CDE
August, 2009

Cost and Time Overruns in Infrastructure Projects:
Extent, Causes and Remedies

Ram Singh
Department of Economics
Delhi School of Economics
University of Delhi
Delhi 110007
ramsingh@econdse.org
http://www.econdse.org/faculty/ram/ram.htm

Working Paper No. 181

Centre for Development Economics
Department of Economics, Delhi School of Economics

Cost and Time Overruns in Infrastructure Projects: *Extent, Causes and Remedies*

Ram Singh
Department of Economics
Delhi School of Economics
University of Delhi
Delhi 110007
ramsingh@econdse.org

ABSTRACT

Media reports abound on instances of prolonged delays and excessive cost overruns in infrastructure projects. Realizing the gravity of the issue, as a part of its 'agenda for first 100-days,' the new UPA government has plans to expedite the implementation process for infrastructure projects. Indeed, the problems of time and cost overruns are widespread and severe. Yet, very few empirical studies exist on the subject. Even rarer are the studies based on completed projects, though by now a large number of projects have been completed. As a result, both the extents as well as the causes behind the time and the cost overruns have remained under-researched. In this paper, we investigate various issues related to delays and cost overruns in publically funded infrastructure projects. In theoretical and empirical frameworks, we pose and answer the following questions: How common and how large are the time and cost overruns? What are the essential causes behind time and cost overruns? Are these underlying causes statistically and economically significant? Are Contractual and Institutional failures significant causes behind cost and time overruns? What are the policy implications for planning, development and implementation of infrastructure projects? The study is based on, by far, the largest data-set of 850 projects across seventeen infrastructure sectors. The focus is on the causal factors behind time and cost overruns. Among other results, we prove that: There is simultaneity between delays and cost overruns; The contractual and the institutional failures are economically and statistically significant causes behind cost and time overruns; *Ceteris paribus*, delays and cost overruns are considerably higher for the *interstate*, the road, the railways and the urban-development projects; Moreover, contrary to the common perception, delays as well as cost overruns are higher for projects located in relatively rich states. We show that the contractual and the institutional differences across projects and sectors are the keys to the understanding of the observed differences regarding delays and cost overruns.

KEY WORDS: Delays, Cost Overruns, Time Overruns, Infrastructure, Projects, Causes, Contractual Failures, Organizational Failures, Institutional Failures

AKNOWLEDGEMENT: I am indebted to TCA Anant, Lee Benham, Neha Jain, JV Meenakshi, Anusha Nath, and Bharat Ramaswami for comments and very helpful suggestions on various issues covered by the paper. Atika Gupta and Nitya Mittal provided excellent research support and also helpful suggestions. Digvijay Negi, Nitin Madan and Pawan Gopalakrishnan provided crucial help during data collection. Finally, I am thankful to the *Centre for Development Economics*, at the *Delhi School of Economics*, for research and institutional support.

1. Introduction

Infrastructure projects in India are infamous for delays and cost overruns. Even the Ministry of Statistics and Programme Implementation (MOSPI) confirms that many projects are suffering from delays and cost overruns. However, the extents as well as the causes behind the time and the cost overruns have remained under-studied. For several reasons delays and cost overruns have implications significant from economic and political points of view. For one, in most cases, these projects are funded by taxpayers' money. Therefore, people should know how efficiently their money is utilized by officials while making provisions of public goods and services. Two, delays in project implementation mean that the people and the economy have to wait for infrastructure facilities longer than is necessary. This in turn limits the growth potential of the economy at large. Three, services provided by infrastructure projects serve as input for many other sectors of the economy. Therefore, cost overruns lead to an increase in the capital-output-ratio for the entire economy. Simply put, delays and cost overruns reduce the efficiency of available resources and limit the growth potential of the entire economy. Therefore, inadequacy of research on the subject is somewhat surprising.

The literature suggests that cost overruns in infrastructure projects are a global phenomenon. In a series of empirical studies covering twenty countries across the five continents, Flyvbjerg *et al* (2002, 2003, and 2004) have shown that infrastructure projects often suffer from cost overruns.[1] Merewitz (1973), Kain (1990), Pickrell (1990), Skamris and Flyvbjerg (1997), among others, have come out with similar findings. In addition, there are numerous case studies depicting the extent and gravity of delays and cost overruns.[2] Therefore, cost escalations seem to be generic to infrastructure projects. These studies also reveal that the frequency and the magnitude of cost overruns differ from country to country. However, these empirical works do not explain why delays and cost overruns occur.

[1] The authors have studied 258 large infrastructure projects from 20 countries including developed as well as developing countries. They have shown that *ninety* percent of large transport projects suffer from cost overrun.

[2] For example, Suez canal was constructed at costs three times of the estimated cost (Flyvbjerg et al, 2002). According to some estimates, the cost overrun for Panama Canal was in the range of 70-200 percent (Summers, 1967, p. 148). Similarly, for the Concorde supersonic airplane project, the actual costs were 12 times the projected costs (Hall, n.d., p.3). For more case studies see Pickrell, 1990; Skamris and Flyvbjerg, 1997; Kain, 1990; among others.

Theoretical literature on the subject offers several explanations as to why cost overruns occur. For example, Morris and Hough (1987), Gaspar and Leite (1989), Arvan and Leite (1990), and Ganuza (2007) attribute cost overruns to technical constraints. According to these studies, due to imperfect estimation techniques and the lack of data, the estimated and the actual project costs turn out to be different. That is, delays and cost overruns are claimed to be a manifestation of 'honest' mistakes on the part of government officials. Some other researchers attribute cost overruns to political factors. In order to make projects sellable, politicians understate costs and exaggerate benefits. That is cost overruns are attributed to "lying" by politicians. (See Wachs, 1989; Kain 1990; Pickrell 1990; Morris 1990; Flyvbjerg *et al* 2002, 2004; and Wilkinson 2006). However, as we will demonstrate, this literature is not helpful at all in explaining the nature of delays and cost overruns observed in India.

In contrast, several India-focused studies have made interesting contributions. Morris (1990 and 2003), Dalvi (1997), Thomas (2000), Sriraman (2003), Thomsen (2006), Jonston and Santillo (2007), Chakrabarti (2008), and Raghuram *et al* (2009), among others, are notable works. According to these studies, delays in land acquisition, shifting of utilities, environmental and inter-ministerial clearances are the major causes behind time and cost overruns in India. In addition, shortage of funds, litigations over land acquisition and contractual disputes have been claimed to be responsible for delays. However, these studies too have some serious limitations. Very few of these are empirical works. Though there are some empirical works, but they have used data on the ongoing, rather than the completed projects.[3] Therefore, these studies are based on the estimates, rather than the actual figures for the time and the cost overruns. For infrastructure projects, the estimated and the actual figures for delays and cost overruns are invariably and in some cases considerably different. Moreover, as we will demonstrate, these studies have ignored several underlying causes behind delays and cost overruns. Consequently, they have not explored the exact nature of causal relationships of the underlying factors with delays and cost overruns. Therefore, the main causes behind time and cost overruns in India and their relative significance have remained unsubstantiated.

[3] See, for example, Morris (1990 and 2003).

In this backdrop, it is somewhat disquieting that the privatization of public services is believed to be the only way out. Indeed, the problems of delays and cost overruns with the official delivery system are being used to rationalize privatization of the supply and the maintenance of infrastructure services. The government machinery is perceived to be incapable of procuring and maintaining infrastructure facilities. Privatization in the form of Public Private Partnerships (PPPs), in contrast, is believed to be capable of avoiding delays and cost overruns. Several commentators and policy makers share this view. So, PPPs are being pushed as politically acceptable means of transferring management and control rights over infrastructure facilities to private firms. It is worth quoting an excerpt of a decision made in a meeting chaired by the Prime Minister:[4]

> "As regards the issue of EPC vs BOT, *it was agreed that for ensuring provision of better road services, i.e., higher quality of construction and maintenance of roads and completion of projects without cost and time overrun, contracts based on BOT model are inherently superior to the traditional EPC contracts*. Accordingly, it was decided that for NHDP Phase-III onwards, all contracts for provisions of road services would be awarded only on BOT basis …."

In the above quote the BOT model means the PPP model. In contrast, publically funded projects are executed through EPC contracts. In various other official reports also BOT contracts are recommended as the preferred means for constructing national highways.[5] In other sectors too the supply and the management of infrastructure services is being privatized, ostensibly to overcome the cost and other inefficiencies of the public sector, though the nature and extent of privatization differs from sector to sector (see Kundu 2001, 2003; Nagaraj 2006; Goyal 2008; and GoI 2007).

We will show that a change in the ownership itself cannot mitigate the problems of delays and cost overruns. Moreover, the recent experiences with PPPs suggest that private sector will invest in supply and maintenance of only commercially viable projects.[6] Inevitably, most provisions of public goods will still have to be funded and executed through the traditional official machinery. At the same time, given the fiscal constraints faced by the Center and the state governments, public funding of infrastructure projects is under serious strain. Therefore, it is extremely important to improve the official delivery system for infrastructure projects, so as to minimize the wastage. Clearly, the remedy depends on

[4] The meeting regarding financing of NHDP and was held on March 15, 2005. See GoI (2006 a).
[5] *Report of the Core Group on financing of NHDP* (2006, pp. 14 and 18) published by the Secretariat for the Committee on Infrastructure.
[6] For an analysis of PPPs in road sector, see Anant and Singh (2009).

the underlying causes. In this paper, among other things, we investigate the underlying causes for time and cost overruns observed in India.

The following four features set this study apart. First, it is based on by far the largest dataset on completed projects. Our database includes 850 projects completed during April 1992-September 2008. It covers seventeen infrastructure sectors. Each project is worth at least 20 crore. Second, it explores the factors that can trigger time and/or cost overruns during the planning and the implementation phases of infrastructure projects.[7] Third, it examines the nature of causal relationships for time and cost overruns along with their statistical significance. Fourth, we show that there is simultaneity between delays and cost overruns. So, we have introduced a *simultaneous equation model*, and the same is used for regression.

Our analysis shows that since early 1980s there has been significant decline in time and cost overruns. However, delays and cost overruns are still unacceptably frequent and large. With respect to the underlying causes, we show that several hitherto neglected factors are among the major causes behind delays and cost overruns observed in India. Specifically, a deficient project planning process, use of inappropriate procurement contracts and faulty contract management are the leading and statistically significant causes. Several kinds of organizational-cum-institutional failures also greatly add to time and cost overruns. As regards to project types, we show that bigger projects are much more vulnerable to cost overruns. Moreover, *ceteris paribus*, delays and cost overruns are considerably higher for the interstate, the road, the railways and the urban-development projects. In addition, we show that there are regional variations with respect to delays and cost overruns. Contrary to the common perception, delays as well as cost overruns are higher for projects located in relatively rich states.

In Section 2, we present an overview of the delays and cost overruns in infrastructure projects in India. Section 3 shows that the existing literature is inadequate to explain the time and cost overruns observed in India. In Section 4, we propose and analyse various

[7] There are several interesting studies with a focus on the operation-and-maintenance phase of infrastructure projects. For a comprehensive account of various challenges faced by urban-development projects see Kundu (2001 and 2003), also see Banerjee-Guha (2009). Goyal (2008) provides an enlightening discussion on the problems faced by railways and civil aviation sectors. These works show that privatization itself has not delivered the expected results in urban-development and civil aviation sectors. For a discussion on power sector see Nagaraj (2006).

possible factors that can trigger delays and cost overruns. The model and regression results are presented in Section 5. Section 6 concludes with remarks on policy implications of our results.

2. Delays and Cost Overruns in India

Definitions: When an infrastructure project is planned, the sponsoring department prepares estimates of time and funds (cost) needed to complete the project. An expected date of completion is also announced. The actual date of completion is invariably different from the expected date. We define 'time overrun' as the time difference between the actual and the initially planned (i.e, expected) dates of completion.[8] We measure the time difference in months. A related term used in the paper is the 'implementation phase'. It is defined as the duration in which a project is planned to be completed, i.e., the duration between the date of approval of the project and its *expected* date of completion. Therefore, for each project we can define percentage time overrun as the ratio of the time overrun and the implementation phase for the project. Similarly, we define 'cost overrun' as the difference between the actual cost and the initially projected (i.e., expected) cost of the projects. The actual costs become known only at the time of completion, the projected costs are the estimated costs when a project is planned. Percentage cost overrun for a project is defined as the ratio of the cost overrun and the initially anticipated cost of the project.

The Data: The programme implementation division of the MOSPI publishes quarterly reports on the ongoing projects. A report also provides information about projects that get completed in that quarter. According to these reports, during April 1992-September 2008, a total of 991 projects belonging to seventeen infrastructure sectors have been completed. Most of these are publically funded projects; only few road projects are PPPs. Each project is worth at least Rs 20 Crore. Unfortunately, no single report or document provides all the information needed to determine the time and the cost overruns, the implementation phase, and the location of the project. In order to collect the required information, we had to track each project at various stages, such as the project development, construction and commissioning stages. That meant that for each project we

[8] In the terminology of MOSPI, the former is known as the *actual* date of commissioning and the latter as the *original* date of commissioning.

had to wade through several reports and publications. Still, we could get the required information for only 850 projects; for the remaining 141 projects information on one or the other aspect was missing. Nonetheless, ours is the largest dataset on completed projects for any study on the subject by far. For each of the 850 projects, we have compiled data on the aspects mentioned in Table 1.

TABLE 1: Total number of projects 850.

S. No.	ASPECT	DESCRIPTION	DATA SOURCE
1	DATE OF PROJECT START	It is the start date of the project	MOSPI reports
2	INITIAL DATE OF COMMISSIONING	It is the initially planned (i.e, expected) date of completion of the project	MOSPI reports
3	ACTUAL DATE OF COMMISSIONING	It is the actual dates of completion of the project	MOSPI reports
4	TIMEOVER RUN	The time difference between (in months) the actual and the initially planned dates of completion	OUR CALCULATIONS based on the data collected from MOSPI reports. .
5	IMPLEMENTATION PHASE'	The duration in which a project is planned to be completed, i.e., the duration between the date of approval of the project and its *expected* date of completion.	OUR CALCULATIONS based on the data collected from MOSPI reports.
6	PCTIMEOVER RUN	The ratio of the time overrun and the implementation phase for the project. (multiplied by one hundred)	OUR CALCULATIONS based on the data collected from MOSPI reports. .
7	THE INITIAL PROJECT COST	The initially projected (i.e., expected) cost of the project.	MOSPI reports
8	THE ACTUAL PROJECT COST	The actual cost at the time of completion of the project.	MOSPI reports
9	COST OVERRUN	The difference between the actual cost and the initially projected (i.e., expected) cost of the projects	OUR CALCULATIONS based on the data collected from MOSPI reports.
10	PCCOSTOVER RUN	The ratio of the cost overrun and the initially anticipated cost of the project. (multiplied by one hundred)	OUR CALCULATIONS based on the data collected from MOSPI reports. .
11	TIMELAPSE	It is the time that has lapsed since May 1974. to the date of approval of the project. The *first* project in our dataset was approved in May 1974.	OUR CALCULATIONS based on the data collected from MOSPI reports.
12	PGSDP	Average Per-capita Gross State Domestic Product of the state in which project is located. Average for the years 2006-07,2007-08 & 2008-09 has been taken. All figures are at 1999-2000 constant prices. Figures for years 2007-08 and 2008-09 have been extrapolated using the average growth rate for the previous four years.	Ministry of Statistics and Programme Implementation (MOSPI), Central Statistical Organization (CSO)
13	INFRAINDEX	Infrastructure index of the state in which the project is located.	Finance Commission of India

TABLE 2: Delays and cost overruns in infrastructure projects during April1992-Sept 2008.

1 S. No.	2 SECTORS	3 Total no. of projects completed	4 % of projects with Time overrun	5 % Time overrun (as % of implementation phase)	6 % of projects with Cost overrun	7 Cost overrun as a %age of initial cost of all projects	8 % Projects with cost but not time overrun
1	Atomic Energy	11	90.91	84	27.27	84	09
2	Civil Aviation	43	90.70	60	41.86	-01	00
3	Coal	92	60.87	28	22.83	-17	03
4	Finance	1	100.00	303	100.00	133	00
5	Fertilizers	16	62.50	25	25.00	00	13
6	I & B	7	100.00	190	42.86	09	00
7	Mines	5	80.00	45	0.00	-26	00
8	Steel	41	80.49	51	19.51	49	05
9	Petrochemicals	3	100.00	74	33.33	14	00
10	Petroleum	119	78.99	33	20.17	-11	03
11	Power	101	62.38	41	47.52	26	05
12	Health and Family Welfare	2	100.00	228	100.00	265	00
13	Railways	120	98.33	83	83.33	84	00
14	Road & Transport	147	86.39	47	53.74	08	05
15	Shipping and ports	60	95.00	78	30.00	01	02
16	Telecommunication	60	90.00	109	16.67	-55	00
17	Urban Development	22	100.00	54	40.91	99	00
	Total/Overall projects	**850**	**82.35**	**56**	**41.06**	**21**	**03**

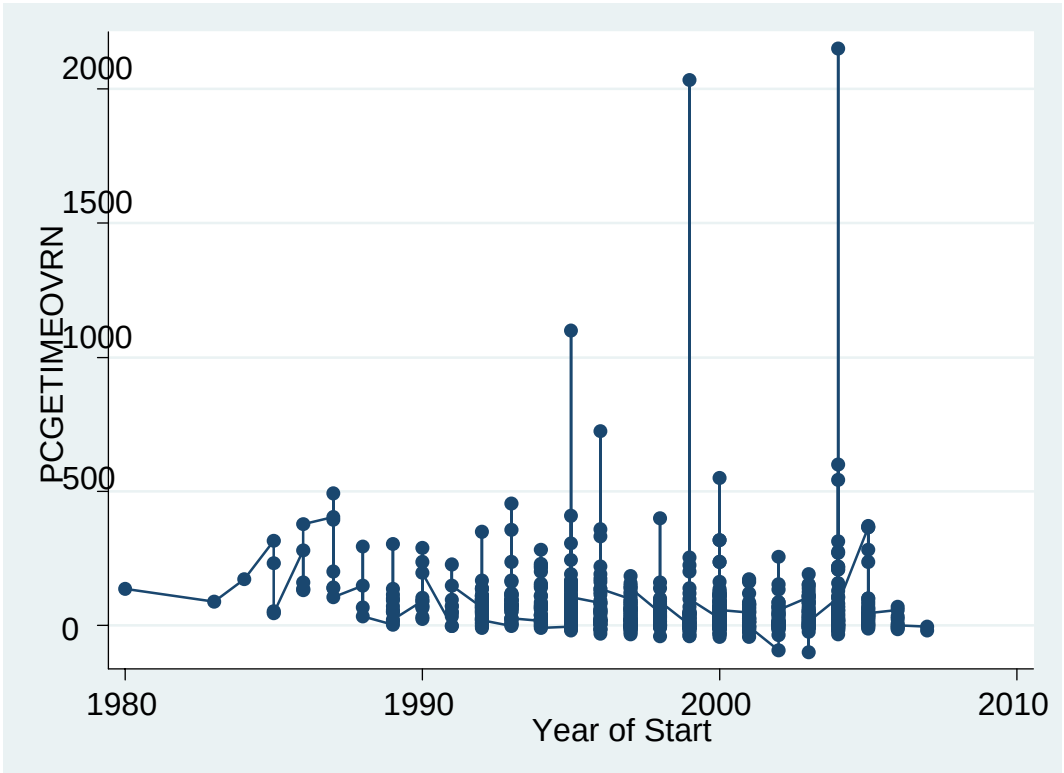
Source: Calculations based on MOSPI data.

Summary Statistics: Table 2 provides sector-wise details of the number of projects with time and cost overruns. Table 3 provides state-wise details of the number of projects with time and cost overruns. There are wide-ranging variations in terms of the size, duration, and the nature of the activity covered by the projects. Yet, projects in road, railways and

urban-development sectors are more homogeneous; most are construction projects. In contrast, project type in sectors like power, shipping and ports, civil aviation, mining, etc., is very heterogeneous.[9]

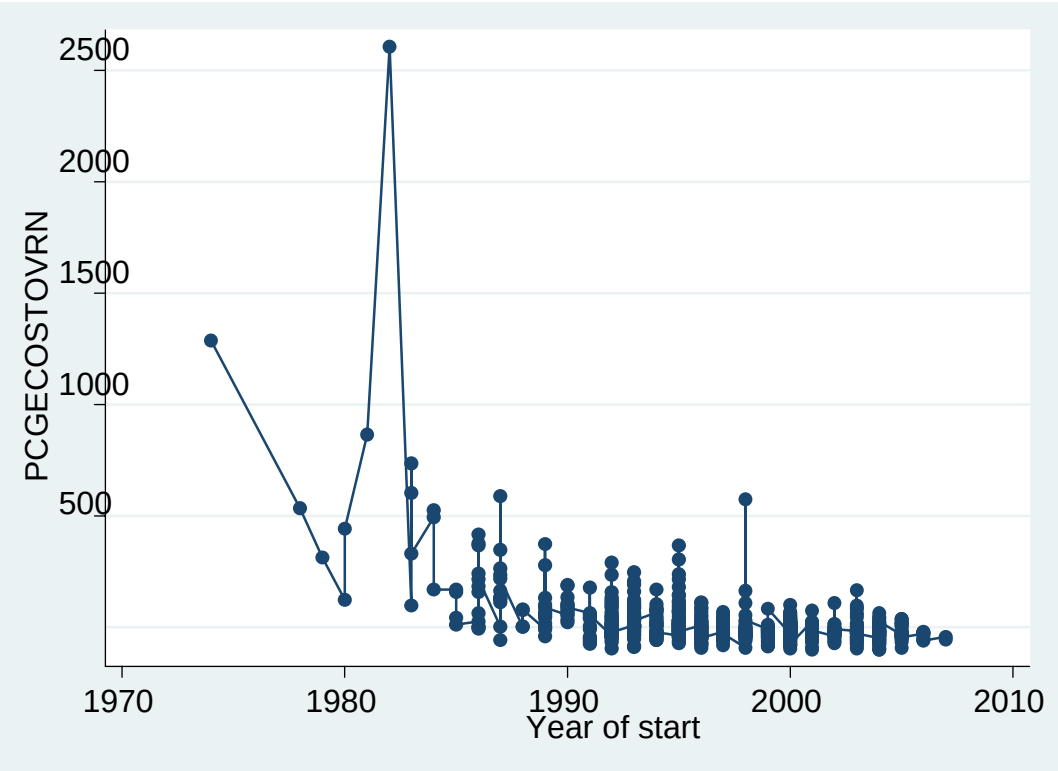
Time Pattern of Delays and Cost Overruns: Using the above definitions of time and cost overruns, we have calculated percentage time and cost overruns for each project. Graph 1 depicts the time pattern of percentage time overruns. For each project percentage time overrun is plotted against the year of start of the project. Similarly, Graph 2 shows the movements of percentage cost overruns over the years. Together these graphs show that since 1980s the official delivery system has improved. Delays along with cost overruns have come down over the years. However, even today cost overruns are unacceptably large. According to the latest MOSPI report, as on December 31, 2008, more than one-third of the ongoing projects are experiencing cost overruns. Collectively, cost overruns for these projects are huge at Rs 55,533.42 crore; which is 47 percent of their original cost and 13 percent of the cost of all projects. From another perspective, the wastage due to cost overruns in the ongoing projects is larger than the three consecutive fiscal packages announced during 2008-09! Similarly, delays are intolerably long.

GRAPH 1: Patterns of percentage time overruns over the years



[9] For details on project types across and within sectors see Singh (2009)

GRAPH 2: Patterns of percentage cost overruns over the years



3. The Literature and the Indian Scenario

As discussed in the Introduction, one strand of the existing literature attributes delays and cost overruns to imperfect information and technical constraints. That is, time and cost overruns are attributed to the estimation errors caused by imperfect estimation techniques. See Morris and Hough (1987), Arvan and Leite (1990), Gaspar and Leite (1989) and Ganuza (2007). Another strand attributes cost escalations to political factors, i.e., to 'lying' by politicians. See Wachs, 1989; Kain 1990; Pickrell 1990; Morris 1990; Flyvbjerg *at el* 2002, 2004; and Wilkinson 2006). However, if time and cost overruns are only due to the imperfect estimation technology, then one would expect the estimation errors to be unbiased with zero mean. Since, due to technological constraints, underestimation of cost should be as likely as overestimation. As a result, negative cost overruns should be as frequent as positive cost overruns. Moreover, as more and more projects get implemented, the officials should be able to learn from the past mistakes and avoid them in future. On top of it, the estimation technology also advances with the

TABLE 3: Delays and cost overruns in infrastructure projects during April1992-Sept 2008.

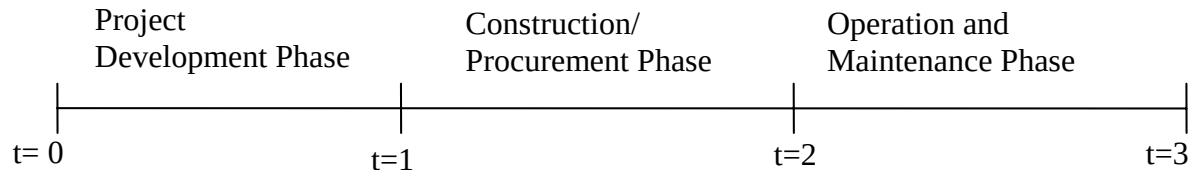
S. No.	STATES	Total No. of Projects	% of projects having Time Overrun	% Time Overrun(as a % of Length Imp)	% of projects having Cost Overrun	Cost Overrun as a %age of total initial cost	% Projects with cost but not time overrun
1	**All India**	5	100.00	1.27	60.00	-05	00
2	Andaman&Nicobar Islands	2	50.00	0.11	100.00	281	50
3	Andhra Pradesh	85	76.47	0.47	25.88	-20	01
4	Arunachal Pradesh	3	100.00	1.07	66.67	297	00
5	Assam	27	92.59	0.60	51.85	60	00
6	Bihar	29	93.10	0.81	58.62	13	03
7	Chattisgarh	19	68.42	0.18	26.32	-06	05
8	Delhi	32	93.75	0.87	56.25	71	00
9	**ER States**	2	100.00	0.30	50.00	28	00
10	Goa	5	100.00	0.89	40.00	37	00
11	Gujarat	52	82.69	0.53	44.23	02	08
12	Haryana	12	75.00	0.37	41.67	-04	08
13	Himachal Pradesh	4	75.00	0.78	75.00	160	25
14	Jammu&Kashmir	7	100.00	1.03	71.43	298	00
15	Jharkhand	17	88.24	0.75	17.65	06	00
16	Karnataka	34	79.41	0.51	50.00	47	06
17	Kerala	14	85.71	0.61	35.71	-10	00
18	Madhya Pradesh	42	61.90	0.23	21.43	-19	02
19	Maharashtra	119	76.47	0.43	28.57	-03	06
20	Manipur	2	100.00	3.17	50.00	144	00
21	Mizoram	1	100.00	0.59	0.00	-27	00
22	**Multi City**	2	100.00	0.88	0.00	-45	00
23	Nagaland	3	100.00	1.08	66.67	411	00
24	**NR Or North East States/Region**	7	85.71	0.52	42.86	16	00
25	Orissa	52	82.69	0.51	36.54	-03	02
26	Punjab	10	90.00	1.08	60.00	31	00
27	Rajasthan	18	66.67	0.26	27.78	32	00
28	Sikkim	4	75.00	0.32	75.00	20	25
29	**SR States**	3	33.33	0.21	0.00	-24	00
30	Tamil Nadu	57	92.98	0.61	35.09	-07	00
31	Tripura	4	100.00	0.42	100.00	40	00
32	Uttar Pradesh	58	82.76	0.50	44.83	14	00
33	Uttaranchal	3	100.00	1.28	66.67	165	00
34	West Bengal	54	92.59	0.79	51.85	48	02
35	**WR States/Region**	4	25.00	0.10	25.00	-32	25
36	**Spans in more than one state**	58	86.21	0.67	67.24	19	00
	Total/Overall Data	**850**	**82.35**	**0.57**	**41.06**	**21**	**03**

Source: Calculations based on MOSPI data.

passage of time. That is, over the years, institutional capacity of government departments to plan and develop projects improves. Therefore, if delays and cost overruns are caused by imperfect techniques only, then the frequency as well as the magnitude of time and cost overruns should come down over the years.

As Graphs 1 and 2 show, over the years there has been some decline in the magnitudes of estimation errors. That is, some learning seems to have taken place over the years. To that extent, delays and cost overruns in India seem to have been caused by the technological constraints. Nonetheless, estimation errors are anything but unbiased with a zero mean. Table 1 shows that barring a few sectors, time and cost overruns are nowhere close to zero. For most sectors, estimation errors for project time and the costs have remained biased with a positive mean. Moreover, there is no indication of a significant decline in the frequency of delays and cost overruns. Altogether, at least 85 percent of the projects under study have suffered from either delays or cost overruns. Even today, of the 903 ongoing projects, 380 [303] have already experienced delays [cost overruns]. Therefore, at least, in the case of India, the imperfect information and technological constraints cannot fully explain delays and cost overruns. Similarly, the theory of 'lying' by politicians does not seem to hold the key to delays in programme implementations. In principle, cost overruns do not necessarily imply time overruns; once a project has been approved by the people or their representatives, more funds can be commissioned to ensure timely completion. After all, politicians would want to take credit for faster completion of projects. Even otherwise, in India projects are planned by bureaucrats who need not please people, and politicians are not known to effectively control bureaucracy. As the following section shows, the underlying causes for time and cost overruns in India are different. It also shows that even the existing Indian literature on the subject has neglected several crucial causes behind delays and cost overruns along with their statistical significance.

FIGURE 1:



4. Delays and Cost Overruns in India: *Causes and Proxies*[10]

Every infrastructure project has to undergo several stages: from planning of the project to its approval to awarding of contract(s) to actual construction/procurement, and so on. Broadly put, a project's lifecycle has three phases; development, construction, and operation-and-maintenance phase. See Figure 1. During the development phase, project sponsoring authority makes and approves estimates of time and funds needed for completing the project. Generally, a project requires approval from several other departments also.[11] The construction or the implementation phase starts with the signing of a contract between the sponsoring department and a contractor, generally selected through bidding. Depending on the context, the contract is for construction or for procurement of assets. During this second phase, timely completion of the project requires active cooperation of the sponsoring authority, the contractor(s) and several other departments. Whether a project can be delivered on time and on cost depends on how well the activities of the departments and the individuals concerned are coordinated. Activities of the contractor are governed by market contracts. On the other hand, efforts of government officials are determined by the hierarchical relations among and within the government organizations. Each mode of governance is subject to failure. Such failures, among other factors, can cause delays and cost overruns. For the ease of exposition, it is helpful to divide the set of possible causes in the following subgroups.

***Technical and Natural Factors*:** The estimation of project time and cost for infrastructure projects is a characteristically complex exercise. Though the estimation techniques have become better and sophisticated in recent times, still they are imperfect. As work on a project starts, its future unfolds and the authorities along with the contractor become better informed about the specific technological and material requirements of the project. For example, during construction phase of a road project, an unexpectedly poor quality of soil may necessitate changes in engineering, design and the quality of bitumen, from what was initially planned. Such changes may require extra time as well as funds. In some cases the actual circumstances, in contrast, may turn out to be favourable and the parties may find that they had made excessive provisions of funds and time. Similarly, flood or

[10] For a detailed discussion and analysis of the issues discussed in this subsection see Singh (2009).
[11] For example, a typical civil aviation project needs clearances from the ministries of civil aviation, finance, environment and forest, and the Airport Authority of India.

any other event of *force majeure* may cause delay as well as destroy the project assets. Alternatively, the natural conditions may turn out to be very favourable saving construction time plus costs.

However, one would expect the effects of the technical and natural factors to be random without any bias. Also, due to the above-discussed learning among officials, both the delays and the cost overrun would be expected to come down over the years. Therefore, if the decline in the delays and cost overruns over the years turns out to be statistically significant, we can attribute the decline to the technical and natural constraints. To confirm whether this is the case, for each project we have calculated the *TIMELAPSE*. It is the time that has lapsed since May 1974 to the date of approval of the project. The *first* project in our dataset was approved in May 1974. *Ceteris paribus*, the longer is TIMELAPSE for a project the lower should be time and cost overruns. However, the effects of learning on decline in delays and cost overruns should come down over the years. Also, effects of policy interventions are expected to decline over time. Therefore, we expect that with the passage of time delays and cost overrun will come down, but at a decreasing rate. Formally, the variable TIMELAPSE has a quadratic relation with time and cost overruns.

***The Contractual Failures*:** As argued before, successful implementation of a project turns on joint and timely efforts of the sponsoring authority and the contractor(s). In terms of Figure 1, at date t=1 the initial construction/procurement contract is signed between the authority (employer) and the contractor. This contract specifies the works that are to be performed or the good that is to be delivered by the contractor. In principle, contracts known as *complete-contingent-contracts* can ensure that project is completed on time and within budget. Such contracts are assumed to provide every detail of works that are to be performed by the contractor in each possible scenario during the construction phase. In reality, however, the initial contract cannot fully describe every possible scenario that may unfold during the construction phase. Moreover, it does not completely specify every relevant aspect of the project works. The bounded rationality of the parties along with technological constraints makes it impossible to specify every task to the last detail; since different states of nature require different modifications in the assets to be built. This is especially true of the contract for infrastructure projects, which are inherently complex and have long gestation phase. Therefore, infrastructure procurement contracts are

intrinsically 'incomplete'.[12] Once the contractor starts work and future unfolds, the need for 'additional' works arises. For example, on a railways project it may become necessary to have more of manned-crossings or railway-over-bridges than were initially intended. Additional works invariably require more funds. In some cases, they may need extra time also. Therefore, some of the cost overruns are caused by what we have called the contractual incompleteness. Contractual incompleteness increases with the project size. Big projects are more complex than the smaller ones. As complexity of a project increases, it becomes more difficult to provide every minute detail in the initial contract.

However, the initial contract can be made more or less incomplete. A meticulous planning in terms of technical and material requirements of the project can enable the parties to stipulate most of work details in the initial contract itself; fewer details are left for the future decisions. In contrast, if project planning is bad, the estimates of project time and cost will be vague, and so will be the initial contract. Project planning processes in India are infamous for their ad-hoc and lackadaisical approach. Detailed project reports (DPRs) as well as feasibility reports are sloppy and vague, prepared only for the sake of formality.[13] As a result, initial contracts for infrastructure projects are rather incomplete. The problem is severer for bigger projects. Since big projects are more complex, a lackadaisical planning produces only sketchy estimates of time and cost. So, the initial contracts for bigger projects inevitably omit relatively many more details of project works, which result in cost overruns during the implementation/construction phase. This problem is further exacerbated by the use of *unit-price EPC* contracts. Under these contracts neither the officials nor the contractors find it worth haggling over details.[14] On this count also, contractual incompleteness increases with project size.

In other words, contractual failures caused by the inferior project planning and flawed contracting processes appear to be leading causes behind delays and cost overruns observed in India. However, if this is the case then the cost and the time overruns would be expected to escalate with the project size. We will test this hypothesis. The initially expected project cost (*INITIALCOST*) is a very good proxy for project size, its complexity, and hence the contractual failures. Clearly, larger projects have higher initial

[12] For an accessible account of 'incomplete' contracts see Hart (1995).
[13] See Lok Sabha (2006) and LEA (2008).
[14] Under unit-price EPC contracts, the contractor gets paid based on the quantities of inputs used. Therefore, he does not have to worry too much about details of material requirements.

costs than smaller projects, and *vice-versa.*[15] Another proxy is also available. It is the implementation phase or IMPLPHASE for short. It is the duration in which the project is initially planned to be completed. Typically, implementation phase increases with the project size.

We expect delays and cost overruns to go up with an increase in the initial cost. Similarly, we expect projects with longer implementation phase to experience higher cost overruns due to greater uncertainty. But, what is the relationship between the implementation phase and the time overrun? The above discussion suggests that projects with longer IMPLPHASE are more given to delays. Nonetheless, *ceteris paribus,* longer IMPLPHASE projects have already got longer time for completion. Therefore, they should show relatively low time overruns. For instance, between the two similar and same-sector projects, the one with longer IMPLPHASE should show lower time overrun. On top of it, longer IMPLPHASE projects have greater flexibility for accommodating additional works without needing extra time. Therefore, *ceteris paribus,* we expect the *percentage* time overrun to come down as implementation phase increases.[16]

***Organizational or Institutional Failures*:** As argued above, a timely and efficient execution of infrastructure projects requires active cooperation of several departments within as well as among various ministries. However, real world hierarchy based organizations, especially the government organizations, are inherently weak in inducing the desired efforts from the people involved. Incentives created by government organizations are particularly weak. At every stage of hierarchy there is a conflict between the individual and the social objectives. Therefore, infrastructure projects have to face the consequences of many sources of failures within the sponsoring organization. On top of it, these projects need joint efforts of several other organizations. In India, different departments are responsible for different project activities. For example, project implementation, shifting of power lines, water lines, sewer lines, cutting of trees, environmental clearances and other such activities are performed by different departments.[17] Executions of these activities are highly dependent on joint and timely

[15] Please note the initially expected project cost, rather than the actual cost, is a better indicator of the size and incompleteness of the contract. Due to cost overrun, the final cost can be large even for small projects. The same argument applies to the implementation phase.
[16] In absolute terms, time overrun is likely to increase with implementation phase.
[17] See Lok Sabha (2006), Morris and Pandey (2007), Raghuram *et al* (2009) and other studies cited in Introduction.

efforts of the departments involved. However, interdependence of efforts means that it is easy for departments to shirk and pass the blame on others. So, in addition to intra-organizational failures, infrastructure projects in India are vulnerable to inter-organization failures. But, how can we measure the degree of these failures?

As mentioned earlier, several departments of the state government concerned play rather crucial role in project implementation. After all, activities like land-acquisition, shifting of utilities, etc., are performed by the state government concerned. This means that if a project spans across more than one state, it has to deal with the concerned departments in each state. Therefore, projects spanning across multiple states seem more susceptible to inter-organizational failures. If these failures are a statistically valid cause of delays and cost overruns, *ceteris paribus*, projects spanning across multiple states should experience higher time and cost overruns. To test this hypothesis, we introduce a dummy variable called *DSTATES*. Other proxies for organizational factors are also available.

As clarified in Section 2, most projects in road, railways and urban-development sectors are construction projects. Projects in these sectors generally need environmental clearance from the central as well the state agencies. Moreover, compared to those in the other sectors, these projects require much more active cooperation of several departments for land/property acquisition, shifting of power lines, water lines, sewer lines, approval of under or over-passes, etc. So, these projects are highly vulnerable to all kinds of organizational failures. Again, if organizational failures are a major underlying cause, compared to other sectors, project in road, railways and urban-development sectors should exhibit high time and cost overruns. This suggests that dummy variables *DROADS*, *DRAILWS*, and *DURBNDEV* for road, railways and urban-development projects, respectively, can also serve as proxies of institutional failures.

To sum up, if organizational failures are a significant cause of delays and cost overruns, then multistate, road, railways and urban-development sector projects should exhibit relatively high time and cost overruns. One may be tempted to apply the above arguments to some other sectors too; like civil aviation, shipping and ports, power, oil and petroleum, etc. In these sectors, some projects are big and technologically challenging. In several cases, ecologically sensitive land has to be acquired. This means more

regulations.[18] Therefore, one can expect projects in these sectors to exhibit higher cost overruns on account of contractual as well as organizational failures. Unfortunately, due to large heterogeneity, projects in these sectors are not amenable to statistical analysis we are interested in. Nonetheless, we will confirm this conjecture by using dummies DPORTS and DPOWER for shipping and power sectors, respectively.

***Economic Factors*:** Each project is located in some state(s). Apart from the above introduced causes, economic aspects of the state(s) concerned also affect the project time and costs. For example, if a state has better transport, power and telecommunication infrastructure in place, it will be easy to execute projects in the state. So, projects located in states with higher infrastructure index (or *INFRA INDEX* for short) are likely to experience lower time and cost overruns and *vice-versa*. In addition, the income level of a state may also have a bearing on delays and cost overruns. We would like to find out whether per-capita SGDP of the state concerned has some explaining to do. In addition, we will check if delays and cost overruns vary across regions in India.

5. A Simultaneous Equation Model and its Results

In general, a factor that causes delay will also trigger off cost overrun, and *vice versa*. Therefore, the time and the cost overruns are jointly dependant on the above introduced explanatory variables. Such scenario warrants use of a simultaneous-equation model in which the time and the cost overruns are endogenous variables, jointly dependant on the above explanatory variables. In fact, there is more to the relationship between the time overrun and the cost overrun. Logically, any delay in implementation in itself will cause cost overrun for the project. This should happen simply on account of inflation itself. In most cases, initial cost estimates are arrived at using the current input prices. If there are delays, inputs will become more expensive and, in turn, will cause an increase in the project cost. Moreover, certain overhead costs have to be met as long as the project remains incomplete. Delays should increase these costs also. Also, a long delay may cause depreciation of project assets, necessitating expenses on repairs or replacements. This means that in addition to the above variables, 'time overrun' is an explanatory variable for 'cost overrun.' In contrast, cost overrun *per se* does not imply time overrun. Suppose, project cost has increased due to inflation. There is no reason why this in itself

[18] For a case study of Dhamra Port expansion project see Jonston and Santillo (2007).

should lead to a delay in the implementation.[19] Therefore, between the time overrun and the cost overrun, the causation seems to run from the former to latter, not the other way round. Moreover, time overrun is a manifestation of the effects of several factors not considered above. For example, poor project management, delays on the part of the contractor, etc. These factors also lead to cost escalations through time overrun. So for our purpose the relevant model is the following *recursive simultaneous-equation model*.[20]

$$\begin{aligned}\log PCTIMEOVERRUN_t = {} & \alpha_0 + \alpha_1 TIMELAPSE_t + \alpha_2 TIMELAPSE^2{}_t + \alpha_3 INTIALCOST_t \\ & + \alpha_4 IMPLPHASE_t + \alpha_5 DSTATE_t + \alpha_6 DROAD_t + \alpha_7 DRAILWAYS_t + \alpha_8 DURBANDEV_t \\ & + \alpha_9 DPOWER_t + \alpha_{10} DPORTS_t + \alpha_{11} DSR_t + \alpha_{12} DWR_t + \alpha_{13} DNE_t + \alpha_{14} PSGDP_t \\ & + \alpha_{15} INFRAINDEX_t + \varepsilon_{1t}\end{aligned} \quad \textbf{(1)}$$

$$\begin{aligned}\log PCCOSTOVERRUN_t = {} & \beta_0 + \beta_1 TIMELAPSE_t + \beta_2 TIMELAPSE^2{}_t + \beta_3 INTIALCOST_t \\ & + \beta_4 IMPLPPHASE + \beta_5 DSTATE_t + \beta_6 DROAD_t + \beta_7 DRAILWAYS_t + \beta_8 DURBANDEV_t \\ & + \beta_9 DPOWER_t + \beta_{10} DPORTS_t + \beta_{11} DSR_t + \beta_{12} DWR_t + \beta_{13} DNE_t + \beta_{14} PSGDP_t \\ & + \beta_{15} INFRAINDEX_t + \beta_{16} \log PCTIMETOVERRUN_t + \varepsilon_{2t}\end{aligned} \quad \textbf{(2)}$$

The magnitudes of project time and costs vary across sectors as well as within a sector. Therefore, for the ease of comparison, for each project we have considered percentage rather than absolute value of the cost and the time overruns. For technical convenience, we have considered log values of percentage cost and time overruns.[21] The log transformations of time and cost overruns have improved the distribution of the residual terms. The explanatory variables along with the relevant causes have been introduced in the previous sections. Also, note the use of regional dummies DNE, DSR and DWR for North Eastern states including J&K, Southern and Western states, respectively.[22] These variables have been incorporated to check whether some regions exhibit comparatively long delays and high cost overruns. Data on PSGDP is taken from CSO and for INFRAINDEX we have used the index prepared by the Finance Commission. For the rest

[19] Cost escalation can cause delays, one may argue, if there are not enough funds available for the project. However, a study by the author shows that in most cases the actual expenditures have been less than the project outlays. Therefore, delays cannot be attributed to the shortage of funds. Moreover, lack of funds seems to be serious issue only for state government funded projects. See *Express Newsline*, April 22, 2009.

[20] See Green (2008, Ch 13).

[21] The exact transformation used is $\log(\%COSTOVERRUN + 100)$. While a log transformation is possible for only strictly positive % cost overruns, some projects in our dataset have negative cost overruns. To take care of this problem, we have added 100.

[22] Western region includes states of Rajasthan, Gujarat and Maharashtra. Southern region includes states of Karnataka, AP, Kerala and Tamil Nadu.

of the variables, we have done our calculations based on the relevant data from MOSPI reports.

As noted above, our dataset includes 850 projects from seventeen sectors. Out these, we had to drop 77 outliers distributed randomly across sectors. Moreover, out of the dropped 77 projects, 38 have had *negative* cost overrun of at least 68 percent. This means that if, for example, the initially estimated cost of a project was Rs 100 crore, the actual cost turned out to be less than Rs 32 crore! Clearly, these figures are incredible. No convincing explanation can be provided to rationalize saving at this scale, that too by government officials. I can think of only two possible explanations. Most probably these are instances of reporting/typing errors. Alternatively, it could be that during the implementation phase the changes made in the scope of project were so large that the final project and the initial one are incomparable.[23] Therefore, even without statistical reasons it was not meaningful to include such projects in the analysis.

We have tested the two error terms in equations (1) and (2) and found that each error term is normally distributed. Also, we tested these error terms for any correlation between the two. The null hypothesis that the two errors are correlated was strongly rejected. Therefore, the test has confirmed that $\text{cov}(\varepsilon_{1t}, \varepsilon_{2t}) = 0$. That is, the model specified in (1) and (2) does not seem to have omitted any significant variables. Moreover, it is actually a *fully recursive simultaneous-equation model*. Therefore, we can apply OLS estimation to each equation individually to get consistent estimated parameters (see Green, 2008, Ch 13). The regression results are presented in Tables 4. Column 2 shows results for equation (1). Columns 3 and 4 show results for equation (2) with and without regional dummies, respectively.

Our hypotheses have turned out to be valid for all variables except PGSDP. In each regression, the trend variable TIMELAPSE has negative coefficient and is highly significant at 1%. However, in both the equations, the coefficient of $TIMELAPSE^2$ is positive and significant at 1%. These results imply that the downward trends for percentage time and percentage cost overruns are statistically significant. However, the

[23] For example, initially a 200 km road was to be built but finally it was decided to bring down the length to just 40 km. Clearly, a road project of 200 km is not comparable to the one covering just 40 Km.

rate of decline in delays and cost overruns has come down in due course.[24] The coefficients of INTIALCOST in equation (2) is positive and significant at 5%.That is, as project size increases cost overruns soar up not only in absolute terms but also as a percentage of project cost. Also, coefficient of IMPLPHASE in equation (2) is positive and significant at 5%. These results confirm our claim that poor project planning and the contractual failures are statistically significant causes behind cost overruns observed in India. For equation (1), as expected, the coefficient of IMPLPHASE is negative and highly significant at 1%. In contrast, the coefficient of INTIALCOST though positive is insignificant. Therefore, the main effect of contractual failures seems to be on cost overruns; and not so much on time overruns.[25]

As predicted, time overrun is an important factor behind cost overruns; the coefficient of LOGPCTGTIMEOVERRUNS is positive and very significant at 1%. This corroborates our argument that regardless of the underlying reason, delays in implementation are a major cause of cost overruns.

Our results have confirmed that organizational failures are a significant cause behind delays and cost escalations. Indeed, proxies for organizational factors – DSTATE, DROADS, DRAILWS and DURBNDEV – have all come out to be positive and highly significant. That is, *ceteris paribus* the interstate, road, railways, and urban-development projects have experienced relatively high percentage of time and cost overruns. As expected, variables DPOWER and DPORTS have not shown any consistency. However, given the heterogeneity in these sectors, this outcome, is not entirely surprising.

As far as the relative performance of the states is concerned, western and southern states have done better than the rest. Projects in these regions have experienced relatively short delays and low cost overruns. The coefficients of DNE suggest that projects located in north-eastern states and Jammu and Kashmir have experienced shorter delays and higher cost overruns. The coefficients, however, are not significant at all. Apparently, the coefficients of INFRAINDEX though of expected sign are not significant. However, due

[24] In fact, the TIMELAPSE variable has a U-shape effect on delays and cost overruns.
[25] However, note that in equation (1) the dependant variable is log of *percentage* time overrun rather than the absolute value of the time overrun. Time overruns in absolute terms should increase with the project size. To confirm this, we replaced the dependant variable in equation (1) with the absolute value of time overrun. With this substitution, coefficient of INITIALCOST along with that of IMPLPHASE became positive.

to the presence of regional dummies this insignificance is misleading. Note that regional dummies and INFRAINDEX capture similar effects. If we drop the regional dummies, coefficient INFRAINDEX becomes highly significant - at 1%. See column 4. Similarly its significance level goes up in equation (1). Therefore, projects located in states with better infrastructure have shown lower time and cost overruns. The signs of PSGDP are somewhat intriguing. In both the equations, coefficients of PSGDP are positive and highly significant at 1%!

TABLE 4: Regression results

1	2 LOGPCTIME OVERRUN	3 LOGPCCOST OVERRUN	4 LOGPCCOST OVERRUN
TIMELAPSE	-0.0100958* [0.0006945]	-0.0033940* [0.0008000]	-0.0034574* [0.0007994]
$TIMELAPSE^2$	0.0000142* [0.0000012]	0.0000047* [0.0000014]	0.0000049* [0.0000014]
INITIALCOST	0.0000082 [0.0000080]	0.0000194** [0.0000088]	0.0000192** [0.0000088]
IMPLPHASE	-0.0030650* [0.0002796]	0.0007531** [0.0003569]	0.0008064** [0.0003567]
LOGPCTIMEOVERRUN		0.0617547* [0.0147922]	0.0642878* [0.0147832]
DSTATES	0.0294957+ [0.0171745]	0.0369198+ [0.0189287]	0.0365975+ [0.0188830]
DROADS	0.1162002* [0.0144094]	0.1355875* [0.0161297]	0.1314382* [0.0160233]
DURBNDEV	0.0882851* [0.0316054]	0.0590039+ [0.0349236]	0.0699818** [0.0345647]
DRAILWS	0.1990223* [0.0166489]	0.1533157* [0.0192843]	0.1542668* [0.0192648]
DPOWER	-0.0345449+ [0.0176383]	0.0688762* [0.0195483]	0.0744935* [0.0190209]
DPORTS	0.1125947* [0.0195119]	0.0212278 [0.0218067]	0.0197065 [0.0217922]
DSR	-0.0248747+ [0.0139923]	-0.0301908+ [0.0154278]	
DWR	-0.0615962* [0.0153470]	-0.0354110** [0.0169545]	
DNE	-0.001763 [0.0230726]	0.0274081 [0.0254427]	
PGSDP	0.0000028* [0.0000008]	0.0000026* [0.0000009]	0.0000030* [0.0000009]
INFRAINDEX	-0.0004357+ [0.0002553]	-0.0003184 [0.0002821]	-0.0006990* [0.0002395]
Constant	6.5340209* [0.0989325]	2.1021397* [0.1611224]	2.1111899* [0.1613806]
Observations	773	773	773
R-squared	0.5546101	0.3415911	0.3359042

Standard errors in brackets
+ significant at 10%; ** significant at 5%; * significant at 1%

Before concluding, let me make an observation. As Tables 2 and 3 show, most projects suffering from cost overrun have experienced delays. In contrast, there are a number of projects with delays but no cost overruns. In view of our arguments on time overruns versus cost overruns, these figures are somewhat puzzling. It appears that these paradoxical figures are a result of somewhat different procedures used to calculate time and cost overruns. In terms of Figure 1, initial estimates of time and cost are made at time t=0, however the contract is awarded at t=1. Generally there are delays between t=0 and t=1. As a result, input prices at t=1 are significantly higher than at t=0. Only cost estimates get revised upward at t=1, not the time estimates, and these revised cost figures are reported in official files. This indeed has been found to be the case with road projects. Moreover, since cost escalations necessitate additional funds, so cost figures get revised to avoid audit objections; time, in contrast, appears to be a free good in government departments. As a consequence of such midway revisions, the cost overruns get under-reported.

6. Conclusions and Policy Implications

Our results have confirmed that since 1980s the time and the cost overruns have been declining. The decline is statistically significant. Cost overruns have systematically declined not only in absolute terms but also as a percentage of project cost. Similar is the case with delays. The technological advances and intermittent policy initiatives seem to have enabled the government officials to improve estimates of project time and cost.[26] However, efficacy of these factors in reducing delays and cost overruns has weakened in the due course. Delays along with cost overruns are still too frequent and too large. They are inflicting huge but largely avoidable cost on the economy.

Several types of contractual and organizational failures have come to beset the project planning and implementation processes. Planning process is ad-hoc and lackadaisical. The implementation is much worse. We have shown that the deficient planning, choice of inefficient contracts and the protracted implementation processes are responsible for delays. Delays, in turn, are one of the major causes of cost overruns. Therefore, planning,

[26] This result supplements findings that performance of public sector as a whole has improved since mid 1980s (see Nagaraj, 2006).

contracting and implementation processes all call for drastic and imminent reforms. This study offers several policy suggestions.

First of all, to the extent possible, policy makers should avoid planning for large projects. Our results show that cost overruns soar as project size increases; the cost overruns escalate not only in absolute terms but also as a percentage of project cost. This happens largely on account of inadequate project planning and use of inefficient contracts. Similarly, projects with longer implementation phase have shown larger cost escalations. Projects with long implementation phase are vulnerable to deterioration in project assets and inflationary fluctuations. The gravity of these problems can be reduced by, wherever possible, keeping the project size small. However, project planning process itself needs a radical overhaul. It is worth investing resources to have more precise estimates of project time and cost. Moreover, wherever possible *fixed-price* rather than *unit-price* EPC contracts should be used. Under the commonly employed unit-price EPC contracts neither government officials nor the contractor have incentives to take the contract seriously. As a result, contracts are vague at the time of signing and poorly managed afterwards, leading to delays and cost overruns.

Also, wherever possible interstate projects should be avoided. Our results have proved that regardless of the sector and the size, projects spanning across multiple states have experienced larger time and cost overruns. Interstate projects suffer from inter-organizational failures. Indeed, the organizational failures are a statistically significant cause of delays and cost overruns. This finding is corroborated by our other results also. Regression results show that, due to organizational failures, the road, railways and urban-development projects have experienced relatively long delays and high cost overruns. In fact, organizational failures frequently trigger yet another form of contractual failure. It is widely known that contract management during the construction phase is very important if delays are to be avoided. At present, construction contracts are generally awarded even before the required land for the project is acquired. Similarly, utilities are shifted during the construction phase. Invariably, several departments are involved in approving and the actual shifting of power, water and sewer lines and other utilities. Government agencies rarely do what they are required to do, but can use cobweb of complicated rules and procedures to pass the blame for delays on each other. So much so that even if the delay is caused by the contractor it is almost impossible to punish him. Since contractor can

easily prove a contributory negligence on the part of one or the other department. This explains why contracts are rarely terminated, even when contractors cause prolonged delays. Several measures can help on this front too. For example, if activities like land acquisition and shifting of utilities can be completed either before or soon after the award of contract, the contractors can be put on high powered incentives to deliver on time and quality.

Furthermore, while arriving at time and cost estimates, project planners need to be mindful of the location of the project. Projects located in western and southern states have experienced relatively short time overruns and lower cost overruns. The high cost overruns shown by north-eastern states, however, are not statistically significant. *Ceteris paribus*, states with better infrastructure have shown lower time and cost overruns. However, contrary to popular perception, projects located in richer states have experienced longer delays along with higher cost overruns. It could be that people in rich states have higher acceptable standards for public goods and services. Therefore, local resident demand more of extra works in such states. This definitely seems to be the case for road projects.[27] However, this issue needs to be explored further.

Our results are relevant for the present official policies toward infrastructure as well. Policy makers seem to be keen to privatise the funding, management and ownership of infrastructure facilities. The problems of delays and cost overruns with the public delivery systems are being used to justify privatization of public goods and services. While an outright privatization has invited strong protests from several quarters, the PPPs have become politically acceptable means of transferring management and ownership rights to private firms. Our results imply that a change in ownership itself cannot mitigate all the problems with the supply and administration of infrastructure facilities. After all, even PPP projects have to be initially planned by government officials. Moreover, such projects are also vulnerable to some of the contractual and organizational failures discussed in this paper. Projects for upgradation of Delhi and Mumbai airports, construction of Bangalore Metro and for Delhi-Gurgaon Expressway are some of the cases in point. These are all PPP projects and have experienced major delays. In contrast, the contractual and institutional approach adopted by the DMRC for the construction of Delhi Metro is worth emulating. Interestingly, DMRC has adopted some aspects of the

[27] See Lok Sabha (2006).

approach suggested above. As a result, most projects have been completed on time and within budget.

I would like to conclude with a remark on our results. Most of the results are applicable to all infrastructure projects, regardless of the sector and the project type. However, generality always comes at a cost. Infrastructure projects are quite different in term of the size, gestation period and the nature of project work. Apart from the issues discussed here, there are sector-specific issues also that impinge on delays and cost overruns. It will be useful to supplement the present study with sector-specific analyses. Sector-specific studies may allow testing of some additional hypotheses. For example, it may be possible to evaluate the comparative performance of different types of contracts, say acquisition versus construction contracts, PPP vs Non-PPP contracts. It may also be possible to explore whether ownership structures have some bearing on the delays and cost overruns. I intend to take some of these next steps.

REFRENCES:

ADB (2006), "Facilitating Public–Private Partnership for Accelerated Infrastructure Development in India, Asian Development Bank, Delhi.

Anant, TCA and Singh, Ram (2009), "Public Private Partnership Contracts in Roads: *Some Key Determinants*," manuscript.

Arvan, L. and Leite. (1990), 'Cost Overruns in Long-Term Project,' *International Journal of Industrial Organization*, 8(3), 443-67**.**

Banerjee-Guha, Swapna (2009), Neoliberalizing the 'Urban': New Geographies of Power and Injustice in Indian Cities, *Economic and Political Weekly*, XLIV 22, pp. 95-107.

Chakrabarti B. (2008), "Role of Agencies in Land Acquisition: Problem of Coordination and Process Failure", paper presented in Writers' Workshop, 3i network, IIM Ahmadabad, November 1, 2008.

Dalvi, Qasim (1997), "Transport Planning and Policy in India", Mumbai: Himalaya Publishing House.

Flyvbjerg, B., Holm , M.K.S. and Buhl, S.L. (2002), "Cost underestimation in public works projects: Error or lie?," *Journal of the American Planning Association*, 68(3), 279 – 295.

Flyvbjerg, B., Holm , M.K.S. and Buhl, S.L (2003), "How common and how large are cost overruns in Transport infrastructure projects?," *Transport Reviews*, 23, 71-88.

Flyvbjerg, B., Holm , M.K.S. and Buhl, S.L (2004), "What Causes Cost Overrun in Transport Infrastructure Projects?" *Transport Reviews*, 24 (1), 3-18

Ganuza, J.-J. (2003), "Competition and Cost Overruns: *Optimal Misspecification of Procurement Contracts*," Universitat Pompeu Fabra, Department of Economics and Business, *Working Paper no.* 471.

Ganuza (2007), 'Competition and cost overruns in Procurement,' *International Journal of Industrial Organization*, Vol. 55(4), 633-660.

Gaspar, V. and Leite, A. (1989), 'Selection Bias Induced Cost overruns,' *International journal of Industrial Organization*, 8(3), 443-67.

GoI (2006 a), "Financing of the National Highway Development Programme", *Report of the Core Group*, Planning Commission, Government of India.

GoI (2006 b), "*Guidelines on Financing Support to Public Private Partnerships in Infrastructure*, Planning Commission.

GoI (2007), "The report of The Committee on Infrastructure Financing" (Deepak Parekh Committee) available at www.pppinindia.com

Goyal, Ashima (2008), "Governance in India's Public Transport Systems: *Comparing Indian Railways and Airlines*", *Economic and Political Weekly*, XLIII ,28, 119-127.

Green, William H (2008), *Econometric Analysis*, 6th Ed. Pearson Prentice Hall, New Jersey.

Hart, Oliver (1995), *Firms, Contracts and Financial Structure*, Clarendon Press, Oxford.

Jonston P and Santillo D (2007), "The Dhamra-Chandbali Port Expansion Project, Critique of the Environmental Impact Assessment, Greenpeace Research Laboratories, Bangalore.

Kain, J. F. (1990), "Deception in Dallas: Strategic misrepresentation in rail transit promotion and evaluation", *Journal of the American Planning Association, 56*(2), 184–196.

Kundu, Amitabh (2001), "Urban Development, Infrastructure Financing and Emerging System of Governance in India: *A Perspective" Management of Social Transformations*, Volume 4(15).

Kundu, Amitabh (2003), "Infrastructure Financing and Emerging Pattern of Urbanisation: *A Perspective*" Planning Commission, available at http://www.planningcommission.nic.in/reports/genrep/bkpap2020/9_bg2020.pdf.

LEA International Ltd. (2008), "Suggestion for Improvement of the PWD Costing Methods, Processes, Centralize Costing/Estimating Policy Function, Upgrade Cost Estimating Tools, Skills" Report No 9.

Lok Sabha (2006) "*Fourteenth Report*" of Committee on Public Undertakings (2006-07), published by Lok Sabha Secretariat, New Delhi.

Merewitz, L. (1973), "Cost overruns in public works", in W. Niskanen, A. C. Hansen, R. H. Havemann, R. Turvey, & R. Zeckhauser (Eds.), *Benefit cost and policy analysis*. Chicago: Aldine.

Morris, Sebastian (1990), "Cost and Time Overruns in Public Sector Projects", *Economic and Political Weekly*, Vol. XXV, No.47, pp.M-154-M-168.

Morris, Sebastian (2003), "Public Investment in India: Delays and Cost Overruns", *India Infrastructure Report* 2003, Chapter 5.1.

Morris, P. W. G., & Hough, G. H. (1987). *The anatomy of majorprojects: A study of the reality of project management*. New York: John Wiley and Sons.

Morris S and Pandey A (2007). Towards Reform of Land Acquisition Framework in India. *Economic and Political Weekly* 42 (22), pp 2083-2090.

Nagaraj, R (2006), "Public Sector Performance since 1950: *A Fresh Look*," *Economic and Political Weekly*, 41 (25) 2551-57.

Pickrell, D. H. (1990) *Urban rail transit projects: Forecast versus actual ridership and cost*. Washington, DC: U.S. Department of Transportation.

Raghuram, G., Samantha Bastian and Satyam Shivam Sundaram (2009), "Mega Projects in India: *Environmental and Land Acquisition Issues in the Road Sector*", *IIMA W.P. No*. 2009-03-07

Singh, Ram (2009), "Delays and Cost Overruns in Infrastructure Projects: *Causes and Consequences*" mimeo.

Skamris, M. K., & Flyvbjerg, B. (1997), "Inaccuracy of traffic forecasts and cost estimates on large transport projects", *Transport Policy*, *4*(3), 141–146.
Sriraman S (2003), "Capital Expenditure Budgeting Process in the Indian Railways", *India Infrastructure Report* 2003, Chapter 5.2
Thomas M.K. (2000), *Public Sector Transport in India in the New Millennium: A Historical Perspective*, Ebenezer Publishers, Pune.
Thomsen Stephen (2006)" Sacred Cows on the road to Development: Reforming India's Infrastructure" available at http://www.tcf.or.jp/data/2006120607_Stephen_Thomsen.pdf
Vijayamohanan Pillai, N. and K.P. Kannan (2003), "Time And Cost Over-Runs Of The Power Projects In Kerala" *Centre for Development Studies*, Trivandrum, Working Papers Working Paper No. 320.
Wachs, M. (1989). "When planners lie with numbers," *Journal of the American Planning Association*, *55*(4), 476–479.
Wilkinson, Steven (2006), "Politics of Infrastructural Spending in India," Department of Political Science, University of Chicago, mimeo.

Data Sources:

MOSPI: various quarterly reports and other publications.
CSO: various publications
Finance Commission: "State Infrastructure Index" accessed from **http://fincomindia.nic.in/fincomnet/rpt_intra/st_infrast.doc**