









































Their results suggest that entrenchment of any single right seldom has a significant general economic effect, while the effect of economic freedom is significant and substantial. The paper then considers whether such evidence could support the proposition that “constitutions do not matter.” While it concludes otherwise, it does caution against incurring excessive negotiation costs to obtain entrenchment of a comprehensive “wish list” of rights.

Persson and Tabellini (1994) question whether inequality is harmful for growth. They argue that in a society where distributional conflict is important, political decisions produce economic policies that tax investment and growth-promoting activities in order to redistribute income. The paper formulates a theoretical model that captures this idea. They support their model’s implications by the evidence. They show that both historical panel data and post-war cross sections indicate a significant and large negative relation between inequality and growth. Finally, Spindler (1991) uses the Wright ratings of economic freedom to investigate the relationship between economic freedom and economic development for most countries in the world. The study finds that relationship is apparently strong and direct for such economic freedoms as freedom of property and freedom of movement but inverse for freedom of association.

The examples mentioned above confirm the idea that NIE approach has the potential for application in very diverse areas. In the following sections, we will present the first empirical study that analyses electricity market reforms with tools supplied by NIE.

### **3. What we have learned from NIE for electricity market reform**

New institutional economics contributes to the analysis of power sector reforms in multiple ways. First of all, the literature that we summarized above clearly shows that institutions matter for any economic reform and electricity market reform is not an exception. In essence, electricity market reform is an institutional reform that necessitates *de facto* or *de jure* regime change, creation of new institutional structures and rearrangement or removal of existing ones.

Institutions may determine the divergent patterns of evolution of reform processes in various countries over time. In the literature, the relationship between institutions and economic transformations has been investigated by many scholars. For instance, the link between political institutions and economic change is explored by Aghion et al. (2008), Alesina et al. (1996), Alesina and Rodrik (1994), Besley and Kudamatsu (2008), Caselli et al. (1996), Clague et al. (1996), Drury et al. (2006), Helliwell (1994), Isham et al. (1997), Mauro (1995), Persson and Tabellini (2008) and Scully (1988); while the impact of economic institutions on economic change is investigated by Assane and Grammy (2003), Barro (1991, 1996, 2000), Philip Keefer and Knack (1997), Persson and Tabellini (1994), Spindler (1991) and Vanssay and Spindler (1994).

Second, while analysing reforms in electricity markets, we need to abandon the standard neoclassical assumptions that we have perfect information and unbounded rationality and that transactions are costless and instantaneous. The NIE implies that information during whole reform process is rarely complete, and transactions related to reform process have costs associated with them, such as costs of finding out what and how to reform, of negotiating the reform direction with interested parties, of passing necessary legislation, and then of monitoring and enforcing it.

The third contribution of NIE is its suggestion that reformers should see institutions as means of reducing information and transaction costs related to reform design and implementation; and never forget that institutions may easily turn into critical constraints on reform performance if not taken into account properly. Simply, the performance of a reform program largely depends upon the formal and informal institutions, which affect the reforms by influencing the level of transaction costs and, hence, the feasibility of engaging in a reform initiative.

Fourth, NIE maintains that there is a fundamental relationship between property rights, transaction costs and institutions. When property rights are not clearly defined in the course of an electricity market reform, transaction costs increase and reforms may fail.

The fifth advise from NIE for electricity market reform is that policy makers should pay due attention to non-market transaction costs faced by the firms in the market and do their best to eliminate or, at least, minimize them.

The sixth repercussion of NIE relevant to electricity reform is that the process of electricity market reform is largely path dependent, which may explain why some countries succeed and others do not in reforming their power sectors. So, getting the institutions right is critical to reform success as getting them wrong can lead to path-dependency, whereby inefficient electricity markets may persist. So, to prevent inefficient institutional structures in the subsequent reform phases, the utmost attention should be paid to arrangements at the very beginning of the reform programs. Right people should set up right structures. In this context, the chairperson of the electricity market regulator and the minister responsible for energy policy when reforms started may have an important impact on subsequent reform progress.

To sum up, the NIE approach suggests that the differences in performances of different reform processes are related to institutional endowments. The success or failure of a power market reform initiative depends to some extent on whether a strong legal system, a proper investment environment, clearly defined property rights, control structures for enforcing necessary legislation and enforceable contracting arrangements exist or not. When we take into account the notion that democratic systems encourage and support private participation and free enterprise in the economy, we may assume that democratic countries advance more rapidly in terms of power market reform process than those with less democratic systems. Given the institutional environment, the opportunities provided by the institutional environment will be reflected in the nature and performance of reform process.

## 4. Methodology

In our study, we focus on the background of the chairperson of electricity market regulatory agency when reforms started or were considered, that of the governor or minister responsible for energy policy at that time and macro institutional indicators to explain the progress in reform process in a country.

The ministers responsible for energy-related issues in countries or governors in US or Canadian states set general policies for electricity industry and the regulatory agencies put these policies into practice. Both policy setting and policy implementation are crucial factors that explain the reform progress in any country. Besides, path dependency implies that the chairperson of electricity market regulatory agency when reforms started or were considered and the governor or minister responsible for energy policy at that time play a critical role in the progress of subsequent reform process. For instance, in Argentina, Carlos Bastos, Secretary of Energy between 1991-96, led the privatisation of the electricity sector within the general policy framework of the Minister of Economy. Bastos was formerly an electrical engineer, researcher and a consultant on electricity issues for the Inter-American Development Bank and the Harvard Institute for International Economic Development. He brought the conceptual vision and insistence on a reformed, privately owned and competitive sector. He gave general direction and control to the privatisation of the energy sector, and took on the political battles, including with parties from the existing industry. The reform was along similar lines to the UK, and even went further with respect to restructuring (Littlechild & Skerk, 2004).

Similarly, UK has been successful in market reform because it managed to find a set of quite able, fair-minded regulators. Prof. Stephen C. Littlechild was Director General of Electricity Supply (DGES), in charge of the Office of Electricity Regulation (OFFER), from its foundation in September 1989 to 1998. Littlechild, one of the architects of the successful UK electricity reform, has been a true believer in competition in electricity markets. Before the appointment, he was Professor of Commerce and Head of Department of Industrial Economics and

Business Studies at the University of Birmingham from 1975 to 1989, and a member of the Monopolies and Mergers Commission from 1983 to 1989. In response to the apparent problems of the cost-recovery methods, in 1983, Professor Littlechild proposed a “high-powered” incentive scheme, popularly known as RPI-X or price cap, in which the regulator caps the allowable price or revenue for each firm for a pre-determined period. Thus far, in terms of economic efficiency, RPI-X has been a clear success. In the United Kingdom, the RPI-X regulatory approach has induced cost reductions well beyond expectations. Electricity companies have been able to greatly reduce operating costs in large part through substantial work force reductions. In short, the educational and professional backgrounds of energy minister and regulator played an important role in the reform progress in Argentina and the UK, respectively. Within this framework, our first hypothesis is as follows:

***Hypothesis 1:*** *Due to path-dependency, the background of the chairperson of the regulator and that of the governor or minister responsible for energy policy when reforms started or were considered have an impact on overall reform progress.*

As in the case of any competitive market, a competitive electricity market requires a liberal economy with strong democratic institutions. Hence, we also test for following hypotheses:

***Hypothesis 2:*** *In countries with strong legal systems that secure property rights, reforms go further.*

***Hypothesis 3:*** *Democratic countries advance more rapidly in terms of power market reform process than those with less democratic systems. So, expansion of civil liberties and political rights contribute to power market reform progress.*

***Hypothesis 4:*** *The reform progresses more rapidly in countries where there are few obstacles to investment and less corruption than in those*

*where investment is hindered by bureaucratic, structural or political reasons.*

In our study, the scope of the reforms in each country is represented by the electricity market reform score variable. Therefore, in our analysis, we describe the electricity market reform score as a function of

- (a) the background of the chairperson of electricity market regulatory agency when reforms started or were considered (his/her experience in electricity industry, his/her length of term, his/her education level, his/her educational background in business or economics, in engineering or in law);
- (b) the background of the governor or minister who was responsible for energy policy at that time (his/her experience in electricity industry, his/her length of term after reforms started or were considered, his/her education level, his/her educational background in business or economics, in engineering or in law);
- (c) macro variables representing the institutional endowments of the countries (namely, investment freedom index, polity score, corruption perceptions index, property rights index, civil liberties and political rights scores);
- (d) control variables (i.e. population, GDP per capita, dummy variable for being an OECD country).

In our analysis, our dependent variable is limited, that is, it is a count variable, which can take on nonnegative integer values,  $Y_i \in \{0, 1, 2, 3, 4, 5, 6, 7, 8\}$ . We cannot take the logarithm of a count variable because it takes on the value zero. An appropriate approach is to model the expected value as an exponential function

$$\mathbb{E}(y | x_1, x_2, \dots, x_k) = \exp(\beta_0 + \beta_1 x_1 + \dots + \beta_k x_k) \quad (1)$$

Since  $\exp(\cdot)$  is always positive, the predicted values for  $y$  will also be positive. Although this is more complicated than a linear model, we know how to interpret the coefficients. Taking the log of Equation 1 shows that

$$\log[\mathbb{E}(y | x_1, x_2, \dots, x_k)] = \beta_0 + \beta_1 x_1 + \dots + \beta_k x_k \quad (2)$$



so that the log of the expected value is linear. Using the approximation properties of the log function, we write

$$\% \Delta \mathbb{E}(y | x) \approx (100\beta_i)\Delta x_i \quad (3)$$

In other words,  $100\beta_i$  is roughly the percentage change in  $\mathbb{E}(y|x)$ , given a one-unit increase in  $x_i$ .

Because Equation 1 is nonlinear in its parameters, we cannot use linear regression methods. We could use nonlinear least squares, which, just as with OLS, minimizes the sum of squared residuals. It turns out, however, that all standard count data distributions exhibit heteroskedasticity and nonlinear least squares does not exploit this. Instead, we will rely on maximum likelihood and the important related method of quasi-maximum likelihood estimation. Besides, as we know, normality is the standard distributional assumption for linear regression. The normality assumption is reasonable for continuous dependent variables that can take on a large range of values. A count variable cannot have a normal distribution (because the normal distribution is for continuous variables that can take on all values), and if it takes on very few values, the distribution can be very different from normal. Instead, the nominal distribution for count data is the Poisson distribution. A random variable  $Y$ , which only takes on nonnegative integer values, follows the Poisson distribution if, for  $k = 0, 1, 2, \dots$

$$\Pr(Y = k) = \frac{\exp(-\lambda)\lambda^k}{k!} \quad (4)$$

where  $\lambda > 0$ . The mean and variance of Poisson random variable is  $\lambda$  and

$$\mathbb{E}(Y) = \text{var}(Y) = \lambda \quad (5)$$

Figure 2 shows the Poisson distribution for different  $\lambda$  values. Because we are interested in the effect of explanatory variables on  $y$ , we must look at the Poisson distribution conditional on  $x$ . The Poisson distribution is entirely determined by its mean, so we only need to specify  $\mathbb{E}(y|x)$ . Then, the probability that  $y$  equals the value  $k$ , conditional on  $x$ , is (for  $k = 0, 1, 2, \dots$ )

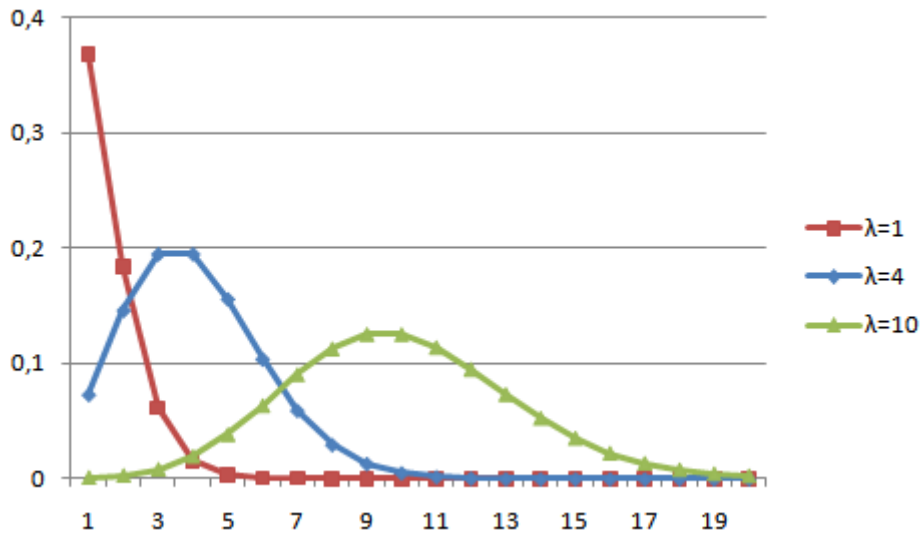
$$\Pr(Y_i = k | X_i) = \frac{\exp(-\lambda_i)\lambda_i^k}{k!} \quad (6)$$

$$\lambda_i = \mathbb{E}(Y_i | X_i) = \exp(\beta_0 + \beta_1 X_i) \quad (7)$$

$$\ln(\lambda_i) = \beta_0 + \beta_1 X_i \quad (8)$$

Here, the interpretation of  $\beta_1$  is that when there is a one unit increase in  $X_i$ , the percentage change of  $\mathbb{E}(Y | X)$  is  $100 \times \beta_1$ . This distribution, which is the basis for the Poisson regression model, allows us to find conditional probabilities for any values of the explanatory variables.

**Figure 2.** Poisson distribution for different  $\lambda$  values



In principle, the Poisson model is simply a nonlinear regression. It is much easier to estimate the parameter with a maximum likelihood method. The log-likelihood function is

$$\ln L(\beta_0, \beta_1; \{Y_i | X_i\}_{i=1}^N) \quad (9)$$

$$= \sum_{i=1}^N \ln \Pr(Y_i = y_i | X_i) \quad (10)$$

$$= \sum_{i=1}^N [-\exp(\beta_0 + \beta_1 X_i) + Y_i(\beta_0 + \beta_1 X_i) - \ln(Y_i!)] \quad (11)$$

where we can drop the term  $-\ln(Y_i!)$  because it does not depend on  $\beta$ . So, we get

$$= \sum_{i=1}^N [-\exp(\beta_0 + \beta_1 X_i) + Y_i(\beta_0 + \beta_1 X_i)] \quad (12)$$

While employing Poisson regression, we should keep in mind two important points. First, we cannot directly compare the magnitudes of the Poisson estimates of an exponential function with the OLS estimates of a linear function. Second, although Poisson analysis is a natural first step for count data, it may be restrictive. All of the probabilities and higher moments of the Poisson distribution are determined entirely by the mean. In particular, the variance is expected to be equal to the mean. This is restrictive but, fortunately, the Poisson distribution has a very nice robustness property: whether or not the Poisson distribution holds, we still get consistent, asymptotically normal estimators of the  $\beta_i$ .

Because of the restrictions on the length of the paper and because it is not one of the aims of this paper, further details of Poisson regression is not presented here but available from Winkelmann (2008), Cameron and Trivedi (1998) and Wooldridge (2009).

## 5. Overview of data

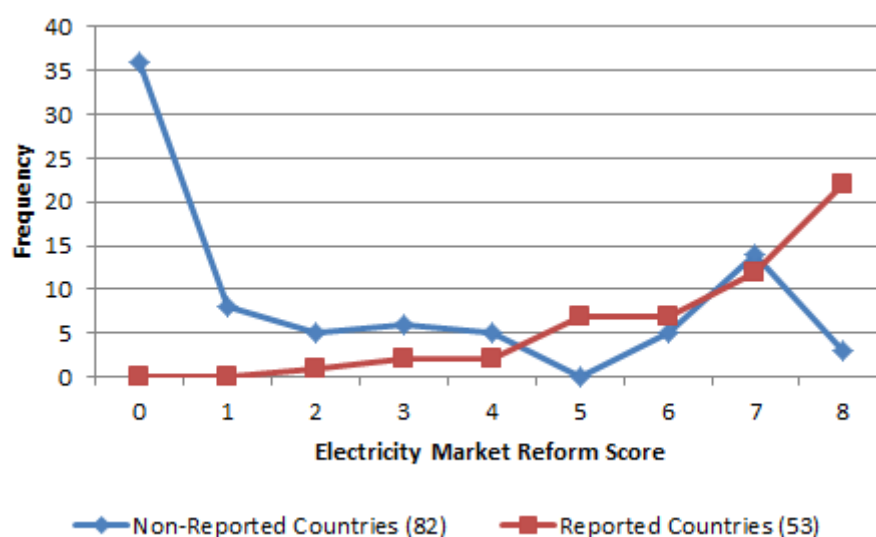
Our data set is cross-section and covers 51 states in US, 13 states in Canada and 51 other countries<sup>2</sup>. In total, we have 115 potential observations for each variable. We have some missing observations in our dataset. The sample countries and states in our analysis are determined by data availability. There are two main reasons for the limited nature of the dataset. First, since our analysis requires data on the chairperson of the regulatory agency when reforms started or were considered, we automatically exclude all countries without a regulatory agency for electricity industry. We could detect the existence of electricity market regulatory agencies in 135 countries. Second, out of these 135

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<sup>2</sup> Albania, Argentina, Armenia, Australia, Austria, Bangladesh, Belgium, Bosnia and Herzegovina, Brazil, Bulgaria, Cambodia, China, Colombia, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, India, Ireland, Italy, Jamaica, Kenya, Latvia, Lithuania, Luxembourg, Macedonia, Malaysia, Mexico, Netherlands, New Zealand, Nigeria, Norway, Pakistan, Philippines, Poland, Portugal, Romania, Russia, Serbia, Singapore, South Africa, Spain, Thailand, Turkey, Uganda, United Kingdom.

countries, we could include only those for which we could obtain data on all variables in our model. If excluded countries have some characteristics that cause them to be less likely to be included than others, that is, if the sampling of the population is non-random; then there may be a sampling bias. Figure 3 provides electricity market reform score frequencies of reported and non-reported countries. As can be seen in Figure 3, more than half of the non-reported countries have a reform score of either 0 or 1. Besides, most of the non-reported countries have highly inefficient and corrupted institutional structures that are incapable of organizing even a *de facto* reform program, let alone a *de jure* one.

**Figure 3.** Reform score frequencies of reported and non-reported countries



The variables used in the study are electricity market reform score; experience of the chairperson of electricity market regulatory agency in electricity industry when reforms started or were considered, his/her length of term after that time, his/her education level, his/her educational background in business or economics, in engineering or in law; electricity industry experience of the governor or minister who is responsible for energy policy when reforms started or were considered, his/her length of term after that time, his/her education level, his/her educational background in business or economics, in engineering or in law; investment freedom index, polity score, corruption perceptions index,

property rights index, civil liberties score, political rights score; population, GDP per capita and dummy for being an OECD country. Table 1 shows descriptive statistics of the variables.

Since it is very difficult, if not impossible, to develop a true measure of success or failure of the reform process; in this paper, we focus on the reform progress rather than reform success or failure. Besides, reform success or failure may be country specific and therefore it is not easy to develop a measure of it applicable to all countries. On the other hand, reform progress is a variable standardizable through countries and therefore a suitable indicator for a cross-country analysis. However, the measurement of reform progress also requires a great deal of effort as the main steps of electricity reform are usually established progressively and have a qualitative dimension. To measure reform progress, we construct an electricity market reform score variable that takes the values from 0 to 8; depending on how many of the following reform steps have been taken in each country as of 2011: (1) introduction of independent power producers, (2) corporatization of state-owned enterprises, (3) law for electricity sector liberalization, (4) introduction of unbundling, (5) establishment of electricity market regulator, (6) introduction of privatization, (7) establishment of wholesale electricity market, and (8) choice of supplier. To build this variable, we created 8 dummy variables for each of the reform steps mentioned above and calculated the total number of reform steps taken in each country. Dummy variables for reform steps are created based on the data collected and cross-checked from various international and national energy regulators' web sites<sup>3</sup>. Figure 4 provides the histogram of the reform score variable showing the frequency of observations while Figure 5 shows current status of electricity reform in US states. When we evaluate Figure 4, we see that all countries in our dataset have taken at least one reform step and more than half of them have taken 5 or more reform steps.

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<sup>3</sup> The full list of sources from which data are obtained can be found at IERN web site (<http://www.iern.net>).

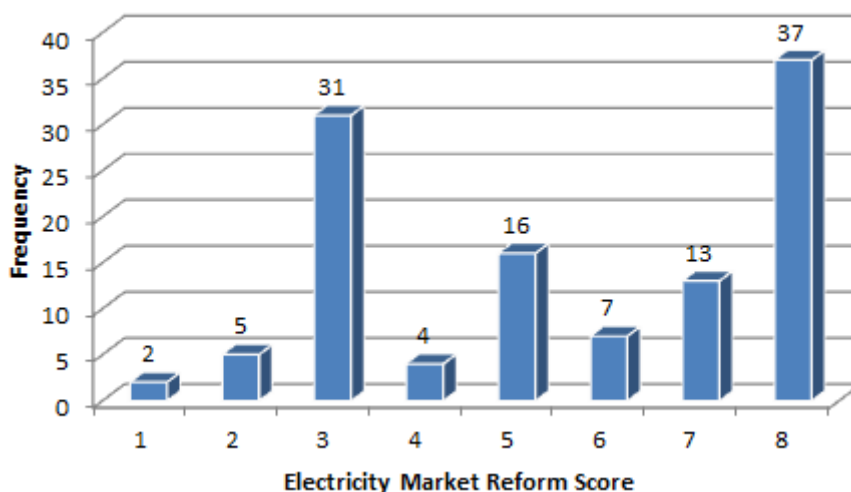
**Table 1.** Descriptive statistics of the variables

<b>Variables</b>	<b># of obs.</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
Electricity market reform score in 2011	115	5.48	2.24	1	8
<b>Chairperson*</b>					
His/her experience in electricity industry at appointment (years)	95	6.59	8.58	0	36
Length of term (years)	100	4.97	3.05	0	14
Education level (1: BSc, 2: MSc, 3: PhD)	94	1.89	0.99	0	3
<i>Educational background in</i>					
- Business or economics	94	0.40	0.49	0	1
- Engineering	94	0.20	0.40	0	1
- Law	94	0.44	0.50	0	1
- Other	94	0.15	0.36	0	1
<b>Energy minister/governor**</b>					
His/her experience in electricity industry (years)	101	3.40	4.92	0	36
Length of term (years)	106	3.48	2.06	0	10
Education level (1: BSc, 2: MSc, 3: PhD)	103	1.64	0.95	0	3
<i>Educational background in</i>					
- Business or economics	103	0.26	0.44	0	1
- Engineering	103	0.17	0.37	0	1
- Law	103	0.31	0.47	0	1
- Other	103	0.44	0.50	0	1
<b>Institutional variables</b>					
Legal system & property rights index in 2009	114	6.93	1.18	3.55	8.80
Investment freedom index in 2011	115	70.83	12.94	25	95
Polity score in 2010	114	8.79	3.13	-10	10
Corruption perceptions index in 2010	115	6.37	2.06	2	9
Property rights index in 2011	115	72.61	22.33	20	95
Civil liberties score in 2011	115	1.60	1.15	1	6
Political rights score in 2011	115	1.62	1.32	1	7
<b>Control variables</b>					
Population in 2010 (million people)	115	41.80	166.67	0.03	1,338.30
Log of population in 2010	115	1.83	1.86	-3.40	7.20
GDP per capita in 2010 (thousand \$)	115	36.43	22.49	1.26	172.25
Log of GDP per capita in 2010	115	3.32	0.91	0.23	5.15
OECD country dummy	115	0.75	0.44	0	1

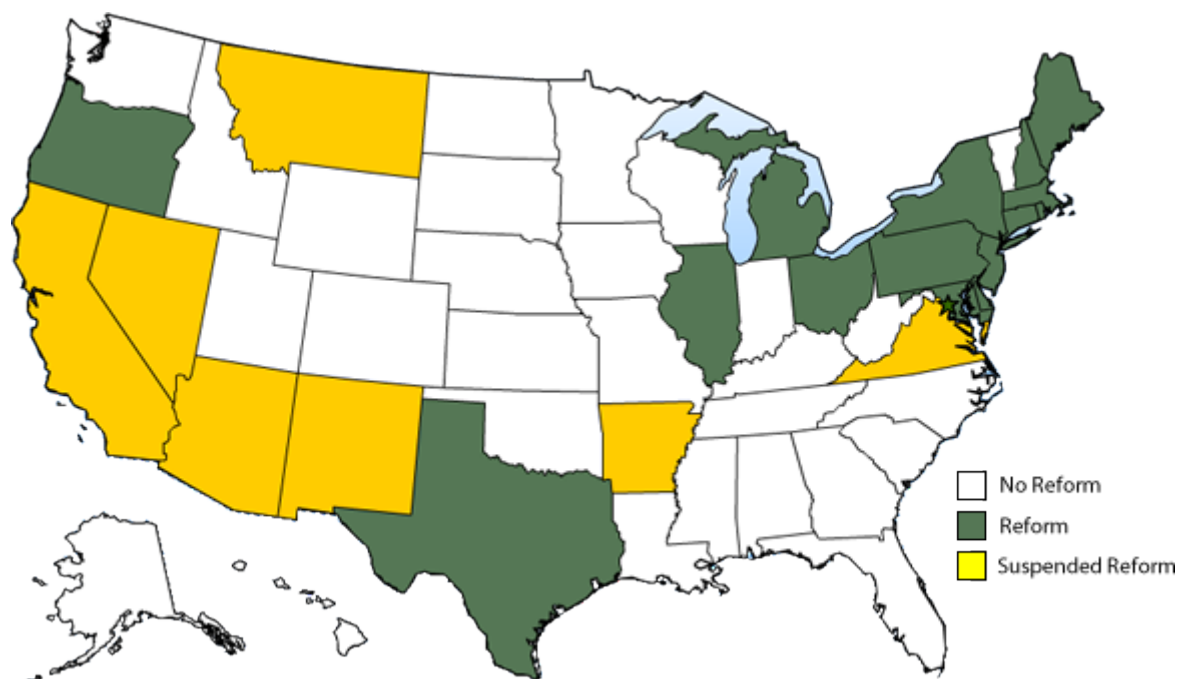
\* *The Chairperson* refers to the chairperson of electricity market regulatory agency when reforms started or were considered.

\*\* *Energy minister/governor* refers to the governor or minister who was responsible for energy policy when reforms started or were considered.

**Figure 4.** Histogram of reform score variable



**Figure 5.** Electricity reform in US states as of 2011

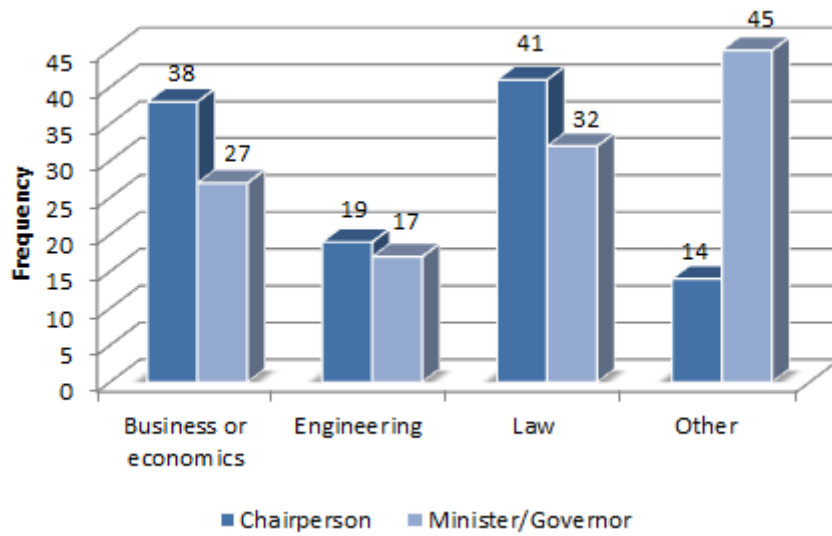


We collected data for each country on the background of the chairperson of electricity market regulatory agency when reforms started or were considered, and the governor or minister who was responsible for energy policy at that time. Data collection for these variables lasted 10 months from February to November

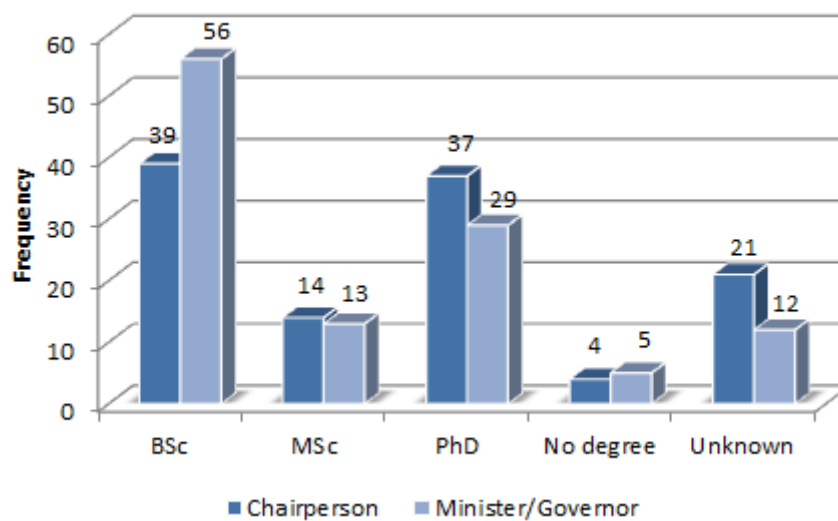
2011. The data on chairperson include his/her experience in electricity industry, his/her length of term, his/her education level (BSc, MSc or PhD) and his/her educational background (business or economics, engineering, law, other/unknown). We also gathered data about the governor or minister who was responsible for energy policy when reforms started or were considered. Similarly, these data include his/her experience in electricity industry, his/her length of term, his/her education level (BSc, MSc or PhD) and his/her educational background (business or economics, engineering, law, other/unknown). The data on chairpersons and the ministers/governors are obtained from various reports and documents published by regulatory agencies and ministries of the countries. While deciding on which educational backgrounds to include into our analysis, we select the three most common backgrounds, namely business or economics, engineering and law. We also create an “other/unknown” category to represent other educational backgrounds. For instance, when we look at the educational backgrounds of chairpersons, we see that 36.6% of them have a background in law, 33.9% in business or economics, 17% in engineering and 12.5% in other/unknown educational backgrounds. Figure 6 shows the number of chairpersons and ministers/governors in the sample countries by their educational background while Figure 7 presents this by education level. Besides, Figure 8 provides the number of chairpersons and ministers/governors in the sample countries by their length of term. While evaluating Figure 8, it is important to keep in mind that length of term refers to length of term after the reforms started or were considered.

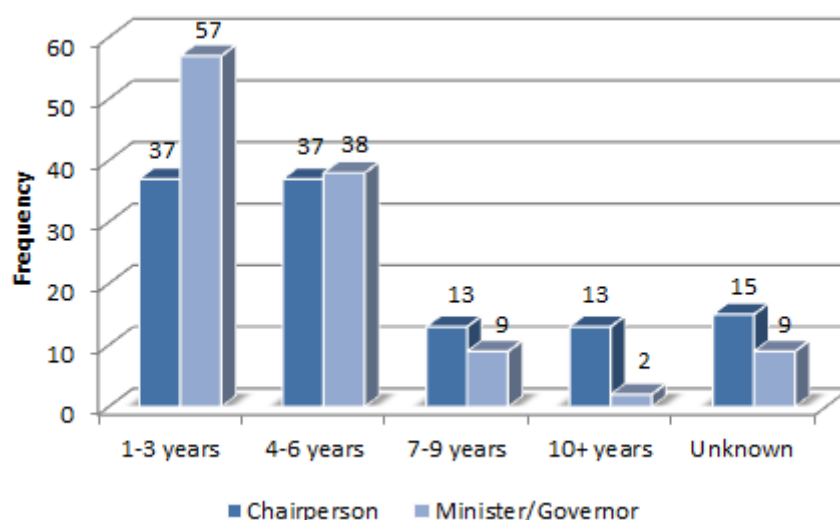


**Figure 6.** Educational backgrounds of chairpersons and ministers/governors



**Figure 7.** Education level of chairpersons and ministers/governors



**Figure 8.** Length of term of chairpersons and ministers/governors

The data on polity score for each country in 2010 are obtained from Center for Systemic Peace (CSP, 2010). The polity score ranges from +10 (strongly democratic) to -10 (strongly autocratic). Investment freedom index and property rights index scores for 2011 are provided by Heritage Foundation (2011) and both indexes range from 0 to 100. In an economically free country, there would be no constraints on the flow of investment capital. Individuals and firms would be allowed to move their resources into and out of specific activities both internally and across the country's borders without restriction. Such an ideal country receives a score of 100 in Heritage Foundation's Investment Freedom Index. In practice, however, most countries have a variety of restrictions on investment. Some have different rules for foreign and domestic investment; some restrict access to foreign exchange; some impose restrictions on payments, transfers, and capital transactions; in some, certain industries are closed to foreign investment. Moreover, labour regulations, corruption, red tape, weak infrastructure, and political and security conditions can also affect the freedom that investors have in a market. The index evaluates a variety of restrictions typically imposed on investment. Points are deducted from the ideal score of 100 for the restrictions found in a country's investment regime. Moreover, the property rights index assesses the ability of individuals to accumulate private







transformed variables in our model. Finally, we include a dummy variable into our dataset to represent OECD member countries.

## **6. Empirical analysis and discussion of the results**

Throughout our analysis, we explain electricity market reform score as a function of (i) the background of the chairperson of electricity market regulatory agency when reforms started or were considered, (ii) the background of the governor or minister who was responsible for energy policy at that time, (iii) macro institutional variables, and (iv) control variables.

The assumption of the Poisson model is that the conditional mean is equal to the conditional variance. Poisson regression will have difficulty with over dispersed data, i.e. variance much larger than the mean. Therefore, before starting our analysis, we need to look at the mean and variance of our dependent variable, that is, electricity market reform score. In our case, the mean of reform score variable is 5.48 and the variance is 5.01. Even though these numbers are for the unconditional mean and variance it can be informative because it gives us some indication of whether a Poisson regression should be used. In our analysis, reform score variable appears not to be overdispersed, as the mean is larger than the variance, and the predictor variables should help, so it may be reasonable to fit a Poisson regression model. Moreover, to make sure that Poisson regression is an appropriate tool to analyse our dataset, we report the results of the two Poisson goodness-of-fit tests (Deviance and Pearson goodness-of-fit tests) in the regression output table. The large value for chi-square in these tests may be an indicator that the Poisson distribution is not a good choice. A significant ( $p < 0.05$ ) test statistic from the tests indicates that the Poisson model is inappropriate. In our model, values for chi-square in these tests are quite small and the test statistics are insignificant even at 80% level. So, it is obvious that Poisson regression is an appropriate method for our analysis.

We start the empirical analysis by estimating a Poisson regression for our model<sup>4</sup>. Cameron and Trivedi (2009) recommend the use of robust standard errors when estimating a Poisson model, so we use robust standard errors for the parameter estimates. Table 2 presents Poisson estimation results. In the output table, we also report “Log pseudolikelihood”, which is the log likelihood of the fitted model. It is used in the calculation of the Likelihood Ratio (LR) chi-square test of whether all predictor variables’ regression coefficients are simultaneously zero. Moreover, we provide the number of observations. This is the number of observations used in the Poisson regression. It may be less than the number of cases in the dataset if there are missing values for some variables in the model. By default, Stata and Eviews do a listwise deletion of incomplete cases. Besides, we also report *Wald chi2* value, which is the LR test statistic for the omnibus test that at least one predictor variable regression coefficient is not equal to zero in the model. The degrees of freedom (the number in parenthesis) of the LR test statistic are defined by the number of predictor variables. Finally, “Prob>chi2” value indicates the probability of getting a LR test statistic as extreme as, or more so, than the one observed under the null hypothesis that all of the regression coefficients are simultaneously equal to zero. In other words, this is the probability of obtaining this chi-square test statistic if there is in fact no effect of the predictor variables. This p-value is compared to a specified alpha level, our willingness to accept a Type I error, which is typically set at 0.05 or 0.01. The small p-value from the LR test,  $p < 0.0001$ , would lead us to conclude that at least one of the regression coefficients in the model is not equal to zero.

While analysing the estimated Poisson regression coefficients, we should keep in mind that the dependent variable is a count variable, and Poisson regression models the log of the expected count as a function of the predictor variables. We can interpret the Poisson regression coefficient as follows: for a one unit change in the predictor variable, the difference in the logs of expected counts is expected to change by the respective regression coefficient, given the other predictor variables in the model are held constant. For instance, the coefficient of the

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<sup>4</sup> Throughout the paper, model estimations are carried out and cross-checked by Stata 12.0 and Eviews 7.1.

variable “Chairperson’s education level” can be interpreted as follows: If Chairperson’s education increases by one level (e.g. from MSc to PhD), the difference in the logs of expected counts would be expected to increase by 0.073 unit, while holding the other variables in the model constant.

The output table also presents the standard errors of the individual regression coefficients. They are used both in the calculation of the z test statistic and the confidence interval of the regression coefficient. P-value gives the probability that a particular z test statistic is as extreme as, or more so, than what has been observed under the null hypothesis that an individual predictor’s regression coefficient is zero given that the rest of the predictors are in the model.

Since interpretation of coefficients from a Poisson regression is not straightforward, the incidence rate ratios (IRR) are obtained by exponentiating the Poisson regression coefficients. When we use IRR option, estimated coefficients are transformed to incidence-rate ratios, that is  $e^{\beta_i}$  rather than  $\beta_i$ . Standard errors and confidence intervals are similarly transformed. This option affects how results are displayed, not how they are estimated. As we discussed before, Poisson regression coefficients are interpreted as the difference between the log of expected counts. We also know that the difference of two logs is equal to the log of their quotient,  $\log(a) - \log(b) = \log(a/b)$ , and therefore, we could have also interpreted the parameter estimate as the log of the ratio of expected counts: this explains the “ratio” in incidence rate ratios. In addition, what we referred to as a count can also be called a rate. By definition a rate is the number of events per time (or space), which our response variable qualifies as. Hence, we could also interpret the Poisson regression coefficients as the log of the rate ratio: this explains the “rate” in incidence rate ratio. Finally, the rate at which events occur is called the incidence rate; thus we arrive at being able to interpret the coefficients in terms of incidence rate ratios. Table 3 shows Poisson estimation results as incident rate ratios.



**Table 2.** Poisson regression estimation results

<b>Variables</b>	<b>Variable Type</b>	<b>Coefficient</b>	<b>Robust Std. Err.</b>	<b>z</b>	<b>P&gt; z </b>	<b>[95% Conf. Interval]</b>	
Electricity market reform score	Dependent						
<b>Chairperson of the regulator when reforms started/considered</b>							
His/her experience in electricity industry at appointment	Explanatory	0.001	0.0039	0.35	0.730	-0.0063	0.0090
Length of term	Explanatory	0.019	0.0129	1.44	0.149	-0.0066	0.0438
Education level (1: BSc, 2: MSc, 3: PhD)	Explanatory	0.073*	0.0442	1.65	0.098	-0.0136	0.1597
<i>Educational background in</i>							
- Business or economics	Explanatory	-0.186*	0.1106	-1.69	0.092	-0.4031	0.0303
- Engineering	Explanatory	0.083	0.1085	0.76	0.447	-0.1301	0.2953
- Law	Explanatory	0.002	0.1117	0.02	0.984	-0.2167	0.2213
- Other	Explanatory	0.019	0.1389	0.14	0.891	-0.2532	0.2912
<b>Energy minister/governor when reforms started/considered</b>							
His/her experience in electricity industry	Explanatory	-0.007	0.0092	-0.80	0.424	-0.0253	0.0106
Length of term	Explanatory	-0.001	0.0217	-0.05	0.963	-0.0436	0.0416
Education level (1: BSc, 2: MSc, 3: PhD)	Explanatory	0.096*	0.0572	1.67	0.095	-0.0165	0.2077
<i>Educational background in</i>							
- Business or economics	Explanatory	-0.194*	0.1117	-1.74	0.083	-0.4129	0.0250
- Engineering	Explanatory	-0.339**	0.1624	-2.09	0.037	-0.6574	-0.0209
- Law	Explanatory	-0.154	0.1394	-1.10	0.270	-0.4273	0.1193
- Other	Explanatory	-0.275**	0.1160	-2.37	0.018	-0.5021	-0.0474

Variables	Variable Type	Coefficient	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
<b>Institutional variables</b>							
Investment freedom index in 2011	Explanatory	0.012***	0.0043	2.87	0.004	0.0039	0.0207
Polity score in 2010	Explanatory	0.045	0.0328	1.38	0.167	-0.0189	0.1097
Corruption perceptions index in 2010	Explanatory	0.203***	0.0772	2.63	0.008	0.0520	0.3546
Property rights index in 2011	Explanatory	-0.021***	0.0062	-3.43	0.001	-0.0332	-0.0090
Civil liberties score in 2011	Explanatory	0.281***	0.1071	2.62	0.009	0.0711	0.4910
Political rights score in 2011	Explanatory	-0.148	0.0926	-1.59	0.111	-0.3290	0.0339
<b>Control variables</b>							
Log of population in 2010	Control	0.177***	0.0330	5.37	0.000	0.1126	0.2421
Log of GDP per capita in 2010	Control	0.315***	0.0943	3.34	0.001	0.1300	0.4997
Dummy (1: OECD country, 0: non-OECD country)	Control	-0.306*	0.1567	-1.95	0.051	-0.6134	0.0010
Constant	Constant	-0.772	0.8297	-0.93	0.352	-2.3986	0.8539

**Note:** Log pseudolikelihood: -173.87, Number of obs: 86  
Wald  $\chi^2(23)$ : 107.98, Prob >  $\chi^2$ : 0.000  
Deviance goodness-of-fit: 48.87, Prob >  $\chi^2(62)$ : 0.8876  
Pearson goodness-of-fit: 48.28, Prob >  $\chi^2(62)$ : 0.8989

\*\*\* Significant at 1% level,  
\*\* Significant at 5% level,  
\* Significant at 10% level.

**Table 3.** Poisson regression estimation results as Incident Rate Ratios (IRR)

Variables	Variable Type	IRR	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
Electricity market reform score	Dependent						
<b>Chairperson of the regulator when reforms started/considered</b>							
His/her experience in electricity industry at appointment	Explanatory	1.001	0.0039	0.35	0.730	0.9937	1.0091
Length of term	Explanatory	1.019	0.0131	1.44	0.149	0.9934	1.0447
Education level (1: BSc, 2: MSc, 3: PhD)	Explanatory	1.076*	0.0475	1.65	0.098	0.9865	1.1731
<i>Educational background in</i>							
- Business or economics	Explanatory	0.830*	0.0918	-1.69	0.092	0.6682	1.0307
- Engineering	Explanatory	1.086	0.1179	0.76	0.447	0.8780	1.3435
- Law	Explanatory	1.002	0.1120	0.02	0.984	0.8051	1.2477
- Other	Explanatory	1.019	0.1415	0.14	0.891	0.7763	1.3380
<b>Energy minister/governor when reforms started/considered</b>							
His/her experience in electricity industry	Explanatory	0.993	0.0091	-0.80	0.424	0.9750	1.0107
Length of term	Explanatory	0.999	0.0217	-0.05	0.963	0.9573	1.0425
Education level (1: BSc, 2: MSc, 3: PhD)	Explanatory	1.100*	0.0629	1.67	0.095	0.9836	1.2308
<i>Educational background in</i>							
- Business or economics	Explanatory	0.824*	0.0920	-1.74	0.083	0.6617	1.0253
- Engineering	Explanatory	0.712**	0.1157	-2.09	0.037	0.5182	0.9793
- Law	Explanatory	0.857	0.1195	-1.10	0.270	0.6523	1.1267
- Other	Explanatory	0.760**	0.0881	-2.37	0.018	0.6052	0.9537

Variables	Variable Type	IRR	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
<b>Institutional variables</b>							
Investment freedom index in 2011	Explanatory	1.012***	0.0043	2.87	0.004	1.0039	1.0210
Polity score in 2010	Explanatory	1.046	0.0343	1.38	0.167	0.9812	1.1159
Corruption perceptions index in 2010	Explanatory	1.225***	0.0946	2.63	0.008	1.0534	1.4256
Property rights index in 2011	Explanatory	0.979***	0.0060	-3.43	0.001	0.9674	0.9910
Civil liberties score in 2011	Explanatory	1.325***	0.1419	2.62	0.009	1.0737	1.6339
Political rights score in 2011	Explanatory	0.863	0.0799	-1.59	0.111	0.7196	1.0345
<b>Control variables</b>							
Log of population in 2010	Control	1.194***	0.0394	5.37	0.000	1.1192	1.2739
Log of GDP per capita in 2010	Control	1.370***	0.1292	3.34	0.001	1.1388	1.6482
Dummy (1: OECD country, 0: non-OECD country)	Control	0.736*	0.1154	-1.95	0.051	0.5415	1.0010
Constant	Constant	0.462	0.3833	-0.93	0.352	0.0908	2.3489

**Note:** Log pseudolikelihood: -173.87, Number of obs: 86  
Wald chi2(23): 107.98, Prob > chi2: 0.000  
Deviance goodness-of-fit: 48.87, Prob > chi2(62): 0.8876  
Pearson goodness-of-fit: 48.28, Prob > chi2(62): 0.8989

\*\*\* Significant at 1% level,  
\*\* Significant at 5% level,  
\* Significant at 10% level.

Having presented the study results let me interpret them in detail as follows.

*Results for the chairperson of electricity market regulatory agency when the reforms started or were considered:*

Our empirical findings suggest that the educational background and education level of the chairperson of the electricity market regulatory agency are two determinants of the scope of power industry reform in a country. We could not detect any statistically significant relationship between experience or length of term of the chairperson and scope of reforms. We find that if the chairperson's education were to increase by one level (e.g. from MSc to PhD), its rate ratio for reform score would be expected to increase by a factor 1.076, while holding all other variables in the model constant. Besides, we detect a negative relationship between educational background of the chairperson in business or economics and scope of reforms. Our results imply that if the chairperson holds a degree in business or economics, the reform score is expected to decrease by a factor 0.830, while holding all other variables in the model constant (see Table 3).

Let me illustrate these results using data from our dataset. In 2004, South Africa started a reform process in its electricity market and set up its regulatory agency (National Energy Regulator, NERSA) and its first chair held an MSc degree. One year later, Nigeria also started a reform process and established its regulatory agency (Nigerian Electricity Regulatory Commission, NERC) and its first chair had a PhD degree. For 2011, the electricity market reform scores of South Africa and Nigeria are 5 and 6, respectively. Our results suggest that if the chairperson's education in a country were to increase by one level, its rate ratio for reform score would be expected to increase by a factor 1.076. Therefore, holding all other variables constant and assuming that two countries are the same apart from the education levels of chairpersons of their regulatory agencies when reforms started, our results require that South Africa's reform score would be 5.38 ( $5 \times 1.076$ ) if the education of the first chairperson of South Africa's regulatory agency were to increase by 1 level (from MSc to PhD). So, our findings imply that 0.38 point of 1 point difference between the reform scores of two

countries may be explained by the difference between education levels of two chairpersons.

*Results for the governor or minister responsible for energy policy when the reforms started or were considered:*

The educational background and education level of the governor or minister responsible for energy policy when the reforms started or were considered seem to be other important determinants of the scope of power industry reform in a country. We could not detect any statistically significant relationship between length of term or experience of the minister/governor and scope of reforms. Our findings show that if the minister/governor's education were to increase by one level, its rate ratio for reform score would be expected to increase by a factor 1.1, while holding all other variables in the model constant. This result implies that a minister/governor's education level positively contributes to the reform process. The results also show that if the minister/governor holds a degree in business/economics or engineering, reform score is expected to be 0.824 and 0.712 times less, respectively (see Table 3).

To illustrate these results, we may use data from our dataset. In 1996, Pennsylvania State of US considered whether to initiate a reform process. The Governor of Pennsylvania at that time held a non-engineering (law) university degree. Four years later, Kentucky State also considered the reforms in its electricity market and, at that time, the Governor of Kentucky had a degree in engineering. In 2011, the electricity market reform scores of Pennsylvania and Kentucky were 8 and 3, respectively. Our results suggest that if the governor holds a degree in engineering, reform score is expected to be 0.712 times less. Therefore, holding all other variables constant and assuming that two states are the same apart from educational background of the governors when the reforms were considered, our results require that reform score of Pennsylvania would be 5.7 ( $8 \times 0.712$ ) if the Governor of Pennsylvania were to have an educational background in engineering. So, our findings imply that 2.3 ( $8 - 5.7$ ) points of 5

points difference between the reform scores of two states may be explained by the difference between educational backgrounds of two governors.

*Results for macro institutional variables:*

Most of the institutional variables in our analysis have a strong impact on the reform progress. 4 (out of 6) coefficients of institutional variables are significant even at 1% level. We find that reform progress is highly correlated with investment freedom index, corruption perceptions index, property rights index and civil liberties score. We could not detect a statistically meaningful relationship between reform score and polity score or political rights score. First of all, our findings suggest a positive relationship between investment freedom index and reform progress. If investment freedom index of a country were to increase by one unit, its rate ratio for reform score would be expected to increase by a factor 1.012, while holding all other variables in the model constant. Similarly, we see a positive relationship between reform progress and corruption perceptions index (which increases as corruption declines in a country). If corruption perceptions index of a country were to increase by one unit, its rate ratio for reform score would be expected to increase by a factor 1.225, while holding all other variables in the model constant. Moreover, we detect a negative relationship between property rights index and reform score. Although this negative relationship is statistically significant, its impact is extremely limited. If property rights index of a country were to increase by one unit, its rate ratio for reform score would be expected to decrease by a factor 0,979, while holding all other variables in the model constant. While evaluating these results, it is better to keep in mind that investment freedom index and property rights index are indicators based on a scale from 0 to 100, while corruption perceptions index ranges from 0 to 10. So, a one unit increase does not mean the same in all variables. The most unexpected result from our study is that any improvement in civil liberties score of a country results in a decline in reform score of that country. Civil liberties score ranges from 1 to 7, 1 representing the highest and 7 the lowest level of freedom. If civil liberties score of a country were to increase

by one unit (that is when civil liberties become more limited), its rate ratio for reform score would be expected to increase by a factor 1.325 (see Table 3).

*Results for control variables:*

Population and per capita income of a country seem to be other important factors in the reform progress. According to our results, population and GDP per capita of a country are positively correlated with its reform score. Moreover, being an OECD country has a significant negative impact on reform progress. If a country is a member of OECD, then the reform score in this country is expected to be 0.736 times less (see Table 3). This result may be regarded as an indication that in countries with well-established institutions the backgrounds of the chairpersons and the ministers/governors are much less important than in those with weaker institutions in terms of reform progress.

To illustrate the results above, we again use data from our dataset. Malaysia and Australia started a reform process in their electricity markets in 2001 and 2005, respectively. Malaysia is a non-OECD country with an investment freedom index score of 45 in 2011. On the other hand, Australia is an OECD country and its investment freedom index score is 80 for 2011. For 2011, the electricity market reform scores of Malaysia and Australia are 6 and 8, respectively. Our results suggest that if a country is a member of OECD, reform score is expected to be 0.736 times smaller. Similarly, our findings imply that if investment freedom index of a country were to increase by one unit, its rate ratio for reform score would be expected to increase by a factor 1.012. Therefore, holding all other variables constant and assuming that two countries are the same apart from their OECD membership status and investment freedom index scores, our results require that Malaysia's reform score would be 6.7 [ $6 \cdot 0.736 \cdot 1.012^{(80-45)}$ ] if Malaysia were to be an OECD country and its investment freedom index score were to be equal to that of Australia (i.e. 80). So, our findings imply that 0.7 points of 2 points difference between the reform scores of two countries may be explained by OECD membership status and investment freedom index score.



In our analysis above, we used observations from countries together with those from the states in US and Canada. Although the states in US and Canada are usually free to decide whether to initiate a reform process in their power industries, their discretion may be restricted by the central government in some instances. Besides, the states in US and Canada are similar in terms of their geographical location (i.e. North America) and income level (i.e. high income group), which implies that they may have common tendencies towards electricity market reform. Taking into account also the fact that the observations from the states in US and Canada constitute more than half of the observations in our dataset, our results may be dominated by common characteristics of the states in US and Canada that may or may not be relevant to reform process. Therefore, re-estimating our models without the states in US and Canada may produce useful insights for our analysis. In this second phase of estimation, we look at micro and macro institutional determinants of the reform progress separately. Table 4 presents Poisson regression estimation results without the states in US and Canada as Incident Rate Ratios (IRR) for micro institutional determinants of the reform progress while Table 5 does the same for macro determinants. In Table 6, we replace “civil liberties score” with “political rights score” and estimate the model again.

The empirical findings from the second phase of estimation suggest that the length of term and educational background of the chairperson of the electricity market regulatory agency are two determinants of the scope of power industry reform in a country. We could not detect any statistically significant relationship between experience in electricity industry or education level of the chairperson and scope of reforms in a country. We find that if the chairperson’s length of term in a country were to increase by one year, its rate ratio for reform score would be expected to increase by a factor 1.042, while holding all other variables in the model constant. Moreover, we detect a positive relationship between educational background of the chairperson in engineering and law and scope of reforms in a country. Our results imply that if the chairperson holds a degree in engineering or law, the reform score is expected to be 1.459 or 1.477 times greater, respectively; while holding all other variables in the model constant.

Experience of the minister responsible for energy policy and his/her educational background seem to be other important determinants of the scope of power industry reform in a country. We could not detect any statistically significant relationship between length of term or education level of the minister and scope of reforms. Our findings show that if the minister's experience in electricity industry were to increase by one year, its rate ratio for reform score would be expected to decrease by a factor 0.978, while holding all other variables in the model constant. This result implies that minister's experience in electricity industry adversely affects the reform process. The results also show that if the minister holds a degree in economics or business, reform score in this country is expected to be 1.601 times greater. However, if s/he holds a degree in law, then the reform score in this country is expected to be 0.737 times smaller.

**Table 4.** Poisson regression estimation results without the states in US and Canada as IRR (Micro Model)

<b>Variables</b>	<b>Variable Type</b>	<b>IRR</b>	<b>Robust Std. Err.</b>	<b>p-value (P&gt; z )</b>
Electricity market reform score	Dependent			
<b>Chairperson of the regulator when reforms started/considered</b>				
His/her experience in electricity industry at appointment	Explanatory	1.007	0.007	0.351
Length of term	Explanatory	1.042**	0.021	0.044
Education level (1: BSc, 2: MSc, 3: PhD)	Explanatory	1.120	0.133	0.338
<i>Educational background in</i>				
- Business or economics	Explanatory	0.946	0.165	0.752
- Engineering	Explanatory	1.459*	0.313	0.078
- Law	Explanatory	1.477**	0.228	0.011
<b>Energy minister when reforms started/considered</b>				
His/her experience in electricity industry	Explanatory	0.978**	0.011	0.038
Length of term	Explanatory	0.998	0.045	0.963
Education level (1: BSc, 2: MSc, 3: PhD)	Explanatory	1.012	0.095	0.900
<i>Educational background in</i>				
- Business or economics	Explanatory	1.601***	0.252	0.003

Variables	Variable Type	IRR	Robust Std. Err.	p-value (P> z )
- Engineering	Explanatory	1.403	0.333	0.154
- Law	Explanatory	0.737*	0.127	0.077
<b>Control variables</b>				
Population in 2010 (million people)	Control	1.001***	0.000	0.000
Dummy (1: OECD country, 0: non-OECD country)	Control	1.471**	0.269	0.035
Polity score in 2010 [-10, +10]	Control	1.090***	0.034	0.006

**Note:** Log pseudolikelihood: -78.25, Number of obs: 35  
Wald chi2(15): 3384.83, Prob > chi2: 0.000  
Deviance goodness-of-fit: 26.42, Prob > chi2(19): 0.1188  
Pearson goodness-of-fit: 27.68, Prob > chi2(19): 0.0898

\*\*\* Significant at 1% level,  
\*\* Significant at 5% level,  
\* Significant at 10% level.

**Table 5.** Poisson regression estimation results without the states in US and Canada as IRR (Macro Model 1)

Variables	Variable Type	IRR	Robust Std. Err.	p-value (P> z )
Electricity market reform score	Dependent			
<b>Institutional variables</b>				
Legal system & property rights index in 2009	Explanatory	1.119***	0.024	0.000
Polity score in 2010	Explanatory	1.036***	0.011	0.001
Investment freedom index in 2011	Explanatory	1.007***	0.002	0.002
Civil liberties score in 2011	Explanatory	1.129***	0.024	0.000
<b>Control variable</b>				
Log of population in 2010	Control	1.062***	0.023	0.005

**Note:** Log pseudolikelihood: -99.73, Number of obs: 49  
Wald chi2(5): 5381.81, Prob > chi2: 0.000  
Deviance goodness-of-fit: 16.84, Prob > chi2(43): 0.9999  
Pearson goodness-of-fit: 16.00, Prob > chi2(43): 0.9999

\*\*\* Significant at 1% level,  
\*\* Significant at 5% level,  
\* Significant at 10% level.

**Table 6.** Poisson regression estimation results without the states in US and Canada as IRR (Macro Model 2)

Variables	Variable Type	IRR	Robust Std. Err.	p-value (P> z )
Electricity market reform score	Dependent			
<b>Institutional variables</b>				
Legal system & property rights index in 2009	Explanatory	1.100***	0.025	0.000
Polity score in 2010	Explanatory	1.042***	0.013	0.001
Investment freedom index in 2011	Explanatory	1.008***	0.002	0.000
Political rights score in 2011	Explanatory	1.107***	0.020	0.000
<b>Control variable</b>				
Log of population in 2010	Control	1.080***	0.020	0.000

*Note:* Log pseudolikelihood: -100.07, Number of obs: 49  
Wald chi2(5): 5028.85, Prob > chi2: 0.000  
Deviance goodness-of-fit: 17.51, Prob > chi2(43): 0.9998  
Pearson goodness-of-fit: 16.64, Prob > chi2(43): 0.9999

\*\*\* Significant at 1% level,  
\*\* Significant at 5% level,  
\* Significant at 10% level.

Population of a country seems to be an important factor in the reform progress but its impact is quite limited. According to our results, if the population of a country were to increase by one million, its rate ratio for reform score would be expected to increase by a factor 1.001, while holding all other variables in the model constant. Being an OECD country has also a significant positive impact on reform progress. If a country is a member of OECD, then the reform score in this country is expected to be 1.471 times greater. This result may be regarded as an indication that in countries with well-established institutions the backgrounds of the chairpersons and the ministers are much less important than in those with weaker institutions in terms of reform progress.

The results from the models for macro determinants of reform progress confirm that all institutional variables have a strong impact on the reform progress. All coefficients are significant even at 1% level (see Table 5 and Table 6). We find a positive relationship between legal system and property rights index and reform progress in a country. If legal system and property rights index of a country were

to increase by one unit, its rate ratio for reform score would be expected to increase by a factor 1.119, while holding all other variables in the model constant (see Table 5). Similarly, we see a positive relationship between reform progress and polity score and investment freedom index. If polity score or investment freedom index of a country were to increase by one unit, its rate ratio for reform score would be expected to increase by a factor 1.036 or 1.007 respectively, while holding all other variables in the model constant. While evaluating these results, it is better to keep in mind that polity score is an indicator based on a scale from -10 to +10, while investment freedom index ranges from 0 to 100. So, a one unit increase in these variables does not mean the same.

As in the case of the first phase of estimations, the results from the second phase verify that any improvement in civil liberties or political rights score of a country results in a decline in reform score of that country. As mentioned before, civil liberties score and political rights score range from 1 to 7, 1 representing the highest and 7 the lowest level of freedom. If civil liberties score of a country were to increase by one unit (that is when civil liberties become more limited), its rate ratio for reform score would be expected to increase by a factor 1.129 (see Table 5). In the same way, if the political rights score of a country were to increase by one unit (that is when political rights become more limited), its rate ratio for reform score would be expected to increase by a factor 1.107 (see Table 6).

Table 7 compares the results from the first and second phase of estimations. It presents statistically significant coefficients only. As can be seen in Table 7, the results from two groups of estimations are similar in general with some slight differences in details. In both groups of estimations, we see that characteristics of chairperson and minister/governor and institutional variables have a statistically significant impact on reform progress.

To sum up, based on our results, we reject Hypotheses 2 and 3 but fail to reject Hypotheses 1 and 4. Our results clearly show that both the background of the chairperson and the minister/governor and institutional endowments are important determinants of how far reforms have gone in a country. It should also

be noted that any improvement in the investment environment positively contributes to the scope of reforms in a country. On the other hand, there seems to be a negative relationship between reform progress and civil liberties, which may prove that reforms may be limited in countries with strong civil society institutions such as trade unions or other organized structures in the society that may consider reforms as 'harmful' to their self-interest.

**Table 7.** Results with and without the states in US and Canada as IRR

Variables	Coefficient <i>(with the states in US and Canada)</i>	Coefficient <i>(without the states in US and Canada)</i>
Electricity market reform score		
<b>Chairperson of the regulator when reforms started/considered</b>		
His/her experience in electricity industry at appointment		
Length of term		1.042**
Education level (1: BSc, 2: MSc, 3: PhD)	1.076*	
<i>Educational background in</i>		
- Business or economics	0.830*	
- Engineering		1.459*
- Law		1.477**
- Other		
<b>Energy minister/governor when reforms started/considered</b>		
His/her experience in electricity industry		0.978**
Length of term		
Education level (1: BSc, 2: MSc, 3: PhD)	1.100*	
<i>Educational background in</i>		
- Business or economics	0.824*	1.601***
- Engineering	0.712**	
- Law		0.737*
- Other	0.760**	
<b>Institutional variables</b>		
Investment freedom index in 2011	1.012***	1.007***
Polity score in 2010		1.036***
Corruption perceptions index in 2010	1.225***	
Property rights index in 2011	0.979***	
Civil liberties score in 2011	1.325***	1.129***
Political rights score in 2011		1.107***

Variables	Coefficient	Coefficient
	(with the states in US and Canada)	(without the states in US and Canada)
Legal system & property rights index in 2009		1.119***
<b>Control variables</b>		
Log of population in 2010	1.194***	1.062***
Log of GDP per capita in 2010	1.370***	
Dummy (1: OECD country, 0: non-OECD country)	0.736*	1.471**
Constant		

\*\*\* Significant at 1% level,

\*\* Significant at 5% level,

\* Significant at 10% level.

## 7. Conclusion

Electricity is an indispensable good for households and a key input for industry in almost every economy. The three decades of electricity liberalization so far have taken place in line with a general trend towards liberalization of the economy in general and the energy industry in particular. In this process, the extent of reforms has been largely determined by country specific local conditions (e.g. development stage of the country, demand for electricity, cross-subsidy policy and so on), quality of institutions required for the reform and political preferences related to the reform agenda. Today, the direct benefits of the reforms to households are still not directly visible in many reforming countries, which underlines the need for further analyses of the reforms. This paper contributes to efforts to analyse electricity market reforms with an applied macro level cross-country approach.

This study offered both a macro and micro level econometric analysis on the possible institutional determinants of the electricity market reform progress. Throughout the study, we tried to explain whether differences in institutional structures of countries play an important role in explaining how far reforms have gone in these countries; how specific institutional endowments of a country affect its reform performance and, finally, whether the background of the chairperson of the regulatory agency when reforms started or were considered

or that of the governor/minister responsible for energy policy at that time has an impact on reform progress. We focused on these issues by using an empirical econometric model to observe the impact of institutional variables on the reform progress. Cross-section data from 51 states in US, 13 states in Canada and 51 other countries were employed. As a result of the study, we found that both the background of the chairperson and the minister/governor and institutional endowments of a country are important determinants of how far reforms have gone in a country. Our results imply that any improvement in the investment environment positively contributes to the scope of reforms in a country. On the other hand, there seems to be a negative relationship between reform progress and civil liberties, which indicates that democracy may delay or hinder the reforms by magnifying the voices of anti-reform interest groups.

We hope that future research will continue developing econometric models to analyse electricity market reforms. We suggest the following for future research. First of all, due to lack of essential data, we focused on the reform progress rather than reform success or failure. However, there is a definite need for identifying the determinants of reform success or failure. So, future research on electricity market reforms should focus on identifying what successful reform is and developing new variables that measure the relative success of reforms.

The second possible extension in future research may be the identification of suitable instrumental variables (IV) to overcome the possible endogeneity problem. Despite our efforts, we could not find any suitable instrumental variable in this research and, therefore, did not use IV methods in the paper. As we know credibility of the estimates from a regression using IV methods hinges on the selection of suitable instruments. Utilization of IV methods with inappropriate instruments creates more problems than it solves. If suitable instrumental variables exist for the analysis of electricity market reforms and they are used in the future research, our understanding of the reforms may improve.



The third task for future research should be the extension of the data set in terms of number of countries, time period, frequency of data and number (and quality) of variables. In this paper, we employed data from 53 countries. There may be sample selection bias if the countries making this data available have differing results for the dependent variables than those which do not make data available. Besides, due to lack of data, we could not properly account for the impact of some other variables on reform progress in our analysis. Future research should focus on developing techniques to overcome data-related problems.

The fourth extension may be realized by taking into account the fact that electricity reform is a part of wider economic reform (or liberalization) in general and energy industry reform in particular. In the period 1990-2011, total private investments in the infrastructure industries (energy, telecom, transport, water and sewerage) were about \$1,695 billion. Out of this figure, \$573 billion (33.8%) went to energy industry in general and \$508 billion (30%) to electricity industry in particular. Power market reform affects and is affected by reforms in other energy and non-energy sectors. For instance, it is obvious that the progress in telecommunication reform has facilitated electricity reform, which in turn has contributed to the progress in gas market reform. As observed by Pollitt (2009), the link between electricity reform and institutions more generally remains poorly explored. Electricity reform, Pollitt (2009) argues, requires fundamental change of the institutions in the electricity sector (e.g. the creation of an independent regulator and an Independent System Operator); however, these institutional changes occur in the context of 'deeper' institutions such as competition policy, the judiciary, political fora, and so on. The extent to which electricity reform can make up for deficiencies in these 'deeper' institutions is limited. Moreover, Nepal and Jamasb (2012) investigate the link between power sector reforms and wider institutional reforms in the economy across different groups of transition countries. Their results indicate that power sector reform is highly inter-dependent with wider reforms in other sectors of the economy and failure to harmonize inter-sector reforms leads to power sector reform measures being ineffective. They argue that the success of power sector reforms in developing countries largely depend on the extent to which they synchronize

inter-sector reforms in the economy. In this research, we did not take into account possible spill-over effects from or to other energy and non-energy sectors but inter-reform relationship is clearly an important research area that is open to exploration.

Finally, we studied certain aspects of institutional quality. Of course, there remain many other characteristics of institutions that we did not investigate. They may constitute possible topics for future research if data on them become available.

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## Appendices

### Appendix 1: Summary of previous econometric studies adopting a NIE approach

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
Acemoglu et al. (2001)	<b>H:</b> Settler mortality affected settlements; settlements affected early institutions; and early institutions persisted and formed the basis of current institutions.	- Log GDP per capita (PPP) in 1995 - Log output per worker in 1988	- Average protection against expropriation risk, 1985-1995 - Constraint on executive in 1990 - Constraint on executive in 1900 - Constraint on executive in first year of independence - Democracy in 1900 - European settlements in 1900 - Log of European settler mortality - Continent dummies - Latitude - Malaria in 1994 - Life expectancy - Infant mortality - Mean temperature - Distance from coast - Yellow fever dummy	By exploiting differences in European mortality rates as an instrument for current institutions, large effects of institutions on income per capita are estimated. Once the effect of institutions is controlled for, countries in Africa or those closer to the equator do not have lower incomes.	<b>Data Sources:</b> World Bank, Political Risk Services, National Bureau of Economic Research (US), Atlas of World Population History <b>Methodology:</b> OLS estimation, two-stage least-squares estimation



Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
Acemoglu et al. (2008)	H: There is a negative correlation between economic inequality and long-run economic development.	<ul style="list-style-type: none"> <li>- Secondary school enrolment</li> <li>- Primary school enrolment</li> <li>- Urbanization (1993)</li> <li>- Unsatisfied basic needs</li> <li>- Literacy rate (1937)</li> <li>- Urbanization (1937)</li> <li>- Share of buildings without access to public services</li> </ul>	<ul style="list-style-type: none"> <li>- Land Gini</li> <li>- Contemporary land Gini</li> <li>- Political concentration index</li> <li>- Year of foundation of a municipality</li> <li>- Altitude of the municipality</li> <li>- Distance of the municipality to Bogota (the capital)</li> <li>- Area</li> <li>- Average rainfall</li> </ul>	<ul style="list-style-type: none"> <li>- While the distribution of landed wealth in Cundinamarca was considerably more unequal than in northern U.S. states, it was less unequal than in the U.S. South.</li> <li>- There is a negative association between land inequality (land Gini) and political concentration across municipalities in Cundinamarca.</li> <li>- Land Gini (economic inequality) is positively associated with good outcomes.</li> <li>- There is a fairly robust negative relationship between political concentration (measure of political inequality) and good economic outcomes.</li> </ul>	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- Data on economic inequality in nineteenth century Cundinamarca are from the cadastral (land census) data collected by the state of Cundinamarca in 1879 and 1890</li> <li>- Data on politicians (mayors) are from the Registro del Estado and Gaceta de Cundinamarca, official newspapers</li> <li>- The contemporary data are from the 1993 population census and the Colombian statistical agency DANE</li> <li>- Location and rainfall data from Instituto Geografico Agustin Codazzi in Bogota</li> </ul> <p><b>Methodology:</b></p> <ul style="list-style-type: none"> <li>- Cross-sectional ordinary least squares (OLS) estimations</li> <li>- Quantile regression estimation</li> </ul>

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
Aghion et al. (2008)	H: Democracy enhances economic growth.	- 10 year output growth rate by sector - 10 year value-added growth rate by sector - 10 year employment growth rate by sector	- Democracy - The distance to the technological frontier - Log of GDP per capita - Executive de facto independence - Constraints on executive power - Effectiveness of legislature - Government effectiveness - Competition in the legislative nominating process - Autocracy - Political rights average 1972-99 - Civil rights average 1972-99	- Democratic institutions and political rights enhance growth of more advanced sectors. - An important channel of this effect is freedom of entry in markets. Political rights are associated with freedom of entry, and the latter is especially important for sectors close to the technological frontier. - More advanced economies benefit more from democratic institutions and therefore the demand for democracy should increase with the level of per capita income in a country.	<b>Data:</b> - Industry employment and value-added data from the Industrial Statistics Database collected by the UNIDO (for 180 countries for the period 1963 to 2003) - Polity IV database and the Freedom House measures of civil liberties and political rights - Penn World Table <b>Methodology:</b> OLS estimation, fixed-effects model
Alesina and Rodrik (1994)	H: An economy's initial configuration of resources shapes the political struggle for income and wealth distribution, and this in turn affects long-run growth.	- Average per capita growth rate over 1960-1985 - Average per capita growth rate over 1970-1985	- Gini coefficient of income inequality - Gini coefficient of land distribution inequality - Per capita GDP level in 1960 - Primary school enrolment	- There will be a strong demand for redistribution in societies where a large section of the population does not have access to the productive resources of the economy.	<b>Data:</b> - Cover 35 countries for 1960-85 period - Heston and Summers dataset - Barro and Wolf

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
			ratio in 1960 - Dummy variable for democratic governments	Such conflict over distribution will generally harm growth. - The greater the inequality of wealth and income, the higher the rate of taxation, and the lower growth. - Inequality in land and income ownership is negatively correlated with subsequent economic growth.	dataset <b>Methodology:</b> OLS estimation
Alesina et al. (1996)	<b>H1:</b> There is a general correlation between economic growth and political stability. <b>H2:</b> Political stability fosters economic growth, and low economic growth leads to political instability.	- Annual rate of growth of per capita GDP - Government change - Major government change - Coups	- Democracy - Executive adjustments - Number of unsuccessful attempts at changing the government - Log of real per capita GDP - World business cycle - Percentage of school age population enrolled in primary school - Dummy variable for countries in South American and Latin America - Dummy variable for	- In countries and time periods with a high degree of political instability, growth is significantly lower than otherwise. - The effect of growth on political instability is less clear: the effect of low economic growth on government collapses is strong for coups d'état but much less clear for other types of government change. - The occurrence of	<b>Data:</b> - Cover 113 countries for 1950-1982 period - Summers and Heston dataset - Jodice and Taylor dataset - World Bank Economic and Social Data Base <b>Methodology:</b> OLS estimation

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
			countries in Africa - Dummy variable for industrial countries	government changes in the recent past increases the probability of observing future collapses.	
Assane and Grammy (2003)	<b>H:</b> The “quality” of the institutional framework positively affects economic development.	- Level of income, 1985	- Physical capital formation - Labour force growth - Human capital formation - Economic freedom - Institutional efficiency - Institutional quality - Economic freedom-institutional efficiency interaction - Economic freedom-institutional quality interaction	- “Good” institutions improve efficiency and accelerate growth. - The positive effect of institutional “quality” is more pronounced with mutually reinforcing support of economic freedom. - “Good” institutions help developing countries grow faster to achieve conditional convergence. - Economic development requires not only physical and human capital formation, but also freedom to choose and institutional support.	<b>Data:</b> - Cover 110 countries - Business International Corporation - Human development index - International Country Risk Guide <b>Methodology:</b> OLS estimation
Barro (1996)	<b>H:</b> Economic freedoms, in the form of free markets and small governments that	- Growth rate of real per capita GDP over 1965-75 period	- Log of GDP - Male schooling - Female schooling	- The favourable effects on growth include maintenance of the rule of law, free	<b>Data:</b> - Summers-Heston data set

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
	focus on the maintenance of property rights, encourage economic growth.	<ul style="list-style-type: none"> <li>- Growth rate of real per capita GDP over 1975-85 period</li> <li>- Growth rate of real per capita GDP over 1985-90 period</li> </ul>	<ul style="list-style-type: none"> <li>- Log of life expectancy</li> <li>- Log of GDP x human capital</li> <li>- Log of fertility rate</li> <li>- Government consumption ratio</li> <li>- Public educational spending ratio</li> <li>- Black-market premium</li> <li>- Rule-of-law index</li> <li>- Terms-of-trade change</li> <li>- Investment ratio</li> <li>- Democracy index</li> <li>- Democracy index squared</li> <li>- Democracy index dummy</li> </ul>	<p>markets, small government consumption, and high human capital.</p> <p>- Once these kinds of variables and the initial level of real per capita GDP are held constant, the overall effect of democracy on growth is weakly negative.</p> <p>- There is a suggestion of a nonlinear relationship in which more democracy enhances growth at low levels of political freedom but depresses growth when a moderate level of freedom has already been attained.</p> <p>- Improvements in the standard of living—measured by GDP, health status, and education—substantially raise the probability that political freedoms will grow.</p>	<ul style="list-style-type: none"> <li>- World Bank</li> <li>- Barro-Lee data set (Economics Department, Harvard University)</li> <li>- Gastil measures of political rights</li> </ul> <p><b>Methodology:</b></p> <ul style="list-style-type: none"> <li>- Instrumental-variable technique</li> <li>- OLS estimation</li> </ul>

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
Barro (2000)	<b>H:</b> Income inequality has an effect on macroeconomic performance, as reflected in rates of economic growth and investment.	- Average growth rate (1965 to 1975) - Average growth rate (1975 to 1985) - Average growth rate (1985 to 1995) - Ratio of real investment to real GDP	- Log of per capita GDP - Log of per capita GDP squared - Government consumption/GDP - Rule-of-law index - Democracy index - Democracy index squared - Inflation rate - Years of schooling - Log of total fertility rate - Investment/GDP - Growth rate of terms of trade	- Evidence from a broad panel of countries shows little overall relation between income inequality and rates of growth and investment. - For growth, higher inequality tends to retard growth in poor countries and encourage growth in richer places. - The Kuznets curve—whereby inequality first increases and later decreases during the process of economic development—emerges as a clear empirical regularity. However, this relation does not explain the bulk of variations in inequality across countries or over time.	<b>Data:</b> - Deininger and Squire dataset <b>Methodology:</b> - Conditional convergence - Panel estimation (fixed effects model)
Barro (1991)	<b>H:</b> There are some empirical regularities about growth, fertility, and investment.	- Per capita GDP growth - Investment	- School-enrolment rates at the secondary levels in 1960 - School-enrolment rates at	- The growth rate of real per capita GDP is positively related to initial human	<b>Data:</b> - Cover 98 countries in the period 1960-1985

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
			<ul style="list-style-type: none"> <li>the primary levels in 1960</li> <li>- GDP per capita in 1960</li> <li>- The number of revolutions and coups per year</li> <li>- The number per million population of political assassinations per year</li> <li>- Mortality rates for children aged 0-4</li> <li>- Student-teacher ratio</li> <li>- Adult literacy rate</li> <li>- The total fertility rate</li> <li>- Dummy variables for Africa and Latin America</li> </ul>	<ul style="list-style-type: none"> <li>capital (proxied by school-enrolment rates) and negatively related to the initial level of real per capita GDP.</li> <li>- Countries with higher human capital have lower fertility rates and higher ratios of physical investment to GDP.</li> <li>- Growth is inversely related to the share of government consumption in GDP, but insignificantly related to the share of public investment.</li> <li>- Growth rates are positively related to measures of political stability and inversely related to a proxy for market distortions.</li> </ul>	<ul style="list-style-type: none"> <li>- Summers and Heston dataset</li> <li>- United Nations</li> <li>- World Bank</li> <li><b>Methodology:</b> OLS estimation</li> </ul>
Besley and Kudamatsu (2008)	<b>H1:</b> Autocratic regimes do not always perform badly, at least as judged by economic indicators, such as the	<ul style="list-style-type: none"> <li>- Life expectancy</li> <li>- Gross primary school enrolment ratio</li> <li>- Economic growth</li> </ul>	<ul style="list-style-type: none"> <li>- Per capita income</li> <li>- Ethnic fractionalization</li> <li>- European settlers' mortality</li> <li>- French legal origin</li> </ul>	<ul style="list-style-type: none"> <li>- Democracies can be better or worse than autocracies in terms of accountability.</li> <li>- Successful autocracies are</li> </ul>	<ul style="list-style-type: none"> <li><b>Data:</b></li> <li>- World Bank's World Development Indicators</li> <li>- UNESCO Institute for</li> </ul>

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
	<p>growth rate of income per capita or other components of the human development index.</p> <p><b>H2:</b> Given that democracy per se does not guarantee good economic performance, some features of autocratic regimes may be conducive to good economic performance.</p>		<ul style="list-style-type: none"> <li>- Socialist legal origin</li> <li>- German legal origin</li> <li>- Oil price boom</li> <li>- Decade dummies</li> <li>- Region dummies</li> <li>- Number of leadership changes per year</li> </ul>	<p>those where poor-quality leadership leads to removal of leaders from office.</p> <p>- The forces shaping leadership replacement may be at work in successful autocracies. Leadership turnover is greater in successful compared to unsuccessful autocracies.</p>	<p>Statistics</p> <p><b>Methodology:</b> OLS estimation</p>
Caselli et al. (1996)	<p><b>H1:</b> There are two sources of inconsistency in existing cross-country empirical work on growth: correlated individual effects and endogenous explanatory variables.</p>	- Change in growth rate	<ul style="list-style-type: none"> <li>- GDP per capita in previous year</li> <li>- Male education</li> <li>- Female education</li> <li>- I/GDP</li> <li>- G/GDP</li> <li>- ln(1+BMP)</li> <li>- Revolutions</li> <li>- Life expectancy</li> <li>- Assassinations</li> <li>- Terms of trade</li> </ul>	<p>- Per capita incomes converge to their steady-state levels at a rate of approximately 10 percent per year. This result stands in sharp contrast to the current consensus, which places the convergence rate at 2 percent.</p> <p>- The results reject both the standard and the augmented version of the Solow model.</p>	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- Maddison dataset</li> <li>- Summers and Heston dataset</li> </ul> <p><b>Methodology:</b></p> <ul style="list-style-type: none"> <li>- Regressions using a generalized method of moments estimator.</li> </ul>
Clague et al. (1996)	<p><b>H1:</b> Any incentive an autocrat has to respect property and contract rights</p>	<ul style="list-style-type: none"> <li>- ICRG index</li> <li>- BERI index</li> <li>- Credit risk</li> </ul>	<ul style="list-style-type: none"> <li>- The number of consecutive years that a country has been a democracy</li> </ul>	<p>- There is a compelling empirical relationship between property and</p>	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- The Gurr and Banks database (1986-90)</li> </ul>



Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
	comes from his interest in future tax collections and national income and increases with his planning horizon. <b>H2:</b> In autocracies it is the time horizon of the individual autocrat (or occasionally the ruling clique) that is the main determinant of property and contract rights, whereas in democracies these rights depend upon whether the democratic system is durable.	- Currency depreciation - Black market exchange premium	- The number of years that the chief executive has been in office in a democracy - The number of consecutive years that the chief executive in an autocratic nation has been in power - The duration of the ruling group - The amount of contract-intensive money - Indexes from two firms evaluating risks to foreign investors - Credit rating variable - The rate of currency depreciation - Per capita income	contract rights and an autocrat's time in power. - Autocrats who had been in power longer and who had reason to have longer time horizons were associated with better property and contract rights than autocrats who were in power only for a shorter time. - In general, democracies provide greater security of property and contractual rights than autocracies. But these benefits of democracy did not appear quickly: the property and contract rights were often poor in democracies that had lasted only a short time.	- Gastil indexes - Europa Yearbook - The International Country Risk Guide (ICRG), published since 1982 - Business Environmental Risk Intelligence (BERI), published since 1972 - Report titled "Institutional Investor" <b>Methodology:</b> OLS estimation
Drury et al. (2006)	<b>H:</b> One of democracy's indirect benefits is its ability to mitigate the detrimental effect of corruption on	- Growth of GDP	- Level of corruption - Life expectancy - Trade openness - Population growth	- Corruption has no significant effect on economic growth in democracies, while non-democracies suffer significant	<b>Data:</b> - Time-series cross-section data for more than 100 countries

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
	economic growth.		<ul style="list-style-type: none"> <li>- Log of GDP per capita</li> <li>- Tropical climate</li> <li>- Government spending</li> </ul>	economic harm from corruption.	from 1982 to 1997 - World Bank's World Development Indicators (2003) - International Country Risk Guide's (ICRG) 1982-97 assessments - Transparency International - Polity IV database - Freedom House measure of democracy <b>Methodology:</b> OLS estimation
Easterly and Levine (1997)	<p><b>H1:</b> Higher levels of ethnic diversity encourage poor policies, poor education, political instability, inadequate infrastructure, and other factors associated with slow growth.</p> <p><b>H2:</b> There is a direct effect of ethnic diversity on economic growth and an indirect effect</p>	- Average annual growth rate of GDP per capita in the 1960s, 1970s, and 1980s	<ul style="list-style-type: none"> <li>- Initial income</li> <li>- Ethnolinguistic diversity</li> <li>- School attainment</li> <li>- Political stability</li> <li>- Financial development</li> <li>- Black market premium</li> <li>- Fiscal surplus</li> <li>- Infrastructure development</li> <li>- Dummy variables for Africa and Latin America</li> </ul>	- Low school attainment, political instability, poorly developed financial systems, large black market exchange rate premiums, large government deficits, and inadequate infrastructure are significantly correlated with economic growth.	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- Barro and Lee dataset</li> <li>- World Bank</li> <li>- IMF</li> <li>- Pick's Currency Yearbook</li> <li>- Political Risk Services</li> <li>- World Resources Institute</li> </ul>

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
	of ethnic diversity on public policy choices that influence long-run growth rates.		- Assassinations - Financial depth - Fiscal surplus/GDP		<b>Methodology:</b> - Technique of seemingly unrelated regressions
Helliwell (1994)	<b>H:</b> There are two-way linkages between democracy and economic growth.	- Growth in real GDP per adult from 1960 to 1985	- Bollen democracy index - Real GDP per adult in 1960 - Investment rate - Schooling rate	- The effects of income on democracy are found to be robust and positive. - It is still not possible to identify any systematic net effects of democracy on subsequent economic growth.	<b>Data:</b> - Cross-sectional and pooled data for up to 125 countries over the period from 1960 to 1985 - Bollen index for 1960 and 1985 - Gastil index for 1976 and 1985 - World Bank <b>Methodology:</b> OLS estimation
Isham et al. (1997)	<b>H:</b> There is a link between civil liberties and democracy - critical determinants of how governments exercise public decisions and authority - and the efficacy of public investments.	- Economic rate of return of government projects - The probability of a project being rated satisfactory	- Freedom House civil liberties, 1978-87 - Humana, 1982-85 - Media pluralism, 1983-87 - Freedom to organize, 1983-87	- There is a strong empirical link between civil liberties and the performance of government projects. - Even after controlling for other determinants of performance, countries with the strongest civil liberties	<b>Data:</b> - World Bank's Operations Evaluation Department - Freedom House's civil liberties index - UN's Humana index <b>Methodology:</b> OLS and

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
Keefer and Knack (1997)	<p><b>H:</b> Poor countries are falling back rather than catching up with wealthy countries. Deficient institutions underlie this divergence.</p>	<p>- Average real per capita growth in GDP, 1960-1989</p>	<ul style="list-style-type: none"> <li>- GDP/Capita, 1960</li> <li>- Country Risk Index</li> <li>- Business Risk Index</li> <li>- Executive Constraints</li> <li>- Primary School Enrolment</li> <li>- Secondary School Enrolment</li> <li>- Labour Force Growth</li> <li>- Price Changes</li> <li>- Income Gap</li> <li>- Institutional Variable</li> <li>- Institution x Income Gap</li> </ul>	<p>have projects with an economic rate of return 8-22 percentage points higher than countries with the weakest civil liberties.</p> <p>- The strong effect of civil liberties holds true even when controlling for the level of democracy.</p> <p>- The ability of poor countries to catch up is determined in large part by the institutional environment in which economic activity in these countries takes place.</p> <p>- Institutions are powerful determinants of the ability of countries to benefit from the “catch-up” effect. While poorer countries may have advantages because of low-cost access to advanced technology or the diminishing returns experienced by</p>	<p>probit regressions</p> <p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- International Country Risk Guide (ICRG)</li> <li>- Business Environmental Risk Intelligence (BERI)</li> </ul> <p><b>Methodology:</b> OLS estimation</p>

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
P. Keefer and Knack (2002)	<p><b>H:</b> Social polarization reduces the security of property and contract rights and, through this channel, reduces growth.</p>	<ul style="list-style-type: none"> <li>- International Country Risk Guide Index (ICRG), 1986-95</li> <li>- Annual growth in per capita income over the 1970-92 period</li> </ul>	<ul style="list-style-type: none"> <li>- Ethnic tensions (0-6 scale)</li> <li>- The percent of a country's population belonging to the largest ethnic group</li> <li>- Log of 1985 GDP per capita</li> <li>- Per capita growth, 1980-85</li> <li>- Aggregate GDP, 1985</li> <li>- Gini: income inequality</li> <li>- Gini: land inequality</li> <li>- Ethnic homogeneity</li> <li>- Political violence</li> <li>- Regime type</li> <li>- Continent dummy</li> <li>- Log of 1970 GDP per capita</li> <li>- Mean years of education, 1970</li> <li>- Property rights index, 1982</li> </ul>	<p>wealthier countries, these potential advantages appear to be squandered in countries with poor institutional frameworks.</p> <ul style="list-style-type: none"> <li>- Polarization makes large changes in current policies, including those guaranteeing the security of contract and property rights, more likely under a wide range of institutional arrangements.</li> <li>- Social polarization may directly undermine the security of rights.</li> <li>- If the insecurity of property rights slows growth in unequal or otherwise polarized societies, then governments that commit over the long-run to particular redistributive policies incur less risk of slowing economic growth.</li> </ul>	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- International Country Risk Guide (ICRG), published by Political Risk Services (from 1982 onwards)</li> </ul> <p><b>Methodology:</b> OLS estimation</p>

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
Knack and Keefer (1997)	<b>H:</b> Trust and civic norms have an influence on growth and investment rates.	- Average annual growth in per capita income over the 1980-1992 period for 29 countries - Log of output/worker - Log of capital/worker - School/worker - Log of total factor productivity	- TRUST (the percentage of respondents in each nation replying “most people can be trusted”) - CIVIC (the strength of civic norms) - Per capita GDP in 1980 - Labour force growth - (Exports + Imports )/GDP - M2/GDP - Black market premium - Property rights (ICRG) - Currency depreciation - Investor credit rating - Gini (income) - Confidence in government - Ethnic homogeneity	- Trust and civic cooperation are associated with stronger economic performance. - Associational activity is not correlated with economic performance. - Trust and norms of civic cooperation are stronger in countries with formal institutions that effectively protect property and contract rights, and in countries that are less polarized along lines of class or ethnicity.	<b>Data:</b> - The World Values Surveys containing data on thousands of respondents from 29 market economies - International Country Risk Guide (ICRG) - Business Environmental Risk Intelligence (BERI) <b>Methodology:</b> OLS, 2SLS estimation
Mauro (1995)	<b>H:</b> Efficient government institutions foster economic growth. Corruption and other institutional factors affect economic growth.	- Total Investment/GDP - Equipment investment/GDP - Nonequipment investment/GDP - Equipment investment/Nonequipment	- Index of ethnolinguistic fractionalization - Bureaucratic efficiency index (BE) for 1980-1983 - Political Change - Political Stability - Probability of Opposition	- Corruption lowers private investment, thereby reducing economic growth. - Bureaucratic efficiency may be at least as important a determinant of investment and growth as political	<b>Data:</b> - Business International (BI) indices on corruption, red tape, and the efficiency of the judicial system for the period 1980-1983 for

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
		investment - Private investment/GDP - Public investment/GDP - Private investment/Public investment	Group Takeover - Stability of Labour - Relationship with Neighbouring Countries - Terrorism - Legal System, Judiciary - Bureaucracy and Red Tape - Corruption - Secondary education - Population growth - Primary education - Government expenditure - Revolutions and coups - Assassinations	stability.	70 countries <b>Methodology:</b> Instrumental variable technique, OLS estimation
Nunn (2008)	<b>H1:</b> Large-scale plantation slavery resulted in economic inequality. <b>H2:</b> This resulted in subsequent underdevelopment.	- Per capita GDP in 2000	- Fraction slaves - Nonplantation slaves - Plantation slaves - Population density	- Slavery was detrimental for economic development.	<b>Data:</b> - Historic population data from a variety of sources, most often population censuses - Data on country-level per capita GDP in 2000 are from World Bank, Penn World Table - Population density

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
Persson and Tabellini (1994)	<b>H:</b> Inequality is harmful for growth.	- Annual average growth rate of GDP per capita	<ul style="list-style-type: none"> <li>- Income Distribution</li> <li>- Political Participation</li> <li>- Average Skills</li> <li>- The Level of Development</li> <li>- Initial GDP</li> </ul>	<ul style="list-style-type: none"> <li>- There is a significant and large negative relation between inequality and growth.</li> <li>- This relation is only present in democracies.</li> </ul>	<p>and land data are from Harvard Centre for International Development's Geography Database</p> <p><b>Methodology:</b> OLS estimation</p> <hr/> <p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- Cover 1830-1985 period for 9 countries</li> <li>- Summers and Heston dataset</li> <li>- U.S. Department of Commerce</li> <li>- World Bank</li> <li>- OECD</li> </ul> <p><b>Methodology:</b></p> <ul style="list-style-type: none"> <li>- Model building</li> <li>- OLS estimation</li> <li>- 2SLS estimation</li> </ul>
Persson and Tabellini (2008)	<b>H:</b> There is a positive relation between democracy and growth.	- Per capita income	<ul style="list-style-type: none"> <li>- Length of sample</li> <li>- Income relative to the United States</li> <li>- War years</li> </ul>	<ul style="list-style-type: none"> <li>- Transitions from autocracy to democracy are associated with an average growth acceleration of about 1</li> </ul>	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- Annual per capita income data from Penn World Tables (1960-</li> </ul>



Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology	
				<ul style="list-style-type: none"> <li>- Domestic democratic capital</li> <li>- Foreign democratic capital</li> <li>- Initial value of polity score</li> </ul>	<p>percentage point, producing a gain in per capita income of about 13% by the end of the sample period.</p> <p>- The effect of transitions in the opposite direction is larger: a relapse from democracy to autocracy slows down growth by almost 2 percentage points on average, which implies an income fall of about 45% at the end of the sample.</p>	<p>2000)</p> <ul style="list-style-type: none"> <li>- Polity IV database</li> </ul> <p><b>Methodology:</b> Semi parametric methods, difference-in-difference methods, propensity-score methods, OLS estimation</p>
Scully (1988)	<p><b>H:</b> The material progress mankind made in modern times has been affected significantly by the choice of the institutional framework designed to bring it about.</p>	<ul style="list-style-type: none"> <li>- Economic growth over the period 1960-80</li> <li>- Economic efficiency</li> <li>- Change in economic efficiency</li> </ul>	<ul style="list-style-type: none"> <li>- The compound growth rate of real per capita GDP</li> <li>- The compound growth rate in the capital-labour ratio</li> <li>- Politically liberal</li> <li>- Politically not liberal</li> <li>- Civil liberty</li> <li>- Limited civil liberty</li> <li>- Economic liberty</li> </ul>	<p>- The institutional framework has significant and large effects on the efficiency and growth rate of economies.</p> <p>- Politically open societies, which subscribe to the rule of law, to private property, and to the market allocation of resources, grow at 3 times the rate and are 2.5 times as efficient as societies in which these freedoms are abridged.</p>	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- Cover 115 countries for 1960-1980 period</li> <li>- Gastil measures of liberty</li> <li>- Summers and Heston dataset</li> </ul> <p><b>Methodology:</b> OLS estimation</p>	

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
Spindler (1991)	H: There is appositve relation between economic freedom and economic development for most countries in the world.	- Gross National Product per capita	- Private GNP per capita - Economic freedom - Property freedom - Movement freedom - Association freedom - Information freedom - Civil liberties - Economic system - Dummy for oil exporting countries - Dummy for industrial countries	- The relationship between economic freedom and economic development is strong and direct for such economic freedoms as freedom of property and freedom of movement but inverse for freedom of association. - The findings appear to be independent of the type of economic system or civil liberties, as measured by the Gastil ratings, which have their own important effects on economic development.	<b>Data:</b> - Wright Economic Freedom Ratings covering 165 countries for 1982 onwards <b>Methodology:</b> OLS estimation
Vanssay and Spindler (1994)	H: There is a relationship between per-capita income, the entrenchment of various rights in a country's constitution and the level of economic freedom in a country.	- GNP per capita	- Education - Economic freedom - Political structure - Specific protections against tyranny - Social Rights	- Entrenchment of any single right seldom has a significant general economic effect, while the effect of economic freedom is significant and substantial. - Education, economic freedom, population growth	<b>Data:</b> - Cover 100 countries for 1988 - UNDP Human Development Report 1991 - Scully and Slottje dataset

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
				<p>and the saving ratio together explain more than 75% of the cross-country variation in per capita income.</p> <p>- The entrenched elements of “Political structure”, “Protections from tyranny”, or “Social Charter” are not revealed as important explanatory variables.</p>	<p>- Taubenfel dataset  <b>Methodology:</b> OLS estimation</p>

**Appendix 2:** Summary of previous econometric studies based on NIE by their focus

<b>Focus of the study</b>	<b>Major Explanatory Variable(s)</b>	<b>Data Sources</b>	<b>Examples</b>
The relationship between historical institutions and present economic performance	<ul style="list-style-type: none"> <li>- Protection against expropriation risk</li> <li>- Constraint on executive</li> <li>- Democracy</li> <li>- European settler mortality</li> <li>- Continent dummies</li> <li>- Number of slaves</li> <li>- Population density</li> <li>- Land Gini</li> <li>- Political concentration index</li> </ul>	World Bank, Political Risk Services, National Bureau of Economic Research (US), Atlas of World Population History, Harvard Centre for International Development's Geography Database, the cadastral (land census) data, official newspapers, population census, the Colombian statistical agency (DANE)	Acemoglu et al. (2001), Acemoglu et al. (2008), Nunn (2008)
The relationship between political institutions and economic growth	<ul style="list-style-type: none"> <li>- Polity score</li> <li>- GDP per capita</li> <li>- Executive independence</li> <li>- Constraints on executive power</li> <li>- Effectiveness of legislature</li> <li>- Government effectiveness</li> <li>- Political and civil rights</li> <li>- Ethnic fractionalization</li> <li>- Legal origin</li> <li>- The duration of the ruling group</li> <li>- Domestic and foreign democratic capital</li> <li>- Bureaucratic efficiency index</li> </ul>	Industrial Statistics Database of the UNIDO, Polity IV database, Freedom House, Penn World Table, World Bank's World Development Indicators, UNESCO Institute for Statistics, Business International (BI), Heston and Summers dataset, Barro and Wolf dataset, Maddison dataset, International Country Risk Guide (ICRG), Transparency International, Bollen index, Gastil index, World Bank's Operations Evaluation Department, UN's Humana index, Summers and Heston dataset, Jodice	Scully (1988), Helliwell (1994), Alesina and Rodrik (1994), Mauro (1995), Clague et al. (1996), Caselli et al. (1996), Alesina et al. (1996), Isham et al. (1997), Drury et al. (2006), Aghion et al. (2008), Besley and Kudamatsu (2008), Persson and Tabellini (2008)

Focus of the study	Major Explanatory Variable(s)	Data Sources	Examples
	<ul style="list-style-type: none"> <li>- Probability of opposition group takeover</li> <li>- Revolutions and coups</li> <li>- Assassinations</li> <li>- Gini coefficient of income and land distribution inequality</li> <li>- Primary school enrolment</li> <li>- Level of corruption</li> <li>- Life expectancy</li> <li>- Trade openness</li> <li>- Media pluralism</li> <li>- Freedom to organize</li> </ul>	and Taylor dataset	
The relationship between social structure and economic growth	<ul style="list-style-type: none"> <li>- Ethnic tensions</li> <li>- The percent of a country’s population belonging to the largest ethnic group</li> <li>- GDP per capita</li> <li>- Gini: income and land inequality</li> <li>- Ethnic homogeneity</li> <li>- Political violence</li> <li>- Regime type</li> <li>- Mean years of education</li> <li>- Property rights index</li> <li>- TRUST (the percentage of respondents in each nation replying “most people can be trusted”)</li> </ul>	International Country Risk Guide (ICRG) published by Political Risk Services, the World Values, Business Environmental Risk Intelligence (BERI)	Knack and Keefer (1997), Easterly and Levine (1997), P. Keefer and Knack (2002)

Focus of the study	Major Explanatory Variable(s)	Data Sources	Examples
	<ul style="list-style-type: none"> <li>- CIVIC (the strength of civic norms)</li> <li>- Labour force growth</li> <li>- Currency depreciation</li> <li>- Investor credit rating</li> <li>- Confidence in government</li> <li>- Black market premium</li> <li>- Fiscal surplus</li> <li>- Infrastructure development</li> <li>- Assassinations</li> <li>- Financial depth</li> </ul>		
<p>The relationship between economic institutions (economic equality, protection of property rights etc.) and economic growth</p>	<ul style="list-style-type: none"> <li>- GDP per capita</li> <li>- Schooling</li> <li>- Life expectancy</li> <li>- Fertility rate</li> <li>- Public educational spending</li> <li>- Rule-of-law index</li> <li>- Investment</li> <li>- Democracy index</li> <li>- Country and business risk index</li> <li>- Executive constraints</li> <li>- School enrolment</li> <li>- Labour force growth</li> <li>- The number of revolutions and coups</li> <li>- The number of political assassinations</li> </ul>	<p>Summers-Heston data set, World Bank, Barro-Lee data set (Economics Department, Harvard University), Gastil measures of political rights, Deininger and Squire dataset, International Country Risk Guide (ICRG), Business Environmental Risk Intelligence (BERI), United Nations, Wright Economic Freedom Ratings, Business International Corporation, human development index, U.S. Department of Commerce, OECD, Scully and Slottje dataset, Taubenfel dataset</p>	<p>Barro (1991), Spindler (1991), Persson and Tabellini (1994), Vanssay and Spindler (1994), Barro (1996), Keefer and Knack (1997), Barro (2000), Assane and Grammy (2003)</p>

Focus of the study	Major Explanatory Variable(s)	Data Sources	Examples
	<ul style="list-style-type: none"> <li>- Mortality rates for children aged 0-4</li> <li>- Student-teacher ratio</li> <li>- Adult literacy rate</li> <li>- Economic freedom</li> <li>- Property freedom</li> <li>- Movement freedom</li> <li>- Association freedom</li> <li>- Information freedom</li> <li>- Civil liberties</li> <li>- Physical capital formation</li> <li>- Labour force growth</li> <li>- Human capital formation</li> <li>- Income Distribution</li> <li>- Political Participation</li> <li>- Average Skills</li> </ul>		

**Appendix 3:** Classification of variables employed in previous econometric studies based on NIE by what they measure

<b>Variables measuring presence of institutions</b>	<b>Variables measuring organization of institutions</b>	<b>Variables measuring outcome of institutions</b>	<b>Control Variables</b>
- Ethnic fractionalization	- Bureaucratic efficiency	- Security of property rights	- Fertility rate
- Confidence in government	- Constraints on executive	- Civil liberties	- Life expectancy
- Revolutions and coups	- Government effectiveness	- Political rights	- Literacy rate
- Educational and professional background of decision makers	- Legislative effectiveness	- Country and business risk	- Mortality rates for children
	- Level of corruption	- Economic freedom	- Population
	- Political concentration	- GDP per capita	- Skills
	- Regime type	- Investment level	
	- Rule of law	- Gini coefficient of income and land distribution inequality	
	- Polity score	- School enrolment (education)	