Economic Growth, Law and Corruption: Evidence from India*

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Abstract

Is corruption influenced by economic growth? Are legal institutions such as the 'Right to Information Act (RTI) 2005' in India effective in curbing corruption? Using a novel panel dataset covering 20 Indian states and the periods 2005 and 2008 we are able to estimate the causal effects of economic growth and law on corruption. To tackle endogeneity concerns we use forest share to total land area as an instrument for economic growth. Forest share is a positive predictor of growth which is in line with the view that forestry contribute positively to economic growth. It also satisfies the exclusion restriction as it registers no direct effect on corruption. To capture the effect of law on corruption we use the 'difference-in-difference' estimation method. Our results indicate that economic growth reduces overall corruption as well as corruption in banking, land administration, education, electricity, and hospitals. Growth however has little impact on corruption perception. In contrast the RTI Act reduces both corruption experience and corruption perception. Our basic result holds after controlling for state fixed effects and various additional covariates. It is also robust to alternative instruments and outlier sensitivity tests.

JEL classification: D7, H0, K4, O1

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1 Introduction

Is corruption influenced by economic growth? Are legal institutions effective in curbing corruption? As corruption and economic growth are arguably simultaneously determined, one key question is the issue of causation. Mauro (1995) in his seminal contribution argues that corruption acts as a disincentive for investments and as a result harms growth over the long run. Indeed in figure 1 we observe that economic growth and corruption[1] are negatively related across 20 Indian states and over the period 2005 and 2008. However, one can also argue that economic growth creates additional resources which allow a country or a state to fight corruption effectively. Therefore figure 1 may not be reflective of a causal relationship.

The second key question is how effective legal institutions are in curbing corruption. Our novel panel dataset on corruption covering 20 Indian states and the periods 2005 and 2008 offers an opportunity to empirically test this effect. The Right to Information Act (RTI) in India came into effect on October 12, 2005 which is after the conclusion of our 2005 corruption survey in January. The act ensures citizens' secure access to information under the control of public authorities. In addition, the accompanying Citizens' Charter makes it legally binding for every government agencies to publish a declaration incorporating their mission and commitment towards the people of India. By design, this offers us a rare opportunity to test the effect of the law on corruption using two time series data points in our dataset, one before and the other after the law came into effect. Indeed, in figure 2 we do notice that corruption declined significantly in 2008. However this may

[1] Note that corruption here is computed using a two step procedure. First, an average is computed of the percentage of respondents answering yes to the questions on direct experience of bribing, using a middleman, perception that a department is corrupt, and perception that corruption increased over time for 8 different sectors (banking, land administration, police, education, water, Public Distribution System (PDS), electricity, and hospitals). Second, these averages are also averaged over all the 8 sectors to generate one observation per state and per time period. Higher value of the corruption measure implies higher corruption. We also look at the impact of economic growth and law on corruption in each of these sectors separately in table 4. In table 5 we make a distinction between corruption perception and corruption experience.

also be due to some uncontrolled factors. The only way to find out is by controlling for additional factors that may be influencing corruption.

In this paper, using a novel panel dataset covering 20 Indian states and the periods 2005 and 2008 we are able to estimate the causal effects of economic growth[2] and law on corruption. Since different states have experienced different growth patterns and different levels of corruption, India represents an ideal testing ground to examine the link between economic growth and corruption. To tackle endogeneity concerns we use forest share to total land area as an instrument for economic growth. We notice that forest share is a positive predictor of growth. This is in line with the view that forestry contribute positively to economic growth. Figure 3 plots this relationship. Forest share also satisfies the exclusion restriction of an instrumental variable as it registers no direct effect on corruption in our sample (see table 3A). To capture the effect of law on corruption we are able to use the 'difference-in-difference' estimation method as the RTI came into effect after the completion of Transparency International's 2005 corruption survey. Our results indicate that economic growth reduces overall corruption experience as well as corruption in banking, land administration, education, electricity, and hospitals. Growth however has little impact on corruption perception. This is supportive of the view that corruption perceptions in developing economies are often biased upwards. In contrast the RTI negatively impacts both corruption experience and corruption perception. Our basic result holds after controlling for state fixed effects and various additional covariates (for eg., literacy, Gini coefficient, poverty head count ratio, mining share of state GDP, primary sector share of state GDP, state government expenditure as a share of state GDP, newspaper circulation, and total number of telephone exchanges). It is also robust to the use of rainfall, flood affected area, flood affected population, flood affected crop area, and total number of flood affected households as alternative instruments and outlier sensitivity tests.

[2] Note that the Kolmogorov-Smirnov tests reported in table 1 indicates that the distribution of corruption across states have changed over the two time periods. Forces such as economic growth may be driving these changes.

We make the following four original contributions in this paper. First, by using a novel panel dataset on corruption across Indian states and a Limited Information Maximum Likelihood (LIML) instrumental variable estimation method we are able to estimate the causal effect of economic growth on corruption. Controlling for state fixed effects and additional covariates also allows us to tackle potential omitted variable bias. To the best of our knowledge, ours is the first panel data study of economic growth and corruption covering Indian state. Second, using a time dummy and exploiting the construction of our dataset we are able to estimate the corruption curbing effect of the RTI law in India. This is an important finding which has policy implications not just for India but also for other comparable developing economies suffering from endemic corruption. To the best of our knowledge, no other empirical study on corruption in India provides evidence of this nature. Third, using sector wise disaggregated data we are able to estimate the causal effect of economic growth and law on corruption in banking, land administration, police, education, water supply, PDS, electricity, and hospitals. This in our view is an entirely new finding. Fourth, we are able to separately estimate the effects of economic growth and law on corruption experience and corruption perception and we do find that they are different. We notice that economic growth has very little influence on corruption perception. Our finding adds to a small but growing body of evidence on the difference between corruption perception and corruption experience (see Olken, 2009).

Our economic growth and corruption result is related to a large literature on corruption and development which follows from the seminal contribution by Mauro (1995).[3] However, note that our focus here is to estimate the causal effect of economic growth on corruption and not the other way around. Our law and corruption result is also related to a growing literature on democratization and corruption as it emphasizes the role of accountability. For example, Treisman (2000) show that

[3]Ades and Di Tella (1999), Rose-Ackerman (1999), Dabla-Norris (2000), Leite and Weidmann (2002) are other important contributions in this literature. Bardhan (1997) provides an excellent survey of the early contributions.

a long exposure to democracy reduces corruption. Bhattacharyya and Hodler (2009) using a game theoretical model and cross-national panel data estimation of a reduced form econometric model show that resource rent is bad for corruption however the effect is moderated by strong democratic institutions. In contrast, Fan *et al.* (2009) show that decentralized government may not increase accountability and reduce corruption if the government structures are complex. In a similar vein, Olken (2007) also show that top down government audit works better than grassroots monitoring in Indonesia's village roads project. Therefore, our results contribute to a policy debate which is not only important for India but also for other comparable developing economies. The estimates however are not directly comparable as there are significant differences in scale (microeconomic or macroeconomic), scope (national or international), and nature (theoretical, empirical or experimental) of these studies.

Finally, our results are also related to a large literature on institutions and economic development (see Knack and Keefer, 1995; Hall and Jones, 1999; Acemolgu *et al.*, 2001; Rodrik *et al.*, 2004; Bhattacharyya, 2009). The major finding of this literature is that economic institutions (for eg., property rights, contracts, regulation, and corruption) are one of the major drivers of long run economic development. Besley and Burgess (2000, 2004) and Chemin (2009) provide evidence that land property rights, labor market institutions, and the judiciary have significant effects on economic performance in India. In this paper we estimate the magnitude of the relationship when causality runs in the opposite direction.

The remainder of the paper is structured as follows: Section 2 discusses empirical strategy and the data. Section 3 presents the empirical evidence and various robustness tests. Section 4 concludes.

2 Empirical Strategy and Data

We use a panel dataset covering 20 Indian states and the periods 2005 and 2008. Our basic specification uses corruption data for the periods 2005 and 2008. Economic growth for the periods 2005 and 2008 are growth in GDP[4] over the periods 2004-2005 and 2007-2008 respectively. To estimate the causal effect of economic growth and law on corruption we use the following model:

$$c_{it} = \alpha_i + \delta\beta_t + \gamma_1 \hat{y}_{it} + \mathbf{X}'_{\mathbf{it}}\mathbf{\Lambda} + \varepsilon_{it} \quad (1)$$

where c_{it} is a measure of corruption in state i at year t, α_i is a state dummy variable covering 20 Indian states to control for state fixed effects, β_t is a dummy variable which takes the value 1 for the year 2008 to estimate the impact of the introduction of the RTI Act in October 12 2005, $\hat{y}_{it}$ is economic growth in state i over the period $t-1$ to t, and $\mathbf{X}_{\mathbf{it}}$ is a vector of other control variables. A high value of c_{it} implies a high level of corruption. The motive behind including state fixed effects is to control for time invariant state specific fixed factors such as language, culture, and ethnic fractionalization.

The main variables of interest are $\hat{y}_{it}$ and the time dummy variable β_t. Therefore γ_1 and δ are our focus parameters. In theory, we would expect γ_1 to be significantly negative as faster growing states are able to use additional resources to curb corruption. The coefficient estimate δ is expected to be capturing the effect of the RTI Act. This is equivalent to the commonly used difference-in-difference estimation strategy in micro-econometrics. To illustrate, let c_{1it} be the corruption outcome in state i at time t when the RTI Act is in effect. Similarly, let c_{2it-1} be the corruption outcome in state i at time $t-1$ when the RTI Act is not in effect. Note that these are potential outcomes and in practice we only get to observe one or the other. One can express the above as:

$$E[c_{1it} \mid i, t=1, \hat{y}_{it} = \bar{y}, \mathbf{X}'_{\mathbf{it}} = \bar{\mathbf{X}}] = \alpha_i + \delta \text{ and } E[c_{2it-1} \mid i, t-1=0, \hat{y}_{it} = \bar{y}, \mathbf{X}'_{\mathbf{it}} = \bar{\mathbf{X}}] = \alpha_i \quad (2)$$

[4] Note that we also use GDP per capita growth rate in table 3 and our results are robust.

Given that $E(\varepsilon_{it} \mid i,t) = 0$. The population difference-in-difference yields the causal effect of the RTI Act δ as follows:

$$E[c_{1it} \mid i, t=1, \hat{y}_{it} = \bar{y}, \mathbf{X}'_{\mathbf{it}} = \bar{\mathbf{X}}] - E[c_{2it-1} \mid i, t-1=0, \hat{y}_{it} = \bar{y}, \mathbf{X}'_{\mathbf{it}} = \bar{\mathbf{X}}] = \delta \quad (3)$$

This can be estimated by using the sample analog of the population means. If the RTI law is effective in curbing corruption then we would expect δ to be negative.

Data on corruption is from the Transparency International's India Corruption Study 2005 and 2008. The study was jointly conducted by Transparency International India and the Centre for Media Studies both located in New Delhi. The survey for the 2005 report was conducted between December 2004 and January 2005 and the survey for the 2008 report was conducted between November 2007 and January 2008. The survey asks respondents whether they have direct experience of bribing, whether they have used a middleman, whether they perceive a department to be corrupt, and whether they perceive corruption have increased over time.[5] These questions are asked to on average 750 respondents from each of the 20 state. Respondents are selected using a random sampling technique covering both rural and urban areas. In aggregate the 2005 survey interviews 14,405 respondents spread over 151 cities, 306 villages of the 20 states. In contrast the 2008 survey covers 22,728 randomly selected Below Poverty Line (BPL) respondents across the country. One could argue that this brings in issues of measurement error which will bias our estimates. The bias however is expected to work in the opposite direction as it will push coefficient estimates downwards. In particular, BPL households are likely to face more corruption which will lead to over reporting and a positive measurement error. In that case our coefficient estimates will be biased downwards. This is formally known as attenuation bias. So what we estimate in the presence of measurement error is in fact less in magnitude than the true effect. Furthermore, if the

[5] Note that the survey asks some additional questions. However they are not common over the two time periods in our study. Therefore we are not including them here.

measurement error follows all classical assumptions (in other words, random) then our estimates will remain unaffected. Nevertheless, we do admit that we are unable to rule out measurement error completely. We are constrained by the use of secondary data.

Our aggregate measure of corruption c_{it} is computed using the following two steps. First, an average is computed of the percentage of respondents answering yes to the questions that they have direct experience of bribing, using a middleman, perception that a department is corrupt, and perception that corruption increased over time for 8 different sectors (banking, land administration, police, education, water, Public Distribution System (PDS), electricity, and hospitals).[6] Second, these averages are also averaged over all the 8 sectors to generate one observation per state and per time period. Ideally, one should weight the sectors with their respective usages. But in the absence of reliable usage statistics at the state level, we compute averages with equal weights. This may not be a cause for concern as services from all of these sectors are widely used by citizens. Note that sector level disaggregated data is utilized in table 4 and table 5 treats corruption perception and corruption experience separately. Corruption experience measure is the average of the questions on ‘direct experience of bribing’ and ‘using a middleman’. Corruption perception measure is the average of the questions on ‘perception that a department is corrupt’ and ‘perception that corruption increased over time’.

The state of Bihar turns out to be the most corrupt in our sample with 59 percent of respondents reporting corruption in 2005. In contrast Himachal Pradesh is the least corrupt with only 17 percent of the respondents reporting corruption in 2008. It appears that Police, land administration, and Public Distribution System (PDS) are amongst the most corrupt sectors in our dataset. Kerala and Himachal Pradesh come out to be the least corrupt states in most of the cases. In

[6] Note that the India Corruption Study only reports these macro percentages and the underlying micro data is not reported.

contrast Bihar, Jammu and Kashmir, Madhya Pradesh, and Rajasthan register high levels of corruption.

Economic growth $\hat{y}_{it}$ is defined as the growth in real GDP of the states over the periods 2004-2005 and 2007-2008 respectively. We use real GDP instead of real GDP per capita to compute growth rates because aggregate growth of the economy is more likely to have an impact on corruption at the macro level than per capita growth. Nevertheless, we also use per capita GDP growth to estimate the model and our results are robust. Real GDP data and real per capita GDP data is from the Planning Commission. Our growth variable varies between -4.2 percent in Bihar in 2005 and almost 17 percent in Chhattisgarh in 2005.

As economic growth here is arguably endogenous, one key question is the issue of reverse causation. Corruption as argued by many including Mauro (1995) may dampen growth through the investments channel. In that case a simple OLS estimate of our model will be biased upwards. In order to estimate the causal effect of economic growth on corruption we need to implement the instrumental variable estimation strategy. In particular, we need to identify an exogenous variable that is correlated with economic growth but uncorrelated with the error term ε_{it} in the model. In other words, this exogenous variable would affect corruption exclusively through the economic growth channel. This is commonly known as the exclusion restriction. Indeed, finding such a variable is a challenge in itself. But we are fortunate to have log forest share ($\ln FS_{it-1}$) from the Compendium of Environmental Statistics published by the Central Statistical Organization. Forest share is defined as the ratio of forest area in the total land area of the state. We notice that $\ln FS_{it-1}$ is positively related to economic growth and the relationship is statistically significant (see table 3, panel B). This is in line with the view that forestry and resources from forests positively contributes to economic growth. Figure 3 is a graphical representation of this relationship. Furthermore,

$\ln FS_{it-1}$ is geography based and therefore is exogenous. It also satisfies the exclusion restriction as it has no direct effect on corruption (see table 3A). Therefore, $\ln FS_{it-1}$ can serve as a valid instrument. However, if the relationship between $\ln FS_{it-1}$ and $\hat{y}_{it}$ is not strong enough then it may lead to the weak instruments problem. Staiger and Stock (1997) and Stock and Yogo (2005) show that if the instruments in a regression are only weakly correlated with the suspected endogenous variables then the estimates are likely to be biased. Instruments are considered to be weak if the first stage F-statistic is less than Stock-Yogo critical value. Having more than one weak instrument and a large sample may further complicate this problem by increasing the magnitude of the bias. The Limited Information Maximum Likelihood (LIML) Fuller version of the instrumental variable method is robust to weak instruments. We implement the LIML method to estimate our model. Moreover, we operate with a relatively small sample of 40 observations. Therefore the risk of a significantly large bias due to weak instruments is minor. We also use rainfall (see column 2, table 3), flood affected area, flood affected population, flood affected crop area, and total number of flood affected households as additional instruments and our result survives.[7] However, these are not our preferred estimates because of sample attrition (see table 8) and weak instruments problem[8].

The time dummy is used to capture the effect of the RTI Act. The Act put into effect on October 12, 2005 reads:

"An Act to provide for setting out the practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, the constitution of a Central Information Commission and State Information Commissions and for matters connected therewith or incidental thereto." (The Right to Information Act 2005, Ministry of Law and Justice)

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[7] For rainfall see column 2, table 3. For all other instruments see table 8.

[8] In case of rainfall (see column 2, table 3), more than one weak instrument may aggravate the bias.

The Act along with the Citizens' Charter goes a long way in the handling of information with the public authorities. One can certainly dispute whether our time dummy is solely picking up the effect of RTI and Citizens' Charter. It is possible that other nationwide changes introduced around this time are also affecting corruption. In that case the estimate on the time dummy is also picking up the effects of factors other than the RTI. Even though plausible, it is hard to identify significant national policy changes during this time other than the RTI which may affect corruption. Nevertheless, to tackle this issue we also control for literacy, Gini coefficient, poverty head count ratio, mining share of GDP, primary sector share of GDP, state government expenditure, newspaper circulation, and total number of telephone exchanges as additional control variables. Therefore it is perhaps safe to say that δ is indeed capturing the effects of RTI.

Detailed definitions and sources of all variables are available in Appendix A.1. Table 2 reports descriptive statistics of the major variables used in the study.

3 Empirical Evidence

Table 1 reports Kolmogorov-Smirnov test results for the equality of distributions of corruption over the time periods 2005 and 2008. The test shows that the distribution of corruption across states have changed over the two time periods. This may be driven by the variation in economic growth across states. In table 3 we try to find out by estimating equation (1) using a LIML Fuller instrumental variable method. Column 1 presents estimates of the model using $\ln FS_{it-1}$ as an instrument for economic growth. Our suspicion that economic growth can be endogenous is supported by the endogeneity test reported at the bottom of column 1. We notice that economic growth has a negative impact on corruption. Ceteris paribus, one sample standard deviation (4.1 percentage points) increase in economic growth in an average state would reduce corruption by 1.8 percentage points. In other words, our model predicts that an increase in the growth rate of Bihar from -4.2 percent in 2005 to 16 percent in 2008 would reduce corruption from

59 percent in 2005 to 50.3 percent in 2008. According to our dataset, Bihar's actual corruption in 2008 is 29 percent. Therefore, the estimated coefficient on economic growth explains 29 percent of the actual decline in corruption in Bihar over the period 2005 to 2008.

The coefficient on the year 2008 dummy captures the effect of RTI. Our estimates suggest that RTI has a negative impact on corruption and the effect is statistically significant. In particular, ceteris paribus the RTI Act reduces corruption in an average state by 18.5 percentage points. To put this into perspective, the RTI Act explains approximately 62 percent of the actual decline in corruption in Bihar over the period 2005 to 2008.[9] This is indeed a large effect.

In column 2 we use rainfall as an additional instrument for economic growth and our result survives. However, panel B shows that rainfall is a weak instrument which may bias our estimates (see section 2). Therefore this is not our preferred specification. In column 3 we use per capita GDP growth instead of aggregate GDP growth and our result remains unaffected. Note that we also estimate the model using five year average growth rates instead of economic growth over the periods 2004-2005 and 2007-2008. Our results are robust to this experiment. Results are not reported here to save space.

How good is our $\ln FS_{it-1}$ instrument? Panel B in table 3 show that it is positively correlated with economic growth. Therefore it can serve as an instrument provided it satisfies the exclusion restriction. Table 3A show that indeed $\ln FS_{it-1}$ satisfies the exclusion restriction. In particular, column 1 in table 3A shows that $\ln FS_{it-1}$ has no direct effect on corruption. However, one could challenge this result on the grounds that the correlation between $\ln FS_{it-1}$ and $\hat{y}_{it}$ is leading to high standard error and multicollinearity problem. To be entirely certain, in column 2 we drop $\hat{y}_{it}$ as an explanatory variable and the result of no direct relationship between $\ln FS_{it-1}$ and corruption remains

[9] Model predicts that corruption in Bihar should have reduced by 18.5 percentage points due to the RTI Act. The actual decline however is 30 percentage points. Therefore, the predicted decline is 62 percent of the actual.

unaltered. Finally, in column 3 we use rainfall as an instrumental variable for economic growth[10] and $\ln FS_{it-1}$ as an exogenous control variable. The no direct relationship between $\ln FS_{it-1}$ and corruption result survives. Therefore, it is perhaps safe to conclude that $\ln FS_{it-1}$ satisfies the exclusion restriction.

In table 4 we ask the question whether the effect of economic growth and law on corruption is uniform across all sectors of the economy. In particular we look at corruption in banking, land administration, police, education, water supply, public distribution system, electricity, and hospitals. Indeed there are more sectors in an economy which may have chronic corruption problem and we do admit that our list is far from being comprehensive. However it should be noted that our study is the first attempt to look at corruption at a disaggregated level in India using panel data and of course we are constrained by data availability. The results indicate that the RTI Act had an impact on all sectors examined in this study. The magnitude of the predicted decline however varies from a 20.4 percentage points in policing to 6.2 percentage points in the public distribution system. In contrast the effect of economic growth is far from being uniform. Banking, land administration, education, electricity, and hospitals register a statistically significant negative effect of economic growth on corruption. The effect however is insignificant in case of policing, water supply, and public distribution system. This may be due to the fact that officials and clerks working in these sectors are highly unionized. Open display of loyalty towards political parties and affiliated unions is common in these sectors. These political connections are sometimes used as a cover for corruption by corrupt officials.

In table 5 we check whether there is a difference between actual corruption experience and corruption perception. Indeed we find that the effect of economic growth on corruption is not

[10] Note that economic growth here has the right sign but is statistically insignificant. This may be reflective of the fact that rainfall is a weak instrument.

uniform across actual experience and perception. Panel A reports estimates with actual corruption experience. Note that corruption experience here is the average of answers to the questions on 'direct experience of bribing' and 'using influence of a middleman'. In addition to affecting overall corruption experience, economic growth appears to reduce corruption experiences in banking, land administration, education, electricity, and hospitals. The effects on police, water supply, and public distribution system however is statistically insignificant. The observed pattern is very similar to table 4. This suggests that our corruption results reported in tables 3 and 4 are driven by actual corruption experiences. Panel B reports estimates with corruption perception. Note that corruption perception here is the average of answers to the questions on 'perception that a department is corrupt' and 'perception that corruption has increased'. We notice that economic growth has little effect on corruption perception[11] and in case of policing it appears to have increased corruption perception. This is in line with the view that perpetual pessimism with regards to government services tends to shape corruption perception in developing economies and any impact that economic growth may have on actual corruption is often overlooked. Our result is broadly in line with the findings of Olken (2009) who also report differences in corruption perception and corruption experience in Indonesia, another developing economy.

The effect of RTI on corruption experience and corruption perception is somewhat uniform. The magnitude of the effect however varies across sectors. We notice that the effect of RTI on corruption experience is greater than its effect on corruption perception in case of overall corruption, land administration, and public distribution system. In contrast, the reverse is observed in case of banking, police, education, water supply, electricity, and hospitals.

In table 6 we add additional covariates into our specification to address the issue of omitted variables. In column 1 we add literacy as an additional control variable. The rationale is that literate

[11] According to our estimates, economic growth reduced corruption perception only in education.

citizens are relatively more empowered to fight corruption. Our result survives. Poverty and inequality may also increase corruption. To check whether this has any effect we add Gini coefficient and poverty head count ratio as additional controls in columns 2 and 3. Our result remains unaffected. Natural resources in general and resource rent in particular may also increase corruption (see Ades and Di Tella, 1999; Treisman, 2000; Isham *et al.*, 2005; Bhattacharyya and Hodler, 2009; and many others). To check we add mining share of GDP and primary sector share of GDP in columns 4 and 5 and our results are robust. High levels of government expenditure may increase corruption as corrupt officials now have access to more resources to usurp. It can also work in the opposite direction with the government now able to engage more resources into auditing. Indeed we do notice evidence in support of the latter in column 6 with state government expenditure having a significant negative impact on corruption. This is in line with Olken (2007) who show that government audit reduces corruption in Indonesia. Nevertheless, more importantly our economic growth and law results remain unaffected. In column 7 we test whether controlling for the effect of media would alter our result. Media and an active civil society may reduce corruption. We try to capture this effect using newspaper circulation. Our main result survives. Column 8 tackles the view that telecommunication revolution in India may have triggered this decline in corruption by eliminating the middleman and reducing discretionary power of corrupt officials. To capture this effect we use number of telephone exchanges as a control variable and our results survive.

In table 7 we put our results under further scrutiny. We test whether our results are driven by influential observations. We identify influential observations using Cook’s distance, DFITS, and Welsch distance formula. The influential observations according to these formulas are from Bihar, Kerala, and Madhya Pradesh. We estimate our model by omitting these influential observations and our result remains unaffected.

Finally, in table 8 we test the robustness of our results with alternative instruments. Our basic results survive when we use flood affected area, flood affected population, flood affected crop area, and total number of flood affected households as alternative instruments. These instruments are geography based and likely to be exogenous. They are also likely to satisfy the exclusion restriction as it is hard to imagine them having an effect on corruption through any channels other than economic growth. Nevertheless, they are not our preferred estimates as they lead to a reduction in our sample size.

Overall these empirical findings support our prediction that both economic growth and RTI have negative impacts on corruption. The effect of the RTI Act however is more uniform than the effect of economic growth.

4 Concluding Remarks

We study the causal impact of economic growth and law on corruption. Using a novel panel dataset covering 20 Indian states and the periods 2005 and 2008 we are able to estimate the causal effects of economic growth and law on corruption. To tackle endogeneity concerns we use forest share to total land area as an instrument for economic growth. Forest share is a positive predictor of growth which is in line with the view that forestry contributes positively to economic growth. It also satisfies the exclusion restriction as it registers no direct effect on corruption in our sample. To capture the effect of law on corruption we use the 'difference-in-difference' estimation method. Our results indicate that economic growth reduces overall corruption as well as corruption in banking, land administration, education, electricity, and hospitals. Growth however has little impact on corruption perception. In contrast the RTI negatively impacts both corruption experience and corruption perception. Our basic result holds after controlling for state fixed effects and various additional covariates (for eg., literacy, Gini coefficient, poverty head count ratio, mining share of state GDP, primary sector share of state GDP, state government expenditure as a share of state

GDP, newspaper circulation, and number of telephone exchanges). It is also robust to the use of alternative instruments and outlier sensitivity tests.

The paper makes the following four original contributions. First, the paper presents the first panel data study of economic growth and corruption covering Indian state. Second, using a time dummy and exploiting the construction of the dataset the paper estimates the effect of the RTI law on corruption in India. Third, using sector wise disaggregated data the paper estimates the causal effect of economic growth and law on corruption in banking, land administration, police, education, water supply, PDS, electricity, and hospitals. Fourth, the paper also separately estimates the effects of growth and law on corruption experience and corruption perception and finds that they are different.

Our results have important policy implications not just for India but also for other comparable developing economies. Our findings imply that economic forces have an important role in reducing corruption. Therefore macro policies to promote economic growth not only improves overall living standard, it also enhances the quality of public goods by reducing corruption. It perhaps works through the following channels. First, it provides the government with additional resources to fight corruption. This is supported by the negative coefficient on the state government expenditure variable reported in column 6, table 6.[12] Second, it also reduces the incentives for corruption at the micro level by raising the opportunity cost. More micro level research is certainly called for to find out whether the data supports these conjectures.

Legislations such as the RTI Act in India are also important in curbing corruption. On the one hand it empowers citizens' and breaks the information monopoly of the public officials. Therefore, it prevents corrupt public officials from misusing this information to advance their own interest. On the other hand it provides the government with more power and public support for

[12] See Fisman and Gatti (2002) and Enikolopov and Zhuravskaya (2007) for an alternative view. They show that fiscal decentralization and larger government revenue leads to higher corruption using international data.

conducting top down audit of corrupt departments. There is evidence that the latter works effectively in a developing economy environment (Olken, 2007).

Finally, more caution is required with the measurement of corruption. Our results indicate that there is a fair bit of difference between actual corruption experience and corruption perception in developing economies. Therefore over reliance on one or the other may be counterproductive. We do not stand alone on this as other studies also indicate that perception and actual corruption tends to vary significantly (Olken, 2009). Measuring corruption appropriately in our view is crucial in furthering our understanding of corruption.

Appendix A

A.1 Data description

Corruption [c_{it}]: Corruption is computed using a two step procedure. First, an average is computed of the percentage of respondents answering yes to the questions that they have direct experience of bribing, using a middleman, perception that a department is corrupt, and perception that corruption increased over time for 8 different sectors (banking, land administration, police, education, water, Public Distribution System (PDS), electricity, and hospitals). Second, these averages are also averaged over all the 8 sectors to generate one observation per state and per time period. Higher value of the corruption measure implies higher corruption. Source: India Corruption Study 2005 and 2008, Transparency International.

Corruption in Banks [c_{it}^{BANKS}]: Corruption computed in the same fashion as c_{it} but only for the banking sector. Source: India Corruption Study 2005 and 2008, Transparency International.

Corruption in Land Administration [c_{it}^{LAND}]: Corruption computed in the same fashion as c_{it} but only for the land administration sector. Source: India Corruption Study 2005 and 2008, Transparency International.

Corruption in Police [c_{it}^{POLICE}]: Corruption computed in the same fashion as c_{it} but only for police. Source: India Corruption Study 2005 and 2008, Transparency International.

Corruption in Education [c_{it}^{EDUC}]: Corruption computed in the same fashion as c_{it} but only for education sector. Source: India Corruption Study 2005 and 2008, Transparency International.

Corruption in Water [c_{it}^{WATER}]: Corruption computed in the same fashion as c_{it} but only for the water supply sector. Source: India Corruption Study 2005 and 2008, Transparency International.

Corruption in PDS [c_{it}^{PDS}]: Corruption computed in the same fashion as c_{it} but only for the public distribution system. Source: India Corruption Study 2005 and 2008, Transparency International.

Corruption in Electricity [c_{it}^{ELEC}]: Corruption computed in the same fashion as c_{it} but only for the electricity sector. Source: India Corruption Study 2005 and 2008, Transparency International.

Corruption in Hospitals [c_{it}^{HOSP}]: Corruption computed in the same fashion as c_{it} but only for hospitals. Source: India Corruption Study 2005 and 2008, Transparency International.

Corruption Experience Measures: Corruption experience measures are the average of answers to the questions on 'direct experience of bribing' and 'using influence of a middleman'. Source: India Corruption Study 2005 and 2008, Transparency International.

Corruption Perception Measures: Corruption perception measures are the average of answers to the questions on 'perception that a department is corrupt' and 'perception that corruption has increased'. Source: India Corruption Study 2005 and 2008, Transparency International.

Economic Growth [$\hat{y}_{it}$]: Real growth rate in state GDP measured in 2009 constant prices. Source: Planning Commission, Government of India.

Log Forest Share [$\ln FS_{it-1}$]: Log of the share of forest in total geographic area of a state. Source: Compendium of Environmental Statistics, Central Statistical Organisation, Ministry of Statistics and Programme Implementation.

Log Rainfall [$\ln RAIN_{it-1}$]: Log of rainfall measured in millimeters and collected from weather stations located in the states. Some approximations are made while aggregating rainfall from weather stations to the state level depending on the geographic location of a particular weather station. Source: Compendium of Environmental Statistics, Central Statistical Organisation, Ministry of Statistics and Programme Implementation.

Flood Area: Total area affected by flood in 1994 and 1996 measured in millions of hectares. Source: Central Water Commission, Government of India.

Flood Population: Total population affected by flood in 1994 and 1996 measured in millions. Source: Central Water Commission, Government of India.

Flood Crop Area: Total crop area affected by flood in 1994 and 1996 measured in millions of hectares. Source: Central Water Commission, Government of India.

Flood Household: Total number of households affected by flood in 1994 and 1996 measured in millions of hectares. Source: Central Water Commission, Government of India.

Literacy: Literacy rate for 2002 and 2005. Source: Selected Socioeconomic Statistics India 2006, Central Statistical Organization, Table 3.3.

Gini Coefficient: Gini coefficient urban for the periods 1999-2000 and 2004-05. Source: Planning Commission.

Poverty Head Count Ratio: Percentage of population below poverty line (rural and urban combined). Source: Planning Commission.

Mining Share of GDP: Mining sector share of state GDP. Source: Handbook of Statistics on the Indian Economy, Reserve Bank of India.

Primary Sector Share of GDP: Primary sector share of state GDP. Source: Handbook of Statistics on the Indian Economy, Reserve Bank of India.

State Government Expenditure: State government expenditure as a proportion of state GDP. Source: Indian Public Finance Statistics, Ministry of Finance.

Newspaper Circulation: Number of registered newspapers in circulation. Source: Registrar of Newspapers, Government of India.

Telephone Exchange: Number of telephone exchanges. Source: Ministry of Information and Broadcasting, Government of India.

A.2 Sample and State Codes

Andhra Pradesh (AP), Assam (AS), Bihar (BH), Chhattisgarh (CG), Delhi (DL), Gujarat (GJ), Haryana (HR), Himachal Pradesh (HP), Jammu and Kashmir (JK), Jharkhand (JH), Karnataka (KT), Kerala (KL), Madhya Pradesh (MP), Maharashtra (MH), Orissa (OS), Punjab (PJ), Rajasthan (RJ), Tamil Nadu (TN), Uttar Pradesh (UP), West Bengal (WB).

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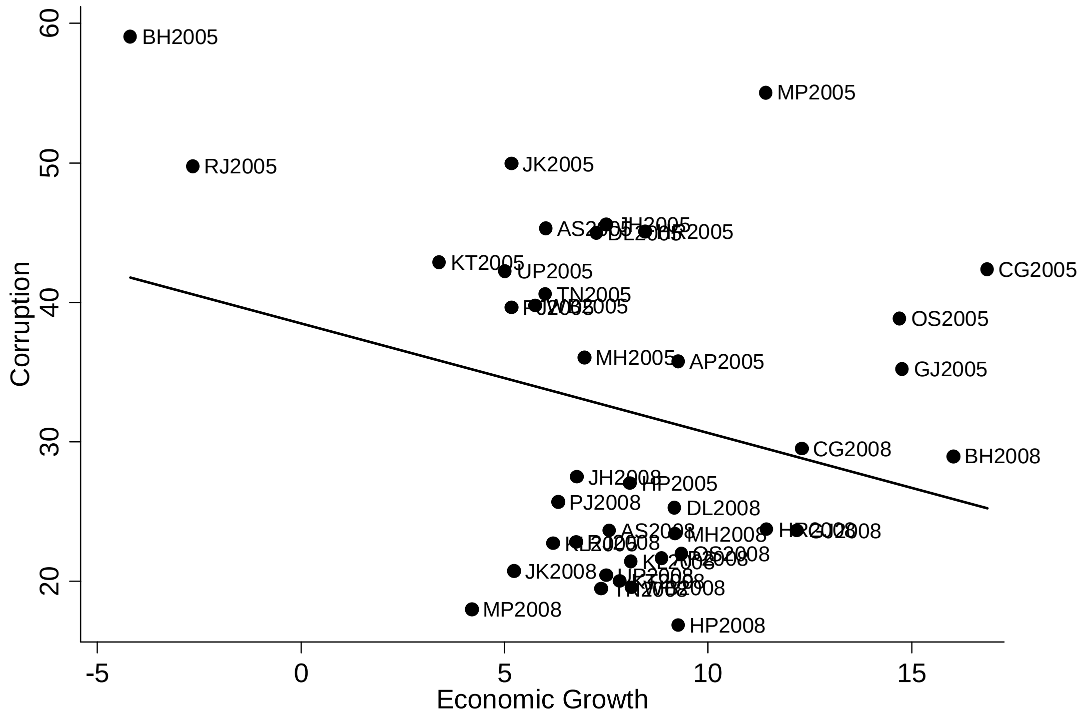
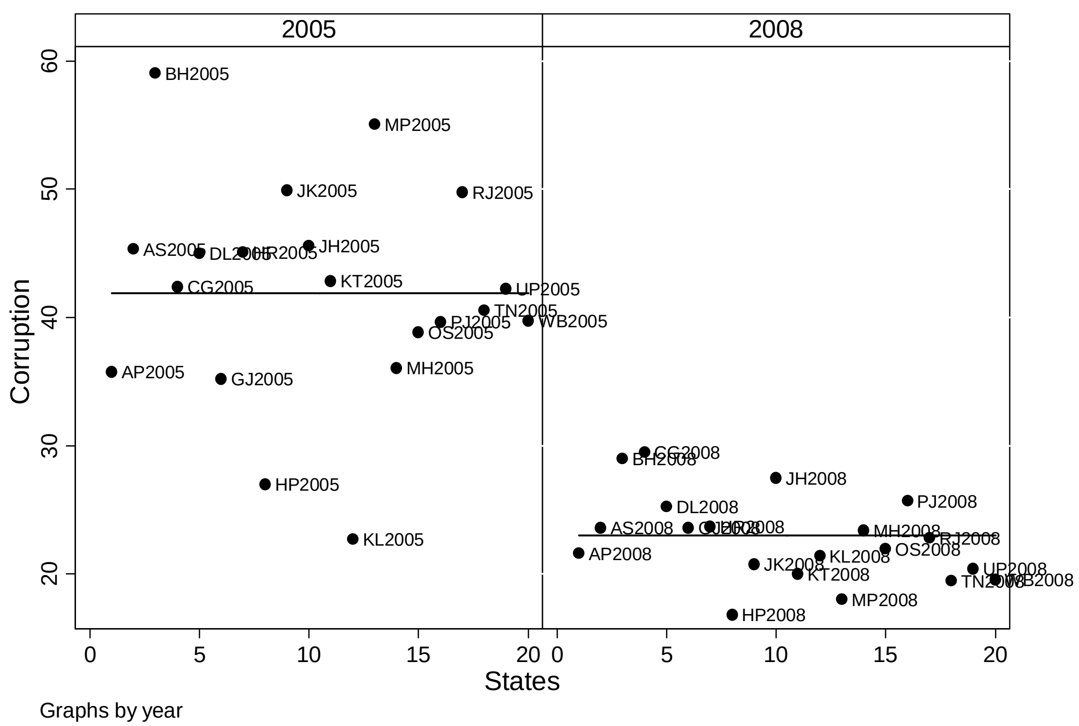
Figure 1: Economic Growth and Corruption



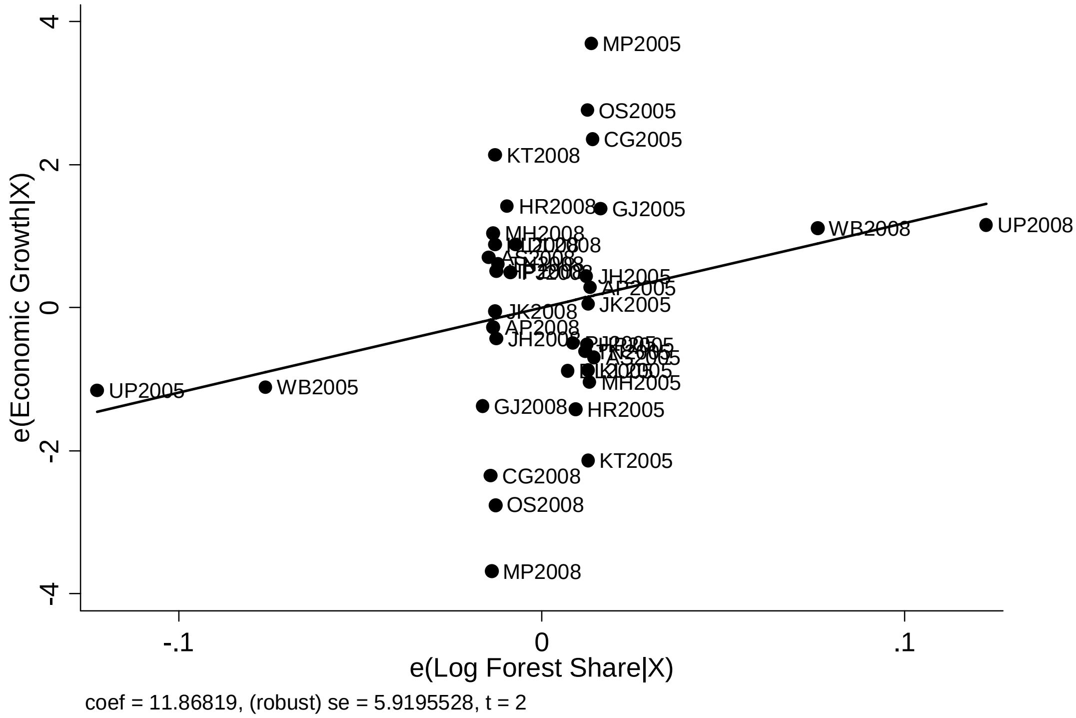
Note: State codes are available in Appendix A1. High value of the corruption variable indicates higher corruption

Figure 2: Corruption across States in 2005 and 2008



Note: High value of the corruption variable indicates higher corruption. The line indicates period average across states. State codes are available in Appendix A1.

Figure 3: Economic Growth and Forest Share Instrument: First Stage Added-variable Plot



(a) Residuals of Economic Growth and Resource Rent

Note: The added-variable plot presented above is a diagrammatic representation of the coefficient estimate in regression reported in panel B, table 3. In particular, figure 3 presents the estimate on $\ln FS_{it-1}$. To illustrate a bit further, figure 3 plots the residual from a regression of $\ln FS_{it-1}$ on country dummies, and year dummies on the x-axis and the residual from a regression of $\hat{y}_{it}$ on country dummies, and year dummies on the y-axis. State codes are available in Appendix A1.

Table 1. Kolmogorov – Smirnov Equality of Distribution test over time periods 2005 and 2008

Variable	Kolmogorov – Smirnov test statistic	p-values
Corruption [c_{it}]	0.90	0.00
Corruption in Banks [c_{it}^{BANKS}]	0.45	0.02
Corruption in Land Admin. [c_{it}^{LAND}]	0.80	0.00
Corruption in Police [c_{it}^{POLICE}]	0.95	0.00
Corruption in Education [c_{it}^{LAND}]	0.60	0.00
Corruption in Water [c_{it}^{WATER}]	0.45	0.02
Corruption in PDS [c_{it}^{PDS}]	0.35	0.11
Corruption in Electricity [c_{it}^{ELEC}]	0.60	0.00
Corruption in Hospitals [c_{it}^{HOSP}]	0.70	0.00

Notes: The Kolmogorov – Smirnov non-parametric test is to test the hypothesis that distribution of corruption across states over the two time periods (2005 and 2008) are identical. In other words, the null hypothesis is $H_0 : F_{2005}(c) = G_{2008}(c)$, where $F_{2005}(c)$ and $G_{2008}(c)$ are empirical distribution functions of corruption across states in 2005 and 2008 respectively. The test statistic is defined as $D = \max_{0<c<\infty} | F_{2005}(c) - G_{2008}(c) |$ and can be compared with Table 55 of Biometrika Tables, Vol. 2. If the difference is large then it leads to rejection of the null hypothesis. Note that PDS stands for Public Distribution System.

Table 2. Summary Statistics

Variable	Number of obs.	Mean	Standard Deviation	Minimum	Maximum
Corruption [c_{it}]	40	32.3	11.6	16.8	59.1
Corruption in Banks [c_{it}^{BANKS}]	40	22.2	12.5	2.3	55.0
Corruption in Land Admin. [c_{it}^{LAND}]	40	48.8	13.9	19.2	77.3
Corruption in Police [c_{it}^{POLICE}]	40	53.4	14.0	14.0	80.8
Corruption in Education [c_{it}^{EDUC}]	40	18.9	9.9	3.2	49.3
Corruption in Water [c_{it}^{WATER}]	40	29.3	11.95	4.1	54.0
Corruption in PDS [c_{it}^{PDS}]	40	32.4	10.9	10.6	60.3
Corruption in Electricity [c_{it}^{ELEC}]	40	30.95	11.7	4.6	57.0
Corruption in Hospitals [c_{it}^{HOSP}]	40	30.8	10.9	9.6	57.8
Economic Growth [$\hat{y}_{it}$]	40	7.9	4.1	-4.2	16.9
Log Forest Share [$\ln FS_{it-1}$]	40	2.6	0.8	1.1	3.7
Log Rainfall [$\ln RAIN_{it-1}$]	40	6.9	0.9	2.4	8.1

Table 3: Economic Growth, Law and Corruption

	Dependent Variable: Corruption [c_{it}]		
	(1)	(2)	(3)
	Panel A: LIML Fuller IV Estimates		
Economic Growth [$\hat{y}_{it}$]	-0.43***	-0.35***	
	(0.14)	(0.13)	
Year 2008 Dummy	-18.48***	-18.61***	-19.02***
	(1.89)	(1.80)	(1.84)
Per capita GDP Growth			-0.37*
			(0.22)
Endogeneity test ($p - value$)	0.06	0.04	0.06
Sargan overid. test ($p - value$)	--	0.55	--
Controls:	State Dummies		
Instruments	Log Forest Share [$\ln FS_{it-1}$]	Log Forest Share [$\ln FS_{it-1}$], Log Rainfall [$\ln RAIN_{it-1}$]	Log Forest Share [$\ln FS_{it-1}$]
States	20	20	20
Observations	40	40	40
	Panel B: First Stage Estimates		
	Economic Growth [$\hat{y}_{it}$]	**Economic Growth [$\hat{y}_{it}$]**	**Per capita GDP Growth**
Log Forest Share [$\ln FS_{it-1}$]	11.9*	12.2*	14.7*
	(5.91)	(6.55)	(9.30)
Log Rainfall [$\ln RAIN_{it-1}$]		0.14	
		(0.44)	
F statistic	2.7	2.4	1.14
Stock – Yogo critical value	23.81	12.38	23.81
Partial R^2 on instruments	0.004	0.007	0.018
Controls:	State Dummies, Year 2008 Dummy		
States	20	20	20
Observations	40	40	40
Adjusted R^2	0.76	0.76	0.57

Notes: ***, **, and * indicates significance level at 1%, 5%, and 10% respectively against a two sided alternative. Figures in the parentheses are cluster standard errors and they are robust to arbitrary heteroskedasticity and arbitrary intra-group correlation. All regressions are carried out with an intercept. Sample years are 2005 and 2008. Fuller's modified LIML estimator with $\alpha = 1$(correction parameter proposed by Hausman *et al.*, 2005) is used in Panel A which is robust to weak instruments. Endogeneity test for one or more endogenous regressors p-values are reported. The null hypothesis is that the specified endogenous variables can actually be treated as exogenous. Under the null the test statistic follows χ^2 -distribution with degrees of freedom equal to the number of regressors tested. Note that Sargan overidentification test is not reported for columns 1 and 3 as we have an exactly identified system. Sargan test null hypothesis is that the instruments are jointly valid. Stock –Yogo critical value are based on LIML size and significance level of 5%. An F statistic below the level of Stock –Yogo critical value would indicate that the instruments are weak. Partial R^2 on excluded instruments are also reported which measures instrument relevance.

Table 3A: Forest Share Instrument and the Exclusion Restriction

	Dependent Variable: Corruption [c_{it}]		
	(1)	(2)	(3)
	OLS Estimates		**LIML Fuller IV Estimates**
Economic Growth [$\hat{y}_{it}$]	-0.32 (0.54)		-0.25 (0.88)
Log Forest Share [$\ln FS_{it-1}$]	-8.22 (12.52)	-9.81 (13.45)	-8.59 (18.11)
Year 2008 Dummy	-18.46*** (3.43)	-18.94*** (2.96)	-18.58*** (1.84)
R^2	0.97	0.97	--
Endogeneity test ($p-value$)			0.09
Controls:	State Dummies		
Instruments			Rainfall [$\ln RAIN_{it-1}$]
States	20	20	20
Observations	40	40	40

Notes: ***, **, and * indicates significance level at 1%, 5%, and 10% respectively against a two sided alternative. Figures in the parentheses are cluster standard errors and they are robust to arbitrary heteroskedasticity and arbitrary intra-group correlation. All regressions are carried out with an intercept. Sample years are 2005 and 2008. Fuller's modified LIML estimator with $\alpha = 1$(correction parameter proposed by Hausman *et al.*, 2005) is used which is robust to weak instruments. Endogeneity test for one or more endogenous regressors p-values are reported. The null hypothesis is that the specified endogenous variables can actually be treated as exogenous. Under the null the test statistic follows χ^2-distribution with degrees of freedom equal to the number of regressors tested. Note that Sargan overidentification test is not reported as we have an exactly identified system.

Table 4: Economic Growth, Law and Corruption in Different Sectors

	Corruption in Banks [c_{it}^{BANKS}]	**Corruption in Land Admin. [c_{it}^{LAND}]**	**Corruption in Police [c_{it}^{POLICE}]**	**Corruption in Education [c_{it}^{EDUC}]**	**Corruption in Water [c_{it}^{WATER}]**	**Corruption in PDS [c_{it}^{PDS}]**	**Corruption in Electricity [c_{it}^{ELEC}]**	**Corruption in Hospitals [c_{it}^{HOSP}]**
	LIML Fuller IV Estimates							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Economic Growth [$\hat{y}_{it}$]	-0.46**	-0.97***	0.33	-0.59***	-0.85	0.11	-0.76**	-0.85***
	(0.18)	(0.20)	(0.28)	(0.12)	(0.60)	(0.44)	(0.31)	(0.18)
Year 2008 Dummy	-9.55***	-17.18***	-20.38***	-9.00***	-7.91***	-6.15*	-11.55***	-12.78***
	(3.13)	(3.14)	(2.71)	(1.83)	(2.86)	(3.33)	(2.48)	(2.44)
Endogeneity test ($p-value$)	0.06	0.07	0.04	0.04	0.04	0.06	0.06	0.06
Controls:	State Dummies							
Instruments	Log Forest Share [$\ln FS_{it-1}$]							
States	20	20	20	20	20	20	20	20
Observations	40	40	39	40	39	40	40	40

Notes: ***, **, and * indicates significance level at 1%, 5%, and 10% respectively against a two sided alternative. Figures in the parentheses are cluster standard errors and they are robust to arbitrary heteroskedasticity and arbitrary intra-group correlation. All regressions are carried out with an intercept. Sample years are 2005 and 2008. Fuller's modified LIML estimator with $\alpha = 1$(correction parameter proposed by Hausman *et al.*, 2005) is used which is robust to weak instruments. Endogeneity test for one or more endogenous regressors p-values are reported. The null hypothesis is that the specified endogenous variables can actually be treated as exogenous. Under the null the test statistic follows χ^2-distribution with degrees of freedom equal to the number of regressors tested. Note that Sargan overidentification test is not reported as we have an exactly identified system.

Table 5: Effect of Economic Growth and Law on Corruption Experience and Corruption Perception

	Corruption Experience overall	Corruption Experience in Banks	Corruption Experience in Land Admin.	Corruption Experience in Police	Corruption Experience in Education	Corruption Experience in Water	Corruption Experience in PDS	Corruption Experience in Electricity	Corruption Experience in Hospitals
	Panel A: LIML Fuller IV Estimates with Corruption Experience								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Economic Growth [$\hat{y}_{it}$]	-0.91*** (0.22)	-0.77*** (0.25)	-1.66*** (0.59)	-0.18 (0.58)	-0.85*** (0.09)	-0.87 (0.87)	-0.13 (0.37)	-0.97*** (0.29)	-1.79*** (0.34)
Year 2008 Dummy	-17.09*** (2.05)	-11.55*** (2.19)	-29.25*** (4.99)	-12.09*** (4.49)	-7.55*** (1.47)	-7.63** (3.82)	-10.39*** (3.31)	-11.04*** (1.93)	-7.22*** (2.74)
Endogeneity test (*p–value*)	0.06	0.06	0.08	0.05	0.04	0.05	0.06	0.06	0.06
Controls:	State Dummies								
Instruments	Log Forest Share [$\ln FS_{it-1}$]								
States Observations	20 40	20 40	20 40	20 39	20 40	20 39	20 40	20 40	20 40
	Corruption Perception overall	**Corruption Perception in Banks**	**Corruption Perception in Land Admin.**	**Corruption Perception in Police**	**Corruption Perception in Education**	**Corruption Perception in Water**	**Corruption Perception in PDS**	**Corruption Perception in Electricity**	**Corruption Perception in Hospitals**
	Panel B: LIML Fuller IV Estimates with Corruption Perception								
Economic Growth [$\hat{y}_{it}$]	-0.21 (0.36)	-0.11 (0.45)	-0.83 (0.62)	0.72* (0.37)	-0.64* (0.34)	-0.84 (0.96)	0.05 (0.65)	-0.62 (0.54)	0.22 (0.41)
Year 2008 Dummy	-15.35*** (2.86)	-14.42** (5.95)	-12.17*** (4.11)	-14.27*** (3.69)	-14.54*** (2.77)	-12.47*** (4.73)	-6.67 (4.44)	-19.14*** (3.83)	-18.12*** (2.59)
Endogeneity test (*p–value*)	0.03	0.04	0.07	0.05	0.03	0.06	0.05	0.06	0.06
Controls:	State Dummies								
Instruments	Log Forest Share [$\ln FS_{it-1}$]								
States Observations	20 40	20 40	20 40	20 39	20 40	20 39	20 40	20 40	20 40

Notes: ***, **, and * indicates significance level at 1%, 5%, and 10% respectively against a two sided alternative. Figures in the parentheses are cluster standard errors and they are robust to arbitrary heteroskedasticity and arbitrary intra-group correlation. All regressions are carried out with an intercept. Sample years are 2005 and 2008. Fuller's modified LIML estimator with $\alpha = 1$(correction parameter proposed by Hausman *et al.*, 2005) is used which is robust to weak instruments.

Endogeneity test for one or more endogenous regressors p-values are reported. The null hypothesis is that the specified endogenous variables can actually be treated as exogenous. Under the null the test statistic follows χ^2-distribution with degrees of freedom equal to the number of regressors tested. Note that Sargan overidentification test is not reported as we have an exactly identified system.

Table 6: Economic Growth, Law and Corruption: Robustness with Additional Covariates

	Dependent Variable: Corruption [c_{it}]							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	LIML Fuller IV Estimates							
Economic Growth [$\hat{y}_{it}$]	-0.33*** (0.05)	-0.37*** (0.12)	-0.44*** (0.13)	-0.44*** (0.16)	-0.48** (0.22)	-0.16*** (0.02)	-0.77*** (0.06)	-0.64*** (0.21)
Year 2008 Dummy	-19.12*** (2.02)	-19.58*** (1.75)	-18.62*** (1.81)	-18.83*** (2.27)	-18.56*** (2.24)	-15.51*** (2.18)	-17.21*** (1.70)	-19.91*** (3.19)
Endogeneity test (*p–value*)	0.06	0.07	0.06	0.06	0.06	0.06	0.06	0.07
Controls:	State Dummies							
Additional Controls:	Literacy	Gini Coefficient	Poverty Head Count Ratio	Mining Share of GDP	Primary Sector Share of GDP	State Government Expenditure*** (-)	Newspaper Circulation	Telephone Exchange
Instruments	Log Forest Share [$\ln FS_{it-1}$]							
States	18	20	20	20	20	19	18	14
Observations	36	40	40	40	40	38	36	28

Notes: ***, **, and * indicates significance level at 1%, 5%, and 10% respectively against a two sided alternative. Figures in the parentheses are cluster standard errors and they are robust to arbitrary heteroskedasticity and arbitrary intra-group correlation. All regressions are carried out with an intercept. Sample years are 2005 and 2008. Fuller's modified LIML estimator with $\alpha = 1$(correction parameter proposed by Hausman *et al.*, 2005) is used which is robust to weak instruments. Endogeneity test for one or more endogenous regressors p-values are reported. The null hypothesis is that the specified endogenous variables can actually be treated as exogenous. Under the null the test statistic follows χ^2-distribution with degrees of freedom equal to the number of regressors tested. Note that Sargan overidentification test is not reported as we have an exactly identified system.

Table 7: Economic Growth, Law and Corruption: Robustness with Alternative Samples

	Dependent Variable: Corruption [c_{it}]		
	(1)	(2)	(3)
	LIML Fuller IV Estimates		
Economic Growth [$\hat{y}_{it}$]	-1.37*** (0.50)	-1.37*** (0.50)	-1.37*** (0.50)
Year 2008 Dummy	-17.13*** (1.61)	-17.13*** (1.61)	-17.13*** (1.61)
Endogeneity test (*p–value*)	0.06	0.06	0.06
Controls:	State Dummies		
Instruments	Log Forest Share [$\ln FS_{it-1}$]		
Omitted Observations	Obs. Omitted using Cook's Distance	Obs. Omitted using DFITS	Obs. Omitted using Welsch Distance
States	17	17	17
Observations	34	34	34

Notes: ***, **, and * indicates significance level at 1%, 5%, and 10% respectively against a two sided alternative. Figures in the parentheses are cluster standard errors and they are robust to arbitrary heteroskedasticity and arbitrary intra-group correlation. All regressions are carried out with an intercept. Sample years are 2005 and 2008. Fuller's modified LIML estimator with $\alpha = 1$ (correction parameter proposed by Hausman *et al.*, 2005) is used which is robust to weak instruments. Endogeneity test for one or more endogenous regressors p-values are reported. The null hypothesis is that the specified endogenous variables can actually be treated as exogenous. Under the null the test statistic follows χ^2-distribution with degrees of freedom equal to the number of regressors tested. Note that Sargan overidentification test is not reported as we have an exactly identified system. In column 1, omit if $|Cooksd_i| > 4/n$; in column 2, omit if $|DFITS_i| > 2\sqrt{k/n}$; and in column 3, omit if $|Welschd_i| > 3\sqrt{k}$ formulas are used (see Belsley *et al.*, 1980). Here n is the number of observation and k is the number of independent variables including the intercept. Note that the Cook's Distance, DFITS, and Welch Distance are calculated using the OLS version of the model (ie., table2, column 3). The influential observations according to the Cook's Distance, DFITS, and Welsch Distance formula are BH2005, BH2008, KL2005, KL2008, MP2005, MP2008.

Table 8: Economic Growth, Law and Corruption: Robustness with Alternative Instruments

	Dependent Variable: Corruption [c_{it}]			
	(1)	(2)	(3)	(4)
	LIML Fuller IV Estimates			
Economic Growth [$\hat{y}_{it}$]	-0.94** (0.46)	-0.87* (0.44)	-0.56* (0.34)	-0.76*** (0.27)
Year 2008 Dummy	-18.14*** (2.55)	-18.29*** (2.29)	-18.73*** (1.84)	-18.16*** (1.69)
Endogeneity test (*p–value*)	0.09	0.08	0.04	0.06
Controls:	State Dummies			
Instruments	Flood Area	Flood Population	Flood Crop Area	Flood Households
States	16	16	16	16
Observations	32	32	32	32

Notes: ***, **, and * indicates significance level at 1%, 5%, and 10% respectively against a two sided alternative. Figures in the parentheses are cluster standard errors and they are robust to arbitrary heteroskedasticity and arbitrary intra-group correlation. All regressions are carried out with an intercept. Sample years are 2005 and 2008. Fuller's modified LIML estimator with $\alpha = 1$ (correction parameter proposed by Hausman *et al.*, 2005) is used which is robust to weak instruments. Endogeneity test for one or more endogenous regressors p-values are reported. The null hypothesis is that the specified endogenous variables can actually be treated as exogenous. Under the null the test statistic follows χ^2-distribution with degrees of freedom equal to the number of regressors tested. Note that Sargan overidentification test is not reported as we have an exactly identified system.