Financing Transport Projects

Why integrating externalities matters for decision making

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1.0 Problem Definition

The recent surge in environmental challenges, social inequalities, and cyclical financial crises has highlighted how conventional financial analysis is inadequate in capturing the intricate dynamics of our modern world. While financial risks are typically integrated across various aspects of financial analysis, long-term and non-financial risks, such as climate transition, environmental degradation, and social issues, are often overlooked (European Commission, 2017).

Financial analysis is typically rooted in neoclassical financial theories that fail to consider the interconnection between the ecosystem, communities, and economy. Therefore, the failure to integrate environmental and social constraints into financial analysis has prevented financial decision-makers from fostering more resilient economies (Walter, 2020).

Neoclassical financial theories were developed at a time when resources were considered abundant, and carbon emissions were not a significant concern. In these theories, labour and capital were viewed as the primary resources for economic production, while natural services were assumed to be freely available. As a result, there was no inherent need to incorporate environmental and social boundaries into the models, beyond labour and capital considerations. Furthermore, neoclassical financial theories tend to focus on short-term cash flows and do not adequately account for the long-term value of natural resources. The emphasis is often on immediate financial gains without considering the broader long-term implications for the environment and society (Schoenmaker & Schramade, 2019).

Therefore, current research questions whether the modern neoclassical financial theories are fit for purpose in an era of environmental challenges. It is necessary to depart from neoclassical financial perspectives to move toward "ecological finance" approaches that embed natural and social constraints into their modelling (Walter, 2020).

Transportation project appraisals in emerging and developed countries often overlook non-financial considerations, even though the need to integrate environmental and social dimensions into financial decision making is widely acknowledged by policy-makers. The pressing need to stimulate economic growth has led to prioritizing financial aspects over social and environmental issues (Melvisto et al., 2017).

In the assessment of transportation projects, non-financial considerations include the positive or negative externalities that arise from the project. Externalities are costs or benefits that impact third parties, including individuals or society. For instance, if a transport project enhances air quality in a city, the resulting health benefits for the residents would constitute a positive externality. Conversely, negative externalities are costs that arise from a project and are borne by third parties. For example, pollution caused by the project, such as vehicle emissions, can have adverse effects on people's health, making it a negative externality (Kenton, 2022).

The persistent lack of internalization of externalities continues to drive investments toward carbon-intensive road transport, at the expense of sustainable transport alternatives (Melvisto et al., 2017).

On the one hand, failing to internalize negative externalities leads to an underestimation of the true cost of a transport project. This is because the private marginal cost does not reflect the cost to society, resulting in a lower overall price for the project. Consequently, a carbon-intensive transport project may seem cheaper initially, but it fails to address market failures and becomes more expensive in the long run. On the other hand, sustainable transport projects that internalize externalities can address market failures and ultimately prove to be more cost-effective and beneficial to society. By properly accounting for both positive and negative externalities in the evaluation of transport projects, we can ensure that the true costs and benefits to society and the environment are considered, leading to more informed decision making and more sustainable transportation choices (Stetjuha, 2017).

The purpose of this briefing paper is to advocate for a more holistic approach in evaluating sustainable transport projects. This can enable financial decision-makers to have a more comprehensive understanding of the project's overall value and promote the development of more sustainable projects. The following sections will explore financial and economic analysis and ultimately lead to an integrated analysis that considers externalities as a source of financing.

Please note that in the context of project evaluation, we refer to externalities as the avoided costs and added benefits generated by the project implementation and identified under the economic analysis.

2.0 Practical Considerations

At the outset, it is crucial to highlight that holistic project evaluations typically involve both economic and financial analyses. The economic analysis assesses the project's economic impact on the community or the country by considering externalities and determining its societal value. On the other hand, the financial analysis focuses on evaluating the project's financial feasibility by considering direct costs and revenues. Typically, decision-makers need to rely on both evaluations to make informed decisions (Asian Development Bank, 2017).

The two evaluations can be perceived as complementary, but the financial evaluation often has a more direct impact on the final decision. This is because financial viability is necessary to attract investors and provides the means for executing the project. Economic externalities can play a significant role also in the financial evaluation if they are used to generate alternative revenue and sustain the financial viability of the project. By monetizing and converting externalities into financial cash flows, financial decision-makers can achieve a more comprehensive project evaluation.

Financial and Economic Evaluation

The **financial evaluation** of a public transport project is typically based on whether the project can generate enough income to be financially sustainable. This assessment is based on the direct revenues and costs generated by the project, such as the revenue from the sale of tickets. To evaluate the financial profitability, stakeholders typically look at the project's cash flow and internal rate of return (IRR). The IRR can be defined as the discount rate that returns a zero net present value (NPV). If the IRR falls below the cost of funding rate, the project may not be a worthwhile investment, and alternative sources of funding such as grants may be necessary (European Investment Bank [EIB], 2013).

Another key indicator used to assess the financial performance is NPV, which is the difference between the cash inflows and outflows, discounted to a present value. The project is a worthwhile investment if it generates a positive NPV (Fernando, 2023).

Conventional financial analysis primarily focuses on financial indicators that are crucial in attracting private investors. Hence, projects with weak financial performance may not be attractive to private investors who seek a certain level of profitability. On the other hand, economic evaluations take a wider perspective of the project's impact, assessing its potential benefits to society beyond just financial returns (EIB, 2013).

The **economic evaluation** applies different techniques to assess project externalities.[1] One of the commonly used techniques is the cost-benefit analysis (CBA), which helps determine the project's social and economic performance and address market distortions.

For instance, a sustainable transport project can produce positive externalities, such as reduced air pollution, accident avoidance, and decreased habitat damages, which are

[1] Monetization of externalities can be done through various approaches such as CBA, cost-effectiveness analysis, and multi-criteria analysis (MCA).

internalized as avoided costs. This internalization aligns the market price to the society, enabling a more accurate reflection of the true cost of the project (Schroten et al., 2019). On the other hand, road transport generates negative externalities for society, including environmental damage, carbon emissions, accidents, and oil dependency. However, the costs associated with positive and negative externalities are often not reflected in market value of transport projects, resulting in market inefficiencies (Santos et al., 2010).

Depending on the scope of the evaluation, the CBA can provide a framework for identifying and monetizing externalities that arise from a project in the form of costs and benefits. This approach allows the evaluation of the project's economic feasibility, and the results can be summarized by two complementary indicators, namely the economic rate of return (ERR) and the economic net present value (ENPV).

The ENPV is the difference between the benefits and costs valued at a social discount rate. The economic viability of the project is determined by a positive ENPV, indicating that the project generates net social benefits over time. Similarly, the ERR calculates the annual return on investment to society, representing the discounted benefits and costs valued from a societal perspective. The project is deemed economically acceptable if the ERR exceeds the social discount rate (EIB, 2013).

Social Discount Rate

The discussion about the appropriate discount rate to use for estimating future costs and benefits is highly contentious. The social discount rate can be defined as the rate at which benefits and costs are discounted, reflecting the perception of the society over time. There are two principal approaches typically used for determining the discount rate in economic evaluations of projects.

The first one is the **social time preference rate (STPR)**, which reflects the value placed by society on present consumption compared to future consumption. In other words, it represents the societal preference for receiving benefits now rather than later and it reflects the rate at which society discounts the value of future benefits and costs (Addae-Dapaah, 2012).

For example, the British Government's *Green Book*[2] uses the STPR to discount costs and benefits in project appraisal. The STPR is based on the time preference and the wealth effect, which reflect the consumption growth per capita over time. The STPR of the *Green Book* is set at a fixed 3.5% in real terms (HM Treasury, 2022), which is lower than conventional market rates.

The second is the **social opportunity cost rate (SOCR)**, which reflects the marginal social opportunity cost of funds in the private sector. This means that the discount rate used in the economic evaluation of a project should reflect the costs of investment in the private sector. In other words, the investment returns from a public project should be at least as high as those of a private investment. This is because private investments generate future income and

[2] The *Green Book* is a set of instructions provided by HM Treasury that offers guidance on how to assess policies, programs, and projects.

consumption that have value in the future. The SOCR is derived from the idea that society should invest in projects that generate returns that are equal to or greater than the returns of private investments (Florio & Sirtori, 2013).

The social discount rate has traditionally been used to calculate the present value of future costs and benefits by assuming that economic growth will continue to increase future consumption. However, recent events such as financial crises, pandemics, and climate change have raised doubts about this assumption. These events have highlighted the fact that sustained economic growth cannot be taken for granted and that external factors, such as climate change generating supply chain disruptions, can have a significant impact on production and consumption patterns. As a result, the validity of using a social discount rate that assumes sustained economic growth has come under scrutiny (Brumbay & Cloutier, 2022).

One of the most effective interventions for addressing climate change is to lower the discount rate compared to conventional market rates. The rationale for this argument rests on the fact that a high discount rate used to discount costs and benefits results in the delay of the negative effects of climate change until a later time in the future (Weitzman, 2007). Therefore, to incentivize sustainable projects with long-term positive externalities, a lower social discount rate is needed.

When a high social discount rate is used to evaluate a project, it means that costs and benefits that will occur in the future are given less weight or importance compared to those that will occur in the present. This can lead to a lower present value for future costs and benefits, which can make sustainable transport projects seem less valuable. On the contrary, the negative impacts of high-carbon-intensity projects, such as environmental damages, are delayed until later in the future, while the benefits are enjoyed in the present. As a result, future generations may be burdened with the costs of dealing with these negative impacts, while the present generation enjoys the benefits (Bazelon & Smetters, 2001).

Also, some researchers suggest using a zero-discount rate to minimize the risks of moral hazard and ensure equitable treatment between generations. This approach avoids predicting future consumption patterns and emphasizes the importance of considering the long-term impacts of current actions (Brumbay & Cloutier, 2022).

Integrated Financial Analysis

To tackle the challenges mentioned earlier, it is crucial to include economic factors such as externalities in the financial evaluation. The goal is to merge financial and economic factors into a cohesive, integrated analysis rather than handling them as distinct and supplementary elements of the decision-making process.

Project promoters can use financial modelling to quantify the portion of benefits and avoided costs that need to be converted into alternative revenue streams to ensure the project's financial viability. Analyzing the project's financing opportunities can further optimize the financial benefits by determining the portion of externalities that can be converted into revenue to cover implementation and financing costs.

If externalities are incorporated into the financial cash flow, they become not only a benefit to society but also a means of financing the project. It is not a surprise that sustainable transport projects that generate high social and environmental benefits would only require a small portion of their monetized externalities to be converted into a revenue stream to break even. This demonstrates the potential for sustainable projects to both deliver positive impacts on society and the environment and be financially viable.

The concept of internalizing benefits and avoided costs is applied in financial mechanisms such as **outcome-based financing**, where such externalities are converted into revenue streams to fund projects and generate returns for investors (Brand et al., 2021). The way to generate revenue from these indirect benefits and avoided costs varies depending on the context, but the objective is to demonstrate how monetizing them can improve the financial soundness of a sustainable transport project. For instance, the avoided costs resulting from reduced carbon emissions can be monetized by selling carbon credits, which can generate additional income. (Twidale & Evans, 2022).

From a government perspective, another mechanism that allows the internalization of externalities is the potential increase in tax revenue from project benefits, which is a concept used in financing mechanisms such as **tax increment financing (TIF)**. This involves forecasting a boost in tax revenue based on the project's generated value. For instance, a significant project implementation could result in higher property values in the area, leading to increased tax revenue for the local government (World Bank, 2019). This highlights the fact that the incremental tax revenue resulting from benefits and avoided costs can contribute to the project's financial sustainability.

The integrated financial analysis treats this additional income, such as carbon credits or increased tax revenue, as project revenue. This integration can improve the project's financing opportunities. By incorporating externalities into the financial analysis, it becomes possible to leverage the project's positive impact to attract potential investors and secure funding. Hence, a crucial step involves accurately quantifying and incorporating monetized externalities to showcase the sound financial feasibility of sustainable transport initiatives.

To provide a concrete example, the next section will explore an IISD project evaluation conducted for a sustainable transport project in Indonesia, delving into the aforementioned concepts in more detail.

3.0 Case Study of a Sustainable Transport Project

This case study is drawn from the Sustainable Asset Valuation (SAVi) of a Bus Rapid Transit (BRT) system in Bandung, Indonesia. The SAVi assessment of the BRT system is part of a broader series of SAVi assessments focused on sustainable transport and mobility projects. These assessments aim to increase awareness of sustainable transport infrastructure investments and to guide decision-makers in adopting systemic approaches that facilitate the shift toward sustainable mobility.

To create a comprehensive integrated analysis, this case study will follow the same steps described above, which includes analyzing both the financial and economic aspects of the project. The goal is to combine the results of the financial analysis and the economic analysis into a single evaluation that takes into account alternative sources of income to fund the project.

The SAVi assessment involves two scenarios: the current BRT scenario and the high-ambition BRT scenario. The current BRT scenario is based on demand projections[3] from the Bandung BRT feasibility study (Deutsche Gesellschaft für Internationale Zusammenarbeit, 2020), while the high-ambition BRT scenario assumes that demand will double by 2035, triple by 2045, and remain linear until 2050. The high-ambition scenario was created to evaluate the benefits of the BRT system in a scenario where demand exceeds the original projections made in the Bandung BRT feasibility study.

Financial and Economic Analysis of the Case Study

As discussed in the previous section, the next step is to assess financial feasibility of the project. According to the **financial analysis** the project delivers a negative NPV under both the current and high-ambition scenario, due to high construction and maintenance costs. In addition, the IRR does not yield meaningful results for the two scenarios (Appendix A, Table A1). Based on these financial indicators, the project appears not to be financially viable, and private investors are unlikely to be interested in financing it.

Even if the BRT project receives financing from multilateral development banks, it is unlikely this could be the sole source of financing. Debt financing, often in the form of loans, is commonly used by project promoters to cover capital and operating expenditures. A well-designed BRT system project is typically eligible for up to 70% of total costs in debt financing and public grants (Institute for Transportation & Development Policy, n.d.). To evaluate

[3] For the two BRT scenarios, we have assumed that as BRT demand increases, trips are shifted from individual transportation modes to BRT, while demand for taxis and other buses remains constant. The individual motorized transportation modes considered include motorcycles, angkots, and private cars, with an equal share of each of these modes being shifted to BRT as its demand increases. This approach is based on the assumption that the growth in BRT demand will be met by a proportional reduction in the use of these individual transportation modes, without affecting the demand for taxis and other buses (Kapetanakis et al., 2023). For additional information on the scenarios, please see the table at page 11 in Kapetanakis et al., 2023).

the investment opportunity of the BRT project under different financing conditions, we developed a financial model that considers three different combinations of debt and non-repayable grants.[4]

Despite generating operational revenue from ticket sales, the BRT revenue falls short of covering the majority of costs and debt. For example, in the high-ambition scenario the BRT revenue can cover only 4.2% of total costs and debt, while in the current ambition scenario, it covers just 3.4%. Consequently, an increase in BRT revenue is necessary to attain the financial breakeven point (Appendix A, Table A2).

Assuming that the BRT project could generate additional revenue by increasing ticket prices, a significant increase would be necessary to cover the costs and debt. In fact, in some cases, the ticket price would need to be increased by 23.7 times (Appendix A, Table A3). However, such a drastic price change would not be economically feasible, as it could have a negative impact on the project's societal benefits and restrict access for low-income families. Therefore, alternative revenue streams need to be identified to ensure the financial sustainability of the BRT project without compromising its social impact.

One way to achieve this is by assessing benefits and avoided costs delivered by the project to evaluate its investment worthiness from a societal standpoint. This assessment can help identify externalities that could potentially provide an additional revenue stream in addition to the direct income generated by the BRT.

Unlike the financial analysis, the **economic analysis** demonstrates a significantly positive impact from a societal perspective. This is primarily due to the large amount of added benefits and avoided costs generated by the project, with the most significant externalities being the value of time saved, the increase in retail revenues, and the health impact benefits. (Refer to Appendix A, Table A4 for more details.) The ENPV indicates that the project is economically viable, particularly in the high-ambition scenario. Additionally, the ERR of the net integrated value shows high values for both scenarios.

Although the project may not be financially sustainable based solely on BRT revenue, it clearly offers significant economic benefits. Foregoing its implementation due to a lack of direct revenue would represent a loss for society. Therefore, there is a strong rationale for exploring innovative ways of further monetizing the value of the added benefits and avoided costs from the project and leveraging this as a source of income to increase its financial viability.

Application of the Social Discount Rate in the Case Study

The economic analysis applied a fixed **social discount rate** of 3.5%, which is in accordance with the guidelines set out in the British Government's *Green Book*. This rate was applied

[4] We assessed the current and high-ambition scenarios for three levels of debt financing, assuming that eligible costs are covered by a combination of debt and non-repayable grants: 70% debt and 30% grant, 50% debt and 50% grant, or 100% grant (no debt). In terms of debt repayment, we assumed a front-end fee rate of 0.25%, a commitment fee of 0.25%, and an interest rate of 8.88%. This interest rate comprises a 7.12% base rate, 1.6% interest margin, and 0.50% maturity premium. The repayment period begins in January 2027 and lasts for 13 years. These assumptions are based on the financial terms of IBRD flexible loans for Indonesia (World Bank, n.d.).

to harmonize the social time preference, climate change scenarios, and financial aspects of the project evaluation. By using a consistent social discount rate, the analysis ensures that the time value of money and the cost of carbon emissions are appropriately reflected in the financial evaluation of the project. This allows decision-makers to make more informed and comprehensive decisions regarding the financial feasibility and sustainability of the project.

The use of the *Green Book* social discount rate diverges from higher conventional market rates or certain multilateral banks' practices. For instance, for a project appraisal in Indonesia, the World Bank (2018) applied a 12% discount rate to assess the costs and benefits of the project. However, we believe that the application of the *Green Book* social discount rate better reflects the environmental and social considerations of the project, allowing for a more balanced evaluation of the project's costs and benefits.

Integrated Financial Analysis of the Case Study

By incorporating the externalities identified in the economic analysis into the financial cash flow, financial decision-makers can determine the level of alternative income from monetized benefits and cost savings needed to compensate for the insufficient direct revenue.

For the Bandung case study, we found that internalizing between 12% and 19% of the total externalities generated by the project was sufficient to make the project break even. In particular, by internalizing only a part of the larger benefits, such as value of time saved and retail revenue, it is possible to generate enough of a revenue stream to fund the project (Appendix A, Table A5).

From a government perspective, we assessed the tax percentage on taxable benefits as a possible source of financing. We identified employment benefits, value of time saved, and retail revenue as the three most relevant benefits to leverage for generating future tax revenue. For example, the required tax percentage ranges from 21% with 70% debt financing to 13.2% with full grant financing. This means that the municipality can generate additional income tax on only a fraction of the project's benefits to reach the breakeven point.

In contrast to the initial financial analysis, the IRR that reflects internalization with taxable benefits yields positive values for both debt financing scenarios. The IRR results exceed the social discount rate applied in the analysis, confirming the financial viability of the project (Appendix A, Table A5).

Monetized benefits offer a viable alternative to relying solely on revenue generated from BRT ticket sales, which would otherwise require a significant increase in ticket prices to support the project's financing. By internalizing the externalities and incorporating monetized benefits into the project's financial analysis, the project can be financially feasible without compromising its societal value. In this case, the project can be considered financially attractive and economically sustainable at the same time.

4.0 Policy Recommendations

This briefing paper emphasizes the importance of incorporating externalities into financial decision making. Its approach demonstrates how sustainable transport projects that lack financial attractiveness can still be financially feasible through the monetization of avoided costs and benefits. Excluding "non-financial" factors from financial analysis often leads to a misalignment between societal needs and financial priorities, exacerbating climate change risks by favouring non-sustainable transport projects. To address these issues, the following practices in financial analysis should be considered:

- **Incorporating externalities systematically in financial decision making**. The ongoing failure to internalize externalities in the financial decision-making process leads to a continued investment in carbon-intensive road transport, while sustainable transport alternatives are neglected. When the negative impacts of these projects on society and the environment are not taken into account, due to the lack of consideration of externalities, it results in market failures.
- **Improving financial decision making through integrated project appraisal analysis**. An integrated economic and financial evaluation offers a better overview of project's financial sustainability and societal value. The aim is to converge financial and economic factors into a cohesive, integrated financial analysis, rather than treating them as separate and complementary elements of the decision-making process.
- **Lowering social discount rates for long-term sustainable investments**. Lowering the social discount rates compared to conventional market rates is crucial for tackling climate change effectively. A lower social discount rate is required to encourage sustainable projects that have long-term positive externalities. This approach would incentivize investments that contribute to the well-being of future generations.

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Appendix A

Table A1. Financial indicators (discounted values)

		BRT scenarios (2022–2050)	
		Current BRT scenario	**High-ambition BRT scenario**
Cash flow statement	Capital costs	-1,244.34	-1,244.34
	Operation and maintenance costs	-4,257.04	-8,757.21
	Revenues from BRT	248.95	512.12
	Net present value (NPV)[5]	-5,252.43	-9,489.44
	Internal rate of return (IRR)	N.A.	N.A.

Source: Kapetanakis et al., 2023.

Table A2. Percentage of capital expenditures (capex) and operating expenditures (opex) and debt costs covered by the BRT revenue

	Current ambition BRT scenario			**High-ambition BRT scenario**		
	70% debt 30% grant	**50% debt 50% grant**	**100% grant**	**70% debt 30% grant**	**50% debt 50% grant**	**100% grant**
% of costs and debt covered by BRT revenue	3.5%	3.8%	5.0%	4.2%	4.5%	5.3%

Source: Kapetanakis et al., 2023.

[5] In present value terms, discounted at 3.5% p.a. real to December 31, 2022.

Table A3. BRT revenue increase—financial analysis

	Current	High	Current ambition BRT scenario			High-ambition BRT scenario		
	Pre-financial analysis	Pre-financial analysis	70% debt 30% grant	50% debt 50% grant	100% grant	70% debt 30% grant	50% debt 50% grant	100% grant
BRT revenue multiplier	20.0	18.7	28.8	26.1	20.0	23.7	22.2	18.7
BRT revenue (IDR billion – present values)	248.95	512.12	7,180.37	6,503.17	4,988.54	12,126.27	11,345.81	9,600.22

Source: Kapetanakis et al., 2023.

Table A4. Economic analysis—externalities (discounted values)

	Current BRT scenario	High-ambition BRT scenario
Capital costs	-1,244	-1,244
Operation and maintenance costs	-4,257	-8,757
Revenues from BRT	249	512
Income creation from employment	324	324
Health impact benefits	2,090	4,651
Value of time saved	26,386	55,478
Retail revenues	6,393	13,150
Avoided social cost of carbon benefit	277	607
Avoided cost of accidents benefit	33	71
Avoided cost of fuel use benefit	931	1,959
Economic net present value	**31,181**	**66,751**
Economic rate of return	**1.69**	**1.82**

Source: Kapetanakis et al., 2023.

Table A5. Internalization of externalities—financing scenarios

	Current ambition BRT scenario			High-ambition BRT scenario		
	70% debt 30% grant	50% debt 50% grant	100% grant	70% debt 30% grant	50% debt 50% grant	100% grant
Internalization of externalities	19.1%	17.2%	13.1%	15.4%	14.3%	12.0%
Tax revenue on/ from taxable benefits	21.0%	18.9%	14.3%	16.9%	15.7%	13.2%
IRR with internalization	16.0%	11.5%	n.a	14.8%	11.5%	0.7%
IRR with tax revenue	16.1%	11.6%	n.a	14.8%	11.5%	n.a

Source: Kapetanakis et al., 2023.

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