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Impact of Risk, Subsidy, and Bid-Criteria on the Private Investment in Public–Private Partnerships in Infrastructure Projects

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Abstract: Public–Private Partnerships (PPPs) are formed to finance and deliver large infrastructural projects that may not be entirely feasible by governments alone. This study investigates the intricate role of financial risks, subsidies, and bidding criteria in the context of PPPs in India, and their relationship to the amount and extent of investments made by private partners. Studies have claimed that the success of PPP projects is determined by the type of funding, the nature of risk undertaken by investors, and the bidding criteria used by a government to attract investors. However, there is sparse literature on these variables impacting the private investment in these projects. Thus, in an attempt to address this gap, we collated data from the World Bank for a ten-year period (i.e., 2009 to 2019) for the study variables, and used regression to analyze the hypotheses, while adopting both SPSS 24 and PROCESS Macro. This study disapproved some commonly held notions of risk relationships, such as the government using "viability gap" funding to attract private investment, and that "leverage" does not moderate the relationship between risk assumed and private investment, thereby contributing to the literature on private investment in PPPs as impacted by several factors. This study is among the first to recognize and elaborate on financial risk relationships, specifically in the context of Indian PPPs. These findings are significant for both private and public participants in terms of financial considerations in PPP projects, especially within the ambits of emerging markets.

Keywords: public–private partnerships; infrastructure financing; risk management; India; financial leverage; subsidies; private investment

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1. Introduction

Many global economies face significant long-term fiscal challenges that are likely to jeopardize the delivery of essential projects and public services (Evenett 2019). Several governments have thereby adopted "creative" financing solutions and a stricter fiscal discipline. Over the past few years, both federal and state governments have shown renewed interest in Public–Private Partnerships (PPPs), as a way to provision public assets and services across sectors (Bayliss and Waeyenberge 2018). Notably, the PPP model, particularly in developing economies, is most commonly used in infrastructure projects and involves the sharing of risks and rewards between public and private sector investors.

Given the multidimensional nature of PPPs, academics have been studying them from several perspectives, including economic, financial, engineering, political, governance, and sociological (Baker et al. 2019). Surprisingly, despite the rising popularity of PPP projects globally, academic research on their myriad dimensions is sparse within the broad realm of management studies (Zhang et al. 2020). In fact, even fewer studies have focused on the economic drivers of PPPs from the perspective of "expected returns". Additionally, empirical studies on the determinants of financial risk in PPPs and the interrelationships between risk-related elements in PPPs, such as the leverage (Hu et al. 2022), bidding criteria, and subsidies offered (Mazher et al. 2018), vis a vis their relationship with the extent of

private investments in projects, have also been limited (Zhang et al. 2020). We attempt to address these gaps in the literature by conceptualizing and testing the impact of risk, subsidy, and bid criteria on the investments made by private players. We also tested the impact of leverage moderating these relationships. Our study makes a significant contribution by showing that the bid criteria, risk assumed, and subsidies together do have an impact on private investment (PI); however, the "leverage" does not moderate the relationships between the bid criteria and risk assumed with PI.

1.1. Function and Scope of PPPs

PPP is a contractual arrangement between a public agency and a private sector entity in which the skills and assets of each sector are pooled together to deliver a service or facility for the public good. Interestingly, there is no internationally accepted definition of a PPP. The World Bank Group of affiliated entities, for instance, defines it as "a long-term contract between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility, and remuneration is linked to performance" (World Bank 2014). Standard and Poor's (S&P) (2005) defines a PPP as "any medium- to long-term relationship between the public and private sectors, involving the sharing of risks and rewards of multisector skills, expertise, and finance to deliver desired policy outcomes." Thus, one could assume that when properly structured and managed, PPPs can help finance and deliver large-scale infrastructure projects, which may not otherwise be feasible for governments to fund and execute independently (Gansler and Lucyshyn 2016). Successful PPP projects arguably provide "value for money" (VFM), where VFM is construed as an optimal combination of quantity, quality, features, and expected cost over the life of the project (Almarri and Boussabaine 2017). An OECD literature review that compared the ex post performance of successful PPPs to traditional infrastructure procurement in terms of the actual cost and time required to launch operations found that PPPs effectively outperform traditional procurement, with outperformance on cost being the most significant (OECD 2021). There are several reasons for this; for example, successful PPPs allocate risks to parties that are best able to control or mitigate them. This, in turn, enables governments to focus on their role as service providers, as opposed to developers, while mitigating most of the state's risks. Hodge and Greve (2017a) asserted that a PPP structure requires (a) private financing because public finance is either unavailable or politically unattractive in meeting the government's infrastructure policy projects. (b) Moreover, with private financing, the private sector receives an incentive to become fully engaged in the project, and the structure is therefore an effective way to secure a project over its long life, both regarding time and budget. Trebilcock and Rosenstock (2015) indicated that although PPPs are more efficient than traditional procurement methods used by the public sector, there is evidence of improvements in efficiency when the private sector involvement is mixed. In fact, these studies have called for further empirical research to better understand the efficacy of PPP projects.

The PPP model is unique because a contract underpins the relationship between government and private parties, known as a "special purpose vehicle" (SPV), which refers to a company that is legally and specifically incorporated into the project (Burke and Demirag 2019). Notably, a contract is usually drawn in the form of a concession agreement or a take agreement defining the rights and responsibilities of both parties, as well as revenue-sharing mechanisms. The functions for which the private party is responsible can vary depending on the type of assets and services involved. Typical PPP functions involve design (engineering), construction and rehabilitation, financing, operations, and maintenance (Ye 2009).

PPPs' importance has been acknowledged by several organizations; for instance, the McKinsey Global Institute forecasted that the world would need to invest an average of USD 3.7 trillion in roads, railways, ports, airports, power, water, and telecoms every year through 2035 to keep pace with the projected GDP growth, especially with emerging economies accounting for nearly two-thirds of that investment need (Hussain et al. 2019).

The European Court of Auditors (2018), on the other hand, reported that since the 1990s, about 1750 PPPs worth a total of EUR 336 billion had reached financial closure in the EU, with the UK leading the way with over 700 PPP transactions. In fact, within the same time frame, over 280 PPP projects worth CAD 130 billion were executed in Canada (Siemiatycki 2015), while the U.S., in contrast, used PPPs in a limited manner. However, one cannot deny that the U.S.' potential is huge given the country's massive and growing unfunded infrastructure needs. According to the American Society of Civil Engineers (American Society of Civil Engineers 2023), the cumulative infrastructure investment needs in the U.S. alone are projected to be worth approximately USD 10 trillion by 2040. Of this, anticipated funding would cover only about half of this needed investment, leaving thereby an estimated private sector financing requirement of about USD 4.7 trillion by 2040. Further, it may be reiterated that both the scale and scope of investment in PPPs are not limited to developed countries. A World Bank Report (2020) estimated that between 1990 and 2020, approximately 8300 PPP projects in developing nations alone garnered approximately USD 1980 billion in private sector investments. Because of this, multilateral institutions, such as the OECD, World Bank, Asian Development Bank, International Finance Corporation, ASEAN, and European Commission have all been broadly advocating the PPP concept. As a matter of fact, the World Bank recently established the PPP Knowledge Lab, and it supports this advocacy (World Bank 2021). Collectively, these compelling statistics, along with continued institutional support, argue that PPPs will play a greater role in global infrastructure development over the next several decades.

1.2. Need for the Study

Most studies in the field of management have either been descriptive in nature (Hodge and Greve 2017b), have comprised a compilation of literature reviews (Cui et al. 2018; Neto et al. 2016), or have focused on a single dimension of PPPs (e.g., "VFM") (Palaco et al. 2019). For instance, Neto et al. (2016), while conducting a comprehensive bibliometric analysis of 600 papers relating to PPPs and PFIs (private finance initiatives), published between 1990 and 2014, found that PPP studies appear to have a steady momentum towards growth, but primarily in engineering or law journals. Approximately two-thirds of the papers in that study (Neto et al. 2016) were authored by researchers based in Europe and Asia, covering aspects such as design implications or contractual obligations. This establishes that extant research on broader business management issues has indeed been limited in this regard; moreover, it also reinforces that future studies should also consider them within the ambits of developing economies (Osei-Kyei and Chan 2015).

Furthermore, the limited management research available thus far on understanding the effectiveness of a PPP model as a tool to deliver public services efficiently has yielded mixed results. One possible reason for this could be that the success of a PPP project depends on several interrelated factors, such as the structure of the PPP deal, type of asset and sector, sophistication of PPP regulations, and governing institutions in the country in which the projects are being delivered, along with the larger PPP experience of the parties involved, among others (World Bank 2019). Notably, very few comprehensive empirical studies have provided a more encompassing and compelling narrative for analyzing the performance of PPPs (Vecchi et al. 2022). As governments around the world continue to consider the adoption of PPPs, there is an obvious need to address these knowledge gaps, both in terms of understanding PPP elements and PPP performance (Rybnicek et al. 2020).

Researchers recognize that each PPP project is unique and deeply embedded within its local context. However, common critical factors determine their success and are often marked by similar experiences across multiple projects and national boundaries. These commonalities in turn could provide a basis for broader PPP studies (Palcic et al. 2019). A recent literature review (Cui et al. 2018) concluded that most existing studies on PPPs in the management stream could broadly be categorized into economic viability and VFM, PPP project financing, success factors of PPPs, determinants of the award of PPP contract management, and governance and regulatory issues. Using social network analysis tools,

Wang et al. (2018) conducted a comprehensive review of papers published in public administration journals and obtained similar results. Nevertheless, the interplay between the risk relationships (especially financial) among PPP parties has not been explored in depth (Khahro et al. 2021).

Thus, we explore the specifics of risk relationships among several PPP[1] elements within India while controlling for extraneous risk factors, including cross-border effects. Specifically, we examine embedded subsidies, risks related to bid criteria, the level of risk assumed by the two parties during a project's life, and financial risk (leverage in the capital structure). We selected India because from 2008 to 2012 it was the top recipient of PPP activities (Mishra et al. 2013). In fact, in 2011, India alone accounted for almost half of the investments in new PPP projects in developing countries. This was the result of regulatory and institutional initiatives undertaken by relevant government institutions to support changes in public policy. According to a Report of the Committee on Revisiting and Revitalizing Public Private Partnership Model of Infrastructure (2015), commonly referred to as the "Kelkar Committee Report", "India offers today the world's largest market for PPPs . . . As the PPP market in infrastructure matures in India, new challenges and opportunities have emerged and will continue to emerge." More importantly, the report noted that "the dominant, primary concern of the Committee was the optimal allocation of risks across PPP stakeholders. Inefficient and inequitable allocation of risk in PPPs can be a major factor in PPP failures. . ." Further, the Committee noted that "the adoption of the Model Concession Agreement (MCA) has meant that project implementation authorities rarely address project-specific risks in this 'one-size-fits-all' approach." Based on the same, we believe that periodic studies across countries, including India, are needed to address any issues that may arise as a consequence of policies put in place to ensure the success of the PPP model, and this study contributes to the literature in that direction.

In the following sections, we identify and discuss the variables included in our research model, highlight issues within the general framework of our research, and present our hypotheses. Next, we discuss our materials methodology, present our findings, discuss the implications of our findings, and conclude by noting the limitations of our study, as well as avenues for future research in this area.

2. Literature Review

2.1. PPPs and Risk

Brown et al. (2016) stated that, in general, risks should be borne by the party that can carry them at a minimal cost. Our review of the literature on risks in PPPs shows that they have mainly focused on specific case studies, sectors, and/or regions. For example, Carbonara et al. (2015) focused their review on risk management in motorway PPPs, while Hellowell (2016) looked at the cost–benefits of PPP structures in healthcare infrastructures. Callens et al. (2022) studied PPP structures in transportation infrastructure, whereas Alam et al. (2014) studied generic trends in PPP in Australia. Sarmento and Renneboog (2016) examined the role of renegotiations in PPP contracts, while Warsen et al. (2018) explored specific risk-related factors, such as the role of trust. Other studies on risks in PPPs have focused either on simply identifying general risk factors (Li and Wang 2019), risk allocation issues (Ke et al. 2010; Nguyen et al. 2018), or on ways to undertake a risk assessment (Li and Zou 2011). In fact, a recent study (Rybnicek et al. 2020) identified genetic risk factors in PPPs; the authors conceptually related them to risk-management frameworks. Interestingly, however, no "in-depth" studies (conceptual or empirical) have explored the relationships between the multiple elements of risk embedded in PPP structures (Hu et al. 2022). Moreover, it may be noted that extant research seems to have been bifurcated in terms of its focus on either private or public institutions, without giving equal consideration to their partnership and risk interdependencies. Several researchers have thereby long advocated for a partial merger of the two research streams on the grounds that both private and public interests cannot be holistically studied if conceived independently (Mahoney et al. 2009). Based on some of these gaps and limitations identified, in this study, we

examine the interrelationships between multiple PPP risk elements from the viewpoint of both private investors and public participants. We believe our exploration would provide a holistic insight in terms of understanding how risks embedded in structural elements (e.g., subsidies provided by the public partner) or process elements (e.g., bid criteria for evaluating competitive bids) effectively relate to investments made by private sector participants. We believe that this would help PPP managers better understand the impact of risk interrelationships, such that project structures can be tweaked to best position all parties so that they could work in coherence towards a common goal of ensuring project success.

2.2. Hypotheses Development

In this section, we present a theoretical model to study the four structural elements of a PPP model from a common perspective of "embedded financial risk" so that we can better understand whether these elements are related and how much equity private investors are willing to invest in these PPP projects. We present our hypotheses while linking the three independent risk-related variables: Subsidies (S) provided by the public sector partner, Risk Assumed (RA) by the private sector partner, and the Bid Criteria (BC) applied by the public sector to the dependent variable—the level of Private Investment (PI) in a PPP project. Additionally, we propose a fourth risk variable, financial leverage (FL), which we believe would serve as a moderating factor in these relationships. Then, we test our hypotheses using data from an extensive World Bank database and present the results.

2.2.1. Moderating Role of Leverage in PPPs

The relationships between subsidies, assumed risk, bid criteria, and the extent of private investment are all affected by the amount of leverage in the capital structure of the SPV (Hu et al. 2022). It may be noted herein that PPP project financing normally consists of a mix of equity provided by private investors, loans provided by banks or other financial institutions, and issuance of debt such as bonds. Generally, equity providers refer to private investors and shareholders in SPV; they receive their returns only after paying the operating costs and capping required financial reserves, while simultaneously servicing costs associated with debt. Importantly, they are the ones to absorb the first loss when there is a shortfall in the contract payments and/or increased operational costs. Like most capital financing, equity investors take a higher risk than debt providers, owing to which they expect higher returns. Further, it may be noted that in PPPs, leverage is determined by a number of risk factors, such as country and political risk, along with the risk of technology reliability that would be employed for the project and credit ratings of equity providers, among others (Wang et al. 2019a).

Project financing in PPP is often considered limited-recourse financing because lender security is normally limited solely to the cash flows of the project. On the other hand, the sponsor's equity invested in SPV is effectively ring-fenced from the rest of the sponsor's business interests. Therefore, there is a clear management focus on the full transparency of cash flows throughout the life of the project. Notably, herein, sponsors do not guarantee the project as a whole, while lenders, on the other hand, rely primarily on the cash flow of the project for debt service. Because the sole recourse of debt providers is linked to the assets of SPV, and because the physical assets in a PPP project (e.g., a road or an airport) have little value if they are not used in the context of the project, the main assets that lenders tend to rely on as "security" are the *contracts* between the public authority and the private sector project entity, including the *cash flows derived from this contract*. As a result, SPV may also be subject to several restrictive and affirmative covenants, such as restrictions on the sale of assets, restrictions on incurring additional debt backed by SPV assets, interest rate hedges, and requirements to provide periodic compliance reports. Thus, in a typical PPP project, the greater the financial leverage in the capital structure, the greater the expected level of private investment. Based on this broader understanding, we believe that there is a need to study the unique moderating role of leverage in the risk relationships among Indian PPPs.

2.2.2. Subsidies and Private Investments (PI)

There are many implicit ways to financially help a PPP project, usually in terms of providing subsidies, concessional loans, guarantees, or paying for project preparation; however, "subsidies" are the most common way. In theory, subsidies to PPPs serve a single purpose: they ensure projects that promise to produce a net economic or social that could be commercially financed (World Bank 2019). One plausible reason as to why subsidies are popular could be because they can be structured in several ways, depending on the cash flows of a project per se. For instance, at times, governments provide subsidies by making up-front cash contributions to pay for capital costs, specifically in the case when partners agree that the project might not be financially viable, but it is required for the delivery of social goods. On the other hand, governments can make regular subsidy payments to private companies based on both the availability and quality of the service, albeit as a function of the expected revenue stream over project life (pppinindia.gov.in 2020). Another reason for offering subsidies is to invite broader private participation in the project bid. Generally, when subsidies are offered, other private investors (those with no other contractual relationship with the project) are incentivized to align with the primary private partner to ensure that the PPP project is viable and succeeds. The literature exploring the relationship between government support subsidies is primarily focused on the elements of government policies that support PPP project performance, the level of private investment (Osei-Kyei and Chan 2017; Silaghi and Sarkar 2021), and/or whether both loans and subsidies influence the structure of PPP projects (Vecchi et al. 2022).

Based on the discussions above, one would assume that there would be a positive relationship between the subsidy provided and total private investment; in other words, the greater the subsidy, the more private investors would be incentivized to invest in the PPP project. However, conversely, one could argue that if the subsidy is relatively high, it probably means that the public partner has predetermined the cash flows from the project and is suspected of the economic viability of the PPP project in question. In such cases, the primary private investor would not need to invest as much, would be less accountable, and, therefore, may choose to walk away if the project does not seem promising enough to generate adequate returns. For example, a recent study used the principal-agent theory to show that while government subsidies are related to expected revenue and costs, the government's altruism in terms of providing subsidies can undermine the investors' enthusiasm in terms of cooperation and risk-sharing propensity (Wang et al. 2020). For the private partner, the investment made comes from its own balance sheet, combined with funding from "other investors" (e.g., private equity, investment banks) who help capitalize on the transaction. Based on this understanding, it may be assumed that subsidies should ideally be structured in light of the projected cash flows from the PPP project but should be kept under consideration of both the scope and leverage of private investment (Wang et al. 2019a). A detailed study of subsidies (provided through "Viability gap fund" VGF) in India reveals that private players benefit greatly from subsidies and, interestingly, contribute a very low percentage of equity funding (World Bank 2014).

The VGF program may not be ideal, and it certainly has some drawbacks or questionable criteria. However, given the enthusiasm for and sheer number of private sector participants in PPP projects in India, our position is that the provision of subsidies to PPPs in India has generally been successful. Interestingly, the Kelkar Committee Report of 2015 held a similar stance. However, they made multiple recommendations to rectify the issues associated with the provisioning of subsidies in Indian PPPs.

From a financial perspective, the certainty of government support programs, such as the VGF, could decrease risk in the private sector, incentivizing it in the process, to make more investments (Urpelainen and Yang 2016). Table 1 outlines the distribution of the percentage of subsidies received across 136 PPP projects in India[2], along with the nature of risk associated with each PPP model (i.e., risk assumed).

Table 1. Subsidy across projects in India.

Subsidy (Difference between Total Investment and Sum of Debt and Equity Financing)	No. of Projects
0% to 10%	13
11% to 20%	22
21% to 30%	22
31% to 40%	69
41% to 50%	8
51% and above	2
Total	136

(Source: Compiled by the authors from the World Bank data on PPPs 2020).

As may be noted, the distribution is evenly spread, although many projects did receive subsidies in the range of 31–40%. We also noticed that within this range, almost all the projects received the maximum subsidy—40%—as capped under the Indian government policies for VGF. From these observations, we conclude that the public sector probably engages in some sort of revenue projection (even though these are not made publicly available) to decide on the amount of subsidy to be awarded to a PPP project. Moreover, the data from the table above also leads us to believe that a significant number of PPP projects in India would probably not be economically viable on their own. Thus, subsidies in the form of VGF are essential for substantial Private Investment (PI) to take place, especially in the context of Indian PPPs. Furthermore, it may be noted that the provision of subsidies shows commitment from the public sector; in addition, it incentivizes private sector players to bid on the project and have more skin in the game. Notably, the amount of external support (or leverage in the project) influences the relationship between subsidies and the PI. Subsidies, PI, and funding from third-party providers (which impact leverage) shall, taken together, determine the final capital structure of the project. Therefore, we propose that the amount of private investment in Indian PPP projects is positively related to the overall subsidies provided. Additionally, we also posit that this relationship is moderated by leverage in transactions. This leads us to propose our first set of hypotheses:

H1(a). *Subsidies and Private Investment (PI), in Indian PPPs will be positively related.*

H1(b). *Leverage would moderate the relationship between Subsidies and Private Investment (PI).*

2.2.3. Risk Assumed (RA) and Private Investment

Risk Assumed (RA) is inherently difficult to deal with, and risk allocation within PPP projects is particularly complicated. Governments floating tenders for a PPP project typically state their preferences up-front as to how project risks are shared. Private investors then assess their capacity to take risks and bid accordingly (Warsen et al. 2018). Theoretically, "risk" should be allocated to the party that can best manage it at minimum cost (Leo-Olagbaye and Odeyinka 2020). Notably, in a PPP contract, the optimal risk allocation strategy is not to pass all risks to the private sector but to ensure that there is a fine balance between efficient risk management and total costs to both the public and private sectors. However, in practical terms, extant research shows that the private sector usually ends up taking the most risks at the project level (Mazher et al. 2018).

At one end of the risk assumption spectrum, where the PPP project may be in the form of a "service contract" or "delegated management contract", the private sector partner assumes a minimal risk. However, it may be noted that in a service contract, it is the private sector that provides support, and it is actually the public sector that is responsible for operations, owing to which the "supporting partner" assumes minimal risk. Additionally, the private sector also does not influence how services are distributed, although one must

agree to a certain extent that it is dependent on the public sector for generating profits. On the other hand, delegated management contracts are similar in that the public sector retains the overall ownership of assets but delegates operational responsibility to private investors. However, the most wide-ranging form of PPP contract requires the private operator to be involved in the design and construction phases of the new infrastructure; and it is in these cases that the risk factor to private players is relatively high. In fact, it varies because of the various types of involvement.

In India, the four most common forms of PPP contracts include build–operate–transfer (BOT), build–own–operate (BOO), build–rehabilitate–operate–transfer (BROT), and rehabilitate–operate–transfer (ROT). Table 2 displays brief descriptions of these four types of arrangements in terms of project design and construction elements, along with the associated degree of risk assumed by the private sector partner.

Table 2. Bid criteria (criteria for selecting the winning bid).

Bid Criteria	Primary Risk	Level of Risk—Private Partner	Level of Risk—Public Partner
Lowest Cost of Construction and Operation	Design, Construction, and Operational Risk	High	Low
Lowest Government Payments into the PPP	Political (risks related to expropriation, land acquisition, corruption, uncompetitive tenders, etc.)	High–Medium	Low–Medium
Lowest Subsidy Required	Financing Risk (access to capital, interest rates risk, foreign exchange risk, failure of consortium, etc.)	High–Medium	Low–Medium
Lowest Average Tariff	Demand Risk	Low–Medium	Medium–High

(Source: Compiled by the authors from the World Bank data on PPPs 2020).

Furthermore, it may be noted that in almost all cases, private investments in Indian PPPs come from (a) private developers and concession operators (the "private sector partner's partner") and (b) supporting partners that provide funding, such as banks, other financial institutions looking to invest, and indirect investors. Therefore, one would expect that the higher the risk assumed by the private sector partner, the lower the level of financial support that third-party lenders (banks, financial institutions, and other investors) would be willing to contribute to the capital structure in order to minimize their risk exposure in the project. In addition, high investment by the private sector partner should incentivize the private player to do everything to make the project successful.

Because Indian PPPs involve varying amounts of assumed risk wherein the exact nature of inherent risks is significantly unknown at the time of initiation of the project, notably, public partners and the Indian Government have often struggled to forge new and successful partnerships with private players. The Kelkar Committee report pointed out that "attempts to improve well-defined expected service outcomes and equitable sharing of risks has met with limited success". Importantly, since project offerings are not explicitly tied to assumed risk, they compete more on the basis of governmental policies and standard contracts across sectors, and under conditions of expected but unknown cash flows, as well as associated subsidies, the amount of which is effectively decided by the public partner. We posit that the risk assumed by private investors would be closely analyzed, and cash flows would be projected across multiple scenarios, with investments made accordingly. Furthermore, it may be noted that broad private investor groups (lead investors and supporting investors) reach a consensus regarding the amount of investment that needs to be made by the private sector partner, as well as the amount of leverage required in the project, which will be acceptable to all participants in the private consortium. This discussion leads to our second set of hypotheses.

H2(a). *Risk Assumed (RA) and Private Investment (PI), in the context of Indian PPPs, will be positively related.*

H2(b). *Leverage will moderate the relationship between Risk Assumed (RA) and Private Investment (PI).*

2.2.4. Bid Criteria and PI

In PPPs, there are several types of procurement options, viz., bid criteria to choose a winning bid; they are made known by the public sector party before inviting the bids. In fact, bids can be invited using an open procedure, wherein everyone is allowed to bid; they could also be made via selective or restrictive procedures that involve an additional pre-qualification step. However, in some cases, the invitation to bid might be offered only to a select group of bidders, an option known as "limited procedure". Moreover, some of the other procurement options could be through a "negotiated procedure" that allows bidders to propose different solutions, which are then negotiated to reach a best and final offer ("BAFO") for evaluation purposes.

Importantly, when only one bid criterion is involved, such as the lowest average tariff, royalty, subsidy, or net present value (NPV), the evaluation process for bids is quite straightforward. However, when there is more than one bid criterion, this issue becomes more complex. This, in turn, may call for a multi-criteria decision analysis to select the winning bid. The World Bank data show that Indian PPPs essentially use one of the four types of bid criteria (given in Table 3), which have varying degrees of risk.

Table 3. Summary of projects.

	Total # of Projects (*n* = 157)	**India-Specific Projects (*n* = 136)**
A. Types of Projects		
Brownfield Projects	112 projects	102 projects
Greenfield Projects	45 projects	34 projects
B. Type of Financing		
Rehabilitate–Operate–Transfer (ROT)	6 projects	6 projects
Build–Rehabilitate–Operate–Transfer (BROT)	106 projects	97 projects
Build–Own–Operate (BOO)	7 projects	4 projects
Build–Operate–Transfer (BOT)	38 projects	29 projects
C. Bid Criteria		
Lowest cost of construction	59 projects	69 projects
Lowest government payment	27 projects	7 projects
Lowest subsidy required	66 projects	59 projects
Highest % of revenue share with Government	5 projects	1 project

(Source: Compiled by the authors from the World Bank data on PPPs 2020).

Furthermore, when a bid criterion is the "lowest cost of construction or operation", the private partner asserts that it can deliver the project at the lowest cost from construction to the end of the operation. In other words, it promises to provide the most value for money (VFM). However, risk-sharing does play a fundamental role in determining whether a PPP project would actually yield VFM. This is a key mechanism to ensure that a private partner performs as efficiently as possible. A good measure for the VFM criteria is to compare the net present value (NPV) of various bids (Tallaki and Bracci 2021), which private players more commonly use. For the public partner, cost–benefit analysis (CBA) or cost–effectiveness analysis (CEA) is more appropriate. In the CBA approach, both benefits

and costs are quantified to a large extent in monetary value, whereas the CEA approach is primarily a cost-minimization technique. Importantly, both CBA and CEA consider a broader socioeconomic assessment and the net contribution of an activity or project to overall benefits. They are relatively more complicated in PPP projects, in which most benefits cannot be readily monetized (Sdoukopoulos et al. 2019). Under this "lowest cost of construction or operation" bid criterion, the public sector partner carries minimal risk, whereas the level of risk carried by the private sector partner is high. However, it could also vary, depending on its knowledge base and experience, ability to take advantage of economies of scale, and managerial skills over the entire life-cycle of a project (i.e., from design stages to the end of the concession period).

Specifically, when a bid criterion is "lowest government payments" in the PPP project, the primary risk for the private party alludes to a political risk. Thus, the bid is made under the assumption that the public partner would deliver on its commitments in terms of issues, such as timely acquisition and deliverance of land, shifting of utilities, and right-of-way issues. Additionally, it may be noted that the project would proceed fluidly without any major interruptions, project-related scandals, or other delays that might add uncertainties to the expected cash flows from the project. Importantly, the risk to private partners in this case is fairly high because there are multiple ways in which a PPP project might be delayed. The risk to the public partner, on the other hand, is relatively low, because the key criterion is the lowest payment commitment. Further, if the bid criterion is "lowest subsidy required" by the private partner from the public partner, the risks to the private party are primarily in the construction phase and in the form of financing risk. Notably, an inadequate up-front subsidy could result in a higher financing risk or total cost to the private party, and if the subsidy is delayed, the cost of capital can be much higher. Therefore, under these bid criteria, the risk to the private partner is relatively high, and the risk to the public partner is relatively low. On the other hand, when the bid criterion is the "lowest average tariff" charged by the concessionaire, the primary risk includes "demand risk". For Indian PPPs, in the absence of substantiated cash flow projections, the public sector has historically often underestimated tariff revenues to the private sector from PPPs, resulting in a substantial loss of "potential revenues" to the public sector. This, in fact, has been evident from several case studies; for example, the now-defunct Delhi Gurgaon Tollway (Delhi and Mahalingam 2020; Kudtarkar 2020). In other words, demand risk is usually low for private partners, whereas the risk of losing out on project upside benefits, such as potential revenue, is high for public partners.

Based on the discussions thus far, we posit that the greater the amount of risk related to the bid criteria, the higher the private investment that is required by private players, whereby "leverage" effectively moderates this relationship. Therefore, we hypothesize the following:

H3(a). *In India-based PPPs, there is a significant and positive relationship between Bid Criteria (BC) and Private Investment (PI).*

H3(b). *Leverage will moderate the relationship between Bid Criteria (BC) and Private Investment (PI).*

2.2.5. Conceptual Model

Our model helps in testing the relationships between subsidy, assumed risk, bid criteria, and private investment (PI) as dependent variables. PI, as noted before, is a key component of PPPs, and is especially significant in emerging markets. Without the support of private players, governments often find it difficult to develop infrastructure projects. Therefore, governments in emerging markets highly incentivize and look to provide all kinds of direct and indirect support to private investors. A high PI can be used as a surrogate measure of project attractiveness. It also represents a commitment to, as well as confidence in, the success of a PPP from the private partner's perspective. In order to

enhance the internal validity of the study (Becker 2005), we controlled for the sector in which these projects were operational and the primary revenue sources (Wang et al. 2019b).

We considered leverage as the moderating variable; our empirical model proposes that leverage in the transaction would affect the relationship between assumed risk, bid criteria, subsidy, and PI. Figure 1 shows the tested empirical model.

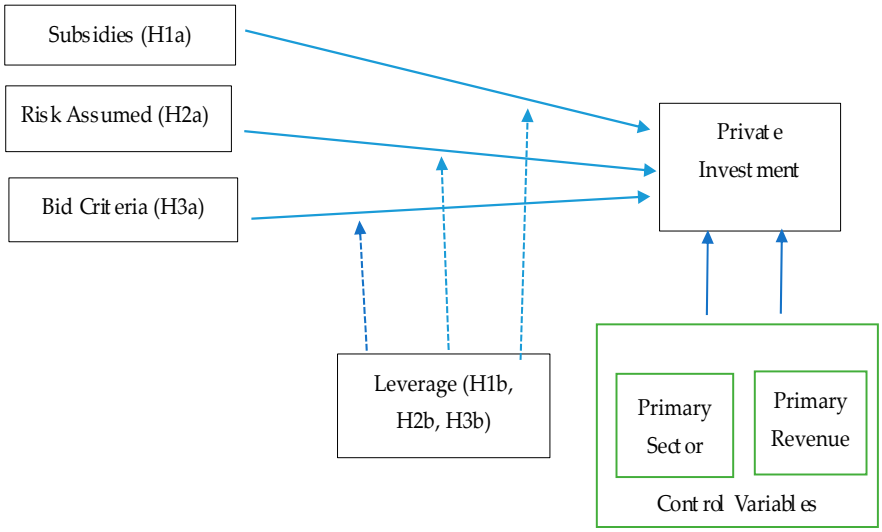

Figure 1. Research framework.

3. Materials and Methods

We used the World Bank database for PPPs, comprising 10,450 global PPP projects from 1990 to 2019. Table 3 summarizes the projects across the various variables of the conceptual model developed for this study.

Of these 10 K+ projects, 9583 were active, 380 were canceled, 226 were concluded, and 262 were distressed. These projects were spread across seven regions: Africa, Latin America, South Asia, East Asia, the Middle East, North Africa, and East Europe. The projects included greenfield projects, brownfield projects, and divestitures, along with management and lease contracts. The nature of investments in these projects covered a vast spectrum, and were bucketed into the following categories: full investment, build–lease–transfer, build–operate–transfer, build–own–operate, build–rehabilitate–operate–transfer, lease contracts, management contracts, rehabilitate–lease–transfer, rehabilitate–operate–transfer, and rental (see Table 4 for details). We screened the entire database thoroughly to identify missing values. The data for 157 projects were complete. Most of these (n = 136) were PPPs based in India; of these, 112 projects operated as brownfield projects, whereas the remaining operated as greenfield projects. Since most of the projects (136 out of 157) were from India, we considered it appropriate to test the model for PPPs in India only. Furthermore, the projects belonged to three sectors primarily (i.e., Energy −5, Transport 128, and Water and Sewage 3); the primary revenue sources for these projects included annuity (74), purchase agreement (three), and user fees (58). Interestingly, both of these variables were controlled to restrict their impact on the outcome. In fact, the aim was to understand the impact of predictor variables on the dependent variables, irrespective of the sector of the project, and revenue sources.

We used four types of models to finance these projects: the rehabilitate–operate–transfer (ROT) model (six projects), build–rehabilitate–operate–transfer (BROT) model (106 projects), build–own–operate (BOO) model (seven projects), and build–operate–transfer (BOT) model (38 projects). These projects were categorized as per the "bid criteria" used to finance them—"lowest cost of construction or operation" (59 projects), "lowest government payment (27 projects), "lowest subsidy required" (66 projects), and "lowest tariff" (five projects). Table 5 shows the corresponding number of Indian PPPs. Notably, all the projects

were funded through private investments, which were taken at their dollar value in order to serve as a dependent variable. Finally, based on the data given for debt and equity funding for each project, we calculated the "leverage", and categorized them as follows: low-leverage projects (leverage < 0.25), moderately leveraged projects (leverage between 0.26 and 0.5), and highly leveraged projects (leverage > 0.5). Further, we calculated the "leverage" using a standard formula of debt as a proportion of total capital (debt and equity). The project subsidy was calculated by deducting equity and debt investments from the project's total investment. Then, we mapped the projects against the percentage of subsidy received for the project (i.e., the funding gap received after debt and/or equity funding for the project).

Table 4. Risk assumed (degree of private involvement).

Type of Private Involvement	Description and Overview	Level of Risk Assumed—Private Partner	Level of Risk Assumed—Public Partner
Build–Operate–Transfer (BOT)	This approach describes PPPs for new assets. In a BOT structure, the private party has legal ownership and control of project assets until they are transferred at the end of the contract.	High (cash flows are unknown)	Low (cash flow risk is with the private party)
Build–Own–Operate (BOO)	These contracts are similar to BOTs except that they do not involve the transfer of assets to the public sector after a pre-determined period of time.	High–Medium (if cash flows are not adequate—no transfer)	Medium–Low (no risk in terms of being handed over an uneconomical project)
Build–Rehabilitate–Operate–Transfer (BROT)	In this arrangement, the private party is responsible for rehabilitating and extending/adding infrastructure assets.	Medium–Low (some record of revenue flows is available)	Medium–High (not sure if rehabilitation will result in a higher revenue stream)
Rehabilitate–Operate–Transfer (ROT)	Applied to existing assets/infrastructure, in this form of PPP structure, the private party is responsible for rehabilitating, upgrading, or extending existing assets.	Low (cash flows are known, potential or additional cash flows are probably limited)	High (private sector has not capitalized, requires private involvement but upside is limited)

(Source: Compiled by the authors from the World Bank data on PPPs 2020).

Table 5. (**a**) Model summary; (**b**) ANOVA results.

(a)						
Regression Statistics						
R-Sq	0.453					
Adjusted R-Sq	0.416					
Std Error of Estimate	8.76					
Sig.	0.000					
Observations	136					
(b)						
	df	**SS**	**MS**		**F**	**Significance F**
Regression	5	6,185,046.862	1,237,009.372		8.760	0.000
Residual	131	18,075,890.443	141,217.894			
Total	136	24,260,937.306				
	Coefficients	**SE**	***t*-stat**	***p* value**	**LL**	**UL**
Intercept	−908.639	177.698	−5.113	0.000	−1260.193	−557.085
Risk Assumed	179.286	56.151	3.193	0.002	68.198	290.374
Subsidy	10.648	2.657	4.008	0.000	5.392	15.903
Bid Criteria	202.111	39.583	5.106	0.000	123.801	280.421

Analysis and Results

As mentioned at the outset, we sought to investigate the relationship between the predictors—Risk Assumed, Subsidy, and Bid Criteria with Private Investment (PI)—as the dependent variables, and leverage as the moderating variable. Therefore, we analyzed the panel data using SPSS 24 and PROCESS macro. Notably, the overall regression is significant for this model (R2 = 0.453). The value of the adjusted R2 is 0.416; this reflects that 41.6% of the variance was actually accounted for by the following predictors: BC, Subs, and RA collectively (F(5, 131) = 8.76; $p < 0.000$). The F value is 8.760 at $p \leq 0.000$, indicating thereby that the overall regression is indeed significant. Finally, the predictor variables forecasted the response variable PI as the beta values are shown to be significant (Table 5a,b).

Next, we tested the moderating effect on the relationship between the predictor variables and PI, as shown in our research model. Thus, we tested the impact of leverage on the relationship between subsidies and PI.

The interaction effect between leverage and the predictor seems significant in the case of subsidies and PI (beta = 178.30, SE = 77.35, and $p = 0.0023$). The moderating effect of leverage on this relationship is both positive and significant, supporting Hypothesis H1b thereof. Then, we analyzed the impact of leverage on the assumed risk, along with PI; we noted it to be significant too (beta = 44.54, SE = 55.88, and $p = 0.4098$). Finally, we observed the moderating effect of leverage on bid criteria and PI (beta = 85.12; SE = 81.71; $p = 0.2994$). As may be noted, the moderating effect is positive and insignificant in both relationships (Table 6a); therefore, these findings do not support Hypotheses H2b and H3b. Table 6a provides a summary of all the hypotheses for the moderating variable, along with their results.

Table 6. (**a**) Moderating effect of leverage on Subsidy, Risk Assumed, Bid Criteria; (**b**) summary of results.

(a)						
	Coefficients	**SE**	***t*-Stat**	***p* Value**	**LL**	**UL**
(Risk assumed → PI) X Leverage	85.1292	81.7173	1.0418	0.2994	−76.4719	246.7303
(Subsidy → PI) X Leverage	−178.3084	77.6350	−2.2968	0.0023	−331.8365	−24.7803
(BidCriteria → PI) X Leverage	44.5445	53.8801	0.8267	0.4098	−62.0067	151.0957

(b)	
Hypotheses	**Result**
H1a	Supported
H1b	Supported
H2a	Supported
H2b	Not Supported
H3a	Supported
H3b	Not Supported

In the following section, we explain the results in detail, and discuss the implications for both practice and research.

4. Discussion

We explored financial risk-related factors in the context of Indian PPPs vis a vis their relationship with the amount and extent of investments made by private partner(s). We hypothesized relationships that may seem contrary to the commonly held notion of risk relationships. However, it is important to note herein that we framed our arguments in the Indian context given the country's unique PPP landscape; for instance, legal and regulatory frameworks often lack transparency in terms of cash flows (actual or projected), and the government is not motivated enough to incentivize private participation in these projects.

Our results (refer to Table 6b) show that assumed risk and private investment are directly related, and that leverage does not moderate this relationship. Further, it may be noted that traditional thinking propounds that in order to protect downside risk, the greater the risk assumed by the private partner, the lower the investment in the project. Our hypothesis argued for the contrary and found empirical support. Interestingly, we also observed that leverage does not act as a moderating factor in this relationship. There could be two reasons for this anomaly: (a) most projects belong to the BOT or BROT category, ensuring that they are eventually transferred to the government. Therefore, although these projects would be risky (Wang et al. 2019b), handing over the project to the government seems like a reasonable assurance that private players assume, whereby higher risk is unaffected by project leverage. (b) Secondly, most of the projects belonged to sectors wherein either the central or the state government had focused on budgetary allocations and had set sectoral development targets. For instance, sectors such as "transport" and "energy" have received an immense boost from governments recently, motivating the private sector thereby to take up higher risks despite higher leverage. We also noted that subsidies and private investments are directly related to Indian PPPs, and that leverage does play a moderating role in this relationship. Wang et al. (2019a) alluded that subsidies guiding investments in PPPs are generally strong in developing economies; and as India is an emerging and fast-developing economy, government spending is exorbitant, and private participation is highly encouraged. Thus, to ensure the success of government projects, the private sector is incentivized by offering high subsidies. For example, most of these projects received subsidies between 31% and 40% (69 projects), whereas 113 received subsidies between 11% and 40%. Thus, our understanding that the government uses VGF as a lever to attract private investment has strongly emerged. Finally, we posit that bid criteria and private investment are directly related and moderated by leverage. Herein, our findings support the former but negate the latter relationship. In other words, the support for the former relationships (i.e., the nature of bid criteria) has been believed to impact private investment, and this seems evident even in Indian PPPs. However, the relationship does remain unaffected by project leverage. Although this finding is surprising, it may be justified by arguing that India is a fast-growing and emerging nation that attracts private investors who are willing to take risks, which are perceived to be less than the opportunities provided by the government across sectors, resulting in long-term growth prospects. We also validate this with the GDP figures and FDI inflows during these years.

5. Conclusions

Empirical support for our findings is both interesting and significant. We conclude that subsidies are often a necessary condition for investment by private players, especially in the context of Indian PPPs, wherein leverage in total financing affects the total capital contribution. However, in the absence of sophisticated cash flow projection models and sensitivity analysis, the presence of subsidies is often a reassuring component that demonstrates the commitment of the public partner. In addition, from a broader and possibly unique perspective, the private investor group looks at other financial risk factors, such as assumed risk, bid criteria, and leverage, and makes investment decisions that they believe are optimal given the overall assessment of project risk.

6. Contributions of This Study

Our findings contribute to the literature in several ways; first, we believe that this is among the first studies to explore and understand the relationships between risk elements and resultant private investment in India's PPPs. Our findings are critical for both private and public participants in terms of the financial considerations for PPP projects. Through our findings, we highlight that financial risk-related relationships are intricately situated within the context of a country's PPP environment. Therefore, participants must contextualize the findings within their geographical and political contexts to understand what modes of financial commitment and risk-taking are appropriate for them. Third,

although the extant literature has emphasized leverage as a significant moderator of these relationships, our findings do not completely support them. In turn, we highlight the reasons for this anomaly and believe that more empirical studies could possibly further validate and substantiate our findings.

7. Limitations of This Study and Future Directions for Research

As in most empirical studies, this study has several limitations. First, we focused on India; testing the hypotheses with data from other emerging economies could provide additional validation and generalizability. Second, the risks and challenges in developed countries may differ from those in developing countries. Additionally, the process or approach to managing risk in the two contexts might also differ. Therefore, further research is needed to understand the differences between developed and developing countries in terms of risk and risk management in PPPs. Third, we only considered financial risk factors; however, other risk-related factors, such as political risk, partner selection criteria, governance risk, currency risk, and repatriation risk, could impact financial risk relationships. Therefore, analyzing these factors in detail could provide helpful information for PPP project practitioners.

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Conflicts of Interest: The authors declare no conflicts of interest.

Notes

1 PPP as defined by the government of India—https://www.pppinindia.gov.in/faqs (accessed on 19 April 2024).

2 The rationale behind the number of PPP projects in India between 1990 and 2019 has been explained under the Section 3 (Materials and methods) of this article.

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