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An Economic Analysis of Djibouti - Ethiopia Railway Project

Dr. DIPTI RANJAN MOHAPATRA
Associate Professor (Economics)
School of Business and Economics
Madawalabu University
Bale Robe, Ethiopia

Abstract:

Djibouti – Ethiopia railway project is envisaged as a major export and import connection linking land locked Ethiopia with Djibouti Port in the Red Sea's international shipping routes. The rail link is of utter significance both to Ethiopia and to Djibouti, as it would not only renovate this tiny African nation into a multimodal transport hub but also will provide competitive advantage over other regional ports. The pre-feasibility study conducted in 2007 emphasized the importance of the renovation of the project from economic and financial angle. However, as a part of GTP of Ethiopia this project has been restored with Chinese intervention. The operation expected in 2016. The proposed project is likely to provide multiple benefits such as time saving, reduction in road maintenance costs, fuel savings, employment generation, reduction in pollution, foreign exchange earnings and revenue generation. These benefits will accrue to government, passengers, general public and to society in nutshell. Here an economic analysis has been carried out to evaluate certain benefits that the project will realize against the cost streams in 25 years. The NPV of the cost streams @ 12% calculated to be 6831.30 million US$. The economic internal rate of return of investments will be 18.90 percent.

Key words: EIRR, NPV, economic viability, sensitivity analysis

JEL Classification: D6, R4, R42

1.0 INTRODUCTION:

The Djibouti-Ethiopia Railway (*Chemin de Fer Djibouti-Ethiopien*, or CDE) Project is 784 km railway running from Djibouti to Addis Ababa via Dire Dawa. The railway has deteriorated because of absence of commercial motivation. The construction of the line which started in 20th Century became lacklustre project because of lack of maintenance, abysmal management; use of road traffic between Addis Ababa and Port of Djibouti for primary trade. This line is the only railway line connecting directly in between land locked Ethiopia with Red Sea. Djibouti Port has become a major cargo entry point for Ethiopia as it stopped using other port nearby port since 1998. Meanwhile, the freight traffic since then has quadrupled[1]. Both Ethiopia and Djibouti governments are trying to enhance the cross-border transportation capacity to maximum potential as both are joint owners of CDE since 1981. This metric-gauge line is 784 km long of which 685 km are located within Ethiopia and approximately 99 km are in Djibouti. This line covers 30 % of population as well as cultivated land of Ethiopia and 70 percent population of Djibouti. Further the industrial centres of Ethiopia located in Dire Dawa, Awash, Metehara, Modjo, Debre Zeit, Akaki, and Addis Ababa falls along this line. This is envisaged as a major export and import connection linking Ethiopia and rest of the World through Djibouti Port in the Red Sea's international shipping routes and has the potential of becoming a regional transport hub in east African hinterland[2]. Transport service and related activities are considered as major primary activities in Djibouti. Approximately 12,000 jobs exist there in transport related activities in Djibouti. Port and transit services as well as road and rail links are major income and employment source for Djibouti's economy. Seventy percent of GDP of Djibouti comes from service sector which include transport and transit services. The rail connection is supposed to supplement the port activities in Djibouti. The diagrammatic

presentation of Djibouti-Ethiopia Rail link is depicted in Figure 1 below.



Fig. 1: Djibouti-Ethiopia Rail Link (not to the scale)

Technical Feature of Djibouti-Ethiopia Rails: The railway is to be operated at sea level from Djibouti but with an elevation of 2,800 metres above sea level toward Addis Ababa in Ethiopia. Thus the Ethiopian sections of the railway are laid at steep gradients and have curvatures that are being modified in order to use upgraded locomotives at full capacity. The railway has been divided into two sections. First section; with a gauge of 1 meter comprises rails from a low 20 kg/m to 36 kg/m. The second section; with a gauge of 1 meter comprises rails from 20 kg/m rails and can carry traffic with only a maximum axle load of 12 tons, compared to 14 tons for 30 kg/m rails and 17 tons for 36 kg/m rails[3]. The above-mentioned is presented in Table 1.

Table 1: Rail Type

Rail Line	*Type of Rail (Kg/m)*	*Track Length (Km)*
Line A: Djibouti-Dire Dawa	20	94.6
	25	9.7
	30	175.6
	36	28.5
Total		*308.4*
Line B: Dire Dawa-Addis Ababa	20	0
	25	404.1
	30	45.0
	36	23.2
Total		*472.3*

Source: *Financing Transport for Growth in Africa*, 2007.



0km	**Port of Djibouti**
19km	Chebele
	Chebele viaducts
32km	Goubetto
52km	Holhol
	Holhol viaduct
71km	Dasbiyo
88km	Ali Sabieh
98km	Guelile
	Djibouti
	International border
	Ethiopia
108km	Dewele
132km	Adele
140km	Ayesha
162km	Lasarat
	Harr mountains tunnel
202km	Adigale
249km	Milo
266km	Harewa
291km	El Bah
299km	Shinile
311km	**Dire Dawa** (Harar)
338km	Hurso
370km	Erer
377km	Gotha
395km	Bike
421km	Afdem
450km	Mulu
461km	Mieso
475km	Asabot
496km	Kora
518km	Arba Bordode
548km	Awash
	Awash river gorge bridge
579km	Metehara
617km	Malka Jilo
634km	Borchotto
657km	Welenchiti
681km	Adama/Nazaret
708km	Mojo
732km	Debre Zeyit
743km	Dukem
763km	Akaka Beseka
770km	Kaliti
784km	Addis Ababa

Station between Djibouti-Ethiopia Rail Link

(Source: http://www. Wikipedia encyclopedia.html, Ethio-Djibouti Railways, 2016)

2.0 LITERATURE REVIEW

The rail connection between land locked Ethiopia and capital to Red Sea port of Djibouti was initiated by France with establishment of CDE with joint ownership of the government of Ethiopia and Djibouti. At the time beginning of the project the project was considered ambitious and expectations were in height. The company was expected to play a vital role in the socio-economic development of both Ethiopia and Djibouti. But the project was bottlenecked around 2000 on account of inferior quality of railway tracks and lack of infrastructure maintenance. The project was circumvented by number of problems such as slow train services, frequent derailment, high tariff rates (e.g. average of 55 US$ per tonne in rail compared to an average of 30US$ per tonne by road in 2004) which dissuade the clients depending upon rail freight to change to alternative option[4]. The project undertook a major repair work in 1998. However, in 2003 the road freight completed the journey in 3 days compared to 12 days by rail (Cabainus, 2003). This resulted in reduction of rail freight as well as financial turnover. The financial position was so critical that in 2002 CDE was forced to convince it partners - the Agence française de développement (AFD) and the European Commission (EC) to extend the developmental aid. However both the partners agreed for granting an operating concession as both AFD and EC had been recommending this since 1990. By this time the regulations of state aid to French governing state had changed and the provision of sovereign concessional loan to underdeveloped countries was no longer valid. Thus only option left with the AFD to support the CDE initiative was with a non-sovereign loan which required the involvement of a private operator.

The rail link is of utter significance for Djibouti, as it would not only renovate this tiny country into a multimodal transport hub but also will provide competitive advantage over

other regional ports.[5] This would also help both Ethiopia and Djibouti to regenerate their economy and convert it into an economic catalyst. Ethiopia's freight companies will be in advantageous position as Djibouti-Addis Ababa journey is invoiced less than USD 1,500 for a 40 tonne truck by an Ethiopian freight company, compared to USD 3,000 for Djiboutian Freight Company. As per UNDP 2004 report less than 1% of freight is entrusted to Djiboutian freight companies because of the above -mentioned. Besides compared with road transportation especially freight the railway would also provide Ethiopia with a less expensive means of transportation and will augment the country's overall transport capacity. ICA (2007) suggested an investment of USD 68.6 million in this line to maintain the superiority between the costs of transport by truck to the tune of USD 42.80 per tonne, to the cost of USD 15.30 to USD 35.60. As per the report of the United Nations Conference on Trade and Development (UNCTAD, 2003), the cost of transportation represented on average 13.8% of the value of imports in Sub-Saharan Africa, and it goes up to as high as 20.7% for landlocked countries like Ethiopia. Thus the reduction in transportation costs is therefore necessary to reduce the import price of goods in Ethiopia and Djibouti. This will enhance the competitiveness of exports for other countries. Secondary benefit comes in many ways such as major savings could be realised through road maintenance and rehabilitation works e.g. 100,000 heavy trucks weighing 30 tonnes each causes road surface damage equivalent to 240,000 cars (Cabanius, 2003) requiring an investment to the tune of EUR 26 million to rehabilitate 100 km of road in Djibouti. Further, rail requires full rehabilitation every 15 to 20 years, compared to 7 to 10 years for roads. The rail link would also reduce the volume of petrol imports for freight carriers and limit carbon dioxide emission levels. This could be reduced up to 75% for a railroad's energy consumption and 85% carbon footprint could compared to that for highway(Pozzo di Borgo, 2011).

Coming back to Ethiopian perspective the electrification of Ethiopian-Djibouti railway was transferred to two Chinese companies with a contract of $3.4 billion line connecting Addis Ababa to the Djiboutian border by 2016. The 756 km line replaces the out-of-use metre-gauge railway between Addis Ababa and the coast. In 2011 Ethiopian Railway Corp awarded China Railway Engineering Corporation (CREC) a contract to build the 330 km Sebeta/Addis Ababa to Miesso section, and China Civil Engineering Construction Corporation (CCECC) the contract for the 339 km from Miesso to Ethiopia's border with Djibouti. This is a part of Ethiopia's Growth and Transformation Plan (GTP), which seeks to boost up economic growth and achieve middle income status by 2025 as well as to revitalize its export sectors and energised Ethiopia's international relations with South & East Asia, North & South America, Africa and Europe. This a part of Ethiopia's grand series of eight key trade route rail corridors of 4,744 kilometres with Kenya, South Sudan, Sudan and Djibouti.

The double digit economic growth of Ethiopia is one of the remarkable growth stories making it one of the highest performing economies in Africa. According to African Economic Outlook (AEO) of African Development Bank (A_fDB) the real GDP of Ethiopia will remain around 10.3% in 2015-16[6]. At the same time the AEO figure of the real GDP growth (P) of Djibouti is 6.0% for 2015 and likely to increase to 6.2 percent in 2016 (provisional figure)[7]. The transit traffic between Djibouti and Ethiopia increased manifold after Dubai Port International (DPI) - now DP World since 2005- started operation in Djibouti port in June 2000 with signing of a 20 years concession between Dubai Ports International (DPI) and Djibouti government. Latter the contract of managing Djibouti airport was also granted to DP World (formerly DPI) in July 2001[8]. This contract was considered to be a major catalyst to enhance Djibouti's economic performance. Further increasing the competitiveness of existing infrastructure expected to increase

the business compatibility and more trade for Ethiopia as well as smooth operation of the Djibouti port. The said link is not only a vital connection between major industrial centres of Ethiopia and rest of the World but also a major market link of the two east African nations with other industrial hubs of the World. It is expected to reduce the poverty level by creating more job opportunities in port and transit services, and related transport activities in rail and road.

Economic Validation: As per the report of the pre-feasibility study report of Hifab International (2007), there is a sharp decline in the freight traffic on the railway from 450,000 tons per year in 1975 to 215,000 tons per year, and passenger traffic from 1.4 million passengers per year to 650,000 passengers per year. It further stated that the railway traffic could increase from its present level of 250,000 tons per year to 1,500,000 tons per year or more from the sixth year of operations and onward by enhancing railway stocks, providing efficient services and adopting an aggressive marketing policy. However the transit traffic has increased enormously after provision of private concession of Djibouti's port and airport and further naming of Djibouti port as Ethiopia's gate port. The railway represents only 5 percent of total traffic although the total distances to be travelled are 780 km by rail vis-à-vis 918 km by road. The reason may be due to lack of locomotives for the rail and high competition from road transportation through Addis Assab road (via Dikhil and Galafi, with a connection to the Djibouti port. It is expected that restoration of rail track and provision of concession to railway, reduction of rail transport time and re defining the reliability of rail services and etc. will enhance the share of rail traffic.

The study conducted by Hifab International in 2007 on rail road cost concluded that considering the condition of the existing road, and distance in road transport and further with an assumption of 80 percent of trucks return empty from Addis

Ababa to Djibouti, the economic costs of transportation by truck is US$ 42.8 per ton. The consultant had considered three rehabilitation conditions in which it was found to be costing in between US$ 15.3 to US$ 35.6 per ton in rail. Thus, they concluded that the rail enjoy a competitive advantage over road transportation in terms of cost of transportation.

The economic rate of return using a cost of 35$ per tonne of freight carriage by rail and adopting a medium rehabilitation scenario as used by Hifab International and comparing with an all-truck transportation scenario, an economic rate of return of 20 % was obtained as per the report of *ICA Meeting: Financing Transport Growth in Africa* (2007, p-8).

3.0 OBJECTIVE:

The objective of this paper is to carry out an economic analysis to assess the viability of the Ethiopia – Djibouti railway project in term of cost-benefit approach for a horizon period of 25 years.

4.0 METHODOLOGY AND APPROACH

Economic viability of the project is being assessed within the broad framework of "Cost-Benefit Analysis", generally used for appraisal of public investment projects. In economic evaluation, benefits are computed for the economy as a whole rather than for an individual entity that has made the investment. In case of financial analysis the profits become the major factor for evaluation whereas in economic analysis the benefits to the economy are the main criteria for evaluation.

The economic analysis involves comparison of project costs and benefits in economic terms under the "with" and "without" project conditions and determination of the Economic Internal Rate of Return (EIRR) of the project using discounted cash flow technique. This shows the return which the society could expect from the proposed investment during the project

life, i.e. the benefit period. The feasibility of the project is determined by comparing the EIRR with the current accounting rate of return of 12%. This represents the opportunity cost of capital and is considered an appropriate minimum criterion for economic viability by both the Federal Republic of Ethiopia and international funding agencies like the World Bank and the African Development Bank (A_fDB).

The main steps followed here are:

i) Estimation of future traffic on the proposed facilities
ii) Estimation of capital and operation costs at economic prices
iii) Estimation of economic benefits
iv) Comparison of annual streams of costs with benefits and estimation of EIRR

The project is further subjected to sensitivity analysis by assessing the effects of adverse changes in the key variables on the base EIRR. This helps to gauge the economic strength of the project to withstand future risks and uncertainties.

5.0 PROJECT COST AND SCHEDULING

The total project cost is estimated as 4278 million US$. Out of this total Ethiopian part of the project will cost around 3400 million US$ and development in Djibouti will cost around 878 million US$. 55% of the total project cost will be financed through external debt from China Export-Import Bank and 45 % will be financed by raising equity in the open market by Ethiopian government. The debt and equity ratio thus is 55:45.

The project cost consists of two main components:

- Capital cost
- Operation cost

Economic analysis requires the conversion of financial costs into economic costs to take care of distortions in prices due to market imperfections. Taxes and duties are removed from financial prices as these are not real costs to the economy, but are only transfer payments.

All financial costs have been converted into economic costs by applying a Standard Conversion Factor (SCF) of 0.85, as suggested by the Ministry of Transport, Ethiopia and AfDB/World Bank and is generally used for economic evaluation of transport projects in Africa.

5.1 Capital Cost

The capital cost includes the cost of construction of Light Rail Transit system in Addis. This will be incurred from 2011 to 2015 for this project. The financial cost of LRT is estimated at market prices. The economic cost is derived by applying SCF of 0.85 to the financial cost. The capital cost of the project in financial and economic terms is presented in **Table 1**.

Table 1: Capital Cost of the LRT Project at 2015 Prices *(In million US$)*

Sl. No.	*Total Cost*	*Financial Cost*	*Economic Cost*
1.	Capital cost of Ethiopia-Djibouti Rail	4278.00*	3636.30

Source: Ministry of Transport, Ethiopia and Transport Minister Djibouti, Walta Information Center Addis Ababa, Ethiopia, July 2015
*(*The total amount of 4278 million US$ includes 3400 million US$ from Addis Ababa to Djibouti border and 878 million from Djibouti port to Ethiopia border in Djibouti)*

5.2 Operation Cost

Operation costs are recurring costs for daily operation of freight railway services comprising routine cost components. Operation cost per ton of freight has been calculated taking into account the Scenario 3 of Hifab International feasibility studies as the base and modifying it at 2015 market prices. The operation cost

slab to calculate the financial operation cost is presented in Table 2 below.

Table 2: Operation Cost Slab* (in USD)

Period	*Cost per ton of freight*
Year 1 to Year 5	18.5
Year 6 to Year 10	15.3
Year 11 to Year 15	15.8
Year 16 to Year 20	16.9
Year 21 to Year 25	16.4

**Calculated by author*

The annual operation cost of the project in financial and economic terms are summarized in **Table 3**.

Table 3: Operation Cost of the Project at 2016 Price*
(In million US$)

Year	*Operation Cost (financial)*	*Operation Cost (Economic)*
2016	129.87	110.39
2017	152.52	129.64
2018	179.11	152.25
2019	210.35	178.79
2020	262.15	222.83
2021	270.20	229.67
2022	280.62	238.53
2023	291.45	247.73
2024	302.69	257.29
2025	314.37	267.22
2026	337.17	286.60
2027	360.22	306.18
2028	384.84	327.11
2029	411.14	349.47
2030	439.24	373.35
2031	501.93	426.64
2032	519.50	441.57
2033	537.68	457.03
2034	556.50	473.02
2035	575.98	489.58
2036	578.50	491.72
2037	595.85	506.48
2038	613.73	521.67
2039	632.14	537.32
2040	651.10	553.44

**Calculated by author*

6.0 Debt-Equity Model:

For this project a debt-equity model on 55:45 patterns has been assumed. The debt to be incurred EXIM Bank China is 1.2 times of the equity to be raised from the market. A loan repayment period of 15 years from 2011-2025 has been further assumed. The total debt amount is 2352.90 million US$ and the equity amount is 1925.10 million US$. The interest rate on the debt is taken as @3% per annum. Total amount of interest rate to be paid during this period is calculated as 550.58 million US$. The assumption of the debt-equity model is presented in Table 4.

Table 4: Assumptions of Debt-Equity Model

Sl. No.	***Items***	***Assumptions***
1	Debt -Equity	55:45
2	Interest Rate	3%
3	Moratorium Period	5 year
4	Loan Repayment Period	15 years.
5	Infrastructure Development	4 years

The debt-equity model is presented in Table 5.

Table 5: Debt-Equity Model

(In million US$)

Year		*Opening Balance*	*Loan*	*Interest*	*Principal Repayment*	*Closing Balance*	*Equity*
Year 1	2011	0.00	470.58	14.12	0.00	470.58	385.02
Year 2	2012	470.58	470.58	28.23	0.00	941.16	385.02
Year 3	2013	941.16	470.58	42.35	0.00	1411.74	385.02
Year 4	2014	1411.74	470.58	56.47	0.00	1882.32	385.02
Year 5	2015	1882.32	470.58	70.59	0.00	2352.90	385.02
Year 6	2016	2352.90	0.00	70.59	156.86	2196.04	0.00
Year 7	2017	2196.04	0.00	65.88	313.72	1882.32	0.00
Year 8	2018	1882.32	0.00	56.47	313.72	1568.60	0.00
Year 9	2019	1568.60	0.00	47.06	313.72	1254.88	0.00
Year 10	2020	1254.88	0.00	37.65	313.72	941.16	0.00
Year 11	2021	941.16	0.00	28.23	313.72	627.44	0.00
Year 12	2022	627.44	0.00	18.82	313.72	313.72	0.00
Year 13	2023	313.72	0.00	9.41	156.86	156.86	0.00
Year 14	2024	156.86	0.00	4.71	156.86	0.00	0.00
Year 15	2025	0.00	0.00	0.00	0.00	0.00	0.00

Calculated by author

7.0 PROJECT BENEFITS

The economic benefits of the Ethiopia –Djibouti railway project is realized by the changes brought out by it in the transport sector of the economy. A high proportion of freight traffic from road is diverted to railway transportation because of the operation of this rail. Reduction in numbers of truck on road reduces the annual road maintenance. The vehicular pollution gets reduced with this project as the rail will be run on electricity and there is less use of gasoline and diesel. Thus, there will also be high amount of fuel savings and saving in foreign exchange. Benefits will also come in terms of employment generation for unskilled labor during construction period of LRT (2011 -2015) as well as to the skilled and unskilled professionals during the operation phase. The freight and fare box revenues are the financial benefits from this railway project. The benefits accrue to the local economy due to operation of this rail projects are many. However, certain economic benefits are easy to quantify and certain other are complex in nature to calculate due to paucity of data. Here the following benefits have been quantified against the cost streams. Benefits from this railway project will be both direct and indirect. The indirect benefits like increase in exports (which is related to the country's external sector), improved environmental conditions, saving in time etc. are difficult to quantify and hence are not included in this economic analysis. The present analysis, however, is restricted to quantification of direct benefits as presented below.

- ✓ Revenue tariff from freight and,
- ✓ Revenue tariff from passenger fares
- ✓ Employment generation for both professional and unskilled labor.

The above-mentioned benefits have been considered here for economic evaluation and are taken as "*With project*" situations.

The cost-benefit stream of this railway project which has been taken into consideration for economic analysis in this study is presented in Table 6.

Table 6: Cost-Benefit Streams

Sl. No.	*Cost*
1	Capital Cost of the project
2	Operation Cost
Benefits	
1	Revenue tariffs from freight traffic
2	Revenue tariff of operation from passenger fare
3	Employment generation

7.1 Revenue Tariffs

Revenue will be generated from both freight and passenger traffic. However the major consideration here is freight traffic. The total revenue tariff includes revenue generated from freight tariffs and passenger tariffs.

7.1.1 Freight Tariffs: The freight rate in Djibouti-Ethiopia railway corridor has been calculated by taking the Transport cost in Ethiopia as the base and then calibrating it to the 2015 market price. The cost of transport in Djibouti – Ethiopia corridor per ton kilometer is 1.74 $. Thus the revenue comes around 38.4$ per ton for a distance of 784 kilometer between Djibouti and Addis Ababa. But for the rail project corridor, we have considered 35$ per ton for 2016 -2020, then a subsequent increase in revenue tariff by 10% each time from the 5th years onward up to 2040. The revenue tariff per ton from Djibouti to Addis Ababa is presented in Table 7.

Table 7: Freight Tariff Slab in Djibouti-Addis Ababa Railway Project *(per ton of freight)*

Year	*Tariff (in USD)*
2016 -20	35.0
2021 -25	38.5
2026-30	42.4
2031-35	46.6
2036-40	51.2

The freight tariffs have been calculated from 2016 taking into account that the operation of Djibouti –Addis Ababa will be operational from 2016. The revenue tariff per annum for 25 years (2016 to 2040) calculated is presented in Table 8.

Table 8: Revenue Tariffs from Freight Traffic During 2016-2040

Year	*Tariff (in Million USD)*
2016	245.70
2017	288.54
2018	338.86
2019	397.95
2020	495.96
2021	679.91
2022	706.14
2023	733.39
2024	761.68
2025	791.07
2026	903.75
2027	965.52
2028	1031.51
2029	1102.01
2030	1177.33
2031	1383.57
2032	1432.00
2033	1482.12
2034	1533.99
2035	1587.68
2036	1807.58
2037	1861.81
2038	1917.66
2039	1975.19
2040	2034.44

Calculated by author

7.1.2 Passenger Tariffs: The distance between Addis Ababa to Djibouti Port is 784 kilometer. Djibouti Port to Dire Dawa 311 km and Dire Dawa to Addis Ababa 473 km. The service of the train meant for passenger is not regular and suffer from many bottlenecks. There are three categories of passenger services in this line such as 1st class, 2nd class and 3rd class with different tariff rates in Ethiopia and Djibouti. The ticket charges are little higher in Djibouti compared to Ethiopia. The rate of one

way ticket from Dire Dawa to Djibouti in March 2014 was 8.2 US$ {155 Ethiopian Birr (ETB)} in 2nd class whereas in Djibouti it was 22 US$ {3600 Djibouti Francs (DJF)}. Thus, here we have taken a weighted average of all the three class considering both Ethiopian and Djiboutian calculation of fare structure from Addis Ababa to Dire Dawa and Dire Dawa to Djibouti Port and have followed a very minimum fare structure of 510 ETB equivalent to 24.34 US$ in 2016. This rate has been considered up to 2020. The rate has been hiked @ 10% in every five years. The passenger ticket fare from Addis Ababa to Djibouti considered for economic analysis is presented Table 9.

Table 9: Passenger Tariff Rates (in US$)

Year	*2016-20*	*2021-25*	*2026-30*	*2031-35*	*2036-40*
Ticket Fare	25.50	28.05	30.86	33.94	37.33

Calculated by author

The revenue generated from passenger tariff from 2016 to 2040 presented in Table 10.

Table 10: Revenue Tariff from Ticket during 2016-2040

Year	*Tariff (in Million USD)*
2016	132.69
2017	135.39
2018	138.15
2019	140.95
2020	158.20
2021	161.42
2022	164.70
2023	168.05
2024	171.47
2025	192.54
2026	196.45
2027	200.44
2028	204.52
2029	208.68
2030	233.85
2031	238.60
2032	243.46
2033	248.41
2034	253.46

Year	*Tariff (in Million USD)*
2035	284.47
2036	290.26
2037	296.16
2038	302.18
2039	308.32
2040	314.59

Calculated by author

The total revenue generated both from freight tariff and passenger tariff during 2016 to 2040 presented in Table 11.

Table 11: Total Revenue Tariff from Freight and Passengers during 2016-2040

Year	*Tariff (in Million USD)*
2016	421.24
2017	474.25
2018	536.10
2019	636.91
2020	838.11
2021	867.56
2022	898.09
2023	929.73
2024	962.54
2025	1096.28
2026	1161.97
2027	1231.94
2028	1306.53
2029	1386.01
2030	1617.42
2031	1670.60
2032	1725.58
2033	1782.40
2034	1841.14
2035	2092.05
2036	2152.06
2037	2213.82
2038	2277.37
2039	2342.77
2040	2410.07

Calculated by author

7.2 Employment Generation

The railway project creates jobs for both unskilled labours and skilled professional. As defined by Murty and Goldar (2006) in Indian context, the unskilled labour employed on the construction and maintenance of railway projects will be benefited to the extent of the difference between the project wage rate and the wage rate in an alternative employment.

Employment of Unskilled Labour: The job created for unskilled labour in Addis Ababa –Djibouti rail project is defined below:

- Number of unskilled labour working in the construction of Railway = 3000
- Working days in a year = 300
- No of years since construction begin (2011 -2015) = 4 year = 1200 days
- Wage rate per day = ETB 90 = 4.46 USD
- Total earnings in 4 years up to 2015 = 324,000,000 ETB = 16.04 million US$
- Increase in wage rate per annum = 5%
- Number of unskilled labour employed daily after 2015 construction end = 1000
- Increased in number of unskilled labour every year = 5%

Employment of Skilled Professional: The job created for skilled professional in Addis Ababa –Djibouti rail project is defined below:

- Number of skilled professional working in the construction of LRT = 2500
- Working days in a year = 300
- No of years since construction begin (2012 -2015) = 4 year = 1200 days
- Wage rate per day = ETB 230 = 11.37 USD
- Total earnings in 4 years up to 2015 = 688,780,000 ETB = 688.78 million US$

- Increase in wage rate per annum = 5%
- Number of skilled professional employed daily after 2015 construction end = 2500
- Increased in number of skilled professional every year = 5%

The monetary income (benefits) for both unskilled labour and skilled professional are presented in Table 12.

Table 12: Benefits from Employment Generation

Year	***Income Generation from Employment (in million US$)***		
	Income of Unskilled Labour	*Income of Skilled Professional*	*Total Income*
2016	1.40	82.23	83.64
2017	1.55	95.20	96.74
2018	1.71	110.20	111.91
2019	1.88	127.57	129.45
2020	2.07	147.68	149.76
2021	2.29	170.96	173.25
2022	2.52	197.91	220.43
2023	2.78	229.10	231.88
2024	3.06	265.22	268.28
2025	3.38	307.02	310.40
2026	3.72	355.41	359.14
2027	4.11	411.44	415.54
2028	4.53	476.29	480.82
2029	4.99	551.36	556.35
2030	5.50	638.27	643.77
2031	6.07	738.88	744.95
2032	6.69	855.35	862.03
2033	7.37	990.17	997.54
2034	8.13	1146.25	1154.37
2035	8.96	1326.92	1335.89
2036	9.88	1536.08	1545.96
2037	10.89	1778.20	1789.10
2038	12.01	2058.49	2070.50
2039	13.24	2382.96	2396.30
2040	14.60	2758.58	2773.18

Calculated by Author

8.0 ECONOMIC ANALYSIS

The cost-benefit analysis would signify whether adequate returns in terms of benefit results from making such a huge

capital investment. The appraisal is done based on the costs and benefit that would be incurred over the analysis period if no investment *(without project condition)* is made and by comparing the costs and benefits arising as a result of making the investment. The annual cost and benefit streams are used to derive the net cash flow for the project. The analysis considers 25 years of benefit period from the opening year i.e. 2016. For the present purpose, the viability has been established by assessing the Economic Internal Rate of Return (EIRR) and Net Present Value (NPV) using the discounted cash-flow technique for the project. The EIRR has been compared with the accounting rate of return of 12 percent. The result is presented in **Table 13.**

Table 13: Result of the Economic Analysis (EIRR)

Year	Cost					Benefits			Net Benefit
	Capital	Operating	Interest on debt	Equity capital	Total Cost	Revenue	Employment Generation	Total Benefits	
2016	3636.30	110	14.12	385.02	*4145.83*	421.24	86.45	*507.68*	*-3638.14*
2017		130	28.23	385.02	*542.89*	474.25	99.84	*574.09*	*31.20*
2018		152	42.35	385.02	*579.62*	536.10	115.32	*651.42*	*71.80*
2019		179	56.47	385.02	*620.28*	636.91	133.22	*770.13*	*149.84*
2020		223	70.59	385.02	*678.43*	838.11	153.90	*992.01*	*313.58*
2021		230	70.59	0.00	*300.26*	867.56	177.82	*1045.38*	*745.12*
2022		239	65.88	0.00	*304.41*	898.09	205.47	*1103.56*	*799.15*
2023		248	56.47	0.00	*304.20*	929.73	237.44	*1167.17*	*862.97*
2024		257	47.06	0.00	*304.35*	962.54	274.41	*1236.94*	*932.59*
2025		267	37.65	0.00	*304.86*	1096.28	317.15	*1413.44*	*1108.57*
2026		287	28.23	0.00	*314.83*	1161.97	366.59	*1528.55*	*1213.72*
2027		306	18.82	0.00	*325.01*	1231.95	423.75	*1655.71*	*1330.70*
2028		327	9.41	0.00	*336.52*	1306.53	489.87	*1796.40*	*1459.87*
2029		349	4.71	0.00	*354.17*	1386.01	566.33	*1952.34*	*1598.17*
2030		373	0.00	0.00	*373.35*	1617.42	654.78	*2272.20*	*1898.85*
2031		427	0.00	0.00	*426.64*	1670.60	757.08	*2427.68*	*2001.04*
2032		442	0.00	0.00	*441.57*	1725.58	875.41	*2600.98*	*2159.41*
2033		457	0.00	0.00	*457.03*	1782.40	1012.29	*2794.69*	*2337.66*
2034		473	0.00	0.00	*473.02*	1841.14	1170.63	*3011.77*	*2538.75*
2035		490	0.00	0.00	*489.58*	2092.05	1353.81	*3445.86*	*2956.28*
2036		492	0.00	0.00	*491.72*	2152.06	1565.72	*3717.78*	*3226.06*
2037		506	0.00	0.00	*506.48*	2213.82	1810.88	*4024.70*	*3518.23*
2038		522	0.00	0.00	*521.67*	2277.37	2094.52	*4371.89*	*3850.22*
2039		537	0.00	0.00	*537.32*	2342.77	2422.69	*4765.45*	*4228.13*
2040		553	0.00	0.00	*553.44*	2410.07	2802.37	*5212.44*	*4659.00*
EIRR									*18.90%*
NPV @12%									*$6,831.30*

Calculated by Author

The Economic Internal Rate of Return of Addis Ababa – Djibouti railway project is 18.90% is well above the desired rate of return of 12%. Thus the project is economically viable. The

NPV of all the cost streams calculated @ 12% is 6831.30 million US$.

9.0 SENSITIVITY ANALYSIS

The robustness of the project's viability is further demonstrated by the sensitivity analysis. Because of the uncertainties surrounding many of the variables like freight traffic forecasts, cost changes etc., a sensitivity analysis is carried out to test the economic strength of the project. The variations in the following parameters have been examined, considering them to be on the conservative side:

i) Increase in cost by 15 percent
ii) Decrease in benefits by 15 percent
iii) Increase in cost by 15 percent and decrease in benefits by 15 percent

The results of the sensitivity analysis are presented in **Table 14.**

Table 14: Sensitivity Analysis
(In million US$)

Year	*Cost increase by 15%*	*Benefits decrease by 15%*	*Cost increase by 15% and Benefits Decrease by 15%.*
2016	-4260.02	-3714.30	-4336.17
2017	-50.24	-54.92	-136.35
2018	71.80	-25.91	-25.91
2019	149.84	34.32	34.32
2020	313.58	164.78	164.78
2021	745.12	588.32	588.32
2022	799.15	633.61	633.61
2023	862.97	687.89	687.89
2024	932.59	747.05	747.05
2025	1108.57	896.56	896.56
2026	1213.72	984.44	984.44
2027	1330.70	1082.34	1082.34
2028	1459.87	1190.41	1190.41
2029	1598.17	1305.32	1305.32
2030	1898.85	1558.02	1558.02
2031	2001.04	1636.89	1636.89
2032	2159.41	1769.26	1769.26
2033	2337.66	1918.46	1918.46

2034	2538.75	2086.98	2086.98
2035	2956.28	2439.40	2439.40
2036	3226.06	2668.39	2668.39
2037	3518.23	2914.52	2914.52
2038	3850.22	3194.44	3194.44
2039	4228.13	3513.32	3513.32
2040	4659.00	3877.14	3877.14
EIRR	***17.12%***	***15.99%***	***14.49%***

Calculated by Author

The result of the sensitivity analysis shows that even in the worst case of increase in cost and decrease in benefits the projects remains economically viable.

10.0 CONCLUSION

The economic analysis of Djibouti - Ethiopia railway project is economically viable with consideration of only certain benefits such as revenue generated from freight & passenger tariffs and employment generations. The EIRR for the above-mentioned project calculated as 18.90%. However the project benefits in long run will be much higher as other benefits like reduction in annual road maintenance cost, decrease in vehicular pollutions, fuel savings, time savings, foreign exchange earnings etc. have not been taken into consideration in this study due to data lag and complexity of calculation.

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End Note

[1]http://www.ethioembassy.org.uk/articles/articles/focus%20electronic-00/Wuhib%20Muluneh%20-%201.htm

[2] World Bank Social and Economic Development Group Middle East and North Africa Region, «Republic of Djibouti Country Economic Memorandum - Unlocking Djibouti's Growth Potential: The Road Ahead (In Three Volumes) Volume I: Summary Report,» Report No. 33115-DJ, August 10, 2006

[3] Infrastructure Consortium Africa (ICA) Meeting: Financing Transport for Growth in Africa, Dec3-4, 2007

[4] *Ibid iii*

[5] Djibouti already has several comparative advantages which explain its special position: its port sector has been modernised, its political situation is stable, the country is safe and the road to Addis Ababa was rehabilitated in 1998 (Foch, 2010).

[6] http://www.afdb.org/en/countries/east-africa/ethiopia/ethiopia-economic-outlook/

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