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PPP Distress and Fiscal Contingent Liabilities in South Asia

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Abstract

Since the early 1990s, public-private partnerships (PPPs) in infrastructure provision have been expanding around the world and in South Asia. Well-structured PPPs can unleash efficiency gains in the provision of infrastructure. But PPPs create liabilities for governments, including contingent liabilities. Providing infrastructure through PPPs is preferred to public provision if the efficiency gains offset the higher cost of private financing and the unexpected public liabilities that PPPs may create. This paper attempts to assess the fiscal risks from contingent liabilities assumed by South Asian governments owing to their current stock of PPPs in infrastructure. First, it analyzes the drivers of PPP distress. Second, it simulates scenarios of fiscal risks for South Asian governments from risky PPPs. Third, it studies specific PPP contract designs and their relationship with early termination in South Asia to draw lessons for future PPP contract structuring.

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PPP Distress and Fiscal Contingent Liabilities in South Asia[1]

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1. Introduction

Worldwide, close to 1 billion individuals are without electricity, 1 billion live more than 2 kilometers from an all-season road, and many are unable to access work and educational opportunities because of lacking or costly transport services. In South Asia, the annual investment needs to close the infrastructure gap can range from 7.5 percent of GDP (Rozenberg and Fay 2019) to 8.8 percent of GDP (Asian Development Bank 2017). To this end, infrastructure spending will have to increase by 3.5-4.3 percent of GDP.[2]

There are different approaches to providing infrastructure services. In the traditional, public-provision approach, line ministries, government agencies, or state-owned enterprises directly procure the infrastructure. In the private-provision approach, regulated or unregulated private companies that own the infrastructure assets provide infrastructure. Infrastructure provision through public-private partnerships (PPPs) falls in-between the public and private approaches. In a PPP, the private party has control rights over the infrastructure during the contract and returns the infrastructure to the government when the contract term expires.

Public-private partnerships can help emerging markets and developing economies expand their infrastructure stock, build required infrastructure more efficiently, and maintain it better in the long-run. The potential efficiency gains can be seized through an appropriate design of PPP contracts which bundle various aspects of the infrastructure project and allocate risks according to the partners' ability to manage them. Economies such as Brazil, China, India, South Africa, and Turkey have keenly used PPP arrangements to boost their infrastructure investments.

Infrastructure PPPs are no free lunch. They create liabilities for governments, including contingent (hidden) ones. To share risk appropriately between the public and private parties, governments tend to provide explicit guarantees to the private party, such as revenue or credit guarantees. The government, as implicit guarantor of the endeavor undertaken by the PPP, backstops the fiscal and economic consequences of any failures by the partnership.

At the center of the PPP approach rests a trade-off between the efficiency of execution and the efficiency of financing. The private partners can achieve efficiency of execution thanks to their better monitoring of the project and the governments can finance projects more efficiently because they are usually able to finance a project at cheaper rates than the private sector, which pays a funding premium on top of the sovereign rate.[3] If the efficiencies in project execution are systematically overestimated or the contingent liabilities due to risk and uncertainty underestimated, the government may be better off executing investments through conventional contracting of the private sector or even state-owned enterprises.

The rising popularity of PPPs, and thus the increase in the contingent liabilities from them, warrant careful management of the fiscal and economic risks they pose. The opacity of financial records, confidentiality of most PPP contracts, and prevalence of cash rather than accrual accounting

[2] Fay and others (2019) estimate infrastructure spending in South Asia was 4.5 percent of GDP in 2011.

[3] In some cases, companies in developing countries are able to borrow at lower costs than the government. Companies for which this is true tend to have substantial export earnings and/or a close relationship with either a foreign firm or with the home government (Durbin and Ng 2005 and Grandes, Panigo and Pasquini 2017).

systems in emerging markets and developing economies hide the fiscal risks for government finances until the contingent liability materializes.

This paper tries to assess the fiscal risks that South Asian governments assume when infrastructure PPPs are terminated early. For the assessment, the study adopts the value-at-risk methodology. The expected loss from a PPP project is gauged using the probability of distress, exposure of the government in the event of distress, and the loss given distress. Using data from the World Bank Private Participation in Infrastructure (PPI) database, World Bank World Development Indicators (WDI), the Polity IV Project, and Laeven and Valencia (2018), the study identifies systematic contractual, institutional, and macroeconomic factors that can help predict the probability that a PPP project will be terminated early.

The analysis finds that, in the developing countries, PPPs show lower probability of early termination when they are contracted by subnational entities and when they are backed by direct support from the government, which includes capital grants, revenue subsidies, and in-kind transfers. Direct support from the government decreases the financing risk of the project. Early termination probability is also reduced for PPP contracts in countries with greater constraints in the executive power. Large physical investments and macro-financial shocks increase the likelihood of early terminations.

The analysis also derives lessons on contract structuring from the PPP highway sector in India for which richer data are available. In India, PPPs for national highways are more likely to terminate early if, through contractual obligations, they put the private sponsor under larger financial commitments—namely, larger payments to the government and a larger share of debt financing. The former might be a reflection of a perverse incentive structure that encourages overoptimistic bids on payments to the government in order to win tenders on PPP contracts.

The remainder of the paper is structured as follows. Section 2 discusses the benefits of PPPs and the government liabilities from PPPs. Section 3 discusses the use of PPPs in infrastructure in South Asia. Section 4 presents the estimated fiscal risks from contingent liabilities of PPPs. The section also discusses the empirical approach and the data used for the estimations. Section 5 assesses the contract and financing characteristics of national highways PPPs in India that tend to lead to early termination of PPPs. Section 6 concludes and discusses policy recommendations.

2. Benefits and liabilities of PPPs

A public-private partnership is an organizational arrangement that enables the cooperation of public and private institutions in the provision of a public project, which in the context of this paper is an infrastructure project. As Grimsey and Lewis (2017) point out, a PPP is an enduring and relational partnership,[4] with each partner bringing something of value (money, property, authority, reputation) to the partnership. A key defining feature of a PPP is the sharing of responsibilities and risks for outcomes between the partners. Underpinning the partnership is a framework contract that sets out the "rules of the game" delineating each partner's rights and

[4] For example, a government buying goods or services from the same supplier year after year is not an enduring and relational partnership, and therefore not a PPP.

obligations. Because of uncertainties inherent in long-term projects, PPP contracts are incomplete: that is, they do not cover all possible scenarios and leaving room for renegotiation (Guasch 2004).

Well-structured PPPs have the potential to provide infrastructure services at lower cost for the society, which can increase a country's infrastructure investment capacity as some investments would potentially be only feasible under a PPP arrangement (Iossa and Martimort 2012). PPPs aim to efficiently allocate among the partners the risks and responsibilities associated with different stages of the project to maximize the value for money. Outsourcing of responsibilities to the private sector and bundling of investment and service provision can bring efficiency gains. Outsourcing allows the public sector to leverage private sector expertise and organizational efficiency in service provision. The potential of knowledge and technology spillovers from foreign sponsors may be better harnessed by the host country within a PPP relationship (ITF 2018). Additionally, competitive procurement to select the private partner can drive the cost down compared to in-house public sector provision.

PPPs bundle investment and service provision—that is financing, design, construction, rehabilitation, operation, and maintenance—into a single long-term contract. This contrasts with traditional procurement practices in which the government gets into separate contractual relationships for each phase of the infrastructure investment and operation. The idea behind bundling is to combine the two major stages of a typical infrastructure project to achieve efficiency gains. When investment and service provision are bundled, the private party has the incentive to adopt improvements during the design and construction stages that reduce operation and maintenance costs or increase the quality of services and the revenues during operation, as long as the additional construction costs are offset by higher returns in the latter stage.[5]

Efficiency gains from PPPs may also arise from mobilizing private finance. Private finance may provide the expertise that public finance lacks in valuing risks and monitoring effort. Hence, when private creditors who are specialized in project finance are involved in financing, private finance may resolve uncertainty and agency problems faced by the government (Iossa and Martimort 2012, 2015). By incentivizing efficient termination, private finance may also resolve soft budget constraints through which governments can keep bad projects alive (de Bettignies and Ross 2009).[6]

The allocation of demand risk affects the financing cost of the project and the operator's incentives to provide adequate service under conditions of imperfect monitoring and regulation. The funding structure determines the allocation of demand risk between the government and the private sponsor. A contract funded purely by user fees allocates the whole demand risk on the private

[5] The incentive to adopt the improvement requires that either the service quality is contractible or the demand for the service depends on its quality. If quality is not contractible, PPPs may lead to innovations during the design stage that are both cost and quality reducing. This might lead to provision of some service with the least cost but not at the socially optimal levels if the social benefits from the innovations are larger than the net savings incurred by the firm (Hart 2003, Martimort and Pouyet 2008).

[6] Mobilizing private finance may also be able to solve a political problem hindering infrastructure investment by the incumbent. For example, when there are fiscal rules that prevent public financing of infrastructure, PPPs might still be politically and legally feasible (Budina, Polackova Brixi and Irwin 2007). Another possibility is that when a different political faction can bar any public financing of infrastructure within an incumbent's district, the incumbent can utilize private finance to skirt around the political constraint.

sponsor. In contrast, the government assumes the demand risk under an availability payment scheme. The operator in the former case would face higher costs of capital than in the latter case, as creditors would require compensation for the risk. The operator in the former case would have the incentive to attract more users through better services to increase its revenues, while in the latter case the public partner would have to monitor the quality of service to ensure a certain level of service. Intermediate arrangements, in which the government guarantees a minimum revenue from user fees or provides some availability payments and allows the operator to charge reduced user fees, are common.

PPPs have the potential to weed out the bad projects when a project is funded by user fees, and the government commits not to fund it through tax revenues. When the demand risk is effectively transferred to the private party, the project will only attract private sponsors and external creditors if the projects is financially profitable. This means that bridges to nowhere would not be built under a PPP arrangement funded by user fees. However, this market test is less useful than it appears. It fails to indicate whether projects, even if they are unprofitable, yield benefits to the society.

Sometimes policy makers and development practitioners claim that a benefit of mobilizing private finance is that it allows governments to invest in infrastructure when there is no fiscal space. This argument is based on confusion between funding and financing. Private financing, by itself, does not reduce the fiscal burden on the government because either through future availability payments or foregone user fees, the government ends up funding the provision of the infrastructure service over the lifetime of the project (Hart 2003; Engel, Fischer, and Galetovic 2013; Grout 1997). It could be argued that in a developing economy when the government is facing temporary credit constraints and investing in critical infrastructure is imperative in the short run, mobilizing private financing could be beneficial—if international private sponsors with well-diversified portfolios and good-credit ratings can obtain financing at a low cost (de Bettignies and Ross 2010; Yehoue 2013).

PPPs can create liabilities for governments based on how risks are shared with the private partner. A good way to categorize these liabilities is to use the fiscal risk matrix, which categorizes the government's liabilities as direct or contingent and explicit or implicit (Polackova 1998; Budina, Polackova Brixi, and Irwin 2007). Direct explicit liabilities created by PPPs are contractual or legal promises by the government in the event that all stages of the project go according to the schedule foreseen in the contract. Availability and capacity payments, shadow tolls and energy payments in power purchasing agreements where the public party has no control over energy generated are examples of direct explicit liabilities for the government.[7]

Contingent liabilities can be explicit or implicit. Explicit contingent liabilities created by PPPs are the contractual or legal guarantees by the government contingent on the occurrence of an exogeneous event. For example, the government may commit to a minimum revenue guarantee for a toll road or for an independent power producer in the PPP contract. Implicit contingent

[7] PPPs typically do not create direct implicit liabilities unless payments to the private party are expected to continue due to noncontractual or noncontingent reasons such as political relation even after the contract is over (Budina, Polackova Brixi and Irwin 2007).

liabilities created by PPPs are the noncontractual liabilities that the partnership and incomplete contracts create in various states of the world. For example, even though the government might not contractually promise any guarantees to the private party in the event of a default, considering the fact that the government is the ultimate guarantor of public services in most societies, the government might have to bail out the private party or assume the remaining debt and service obligations of the private party to avoid service disruption. It means that when a PPP contract is agreed upon, the government assumes the ultimate insolvency risk (Irwin 2007). The most common implicit contingent liabilities of PPPs stem from renegotiation and early termination— when the compensation is beyond what is included in the termination clauses.

The current public-sector accounting principles do not provide an adequate framework for valuating and reporting the liabilities created by PPPs, which exacerbates the fiscal risks from PPPs. The cash-based accounting practices, which are still popular in the developing world, do not provide a way to include the liabilities into government finances. Even the financial accounting frameworks recommended by the IMF and the EU limit their inclusion based on assessment of the risks and control borne by the government (Heald and Georgiou 2010; de Vries 2013). Furthermore, governments facing fiscal constraints tend to increase their levels of PPP investments as a percentage of GDP without proper institutional mechanisms to deal with the liabilities they create (Reyes-Tagle and Garbacik 2016).

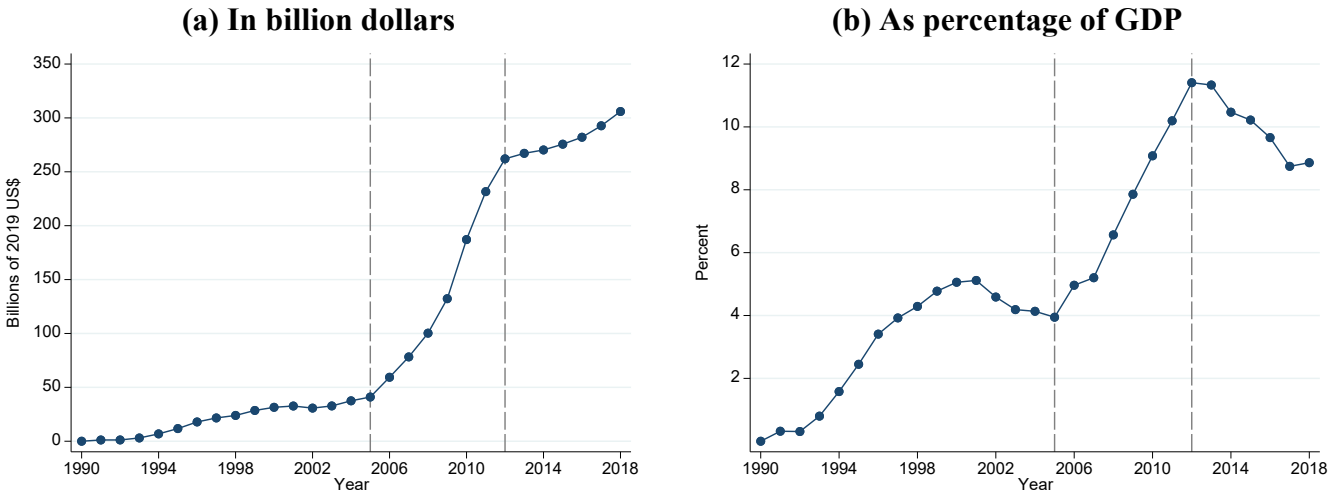
3. PPPs in infrastructure in South Asia

The use of PPPs in infrastructure in South Asia grew exponentially from the early 1990s to the early 2010s, slowing down after 2012. PPP investments accelerated between 2005 and 2012, increasing the value of the active portfolio by more than five-fold from $45 billion to $267 billion, and from 3.9 to 11.4 percent of the region's GDP (figure 1). After 2012, investment growth slowed down and fell behind GDP growth, as indicated by the decline in investments as a percentage of GDP (figure 1, panel b). At the end of 2018, cumulative investment in the active portfolio of PPP projects was just over $320 billion,[8] according to the World Bank Private Participation in Infrastructure Project Database (PPI),[9] which corresponds to 8.9 percent of the region's total GDP.

The number of active PPP projects in infrastructure in South Asia increased exponentially between the early 1990s and the early 2010s but slowed down after 2012. However, the increase in the number of projects is slower between 2005 and 2012 than the increase in investment volumes, which indicates that the countries in the region increased the number of projects as well as their average size (figure 2).

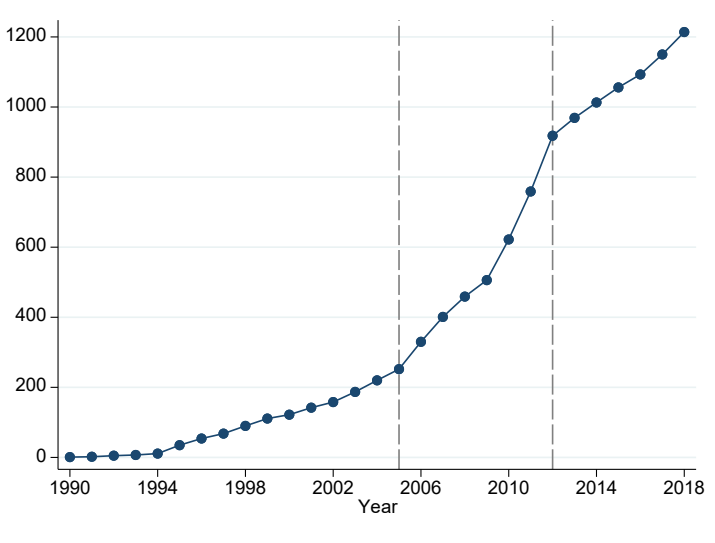
[8] All dollar figures in the study have been expressed in 2019 US dollars, inflated using the US CPI series in WDI.
[9] Version 2019 H1, available at https://ppi.worldbank.org/en/ppidata.

Figure 1 Active portfolio of public-private partnerships in infrastructure in South Asia, 1990–2018



Source: PPI database and World Development Indicators.

Figure 2 Number of active public-private partnership projects in infrastructure in South Asia, 1900–2018



Source: PPI database.

India implemented the largest number of infrastructure PPPs in the region, accounting for over three-quarters of the 1,232 infrastructure PPPs in South Asia. Pakistan and Sri Lanka implemented 81 and 79 PPPs, respectively, and are followed by Bangladesh with 45 and Nepal with 38 PPPs. Afghanistan and Bhutan implemented only two, while Maldives had one PPP in infrastructure (table 1). PPP investments in India—amounting to $283 billion—account for more than 85 percent of the aggregate investment in PPPs in the region. India is followed by Pakistan and Bangladesh with total investments of $31 billion and $6.9 billion, respectively. Sri Lanka's PPP program had

investments of $3.4 billion and Nepal's $2.9 billion. Maldives, Bhutan and Afghanistan's PPP programs have been the smallest with investments of $469 million, $240 million and $39 million, respectively.

Table 1 Sectoral distribution of public-private partnership projects in infrastructure in South Asia, by country, 1990–2018

Country		ICT	Energy	Transport	Water and Sewerage	Total
Afghanistan	*Projects*	0	2	0	0	2
	Mn. US$	0	39	0	0	39
Bangladesh	*Projects*	5 (2)	31	8 (1)	1	45 (3)
	Mn. US$	76	5,372	1,097	333	6,877
Bhutan	*Projects*	1	1	0	0	2
	Mn. US$	0	240	0	0	240
India	*Projects*	7 (1)	414 (3)	543 (27)	20	984 (31)
	Mn. US$	1,624	162,375	117,595	1,337	282,932
Maldives	*Projects*	0	0	1 (1)	0	1 (1)
	Mn. US$	0	0	469	0	469
Nepal	*Projects*	2	34	1	1	38
	Mn. US$	12	2,491	378	0	2,880
Pakistan	*Projects*	0	73	8	0	81
	Mn. US$	0	28,159	3,005	0	31,164
Sri Lanka	*Projects*	1	75	3	0	79
	Mn. US$	81	2,244	1,062	0	3,387
Total	*Projects*	16 (3)	630 (3)	564 (29)	22	1,232 (35)
	Mn. US$	1,764	200,919	123,605	1,670	327,988

Source: PPI database.
Note: The number of canceled projects is in parentheses. Investment totals are in 2019 million dollars. ICT = Information and communications technology.

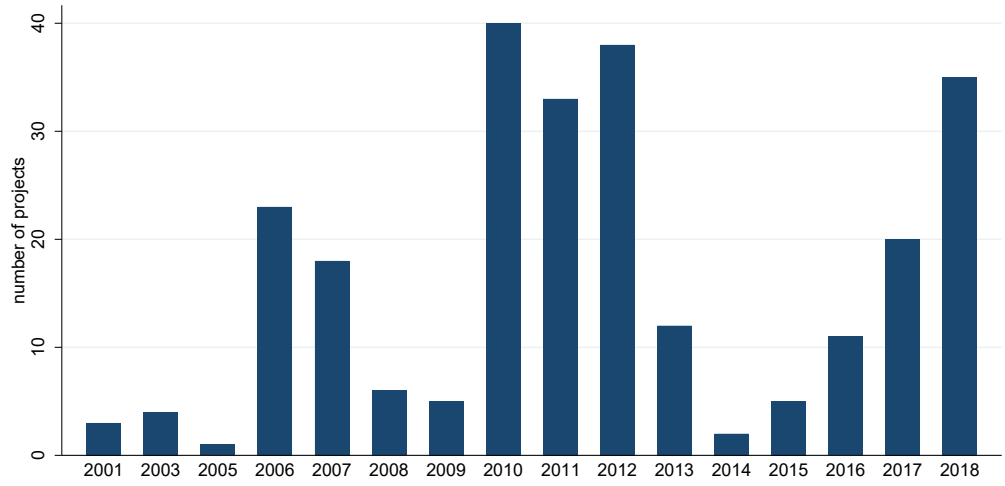
PPPs in South Asia have been predominantly used in the energy and transport sectors. Of the 1,232 PPP projects in infrastructure with financial closure in the region since 1990, 97 percent are in energy or transport sectors (table 1). The remaining 38 projects are in the water and sewerage sector and the information and communications technology (ICT) sector. The composition by country shows that aside from India, Bhutan, and Maldives, the country programs are dominated

by investments in the energy sector. In India, there are 543 PPPs in the transport sector and 414 in the energy sector.

Only 2.8 percent of the infrastructure PPPs initiated in South Asia were canceled. The cancellations have mostly been in the Indian transport sector, which accounts for 27 out of the 35 canceled PPPs in the region (table 1). Even though the highest number of cancellations occurred in the transport sector, the sector with the largest share of canceled PPPs is the ICT sector, with 19 percent. The share of canceled PPPs in the region is similar to the global share, which is 3.7 percent.

The PPP transport program in India showed signs of distress in 2013 and 2014. Twenty-four of the 27 cancellations in the Indian transport sector occurred in 2013 and 2014. At that time, there were about $7 billion of highway PPPs in operation and roughly $34 billion of highway PPPs under construction. About one-third of the PPPs under operations and two-thirds of those under construction were showing signs of distress. Infrastructure developers and banks (mainly public) that financed highways PPPs were also stressed. As a result, the national highways development program experienced a sudden stop in 2013 and 2014 after a period of rapid growth between 2010 and 2012 (figure 3).

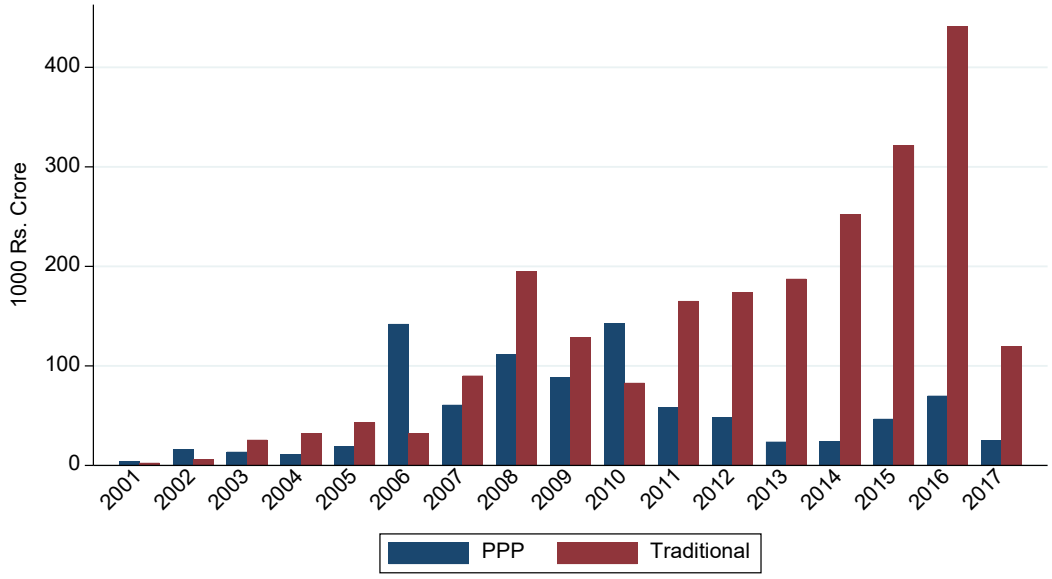
Figure 3 Number of national highway public-private partnership projects in India by financial closure year, 2001–2018



Source: PPI database.

The distressed projects in India also coincide with the slowdown in PPP investments in South Asia, as can be seen in figures 1 and 2. Although it can be argued that it is coincidental, there is evidence that the cancellations led to more caution in initiating new PPPs. For example, a federal statute, which came into effect in 2014, set the requirement that a PPP must obtain the consent of at least 70 percent of the affected persons for land acquisition and made compensation more generous—and thus more costly for the project. Earlier projects were undertaken with as little as 30 percent of the land having been secured (Pratap and Chakrabarti 2017). Furthermore, after 2010, in India, traditional procurement of infrastructure was favored to PPPs at an increasing rate (figure 4).

Figure 4 Traditional versus public-private partnership procurement of infrastructure in India, 2001–2017



Source: Department of Economic Affairs, Ministry of Finance, India and PPI database.
Note: For public-private partnerships, year is the year of the concession agreement, financial closure, or the appointed date, whichever is available, in that order. For traditional procurement the year is the project award year.

4. Fiscal risks from contingent liabilities due to early termination of PPPs

The objective of the analysis in this section is to value the fiscal risks from contingent liabilities that are realized when an infrastructure PPP project is distressed. In this analysis, distress refers to early termination of the PPP project. The fiscal risks estimated in this section are the costs that a government incurs in the event of early termination of the project, which can occur as a result of government's default or voluntary termination of the project, private partner's default or breach of contract, or force majeure.

To value the fiscal risks, the study adopts a value-at-risk methodology. The fiscal risk faced by country c from a portfolio of projects I_c is valued as the maximum expected loss with 99 percent confidence:[10]

$$EL_{c,99\%} = \sum_{i \in I_c} EL_i + z_{1\%} \times s.e.\left(\sum_{i \in I_c} EL_i\right), \quad (1)$$

where EL_i is the expected loss from the early termination of project i:

[10] In the calculation of $EL_{c,99\%}$, correlations across projects in the same country are taken into account via both the distress probabilities and the standard errors calculated via the delta method using the coefficient variance-covariance matrix, which was estimated assuming that the observations are clustered at the country level.

$$EL_i = PD_i * EAD_i * LGD_i \quad (2)$$

where PD_i is the probability of distress for project i, EAD_i is the exposure at distress of the government from project i, and LGD_i is the government's loss given distress from project i.

The PD_i, EAD_i and LGD_i are obtained separately. The probability of distress of a PPP is predicted using a flexible parametric survival model of the realization of distress conditional on project-specific and country-specific institutional variables and macroeconomic shocks. The EAD_i is estimated based on the debt and equity invested in the project. The LGD_i is determined based on different practices by countries in case of termination of PPP contracts and the recovery rates of defaulted loans to infrastructure projects.

4.1. Probability of distress

4.1.1. Econometric model

The probability of distress of a PPP at a specific point during its contract period is predicted by estimating a flexible parametric proportional hazards model (Royston and Parmar 2002; Royston and Lambert 2011).[11] The model is an extension of the parametric proportional hazards model with a Weibull baseline hazard function. The generalization allows for a non-monotonic baseline hazard function using restricted cubic splines. Accordingly, coefficients of the following equation are estimated to maximize the likelihood of the observed distribution of failure times:

$$\ln H(t|\boldsymbol{X_{it}}) = \gamma_0 + \sum_{m=1}^{2} \gamma_m z_m(\ln t) + \boldsymbol{X_{i,proj}\beta_{proj}} + \boldsymbol{X_{it,inst}\beta_{inst}} + \boldsymbol{X_{it,macro}\beta_{macro}} \quad (3)$$

where $\ln H(t|\boldsymbol{X_{it}})$ is the log cumulative hazard at time t for project i conditional on $\boldsymbol{X_{it}} = (\boldsymbol{X_{i,proj}}, \boldsymbol{X_{it,inst}}, \boldsymbol{X_{it,macro}})$. $\boldsymbol{X_{i,proj}}$ is the vector of project-specific time-invariant covariates, $\boldsymbol{X_{it,inst}}$ is the vector of country-specific time-varying institutional covariates and $\boldsymbol{X_{it,macro}}$ is the vector of country-specific time-varying macroeconomic shocks. The terms under the summation operator represent the set of restricted cubic spline terms in log time scale, $z_m(\ln t)$. The time scale is chosen as the percentage of contract period elapsed.

The probability of distress, PD_i, between time t_0 and t, given that the project survives until t_0 can be recovered using the log cumulative hazard from equation (3), and the relationship between the survival function, $S(t)$, and the cumulative hazard function (see appendix A for detailed discussion). The estimated probability of distress can be written as follows:

$$\widehat{PD}_i = 1 - \hat{S}_i(t|t_0) \quad (4)$$

[11] The model is estimated in Stata using the stpm2 routine, which has been authored by Lambert and Royston (2009).

4.1.2. Data

Data come from four sources, the World Bank Private Participation in Infrastructure Project Database (PPI),[12] the Polity IV Project,[13] World Bank's World Development Indicators (WDI),[14] and Laeven and Valencia (2018).

The PPI database includes data on project characteristics as they were agreed at the time of the signing of the PPP contract or at the time of financial closure. These characteristics include the type of project, sector, contract period, government level granting the contract, identities of the sponsors, types of government support, amount of investment commitments and financing information. The PPI also provides the current status of the project as active, concluded, distressed or canceled.

A considerable number of projects in the PPI database lack the data for all characteristics. Missing data on the variables essential for the analysis, namely contract period and the level of government which granted the contract, were added for all projects using the individual project descriptions provided in the database if available.

The Polity IV data is used to identify the institutional characteristics of a country. To identify these characteristics, yearly executive recruitment, constraints on the executive and political competition concept variables are used. The values for the interruption, interregnum and transition periods, during which the variables are coded out of their respective ranges in Polity IV, were linearly interpolated.

From the WDI, annual series of per capita growth rate and nominal exchange rates are used to create series of detrended and demeaned series of per capita growth rate and exchange rate shocks using the filter suggested by Hamilton (2018). The data on financial crises come from the Systemic Banking Crises data set of Laeven and Valencia (2018).

The econometric estimation uses the data on all PPP projects in low- and middle-income countries. After estimating equation (3), predicted probabilities of distress are obtained for the PPP projects in South Asia using the predictions implied by the survival analysis. Data limitations preclude estimation using only the South Asian countries.

The PPI database records 7,979 projects in the developing world, encompassing 127 countries, with financial closure dates from 1990 to 2019. The database includes projects from five different sectors: ICT, energy, transport, water and sewerage, and municipal solid waste. Since the municipal solid waste data has been a recent addition to the database, and only covers the currently active projects with financial closures starting in 2009, they were dropped from the sample to make all projects comparable. ICT projects, merchant and rental greenfield projects, management and lease projects, and divestitures were also excluded from the sample because they are not PPPs as this study defines them.

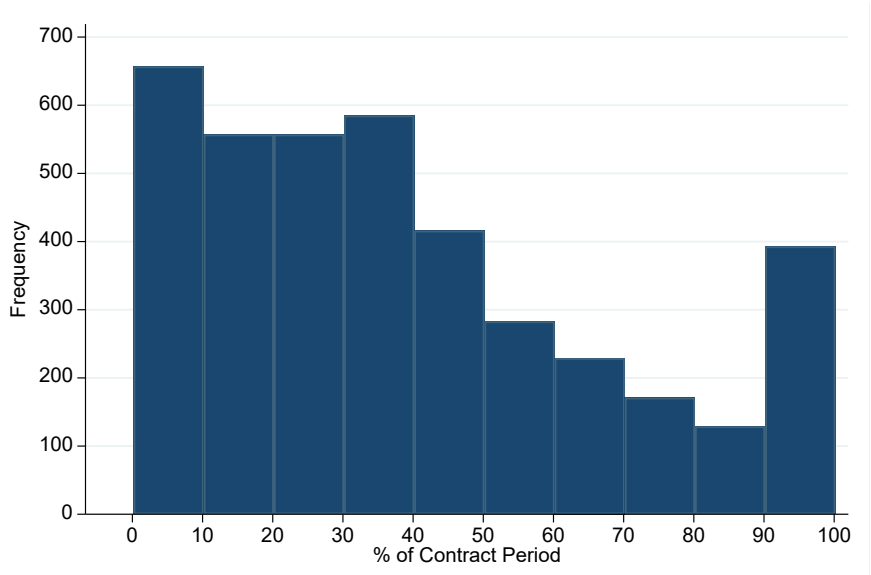
[12] Version 2019 H1, available at https://ppi.worldbank.org/en/ppidata.
[13] Polity IV Project, Political Regime Characteristics and Transitions, 1800-2018, available at http://www.systemicpeace.org/inscrdata.html.
[14] Available at http://datatopics.worldbank.org/world-development-indicators/.

In the analysis, distress is defined as early termination of a project. The PPI database labels any project from which the private party has exited by selling or turning over its shares back to government, or by ceasing operations as canceled. The database labels any project that is in international arbitration or for which contract termination has been requested by either the government or the private party as distressed. Using news articles and other public online sources, the current status of the distressed projects was determined and the projects were relabeled as canceled, concluded, or active. When no definitive information about the resolution of the distress could be found, the project was dropped from the sample.

The contract periods of some projects in the PPI database have been completed although they are labeled as still active. Potential reasons are that successfully concluded projects have gone unnoticed because they are not covered in the news, or that project companies have obtained contract extensions after the fulfillment of their initial contract terms. The projects with completed contract periods but still labeled as active are kept in the analysis and relabeled as concluded.

Figure 5 shows the distribution of the percentage of contract period elapsed within the estimation sample. It includes 3,977 projects, out of which 167 are canceled. One stark observation is that an overwhelming majority of the included projects have not passed half of their contract periods. One reason is that PPPs are a relatively new phenomenon compared to the median contract period of a PPP in the sample, which is 25 years. Another reason is that some of the older projects in the PPI database are missing crucial information, such as the contract period and level of contracting government, hence they are dropped from the sample used for the econometric estimation.

Figure 5 Distribution of percentage of contract period elapsed, 1990–2018



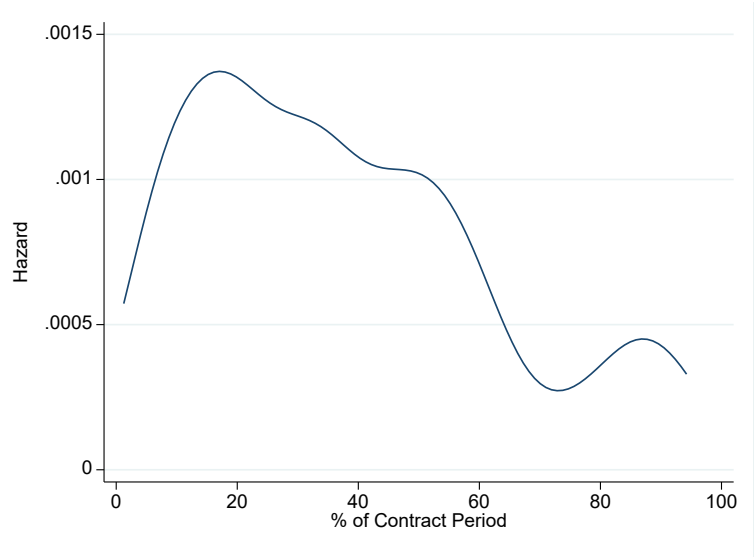
Source: PPI database.

4.1.3. Estimation results

Non-parametric estimates show that PPP projects are more likely to fail during the early portion of their contract periods, and risks accumulated during their contract periods are not trivial. Specifically, the smoothed hazard rate estimate using Gaussian kernel and optimal bandwidth

indicates a unimodal hazard profile for a PPP project (figure 6). The risk of early termination for a project increases rapidly until around 20 percent of the project's contract period elapses. It plateaus at this level and presents a slight decline until it reaches 50 percent. Beyond 50 percent of the contract period, except for a small increase around 80 percent, the risk of early termination decreases until the project approaches the end of the contract period.

Figure 6 Smoothed hazard function estimate over the percentage of contract period elapsed



Source: Authors' calculations using PPI database.
Note: Figure shows smoothed hazard rate estimate using Gaussian kernel and optimal bandwidth.

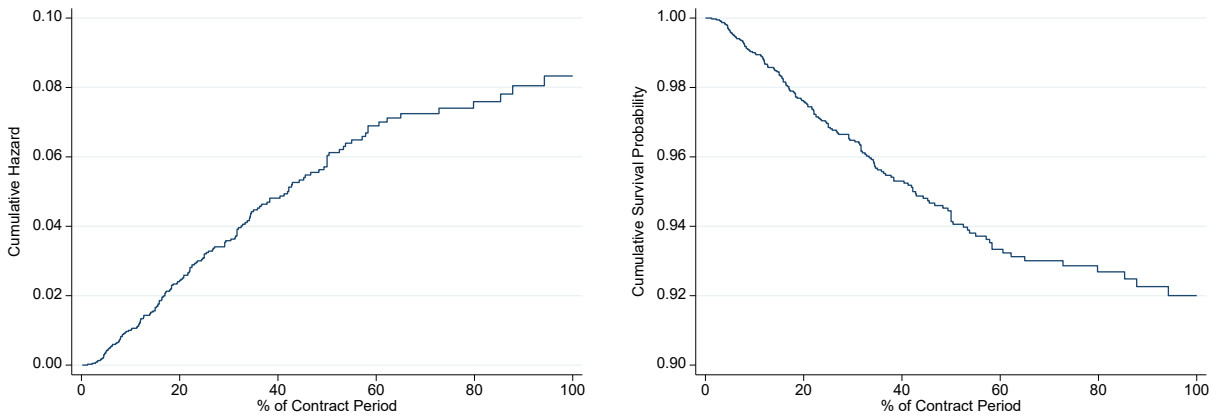
The cumulative hazard curve shows that the accumulated probability of distress increases steadily but its pace decreases after reaching around 50 percent of the contract period (figure 7, panel a). The Kaplan-Meier survival curve estimate mirrors the profile and implies that the probability of an average project to survive until the end of its contract period is 0.92 (figure 7, panel b).[15]

Table 2 presents the results from estimating the flexible parametric proportional hazards model in equation (3). Column (1) presents the results when controlling only for the type of private participation and sector that the project belongs to. Column (2) presents the results when also controlling for the type of government support that the project receives and the contracting authority. Column (3) adds the investment commitment of the project as a control variable. Column (4) presents the results when institutional variables are included as controls. Column (5) introduces the macroeconomic shocks to the model and is the preferred regression for inference. Positive coefficients indicate factors that increase the cumulative hazard, and ultimately the probability of distress, and negative coefficients indicate factors that decrease the cumulative hazard, and ultimately the probability of distress.

[15] Equations (A3) and (A4) in appendix A present the relationships among hazard, cumulative hazard and cumulative survival probability presented in figures 5, 6 and 7.

Figure 7 Survival and cumulative hazard estimates of public-private partnership projects

(a) Nelson-Aalen cumulative hazard curve **(b) Kaplan-Meier survival curve**



Source: Authors' calculations using PPI database.

Table 2 Hazard regression results for early termination of public-private partnerships

	(1)	(2)	(3)	(4)	(5)
Base Type: Greenfield					
Brownfield	0.135	0.0981	0.117	0.186	0.238
	(0.539)	(0.499)	(0.498)	(0.438)	(0.402)
Base Sector: Electricity					
Natural Gas	0.380	0.772**	0.780**	0.811**	0.767*
	(0.280)	(0.362)	(0.376)	(0.393)	(0.406)
Airports	1.703***	1.743***	1.680***	1.651***	1.550***
	(0.638)	(0.577)	(0.590)	(0.576)	(0.561)
Railroads	2.027***	2.045***	1.860***	1.705***	1.678***
	(0.465)	(0.396)	(0.353)	(0.380)	(0.359)
Toll Roads	1.267**	1.672***	1.630***	1.692***	1.504***
	(0.585)	(0.545)	(0.520)	(0.463)	(0.382)
Seaports	0.326	0.347	0.393	0.313	0.115
	(0.649)	(0.611)	(0.602)	(0.613)	(0.663)
Treatment plant	1.025***	1.783***	1.853***	1.845***	1.720***
	(0.315)	(0.486)	(0.483)	(0.454)	(0.412)
Water Utility	1.191*	2.016***	1.990***	1.816***	1.717***
	(0.707)	(0.695)	(0.645)	(0.572)	(0.549)
Direct Government Support		-0.935***	-0.884***	-0.705***	-0.645***
		(0.226)	(0.221)	(0.234)	(0.194)
Indirect Government Support		-0.0978	-0.115	-0.0933	0.0374
		(0.808)	(0.804)	(0.778)	(0.752)

Multilateral Support		-0.287	-0.358	-0.443	-0.500
		(0.306)	(0.332)	(0.355)	(0.310)
Subnational Government Contract		-1.018***	-0.940**	-0.841**	-0.784*
		(0.370)	(0.370)	(0.414)	(0.408)
Physical Investment (billions USD)			0.544*	0.482*	0.551**
			(0.315)	(0.273)	(0.247)
Physical Investment (billions USD) Squared			-0.0760	-0.0647	-0.0807*
			(0.0522)	(0.0450)	(0.0476)
Executive Recruitment Concept				0.151	0.102
				(0.121)	(0.151)
Executive Constraints Concept				-0.478***	-0.443***
				(0.153)	(0.125)
Political Competition Concept				0.114	0.142
				(0.121)	(0.111)
Annual GDP per capita Growth rate (detrended, previous year)					0.0995
					(0.0654)
Annual depreciation (detrended, previous year)					0.0144***
					(0.00448)
Banking Crisis Occurred (previous year)					1.272**
					(0.538)
Debt Crisis Occurred (previous year)					1.088**
					(0.536)
Exchange Rate Crisis Occurred (previous year)					-0.636
					(0.542)
γ_1	2.097***	2.093***	2.095***	2.102***	2.085***
	(0.284)	(0.283)	(0.286)	(0.282)	(0.240)
γ_2	0.120***	0.120***	0.120***	0.120***	0.114***
	(0.0242)	(0.0245)	(0.0246)	(0.0241)	(0.0223)
Constant	-9.929***	-9.662***	-9.852***	-9.198***	-9.352***
	(0.675)	(0.698)	(0.739)	(0.881)	(0.818)
N(projects)	3977	3977	3977	3977	3977
N(distressed)	167	167	167	167	167
N(countries)	86	86	86	86	86
AIC	1563.7	1535.1	1531.0	1520.6	1483.4
BIC	1598.0	1581.9	1584.1	1583.0	1561.4
Project-years	39364	39364	39364	39364	39364

Source: Authors' calculations.
Note: Robust standard errors clustered by country are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

The estimation results suggest that the probability of distress from a brownfield project is not statistically different from that of a greenfield project. Private sponsors tend to express a preference for brownfield projects over greenfield projects because the returns of the latter projects are uncertain. The results show that ex-ante uncertainty about the return of projects is not associated with higher risk of distress.

Natural gas, railroad, toll road, treatment plant and water utility projects are associated with higher hazard rates relative to electricity projects. PPPs in water utilities and treatment plant projects experienced high rates of early termination because of difficulties in adapting the contract to changing conditions, contract designs that were not viable, and a bidding process leading to unrealistic financial conditions. For example, the concession in Cochabamba (Bolivia) required substantial tariff hikes to make the large investment required from the private operator viable, something that proved socially unsustainable and brought about the rapid demise of the contract (Marin 2009).

Government support that decreases financing risk is the most effective in preventing distress. Direct government support, which includes capital and revenue subsidies and in-kind transfers, is associated with lower probability of distress. Indirect government support, which includes various guarantees to the sponsors, and support from multilateral organizations bear negative coefficients—but these are not statistically significant at common levels.

PPPs with subnational governments are less likely to face early termination than PPPs with central governments. This finding could be related to better project selection at the local level, as the local authorities may understand the local problems better or oversee the project better because of its proximity. It could also be the case that national governments tend to engage in risky projects as they can bear the termination risk from an individual PPP project because they have a more diversified PPP portfolio and fiscal resources. The highway projects in India provide an interesting example: All the highway projects that were canceled in India between 2012 and 2015 were PPPs with the central government. At the same time, state governments continued to enter into successful PPPs for road construction and operation.

Larger projects are associated with higher probability of distress except for the largest of PPP projects. Increases in the committed investment in physical assets are associated with higher probability of distress as long as the investment is less than 3.4 billion dollars. For investments in physical assets above 3.4 billion dollars, the higher the investment the lower the probability of distress. The 3.4 billion dollars threshold is about the 99th percentile of the project size distribution in the sample.

Greater constraints on the executive are associated with lower probability of distress. When the government can exercise authority without adequate checks and balances, it leaves PPPs vulnerable to expropriation by the government through a change in policy or political takeover. Hence, the project becomes susceptible to policy and political risks (Irwin 2007; Grimsey and

Lewis 2017). More generally, when the constraints on the executive are not stringent enough, the contract loses its value in mediating the relationship between the government and the private party, and hence makes the project more susceptible to distress.

The deviation of the annual depreciation rate from its long-run average—a surprise local currency depreciation—is associated with higher risk of distress. Irwin (2007) notes that exchange rate risk affects infrastructure investment in two ways. First, many infrastructure PPPs, such as those in power generation, use inputs priced in foreign currency. Second, given the insufficient local savings and underdeveloped local currency markets in most low- and middle-income economies, financing of long-term infrastructure projects most often relies on debt denominated in foreign currency, but the revenues of the operators are in local currency. The currency mismatch between revenues and costs can push the project company to insolvency very quickly, if the local currency depreciates sharply.

Occurrences of systematic banking and debt crises are associated with higher hazard rates for PPP projects. A systematic banking crisis undermines the ability of financial institutions to provide the financing that is necessary to sustain long-term infrastructure projects. A debt crisis can limit the government's ability to fund PPP projects according to the terms of the contracts. It may also hinder the ability of the local private party to secure debt financing through the market and increase the cost of its outstanding debt, leading to early termination of PPP projects. Because of the long-term nature of PPPs and the high transaction costs of preparing, procuring and awarding them, both parties try to negotiate changes to the contract or some kind of compensation in response to macro-financial shocks. Early termination happens only if the parties cannot reach an agreement, hence the lag in the impact of macro-financial shocks.

4.2. Exposure at distress

In general, governments are exposed to obligations from the debt and equity financing of an infrastructure project when the PPP is terminated. As the ultimate guarantor of the public infrastructure service, the government steps in to resolve the matter. As indicated in World Bank's Guidance on PPP Contractual Provisions, the market practice in the event of a PPP contract termination is that both the lenders and the equity owners must be compensated if distress occurred without any fault of either party (World Bank 2019). Without such explicit or implicit guarantees, especially in emerging market and developing economies, private finance cannot be effectively mobilized.

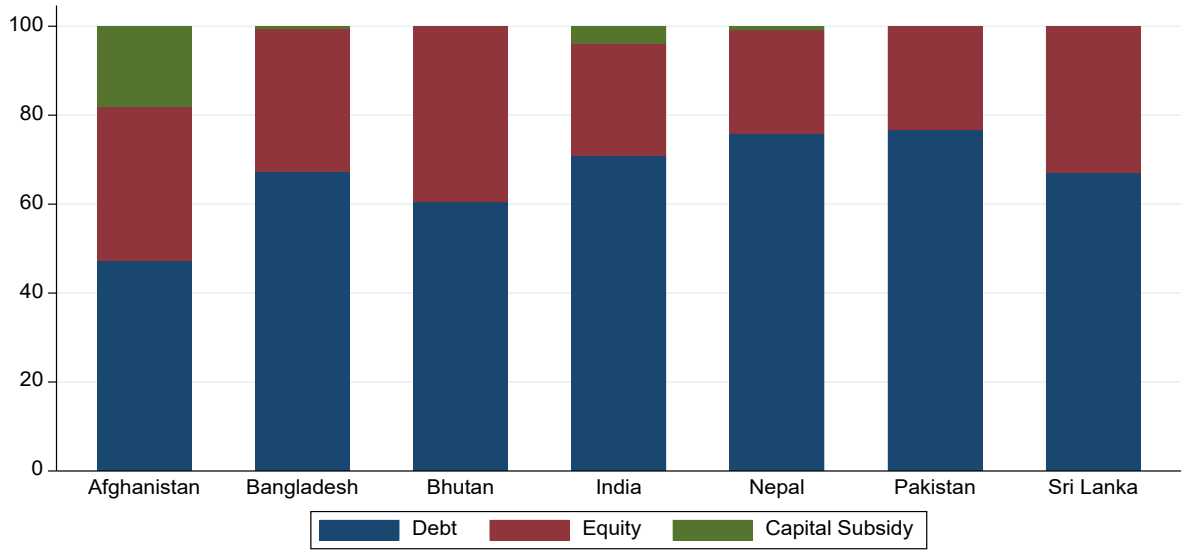
In valuing the fiscal risks from early termination of PPPs, the exposure at distress due to each project is calculated using the debt and equity data in the PPI database. The PPI database provides the shares of the physical investment that have been financed through debt, equity or capital grant from the government. In the case of missing values, data was collected and when information could not be found, the missing values were imputed as discussed in appendix D.

The total debt used to finance the currently active 1,056 greenfield and brownfield PPP projects in energy, transport, and water and sewerage in South Asia[16] is estimated to be $218 billion and the total equity financing is estimated to be $77 billion. The average leverage ratio, at the time of

[16] Excluding the projects which elapsed their imputed or observed contract period.

financial closure, among the active PPP projects in South Asia is 3.22. Debt financing makes up more than 70 percent of total physical investments in India, Nepal, and Pakistan, while it is between 60 and 70 percent of total physical investment in Bangladesh, Bhutan, and Sri Lanka (figure 8). Capital subsidies from government play a larger role in Afghanistan than in the other countries in South Asia.

Figure 8 Composition of public-private partnership financing for active projects in South Asia, by country, 1990–2018



Sources: Authors, based on data from PPI database and own data collection.

4.3. Value at risk

The losses given distress from debt and equity obligations depend on the causes of distress. There are three major reasons for early termination of PPPs: the government's default or voluntary termination of the project, private partner's default or breach of contract, and force majeure. In the first case, based on market practices the private party expects to be compensated for the full amount invested in the project (debt and equity) plus the equity return it had forecasted (World Bank 2019).

In the case of termination due to the private partner's default or breach of contract, the market practice is to provide some amount of compensation. The justification for compensation is that if there is no compensation, the government might be seen as enjoying windfall gains unfairly and would have a hard time attracting lenders and investors for PPP projects in general (EPEC 2013; World Bank 2019). Even in the case of the private partner's default, the private partner may legally allege government responsibility, so the government becomes liable to compensate the private party, or otherwise incur additional legal costs (World Bank 2019).

In the case of force majeure, because the distress event is outside both parties' control, the risk should be shared between both parties. As such, the government is liable for less than full compensation and has the right to take over the relevant asset, while the private partner loses any

return on its invested equity and possibly some of the invested equity itself (EPEC 2013; World Bank 2019).

There is limited data available on losses incurred by governments in cases of early termination of PPPs. The data on the recovery rates of bank loans to PPP projects, mainly those in developed economies, collected by the Data Alliance Project Finance Consortium show that the average ultimate recovery rate is 79.3 percent (Moody's Investor Service 2019).[17] This might be a low estimate in the context of South Asia since the model PPP concession agreements in the road sector in India guarantee as much as 90 percent of the debt financing even in cases of the project company's default or force majeure.

The data on compensation of private equity is even scarcer than data on recovery rates of bank loans. The government's loss given distress on the private equity depends on the reason for termination, the actual clauses in the contract and, potentially, the negotiation at the time of termination. Road concession agreements in India offer a range of possibilities depending on the source of termination of the contract. In the case of the project company default, the concession agreements do not foresee any compensation on equity, but in the case of public authority default, the contract entitles the private sponsor to 150 percent of its equity. If there is a force majeure event which is indirectly caused by a political event, the private party is entitled to 110 percent of the equity it invested in the project. Anecdotal evidence also suggests that no matter the cause for termination governments might pay a premium on the equity to compensate the private party for the loss of expected return on its investment.

It is safe to assume that, in the event of project termination, the government loses the entire public equity. Based on all the considerations discussed, equation (2) can be written as follows, assuming three separate scenarios—low, medium and high—are considered for the loss given distress (LGD).

$$EL_i = PD_i\left(Debt_i LGD_{Debt} + Public\ Equity_i + Private\ Equity_i LGD_{Equity}\right) \qquad (5)$$

Scenarios:

1. Low: $LGD_{Debt} = 0.793$; $LGD_{Equity} = 0$
2. Medium: $LGD_{Debt} = 1$; $LGD_{Equity} = 1$
3. High: $LGD_{Debt} = 1$; $LGD_{Equity} = 1.5$

In the low scenario, the LGD on debt is assumed to be the recovery rate estimated by the Moody's Investor Service (2019). Assuming this, the government does not cover the loss of private equity, and only loses its own equity in the PPP. In the medium scenario, the LGDs on both debt and equity are assumed to be 1 such that the government guarantees the total financing of the project but does not compensate for the foregone return. In the high scenario, on top of the debt the

[17] The most recent Moody's infrastructure projects default study which covers the period from 1983 to 2017 which uses the data shows that 209 of the 1,970 PPP projects included in the data set are from the emerging markets and developing economies (Moody's Investor Service 2019).

government compensates the private party 150 percent of the equity it invested in the project in line with the aforementioned contract terms for India's road sector.

With 99 percent confidence, the maximum expected losses from early termination of PPPs in country c are the sum of the expected losses within the set of all active projects in the country, I_c, which is obtained by plugging equation (5) into equation (1).

4.4. Predicted fiscal risks from active PPPs in South Asia

4.4.1. Baseline

The fiscal risks from early termination of active PPPs are the highest in India, Pakistan and Bangladesh. Afghanistan and Bhutan have the lowest fiscal risks from early termination of active PPPs (table 3). The fiscal risks from early termination over the remainder of the contract periods of the PPPs ranges between $8.2 billion and $15.7 billion in India, $864 million and $1.6 billion in Pakistan, and $290 million and $563 million in Bangladesh. Even though Sri Lanka's current PPP portfolio is only about half the size of Bangladesh's portfolio in terms of the number of projects, and almost 50 percent larger than Nepal's in terms of total investments, the fiscal risk in Sri Lanka is less than one-sixth of the fiscal risk in Bangladesh and about 50 percent less than the estimates in Nepal. The main reason is that the PPPs in Sri Lanka have mostly passed 40 percent of their contract period, while the portfolios in Bangladesh and Nepal are younger.[18]

In most South Asian countries, about 37 to 50 percent of the fiscal risks from early termination of active projects is due to the risks of early termination during the 2020–2024 period. Nepal is the exception to this trend as the costs increase at a slower pace. The fiscal risk from PPP cancellations in 2020 in India is $677 million (8.2 percent of total fiscal risk) in the low scenario, while the fiscal risk that PPPs are canceled in the 2020–2024 period is about $3.1 billion (37 percent of total risks).

Table 3 Fiscal risks from early termination of public-private partnership portfolios of South Asian countries over different periods (in 2019 million US dollars)

	From the end of 2019 to the end of						
	Contract Period	2020	2021	2022	2023	2024	Number of Projects
Afghanistan							
Low	0.50	0.06	0.11	0.16	0.20	0.24	
Medium	1.14	0.14	0.26	0.37	0.46	0.55	2
High	1.39	0.17	0.32	0.45	0.57	0.68	
Bangladesh							
Low	290	38	71	101	125	147	
Medium	495	61	115	164	204	241	30
High	563	68	129	184	230	272	
Bhutan							
Low	4.11	0.35	0.69	1.01	1.32	1.62	1
Medium	5.32	0.45	0.89	1.31	1.71	2.10	

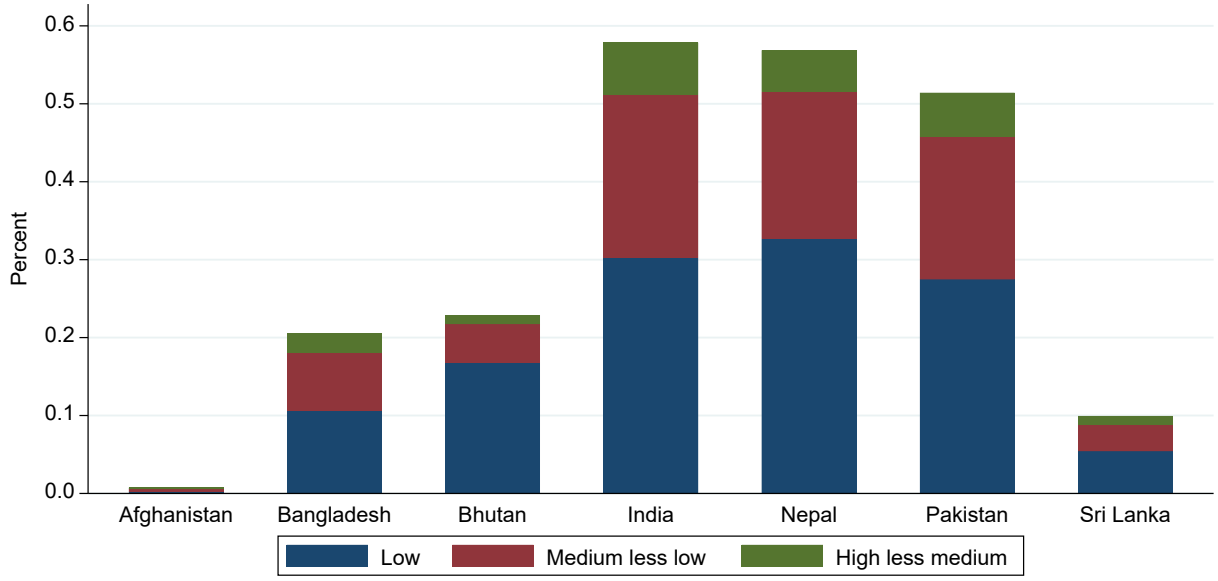
[18] Figure 6 depicts a decreasing hazard profile for projects past 20 percent of their contract periods.

High	5.59	0.48	0.93	1.37	1.80	2.21	
India							
Low	8,219	677	1,322	1,936	2,515	3,062	
Medium	13,913	1,144	2,235	3,272	4,251	5,176	848
High	15,727	1,292	2,524	3,695	4,801	5,845	
Nepal							
Low	95	7	13	19	24	28	
Medium	150	10	20	29	37	44	35
High	165	11	22	32	40	49	
Pakistan							
Low	864	76	151	222	288	349	
Medium	1,441	126	251	368	478	579	72
High	1,618	142	281	413	535	648	
Sri Lanka							
Low	48	5	9	13	17	21	
Medium	79	8	15	22	29	35	66
High	88	9	17	25	33	40	

Source: Authors' calculations.

The fiscal risks from early termination of active PPPs as a share of GDP are the highest in Nepal, India and Pakistan (figure 9). The fiscal risks for the entire lifetime of the PPP portfolio in Nepal range between 0.33 and 0.57 percent of annual GDP, in India between 0.30 and 0.58 percent, and in Pakistan between 0.27 and 0.51 percent. Bangladesh, Bhutan and Sri Lanka follow with fiscal risks from early termination of active PPPs ranging between 0.11 and 0.21 percent, 0.17 and 0.23 percent, and 0.05 and 0.10 percent of annual GDP, respectively. These estimates give an idea of the resources that would be needed in case of early termination of the PPP portfolio relative to the size of the economy.

Figure 9 Total fiscal risks from early termination of public-private partnership portfolios of South Asian countries, as percentage of GDP



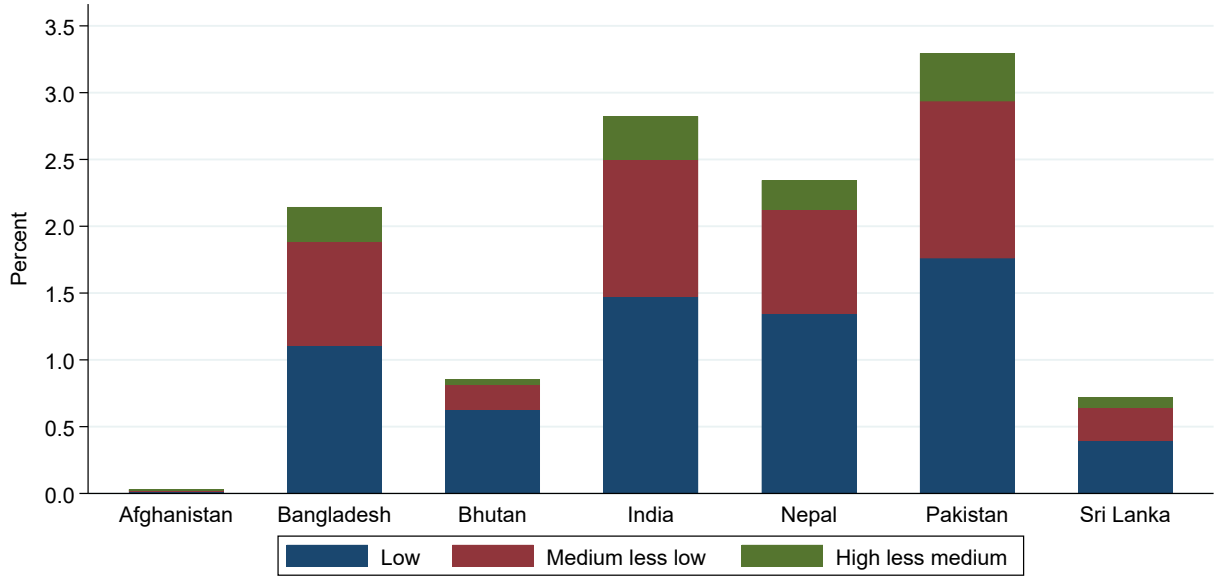
Source: Authors' calculations.

Note: Total fiscal risks are the maximum expected loss at the 99 percent confidence over the entire contract period and are expressed as percentage of GDP of a single year.

Pakistan faces the most significant fiscal challenge from early termination of PPPs in South Asia, largely because of its low revenue mobilization capacity. South Asian governments are quite different in terms of their revenue mobilization capacity, which helps determine their ability to absorb the fiscal costs from early termination of PPPs in infrastructure. The Government of Bangladesh's revenues represent only 9.6 percent of GDP, the Government of Pakistan's revenues represent 15.6 percent of GDP, while the Government of India's revenues represent 20.5 percent of GDP.[19] Pakistan's fiscal risks represent just below 3.3 percent of the government's annual revenues. Even though Bangladesh's fiscal risks are low, relative to the size of its economy, they are significant compared to the annual government revenues (figure 10), posing a significant fiscal challenge to the country, if only the revenues of a single year are available to absorb the costs of early termination of PPPs.

[19] As of 2017, from World Revenue Longitudinal Data (WoRLD), available at http://data.imf.org/?sk=77413F1D-1525-450A-A23A-47AEED40FE78.

Figure 10 Total fiscal risks from early termination of public-private partnership portfolios of South Asian countries, as percentage of annual government revenue



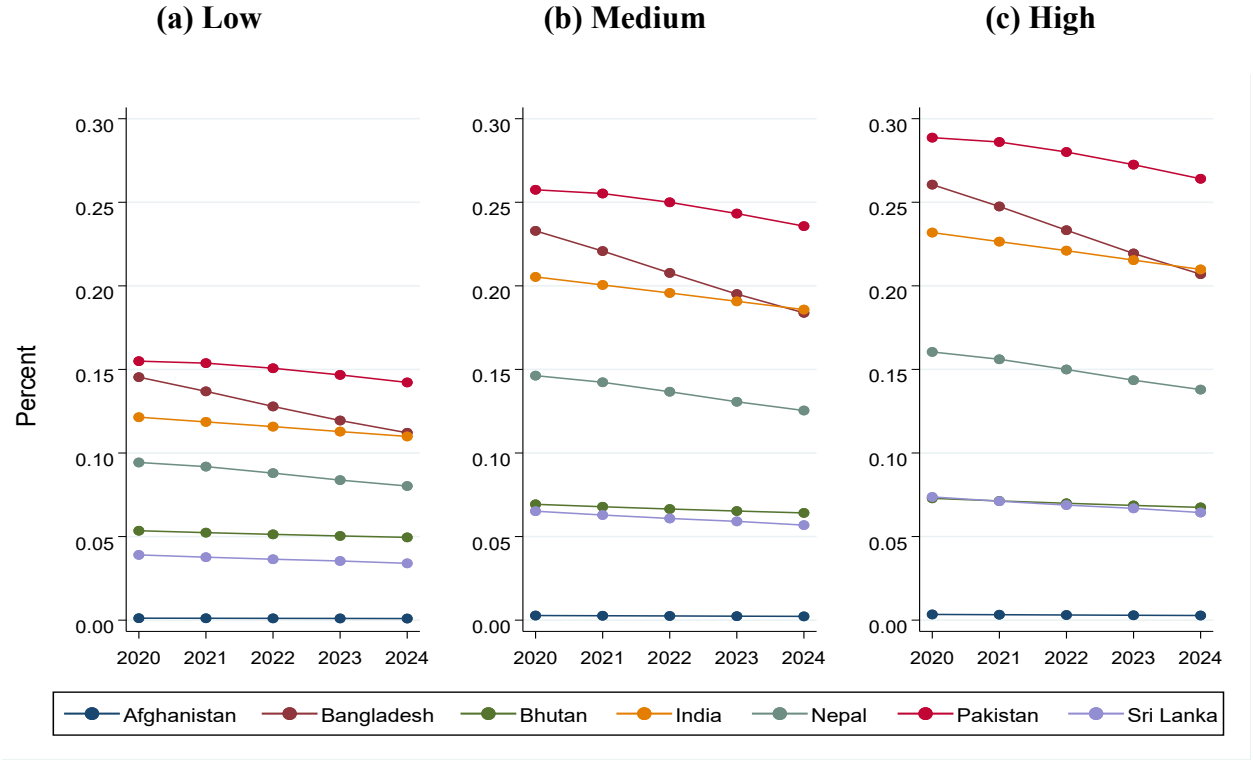
Source: Authors' calculations.

Note: Total fiscal risks are the maximum expected loss at the 99 percent confidence over the entire contract period and are expressed as percentage of government revenue of a single year.

The probability that an entire PPP portfolio is terminated in a single year is very low, hence a more realistic analysis is to compare the fiscal risks over a period of time with an estimate of the government revenues over the same period of time. The fiscal risks from early termination of PPPs as percentage of government revenues tend to decrease over the 2020–2024 period. Figure 11 presents the fiscal risks for different periods, all starting at the end of 2019, as the ratio of government revenues of that period.[20] The fiscal risks decline for most countries because active projects get older and some reach the end of their contract periods.

[20] The analysis assumes that the annual government revenue during the period 2020–2024 is the same as in 2019.

Figure 11 Fiscal risks from early termination of public-private partnership portfolios of South Asian countries as a percentage of total government revenues



Note: Each data point represents the maximum expected loss at the 99 percent confidence from early termination of the public-private partnerships in the portfolio over the period starting at the end of 2019 and ending at the end of the corresponding year as a percentage of the total government revenue over the same period. The analysis assumes that annual government revenues as percent of GDP during the period 2020–24 remains the same as in 2019.

Source: Authors' calculations.

4.4.2. Adverse macro-financial shock

Multiple types of macroeconomic shocks have significant effects on the probability of early termination (table 3). The fiscal risks presented so far assume there will be no macro-financial shock such as depreciation of local currency or a stress in the banking sector.

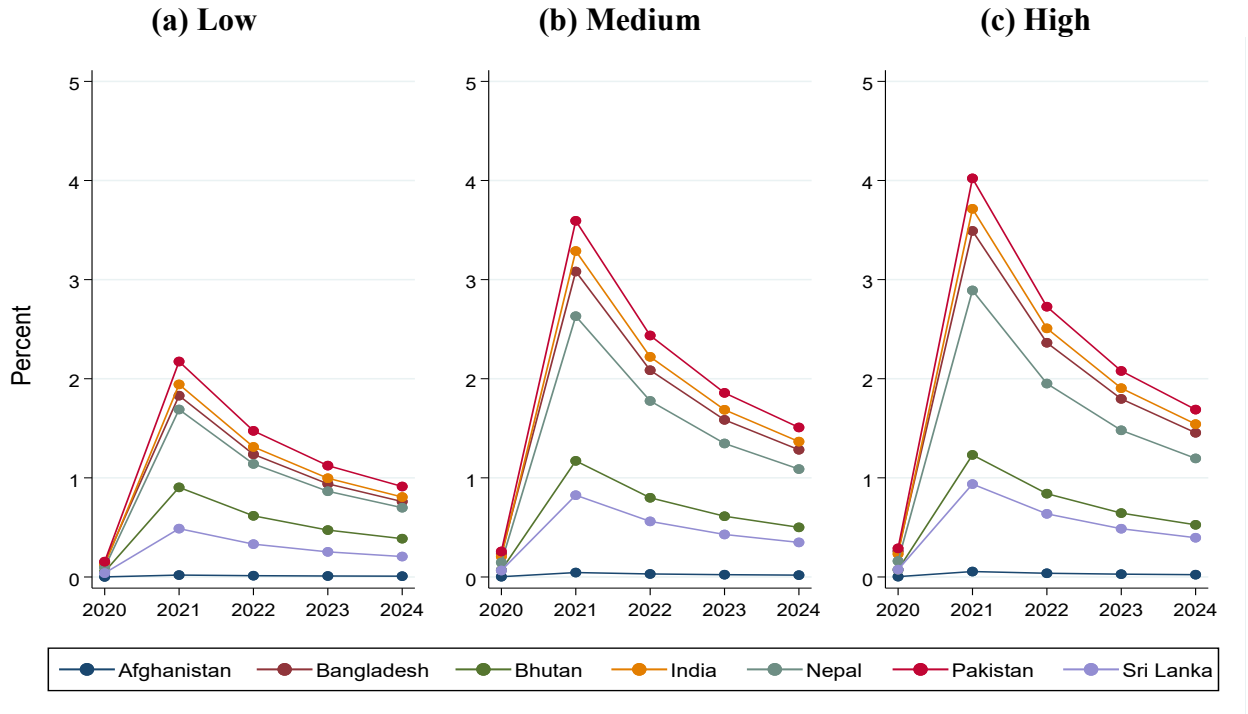
This section simulates the results of a macro-financial shock. The Systematic Banking Crises data set of Laeven and Valencia (2018) identifies 104 banking crisis episodes among the countries included in the PPI data set, out of which 13 also involved both sovereign debt and currency crises. In the episodes of banking, debt and currency crises, the maximum yearly deviation in depreciation rate from its long-run average ranged between 15.1 and 116 percentage points with an average of 48.3 percentage points.[21] The simulation assumes a 48.3 percentage-point depreciation shock,

[21] The statistics exclude two episodes in Ecuador because the adjusted currency conversion factor remained stable, even though the official rate of depreciation was 56.8 and 77.2 percent in the banking crises of early 1980s and the late 1990s, respectively.

occurrence of a banking and a debt crisis in 2020. [22] Such a profound macroeconomic crisis is similar to some crises in emerging and developing economies that led to early termination of many PPPs.

A profound macroeconomic crisis in 2020 would significantly increase the fiscal risks from early termination of PPPs, particularly in 2021. The fiscal risks over the 2020–2021 period can be as high as 4.0 percent of government revenues in Pakistan (figure 12). In Bangladesh and India, the fiscal risks over the 2020–2021 period could be as high as 3.5 and 3.7 percent of government revenues, respectively. In Nepal, early termination of PPPs could require up to 2.9 percent of the government revenues under a scenario of severe macro-financial crisis, while in Bhutan and Sri Lanka it could require around 1 percent of government revenues. These estimates underestimate the effect of the crisis because government revenues, which would contract in such a profound economic crisis, are kept constant.

Figure 12 Fiscal risks from early termination of public-private partnership portfolios of South Asian countries under a macro-financial shock, as a percentage of total government revenues



Source: Authors' calculations.

Note: Each data point represents the maximum expected loss at the 99 percent confidence from early termination of the public-private partnerships in the portfolio over the period starting at the end of 2019 and ending at the end of the corresponding year as a percentage of the total government revenue over the same period. The analysis assumes that annual government revenues as percent of GDP during the period 2020–24 remains the same as in 2019.

[22] The scenario abstracts from the sequencing of different macro events as all events are assumed to occur in the same year.

5. PPP contract design and early terminations of highway PPPs in India

PPPs in national highways in India experienced several early terminations between 2013 and 2015. Anecdotal evidence points to the incentives created by some contract designs as a potential reason for the early termination (ADB and others 2018; Pratap and Chakrabarti 2017). This section takes advantage of the existence of different contract designs for national highways PPPs in India during the early 2010s to identify contract features that can help explain the large number of early terminations. Narrowing the sample to national highways PPPs in India allows looking at contract features that are not available for the global and cross-sectoral sample used in previous sections. The analysis in this section can help improve the design of road PPPs and their contract structure as well as inform the design of PPPs in other sectors with similar incentive structures.

The analysis uses the national highway PPPs in India with financial closure or concession agreement years from 2010 to 2014 included in the PPI database. Out of the 125 projects with financial closure or concession agreement year between 2010 and 2014, 26 were canceled, and 24 of those cancellations occurred between 2013 and 2014. One cancellation occurred in 2015 as a result of a lengthy court process over the terms of termination after the project company decided to withdraw from the project in 2014. The timeframe allows comparing canceled projects with contemporaneous active projects.

Data on the investment amount, the project status, the length of the road to be constructed, and the data on financing mix were extracted from the PPI database. When the data for a project is missing in the PPI database, the data were collected from the concession agreements published on the National Highways Authority of India (NHAI) website, and in the case of financing data from online news articles or private sponsors' annual reports.

During this period, two types of PPP contracts were mainly initiated by NHAI: toll- and annuity-based projects. Toll-based projects entitled the project company to charge tolls, and annuity-based projects entitled the project company to semi-annual availability payments from the NHAI after the construction or rehabilitation of the road.

All contracts were awarded through competitive auctions. For toll-based projects, the outcome of the auction could be either an annual *premium payment* from the private sponsor to the government, which would escalate at 5 percent yearly, or an upfront *capital grant* from the government for the PPP project through the Viability Gap Funding—based on the expected profitability of the roads. Sponsors would bid either the highest premium they would pay or the lowest capital grant they would require. For annuity-based projects, the sponsors would bid the lowest annuity payments they require.[23]

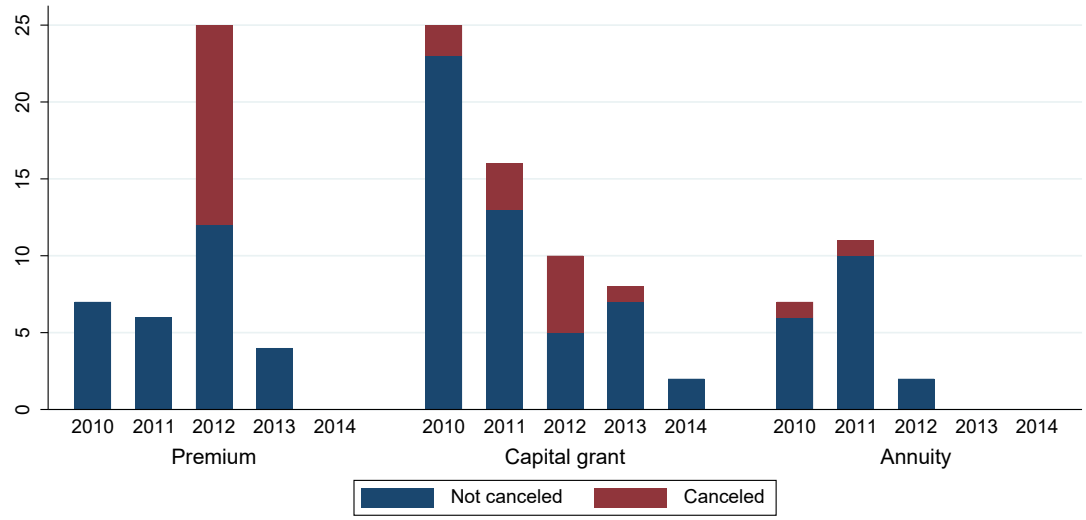
The procurement process ends in three types of contracts each of which presents a different set of risks. While both types of contracts for toll-based projects expose the project company to demand

[23] In the chosen timeframe, there were only two projects which did not adhere to these two schemes. The first is a project which was awarded on the basis of payment of a percentage of toll revenues. The second is a hybrid annuity project which entitled the project company to both availability payments and a capital grant. The hybrid annuity model became the preferred method more recently. Both projects were excluded from the analysis.

risk, *capital-grant* contracts alleviate the financing risk. *Annuity-based* contracts insulate the project company from the demand risk, but the company is still exposed to the full financing risk.

In 2012, an unusually high number of PPP contracts were awarded based on *premium payments* and about half of them were canceled (figure 13). The data shows that this increase occurred partly because of a decrease in the development of annuity-based projects by the NHAI after 2011 and the bidding behavior of private sponsors. The decrease in the capital-subsidy contracts indicates that private sponsors were more optimistic about the projects offered in 2012 compared to the earlier toll-based projects.

Figure 13 Number of national highway public-private partnership projects in India by cancellation status, contract type and financial closure year



Source: PPI Database and National Highways Authority of India.
Note: Concession agreement year is used if financial closure had not been achieved by the time of cancellation.

To assess which contract features could be associated with cancellations, the following equation is estimated using the maximum likelihood method:

$$Canceled_i = f(\beta_0 + X_{i,proj}\beta_1 + u_i) \quad (7)$$

where the dependent variable is the event of cancellation, $f(.)$ is the logistic function, and $X_{i,proj}$ are project-specific variables.

The contract characteristics are introduced in the regression in three different ways. First, they are introduced as indicator variables for each type of contract in columns (1) through (3) in table 4. Second, the net present value (NPV) of payments to the government is introduced as a continuous indicator of the net cost of the contract to the sponsor in columns (4) through (6).[24] Third, the net present value of payments is rescaled by the amount of investment in columns (7) through (9).

[24] Annual discount rate of 8 percent has been assumed.

Two additional variables are introduced in all cases: road length and fraction of the total investment financed by debt. The debt variable only applies to projects that secured financing.

The larger the tendered *premium payments* to the government, the higher the probability that national highway PPPs were later canceled. Similarly, the smaller the tendered payment from the government to the sponsor as capital grant or annuity payment, the higher the probability that national highway PPPs were later canceled. *Premium-payment* contracts are more likely to be canceled than *annuity-based* contracts when no other project characteristics are included (column 1). However, the relationship is not statistically significant when controlling for the length of the road (column 2). When using the net present value of the *premium payments* to government, either by itself or as a share of investment in the project, the coefficient turns again statistically significant—even when controlling for road length and fraction of the total investment financed by debt (columns 4–9). The findings indicate that as the sponsor and the project company's financial burden increases, the likelihood of cancellation of the project increases. Alternatively, the premium-based contracts may create an unsound incentive structure that encourages overoptimistic bids from the private sponsor to win the PPP contract in order to access funds which can be channeled to other connected construction companies.

Table 4 Logit regression estimates of likelihood of cancellation of India national highway public-private partnerships

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Base case: Annuity									
Capital grant	0.68	0.58	1.16						
	(0.82)	(0.83)	(1.37)						
Premium	1.40*	1.18	1.95+						
	(0.812)	(0.84)	(1.20)						
NPV of payments to government				0.003**	0.002*	0.002*			
				(0.001)	(0.001)	(0.001)			
NPV of payments to government as share of project investment							0.74**	0.54+	0.92*
							(0.36)	(0.37)	(0.50)
Road length (log)		1.20**	2.219***		0.978*	1.93**		1.14**	2.10**
		(0.49)	(0.823)		(0.53)	(0.90)		(0.50)	(0.83)
Debt financing share of project investment			9.302*			8.98*			8.923*
			(5.271)			(4.62)			(4.73)
Constant	-2.20***	-7.68***	-20.54***	-1.42***	-5.93**	-17.62***	-1.31***	-6.65***	-18.39***
	(0.75)	(2.43)	(6.06)	(0.24)	(2.48)	(5.66)	(0.23)	(2.37)	(5.48)
Observations	123	123	109	123	123	109	123	123	109

Source: Authors' calculations.
Note: Standard errors in parentheses. $^{+}$ $p < 0.15$, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

The likelihood of cancellation increases with the share of the investment financed through debt. This finding is important from a fiscal risk perspective as roughly 80 percent of the debt to finance

the NHAI portfolio has come from public sector banks in which the government owns more than 50 percent of capital shares. The large number of cancellations in the NHAI portfolio have contributed to the rising number of nonperforming assets in India's banking sector. The State Bank of India, which holds the greatest nominal amount of Indian highway-related debt, reported that about 20 percent of loans to ports and highways were in nonperforming status by the end of 2016, with the trend increasing in 2016 (ADB and others 2018).

The likelihood of cancellation increases with the length of the highway. The finding that longer highways are more likely to be canceled is consistent with the observation that many of the cancellations have been related to the government having problems with securing the right of way.

6. Concluding remarks and policy recommendations

The fiscal risks from the current infrastructure PPP programs in South Asia are not negligible for some countries. Under a severely adverse scenario, the fiscal risks from early termination in 2020–2021 amount to 2.9-4.0 percent of the government revenues in Bangladesh, India, Nepal, and Pakistan. The pipeline of PPP projects in South Asia is quite large, particularly in Bangladesh, which has the same number (30) of infrastructure projects in the pipeline as it has active projects. Such an expansion of the PPP program can lead to a significant increase in fiscal risks. Therefore, an important agenda in South Asia is improving the design and management of infrastructure PPPs to mitigate the corresponding fiscal risks while ensuring financially responsible and timely implementation of infrastructure protects to address the infrastructure deficit.

The analysis identifies five overarching lessons from the global PPP data. First and foremost, several factors that increase the risk of early termination of PPP projects are related to the financing risk of the project. Governments may alleviate some of the financing risk of PPPs by providing support through capital grants, revenue subsidies or in-kind transfers, which lead to reduced rates of early termination. Second, the sector in which a PPP project operates, and the size of a project, in terms of its physical investment, matter in evaluating riskiness of a project. PPPs in the power and seaport sectors are less likely to experience early termination than PPPs in the other infrastructure sectors analyzed. Large physical investments lead to increased rates of early terminations. Third, delegating PPP contracting and monitoring to state and local governments should be considered when it is institutionally and economically possible because PPPs show lower probability of early termination when they are contracted and monitored by state and local entities. Fourth, PPPs tend to have reduced rates of early termination when the contract is executed in a country with stronger constraints on executive power. Fifth, macro-financial shocks are an important cause of early termination of PPPs, highlighting the importance of macroeconomic management in enabling sustainable funding and financing of PPP projects.

In India, contractual obligations that put the private sponsor under large financial commitments are associated with a higher chance of early terminated national highway PPPs. Namely, PPPs for national highways were more likely to terminate early if the contract put the private sponsor under larger financial commitments through higher premium payments to the government, or lower capital grants or annuity payments from the government. The reason behind this result could be exposure to demand risk and a perverse incentive structure that encourages overoptimistic bids on

payments to the government in order to win tenders on PPP contracts that will be financed with loans from state-owned banks with weak due diligence capacity.

Government capacity to prepare, procure, and manage PPP projects must be built to ensure that the expected efficiency gains are indeed achieved and that the fiscal risks from contingent liabilities are contained and properly managed. Good practices on preparation, procurement, and management of PPPs can help governments improve their capabilities to take advantage of PPPs at more acceptable levels of risks (World Bank 2019). An important good practice is to ascertain the fiscal implications of PPPs, including their budgetary, accounting, and reporting treatment, and to task the Ministry of Finance or central budget authority with approving the long-term financial implications of the project (World Bank 2019).

Given the complexity, magnitude, and inherently long-term nature of PPP projects, the procuring authority should exercise a good amount of due diligence and perform rigorous assessments to gauge the viability of infrastructure projects before deciding on a PPP procurement. A sound PPP preparation starts with the identification of potential infrastructure projects that could be procured as PPPs. Based on the results from the econometric analysis, it is important to undertake feasibility studies to inform the structure of the PPP project, including assessing and deciding on the allocation of risks, and sounding out the market to gauge its appetite and capacity, which can reduce the probability of early termination.

The success of project implementation will determine whether the project delivers the expected value for money and whether fiscal risks have been properly managed. Following established good practices, modification and renegotiation of the contract should be expressly regulated to lower the incentives to use these changes opportunistically by either the private partner or the procuring authority. Specific circumstances—force majeure, material adverse government action, change in the law, refinancing—that may arise during the life of the contract should be also expressly regulated, and dispute resolution mechanisms should be in place allowing the parties to resolve disputes in an efficient and satisfactory manner without adversely affecting the project (ADB and others 2018). Giving lenders step-in rights for cases when the private partner is at risk of default or if the PPP contract is under threat of termination for failure to meet service obligations is another good practice to avoid early termination and reduce the fiscal risks. Having well-defined grounds for termination of the PPP contract and its associated consequences can also reduce fiscal risks from early termination (World Bank 2019).

Appendix A Econometric Model

The analysis uses flexible parametric proportional hazards model proposed by Royston and Parmar (2002). The specification assumes that log cumulative hazard is linear in covariates and the restricted cubic spline functions:

$$\ln H(t|\boldsymbol{X_{it}}) = \gamma_0 + \sum_{m=1}^{M} \gamma_m z_m(\ln t) + \boldsymbol{X_{i,proj}\beta_{proj}} + \boldsymbol{X_{it,inst}\beta_{inst}} + \boldsymbol{X_{it,macro}\beta_{macro}} \quad \text{(A1)}$$

The restricted cubic spline functions are:

$$z_1(\ln t) = \ln t$$
$$z_m(\ln t) = (\ln t - k_m)_+^3 - a_m(\ln t - k_{min})_+^3 - (1 - a_m)(\ln t - k_{max})_+^3 \ \ for\ m > 1$$

where k_m are the interior knots, which are picked at the centiles of the uncensored log event-time distribution, and $a_m = (k_{max} - k_m)/(k_{max} - k_{min})$. Then, the likelihood function is

$$L(\boldsymbol{\gamma}, \boldsymbol{\beta}) = \prod_{j=1}^{N} \frac{S(t_j|\boldsymbol{X_j\beta}, \boldsymbol{\gamma})}{S(t_{j0}|\boldsymbol{X_j\beta}, \boldsymbol{\gamma})} \left[h\left(t_j|\boldsymbol{X_j\beta}, \boldsymbol{\gamma}\right)\right]^{d_j} \quad \text{(A2)}$$

where *j* denotes each observation used in the analysis. The number of observations in the estimation sample is the number of project-years because the time-variant variables are all annual. The variable t_{j0} denotes the beginning of the period for a specific observation ending at time t_j, during which the covariates remain constant at X_j. The variable d_j equals 1 if the project goes into distress at time t_j, and $d_j = 0$ if the project survives time t_j.

To estimate the probability of distress at a specific interval (t_0, t), the survival function $S(\cdot)$ and the hazard function $h(\cdot)$ can be restated in terms of $\ln H(t|X_{it})$ in equation (A1) using the relations

$$S(t|\boldsymbol{X_{it}}) = \exp(-\exp(\ln H(t|\boldsymbol{X_{it}}))) \quad \text{(A3)}$$

$$h(t|\boldsymbol{X_{it}}) = \frac{d}{dt}\exp(\ln H(t|\boldsymbol{X_{it}})) \quad \text{(A4)}$$

Then, after obtaining γ and β, the probability of distress for any period (t_0, t) for any project i can be recovered using the relationship between the survival and the cumulative hazard functions:

$$\hat{S}\left(t_j|\boldsymbol{X_{it_j}}\right) = \exp\left(-\exp\left(\ln \widehat{H}\left(t_j|\boldsymbol{X_{it_j}}\right)\right)\right) \quad (A5)$$

$$\hat{S}_i(t|t_0) = \prod_j \frac{\hat{S}\left(t_j|\boldsymbol{X_{it_j}}\right)}{\hat{S}\left(t_{j0}|\boldsymbol{X_{it_j}}\right)} \quad \text{(A6)}$$

where j is any observation for project i such that $\left(t_{j0}, t_j\right) \subseteq (t_0, t)$. Then, the probability distress between (t_0, t) can be written as:

$$\widehat{PD}_i = 1 - \hat{S}_i(t|t_0) \quad \text{(A7)}$$

Appendix B Variable Definitions

Project level variables:

- Distress: Equals 1 if project is canceled, 0 otherwise. A project is canceled if the private party has exited by selling or turning over its shares back to the government, or by ceasing operations, from the PPI database and authors' collection.
- Contract period: Percentage of contract period elapsed until distress as defined in previous bullet, otherwise until the end of 2018, from the PPI database and authors' collection.
- Type: *Greenfield* if the special purpose vehicle (SPV) builds and operates a new facility, *brownfield* if the SPV takes over an existing asset and either rehabilitates or expands it, *management and lease* if the SPV takes over the management of the public asset while the ownership and investment decisions stay with the government, from the PPI database.
- Sector: *Electricity*, *natural gas*, *telecom*, *airports*, *railroads*, *toll roads*, *seaports*, *treatment plants*, *water utility*, from the PPI database.
- Direct government support: Equals 1 if capital, revenue or in-kind subsidies exist, 0 otherwise, from the PPI database.
- Indirect government support: Equals 1 if payment, debt, revenue, etc. guarantee exist, 0 otherwise, from the PPI database.
- Multilateral support: Equals 1 if a multilateral bank provides financial support, 0 otherwise, from the PPI database.
- Subnational government contract: Equals 1 if local or provincial/state government grants the contract, 0 otherwise, from the PPI database and authors' collection.
- Physical investment: Total investment in physical assets, in 2019 billion USD, from the PPI database and authors' collection.

Macroeconomic variables:

- Annual GDP per capita growth rate (detrended, previous year): Annual GDP per capita growth rate of the country detrended and demeaned using the filter suggested by Hamilton (2018). Previous year's value. Calculated using the "GDP per capita growth (annual %)" from the WDI.
- Annual Depreciation (detrended, previous year): Depreciation rate of the local currency against US dollar, detrended and demeaned using the filter suggested by Hamilton (2018). Previous year's value. Calculated using the "DEC alternative conversion factor (LCU per US$)" series, from the WDI.
- Banking Crisis Occurred (previous year): Equals 1 if a systematic banking crisis occurred in the country during the previous year, 0 otherwise, from Laeven and Valencia (2018).

- Debt Crisis Occurred (previous year): Equals 1 if a debt crisis occurred in the country during the previous year, 0 otherwise, from Laeven and Valencia (2018).
- Exchange Rate Crisis Occurred (previous year): Equals 1 if an exchange rate crisis occurred in the country during the previous year, 0 otherwise, from Laeven and Valencia (2018).

Institutional variables from the Polity IV Project:

- Executive Recruitment Concept: Index of openness of executive recruitment. Ranges from 1=Succession by birthright to 8=Competitive election. Values for interruption, interregnum and transition periods have been recalculated using interpolation.
- Executive Constraints Concept: Index of the degree of constraints on the executive. Ranges from 1=Unlimited authority to 7=Executive parity or subordination. Values for interruption, interregnum and transition periods have been recalculated using interpolation.
- Political Competition Concept: Index of degree of competition in politics. Ranges from 1=Suppressed to 10=Institutional electoral. Values for interruption, interregnum and transition periods have been recalculated using interpolation.

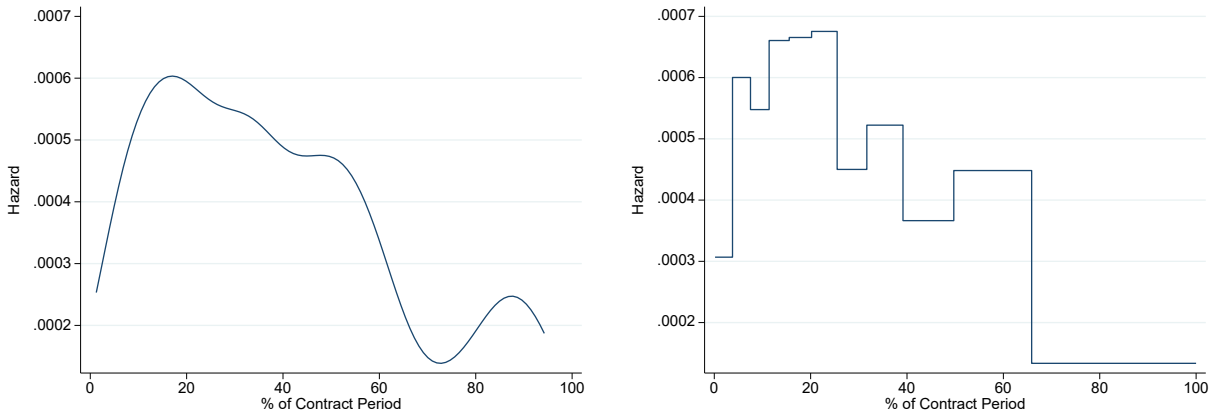
Appendix C Model Selection

The model selection in the context of survival analysis is to choose the correct parametric model for the purposes of the study. This study estimates a non-traditional model—a flexible parametric model—rather than one of the usual out-of-the box models using distributions such as the Weibull or the loglogistic models. The main reason is that the regular parametric models fail to fit the pattern of the baseline hazard function in this study. The baseline hazard is defined in this study as the hazard profile of the project for which all the dummies are at their base cases, all shocks are set to zero and all other continuous variables are set to their means.

To get an idea about the baseline hazard profile, a semi-parametric Cox model can be fit, and the baseline hazard can be extracted as a residual. Alternatively, the total contract period of the project can be partitioned based on the centiles of distresses, and assuming that hazard is constant within each partition, a step function that would indicate the hazard profile over the contract period of a project. Figure C.1 shows the resulting baseline hazard profile using the two methods.

Figure C.1 Baseline hazard profile estimates using semi-parametric methods

a. Cox regression **b. Constant hazard with time dummies**



Source: Authors' calculations
Note: Panel a uses Gaussian kernel and optimal bandwith. Panel b uses 11 interior knots.

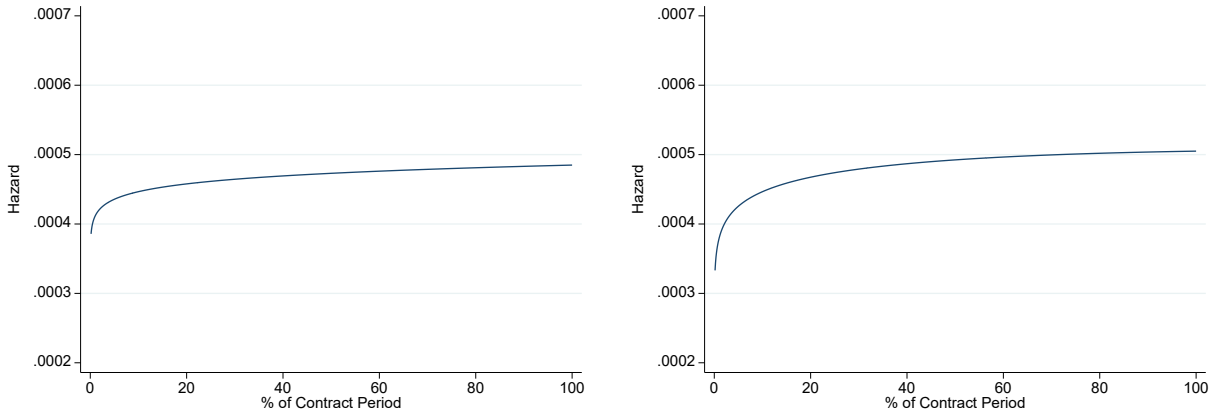
Figure C.1 shows that the baseline hazard must be increasing and then decreasing around 15 to 30 percent of the contract period. The overall shape of the baseline hazard function does not differ drastically compared to the non-parametric estimation of the overall hazard presented in the text. However, observe that the baseline is scaled down to some extent. The parametric model chosen needs to be able to reasonably replicate the major characteristics of these curves.

Two of the common specifications for the baseline hazard are Weibull and loglogistic functions. These models are known to have proportional hazards and proportional odds properties, respectively. When the model is fit using Weibull and loglogistic hazard functions, the resulting estimates of the baseline hazard function are monotonically increasing, neither of which captures the unimodal concave aspect of the baseline hazard captured using the semi-parametric methods

(see figure C.2). This result is potentially due to the fact that the sample overrepresents projects in the early stages of their contract periods, and the models, in their attempt to fit the data, under-penalize the lack of fit in the later stages.

Figure C.2 Baseline hazard profile estimates using parametric methods

a. Weibull **b. Loglogistic**

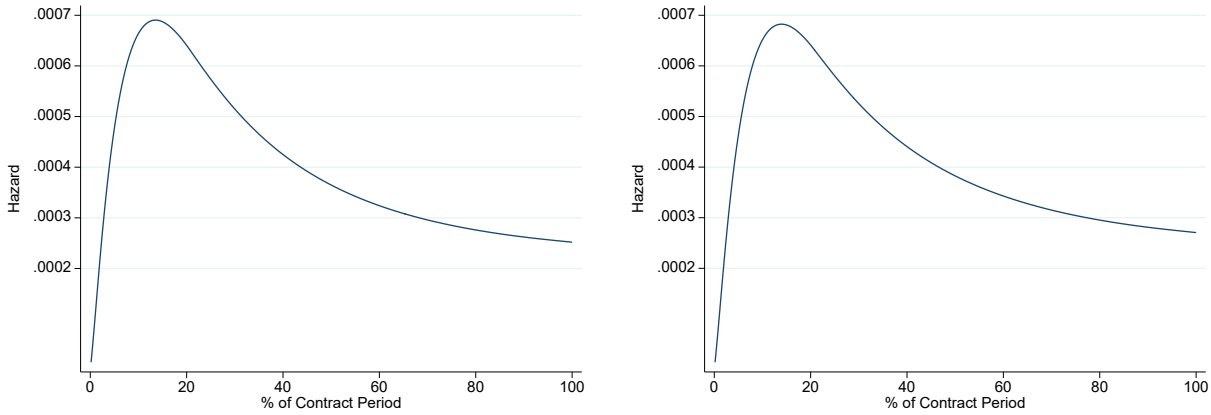


Source: Authors' calculations

Royston and Parmar (2002) provide generalizations of the parametric survival models using Weibull and loglogistic functions. These models partition the analysis period into multiple periods and using restricted splines make the relationship between the strict functional forms of Weibull and loglogistic functions and the analysis period more flexible. The underlying distributions are no longer Weibull or loglogistic but their proportionality properties are preserved. Hence, the flexible models are characterized by the property and the degree of freedom that they provide. Figure C.3 presents the baseline hazard functions using the flexible parametric methods with only a single interior knot, which means that two parameters are used in characterizing the baseline. Even introducing only one interior knot, the model captures the unimodal relationship implied by the semi-parametric methods in figure C.1.

Figure C.3 Baseline hazard profile estimates using flexible parametric methods

a. Proportional hazards: PH(2) **b. Proportional odds: PO(2)**



Source: Authors' calculations.
Note: The model uses one interior knot.

One can introduce more interior knots to obtain a better fit using the flexible parametric approach. Observe that the relationship can still be improved. However, this quest may result in overfitting the sample. To this end, flexible parametric proportional hazards (PH) and proportional odds (PO) models with different degrees of freedom have been fit and the Akaike information criterion (AIC) and the Bayesian information criterion (BIC) are used to select the appropriate model. Table C.1 shows the resulting AICs and BICs. Observe that the PH(2) yields the lowest AIC and BIC, so the analysis overall uses the PH(2) model. It must be noted that choice of the model does not have substantial qualitative or quantitative effects on the estimates.

Table C.1 AIC and BIC under different orders of flexible parametric methods

	PH(1)	PO(1)	PH(2)	PO(2)	PH(3)	PO(3)	PH(4)	PO(4)	PH(5)	PO(5)
AIC	1504.0	1510.7	**1483.4**	1492.6	1485.3	1494.5	1489.8	1497.1	1490.6	1499.8
BIC	1578.8	1585.6	**1561.4**	1570.6	1566.3	1575.5	1580.2	1584.4	1584.1	1593.3

Source: Authors' calculations.
Note: AIC = Akaike information criterion. BIC = Bayesian information criterion. PH = proportional hazards. PO = proportional odds.

Appendix D Imputing the Missing Values for Predictions

Physical Investment

The missing investments in physical infrastructure for small hydro projects in Sri Lanka and Nepal, and for the wind and solar energy projects in India were imputed by estimating the amount of investment needed per megawatt for the same type of energy projects in the same country. Hence, the imputations are obtained from the following regression:

$$Physical\ Investment_i = \beta \times Capacity_i + u_i$$

In the case of Sri Lankan small hydro projects, 41 observations were used to impute three missing values. In the case of Nepalese small hydro projects, 22 observations were used to impute four missing values. In the case of Indian wind projects, 91 observation were used to impute four missing values. In the case of Indian solar projects, 97 observations were used to impute one missing value.

Debt to Physical Investment Ratio

To obtain the estimates for the missing financing variables, debt and equity, the debt to physical investment ratio has been predicted using type, sector, country and financial closure year dummies.

$$Debt\ to\ Physical\ Investment\ Ratio_i = \beta_0 + Type_i + Sector_i + Country_i + Financial\ Closure\ Year_i + u_i$$

where i represents each project in South Asia. With this equation, 737 observations have been used to impute 344 missing values. The physical investment has been apportioned according to the predicted ratio between debt and equity.

Contract Period

There are four kind of projects which have been identified as missing contract period information: energy projects, airport projects, seaport projects, and toll road projects in India. The missing contract periods were imputed using the following regression and were rounded to the nearest integer.

Energy projects in South Asia

$$Period_i = \beta_0 + Type_i + Country_i + Financial\ Closure\ Year_i + u_i$$

where i represents each energy project in South Asia. With this equation, 391 observations were used to impute 194 missing values.

Airport projects in South Asia

$$Period_i = \beta_0 + u_i$$

where i represents each airport project in South Asia. This regression essentially finds the average contract length for airport projects without any predictors. The choice of the model is due to sample limitations. Eight observations were used to impute three missing values.

Seaport projects in South Asia

$$Period_i = \beta_0 + Type_i + Financial\ Closure\ Year_i + u_i$$

where i represents each toll road project in India. With this equation, 53 observations were used to impute one missing value.

Toll road projects in India

$$Period_i = \beta_0 + Type_i + Financial\ Closure\ Year_i + Subnational_i + u_i$$

where i represents each toll road project in India. The inclusion of the subnational contract indicator is due to the differences in the handling of contracts between the National Highways Authority of India and the state highways authorities. With this equation, 393 observations were used to impute 14 missing values.

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