Corruption and Policy Outcomes in Indian States

*Jennifer L.Bussell**

Abstract

The emergence of new information technologies in the 1990s sheds new light on a fundamental, but often flawed, role of government: the provision of public services to citizens. Low-cost, digital technologies offered prospects for increasing the effectiveness and transparency of government. However, policies to reform service delivery using new technologies differ both across and within countries, and the timing of policy initiation in particular has varied dramatically. Drawing on a new data set of technology policies in Indian states, the author uses event history analysis to show that political calculations drive variation in the timing of technology policy initiation. The character of the ruling government's constituency and the level of corruption in a state are found to be the best predictors of when states implement policies promoting computer-enabled services.

Keywords: *Corruption, India, public services, information technology*

1. Corruption and Policy Outcomes in Indian States

The emergence of new information and communication technologies in the 1990s sheds new light on a fundamental, but often flawed, role of government: the provision of public services to citizens. Low-cost, digital technologies were expected to provide opportunities for increasing the transparency and effectiveness of government. Developing country citizens were expected to benefit from the improved delivery of government services, such as issuance of identity cards, birth and death certificates, and licenses; payment of utility bills; the supply of welfare and redistributive goods; and general government-citizen communication (see, inter alia, Davison, Wagner, & Ma, 2005; United Nations, 2003; West, 2005; World Bank, 2004). The benefits of the new technologies were predicted to be greatest in countries where government inefficiency is rife and problems of corruption create major leakages of resources through the service delivery system.

At the turn of the century developing country governments took up this opportunity with vigor and began to develop new systems for "e-governance" and digital technology-based service delivery (see, inter alia, Bussell, 2007; de Tolly et al. 2006; Madon, 2004; Satyanarayana, 2004; Heeks, 2003; and Bhatnagar, 2002). Yet these efforts exhibit significant variation. The timing of technology policies, in particular, has varied greatly across political units, both within and across countries. In India, the main subject of this analysis, subnational states, began to implement policies in the late 1990s to promote the use of computers and the Internet in delivering government services. Yet states varied in the speed with which they adopted these policies. Andhra Pradesh launched a computerized services policy in 1999, for instance, whereas West Bengal, a state with similar economic conditions, did not launch such a policy until 2003. By 2006, despite the substantial attention that technology policies had received in both Indian and international policy circles, 4 of 20 major states had failed to implement any version of a computer-enabled services policy.[1] Figure 1 shows the cumulative adoption of policies over the period under consideration, and Table 1 categorizes the states according to policy timing.

* University of California, Berkeley
Mobile: +1-510-459-5151
Fax: +1-510-642-9515
E-mail: jbussell@berkeley.edu

[1] This excludes the seven northeastern states and Jammu & Kashmir.

Figure 1. Cumulative State Policy Adoption

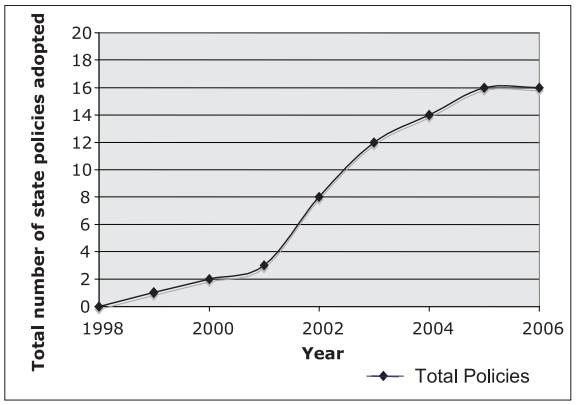

Table 1. Categorization of States by Timing of Policy Initiation[2]

Initial adopters 1999-2001	Early (2002-2003)	Late (2004-2006)	Non-adopters
Andhra Pradesh Kerala Maharashtra	Chhattisgarh Delhi Gujarat Haryana Himachal Pradesh Karnataka Rajasthan Tamil Nadu West Bengal	Orissa Punjab Uttar Pradesh Uttarakhand	Bihar Goa Jharkhand Madhya Pradesh

Why is it that some states began the process of digitizing their service delivery as early as 1999, while others had still not done so by 2006? This paper uses event history analysis to examine the relationship between state-level characteristics and the timing of policy initiation. It found that, in the context of the Indian states, established explanations for subnational policy diffusion are limited in their explanatory value for the case of these new technology policies; neither state socio-economic development and levels of technology infrastructure, nor the previous implementation of similar policies in nearby states can explain the variation in when these new technology policies were implemented.

Instead, it is necessary to examine the expected effects of these policies on established government stakeholders, in particular state politicians, in order to identify what factors affect the initiation, or lack thereof, of computer-enabled services policies.[3] The paper shows that an explanation based on the dynamics of political incentives, and emphasizing the role of corruption in service provision, furnished the greatest analytical leverage for explaining the timing of policy initiation.

2. Federalism, Policy Implementation, and Technology-Enabled Service Center Policies

This analysis focuses on the delivery of services through "technology-enabled service centers,"[4] also known as telecenters, information kiosks, citizen information centers, or common service centers. These centers, which serve as a public outlet for computerized services, have been conceived as a potentially cost-effective model for improving service delivery (Badshah & Khan, 2003).

For our purposes, these service centers are defined by three main components or characteristics. First, they deliver services to private individuals through the use of information technologies, in particular computers and the Internet. The services themselves may be public and/or private in nature. Second, the centers are dedicated, physical locations to which citizens can go to access services. While there may be related policies regarding service delivery via call centers, mobile centers, or mobile phones, computer-based service centers all involve service delivery at an immovable center through the use of information technology. Third, the combination of service delivery and dedicated centers produces a "one-stop shop" environment where there are services available from multiple government departments. Thus, the centers studied here effectively take the ultimate act of service delivery out of the hands of the originating

[2] This categorization is a modified version of that developed by Rogers (1995).

[3] In all of these cases the presumed motivation for the policy lies at the state level, as it was not until 2006 that a related policy was implemented by the central government.

[4] I refer to the centers throughout as technology-enabled, computer-enabled, computer-based, and one-stop service centers.

department and place it in the hands of service center operators.

3. The Argument

It is argued that the observed variation in technology policy adoption results from the strategic calculations of political elites. Politicians attempt to utilize technology initiatives in order to maximize their chances of retaining power, but these policies have both potential benefits and costs. Thus, politicians evaluate the expected effects of policies on their potential for re-election, and when the balance of politicians' calculations differs across states, we observe variation in the adoption of these policies.

The potential advantages for politicians from technology policies stem directly from the benefits these initiatives can provide to citizens. By providing improved access to fundamental government services, the implementation of information technology policies may help politicians improve their chances of re-election by offering a clear example of their ability to serve the needs of citizens. As one citizen noted when patronizing a service center in rural Rajasthan, "I am a lowly electrician in a textile mill and am hired on a daily wage arrangement. I cannot afford to waste a full day being sent back and forth between sundry government offices, without much hope that my job will be done" (Raju Mali, as quoted in Tiku & Kulkarni, 2003). The computerized center which this citizen patronized made it substantially easier for him to access the government services he required.

However, the potential costs to politicians from technology policies derive primarily from decreased income from corruption, due to more transparent service delivery. Corruption in India is seemingly endemic, with Transparency International India finding that more than 60 per cent of Indians have paid a bribe to receive a government service, amounting to more than Rs. 210 billion (approximately US$ 5 billion) in bribes each year across 11 different government departments (Transparency International, 2005, p.3).

Inefficiencies in the traditional provision of government services create opportunities for the extraction of "rents" by bureaucrats and their political superiors; by disrupting established bureaucratic relations and streamlining the process by which citizens access government services, new technologies limit the ability of politicians to generate and appropriate these rents.[5]

More specifically, bureaucrats in India are the face of government, interacting on a daily basis with citizens and often demanding an extra fee to ensure the delivery of services. Bribes collected by bureaucrats, or at least a portion thereof, are likely to be passed on to politicians. In their analyses of Indian bureaucratic institutions, scholars such as Wade (1985) and de Zwart (1994) uncovered a sophisticated flow of bribes extending from the individual citizen through layers of the state bureaucracy and into the pockets of state politicians, who are then likely to use at least some of these proceeds to fund future elections.

The structure of the bureaucracy supports this flow of funds through its model of bureaucratic transfers. State bureaucrats are given appointments at the behest of their superiors, who are ultimately controlled by the chief minister,[6] the state minister overseeing their department or the current member of the state assembly representing their constituency (Wade, 1985; de Zwart, 1994). Because certain posts offer greater potential for bribes, bureaucrats are willing to pay their superiors to retain a lucrative post, or to gain a new post with greater promise of bribes. Politicians take advantage of this willingness to offer bribes for appointments (Wade, 1985) and, as Manor (1995, p.56) noted,

---

[5] Following common definitions in the literature, I consider corruption to be the use of public office for private gain, where "private gain" can entail not just pecuniary gains, but also broader private interests, such as reelection.

[6] Chief ministers in the Indian parliamentary system are the approximate equivalent of the prime minister at the state level and oversee policymaking in the state assembly.

some legislators "collect sizeable sums from bureaucrats who seek agreeable transfers."

Computer-enabled service centers can stem the transfer of funds from bureaucrats to politicians by disrupting the collection of bribes. This reduction in corruption is largely expected to result from changes in current bureaucratic processes that simplify procedures, increase oversight, impose technical constraints on the sources of bribes, and generally reduce the frequency of government-citizen interaction. Improved record-keeping, the introduction of electronic queuing systems, and digital security systems are also expected to reduce the opportunities for bribe-taking.

This disruption in the flow of funds to politicians poses an *electoral* threat, not simply an economic one. This is due to the structure, or lack thereof, of campaign finance in India.[7] There is no explicit funding mechanism for elections to the state assembly. Parties give candidates tickets to run for a particular office in the state, but candidates must fund their own election without significant support from the party (for further elaboration, see Wade, 1985). While the Election Commission of India limits candidate expenditure in state assembly elections from Rs. 500,000 (about US$ 12,500) in small states to Rs. 1 million in large states (ECI 2007), political parties and supporters of candidates can legally spend unlimited amounts, thereby creating the potential for much higher spending if funds are available. This loophole indirectly allows for higher spending by the candidate, who can attribute expenditures above the limit to the party or friends (Iype, 2004), and encourages recourse to illicit funds.

Given the high cost of running election campaigns, incumbent politicians who depend on bribe income to finance their campaigns will have incentives not to support the introduction of transparency-inducing technologies into service delivery channels. As a bureaucrat in West Bengal put it: "One of the biggest issues or challenges for e-government and kiosks [service centers] is all of the people who will lose money from the new system," and "politicians worry about loss of money" (IT Department official, West Bengal government, personal communication, January 18, 2008).

Based on this discussion, it may be expected that the two major factors affecting the timing of technology policy implementation will be politicians' expectations of electoral benefits from the policy and their perceived threat from reduced corrupt income. The anticipated electoral response from constituents and the prevailing level of corruption in a state should have clear effects on policy implementation. Our explicit hypotheses regarding these variables will now be considered.

4. Ruling Government Constituencies

In order to maximize the potential electoral benefits from technology adoption, it is expected that politicians would attempt to target policies at those citizens whom they expect will both see the greatest benefits from the policies and be likely to reward the ruling party for providing them with these benefits. In the case of one-stop service centers, the Indian media focus has tended to emphasize the potential benefits of these centers to poor and rural citizens who have traditionally faced the greatest barriers to accessing government services. Those parties with large constituencies among lower socio-economic categories may then be more likely to expect that these policies will appeal to their constituents. The Congress Party has a stronger historical base among the poor and rural voters than its main competitor the Bharatiya Janata Party or any of the other major parties (Kumar and McMillan, 2004). Thus, it is likely that the Congress Party will be more likely than other parties to implement policies to deliver services through one-stop centers.

[7] This is not to say that politicians in other countries may not face a threat to electoral prospects from a reduction in corrupt funds, yet the details of the system are likely to work differently in different contexts.

5. Corruption

The importance of corrupt income to the political campaigns of incumbents provides a critical, and underinvestigated, explanation for the variation in timing of technology policies across Indian states. The level of bureaucratic corruption differs across states, and it is in highly corrupt states where we should see the greatest effect on policy timing. Politicians in these states are more likely to view these policies as a threat to their resources, which could put at risk their ability to use corrupt funds to contest in the next election. As a result, it is hypothesized that states with higher levels of corruption will be less likely to implement technology-enabled service center policies than states with lower levels of corruption, all else remaining equal.

6. Alternative Arguments – Electoral Competition

Other arguments in the established literature might lead us to believe that alternative political factors should contribute to decisions about policy timing. Analysts of policymaking in India, in particular, have emphasized variation in the number of parties active in the state legislature as a driver of policy outcomes (Chhibber & Nooruddin, 2004; Wilkinson, 2004). These analyses posit that the number of active parties in government, as a measure of electoral competition, affects the strategies of individual parties to target policy goods toward particular groups of constituents. When there are a small number of parties in the legislature, ruling parties have an incentive to provide broadly appealing policy goods. Ruling parties in states with a large number of parties in the legislature should be more inclined toward targeting goods toward smaller groups of constituents (Chhibber & Nooruddin, 2004). One-stop service centers are, in theory, expected to serve large segments of the population. Thus, based on these arguments, one might expect that ruling parties in states with a small number of seats (<3) in government would be more likely to implement service center policies.

7. Election Proximity

According to observers in India, the initiation of the first major state service center project created an electoral incentive for other states to follow suit. As one bureaucrat put it, Chief Minister "Naidu's efforts [in Andhra Pradesh] set up the first really healthy competition between the states.... Because this was a period when states were facing a lot of difficulties in other areas.... This gave them an opportunity to prove their worth to their constituents and show that they could do it also" (former IT Department official, Government of Rajasthan, private communication, May 5, 2007). Bureaucrats in most states also felt that politicians generally believed service center initiatives would be seen as something done to help citizens.

The literature on policy diffusion argues that, when politicians expect an electoral benefit from a particular policy, they will be more likely to implement that policy in the period leading up to an election. Berry & Berry (1990: p. 406) found in their analysis of lottery policies that "politicians do seek to adopt popular policies during election years, when the accompanying electoral rewards should be at their maximum." Because there is evidence that politicians in India did expect to receive an electoral benefit from these policies, it could be derived from this argument that the timing of policy implementation should be associated with the timing of state assembly elections and specifically that the likelihood of policy implementation should be highest in the 12 months leading up to an election.

8. Prior Policymaking

When other political units introduce technology-enabled service centers, this may encourage additional policy implementation at the state level. This effect may occur between states or between states and their sub-state units. At the sub-state level, district-level administrators have in some places been proactive in using computers and the Internet to improve their ability to deliver services within their

administrative domain. It is possible that, in states where local administrators have implemented computer-enabled service initiatives, state-level governments would be more likely to implement similar policies.

The policymaking efforts by geographically close states may also influence later-adopting neighbors. Analysts have seen this dynamic as important both for policy diffusion across states and for diffusion from these subnational "laboratories" to the national policymaking level. Previous studies have typically argued that as states around state A increasingly enact a new policy, the likelihood goes up that state A will implement a similar policy.

9. Economic Conditions and Development

In addition to political characteristics, previous analysts have emphasized a variety of socio-economic variables in attempting to explain the timing of policy enactment. These variables are included in the analysis largely to control for their effects while evaluating key political variables. Characteristics such as income per capita and a political unit's short-term economic health have been linked to the likelihood of policy implementation, especially those policies that would entail capital outlays on infrastructure and technology systems development (Berry & Berry, 1990; McNeal, Tolbert, Mossberger, & Dotterweich, 2003). According to these theories we should expect states with higher per capita income and smaller short-term fiscal difficulties to be more likely to implement technology center policies.

Analysts have also investigated the role of development, as measured by education levels or life expectancy, in evaluating policy diffusion (McNeal, Tolbert, Mossberger, & Dotterweich, 2003). High levels of human development may reflect a historical tendency by the state government to invest in social welfare and indicate a greater likelihood to implement reforms intended to improve the provision of basic services.

10. Technology Infrastructure

The intracountry characteristics of the "digital divide" may also be relevant. McNeal (2003, p.60) hypothesized that e-government initiatives would be more likely in states with high levels of Internet diffusion, as residents would be more likely to want services utilizing these technologies. The opposite is likely to be the case in India, as the policies considered here involve the provision of technologies in areas that might not otherwise have significant levels of technology diffusion. Therefore, states with low levels of technology penetration in homes may be more likely to implement information and communication technology (ICT)-enabled service policies. Unfortunately, good measures of computer and Internet penetration do not currently exist at the state level in India. However, measures of "teledensity," that is, the number of telephone connections per 100 citizens, are available and should provide a reasonably good measure of overall technology infrastructure.

Another measure of the "digital divide" is the number of software companies present in the state. Some observers have noted that software companies can encourage the government to implement governance policies, and so a large number of software companies per capita may be associated with earlier policy implementation.

11. Developing a Model of Policy Initiation

The main analytic technique used for evaluating policy timing is event history modeling.[8] This statistical technique enables an evaluation of what characteristics of states help to predict when a policy is implemented. Established largely in the fields of biology and engineering, event history analysis has increasingly been utilized by social scientists to investigate the timing of actions by social entities. As Box-Steffensmeier and Jones (2004, p. 1, emphasis in the original) put it, "[u]nderstanding

[8] Also known as survival analysis or duration modeling.

an 'event history' entails a consideration of not only if something happens, but also when something happens." In political science this has often meant the analysis of policymaking decisions by subnational or national political units. This technique is applied in this paper to data on the timing of computer-enabled service center policies within the Indian states.

In an event history model the dependent variable is a measure of the "time that units spend in a state before experiencing some event" (Box-Steffensmeier & Jones, 2004, p.1). The model is then used to ask the question, "What is the risk that a unit will experience this event at a given moment in time?" When covariates are added to the model, the question is modified to ask, "What is the risk at this moment, given the unit's measures on these covariates?" As a result, through the use of event history models, "[n]ot only can some claims be made regarding survival and risk, but also, explicit comparative inferences can be made regarding differences across the cases" (Box-Steffensmeier & Jones, 2004, pp.3-4).

The hazard rate for the model is the rate that defines the likelihood that units experience an event (for example, policy implementation) at a given moment. In the context of a Cox proportional hazard model (Cox, 1972), the value of the hazard rate at a given time, t, is calculated from the values of the explanatory values at time t (Box-Steffensmeier, 1996, p. 364). Once a unit has experienced the "event" of interest, it is dropped from the data and is no longer included in these calculations. Thus, for any moment in time the hazard rate is calculated based on the characteristics of those units that remain in the data set, otherwise know as a risk set, at that moment (i.e. those units still at risk of experiencing the event). The likelihood that any particular state will implement a policy at a given moment in time is then determined based on the scores of that unit on the included explanatory variables relative to all of the other units that have not yet experienced the event. The specifics of this model are discussed below.

12. Operationalizing the Variables

"Policy initiation" is measured as the date of initial implementation of at least one computerized service center. This is the most appropriate measure for this analysis because, while it does not provide us with information on overall implementation, unless all of the centers are opened on a single day, it marks the "public" launch of the policy. Initiation of new government initiatives in India is typically marked by the participation of top government officials and significant media attention. For this reason these dates are both the easiest to confirm, and the most relevant in terms of the potential electoral effects for politicians, as these are the dates when the public will be made the most aware of a new government initiative. Overall, the public initiation date of a computer-based service center initiative provides the most reliable and theoretically useful date for measuring the timing of these policies. Thus, the question asked with this model is: "What is the risk that a state will initiate implementation of a computer-enabled service center policy, through the opening of the first center, at a given moment in time?"

We collected the data for the dependent variable through interviews with state government representatives in 16 Indian states, and analysis of primary and secondary documentation for the 20 states included in the dataset.[9] In the model, the dependent variable, Policy, is a dichotomous measure of whether a state implemented a policy in a given month/year.

For the two main hypotheses about the role of corruption and ruling government constituencies, in addition to the control variables, we have attempted to find or develop appropriate measures in the context of the Indian states. State Corruption Level is a measure based on the

[9] Interviews were conducted in the states of Andhra Pradesh, Delhi, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh, and West Bengal during the periods June–July 2004, January–March 2006, May 2007, and December 2007–February 2008.

results of a Transparency International survey of state-level corruption in India. This survey provides an indexed corruption score based on the presence of corruption in public service delivery across 11 departments. The survey asked individual citizens about both their personal experience with corruption in attempting to acquire services and their perception of corruption in government. This makes the survey particularly appropriate for the purposes of this analysis because the focus is explicitly on bureaucratic corruption in low-level service delivery, the area targeted by service center policies, rather than the higher-level corruption more often engaged in by top officials (Rose-Ackerman, 1999).[10]

The Ruling Party Constituency, State Competitiveness, and Election Proximity measures are based on election results and schedules, as tracked by the Election Commission of India. In all of these cases, the score for a state depends on the results of elections for the state assembly, which typically occur every five years, so these measures vary by state every five years.[11] Ruling Party Constituency is a dummy variable that takes on a value of 1 when the Indian National Congress Party (INC) is the lead member of the ruling government. State Competitiveness is measured by the effective number of parties holding seats in the state assembly.[12]

The Sub-State Initiatives variable measures the number of technology service center-type projects launched in a state prior to the state government's own policy. This measure varies by state and year. As noted above, district-level bureaucrats often launched these projects in order to improve local administration. The data for this variable are based on our own collection of information about these projects in the Indian states. The measure for previous policy implementation in contiguous states is a yearly measure of the percentage of states that are geographically contiguous to the state in question, which have already implemented a service center policy. This measure is constructed using the policy initiation dates from the dependent variable Policy.

The economic variables are based on yearly state-level data from the Reserve Bank of India, with per capita measures based on the 2001 national census. The measure of socio-economic development that is used is from India's National Human Development Report (2002). The indexed score varies by state (not year) and includes measures of state income per capita, literacy, rural versus urban population, and life expectancy. While economic factors are incorporated into the index, the inclusion of other development measures makes it worthwhile also to test this measure on its own.

Teledensity is used to measure Technology Infrastructure, which is the number of telephone lines per 100 people. IT companies measures the number of IT companies in the state per capita. This measure is based on a voluntary survey of software and services companies conducted by the Indian National Association of Software and Services Companies (NASSCOM).

Table 2 summarizes the measures used for each independent variable and its sources.

[10] The survey was conducted in 2005, six years after the initiation of the first service center policy. As a result, there is a risk of endogeneity with this variable because states that implemented early policies may have reduced their levels of corruption as a result of these policies by the time the survey was taken. While earlier state-level corruption scores are not available, I did test alternate measures of corruption from within the survey drawn from government departments that have not typically been addressed by these policies, such as the police. In general, these measures show similar results to those presented below using the indexed measure.

[11] In a given year only a portion of states will hold elections, so this measure changes in different years for each state.

[12] Effective number of parties (ENP) is a standard measure of electoral competition that takes into consideration the number of legislative seats held by each party or the number of votes all parties received and is a weighted measure that gives greater weight to parties holding a larger number of seats or receiving a larger number of votes. ENP is calculated by the formula $n = 1/\Sigma p_i^2$ where n = the effective number of parties and pi is either the proportion of seats received by each party in the state assembly or at the elections respectively.

Table 2. Variables and Measurements

Variable type	Variable name	Measure (frequency)	Variation	n	Source
Dependent variable	Service center policy initiation	Date of public initiation	State	20	Author's data collection
Socio-economic	State income	Net state domestic product per capita, scaled 0-1	State and year	180	Reserve Bank of India
	State financial stability	Ratio of total revenue minus total spending to total spending, previous year[13]	State and year	180	Reserve Bank of India
	Development	india State Human Development Index, scaled 0-1	State (at 2001)	20	India National Human Development Report 2001
	Technology infrastructure	Teledensity – telephone lines per 100 people, scaled 0-1	State (at 2003)	20	Ministry of Communications and information technology
	IT companies	Number of IT software and services companies per million people	State	20	NASSCOM survey
Political	Ruling party constituency	Is the Congress Party the lead party in the government?	State and five years[14]	48	Election Commission of India
	State competitiveness	Effective number of parties holding seats	State and five years	48	Election Commission of India
	Election proximity	12 months prior to election	State and five years	84	Election Commission of India
	Sub-state initiatives	Number of non-state government initiatives previously implemented	State and monthly	180	Author's data collection
	State corruption level	Transparency international index of corruption in public Service delivery, scaled 0-10	State (at 2005)	19	Transparency International
	Contiguous state policy	Percentage of contiguous states with policies	State and Year	180	Author's data collection

[13] A normalized measure of the budget surplus (or deficit).

[14] Indian states typically hold assembly elections every five years with the states spread out across the years such that in no year are all states holding an election. As a result, the number of observations for the election-dependent x-variables depends on the number of elections during the period of observation.

13. Cox Proportional Hazards Model of Technology-Enabled Service Center Policy Timing

The heart of this analysis is the event history model of policy initiation. The unit of analysis is the Indian state, of which there are 28 in India, 3 of which became states during the period under investigation.[15] Excluded from the analysis are eight states, the Northeast states and Jammu & Kashmir, owing to the implementation of an earlier national government initiative in those states in 2001. None of these states had implemented its own state-level policies prior to the national government's initiative. This leaves an N of 20 states, 16 of which had implemented policies prior to 2006 and 4 that had not.[16]

The type of event history model used for this analysis is a Cox proportional hazards model. The key benefit of the Cox model is that it does not require the analyst to predetermine a distributional form for the overall hazard rate (Box-Steffensmeier & Jones, 2004, p.47). Alternatives to the Cox model include parametric models, such as the Exponential, Weibull or Log, which require an assumption that the underlying hazard rate is a constant, monotonically increasing or decreasing, or shaped similarly to a log function, respectively. The Cox model, on the other hand, enables the distribution of the hazard rate to be determined by the data, rather than the analyst's assumption. Theoretically, we do not expect the hazard rate

[15] Jharkhand, Chhattisgarh, and Uttarakhand became states in 2000 when they were carved out of the states of Bihar, Madhya Pradesh, and Uttar Pradesh, respectively.

[16] In general it would be preferable to have a larger sample for conducting an event history analysis. However, previous research on maximum likelihood estimation techniques in general and Cox proportional hazard models in particular show that the greatest risk in small sample analyses is a Type II error in which a false null hypothesis is not rejected. The risk of a Type I error, in which the null hypothesis is falsely rejected, is much lower, even in sample sizes of 20. The risk of both error types increases in sample sizes of about 10 (Hart & Clark, 1999).

for enactment of technology policies to be constant or monotonic. Indeed, a slow start is expected followed by an increase in the hazard rate and subsequent dropping off at the end of the period. Because this theoretical expectation does not directly match the assumed distributional forms of any of the parametric models, it is more appropriate to utilize a Cox model in this case.[17]

In the context of a basic Cox model, the hazard rate for unit i is:

$$h_i(t) = h_o(t)\exp(\beta'x)$$

where the baseline hazard rate is $h_o(t)$ and the regression parameters and covariates are $\beta'x$ (Box-Stenffensmeier & Jones, 2004, p.48). Another way of presenting this relationship, which will help in interpreting the results of the model, is:

$$\log(h_i(t)/ h_o(t)) = b_1x_1 + b_2x_2 + \ldots +$$

Partial likelihood estimation is then used to analyze the ordered failure times of the units and their related covariates to estimate coefficients for the model. As can be seen from the above equation, the coefficients are related to the log of the hazard ratio. In other words, $e^{b}1$ is equal to the hazard ratio for the variable x_1. Thus, to calculate the hazard ratio for a specific variable it is simply necessary to calculate *e* to the power of the coefficient.

Once the hazard ratios are known for each variable, their interpretation is relatively simple. If a predicted hazard ratio in the model is greater than 1, this implies that as the variable increases, an increase in the hazard rate would be expected and, thus, the likelihood of policy implementation. For example, if the hazard ratio for a variable is 1.4, then a one-unit increase in that variable is associated with a 40 per cent increase in the hazard (risk) of the outcome under consideration. If the hazard ratio is less than zero, this implies that the variable is associated with a decrease in the baseline hazard rate. If the hazard ratio is . 78, then a one-unit increase in this variable is associated with a 22 per cent decrease (1 – 78) in the baseline hazard. The closer the hazard ratio is to one, the smaller is the effect of a change in the size of the variable on the baseline hazard.

We initially conducted bivariate tests of each independent variable and policy enactment, in addition to testing restricted models with variables grouped into economic and political categories. In the bivariate analyses (results not shown) only the Corruption variable displayed a significant relationship with the timing of policy enactment. In the subcategory model for economic variables, only the Human Development Indicator variable is shown to have a significant relationship with timing of policy implementation. In the model for political variables, Corruption is the only variable with a statistically significant relationship to timing outcomes. When all of the variables are tested together, the National Human Development Index indicator no longer shows a significant relationship, but Corruption continues to be significant, and Technology Infrastructure and Ruling Party Constituency also display statistically significant relationships with policy timing. The results for each of these models are shown in Table 3.[18]

14. Interpreting the Results

The first major result of the analysis is that economic variables cannot explain variation across states in the timing of policy implementation, nor can policy diffusion from contiguous states. None of the estimated hazard ratios on State Domestic Product, State Budget Surplus, Primary Sector, Human Development Index or IT companies are significantly different

[17] I conducted the same analyses as presented here using a parametric model based on a natural log distribution. The natural log model produced largely similar results with the same variables exhibiting significant relationships as what is found using the Cox model.

[18] In the table I have provided hazard ratios, rather than coefficients, in order to simplify interpretation.

Table 3. Computer-enabled Service Center Policies: Cox Proportional Hazards Model

	Variable	*Socio-economic*	*Political*	*Full model*
Socio-economic	State net domestic product	.01		2.33
		(-1.84)		(1.15)
	State budget surplus	.142		3.22
		(-.42)		(.25)
	Human development indicator	214.98*		74.20
		(2.11)		(.98)
	Technology Infrastructure	.48		.000*
		(-.28)		(-2.55)
	IT companies	1.03		16.29
		(.02)		1.41
Political	Ruling party constituency		3.48	12.82*
			(1.75)	(2.42)
	State competitiveness		1.04	.67
			(.14)	(-.86)
	Election proximity		2.33	3.17
			(1.32)	(1.48)
	State corruption level		.55**	.33**
			(-3.01)	(-2.85)
	Sub-state initiatives		.77	.576
			(-.40)	(-.56)
	Contiguous state policy		1.16	.187
			(.11)	(-.87)
	N[19]	20	19	19
	Log likelihood	-35.29	-29.31	-24.58
	Prob > chi^2	.38	.02	.01

Note: Entries are estimated Cox model hazard ratios, with z-ratios in parentheses. *$p < .05$ **$p < .0$

[19] There is no corruption score available from the 2005 Transparency International survey for the state of Goa, therefore this state is excluded from models where the corruption variable is included. A more recent survey of state-level corruption in India placed Goa in its most corrupt ("Alarming") category (Transparency International, 2008). Thus, given that Goa did not implement a service center policy before 2006, it is unlikely that the results would change if Goa were included in the full model.

from zero in the full model, and only the hazard ratio for the National Human Development Index is significant in the restricted model (without political variables). The hazard ratio for Technology Infrastructure (teledensity) is significant in the full model, but the ratio itself is nearly zero, indicating no additional effect on the baseline hazard ratio. Policy diffusion, as proxied by policy adoption in contiguous states, does notexplain variation in the timing of policies; the hazard ratio for Contiguous State Policy is insignificant.[20]

On the other hand, while economic variables do not explain policy adoption, the variables measuring Corruption and Ruling Government Constituency play a robust role in predicting the implementation of computer-enabled service center policies across states. The effects of these variables on the likelihood of implementing a technology-enabled service center policy are substantial and in the predicted directions.

In the full model, with the relative corruption levels of the states scaled from 0 to 10, the hazard ratio for the Corruption variable is .33. In accord with the above discussion, this means that a one-unit increase in the level of corruption is associated with a 67 per cent decrease in the baseline hazard rate for the state. This means that if two states are the same across all other variables, but one has a corruption score of 4 and the other has a corruption score of 5, then the risk that the state with a corruption score of 5 will implement a service center policy is 67 per cent smaller than that of the state with a score of 4, all else being equal.

Ruling Party Constituency is also statistically significant in the full model. As predicted, having the Indian National Congress as the lead party in a state (be it as a single party or

[20] Of course, as discussed above, it may be that policy diffusion works through other mechanisms, for example the spread of media reports via the Internet, that state contiguity does not pick up.

the lead party in a coalition) makes it more likely that a state will implement a technology-enabled service center policy, relative to non-Congress Party states, at a given moment in time. A move from a non-Congress-led state to a Congress-led state is associated with a 120 per cent increase in the baseline hazard rate.

Among the alternative political explanations, a higher number of parties holding seats in the state assembly is associated with a decrease in the baseline hazard rate, but this relationship is not statistically significant. The relationship between policy implementation and election timing shows an above zero hazard ratio for the 12 months prior to an election, but it is again not viable for us to judge this relationship to be different than zero.

15. Conclusion

These findings provide important insights into the role of political incentives in processes to increase the use of new technologies in developing countries, and in efforts to reform public service delivery in general. In particular, the character of the ruling party and the level of corruption in a state exhibit strong relationships with the timing of policy initiation. For analysts of corruption, this has important implications for considering the ways in which new technology may, and may not, be helpful for increasing transparency in service delivery. Because these policies can disrupt established patterns of rent-seeking for corrupt politicians, practitioners must look to the causes of corruption, such as high levels of electoral competition combined with ineffective policing of campaign spending, rather than simply rely on new technological tools. Unless the root causes of corruption are addressed, the results of this research suggest that implementation of policies intended to use technology to reduce corruption are *least likely* to succeed in those states that have high pre-existing levels of corruption.

References

Berry, F. S. and Berry, W. D. (1990). State lottery adoptions as policy innovations: An event history analysis. *American Political Science Review,* 84(2), 395-415.

Bhatnagar, S. (2002). Lessons from egovernment in developing countries. Regional *Development Dialogue,* 24.

Box-Steffensmeier, J. (1996). A dynamic analysis of the role of war chests in campaign strategy. *American Journal of Political Science,* 40(2), 352-371.

Box-Steffensmeier, J. and Jones, B. S. (2004). Event history modeling: *A guide for social scientists*. New York: Cambridge University Press.

Bussell, J. (2007). Electoral competition and digital development in India and South Africa. *Proceedings of the IEEE/ACM International Conference on Information and Communication Technologies for Development* (ICTD2007).

Chhibber, P. and Nooruddin, I. (2004). Do party systems count? The number of parties and government performance in Indian states. *Comparative Political Studies,* 37(2), 152-187.

Cox, Sir D. (1972). Regression models and life tables. *Journal of the Royal Statistical Society, Serial B,* 34, 187-220.

Davison, R. M., Wagner, C. and Ma, L. C. K. (2005). From government to e-government: A transition model. *Information Technology and People,* 18(3), 280-299.

De Zwart, F. (1994). *The bureaucratic merry-go-round: Manipulating the transfer of Indian civil servants*. Amsterdam: Amsterdam University Press.

Electoral Commission of India (ECI) (2007). *Handbook for candidates*. New Delhi: Media Coordination & Publication Section, Electoral Commission of India.

Hart, R. J. Jr. and Clark, D. H. (1999). Does size matter? Exploring the small sample properties of maximum likelihood estimation. Presented at the Annual Meeting of the Midwest Political Science Association.

Heeks, R. (2003). Causes of egovernment success and failure: Factor model. Accessed June 1, 2006, from eGov4Dev.org http://www.egov4dev.org/causefactor.htm

Iype, G. (2004). How much does an election cost? *Rediff Election Special,* March 25. Accessed March 10, 2008., from http://www.rediff.com/election/2004/mar/26espec.htm.

Madon, S. (2004). Evaluating the developmental impact of e-governance initiatives: An exploratory framework. *The Electronic Journal on Information Systems in Developing Countries,* 20(5), 1-13.

McNeal, R. S., Tolbert, C. J., Mossberger, K., and Dotterweich, L.J. (2003). Innovating in digital government in the American states. *Social Science Quarterly,* 84(1), 52-70.

Rogers, E. (1995). *Diffusion of innovations*. 4th ed. New York: Free Press.

Rose-Ackerman, S. (1999). *Corruption and government: Causes, consequences, and reforms*. Cambridge: Cambridge University Press.

Satyanarayana, J. (2004). *E-government…the science of the possible*. New Delhi: Prentice-Hall.

Transparency International (2005). *India corruption study*. New Delhi: Transparency International India.

Transparency International (2008). *TII-CMS India corruption study 2007: Key highlights*. New Delhi: Transparency International.

United Nations (2003). *World public sector report: E-government at the crossroads*. New York: United Nations publication, Sales No. E.03.II.H.3.

Wade, R. (1985). "The market for public office: Why the Indian state is not better at development." *World Development,* 13(4), 467-497.

West, D. (2005). *Global e-government 2005*. Retrieved June 1, 2006 from Inside Politics, http://www.insidepolitics.org/egovt05int.pdf.

Wilkinson, S. (2004). *Votes and violence: Electoral competition and ethnic riots in India*. Cambridge: Cambridge University Press.

World Bank (2004). *World development report: Making services work for the poor*. Washington, D.C.: World Bank and Oxford University Press.