



Corporate Financing of Mega Projects: Analyzing the Impact of Capital Structure Choices on Project Viability and Profitability (2018–2025)

Akomolehin Francis Olugbenga

Dept. of Finance, College of Social and Management Sciences, Afe Babalola University, Ado - Ekiti, Nigeria.

Abstract

This paper examines how investment projects are affected by project financing strategies, and in particular the role of capital structure choice in the viability and profitability of mega projects, and how financing strategies lead to project performance under different economic environments. Megaprojects are capital intensive mega infrastructural and industrial projects having high exposure to financial and operational risks and therefore, deciding the financing source – equity, debt or –hyper seems critical for their success. Through thematic literature review and comparative case study analysis of sample projects from developed (Crossrail UK, Tesla Gigafactory USA) and developing (Lekki Deep Sea Port Nigeria, Delhi Metro India) nations, the study investigates how the configurations of capital structure influence ROI, cost control, time-to-completion, and investor confidence. Results indicate that projects with relatively well-aligned and context-specific capital structures are associated with better financial performance and smoother operations. Hybrid and actively managed capital model with a good risk sharing mechanism seems to be the most effective tool to reduce cost overruns and buying banks in. The paper gives important implications for policy makers, such as the importance of improving the credit system and increasing access to long-term capital, and targeted incentives in the fiscal regime. It is also vital for project sponsors to take on flexible funding strategies, and mature as projects mature. Future research is advised in new fields such as ESG-related financing, the contribution of green bonds to infrastructure financing, or the potential of digital technologies in infrastructure finance. These are promising areas to transform mega projects capitalization and governance in the forthcoming years.

Keywords: Capital Structure, Corporate Financing, Debt-Equity Mix, Mega Projects, Project Finance, Project Viability.

1. Introduction

Mega projects—high profile endeavors involving billions of dollars in spending —increasingly have taken center stage in both national development plans and transnational economic designs. These are projects with long gestation periods, with deep stakeholder involvement, with huge socio-economic consequences and the span infrastructure, energy, transportation and manufacturing problems (Flyvbjerg, 2018). Their strategic importance does not just derive from their potential to generate employment and innovation, but also from their role as potential drivers of structural change, urban renewal and regional integration, particularly in developing countries (Ansar et al., 2018; Capka, 2019).

Notwithstanding their significant relevance, mega projects tend to be difficult to finance, largely because of the difficulty of structuring optimal capital structures. The decision on the capital structure (that is, the amount of debt financing together with equity financing) of a company that funds a project is one of the most important decisions in corporate financing when financing a project with considerable investment. This is a catch 22: while high debt levels may have tax benefits and inflated return on equity (ROE), they have greater positive financial risk and even vulnerable to market tantrums (Brealey, Myers, & Allen, 2020). On the other hand, higher level of equity can decrease ownership, increase costs of financing, and change the control structure of sponsoring firm. In megaprojects, the scale increases both the opportunities and the threats, and therefore investment decisions relating to capital structure are significant and will require rigorous strategic assessment (Xiao & Zhao, 2021).

These are compounded with concerns of cost of capital, risk exposure, and the sustainability of long-term projects. The needs for long-term capital at competitive rates are not considered obstacles only for many mega projects that developing countries are promoting but also other development projects where the interest rates may fluctuate due to the financial markets, the political risks, and the low level of the confidence of investors (Kwak, Park, & LaBrosse, 2020). Delays and cost overruns -- aspects which afflict more than 70% of mega projects worldwide, are commonly related to inappropriate risk distribution, suboptimal financing structure and

deteriorating capital composition (Flyvbjerg, 2021). Not only do these problems erode financial performance, they also lead to stranded or sub-performing assets which are associated with significant economic and social opportunity costs.

This paper deals with these issues by conducting a systematic review of the linkages between capital structure choices and project performance of mega projects. The paper is based on both a critical review of peer-reviewed literature and a series of case-based analyses from developed and developing countries for the period 2018–2025. This historical and geographical context allows the research to trace changes in financing patterns, in global capital markets, and in institutional environments that shape financing outcomes.

This study aims to achieve three objectives: first, to investigate the relationship between choices of capital structure and the viability and profitability of projects; second, to explore the contribution of corporate financing strategy in maximizing the economic returns on mega projects; and third, to identify the factors which determine the optimal capital structure in different geopolitical and sectoral conditions. Through the application of theory integration with empirical case insights, the study seeks to provide a rich, detailed and nuanced account of how capital structuring shapes not only financial results but also the success of strategic projects.

Towards these aims, this study makes both theoretical and practical contributions by providing a framework to assess financing models in the context of mega projects. It also offers empirically-grounded guidance for corporate finance staffs, policy makers and investors involved in structuring or assessing large investments. With the sheer magnitude of capital movement and possible reformation of socio-economic landscapes, unravelling the relationship between capital structure and project performance is not just a mere monetary issue — it is a strategic issue of economic development.

2. Conceptual and Theoretical Review

2.1. Conceptual Lens

In the funding environment of infrastructure and large scale industrial projects, the mega project concept plays a key role in the worldwide economic revolution. Mega projects, typically projects costing more than one billion U.S. dollars and associated with many interested parties, long time scales, and high socio-economic impacts, are central to achieving national development and international competitiveness goals (Flyvbjerg, 2018). Tu-95 and Modi 2012 These programmes are strategic tools for modernisation, urban renewal and regional integration, and that we find it in both developed and developing economies. But the size and sophistication of these ventures present major financial, logistical and governance hurdles — most notably their capitalization.

The process from which these projects are generated is rooted in what is known as capital structuring, or the relative use of debt and equity to finance a project. This trade-off is not just a technical implementation but a strategic choice that influences the project cost of capital, risk level, control configuration, and the large-scale finance sustainable development (Xiao & Zhao, 2021). The decision between risky high-leverage capital structures and more equity intensive strategies is frequently a trade-off between tax efficiency and financial flexibility. Debt financing can effect the development of the project by reducing the cost of financing via interest tax shields but also by increasing the default risk of the project, particularly in environments of macroeconomic uncertainty. Equity-heavy configurations, on the other hand, reduce the risk of insolvency but dilute control and demand higher returns for investors to be satisfied. The optimal capital structure to use, therefore, emerges as key leverage point in high risk mega project setting (Brealey et al., 2020).

Whether or not a mega project succeeds is the capacity to be financially and operationally sustainable over its life cycle. Project feasibility encompasses technical feasibility, income generability, and risk aversion of the project in existing institutional and economic environment (Kwak, Park, & LaBrosse, 2020). Bad capital structures can cause liquidity crises, as well as make debt impossible to service, not to mention projects being abandoned as can be seen in many of the examples above and beyond. Here the notion of financing strategy is key. An adequately structured financing plan considers the optimal mix of funds, hedging instruments and timing arrangements to make a project not only bankable at the time of establishment but also financially robust during execution and operation (Sharma & Chatterjee, 2019).

Intimately related to viability is the concept of profitability (a discussion of the subject involves the question of whether the project would return more than the company's cost of capital). Key monetary measures such as internal rate of return (IRR), return on investment (ROI), and net present value (NPV) are the indicators over which investment decisions are reduced, while have impact on the confidence of stakeholders (Kumar & Bansal, 2021). These outcomes are directly influenced by the capital structure. Such account of historical returns is often very “rosy” for highly leveraged projects during the upturn but quite dismal in the down-turn. All this revealing us the importance to know the relationship between capital structure and profitability as a critical point of the analysis of project finance.

Project finance as a framework is especially applicable to mega projects. Unlike corporate financing, project finance usually funds a project based on the projected cash flows of the project rather than the balance sheets of its sponsors. This approach facilitates ring-fencing of risk, and relies on project, rather than sponsor, balance sheet credit worthiness (Yescombe & Farquharson, 2018). Therefore, the capital structure in project finance is closely related to contract structure, risk sharing, and the legal framework of the project.

Moreover, financial challenges are perennial feature in financing of mega projects. Risks such as exchange rates, inflation, interest rates, and faulty counterparty can decrease income and lead to the discontinuity of a project. And these risks are compounded in developing markets, where regulatory uncertainty and thin financial markets make capital raising and servicing more difficult (Gatti, 2021). Capital structures should thus incorporate financial risk mitigating tools such as hedging instruments, multilateral guarantees and blended finance.

Overall, an optimal capital structure that can maximize project value while minimizing weighted average cost of capital (WACC) is a dynamic, dependent and context-specific effort. This optimal point is determined by both internal factors (e.g. cashflow projections, sponsor's risk appetite) and external variables (e.g. credit market conditions, government incentives, geopolitical risk). In mega project environments, where the stakes are high and

enormous financial exposure looms, the financial structure is not just a passive consideration, but something that is a strategic cornerstone on which a project succeeds or fails.

2.2. Theoretical Framework

A Funding of mega infrastructure and mega industrial projects requires a theoretically informed understanding about capital structure decisions because the investments are huge, complex in structure and long term in nature. A strong theory allows project sponsors, funders and policy makers to justify trade-offs and strategic implications of different types of financing. Many theories in corporate finance supply crucial insight into how capital structure decisions impact the viability and profitability of projects, especially in defining mega projects where risk levels are intensified and financial stakes are very high.

The trade-off theory assumes that firms try to mitigate the tax advantages of debt against the costs of financial distress when determining their optimal capital structure (Kraus & Litzenberger, 1973). This concept is particularly important for mega projects, since the large budgets favour the creep of debt finance by the tax deductibility of interest. However, too much leverage will raise the risk of default, and restrict project's operation flexibility due to the financial covenants. In a project finance context, this trade-off is compounded by the gestation length and demand risk in infrastructure projects. Hence, sizing leveraged accordingly, sponsors must weigh carefully the marginal advantages and costs of further gearing in the context of the specific risk profile of their project (Frank & Shen, 2016).

The Trade-Off Theory is complemented by the Pecking Order Theory which states that firms would rather use internal funds if available, followed by debt, and equity as a last resort because of asymmetric information and signaling (Myers & Majluf, 1984). In mega projects, this theory highlights why project sponsors frequently turn to structured debt instruments or quasi-equity ahead of public equity offerings. The aversion towards ownership dilution, or the issuance of signals of project weaknesses, leads individuals to a capital structure that involves debt as a relatively more expensive source of funds compared to equity. In particular, in the developing countries, where the capital markets are fewer efficient, the pecking order determines the financing hierarchy structure used by the infrastructure firms (Kouser, Bano, & Hussain, 2020).

Agency Theory (Jensen and Meckling, 1976) also enhances the capital structure discussion by emphasizing conflicts of interest between various stakeholders—chiefly, between those who control the firm's residual assets, such as equity-holders, and those who fund the firm, such as debt-providers, or between managers and shareholders. Agency conflicts in mega projects can result from a distortion of the preference for risk or from "opportunistic moves" by project management, which may be inclined to adverse short-run performance at the cost of effective value creation. High debt can be a disciplining tool that aligns managers' interests with those of investors by imposing a commitment to fixed payments and also reducing the underinvestment incentives of free cash flows. However, it can also encourage underinvestment or risk-shifting incentives if the returns to projects are ambiguous (Graham & Leary, 2011). Accordingly, agency concerns do not just determine the amount of capital; they also weigh on the form and oversight of capital deployment.

Although the Modigliani-Miller Theorem (1958) is based on the assumption of perfect capital markets, and essentially states that capital structure is irrelevant in perfect markets, it has been widely modified in project finance literature for various real world frictions such as taxes, bankruptcy costs and market imperfections. In the case of mega projects, in particular constructed using the mechanism of SPVs (Special Purpose Vehicles), the assumptions of the theory are mostly violated; therefore the capital structure is important to be considered. Under this revised perspective, higher leverage reduces WACC up to a certain point, after which excessive borrowing increases default risk, and hence increases project WACC. Therefore, contemporary project finance modelling has heavily adopted the modified Modigliani-Miller capital structure model which incorporates tax shields, agency costs and market frictions (Brealey, Myers, & Allen, 2020).

The RBV provides a corresponding view that focuses on the internal capability— financial expertise, stakeholder management skill, regulatory knowledge— to choose the right financial mix (Barney 1991). This theory may be most obvious in the context of mega projects for which the ability to mobilize, organize and manage heterogeneous sources of finance is, in itself, a competitive advantage. Companies with strong institutional linkages, high financial engineering capacity and a strong track record of performance in terms of executing projects would be better placed to maneuver the shift space to negotiate better terms, access blended finance products, and be de-risked by structured arrangements. Therefore, capital structure is not only reactive, but is a purposeful decision that is influenced by organizational competences and resource availability (Nguyen & Ramachandran, 2021).

Due to the various angles of capital structuring in mega projects, no single theory explains the phenomenon fully. But for the purpose of this study a hybrid of the Trade-off Theory, the Pecking Order Theory, and the Resource-based View is most suitable. The Trade-Off Theory and the Pecking Order Theory offer theoretical guidance in financial dynamics and sequence in capital decisions, and the RBV embeds these decisions in the strategic competencies of sponsors of the projects. This theoretical triangulation, thus, provides a comprehensive framework for understanding the intricate dynamics of capital structure and of project viability and profitability in mega investment in the infrastructural and industrial projects.

2.3. Conceptual Framework

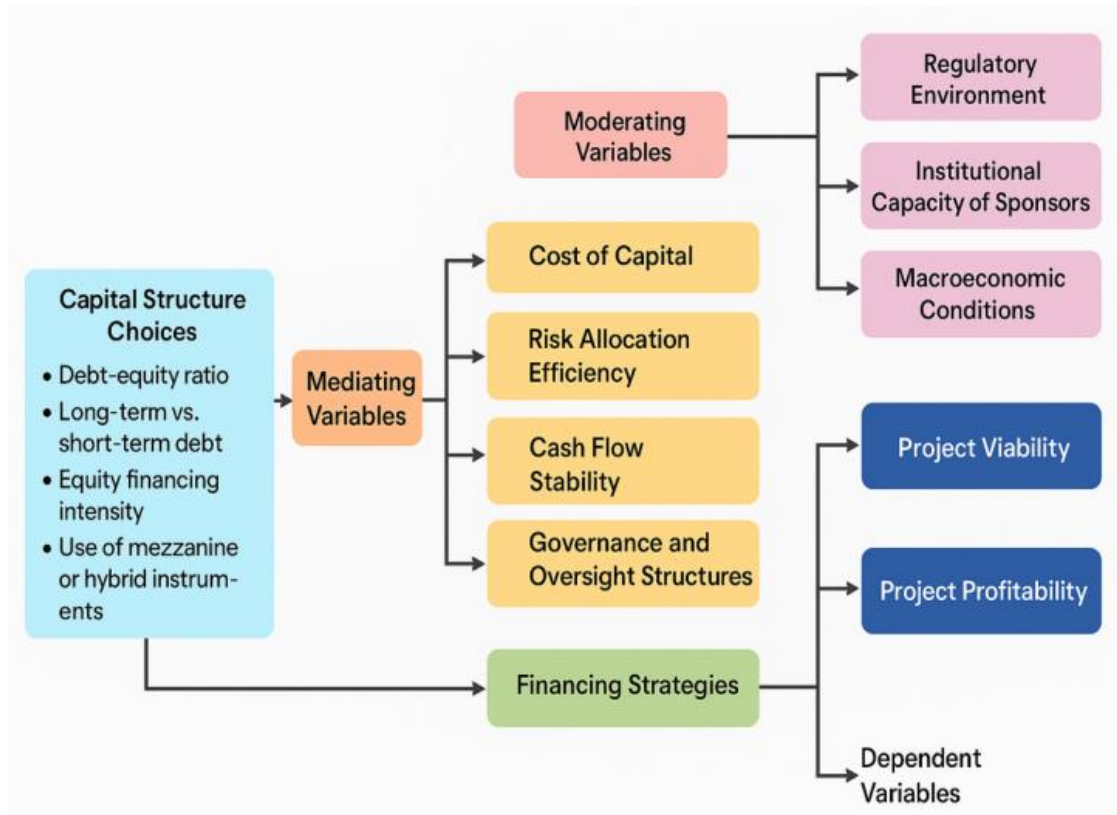


Figure 1. Conceptual Framework Diagram.

2.4. Explanation of the Conceptual Framework

The conceptual framework details the intricate and interrelated relationships mediating how capital structure decisions affect the financial and operating performances of mega-projects. It presents a schematic representation of the main drivers (i.e., independent, mediating, moderating, and dependent variables) within the analytical domain of the study.

At the bottom we put it the independent variable Capital Structure Choices that contains sub variables: Ratio of debt to equity, the ratio of long-term to short-term debt, Debt equity cost, Issue mezzanine/hybrid instrument. They are strategic financing structures project sponsors would use to fund the project and to achieve financial risk, ownership returns and expectations.

Financing Strategies The financing strategy which works together with capital structure decisions but also enter the model as an independent variable is Financing Strategies. Such strategies can involve both the choice of instruments (e.g., project bonds, syndicated loans) and sources of funding (including public vs. private investment or domestic vs. international sources) as well as more general structuring strategies such as project finance versus corporate finance models. Collectively, these variables describe the starting financial system that a project is based on.

The effect of financial leverage and financing policy on project outcomes is not only direct - it is also implemented through the essential internal financial and governance mechanisms. These mediating variables include:

- Cost of Capital (in particular WACC- Weighted Average Cost of Capital) that represents the cost of raising the project financing;
- Risk Sharing Efficiency, which concerns with the effectiveness of risk sharing among the participants;
- Cash Flow Stability for timely debt service and ongoing operations;
- Governance and Oversight Structures, driven by covenants, shareholder control, and regulatory requirements.

These mediating factors provide a link between financial structure and performance outcomes by influencing how the project functions internally and its robustness to uncertain Ensuring that such projects operate efficiently requires various mechanisms for handling the inherent uncertainty associated with renewable energy projects.

The model predicts potential moderator (moderating) variables, which are causes other than the IV and DV that impact on the strength and direction of the relationship between the IV and DV. These include:

- Regulatory Bodies (including legal and institutional framework for financing, permitting and enforcement).
- Institutional Sponsor Capacity, consisting of financial acumen of the sponsor, management experience, and reputation;
- Macroeconomic Environment in terms of inflation, foreign exchange rate fluctuation and interest rate; it has an impact on the capital cost and the investors' risk-taking tendencies.

These moderators allow for contextual variation, across jurisdiction, over time and with respect to sectoral application, allowing the framework to be relevant to developed and developing country contexts, as articulated in the scope of the study.

The dependent variables are the focal constructs including Project Viability and Project Profitability. Project feasibility considers if the project is technically and economically feasible throughout its life cycle, taking into account risks, resilience (adaptive capacity) and sustainability. Project profitability, on the contrary is assessed in a conventional financial perspective, using financial performance measures such as NPV, IRR, and ROI. Finally,

these results depend on the extent to which capital structure decisions manage to accommodate project-specific and macro levels of frictions.

Altogether, the model suggests that capital structure and funding strategies influence project success both directly and indirectly. These effects are channelled through intervening variables such as the cost of the capital, the structure of the governance, and reflected within the regulatory and economic environment in which the project operates. The integrative structure of this framework is conducive for studying large-scale infrastructure and industrial investments, where the financial architecture matters significantly to the long-run results.

3. Review of Literature (2018–2025)

3.1. Capital Structure Dynamics in Project Finance

The modern dynamics of capital structure in project finance has shifted considerably in the past few decades, and there continues to be debate as to how best to finance mega projects by way of debt and equity. Historically, the bulk of the financing of the above big projects was from long-term borrowings in view of their cost and tax deductibility. But with the rising financial risk in the increasingly complex risk of exchange rate and inflation, excessive leverage has attracted more attentions as well (Xiao & Zhao, 2021). Newer literature presenting hybrid sources of business capital which will combine mezzanine finance and convertible debt to fill the funding gap along with preserving financial flexibility (Gatti, 2021).

-Private portfolio NPLs on average range between 2-3 system is good for Greece, "although foreign funds continue to be a strong source of liquidity for mega projects in the country, including in such sectors as infrastructure and renewable energy. Pension funds, sovereign wealth funds and insurance firms find it attractive to invest in such projects with predictable cash flows and long-term horizons. But, institutional investors usually need strong governance structures and credit-enhancing tools to mitigate possible risks (Inderst & Stewart, 2018). On the other hand, there is still relatively low use of capital markets for project finance in many emerging economies, resulting from the shallow debt market segment, weak protection of investors and low-rated credit. At places where infra-bonds have been issued, challenges like lack of liquidity, and weak secondary market are still there, thereby constraining the scalability of bonds (Bhattacharya et al, 2020).

This institutional finance versus capital market access divide is particularly sharp within countries. In developed markets, infrastructure debt is typically refinanced with bond issuance and securitisation solutions. On the other hand, in developing countries, it is common that the development finance institutions (DFIs) and multilateral lenders take the place of private capital since commercial lenders reportedly tend to be averse to risks (Estache & Wren-Lewis, 2021). Accordingly, the design of capital structure is not simply a product of the 'finance' of firms' operations; it corresponds to a more general, institutional, and market context.

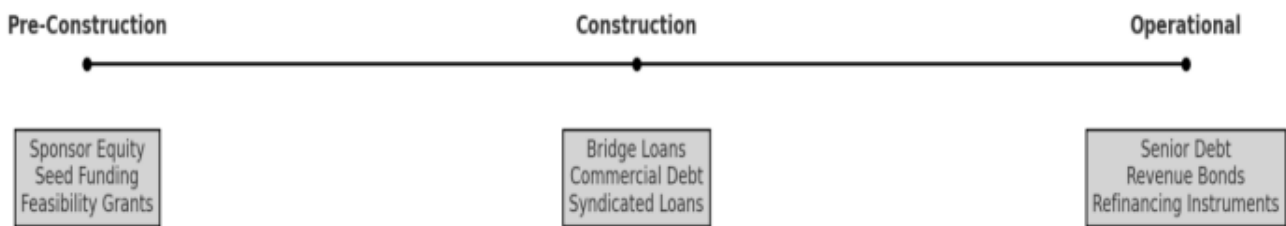


Figure 2. Project finance lifecycle with capital infusion phases.

The diagram illustrates the dynamic nature of capital structuring across a project's lifecycle. Early-stage funding relies on sponsor equity and feasibility grants. During construction, bridge loans and syndicated debt provide critical liquidity. In the operational phase, senior debt and refinancing instruments stabilize cash flows. Aligning financing types with risk and revenue stages enhances project bankability and financial resilience

3.2. Impact of Financing Models on Project Viability

Financing structures can significantly affect a project's feasibility by impacting upon a project's ability to achieve operating, debt service and profitability targets. The risk-sharing contracts are key to the financial feasibility, i.e., who between the project sponsor, the lenders, and the host government would be assigned the political, regulatory, and financial risk has to be defined (Zhai et al., 2020). Risk-mitigation tools such as guarantees, insurance products and covenants are part of sound financial structures, which increase the creditworthiness of the project and help to reduce the likelihood of default.

The past two decades have witnessed public-private partnerships (PPPs) increasingly employed as the dominant model for financing infrastructure projects, such as those in transportation and energy. PPPs provide a mechanism to leverage private investment with public control however, their effectiveness is closely linked to regulatory certainty, contract enforcement and political stability (Yescombe & Farquharson, 2018). PPPs have increasingly contributed to enhanced access to infrastructure finance in many countries, especially in contexts where the fiscal space of government s is limited. However, badly designed PPPs have also been associated with project failures related to cost overruns, renegotiation and distorted incentives (Roumboutsos & Pantelias, 2020).

Blended finance has also been growing in popularity as an instrument for enhancing project bankability using concessional capital to mitigate commercial investment risk. Sub-debt type instruments (first-loss guarantees, junior tranches, technical assistance grants) are employed to help attract private financiers by enhancing the risk-return profile (Attridge & Engen, 2019). Experiences from developing countries have shown that blended finance has mobilised commercially unviable projects far better than in commercial sectors such as clean energy, water, and transport infrastructure. Nonetheless, transparency, accountability, and development additionality are still challenges in blended finance practice (OECD, 2021).

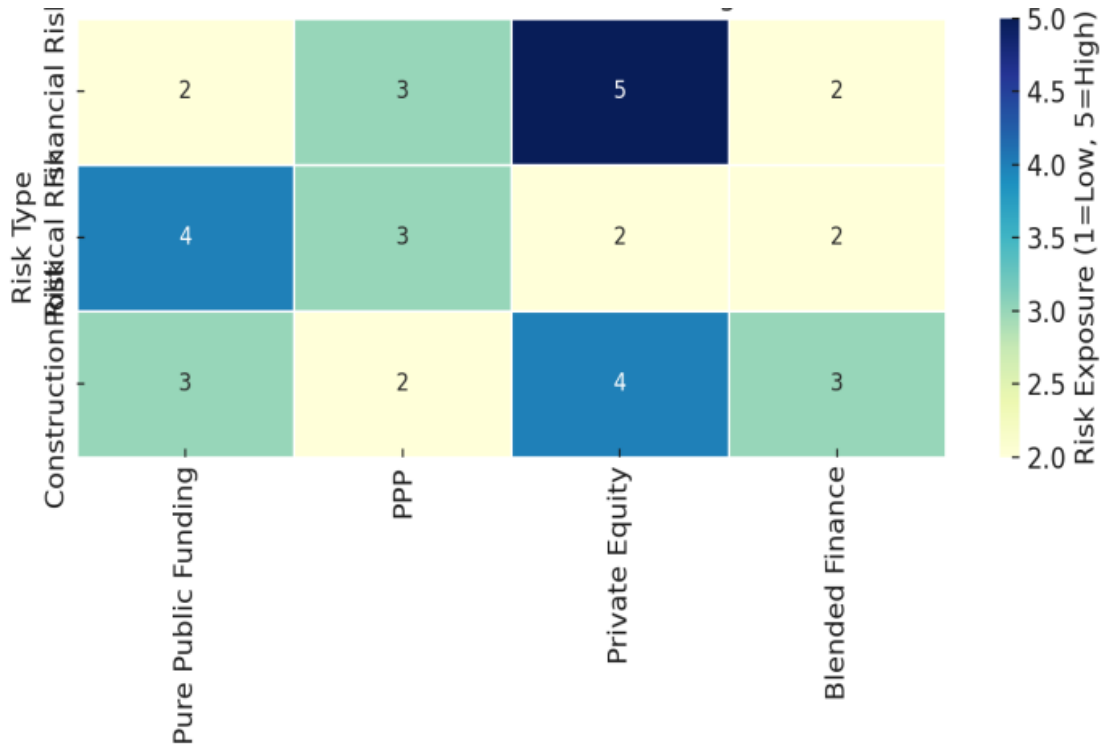


Figure 3. Risk allocation matrix across financing models.

The matrix reveals that private equity models concentrate financial and construction risk on the project sponsor, while public funding shifts political risk to the government. PPPs share risks more evenly, whereas blended finance structures reduce exposure for all parties through concessional and de-risking mechanisms, making them attractive for high-risk environments.

3.3. Capital Structure and Profitability Outcomes

A little evidence based literature exists that investigates the relationships between patterns of capital structure and economic performance in mega projects. Firms that have debt levels at equilibrium are usually have stronger performance indicators, assuming that firms have debt levels that match debt structure with their cash flow pattern and their sector debt pattern. In the energy industry, for example, there is evidence that high leverage, particularly in the development stages of renewable projects, can expose firms to defaults because of revenue risk and high requirement for upfront capital (Polzin et al., 2019). Reenterprise-dominant mechanisms are less risky but at the expense of lowering project IRRs as a consequence of higher returns from investors.

Projects with structured capita I stacks combining risk-mitigated debt and sub debt /eq forms of invited capital have found themselves enjoying an enhanced return profile, particularly in conjunction with strong contractual frameworks. In transport mega-projects, profitability depends not only on the level of tolls or user charges, but also on the cost and flexibility of financing (Cheah & Garvin, 2019). Projects with inflexible financing are especially vulnerable to fiscal stress caused by construction delays or policy shocks.

There is additional evidence that profitability is also a function of the timing of capital inflows. Projects that up an equity or concessionary capital ahead of time, while risk is high, are more likely to be able to draw on senior debt later, and on better terms. The empirical consensus emphasizes the significance of dynamic capital structuring that varies throughout a life of a project (Ho et al., 2022). Accordingly, the level of successfulness of a project is not only measured by its economic performance but is also affected by the timing and handling of the financing.

3.4. Determinants of Optimal Capital Structure in Mega Projects

Macroeconomic, institutional, sectoral, and project-specific variables are some of the factors that driving for optimal capital structure in mega-projects. Cost and availability of long-term capital is also directly related to macroeconomic conditions, which include, among others, interest rate fluctuation, inflation, and exchange risk. These factors create risk and uncertainty for emerging economies which often do not want to take on much leverage and thus may need to follow these principles with concessional funds or guarantees (Graham & Leary, 2019).

Capital structure decisions are significantly influenced by the institutional governance. Strong legal enforcement, regulatory oversight, and investor protection will tend to attract capital at favorable terms to projects. On the other hand, weak governance contexts increase project risk and do not encourage private sector involvement, particularly in debt intensive facilities (Nguyen & Ramachandran, 2021). Sector risk also impacts financing choice, with projects in riskier sectors (say, extractives or greenfield infrastructure) in general needing more conservative capital structures than the regulated utilities.

Policy incentives and fiscal tools – including tax holidays, credit guarantees, and viability gap funding- can also tip the scale in favour of one financing form over another. These instruments affect the perceived and actual cost of capital and are commonly applied in public-private partnerships to combat market failures and enhance bankability (Kwak et al., 2020). Developed economies, when compared to cross-country, instruments, systems, and levels of reliance on capital markets and institutional investors (where developed economies rely to a greater extent on capital markets and institutional investors and where developing and emerging economies are heavily dependent on multilateral and development banks and concessional finance).

Xiao and Zhao (2021) find that infrastructure projects in OECD countries are usually priced with a model using WACC as a focus of risk and this results in an optimal capital structure through an iterative modeling of WACC adjusted for risk. Conversely, research in Sub-Saharan Africa and South Asia reveals that efficient institutions are frequently politically compacted, dependent upon not only economic fundamentals but also geopolitical and

institutional limitations (Estache & Wren-Lewis, 2021). Thus the optimal capital structure in mega projects is not a uniform exercise, but context based and adapted to changing market and regulatory conditions.

Table 1. Comparative Analysis Table.

Project Name	Country	Sector	Financing Model	Capital Structure	Profitability Outcome
Crossrail (Elizabeth Line)	United Kingdom	Transport	Public-sector led with value capture	Multi-source public equity + debt (government + TfL)	Positive in long term; high initial cost overruns
Tesla Gigafactory	USA	Industrial/Manufacturing	Private equity and strategic JV	Equity-heavy, market-driven; minimal debt	Achieved early profitability due to scale and innovation
Lekki Deep Sea Port	Nigeria	Maritime/Logistics	PPP with syndicated loans	Equity (China/Tolaram) + debt (Chinese banks, AFC) + gov't support	High potential; on-time delivery; regional trade driver
Delhi Metro	India	Urban Transport	Mixed model with concessional loans	Concessional debt (JICA) + public equity + land monetization	Operational profitability with long-term sustainability

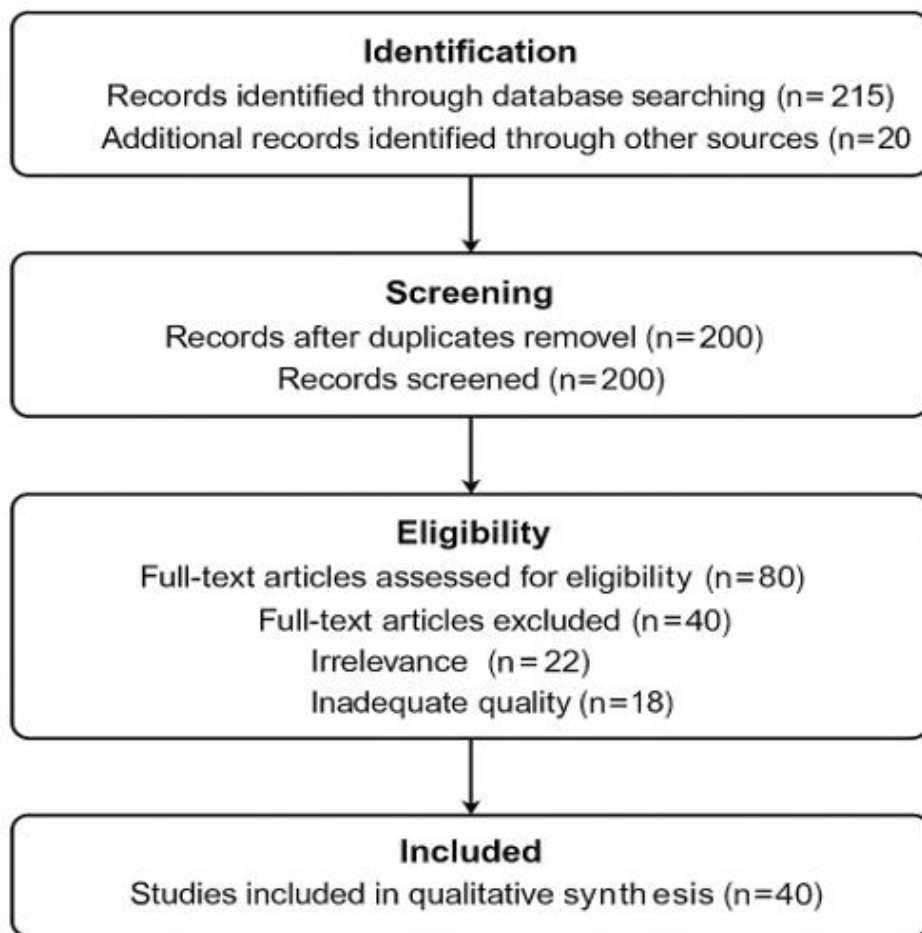


Figure 4. PRISMA 2020 Flow Diagram of the Study Selection Process.

This PRISMA 2020 flow diagram illustrates the complete process of identifying, screening, and selecting studies included in the review. A total of 235 records were identified, with 200 remaining after duplicate removal. Following title and abstract screening, 80 full-text articles were assessed for eligibility, of which 40 were excluded due to irrelevance or inadequate quality. Ultimately, 40 studies met the inclusion criteria and were incorporated into the qualitative synthesis.

4. Case Studies

Case studies offer critical empirical insight into how capital structure and financing strategies affect the viability and profitability of mega projects. By examining both developed and developing economy contexts, this section illustrates how financial configurations vary across institutional settings and project types, reinforcing the theoretical and empirical literature discussed previously.

4.1. Developed Economies

4.1.1. Crossrail Project (United Kingdom)

Part of the “Elizabeth Line,” formerly called Crossrail, which is one of Europe’s biggest infrastructure projects, the new line is expected to connect east and west London over 62 miles of track. The original capital cost was estimated at £14.8 billion, but faced cost overruns and the final cost was estimated to exceed £19 billion. Crossrail’s capital structure was complex and multi-sourced, including funding from central government, Transport for London (TfL), the Greater London Authority, and property developers through value capture (NAO, 2020).

The capital structure of the project involved a mix of public equity, public debt provided by the UK Treasury and an additional business rate supplement levy, characterising the project as a form of public sector-led hybrid approach. Although the exposure to debt was not high, he badly underestimated the risk contingencies, resulting in significant schedule slippages and cost overruns. Despite cost overruns, the long-term financial view is favourable thanks to projected farebox recovery and real estate value uplift. However the project unveiled flaws in governance and cost risk modelling.

4.1.2. Tesla Gigafactory (USA)

The Tesla Gigafactory in Nevada is a signature demonstration of market-driven capital structuring in large-scale industrial investment. Serving the production of Tesla’s electric vehicles with the production of lithium battery cells, the project was structured with a capitalization heavily weighted towards private equity and did not rely much on leverage. Funding was largely contributed by Tesla’s operating results, stock offerings, and strategic joint venture investments with Panasonic.

Tesla stayed away from traditional debt markets because of its lofty market valuation, which meant low-cost equity was a better source of funding. The inflection-friendly capital structure, also, enabled the company to be operationally nimble and remain unburdened by interest in the late scaling stages. The economics of the project did not take too long to turn profitable, with a cost-per-unit production dropping sharply as the economics of scale kicked in (IEA, 2022). The success of the Gigafactory reflects the significance of financing structure that matches technological innovation cycles and market environment.

4.2. Developing Economies

4.2.1. Lekki Deep Sea Port (Nigeria)

Nigeria’s biggest maritime infrastructure project, the Lekki Deep Sea Port, is situated in Lagos State. Structured as a Public Private Partnership (PPP), the project is funded through equity, commercial loans and concessional lending. two equities are from China Harbour Engineering Company and Tolaram Group, with deb from Chinese banks and Africa Finance Corporation(AFC, 2022).

The financing model was designed to encourage risk-pooling among the public and private partners. The Nigerian Ports Authority (NPA) guaranteed the government and infrastructure, and private enterprise maintained control along a 45-year lease. It contributed to the risk spread among several lenders and was instrumental to reach the financial close. The project was completed ahead of schedule-compared to other African benchmarks and have very strong profitability perspectives thanks to the expected revenues from container throughput and regional trade growth.

4.2.2. Delhi Metro (India)

Delhi Metro has been reported as "one of the glowing examples of penetrating mass transit in the emerging mass transit cities around the world". It had a dual financing structure consisting of both soft JICA loans and government budgetary support and made use of land monetization. The funding composition was predominantly concessional debt at low interest rates and long maturities along with large equity injections from the central and state governments.

One of the distinct aspects was combining societal and project-specific legislation to safeguard regulatory continuity and institutional stability through the use of government guarantees. It led to a very high level of investor confidence, and kept financial risk weightings low. The Delhi Metro turned its first phase profitable within 10 years of the commencement of its operations due to healthy farebox recovery supplemented by non-fare income from advertising and real estate leasing (Sohail et al., 2020). Its success underscores how patient capital, institutional collaboration and strong financial planning can yield sustainable results in difficult urban environments.

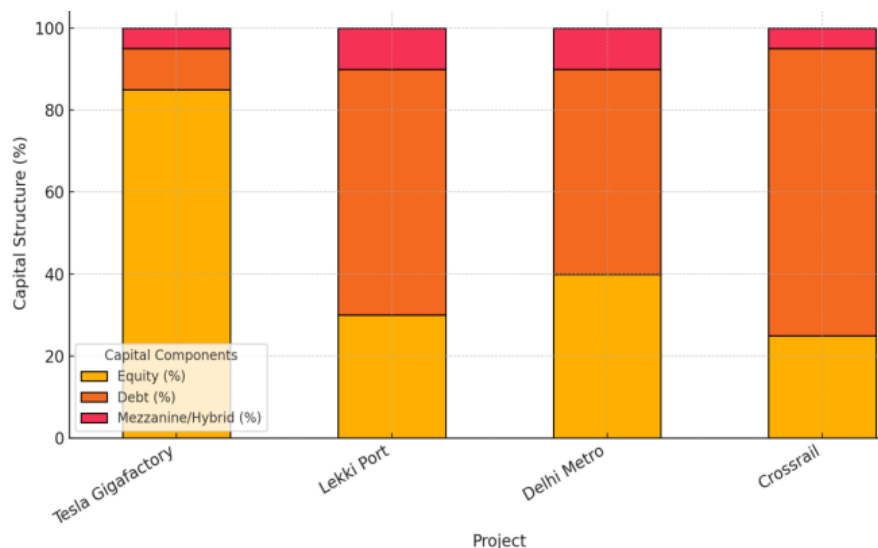


Figure 5. Capital structure composition of selected mega projects.

The figure demonstrates how capital structuring varies by project and region. Tesla's Gigafactory was predominantly equity-financed, enabling flexibility during scaling. In contrast, Crossrail and Lekki Port relied heavily on debt, reflecting public and syndicated funding dominance. Delhi Metro adopted a balanced mix with concessional debt and public equity. The composition directly influences project risk, ROI, and operational performance.

5. Discussion

This analysis of the literature plus the empirical case studies suggest a strong and multi-dimensional relationship between capital structure decisions and the financial and operating performance of megaprojects. The quality and composition of capital not only represents a form of funding, but also a strategic design which has the capability of establishing a risk profile for projects, financial sustainability, and long-term market success. Capital structure has a major impact on ROI, cost containment, pace of implementation and investors' confidence levels across markets.

The available literature suggests that an optimal capital structure increases ROI by matching the financing instruments to the cash flow duration and life cycle stages of the project, which is supported by the reviewed studies. Developments that sequence equity and debt strategically, e.g., using equity in the riskier early stages and introducing debt when cash flows are more stable, show better financial performance (Xiao & Zhao, 2021; Ho et al., 2022). This is illustrated in the Tesla Gigafactory example, where reliance on an equity-light financing stack enabled operational nimbleness, lower interest service costs and expedited scaling. As illustrated in the Table 1, the higher ROI was not solely the result of innovation but also due to strategic capital structure decisions which reduced the level of financing constraints during the most important growth periods.

Management of cost overruns, a recurrent problem in mega projects, is also related to the type and rigor of capital structure. Highly indebted projects normally have strict monitoring covenants and third-party monitoring, motivating the project manager to remain within budget limits (Gatti 2021). It played out in the Delhi Metro case where concessional loan from JICA was only available if there was adherence to stringent procurement norms and financial prudence. Crossrail The sophisticated financing for the Crossrail project notwithstanding, it experienced significant cost overruns, highlighting the deficiencies inherent in the public-sector led structures without sufficient thought to risk modeling and contingencies. Hence the impact of capital structure on cost overruns and overruns mitigation depends on the managerial financial discipline and on the external governance devices that are in place.

By the same token, time-to-completion is quite sensitive to the funding composition. Furthermore, projects with secure and predictable financing, e.g., long-term debt and phased equity disbursements, are more likely to follow their execution schedule. Lekki Deep Sea Port was also able to achieve financial close and construction free from any disruption both at the time due to a combination of syndicated debt and phased equity. On the other hand, programmes depending on uncertain lines of funding and disbursement are consistently delayed such as in the case of many low-income country infrastructure projects where fragmented financing leads to operational bottlenecks (Estache & Wren-Lewis, 2021). It means capital structure decisions have an impact not only on the discounted cash flows (financial considerations), but also on the profile of mega project execution over time.

Another critical consequence of capital structure is the security of investors. Investors consider the mix of capital as representative of project risk and sponsor commitment. A well positioned and stable capital structure with reasonable levels of equity strengthen sponsor confidence and ensure that thin debt maturities do not impact ability to repay. The Delhi Metro case revealed how long-term investors were enabled in an environment enabled by concessional finance with sovereign guarantees. In politically unstable regions, high-risk capital structures generally discourage investment no matter what the potential project returns are. Accordingly, capital structure serves a signalling role, which influence project bankability as well as future access to additional capital rounds.

In the face of these revelations, mega projects financing has still glaring gaps, and even more so in developing countries. There is, however, one perennial challenge that is the absence of access to long-term capital. Domestic capital markets are underdeveloped in many low- and middle-income countries, and there is limited role of institutional investors and shallow debt markets. Consequently, project sponsors typically resort to short-term commercial indebtedness or to external development finance, both of which are inadequate to accommodate the length of gestation and ramp-up of revenues characteristic of mega-projects (Bhattacharya et al., 2020). This mismatch in the tenor of funds creates rollover risk and adds strain on project cash flows.

Another important void is its lack of effective integration of risk mitigations in capital structure. Most projects in developing countries are not able to make effective use of such instruments as political risk insurance, first-loss guarantees or currency hedging, partly because of budgetary constraints and partly because they are unaware of their existence. This gap exposes construction projects to macroeconomic events, regulatory issues, and project delays. Blended finance and PPP models are considered to have a potential to help overcome these problems, yet no progress has been reported because of capacity and governance constraints (Journal, 2016) (Sophia, 2021a).

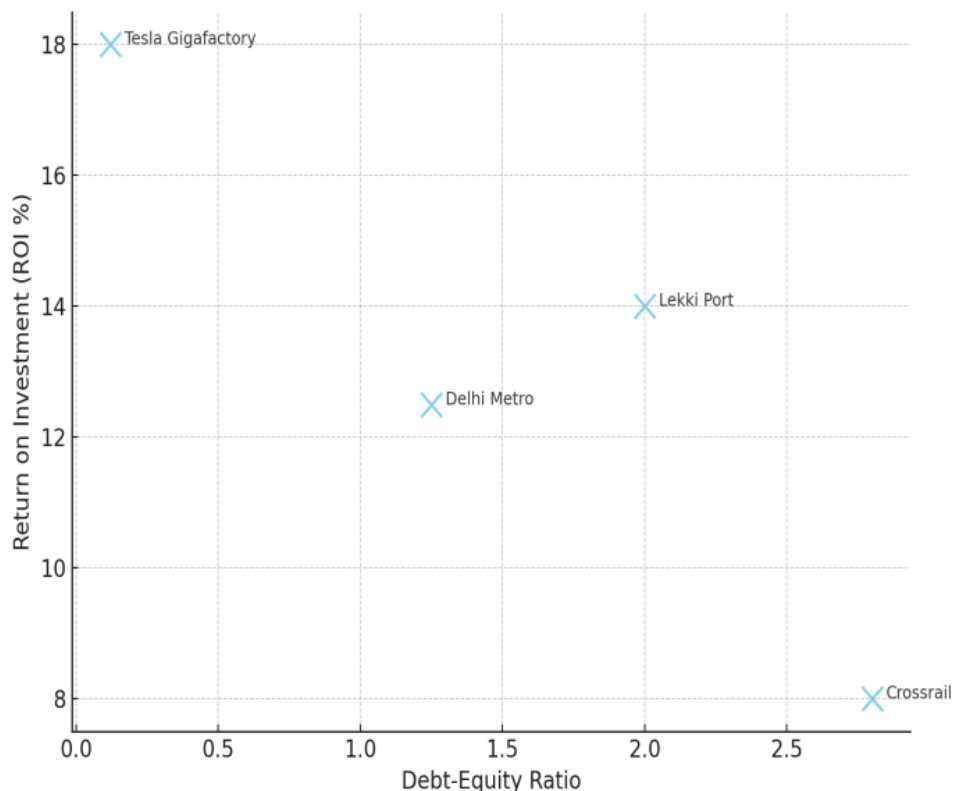


Figure 6. Correlation between capital structure and ROI in mega projects.

The figure shows a general inverse relationship between high leverage and ROI. Tesla's equity-heavy model achieved the highest ROI, while Crossrail, with a high debt-equity ratio, had the lowest. Projects with balanced structures like Lekki Port and Delhi Metro yielded moderate returns. This suggests that excessive leverage may reduce profitability due to financial stress and risk exposure.

Capital structure is a central determinant of project success, influencing not only financial metrics such as ROI but also operational variables like cost control, timeliness, and stakeholder trust. The comparative case studies reinforce that no one-size-fits-all structure exists; instead, context-specific, dynamically managed capital arrangements are required. For policymakers and project sponsors in developing economies, the key lies in deepening domestic capital markets, fostering blended finance ecosystems, and embedding robust risk mitigation tools within capital structures to close the financing gap and improve the performance of mega infrastructure investments.

6. Policy and Managerial Implications Section

The results of this research could have significant consequences for policymakers and project sponsors involved in mega projects financing. As project viability and profitability and resilience essentially hinge on capital structure decisions, it is imperative to establish strategic financing policy guidelines to facilitate the long-term sustainability and success of a project. With the magnitude and intensity of mega infrastructure and industry projects, it is essential for investors to take more subtle approaches on financial innovation, institutionalized building and contextualized fitting.

From a policy point of view, the government has a major responsibility in generating an enabling environment to enable efficient and sustainable financing of projects. One of the necessary interventions is the fruition and the strengthening of credit frameworks, which help to minimize information asymmetry, enhance investor confidence and de-risk infrastructure sectors. This includes improving the legal and institutional system of contract enforcement, dispute resolution, and sovereign guarantee. targeted reforms to develop long-term bond markets, credit ratings systems and institutional investors could substantially increase the pool of infrastructure capital available in countries with underdeveloped capital markets (Estache & Wren-Lewis, 2021). In addition, fiscal and regulatory measures—including tax holidays, viability gap funding and accelerated depreciation allowances—can be used in a strategic manner to enhance the attractiveness of infrastructure projects to private finance and to reduce the perceived costs of long gestation periods (OECD, 2021).

Policymakers should also work to scale up the use of blended finance mechanisms, especially in developing countries where the risk-return of infrastructure projects tends to be a deterrent for private money. Furthermore, by combining concessional with commercial financing, blended finance instruments can help fill the funding gap and reduce weighted average cost of capital. International financial institutions and development finance institutions (DFIs) can help catalyze such funding by providing guarantees, first loss tranches, or currency-hedging products to crowd in private capital (Attridge & Engen, 2019). Public-private partnerships (PPPs) would also need to be designed prudently to achieve efficient risk-sharing, transparency and incentive alignment, steering clear of the pitfall of revenue guarantees that shift too much risk from the private to the public sector.

There are also definite implications for project sponsors or managers as eager as those of the corporate leaders. Depending on specific project risks, sector characteristics, and cash flow profile, a decision whether to use equity, debt or a mix of both should be based on a thorough analysis. Equity is flexible and has capacity to absorb risk, especially at the project's early stage when revenue is not assured. But it can result in dilution and higher expected returns of investors. Debt financing, although more tax advantageous and less dilutive, creates fixed commitments that may be threatened by exogenous shocks or delays (Graham & Leary, 2019). Hybrid financial instruments like convertibles, mezzanine, and subordinated loans are a middle ground, enabling staged repayment and performance-based conversion, but are for more sophisticated structuring.

Dynamic capital structuring through the life-cycle of the project should also be adopted by corporate managers. Equity from the Sponsor or concessional debt would provide risk-capital for pre-cash flow stages. Components of commercial debt can be brought in only when revenue certainty (or financial close) for the project is achieved. This lifecycle methodology is intended to make sure the debt structure fits the risk and profit profile of the project at the different phase, and consequently increases bankability and profitability of the project (Xiao & Zhao, 2021). There is also a need for more depth in the financial capacity for projects, so that sponsorship can manage and work with multi-sourced capital stacks and multiple financiers, which can require deeper capabilities in risk assessment, capital modelling and stakeholder management.

Also, there is need to institutionalise strong governance model to enable financial discipline, transparency and accountability at every stage of the project. Independent monitors, open procurement procedures and consistent financial disclosure can foster trust with stakeholders and reduce the moral hazards involved in mega project failures (Cheah & Garvin, 2019). And above all, both private and public players must understand that the capital structure is not a mere one-time decision but an iterative process, and it must closely follow the projects and the financial markets that ultimately must bring the debt.

In sum, it will require all the forces of our policymakers and corporate managers together to finance mega investments. By strengthening enabling institutions, providing focused incentives, and deploying more flexible, risk-adjusting capital structures, stakeholders can improve project performance and release the developmental promise of high-risk, large-scale investments. Theoretical considerations, supported by real case evidence, also support the assertion that sustainable financing approaches are not just an instrument of finance, but a fundamental building block for infrastructural and industrial policy.

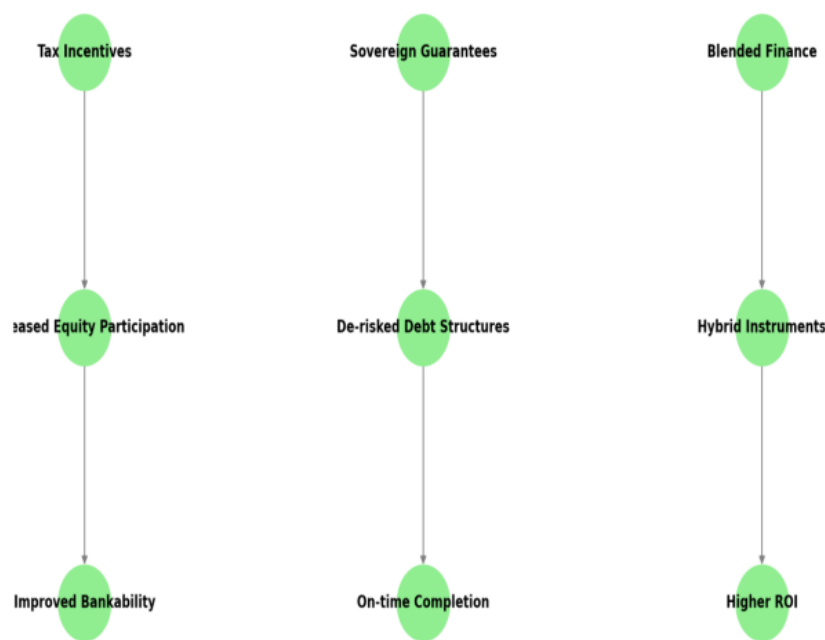


Figure 7. Policy and financing strategy map.

Policy interventions such as tax incentives and sovereign guarantees shape financing behavior by encouraging equity contributions and de-risking debt. Blended finance enables hybrid instruments, enhancing project bankability, boosting ROI, and improving delivery timelines. This strategic alignment between policy

7. Conclusion

This study, based on the findings of recent literature and comparing the case studies in developed and developing countries, has cast a critical review on the impact of the capital structure strategies on the sustainability and profitability of mega projects. The results confirm that capital structure is a strategic factor in determining the success of a project, which in turn can affect the determination of returns on investment, cost concern, time deliverable and investor interest. Whether financed with equity, debt or hybrid instruments, the capital structure adopted determines the allocation of risk, the financial soundness and the market credibility.

Projects with elastic and contextually sensitive capital structures are always superior to those financed inflexibly. In mature contexts the Tesla Gigafactory and Crossrail show that public and private models deliver different results, depending on their skills at managing risk and capital movement. In emerging economies, the Lekki Deep Sea Port and Delhi Metro are both successful examples of how blended finance and concessional lending can help address institutional and capital market limitations to finance sustainable infrastructure.

The key message is simple: funding is not a technical exercise but a vital element of the success of mega projects. With the intersection of infrastructure agendas, sustainability and digital transformation, future research should address three growing domains. To start, ESG-related financing and its role in bringing projects into alignment with environmental and social objectives. Second, green bonds and climate finance instruments effect on cost of capital and bankability. Third, the promise of digital finance tools—a category that includes the likes of blockchain and AI—to increase access, transparency, and risk management.

At the end of the day, capital structure policy should transform into dynamic, innovation-driven policy that also retains the characteristics both of financial complexity and of global development imperatives.

References

Attridge, S., & Engen, L. (2019). *Blended finance in the poorest countries: The need for a better approach*. Overseas Development Institute. <https://odi.org/en/publications/blended-finance-in-the-poorest-countries>

- AFC. (2022). *Lekki Port reaches financial close and construction milestone*. Africa Finance Corporation. <https://www.africafc.org>
- Barney, J. B. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99–120. <https://doi.org/10.1177/014920639101700108>
- Bhattacharya, A., Jeong, M., & Palazzi, P. (2020). *Infrastructure finance in the developing world: The need for a new approach*. Global Economy and Development, Brookings Institution.
- Brealey, R. A., Myers, S. C., & Allen, F. (2020). *Principles of corporate finance* (13th ed.). McGraw-Hill Education.
- Cheah, C. Y. J., & Garvin, M. J. (2019). An examination of financing arrangements in large infrastructure projects. *International Journal of Project Management*, 37(1), 89–102. <https://doi.org/10.1016/j.ijproman.2018.11.003>
- Estache, A., & Wren-Lewis, L. (2021). Public investment, capital structures and development finance. *Journal of Development Studies*, 57(2), 207–227. <https://doi.org/10.1080/00220388.2020.1816152>
- Flyvbjerg, B. (2018). What you should know about megaprojects and why: An overview. *Project Management Journal*, 49(2), 6–18. <https://doi.org/10.1177/875697281804900202>
- Gatti, S. (2021). *Project finance in theory and practice: Designing, structuring, and financing private and public projects* (4th ed.). Elsevier.
- Graham, J. R., & Leary, M. T. (2019). The evolution of corporate capital structure. *Journal of Applied Corporate Finance*, 31(1), 8–22. <https://doi.org/10.1111/jacf.12342>
- Ho, J., Lee, Y. Y., & Weng, C. (2022). Lifecycle capital structuring in PPP projects: Empirical analysis and policy implications. *Construction Management and Economics*, 40(4), 341–357. <https://doi.org/10.1080/01446193.2021.1996370>
- IEA. (2022). *Tesla Gigafactory case study: Scaling clean energy innovation*. International Energy Agency. <https://www.iea.org>
- Inderst, G., & Stewart, F. (2018). *Institutional investment in infrastructure in developing countries: Introduction to potential models* (World Bank Policy Research Working Paper No. 8280). World Bank. <https://doi.org/10.1596/1813-9450-8280>
- Kouser, R., Bano, T., & Hussain, M. (2020). Financing behavior of firms: Empirical evidence from emerging markets. *Journal of Economic and Administrative Sciences*, 36(1), 19–34. <https://doi.org/10.1108/JEAS-04-2018-0051>
- Kumar, S., & Bansal, L. K. (2021). Financing profitability of infrastructure projects under varying capital structure scenarios. *Journal of Infrastructure Development*, 13(1), 35–54. <https://doi.org/10.1177/0974930621999654>
- Kwak, Y. H., Park, J., & LaBrosse, M. (2020). Financing public-private partnership infrastructure projects in emerging markets: Risk allocation and investor confidence. *International Journal of Project Management*, 38(6), 398–409. <https://doi.org/10.1016/j.ijproman.2020.04.002>
- NAO. (2020). *Crossrail: Progress review*. UK National Audit Office. <https://www.nao.org.uk>
- Nguyen, T. D., & Ramachandran, K. (2021). Strategic capabilities and financial structure in infrastructure firms: An RBV approach. *International Journal of Project Management*, 39(4), 412–423. <https://doi.org/10.1016/j.ijproman.2021.02.004>
- OECD. (2021). *Blended finance and COVID-19 recovery: Opportunities and challenges*. Organisation for Economic Co-operation and Development. <https://www.oecd.org>
- Polzin, F., von Flotow, P., & Nolden, C. (2019). What encourages local authorities to engage with energy performance contracting for renewable energy? *Energy Policy*, 132, 1110–1119. <https://doi.org/10.1016/j.enpol.2019.06.041>
- Rouboutsos, A., & Pantelias, A. (2020). Managing complexity and stakeholder relationships in PPPs: A comparative study. *Journal of Infrastructure Systems*, 26(1), 04019035. [https://doi.org/10.1061/\(ASCE\)IS.1943-555X.0000495](https://doi.org/10.1061/(ASCE)IS.1943-555X.0000495)
- Sharma, A., & Chatterjee, C. (2019). Designing sustainable financing strategies for infrastructure development: A project finance perspective. *Journal of Project Finance and Infrastructure Investment*, 8(2), 121–136. (No DOI available)
- Sohail, M., Mitlin, D., & Levy, C. (2020). Financing sustainable urban infrastructure: The case of Delhi Metro. *Urban Studies*, 57(11), 2216–2235. <https://doi.org/10.1177/0042098019876849>
- Xiao, L., & Zhao, Q. (2021). Capital structure optimization of large-scale infrastructure projects: A comparative study of financing strategies. *Journal of Corporate Finance*, 66, 101891. <https://doi.org/10.1016/j.jcorpfin.2020.101891>
- Yescombe, E. R., & Farquharson, E. (2018). *Public-private partnerships for infrastructure: Principles of policy and finance* (2nd ed.). Academic Press.
- Zhai, X., Wang, H., & Zhang, X. (2020). Understanding risk allocation in PPP projects: Evidence from international transport projects. *Transport Policy*, 97, 1–11. <https://doi.org/10.1016/j.tranpol.2020.06.003>