ECONOMIC ANALYSIS

A. Introduction

1. The project will support the government to develop applied science and technology faculties in four universities to nurture a new breed of technology-oriented graduates. The project has five outputs: (i) innovative technology learning and research environment established, (ii) quality and industry-relevant higher technology education programs implemented, (iii) industry linkages and international collaborations strengthened, (iv) faculty management capacity strengthened, and (v) new higher education project preparation supported.

2. To produce these outputs, the project will provide innovative technology and industry-relevant education facilities, help with quality curriculum design and academic staffing aligned with industry demand and international standards, and provide competitive industry and foreign university grant scheme and capacity development opportunities. The selected four universities are (i) the University of Kelaniya; (ii) the Rajarata University of Sri Lanka (RUSL); (iii) the University of Sri Jayewardenepura, Sri Lanka (SJP); and (iv) the Sabaragamuwa University of Sri Lanka (SUSL).

B. Economic Rational

3. The public investment in education, including higher education, is often justified by the externalities of schooling, economies of scale, and public goods. Externalities could take the form of nurturing good citizens, enhancing the productivity of coworkers, reducing crimes, or improving health for families. The marginal cost of getting another student to school is smaller than the average cost of educating each individual student, and there are economies of scale. In addition, some parents with borrowing constraints cannot invest in higher education for their children. The new knowledge created by academic research could be public goods. The higher education plays instrumental roles in improving growth, jobs, and competitiveness with the potential to catalyze economic transformation,[1] and the updating and upgrading of skills for youth and adults is particularly important to adjusting to rapid technological changes.[2] The return to higher education is stable, and the global average of private return is 15.8% and of social return is 10.5%.[3]

4. The Government of Sri Lanka aspires to transform into a knowledge-based economy by 2025, and puts priority on higher education to produce a skilled labor force.[4] However, an aging population and generating skilled labor relevant to industry demands are two major challenges.[5] In particular, the quality of learning in technology and engineering subjects needs to be strengthened.[6] While private higher education is encouraged, it focuses on management and information technology (IT), where capital investment is moderate. Public upfront capital investment is required to boost education and research in technology and engineering subjects.

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1 Independent Evaluation Group. 2017. *Higher Education for Development An Evaluation of the World Bank Group's Support.* Washington, DC.
2 Asian Development Bank (ADB). 2018. *Asian Development Outlook 2018 How technology Affects Jobs*. Manila.
3 G. Psacharopoulos and H. A. Patrinos. 2018. Returns to Investment in Education A Decennial Review of Global Literature. *World Bank Policy Research Working Paper.* Washington, DC.
4 Government of Sri Lanka. 2017. *Vision 2025: A Country Enriched*. Colombo.
5 ADB and International Labour Organization (ILO). 2017. *Sri Lanka Fostering Workforce Skills Through Education Employment Diagnostic Study*. Manila.
6 H. Dundar et al. 2017. *Sri Lanka Education Sector Assessment: Achievements, Challenges, and Policy Options. Directions in Development.* Washington, DC: World Bank.

C. Demand Analysis

5. Increasing demand for higher education is evident from steep competition for public university admission and large number of external degree program students. The gross enrollment rate is 19.0%, which is far lower than that of the upper middle-income country average of 50.8%.[7] In 2016, there were 5,012 new admissions for engineering, IT, and applied science and technology, which is only 17.2% of total admissions.

6. University graduates who have majored in technology and engineering subjects are also in high demand in industry. The government expects that priority economic development initiatives like the Colombo–Trincomalee Economic Corridor will generate 580,000 incremental jobs in the manufacturing sector between 2020 and 2032, and one of the constraints is lack of a skilled workforce. Industry demand for technology and engineering graduates is also evident from the high job placement rate. According to the University Grants Commission (UGC) tracer study in 2018, the job placement rate is the highest among computer science, IT, and engineering university graduates at 92.2% compared with an overall average of 65.5% in state universities.

D. Alternative Analysis

7. An alternative option is to support higher education sector development through results-based lending, but investment lending can address the dire needs of upfront capital investment to develop new technology and engineering faculties in the four selected universities. In addition, the World Bank approved the Accelerating Higher Education Expansion and Development Operation ($100 million) in 2017 which supports higher education policy reforms. The selection of four universities is justified because other development partners have not supported them.

E. Cost–Benefit and Sensitivity Analyses

8. The economic analysis was conducted in accordance with the guidelines set out by the Asian Development Bank (ADB).[8] The analysis measured project costs and benefits for a period of 25 years, and economic net present value (ENPV) as well as economic internal rate of return (EIRR) was calculated by comparing the with-project and without-project scenarios. All financial prices, such as direct investment cost, land values, opportunity cost, laboratory equipment replacement cost, and recurrent cost including maintenance services, were converted into economic prices through shadow exchange rate and shadow wage rate factors. A sensitivity analysis was conducted to ascertain the robustness of analysis.

9. The without-project scenario is that beneficiaries cannot take higher education opportunities, and they join the labor force (or stay out of the labor force) and start to earn salary. The with-project scenario assumes that beneficiaries complete 4-year university programs in technology or engineering and start to work after graduating. Seven hundred and six beneficiary undergraduates enrolled in technology and engineering programs at the four universities in 2018, but this is expected to increase to 1,465 by 2025 (Table 1).

[7] United Nations Educational, Scientific and Cultural Organization Institute for Statistics (http://uis.unesco.org/, accessed on 20 February 2018).
[8] ADB. 2017. *Guidelines for the Economic Analysis of Projects.* Manila.

Table 1: Projections of Annual Undergraduate Enrollment, 2018–2042

	Item	2018	2019	2020	2021	2022	2023	2024	2025	2042
1.	KU	161	236	236	260	286	314	346	380	380
2.	RUSL	275	275	275	303	333	366	403	443	443
3.	SJP	120	120	160	200	300	400	400	400	400
4.	SUSL	150	150	150	165	182	200	220	242	242
5.	**Total**	**706**	**781**	**821**	**927**	**1,100**	**1,280**	**1,368**	**1,465**	**1,465**

KU = University of Kelaniya, RUSL = Rajarata University of Sri Lanka, SJP = University of Sri Jayewardenepura, Sri Lanka, SUSL = Sabaragamuwa University of Sri Lanka.
Source: Asian Development Bank estimates.

10. The specific assumptions used in the analysis are based on (i) a UGC tracer study in 2017,[9] (ii) an annual labor force survey in 2016,[10] and (iii) consultations with various stakeholders.

11. **Assumptions.** General assumptions are as follows:

(i) The exchange rate of SLRs156.4 = $1.00 (as of 19 April 2018) from the Central Bank of Sri Lanka is used for converting foreign cost to local currency equivalent.
(ii) Constant mid-2018 prices were used in valuing costs and benefits.
(iii) The real wage increase is assumed to be 5% per year.[11]
(iv) Taxes, duties, and price contingencies are excluded in the ENPV and EIRRs while physical contingencies are included because they represent the monetary value of additional real resources that may be required beyond the base cost to complete the project.
(v) All costs were valued using the domestic price numeraire. The economic price of tradable goods was considered to equal their financial price by using a shadow exchange rate factor of 1.1 (estimated based on import and export trade data in Sri Lanka during 2014–2015). Costs were adjusted by shadow wage rate factors of 0.4 for unskilled labor and 1.0 for skilled labor to arrive at the economic opportunity cost. The shadow exchange rate factor and shadow wage rate factors are based on recently approved ADB-funded project in Sri Lanka.[12]
(vi) A 6% economic discount rate is used because this is a social sector project.
(vii) A 5-year preparation and construction period starting in 2018 and operational period of 20 years following the construction was used for the economic analysis.
(viii) A straight-line depreciation method was used to calculate the salvage value of physical academic building infrastructure at the end of the analysis period. Physical academic building infrastructure is assumed to have a life of 50 years, and salvage value was calculated based on this assumption.

12. Undergraduate enrollment for the targeted technology and engineering programs is expected to grow gradually until it reaches maximum capacity (Table 1). The University of Kelaniya, RUSL, and SUSL have projections until 2020 and 10% additional increase in enrollment is considered for the next 5 years until 2025 followed by a flat figure during 2026–2042. The SJP has future projections starting from 120 in 2018 to 400 in 2023, and the enrollment will be flat after

[9] University Grants Commission of Sri Lanka. Forthcoming. *University Graduate Tracer Study in 2017.* Colombo.
[10] Department of Census and Statistics, Ministry of National Policies and Economic Affairs, 2017. *Sri Lanka Labour Force Survey Annual Report – 2016.* Colombo.
[11] The real gross domestic product growth rate is used as a proxy for real wage increase, and around 5% real gross domestic product growth rate is estimated in the Asian Development Outlook 2018 and International Monetary Fund Article IV Consultation in 2017.
[12] ADB. 2017. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the Ceylon Electricity Board for the Wind Power Generation Project.* Manila.

reaching 400. This analysis assumes that 90.0% of students will graduate in 4 years, and 92.2% of the graduates are assumed to get jobs, based on the UGC tracer study in 2017.

13. **Benefits.** The benefits of the project are increased wages of graduates, commercialized research and technology, and engineering leaders produced for the future. However, this economic analysis focuses on incremental increase of graduate wages at the four targeted universities because other benefits are minor or hard to quantify and predict.

14. The key assumption for estimating benefits is wages earned by university graduates who enrolled in technology faculties in the University of Kelaniya, SUSL, and RUSL as well as the engineering faculty in the SJP. The wage for graduates from the technology and engineering faculties is assumed to be SLRs80,000 per month because the UGC tracer study in 2017 finds that around 70% of those graduates have salaries over SLRs75,000.

15. Since wage rates can vary depending on the employment status—whether a graduate becomes permanently, temporarily, or self-employed—different wage rates are used. The wage for those temporarily employed is estimated to be 60% of the wage received by those permanently employed, and the wage for the self-employed is assumed to be 80%. The proportion of temporarily employed (60%) is derived from the daily wage for daily earners (SLRs16,800) divided by that for monthly earners (SLRs28,004) based on the labor force survey in 2016. Self-employed people are assumed to be between permanently employed and temporarily employed.

16. The job placement rate is assumed to be 92.2% for the with-project scenario and 52.4% for the without-project scenario. The UGC tracer study in 2017 found that 92.2% of engineering graduates were employed. The percentage for the without-project scenario is calculated taking into account the labor force participation rate of 57.1% and unemployment rate for high school graduates of 8.3%. Eighty percent of salary is assumed to be attributed to the project.[13]

17. **Assumptions for estimating costs.** Assumptions for estimating costs are based on both additional direct costs (land values, opportunity costs of graduates, and replacement of laboratory equipment) and recurrent cost (e.g., salaries for academic and nonacademic staff in university, and maintenance works).

18. To derive the economic costs, project costs are classified into four categories: (i) tradable goods, (ii) nontradable goods, (iii) skilled labor, and (iv) unskilled labor. While the financial cost of the project is $157.6 million, the economic costs after adjustment for distortions in market prices and exclusion of price contingencies, tax, and duties are $121.2 million. In addition, purchased land values for the University of Kelaniya (SLRs284 million), RUSL ($400,000), and SJP ($7,692,308) are added. The SUSL's land is located within the campus and land value is considered zero because it is not used for any productive purpose now or in future.

19. The opportunity cost of graduates is the product of the total number of enrollments and monthly salary without the project (SLRs28,004). This salary comes from the median total monthly earnings from the survey in 2016. Laboratory equipment is assumed to be replaced every 5 years, and the total required recurrent cost is based on the unit recurrent cost per undergraduate student in engineering and IT multiplied by the total number of targeted students.

[13] The 80% attribution rate was assumed for the ADB-funded Skills for Employment Investment Program in Bangladesh, and this analysis followed the same rate. However, the rate was also checked with sensitivity analysis in Table 3.

20. **Results.** The ENPV for the base-case scenario is calculated as SLRs40,573 million, and the EIRR is estimated as 12.3%. The cost and benefit streams are shown in Table 2.

Table 2: Economic Internal Rate of Return
(SLRs million)

	Costs					Benefit	
Year	**Investment Cost[a]**	**Opportunity Cost**	**Equipment Replacement**	**Recurrent Cost**	**Total Cost**	**Graduate earnings**	**Net benefit**
1	1,884	382	-	890	3,156	-	(3,156)
2	4,535	535	-	1,047	6,117	365	(5,751)
3	1,529	709	-	1,225	3,463	789	(2,674)
4	9,508	919	-	1,467	11,894	1,254	(10,640)
5	3,344	1,183	-	1,738	6,265	1,884	(4,382)
6	638	1,508	-	2,086	4,233	2,637	(1,596)
7	151	1,882	-	2,486	4,520	3,496	(1,024)
8	-	2,312	-	2,914	5,226	4,533	(693)
9	-	2,781	-	3,273	6,054	5,834	(220)
10-15	-	29,031	11,241	24,463	64,735	77,018	12,283
16-20	-	46,561	5,620	26,695	78,875	144,418	65,543
21-25	(6,044)	76,919	5,620	34,070	110,565	255,300	144,734
Total	15,546	190,464	28,101	123,270	357,381	567,107	209,726
				NPV =	40,573	**IRR** =	12.3%

( ) = negative, IRR = internal rate of return, NPV = net present value.
[a] Investment cost is a sum of project capital cost.
Source: Asian Development Bank estimates.

21. **Sensitivity analysis.** The sensitivity of the ENPV and EIRR to six scenarios is also considered: (i) a 10% increase in costs, (ii) a 10% decrease in benefits, (iii) the combined effect of a 10% increase in costs and a 10% decrease in benefits, (iv) a 10 percentage point decrease in job placement rate of targeted university graduates, (v) a three percentage point decrease in real wage increase rate, and (vi) a 10 percentage point decrease in wage increase attributable to the project (Table 3). The sensitivity analyses show that these changes bring down the EIRR to 7.9%, but will yield more than the 6% EIRR which is required for a social sector project.

Table 3: Net Present Value, Economic Internal Rate of Return, and Sensitivity Analysis

Scenario	**Switching Value** (%)	**Variation** (%)	**ENPV** (SLRs million)	**EIRR** (%)
Base case			40,573	12.3
Increase in overall costs	32.0	10	27,993	10.3
Decrease in overall benefits	(24.0)	(10)	23,935	10.0
Increase in costs and decrease in benefits	14.0	10	11,355	7.9
Job placement rate of university graduates [a]	(22.0)	(10)	22,528	9.8
Wage increase rate [a]	(4.4)	(3)	9,339	8.1
Benefits attributable to the project [a]	(19.5)	(10)	19,776	9.4

( ) = negative, EIRR = economic internal rate of return, ENPV = economic net present value.
[a] Switching value and variation are percentage points.
Source: Asian Development Bank estimates.

F. Distribution Analysis

22. The project benefits male and female students as well as workers, employers, and the government. Gender equity could be further improved in engineering (only 22.2% female). The RUSL and SUSL provide better access to higher education and linkage with local industries in rural areas. Employers in IT, engineering, and food industries will benefit from skilled graduates, and the government can collect a higher level of taxes from increased salaries.