leads to severe distortion of NHA's financial statements, accumulation of unserviceable debts and accrued interests in the balance sheet, and huge net losses in the income statement every year because of accrual of interest. As of 30 June 2016, accumulated debt amounts to PRs1.2 trillion ($12 billion) including accrued interest of PRs460 billion ($4.6 billion). With these distorted financial statements, NHA cannot mobilize funds from capital markets to promote public–private partnership. To correct the distortion, the government will consider (i) equitizing NHA's accumulated debt; (ii) revaluing NHA's road assets at current prices; and (iii) treating future government support to NHA for road investment either as government equity investment or as a proper financing modality that NHA can absorb and reflect in its financial statements.

[6] The growing shortfall of the maintenance fund since 2014 was caused not by the shrinkage of road revenue (which shows a consistent increase each year) but by steep hikes of unconstrained maintenance requirements that stemmed from heavy floods in 2010 and 2014 (many flood-damaged roads were left unattended despite NHA's effort for post-flood rehabilitation and degenerated into the unmaintainable category of maintenance backlogs [IRI of 6.0–7.0]).