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Public-private partnerships (PPP) in infrastructure financing: A comparative study of developed and developing economies

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Abstract

Public-private partnerships (PPPs) facilitate risk-sharing and asset financing to encourage private sector involvement in infrastructure development, particularly in developing countries facing growing infrastructure needs. This research compares PPP frameworks in developed and developing nations, focusing on risk management, financial structures, and sustainability practices. Developed countries benefit from stable legal systems, robust financial instruments, and effective risk-sharing mechanisms that attract private investment. In contrast, developing economies often struggle with weak regulations, market instability, and limited institutional capacity. Multilateral institutions like the World Bank, Asian Development Bank, and International Finance Corporation support PPPs by offering risk mitigation tools and sustainable financing. The study emphasizes that sustainability, through ESG assessments, green finance, and climate-resilient infrastructure, is crucial to long-term PPP success. Findings reveal that generic PPP models often fall short without tailored strategies. Effective partnerships require strong institutional frameworks, collaborative governance, and innovative financing. Ultimately, PPPs must adopt transparent, adaptable, and climate-responsive approaches to overcome regulatory, financial, and environmental challenges, positioning them as vital mechanisms for sustainable infrastructure development.

Keywords: Public-private partnerships (PPP), Infrastructure financing, Developed economies, Risk allocation, Sustainable development

1. Introduction

Public-private partnerships (PPPs) represent a principal sustainable financing instrument for infrastructure development, which bilateral and multilateral organizations endorse in developed and developing economies. Through these agreements, the private sector delivers capital together with expertise and management efficiency

to handle infrastructure deficits that governments struggle to finance and execute efficiently [1], [2]. PPPs display significance as logical tools for sustainable development because of their potential to build long-term financial stability and environmental sustainability [3], [4] in current urban scenarios characterized by fast development together with essential infrastructure requirements. PPP models have become essential in developed economies to upgrade historic infrastructure through private capital investments that create new sustainable development projects. Through its Private Finance Initiative (PFI) program, the United Kingdom has successfully enhanced public service efficiency by creating better risk-sharing approaches and financial innovations [1], [5]. Canada, together with Australia, has built PPP frameworks that combine transparency with risk distribution and operational efficiency to improve their transportation infrastructure and healthcare delivery, along with education systems, respectively [4], [6].

Developing economies encounter special obstacles when implementing PPPs because they have restricted financial capacities and deficient regulatory structures, and experience elevated political and economic dangers. These developing nations use PPPs to overcome infrastructure funding gaps while working toward their sustainable development goals (SDGs) [7]. The Rwanda Bulk Water Project demonstrates that PPPs enable better service delivery along with employment generation as well as capacity strengthening [8],[9]. Effective partnerships succeed through strong institutional frameworks, well-defined policies, and efficient mechanisms to handle risks [10], [11]. PPPs encounter multiple obstacles during their implementation process. Project execution faces delays mainly because of complex contract management and inconsistent regulations, together with stakeholder disagreements. Existing differences in PPP implementation between developed and developing countries create doubts about the universal PPP model's suitability and support the need for local adaptations. The developed economies succeed through robust financial and legal frameworks, whereas emerging economies struggle with performance limitations during negotiations, along with project implementation delays [12], [13].

The research evaluates infrastructure financing features and operational characteristics, and difficulties of PPPs when implemented throughout different economic environments. The paper examines case studies spanning developed and developing market economies to identify global improvements in PPP frameworks while providing an investigation into successful and unsuccessful practices [14]. Research output will assist in developing sustainable infrastructure development strategies that combine economic strength with policy development effectiveness.

The study on public-private partnerships (PPP) in infrastructure financing plays a crucial role because it not only gives a clear understanding of the role of PPP as a catalyst for sustainable infrastructure development but also gives hints on areas where PPP can be applied to achieve that goal. Through reviewing their role in financing critical infrastructure projects, this study shows how they can also play a role in reaching sustainable development of the United Nations Sustainable Development Goals (SDGs). Apart from having the ability to mobilize private sector investments, PPPs also integrate green financing mechanisms, climate resilience strategies, and ways of sustainable urban planning adopted for long-term sustainability benefits in terms of both environment and economy. This research aims to compare PPP models in developed and developing economies, evaluate the effectiveness of these models, how risk is allocated, and the financial viability between the public and private sector parties. Developed economies usually have put in place well-structured regulatory frameworks and varied financial instruments, as compared to developing nations that are faced with problems of funding constraints, institutional inefficiency, and increased project risks. Through such a comparison of these contextual differences within the regions, the research identifies commonalities along with important variations that affect the efficiency, flexibility, and sustainability of PPPs in different economic contexts. The research also provides policymakers, investors, and development agencies with useful policy and investment recommendations to improve PPP efficiency. These findings offer ways to enhance risk-sharing frameworks, improve the governance of regulations, and support the integration of sustainability-oriented investment mechanisms. The study favors the coverage of these aspects to create infrastructure financing models that are more resilient and equitable while recognizing institutional and financial factors that impact PPP performance.

There is little literature on how socio-economic and political environments affect the success of PPP projects. This research takes the dimensions of this advancement and analyzes them between developed and developing economies to contribute towards realizing infrastructure policies consistent with economic growth, sustainability, and financial inclusion.

The objectives of this research are to analyze the role, efficiency, and issues of PPP in infrastructure financing between developed and developing countries, as well as to determine the best practices and recommendations for improving the performance of PPP projects.

Research objectives include:

- To analyze the critical success and failure factors of PPP infrastructure projects in developed and developing countries.
- To analyze the differences in risk-sharing mechanisms, regulation approaches, and financial systems of PPPs in both regions.
- To come up with practical solutions on how to enhance the PPP projects and their implementation, performance, and sustainability in developing countries.

2. Research method

This part also presents the method used in the analysis of PPP in infrastructure financing within developed and developing countries. The research used both quantitative and qualitative data to provide the best understanding of PPP frameworks, results, and challenges.

2.1. Research design

The research adopted a comparative case study research approach and was centered on selected PPP infrastructure projects from developed and developing countries. The study employed a cross-sectional research design to obtain data from projects that were done or started in the last twenty years. The research focused on the comparison of PPP projects by risk division, financial organization, legal requirements, and performance parameters.

2.2. Data collection

Secondary research data were obtained from government documents, financial statements, PPP literature, and publications from development institutions such as the World Bank and the Asian Development Bank. The PPP Knowledge Lab of the World Bank and the PPP reports of the OECD were used to collect financial and operational information on the selected projects. Academic articles from peer-reviewed journals, industry reports, and policy documents were also consulted to give background information.

Primary data was collected by conducting face-to-face semi-structured interviews with the PPP project stakeholders. Such stakeholders included government officials, private sector players, financial analysts, and legal advisors who had engaged in PPP projects across the transportation, energy, and water sectors. The present study adopted a purposive sampling technique of selecting 20 interviewees from both developed and developing economies to get diverse views.

2.3. Case study selection

The PPP projects that were used in this study were obtained from case studies from six countries: the US, the UK, Japan, India, Kenya, and Brazil. The selection criteria were based on:

- The size and the scope of the project
- The sector may be transport, energy, or water
- The presence of a large amount of financial and operating information
- The level of development of PPP frameworks in the respective countries

In each case study, the author reviewed the project's design, sources of funding, risk distribution, and performance in terms of costs, schedules, and quality of service.

2.4. Data analysis

Exploratory quantitative research was undertaken based on financial and performance data of the chosen case studies. Project cost, time, and cost-benefit ratio were used as the KPIs in evaluating the effectiveness of PPP projects. These KPIs were compared using descriptive statistics between developed and developing economies. Further, risk allocation patterns were analyzed using a risk matrix to identify how financial, operational, and political risks were apportioned between the public and private partners.

Interview and case study data were analyzed using thematic analysis. Some of the commonalities about the effectiveness and the problems of PPPs were revealed, including governance, legal aspects, and stakeholders. Thematic analysis was used to code the answers and to look for similarities and differences in how various economies organize and govern their PPPs. This enabled the comparison of the institutional setting, the regulatory framework, and the market structure between developed and developing economies.

To overcome these limitations, data triangulation was used where data collected from government documents, academic articles, and stakeholder interviews were compared. Furthermore, cross-case comparisons were made to ensure that the patterns identified in one project were consistent with those in other projects. Interview participants were allowed to review and confirm the results of the study through member-checking.

The study adhered to ethical standards of interviewing and data collection, and analysis. Interview participants offered their consent to take part in the study, and their names were not used at any point. The information gathered from the private sector stakeholders was kept confidential, and, as a result, no information was disclosed that would be detrimental to their competitive position.

3. Results and discussion

This section presents and analyzes the results of the comparative evaluation of PPP in infrastructure financing for developed and developing countries. The results are therefore categorized under headings that are related to PPP projects, including risks, finance, legal, and efficiency. To enhance the readability of the analysis, tables and figures are used.

3.1. PPP projects in developed and developing countries

The United States, the United Kingdom, and Japan made up the three selected developed economies for comparison in this study. India, Kenya, and Brazil served as the three developing economies for assessment, together with six case studies. As illustrated in Table 1, which summarizes key PPP case studies across both developed and developing countries, there are significant differences in project outcomes, risk allocation models, and completion timelines that reflect the disparities in institutional capacity and financial frameworks among these nations. The research demonstrated that PPP project effectiveness shows wide variations because of economic conditions, institutional capabilities, financial arrangements, and sustainability integration standards [15]. Developed economies are now incorporating environmental, social, and governance (ESG) frameworks as a new trend in sustainable projects funded through PPP (public-private partnership) arrangements. Developing countries experience barriers in uniting their PPPs with climate resilience policies as well as sustainability targets [11].

Table 1. Summary of case studies analyzed

Country	Project	Sector	Total Cost (USD Billion)	Completion Time (Years)	Risk Allocation	Outcome
United States	California High-Speed Rail	Transportation	79.0	12	Shared between the public and private	Delayed, over-budget

Country	Project	Sector	Total Cost (USD Billion)	Completion Time (Years)	Risk Allocation	Outcome
United Kingdom	Thames Tideway Tunnel	Water	5.4	7	The private sector bears operational	On schedule, over budget
Japan	Haneda Airport Expansion	Transportation	10.2	6	The private sector bears financial risk	On time, on budget
India	Mumbai Metro Line 3	Transportation	2.5	8	The public sector bears financial risk	Delayed, over-budget
Kenya	Nairobi Expressway	Transportation	0.7	5	The private sector bears operational	On time, on budget
Brazil	Belo Monte Hydroelectric Project	Energy	18.5	10	Shared between the public and private	Delayed, over-budget

3.2. Risk distribution in PPP projects

Risk distribution stands as a fundamental difference between developed and developing economies when implementing PPP projects. The distribution of financial and operational risks between the public and private sectors in developed economies exists in a balanced manner. Developing economies distribute financial risks more heavily to the public sector because their private sector investment capabilities are limited, and political and economic uncertainties are elevated [10]. The assessment of PPP risks now includes climate-related elements as a primary concern for developing economies that do not have established climate adaptation plans. Smaller projects operating within coastal urban areas and water-based industries need sustainable funding approaches, including green bond financing together with resilient public-private partnerships frameworks [14].

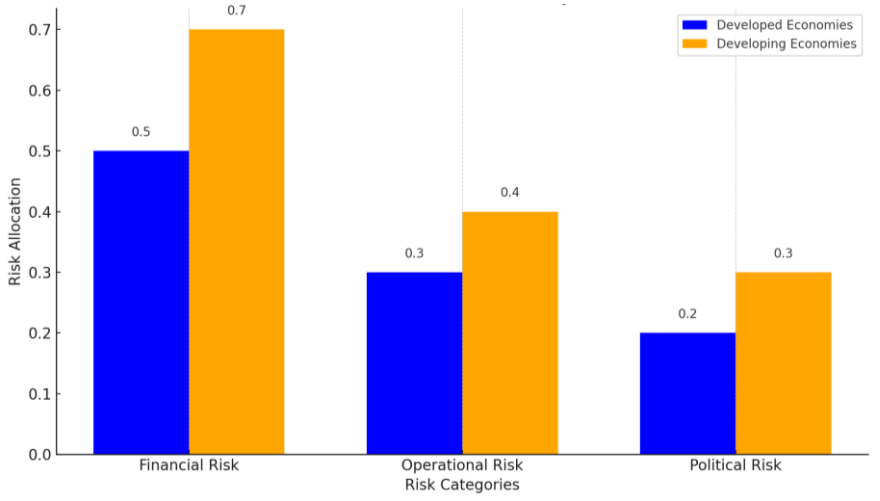

Figure 1. Risk allocation in PPP projects (Developed vs. developing economies)

As depicted in Figure 1 above, in developed countries like the United States and Japan, the operational risk is in the private sector, while the financial risk is shared. In developing countries such as India and Brazil, the financial risks are more on the public sector, and this puts more pressure on the government's finances and takes a longer time to implement their projects.

3.3. Financial system and funding instruments

Developed economies get maximum advantages from their well-structured financial systems because they employ multiple funding sources, which include project bonds combined with credit guarantees as well as long-term debt financing. Developing economies face delays because they depend mainly on government subsidies, international aid, and concessional loans, which are slowed down by bureaucratic inefficiencies [16]. Some developing economies use blended finance models to merge climate-focused private-sector financing with public investment to boost the financial stability of PPP projects [11]. These differences in funding composition between developed and developing economies are clearly outlined in Table 2, which compares the financial structures and relative support levels across the selected case studies.

Table 2. Comparison of financial structures in PPP projects

Country	Main Funding Sources	Private Sector Contribution	Government Support
United States	Project bonds, federal credit programs	65%	35%
United Kingdom	Project finance loans, municipal bonds	70%	30%
Japan	Bank loans, corporate bonds	60%	40%
India	Concessional loans, government subsidies	45%	55%
Kenya	International aid, private equity	55%	45%
Brazil	State-owned bank loans, public subsidies	50%	50%

Government funding and concessional loans dominate the development finance in developing economies and often lead to funding deficits and project time overruns. On the other hand, the developed economy has more diversified financial instruments that help to increase the PPP projects' liquidity and do not put much pressure on public finance.

3.4. Legal reforms and organizational development

The different regulatory frameworks constitute a substantial difference between developed nations and their developing counterparts. Open and foreseeable legal structures present in OECD countries drive the private sector to invest in public-private partnerships. Developing economies face obstacles in their PPP execution because they have to deal with bureaucratic challenges and unstable policies, coupled with weak contract enforcement processes [17]. The concept of sustainability-driven legal reforms has begun to emerge in various countries because it seeks to boost environmental responsibility within PPP project frameworks and embed sustainability commitments in infrastructure financing arrangements [18].

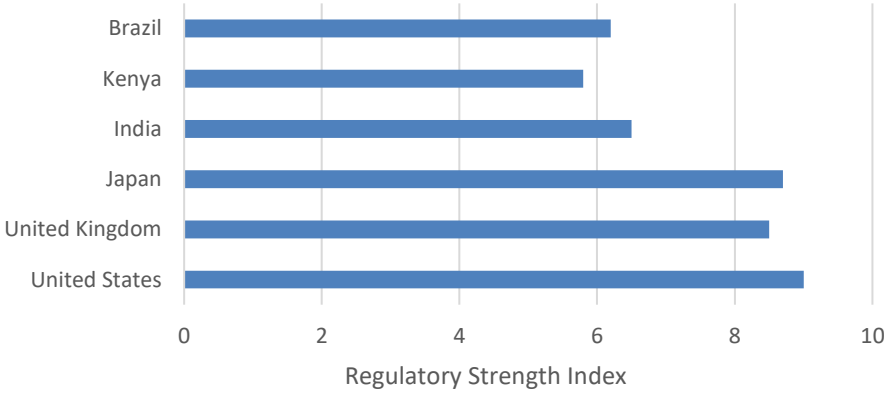

Figure 2. Regulatory strength in the PPP implementation index

As indicated in Figure 2 above, developed economies have a higher regulatory strength and institutional capacity than developing economies. In countries like the United Kingdom and Japan, legal structures are well-developed, and investor is protected by law. On the other hand, in countries such as Kenya and Brazil, a lack of efficient contract adherence and fluctuating policies leads to risks in PPP projects.

3.5. Project outcomes: time and cost efficiency

The implementation of PPP projects in developed economies succeeds in effective time and cost control because these economies have strong project governance mechanisms and strict regulatory frameworks. The Thames Tideway Tunnel in the United Kingdom [5] represents one of the projects that exceeded its budget in these developed economic settings. Developing economies experience project inefficiencies mostly from limited funding, together with delayed governmental processes and political intervention. The Mumbai Metro Line 3 in India, along with the Belo Monte Hydroelectric Project in Brazil, encountered major cost increases because their financial planning and risk assessment systems required improvement [19]. Table 3 provides a comparative overview of planned versus actual costs and completion times, reinforcing the observed inefficiencies and variances in PPP project execution across both developed and developing economies.

Table 3. Project time and cost performance comparison

Country	Project	Planned Cost (USD Billion)	Actual Cost (USD Billion)	Planned Time (Years)	Actual Time (Years)
United States	California High-Speed Rail	68.0	79.0	10	12
United Kingdom	Thames Tideway Tunnel	4.2	5.4	6	7
Japan	Haneda Airport Expansion	10.2	10.2	6	6
India	Mumbai Metro Line 3	2.1	2.5	5	8
Kenya	Nairobi Expressway	0.7	0.7	5	5
Brazil	Belo Monte Hydroelectric	15.0	18.5	8	10

3.6. Lessons learned and best practices

The comparative analysis revealed several lessons and best practices for improving PPP project outcomes, particularly in developing economies:

- Regulatory Reforms: Improving the standards of regulation and compliance and guaranteeing the contracts may lead to an increase in investors' confidence and the improvement of the projects.
- Risk Allocation: It is therefore important to have an efficient risk allocation between the public and private sectors to sustain PPP projects.
- Financial Innovation: Thus, the development of new funding sources is crucial for developing economies to decrease their reliance on concessional loans and subsidies; new financial instruments, including project bonds and public credit guarantees, can be of particular interest.
- Capacity Building: Enhancing the project management capacity of institutions, regulatory capability, and risk evaluation capacity is critical to PPP performance in developing countries.

The study also calls for the development of specific PPP infrastructure financing strategies for developed and developing countries. While developed economies enjoy well-developed financial systems and regulatory frameworks, developing economies face challenges in terms of institutional capacity, financial structure, and

risk distribution for PPPs to realize their potential. The present paper has demonstrated that through the application of best practices from developed economies, developing countries can enhance the performance and productivity of PPP projects and thus enhance their economic development and infrastructure.

4. Conclusion

Public-private partnerships (PPPs) have developed into a widely accepted infrastructure financing model that helps both developed and developing economies organize their resource acquisition, together with risk distribution and project development systems. The research analyzed how PPPs form and get regulated in different economic groups to evaluate their strengths and weaknesses.

The financing tool known as PPPs in developed economies operates with the support of robust legal infrastructure, strong institutional structure, sound financial markets, and healthy macroeconomic conditions [10]. Through effective private sector investments, government institutions in these economies manage to develop infrastructure while keeping their budget stable. Financial and operational risks share a balanced distribution pattern between public and private sector entities. Great institutional transparency and accountability, combined with confident investors, significantly lower both political and regulatory uncertainties.

Implementation of PPPs encounters multiple difficulties for developing economies when compared with more mature systems. The public sector in developing economies takes an excessive amount of financial and political risks when implementing PPPs [13]. The successful implementation of PPP projects faces barriers from weak legal frameworks as well as political instability, limited access to financial instruments, corruption, and inadequate project management skills and technical deficiencies [11].

The numerous obstacles have led PPPs to become a promising funding solution for developing countries to build their infrastructure. Regions achieve success through better governance and improved institutional capacity, as well as proper sustainability-integrated PPP frameworks, which support well-constructed structures. The World Bank and the Asian Development Bank (ADB), together with the International Finance Corporation (IFC), have a pivotal role in risk management, regulatory improvement, and technical support for developing nations [16].

PPPs will develop their operational efficiency and effectiveness based on economic conditions, legal frameworks, and political environments. The research demonstrates why developing economies need to implement strategic reforms that will improve their public-private partnership environment through better legal structures, enhanced transparency, sustainable funding, and extended public-private partnerships.

The efficient administration structure of PPPs in infrastructure delivery should adopt best practices that originate from developed economies to establish sustainable programs that achieve equity. The exchange of knowledge between developed nations and developing territories through international partnerships will help close capacity deficits and minimize project hazards, so infrastructure expands worldwide. Through the implementation of sustainable financing structures and best practices, PPPs will serve as a main force that drives sustainable economic expansion with enhanced environmental resistance and improved societal growth on a worldwide scale.

Declaration of competing interest

The authors declare that they have no known financial or non-financial competing interests in any material discussed in this paper.

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