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Effects of Contract Governance on Public Private Partnership (PPP) Performance

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Abstract

Using the basic instruments of governance as highlighted in the transaction cost economics literature, this paper empirically examines the impact of differences in contract attributes on project outcomes. The hypothesis is to test whether better incentive structure and stricter administrative controls lead to more efficient project outcomes. It compares two sets of contracts (called as toll and annuity) from Indian PPP road projects which are designed for the same task and implemented under the similar conditions, but have some differences in the contract governance attributes. It carries out this exercise using data from more than 150 projects. The empirical findings highlight how instruments of governance influence the degree of efficiency in achieving the desired results. For instance, the annuity model, that has tighter budget constraint (i.e. better incentive structure) than the toll model, performs better in terms of minimizing cost and time overruns. Moreover, the results demonstrate that changes in administrative controls also influence outcomes. Stricter the control, better is the efficiency in the desired outcomes. The empirical findings could be useful to the policymakers for designing better contracts for the road as well as other infrastructure related sectors.

Keywords: Contracts, Transaction Cost Economics, Road sector, Public Private Partnership, India

JEL Code: K12, D23, R42, L33, C20

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1. Introduction

Contractual governance structure is the rules of the game for the contractual relationships. To explain how and why various types of contractual governance structure exist, the Transaction Cost Economics (TCE) takes transactions as a unit of analysis (Williamson, 1998). According to TCE, transaction can be carried out within one of the three governance institutions i.e. markets, firms or hybrid (i.e. long term contracting). The choice of the governance structure depends on the attributes of the transactions, such as how frequent transaction recurs, how much uncertainties and complexities involved, and does it require any dedicated investments or resources (i.e. asset specificity) to complete the transaction (Williamson, 1985). The TCE argues that a complicated transaction (like procuring a customized technical tool), which also requires dedicated assets, would less likely to take place in the market as compared to a simple transaction (like buying fruits). A complicated transaction is more likely to take place either within the firm or through the hybrid mode (also called long term contracting). The TCE draws most of its predictive contents from this premise.

Most of the empirical studies (e.g. (Barron & Umbeck, 1984; Joskow, 1987; Saussier, 1999) and many others[2]) testing TCE premises examine the relationship of attributes of the transactions (i.e. frequency, uncertainty, complexity and asset specificity) and the choice of governance structure (i.e. markets, firms and hybrid). These studies compare governance structures in relation to other, but never focus to examine them alone (Macher & Richman, 2008). This paper attempts to examine the governance structure of hybrid (i.e. long-term contracting). According to TCE, governance structure has four basic properties, i.e. incentive intensity, administrative controls, contract law and adaptation (Williamson, 1991, 1998). The objective of this paper is to examine empirically the impact of differences in the properties of contractual governance

[2] For a detailed survey of empirical research on TCE, please see (Shelanski & Klein, 1995) and (Macher & Richman, 2008).

structures on the final contractual outcomes. The focus is on evaluating the relative efficiency of different types of contracts in terms of their performance.

This exercise uses information from 157 contracts of the Indian public-private partnership (PPP) road projects. The PPP model under DBFO category is implemented through two kinds of contracts, i.e. *'Toll'* and *'Annuity'* contracts. Both sets of contracts have differences in terms of properties of governance structure. It is usually difficult to find a set up of two types of contracts coexisting under the same institutional environment, which makes this exercise more interesting.

With this backdrop, this paper examines the Indian PPP road contracts, in terms of, required efficiency for project outcomes. To achieve this, it analyzes the properties of contracts, and empirically tests them using the information of these contracts. This paper is organized as follows. First, it discusses TCE's instruments of governance for analyzing contracts' performance, followed by brief description of two types of contracts. Next, it examines both sets of contracts from TCE lenses. Further, it tests it empirically, followed by concluding this exercise.

2. Instruments of Governance and Project Performance

According to TCE, governance structures are of three types, i.e. markets, hybrids and hierarchy (i.e. firms). Market is the place where autonomous buyers and sellers can engage in the exchange at a negligible cost. Their identities are not important while transacting in the market. Hybrid is a long term contractual relationship to carry out a specific transaction. The transacting parties are autonomous. The contract between parties safeguards the parties from transaction specific hazards. Hierarchy (also called Firm) is the structure, where both buyers and sellers are from the same enterprise. Transactions are governed by the internal rules. Each type of the governance structure differs due to the intensity of instruments. These instruments are incentive intensity, administrative controls, adaptation and contract law (Williamson, 1996).

As Williamson (1991, 1999) describes that in the markets, incentive intensities and adaptation (of autonomous type) and contract law are very powerful, but administrative controls remain absent, whereas in the hierarchy it is opposite (see *Table 1*). However, in

the hybrid kind of governance structure (which comes in between of market and hierarchy), all the attributes play its role, and any change or difference can lead to different results. These attributes help to analyze the actual contracts, based on the efficiency parameters.

Table 1: Instruments of Governance Structure

	Governance Structure		
	Market	Hybrid	Hierarchy
Instruments			
Incentive Intensity	++	+	0
Administrative Controls	0	+	++
Performance			
Adaptation (Autonomous)	++	+	0
Adaptation (Cooperative)	0	+	++
Contract Law	++	+	0

++ = strong, + = semi-strong, 0 = week
Source: Williamson, 1999

The TCE suggests that each superior attribute leads towards more efficient outcomes, and it is more important for the hybrid type, as all the attributes contribute towards efficiency. While comparing two hybrid contracts of a similar kind, a contract with better incentive structure and stricter administrative controls is expected to give more efficient results. Since the PPP contracts are of the hybrid type of governance, and interestingly, India has two types of such contracts with differences in the attributes of each type, and it should produce different results. Hence, the hypothesis to test in this exercise is, does contractual attributes impact on the project outcomes[3].

The two other attributes are adaptation and contract law. Here, adaptation means the overall learning of the economy or sector and adapt the contracts accordingly. Over the period, Indian PPP contracts have also evolved, and around a decade back, the government of India adopted a standard format of contracts (for both types) called *Model Concession Agreement (MCA)*. This adaptation led to some changes in the attributes in

[3] For the road projects, the efficiency parameters are to minimize any time or cost overruns, and better quality roads. Details of these parameters are given in the next section.

both types of contracts, before and after the MCA, and this difference is mainly for the administrative controls.

A further analysis of changes in the administrative controls can dissect the actual impact of these changes within each contract types, and can provide more insights at the disaggregation level about impact of each attribute. Contract law is the legal support for the contracts. Since, both kinds of the Indian PPP road contracts are contemporary, so the contract law remains same for both kinds of contracts. Therefore, it would be difficult to assess the impact of contract law on the project performance in this study.

The TCE also recommends that transaction should be the unit of analysis, and it suggests three dimensions to look into transactions. These dimensions are frequency of transactions, uncertainties involved in those transactions and asset specificity. Asset specificity could be physical assets, human resources, site possessions or any such specificity required for the contract execution (Williamson, 1999).

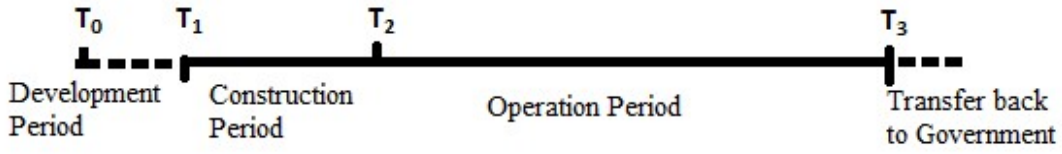
This analysis follows two-step process. The first step analyzes the contract structure of PPP contract, followed by examining the differences of incentive structure and administrative controls in both contract types, which are used as the instruments to compel the private players to achieve the desired outcomes.

3. Two Types of Contracts: Toll and Annuity

India adopted two kinds of PPP contracts for road projects, i.e. '*Toll*' and '*Annuity*' model, to engage private players. *'Toll'* model was chosen for those road stretches, which could be commercially viable due to high anticipated demand, whereas *'Annuity'* based projects are either low dense traffic roads or important for strategic or political reasons.

Both contract types come under BOT (Build-Operate-Transfer) category of PPP. It means private player has the responsibilities of building the road, operate and maintain it for a pre-specified time period (i.e. operation period), thereafter transfer it back to government. In both types of contracts, the responsibility of financing the construction and maintenance of the road remains with private player. The life-cycle of the PPP project is illustrated through the diagram below (see *Figure 1*).

Figure 1: Life cycle of PPP road project



A PPP contract is signed at time T_0 and each party gets a time period between T_0 and T_1 to complete all the formalities, arrange finances, obtain all the clearances and award sub-contracts for construction, auditing and safety consultants. The actual concession period (for which the contract holds) starts at T_1, when concessionaire commences the construction work. Only after completion of the construction work, i.e. at time T_2, concessionaire can enter into operation period and start earning revenue to recover its investments. At time point T_3, concessionaire hand over the project assets to the government.

3.1 Toll Model

In this model, private player has the rights of charging the user fee during the operation period to recover its investment. It, however, carries demand risk of the project as the demand for the road remains uncertain. But as mentioned above, *Toll* model was adopted for high anticipated demand roads to attract private players. The expectations about the demand plays crucial role for this model, right from the bidding stage.

The bidding parameter for this type of contracts is based on the maximum premium shared (or minimum subsidy asked) criterion. It means, the bidder, who pays the highest amount to the government (if all the bidders asking for subsidy, then whoever asks for minimum subsidy), wins the project contract. In this case, the bidding parameter doesn't depend on the project cost only; rather it includes expected revenue too.

Financial calculations for the bidding are based on various uncertain parameters such as inflation, growth of traffic for the whole project life cycle. It is discussed in detail in next sub-section. In case of any breach of contractual commitments, the government agency can penalize the private player, and can ask the concessionaire to pay the damages accordingly.

3.2 Annuity Model

In the '*Annuity*' model, after the completion of the road construction, the government agency (here, NHAI) pays a pre-determined amount annually to the private player during the operation period. In this model, the private player has no rights of charging user fee. The bidding criterion for this model is the minimum amount asked for the annuity payments. That means the bidder with the lowest annuity amount quoted wins the project contract, and gets paid that fixed annuity amount (irrespective of the actual traffic on the road) every year during the operation period.

In the *Annuity* model, for any breach of contractual commitments, the government agency has the right to deduct the damage payments from the annuity amount directly. Here, the government has more direct control on project cash flows.

4. Financial Flexibility and Uncertainty under Two Contract Choices

Both models have differences in the financial flexibility and certainty for the profit. Most crucial is the uncertainty of the actual traffic realization in the *'Toll'* model, which makes the total revenue flexible but unpredictable. It can have either high profit or even loss. On the other hand, the *'Annuity'* model has fixed revenue and cannot go beyond the cap of the awarded project cost. The financial calculation framework for the life cycle of PPP project under both contract types is given below.

$$Max.\ (\text{Profit}) = \text{Revenue - Cost} \quad \text{…. Eq. 1}$$

$$(Cost)^{(Ann./Toll)} = \sum_{k=1}^{n} C^k * Inf^k \quad \text{….Eq. 2}$$

where $C = Base\ Construction\ Cost$

$Inf = Inflation$

$n = No.\ of\ Construction\ Years$

$$(Revenue)^{Ann.} = \sum_{t=1}^{T} A_t \quad \text{….Eq. 3}$$

$$\because A_t = A \quad \forall\, t \qquad \text{where} \quad A = Annuity$$
$$= A * T \qquad\qquad T = Operation\ Period\ in\ years$$
$$= A^{max}$$

$$(Revenue)^{Toll} = \sum_{t=1}^{n} Y_t^e P_t \qquad \text{....Eq. 4}$$

$$\text{as} \quad P_t = P_{t-1} * Inf^{t-1} * F; \quad (0 < F < 1)$$
$$\text{where} \quad Y_t^e = Expected\ Traffic\ in\ year\ t$$
$$P_t = Toll\ Price\ Charged\ in\ year\ t$$
$$F = Inflation\ Index\ Factor$$

To maximize its profit, the private player will have to maximize its revenue and/or minimize the cost (see Eq. 1). Here, the revenue and cost depend on several parameters. In both models, the cost is dependent on the realized inflation and base construction cost (see Eq. 2). Inflation, here, is a random variable. Both models face the same factors related to the cost function.

On the other hand, for revenue, both models differ in terms of certainty. Revenue in *'Annuity'* model is fixed in terms of pre-determined annuities to be received throughout the operation period 'T'. For the complete project, it will receive the total amount of A^{max} (see Eq. 3). The *'Toll'* model has several variable factors, such as expected traffic (in other words, expected traffic growth rate), toll price and inflation during operation period, because in this model, toll price is indexed to inflation (as given in the formula above[4] - see Eq. 4). And if the operation period is also variable, then it adds further uncertainty for the final profit. The empirical results section will discuss the changes adopted in *'Toll'* model after *MCA*, where some variability in the operation period introduced. Effectively, the profit or revenue in *'Toll'* model depends on other parameters and susceptible to uncertainties.

[4] In the current set of *Toll* contracts, F is equal to 0.4 and inflation is WPI (wholesale price index).

Another major difference between both models is the net present value (NPV) of the cash flow. Since *'Annuity'* model has equal installments of payments, so the NPV of each payments decline with certainty, on the other hand, the NPV of cash flow under the *'Toll'* model is variable, and moves along with the traffic growth rate net the prevailing inflation rate. In the fast growing developing country like India, the traffic growth rate is expectedly high, which helps, at least, not to have lower NPV[5]. However, inflation can negate this effect up to an extent.

5. Contract Governance Analysis from TCE Lenses

Each PPP contract is a transaction between the government and the private player, and, it would be useful to first look into the broader contract arrangement of the PPP and analyze it as a transaction (sub-section 5.1), and then to examine the contract types, their attributes and its impact on project outcomes (sub-section 5.2).

5.1 PPP Contract as a Transaction

To analyze the transaction as unit of analysis, the TCE suggests three dimensions. These are frequency of transactions, uncertainties involved in those transactions and the asset specificity. With regard to frequency, in the PPP contracts, transaction happens only once, where the government specifies everything at the time of contract awarding[6].

As far as uncertainties are concerned, it can broadly be of two types, *endogenous* (uncertainties arising from within the project) and *exogenous* (uncertainties arising from outside the project). Usually, *endogenous* uncertainties (in other words, risks) should be assigned to those parties, who can bear them more efficiently. It can be managed by the contract attributes like incentive structure and administrative controls, which is discussed in the next sub-section.

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[5] A matter of fact is that *'Toll'* model is mostly chosen for those road stretches, which have high expected traffic and makes the project financially viable. *'Annuity'* model was chosen for less traffic dense road stretches, but required good quality roads.

[6] If there are any changes in the specifications, it has a set of rules to modify any specifications. Hence, the frequency does not seem to play any crucial role in this analysis

On the other hand, contractual parties should be protected reasonably from the *exogenous* risks. The Indian PPP contract attempts to guard the private player from such uncertainties like any changes in the law or policy or uncertainties from the political environment for the project execution, which can obstruct the parties to fulfill contractual commitments. Any non-fulfillment of responsibility by the government agency, which can have impact on the private player's profit or hinder to fulfill its commitments, there is a provision of compensation to the private party, and vice-versa.

The third dimension is the asset specificity, which implies the assets dedicated to the project. It works as prevention from any kind of *ex-post* exploitation or shirking away from the responsibilities by the private party[7]. In the Indian PPP case, commitment of the complete project finance (it is a sunk cost) by the private player works as asset specificity. Any violations or shirking away from responsibility can cost the entire investment for the private player. At the same time, the asset specificity also requires protection for the committing party, which should protect the interests of the private party from any kind *ex-post* exploitations. For that, there is a pre-defined set of responsibilities given to the government agency (i.e. NHAI). Interestingly, this contract does not have any renegotiation clause. Overall, the contract tries to minimize any gross level of *ex-post* contractual exploitations.

However, the attributes of the contract help to refine the contract conditions to achieve the desired outcomes. The next sub-section compares both the models (*Toll* and *Annuity*), which are different in their contractual attributes and discusses that these attributes can result in different outcomes for the above-said objectives.

5.2 Contract Attributes and their Possible Impact

Out of four attributes, it compares only *Incentive Intensity* and *Administrative Controls* in this sub-section, and the impact of adaptation is explored in the next sub-section. This analysis is carried out for each efficiency[8] parameter (Cost and Time overrun) separately.

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[7] Generally, asset specificity applied for both the contractual parties. But in PPP, Government being sovereign party, which by default can be considered a no-default party.
[8] Here, it is minimizing the inefficiency.

Incentive Intensity & Cost Overrun		
Annuity Model	*Toll Model*	*Remarks*
*Maximum revenue (in terms of Annuity) is fixed/capped; any cost overrun will be direct loss with the certainty; Financing of the extra cost will also be limited, as lenders may not be comfortable to finance given the cap on the revenue; Private player will try his hard to minimize overrun if any, so as to maximize its limited profit; *Bidding criteria is the minimum annuity payments asked ➢ Strong/Powerful Incentives	*Revenue is neither capped nor certain. It always based on the probability of future demand. If the expected future demand is high, then it will be easy to absorb any extra cost, and lenders will also not hesitate to finance such extra cost if it is within the permissible limits. In the Indian PPP set-up, only those projects are taken as *Toll* roads, where the expected demand is high and project seems to be viable. Hence, private player may not be very cautious about the cost overruns; *Bidding criteria does not ask to minimize cost, rather it is based on expected revenue ➢ Weak Incentive Structure	*Given the tight budget constraint (in the incentive structure), the *Annuity* model is expected to be more efficient in terms of minimizing the cost overruns. *In the *Annuity* model, bidding criteria also put extra pressure on the private player to minimize the cost
Administrative Controls & Cost Overrun		
*The Project cost is capped by Total Project Cost (TPC) written in the Contract. The NHAI will not pay any extra cost. Even in case of termination, the NHAI is bound	*Almost same as the *Annuity* Model	*According to the TPC definition[9], it is less likely that private player will quote the actual cost lesser than TPC in either model. Hence, even if there is cost saving, it

[9] TPC's definition is as follows: "Total Project Cost" means the lowest of the following: a) A sum of amount given at Contract Award; b) Actual capital cost of the project on completion of the project highway; or c) Total project cost as set forth in the Financing Documents

to pay only TPC.		will less likely to be reported to the NHAI. So, it will not lead to any *ex-post* redistribution of cost saving among the other stakeholders.
Incentive Intensity & Time Overrun		
Annuity Model	*Toll Model*	*Remarks*
*Loss of Revenue with certainty and high NPV; *Bonus for Early Completion, or will lose revenue for delay equivalent to exact to that much time; ➢ Strong/Powerful Incentives	*Loss of Revenue with uncertainty but with low NPV; *Early completion will get extra revenue for that period, or will lose revenue during delayed time period	*There is not big difference between the two models, but the *Annuity* model still has relatively higher incentive to keep the time overruns as minimum as possible.
Administrative Controls & Time Overrun		
*For delay, apart from loss of revenue, extra penalty provision.	*Almost same Penalty for delay, but slightly lower than the *Annuity* model	

5.3 Adaptation: Modified Standard Contract (Change in Regime)

In 2006, the Government of India made some changes in the PPP contract and adopted a standardized Model Concession Agreement (MCA). The main structure and content remained the same in this standard MCA, but it modified some contract attributes in terms of *incentive intensity* and *administrative controls*. The details of these changes are given in the table below.

Incentive Intensity & Cost Overrun		
Annuity Model	*Toll Model*	*Remarks*
*No Changes	*Cushioning of extended Concession Period, in case expected demand does not realize, but not directly linked to cost overruns	*MCA has given extra Concession Period to *Toll* model, which will fetch extra revenue to compensate the loss. It can also help to recover cost overrun (if any)
Administrative Controls & Cost Overrun		
*NHAI will recognize the actual cost as TPC (even if it is higher), and will not be capped by the Contracted TPC. Termination payment will also be the actual cost.	*Same as Annuity	*Given the recognition of actual cost and cushioning (*only for Toll*), it will be easier for the financing of the cost overruns, as the debt is protected in many of the worst situations including the termination. Private player may comparatively be less cautious about the cost overruns, even in the *Annuity* model too. However, in the *Annuity* model, the recovery of cost overruns in terms of extra annuity is only possible on the termination (*nothing mentions explicitly about extra annuities*). So, cost overrun is expected to be higher in the *Toll* model
Incentive Intensity & Time Overrun		
Annuity Model	*Toll Model*	*Remarks*
*No Major Change	*No Major Change (except cushioning of Concession Period)	*Cushioning can indirectly compensate the time lost in the overrun (only for the *Toll* model
Administrative Controls & Time Overrun		
*A standardized formula of penalty for delay, but the magnitude will relatively be low.	*Same as Annuity	*Given the leniency in the penalty, it could lead to more delay, however, the incentive structure should bind them to complete early. But, the clause of

*A clause of issuing Provisional Certificate on completion (PCOD) of 75% or first 50 Km stretch of road		issuing early PCOD, may give distorted picture of early completion. So results may be ambiguous.

6. Empirical Testing

The objective of this paper is to test empirically the impact of differences in attributes of contractual governance on final contractual outcomes. Though, it is difficult to find the variables matching to these attributes, hence, it uses the two contract types (*Toll* and *Annuity*) and regime change (*pre-MCA* and *MCA based contracts*) as proxies, because differences in the contract types reflect the differences in attributes, and, the varying intensities can be captured through latter variable due to change in regime.

6.1 Methodology

To measure the contractual outcomes, it takes two parameters, i.e. cost overrun and time overrun. These are taken because of the objectives of these contracts, that is to minimize cost overrun and time overrun. Cost overrun implies the extra cost over the contracted project cost. Similarly time overrun means the extra proportion taken for the construction of the road over the scheduled time duration as agreed in the contract.

The empirical testing follows two-step econometric procedure. The first step tests only the odds of presence of inefficiencies i.e. cost and time overruns due to the contract choice using LOGIT model. However, it has limitations to explain the magnitude of the differences. In order to measure the intensity of the impact of differences in contractual governance structure, and then further, impact coming from changes in contract structure while adopting MCA regime, it uses Difference-in-Difference (DiD) equation model.

In the econometric exercise, each inefficiency parameter (i.e. time and cost overrun) is tested separately. In the LOGIT model, the occurrence of cost or time overrun is taken as the presence of odds, whereas in DiD model, the actual overrun amount (normalized as a percentage of the expected value) in continuous form is taken.

Logit Model Specifications

$$logit(p) = \log\left(\frac{p}{1-p}\right) = \alpha + \beta * \mathbf{D_1} + \gamma * \mathbf{D_2} + \theta Zi + \boldsymbol{\epsilon} \qquad \ldots Eq.5$$

Where, p = prob (y =1 | Xβ)

For Cost Overrun:

$y_i = 1$ if project *i* actual cost is greater than 5 per cent of contracted cost

$= 0$ otherwise

For Time Overrun:

$y_i = 1$ if project *i* has taken more than 90 days beyond the actual construction time given to construct the road

$= 0$ otherwise

Difference-in-Difference Model Specifications

$$Y = \alpha + \beta D1 + \gamma D2 + \delta(D1 * D2) + \theta Zi + \varepsilon \qquad \ldots Eq.6$$

For Cost Overrun:

Y = Proportion of extra cost to the Total Contracted Cost

For Time Overrun:

Y = Proportion of extra time taken to the contracted Construction Period

Where,

Table 2: Independent and control variables name and description

Variable Name	*Description*
D1	Dummy for Contract Type; D1 (0=Annuity & 1=Toll)
D2	Dummy for Regime; D2 (0=Old Regime & 2=MCA Regime)
D1*D2	Interaction term between D1 & D2
Control Variables (Z_i)	
op_prd	Operation Period in years
constn_prd	Construction Period
concnprd	Total Concession (Contract) Period
length	Length of the Road Project
tpc	Total Project Cost of the Project as per Contract
Time	Year of Contract Awarding
qlt_ints	Quality Intensity (=TPC/length)
laning	Type of Road (in number of Lanes)

To examine the effect of the contract choice and the regime change, two dummy variables (D1 & D2) have been introduced. For D1, the control group is *Annuity* (i.e. D1=0) and the treatment group is *Toll* (D1=1). For D2, the old regime is the control group (i.e. D2=0) and the new (MCA) regime is the treatment group (i.e. D2=1).

The other possible explanatory variables are construction period, operation period, total project cost, year of the contract awarded, type and length of the road. Sum of construction period and operation period is the total concession period. The size of the project can be reflected through either project cost or the length of the project, but this will not necessarily reflect the true intensity of the project, because of the width of the road. According to NHAI, type of the road is classified on the basis of width, and these are called as 2 lane or 4 lane or 6 lane projects. In some cases, where terrain is very difficult, even a 2 lane road can have high total project cost. In order to measure the intensity, a variable called *qlt_ints* is derived. It is the per km cost of the project, and explains the quality intensity of the project. A few interaction variables using the dummy variables (D1 and D2) are also generated. A description of variables is given in the Table 2.

6.2 Expected Signs of Independent and Control Variables

6.2.1 Cost Overrun

According to the analysis above, the compelling budget constraint of the *Annuity* projects should perform better than the *Toll* projects in terms of minimizing cost overruns. With regard to the new regime, which is more lenient in accepting the cost overruns, and it also protects the lenders (up to a reasonable extent), in case of termination. However, if the project completes its tenure, *Annuity* project will still be facing hard budget constraint. Hence, the new regime may not have strong impact on the *Annuity* models.

The concession period, which is sum of the construction and the operation period, may influence the cost overrun in same or opposite ways depending on their length with regard to the feasibility of two different aspects. The construction period should be in proportionate to the size of the project, whereas the length of the operation period

depends on the commercial or financial viability of the project. Hence, it uses both the durations separately. For the cost overrun, the construction period may not directly influence, but, the length of the operation period (OP) is directly connected to the revenue period. Longer the OP, higher will be the chances to recover the cost (in both the models).

Time (i.e. the year of contract awarding) may signal the learning over the years, which is the indicator of learning by doing in order to reduce the cost overruns. However, Time can also signal about inflation during the construction period and can explain the cost overrun. However as the construction goes for more than a year, it can be considered a week proxy of inflation, and moreover, a long trend of inflation is usually factored in the expected cost calculations.

With regard to the quality intensity of road that means a higher quality roads, which can have more unexpected technical complications, can lead to cost overruns. For bigger projects, cost overrun in absolute terms could be high, but it may not necessarily be high as a proportion of total cost or cost per kilometer (i.e. quality intensity). Hence, the relationship between the quality intensity of the road and the cost overrun can take either direction.

6.2.2 Time Overrun

Given the relatively stricter and direct conditions about timely completion along with its financial impact, the *Annuity* projects should perform relatively better. However, both kinds of the projects face some external factor causing delay in the completion such as delay in land acquisition, environmental or other governmental clearances, which are exogenous in the econometric models.

With regard to change in regime, the MCA regime has given leniency to both types of contracts, which can result in time overruns. However, simultaneously, a new sub-clause of issuing PCOD (Provisional Commercial Operations Date)[10] on the completion of 75

[10] It is the certificate given to the private player as a proof of completion of construction stage, and to enter into operation stage.

per cent of construction work may reflect the early completion of the project work. In sum, it can have ambiguous impact on the time overrun.

Year of the contract awarding can influence time overrun, because in the early years clearances (such as environmental, forest railway and others) were very difficult and time consuming. However, over the period, it was standardized. But in the later years, land acquisition has become serious issue causing long delays to complete the projects. *A priori* it is difficult to expect a clear relationship.

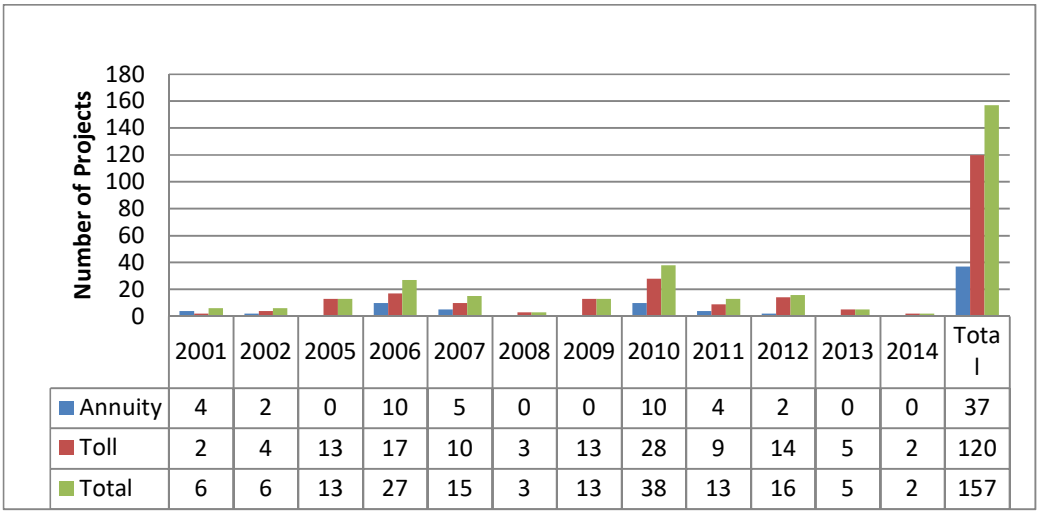
As argued above for the cost overrun, longer the operation period, higher will be the chances to recover the cost, even if the time overrun occurs particularly for the toll model. Under the new regime, operation period can be extended as a cushion to increase the financial viability of the project. However, the *Annuity* contract does not have any provision of extending operation period; therefore, the above said impact should be prominent for the *Toll* projects only.

If the road is high quality intensive with more complexities, it can result in time overruns.

6.3 Data Description and Summary Statistics

This empirical exercise uses the data from 157 PPP road projects under the NHAI. This data has been collated from original documents like the concession agreements, monthly progress reports of the concessionaire and independent engineers and project specific websites along with the NHAI's website. A chart describing year-wise distribution of 157 projects awarded across both types of contracts is given below (*see* Figure 2).

Figure 2: Year-wise PPP projects awarded



	2001	2002	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Annuity	4	2	0	10	5	0	0	10	4	2	0	0	37
Toll	2	4	13	17	10	3	13	28	9	14	5	2	120
Total	6	6	13	27	15	3	13	38	13	16	5	2	157

A brief descriptive statistics of the variables across the contract type and regime is given below (see *Table 3*).

Table 3: Summary Statistics of Contract Types across Regime

Variables (Means)	*Annuity*			*Toll*		
	Old Regime	MCA Regime	Total	Old Regime	MCA Regime	Total
No. of Projects*	20	17	37	46	74	120
Time Overrun (%)	17.7	14.8	17	39.1	27.8	34.6
Cost Overrun (%)	4.85	20.8	12.2	31	32.8	32
Construction Period (years)	2.4	2.9	2.6	2.56	2.45	2.49
Operation Period (years)	16.6	15.2	16	18.6	21.5	20.4
Length of Road (kms)	58.1	79	67.7	63	105.4	89.1
Project Cost (Rs. In Billion)	4.15	9.24	6.49	4.08	9.3	7.3
Quality Intensity (Rs. in Million/Km)	75.2	311	180	97	110	105
Type of Road (Number of Lanes)	4.1	3.4	3.8	4.3	4.1	4.2

Source: Compiled from NHAI

* The actual number of projects is given for this variable, not the mean.

Among the projects that are being analyzed (for the LOGIT model), 27 out of 118 projects, have already crossed the 90 days buffer period at the time of this analysis and these projects are still not completed. Therefore these 27 projects have been considered for LOGIT model, but cannot be included for the DiD time over run model. In the DiD model the percentage time and cost overruns are the dependent variables. The number of observations in the DiD model for the cost overrun is higher than the time overrun, because some projects are not completed, hence time overrun cannot be computed at this

stage for these projects, but their project cost have been revised, and accepted by the lenders and recorded in the project's financial documents.

6.4 Results

Results are summarized below.

6.4.1 Logistic Regression Results

Cost Overrun

Results from the LOGIT model confirms the predictions of the above analysis that the presence of '*Toll*' contract can lead to higher probability of the cost overrun, and it further increases in the MCA regime. In the '*Annuity*' model, where budget constraint is tighter, the probability of cost overrun is far lower, and it is further supported in the old regime case. The coefficients of main variables of interest are having high value with statistical significance. It shows that the better incentive structure can result in the more efficient outcomes (such as tighter budget constraint led to lower probability of cost overrun for *'Annuity'* model). The control variables do have impact on the likelihood of the cost overrun, but except the construction period, the coefficient values are relatively small, so have limited impact on the probability of the cost overrun. Interaction terms between the '*Toll*' dummy and the construction period; and the '*Regime*' dummy and the lane give more insights, that how under the '*Toll*' model, construction period has higher impact, similarly the case of breadth of the road under the new regime. It basically highlights that in the recent years broader roads are more likely to have cost overrun. Variables like length and quality intensity of the roads too impact on the cost overrun likelihood, but the magnitude is relatively low (see *Table 4*).

Table 4: Logit Model for Cost Overrun

	Model1	Model2	Model3	Model4
Dependent Variable: Presence of Cost Overrun (Dummy)				
_cons	-9.032**	-4.901+	-3.451*	-4.220*
D1	1.292*	1.578*	-7.594**	-10.12**
D2	1.330*	-8.129*	-4.019	1.762*
op_prd	0.0233	-0.0424	-0.0428	-0.0102
constn_prd	1.678+	0.486		
Tpc	-0.00416*	-0.00735**	-0.00677**	-0.00516**
qlt_ints	0.277+	0.461**	0.443**	0.364*
length	0.0264	0.0559**	0.0465**	0.0313*
laning	0.475			0.246
D2*laning		2.429**	1.471*	
D1*constn			3.750**	4.750**
N	114	114	114	114
pseudo R^2	0.179	0.223	0.254	0.237
chi2	18.55	24.21	38.23	30.49

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

Time Overrun

As expected, the odds of occurrence of time overrun is high in the '*Toll*' based projects. But, the regime has negative relation with the probability of the time overrun, which means, in the new regime, it is likely the projects to have lower time overrun. However, it may not be the true picture of the situation, because of change in the definition of time overrun. In the new regime, even completing the 75 per cent of work can get the certificate of completion. It means the early likelihood of completion may be due to change in the definition, not because of actual completion. A further analysis of this variable using the interaction term with the time (i.e. over the years) shows that in the new regime too, the probability of time overrun has increased over the period. The results of the dummy variables are in line with the expectations or the analysis carried out above. Other control variables (like the operation period, construction period or TPC) too have impact on the likelihood of the time overrun, but the value of coefficient is not so strong as compared to quantum of the '*Toll*' dummy (see *Table 5*).

Table 5: Logit Model for Time Overrun

	Model1	Model2
Dependent Variable: Presence of Time Overrun (Dummy)		
_cons	0.734	1.031
D1	2.751^{+}	2.878^{+}
D2	-6.205^{+}	-6.232^{+}
op_prd	0.152^{+}	0.150^{+}
constn_prd	-1.650*	-1.690*
D2*time	0.546^{+}	0.551^{+}
D1*laning	-0.499	-0.516
tpc	0.00149	0.00180^{+}
qlt_ints	0.00680	0.00112
length	0.00460	
N	114	114
pseudo R^2	0.148	0.147
chi2	15.95	16.51

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

6.4.2 Difference in difference (Level) Regression Results

Cost Overrun

To decipher the magnitude of the influence of explanatory variables on the cost overrun, it runs the level regression. As there are two dummy variables of interest, to dissect the differences of impact of each variable, it uses the Difference-in-Difference model. The econometric results confirm the hypothesis that the contract choice with tighter budget constraint performs better. The difference between the *Toll* and *Annuity* models is very clear and statistically significant, in which, the cost overrun is high in the *Toll* model (and statistically significant) and it is enhanced further in the new (*MCA*) regime (however, statistically not significant). And this result remains robust, even after controlling for other parameters of the projects. A diagnostic check highlights the issue of heterogeneity. The weighted least square (WLS) method is used to remove the heterogeneity bias.

Further, introducing the control variables expanded the capabilities of the explanatory power of the econometric models. After controlling for heteroskedasticity, it enhanced the statistical significance of the controlling variables too. With regard to controlling variables, a very crucial factor for explaining the cost overrun is the type of road (i.e. lanes of the road). It is statistically significant. It indicates that for broader roads, the cost overrun is higher. Cost overrun has increased over the period (although the increasing

effect is not very high), i.e. newer projects have relatively higher cost overrun. The construction period and operation period too have impact on the cost overrun, but not very strong (see *Table 6*).

Table 6: Difference-in-Difference Model for Cost Overrun

	OLS1	OLS1_R	WLS1	OLS2	OLS2_R	WLS2	OLS3	OLS3_R	WLS3	WLS4	WLS5
Dependent Variable: Magnitude of Cost Overrun (%age)											
_cons	-84.02*	-84.02**	-82.42**	-85.99*	-85.99**	-83.85**	-84.78*	-84.78**	-86.01**	-83.89**	-82.51**
D1	21.90*	21.90**	19.63**	27.78**	27.78**	23.58**	22.21*	22.21**	19.82**	19.12**	23.64**
D2	6.934	6.934	11.46	5.681	5.681	10.06	12.36	12.36	16.66	12.66	8.552
D1*D2	11.43	11.43	9.813	14.00	14.00	12.07	11.45	11.45	9.759	11.42	11.83
op_prd	-1.899*	-1.899*	-1.520*	-1.907*	-1.907*	-1.513*	-1.848*	-1.848^{+}	-1.503*	-1.439*	-1.520*
laning	25.26**	25.26**	17.79**	25.17**	25.17**	17.63**	23.26**	23.26**	16.84**	15.58**	16.42*
qlt_ints	-0.731**	-0.731**	-0.533**								
time	2.348	2.348	2.045*	2.194	2.194	1.950*	2.178	2.178	1.917*	2.116*	2.000*
tpc	-0.00957	-0.00957	-0.0155*	-0.0112	-0.0112	-0.0164*	-0.00964	-0.00964	-0.0168*	-0.0142^{+}	-0.0135^{+}
constn_prd	7.007	7.007	17.51^{+}	6.298	6.298	17.07^{+}	8.405	8.405	19.35*	19.42**	18.05*
D1*qlt_ints				-0.739**	-0.739**	-0.530**					-0.546**
D2*qlt_ints							-0.696**	-0.696**	-0.565**	-0.533**	
N	114	114	114	114	114	114	114	114	114	114	114
R^2	0.367	0.367	0.350	0.367	0.367	0.352	0.363	0.363	0.367	0.399	0.318
adj. R^2	0.313	0.313	0.294	0.312	0.312	0.296	0.308	0.308	0.312	0.348	0.259
rmse	30.30	30.30	25.85	30.31	30.31	25.77	30.39	30.39	25.31	13.71	26.14

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$;
Notes: OLS = Ordinary Least Square; OLS_R = OLS Robust; WLS = Weighted Least Square;

Time Overrun

However, exploring the same factors (other than contract type and regime) to explain the magnitude of the actual time overruns, econometric results give different and interesting insights. The model estimates that the *Toll* type has high time overruns, and it is statistically significant, and the regime does not explain the time overrun. Another crucial variable, the operation period, however, has a strong impact on the time overrun. It reveals that the longer the operation period, higher is the time overrun. It influences strongly to the *Toll* contracts.

With regard to other variables, the quality intensity is the only parameter that has opposite sign than the expectation. It means that better the quality of the road, lower is the time overrun. It may be due to the reason that the high quality road projects are taken up by more experienced and technically sound companies. The year of contract awarding that is positively related to the time overrun, is actually hinting towards the land acquisition issue, which is the serious concern for the road projects in the last few years. But the other parameters like lanes and length of the road do not explain the quantum of the time overrun (see *Table 7*)[11].

[11] Overall, both econometric models for time overrun have a very limited explanatory power due to number of exogenous variables and low number of observations.

Table 7: Difference-in-difference Model for Time Overrun

	OLS1	OLS1_R	WLS1	OLS2	OLS2_R	WLS2	OLS3	OLS3_R	WLS3	OLS4	OLS4_R	WLS4	OLS5	OLS5_R	WLS5
Dependent Variable: Magnitude of Time Overrun (%age)															
_cons	-52.19	-52.19	-14.22	8.384	8.384	41.68	3.573	3.573	38.12	23.58	23.58	30.76	14.39	14.39	20.30
D1	15.25	15.25	16.78	-65.39*	-65.39*	-50.94^{+}	-67.37*	-67.37*	-50.77^{+}	23.27	23.27	22.84^{+}	21.21	21.21	20.78^{+}
D2	-5.224	-5.224	-1.712	-9.667	-9.667	-8.327	-11.60	-11.60	-10.75	-48.57	-48.57	-49.19^{+}	-50.71	-50.71	-48.19^{+}
D1*D2	-30.05	-30.05	-34.03^{+}	-26.31	-26.31	-28.72	-25.42	-25.42	-27.10^{+}	-27.70	-27.70	-38.72*	-25.88	-25.88	-35.60*
op_prd	4.085**	4.085*	3.580*												
time	2.791	2.791	3.073	3.481	3.481	3.592	3.969	3.969	4.057^{+}	3.157	3.157	3.463^{+}	3.799	3.799^{+}	4.164*
constn_prd	-20.73	-20.73	-29.18^{+}	-19.61	-19.61	-27.54^{+}	-16.99	-16.99	-24.69^{+}	-22.39	-22.39	-29.39*	-18.86	-18.86	-26.22*
tpc	0.00411	0.00411	-0.00697	0.00263	0.00263	-0.00288	0.00379	0.00379	-0.00344	0.0108	0.0108	-0.00655	0.0114	0.0114	-0.00667
length	0.0202	0.0202	0.167*	-0.0106	-0.0106	0.103	-0.0164	-0.0164	0.112	0.0120	0.0120	0.189**	0.0125	0.0125	0.210**
laning	9.408	9.408	5.427	10.32	10.32	5.163	9.760	9.760	3.846	7.318	7.318	8.295	7.031	7.031	8.029^{+}
qlt_ints	-0.409	-0.409	-0.270	-0.453	-0.453^{+}	-0.296^{+}				-0.394	-0.394	-0.313^{+}			
D1*op_prd				4.763**	4.763*	4.049*	4.786**	4.786*	3.969*						
new_qlt							-2.737	-2.737^{+}	-1.545				-2.358	-2.358	-1.706^{+}
D2*op_prd										2.213	2.213	2.790^{+}	2.162	2.162	2.498^{+}
N	89	89	89	88	88	88	89	89	89	89	89	89	90	90	90
R^2	0.178	0.178	0.520	0.194	0.194	0.563	0.196	0.196	0.513	0.107	0.107	0.411	0.108	0.108	0.446
adj. R^2	0.072	0.072	0.459	0.089	0.089	0.507	0.092	0.092	0.451	-0.007	-0.007	0.336	-0.005	-0.005	0.375
rmse	42.72	42.72	17.12	42.55	42.55	8.883	42.30	42.30	18.42	44.50	44.50	25.05	44.29	44.29	21.26

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$;

Notes: OLS = Ordinary Least Square; OLS_R = OLS Robust; WLS = Weighted Least Square;

6.5 Additional Testing for the 'Administrative Controls'

In the MCA regime, an administrative control for the 'development period (DP)' was modified. DP is the duration between the date of contract award and the appointed date (the actual date of beginning of the contract). This time window is given to fulfill *a priori* commitments of the project execution such as arranging finances (that means to achieve financial closure), obtaining various clearances, arranging resources and awarding different sub-contracts including design, construction and to appoint auditors and safety consultants.

Usually, the DP for the PPP road projects is around 180 days (for both old and MCA regime), and practitioners consider it as a reasonable time. In the contract, it is defined by the 'Appointed Date (AD)'. The MCA regime made the AD definition more liberal. As per the new definition, the AD can be decided by mutual consent of the NHAI (i.e. government authority) and the concessionaire (i.e. project promoter).

The old definition: *"Appointed Date means the date 180 days from the signing of Concession Agreement"*.

The new definition: *"Appointed Date means the date on which Financial Close is achieved or an earlier date that the Parties may by mutual consent determine, and shall be deemed to be the date of commencement of the Concession Period. For the avoidance of doubt, every Condition Precedent shall have been satisfied or waived prior to the Appointed Date and in the event all Conditions Precedent are not satisfied or waived, as the case may be, the Appointed Date shall be deemed to occur only when each and every Condition Precedent is either satisfied or waived, as the case may be"*.

The new definition is more open-ended and liberal. Under the new definition, neither the early achieving the AD gives direct benefit, nor the excess of time taken fetch any penalty. The new definition can provide a scope to extend the DP without any obligation, and moreover, the contract is silent on the maximum time limit given for the AD, or indirectly to the DP. The implication of such liberal administrative control can lead to either direction, depending on its incentives. If an early AD can bring any extra benefit to the private party, it will try to achieve the AD at the earliest. But on the other side, if

taking extra time to search for better alternatives to minimize the overall cost of the project, then concessionaire will have incentives to go for longer DP so as to maximize its profit. However, it can hamper the objective of building infrastructure within the given time limits.

It is illustrated further by taking a hypothetical project, which got awarded on January 1, 2015. The contract reads that the concession period will be of 20 years including 2 years of the construction period. The concession period will actually start after 180 days of development period, i.e. June 30, 2015. Accordingly, the building of road should get over by June 29, 2017. But as per the liberal AD definition, if both parties mutually agree for say 120 days (or 365 days) of development period, then, the project date will start from May 1, 2016 (or January 1, 2016) and construction should be completed by April 30, 2017 (or December 31, 2017), that is again without any extra financial obligation for either party. It implies that project time-lines will automatically be readjusted. Effectively, the actual project delivery will be adjusted to the period exactly equal to extension for the development period. Hence, the flexible administrative control can have direct impact on the efficiency of the project delivery. So, a further econometric test is carried out using the same data and variables. Here, the dependent variable is the actual days taken for DP.

6.5.1 Econometric Results

The results clearly highlights that the MCA regime has led to the longer development period, and it holds true for both contract types. This one parameter only has the highest explanatory power of the model (see *Table 8*).

The only other parameters, which have influenced the DP is the year of contract award and the road type. Time is positively related to DP that means, in the MCA regime, the development period is constantly becoming larger and larger. However, wider the road, relatively lower is the DP. At this stage, it is difficult to explain this negative relationship. All other parameters have no statistically significant impact on the duration of the development period. It is evident that the true impact of the administrative controls on the project outcomes and its desired efficiencies.

Table 8: Difference-in-difference Model for Development Period

	(M1)	(M2)	(M3)	(M4)	(M5)	(M6)	(M7)	(M8)	(M9)	(M10)	(M11)	(M12)	(M13)
Dependent Variable: Actual Development Period (in number of Days)													
_cons	260.2*	188.5*	192.0*	187.9*	125.7*	304.3*	210.7*	206.5*	211.9*	194.8*	211.5*	219.5*	199.8*
D1	19.87		-4.970	0.861	-6.485	-0.153	-11.25	-7.454	-11.12	-13.01	-12.87	-9.855	-13.78
D2		154.1*	154.7*	164.0*	92.90+	147.1*	67.52	69.09	67.29	65.13	65.96	56.24	64.79
D1*D2				-12.17	-6.515	5.856	11.87	7.119	12.19	8.847	6.504	14.72	12.75
time					12.98+		15.10*	15.61*	15.13*	14.76*	14.74*	14.61*	15.95*
laning						-28.73+	-23.46	-23.17	-23.43	-21.89	-26.43+	-27.10	-21.57
constn_prd								-1.278					
concnprd									-0.0791				
length										0.198			
area											0.0569		
tpc												0.0201	
qlt_ints													-0.108
N	147	147	147	147	147	146	146	143	146	146	146	146	144
R^2	0.003	0.260	0.260	0.261	0.280	0.308	0.333	0.330	0.333	0.336	0.337	0.336	0.329
adj. R^2	-0.004	0.255	0.250	0.245	0.259	0.289	0.309	0.300	0.304	0.307	0.309	0.307	0.300
rmse	150.6	129.7	130.2	130.6	129.4	125.5	123.7	125.4	124.1	123.9	123.8	123.9	124.9

$^{+}$ $p < 0.10$, * $p < 0.05$;

7. Conclusion

This paper attempted to test empirically the impact of differences in attributes of the contract governance structure using the TCE's basic instruments of governance. The hypothesis was to test whether the better incentive structure and stricter administrative controls lead to more efficient project outcomes. To this end, the analysis compared two sets of contracts from Indian PPP road projects where the financing of road construction and maintenance remain with private player, but the methods of recovering the costs are different.

The results support the hypotheses that differences in the contract attributes are strongly correlated with the differences in actual outcomes. For example, results from the exercise on cost overrun clearly show that the differences in the incentive structure are strongly correlated to the likelihood and the amount of actual cost overrun. Further, the results highlight that differences in administrative controls affects the leniency given in the contracts which lead to differential outcomes. Taken together the analysis highlights that specific attributes of contract governance strongly affect contract outcomes.

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Data Sources

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http://nhai.org.in/Home.aspx (for project specific websites under NHAI)

http://morth.nic.in/ (Ministry of Road Transport & Highways)

http://www.pppinindia.com/ (Ministry of Finance's specific website for PPP projects)

https://infrastructureindia.gov.in/ (Ministry of Finance's another website to cover all infrastructure sectors)