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**Essays on Electricity Market Reforms:  
A Cross-Country Applied Approach**

Erkan Erdogdu



Girton College  
**University of Cambridge**

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## Declaration

I declare, as the author of this thesis, the work and research presented here is, to the best of my knowledge and belief, original except where due acknowledgement, in accordance with the standard referencing practices, is made in the text of the thesis. This thesis is the result of my own work and includes nothing which is the outcome of work done in collaboration except where specifically indicated in the text. This thesis has not been submitted in whole or in part for consideration for any other degree or qualification at this university or any other institution. In accordance with the regulations of the Judge Business School, the thesis contains no more than 80,000 words of text.



Erkan Erdogdu

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The first paper of the thesis is published in **Energy Policy** (*ISSN: 0301-4215, Volume 39, Issue 3, March 2011, pages 1080-1092, doi:10.1016/j.enpol.2010.11.023*). The second and third papers are published in **EPRG Working Paper Series** (*No: 1212 & 1216*) and **Cambridge Working Papers in Economics** (*No: 1227 & 1232*). The third paper was also granted one of the top 4 best paper awards (out of 160 papers) at 30<sup>th</sup> USAEE/IAEE North American Conference (*9-12 October 2011, Capital Hilton Hotel, Washington, DC*). In March 2012, on the occasion of the 10 year anniversary of the Austrian energy regulator (E-Control), the thesis as a whole was granted a research award by E-Control in recognition for its contribution to research in the area of electricity market liberalization. The second and third papers were submitted to **Energy Economics** (*ISSN: 0140-9883*) and **The Energy Journal** (*ISSN: 0195-6574*), respectively; and we have received “*revise and resubmit*” decisions from the Editors of both journals at the time when the thesis is submitted. The second paper has also been accepted for presentation at the 2013 Conference of the International Society for New Institutional Economics (ISNIE) in Florence/Italy on June 20-22, 2013. I would like to express my gratitude to all anonymous referees who took part in the review processes of the papers and the thesis in these incidents.

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## Summary

In the last two decades, more than half of the countries in the world have introduced a reform process in their power industries and billions of dollars have been spent on liberalizing electricity markets around the world. This thesis presents a doctoral research concerned with the cross-country empirical analysis of the electricity market reforms. The thesis is in three-paper format; that is, we present three independent but related stand-alone papers.

The *first paper* focuses on the impact of power market reforms on electricity price-cost margins and industrial/residential price ratios. It investigates this issue by looking at the impact of the electricity industry reforms on residential and industrial electricity price-cost margins and their effect on industrial/residential price ratios. Using panel data from 63 developed and developing countries covering the period 1982–2009, empirical models are developed and analysed. The results suggest that each individual reform step has different impact on price-cost margins and industrial/residential price ratios for each consumer and country group. That is to say, our findings imply that similar reform steps may have different impacts in different countries, which supports the idea that reform prescription for a specific country cannot easily be transferred to another one with similar success.

The *second paper* explores whether the question of why some countries are able to implement more extensive reforms is closely related to the question of why some countries have better institutions than others. It analyses this question by using an empirical econometric model based on Poisson regression with cross-section data covering 51 states in US, 13 provinces in Canada and 51 other countries. The study concludes 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.

Considering the fact that ideological considerations, political composition of governments and educational/professional background of leaders have played and will play a crucial role throughout the reform process; the *third paper* attempts to discover the impact of political economic variables on the liberalization process in electricity markets. It develops and analyses empirical models using panel data from 55 developed and developing countries covering the period 1975–2010. The results suggest that a portion of the differences in the reform experiences of reforming countries in the past three decades can be explained by differences in the political structure, in the ideology of the government and in the professional and educational backgrounds of the political leaders.

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# Chapter 1

## 1 Introduction

This thesis presents the doctoral research concerned with the cross-country analysis of the electricity market reforms that have been put into practice in more than half of the countries in the world. The research is inspired by my own experiences working for the energy market regulator (EMRA<sup>1</sup>) in my home country before commencing my doctoral studies in Cambridge. The thesis is in three-paper format. We present three independent but related stand-alone papers which make up Chapters 3, 4 and 5 of the thesis. This introductory chapter has five sections. First of all, we discuss motivations for the electricity market reform. Second, we briefly explain what reform is and how reform progress is measured in the papers. Third; although each paper has its own specific literature review section, here we present a discussion on the link between general theme of the thesis and the earlier relevant literature, especially theory of regulation and public choice theory. Then, we present the connections among the papers. Finally, we mention the expected contribution of the papers into the existing literature.

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<sup>1</sup> EMRA: Energy Market Regulatory Authority, Republic of Turkey

## 1.1 Motivations for the reform

Starting from the early 1980s, a number of political, financial and technical factors converged and started to undermine the logic that electricity industry should be handled via a vertically integrated (and usually state-owned) monopoly (Gratwick and Eberhard, 2008). Among these factors, there were ideological reasons, development of gas-fired combined cycle gas turbines<sup>2</sup> (CCGTs), improvement in information and communication technologies, questions about the efficiency of vertically integrated utilities (whether publicly owned *or* private and regulated by authorities) and poor performance of existing utilities, especially in developing countries.

Electricity reform in developed and developing countries has been a fundamentally different undertaking in terms of motivations, sector conditions, and institutional context. In developed countries, the main targets of the reform has been the improvement in the economic efficiency of the sector, encouragement of inter-regional (or cross border) trade, transferring investment risks to the private sector and offering customer choice. Other subsidiary motives include the demonstration effects of the pioneering reforms of the power sectors in the UK and Norway in the early 1990s, the EU directives, the rapid changes in technology especially in the generation of electricity that made new industrial structures possible, the desire to overcome what might be called sub-optimal regulation, and the policy objective to eliminate tendency to over-invest (so called “gold-plating”).

In developing countries, motivation for reform includes the poor performance of state-run electricity operators in terms of high costs, inadequate expansion of access to electricity

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<sup>2</sup> The advent of highly efficient CCGTs made it possible to build small units in relatively short time with little risk, which eliminated the significant barriers that had previously existed to entry in power generation.

services and unreliable supply; the inability of the public sector to meet the investment and maintenance costs of the electricity industry associated with the increasing demands for power resulting from economic development; the need to remove the burden of price subsidies (so as to release resources for other areas of public expenditure), low service quality, low collection rates, high network losses; the desire to raise immediate revenue for the government through the sale of state assets; the policy to attract foreign direct investment in the power sector; and encouragement of reform by international financial organizations and donor agencies such as the IMF and World Bank (Zhang et al., 2008). Besant-Jones (2006) argues that power market reform in developing countries should be assessed against three outcomes that reflect the drivers for reform. These outcomes are better service quality for electricity consumers to support economic growth and welfare, improvement in government's fiscal position, and more affordable access to electricity for the poor. For him, the most important lesson from reforming power markets in developing countries is that "cookbook" solutions for reforming their power markets are ruled out by the extensive range of economic and institutional endowments of these countries. This lesson emphasizes the importance of country and power market initial conditions for reform that determine the initial (and often subsequent) scope and composition of the reform. Countries with better endowments should be able to achieve more ambitious outcomes from power market reform than countries with lesser endowments. Reforms based on substantial market restructuring for large middle-income countries, for example, may be infeasible for small low-income countries. He lists strategic elements for implementing power market reform as: (i) power market reform has many dimensions, (ii) power market reform must be adapted to starting conditions, (iii) power market reform is a process - not an event, (iv) power market reform is an opportunity to help the poor.

## **1.2 The reform and its measurement**

Since the 1980s, vast amounts of financial resources and effort have been spent on reforming electricity industries in both developed and developing countries. Reforms were pioneered by Chile (in 1982), the UK (in 1989), and Norway (in 1991); and have spread all over the world. In almost all reforming countries, electricity reform has been a part of wider policies towards a liberal market economy. In the process of reform, the former vertically integrated electricity utilities were restructured and unbundled, and competition has been introduced into generation, wholesale and retail segments of the industry. Transmission and distribution businesses have usually remained as regional or national monopolies but they have been put under regulation by an independent regulator. Other common elements of the reforms include the introduction of wholesale and spot power markets, the establishment of impartial market and system operators, the removal of restrictions on third party access to networks and, in some cases, privatization. As indicated by World Bank (2004); competition, unbundling, private participation, and other reform elements are not ends in themselves, but rather intended to contribute to the achievement of broad goals for poverty reduction, economic growth and environmental sustainability. Given the differing points at which they find themselves, countries adopt power sector reform strategies that reflect the strategic priorities for their electricity industry, and the immediate country conditions that influence the suitability of particular approaches. The course that power sector reform takes and the speed at which reforms can be implemented vary from country to country, but reform is a continuous and evolving process.

Many aspects of electricity reforms are not readily quantifiable in physical or monetary units (Jamashb et al., 2006). That is to say, objective comparisons across countries concerning the success or failure of the reforms are inherently difficult in any study and our analysis is not an

exception. Since it is very difficult, if not impossible, to develop a true measure of success or failure of the reform process; in this research, 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.

Since we do not have a perfect tool or variable to measure reform progress, we prefer to use different measures in each paper. In the first paper, we use dummy variables to account for various reform steps and their cross-products. In the second paper, we construct an electricity market reform score variable to represent overall reform progress. The variable takes the values from 0 to 8; depending on how many of the following reform steps have been taken in a specific country and specific year: (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. In the third paper, we do not construct a variable ourselves, but use electricity market reform indicators constructed by OECD and EBRD to represent reform progress. OECD provides data on the reform progress in its member countries and EBRD provides similar data for additional countries where it operates. Each method measures reform progress from a different perspective but, apart from this, they are not directly related. Although these three different approaches to measurement of reform progress in three different papers seem a practical and reasonable representation of reform dimension, we cannot argue that we fully reflect all characteristics of the various reform processes in our papers.

### **1.3 The earlier literature**

Each paper of the thesis has its own specific literature review section. Therefore, in this section, we do not present a review of the literature directly related to the papers. Instead, we present a discussion on the earlier relevant literature, especially theory of regulation and public choice theory. We specifically focus on theory of regulation and public choice theory since “electricity market reforms” may be regarded as a form of regulation (or a change in regulation) implemented as a result of a political decision. As discussed below, theory of regulation, public choice theory and previous empirical investigations based on these theories indicate that economic performance (including performance of prices) is affected by liberal reforms. In the first paper, we try to find out whether this relationship holds true when we take into account the fuel costs. Besides, within the framework suggested by economic theory of regulation, it is expected that the strength of various interest groups determines the outcome of electricity market reforms (including relative electricity prices). Based on this expectation, the first paper also investigates the impact of the reforms on the relative price of electricity for two main interest groups, namely industrial and residential consumers. Moreover, in line with the basic arguments of the economic theory of regulation, the third paper explores the impact of the industrial consumers (as one of the most organized and powerful interest group in electricity sector) and the ideological orientation of politicians on the reform progress. The further details of the links between the earlier literature summarized below and the papers (especially the first and the third papers) are provided in the hypotheses development sections of each paper.

The science of politics and the science of economics have traditionally been separated by the types of questions they ask, the assumptions they make about individual motivation, and the

methodologies they employ. Political science has studied the behaviour of *homo politicus* in the public domain; economics has studied *homo economicus* in the market. Political science has often supposed that *homo politicus* pursues the public interest. Economics has assumed that all economic agents pursue their private interests. “Public choice” has been characterised as the application of economics to political science. It applies the methodology of economics to the study of politics. It is interdisciplinary insofar as it employs the analytic tools of economics and chooses as its subject matter the identical fields as political science does (Kirchner, 2007).

Public choice theory resists modelling public policymakers as disinterested maximizers of society’s welfare (Buchanan and Tullock, 1962). Public choice assumes that all human actors, in or out of government, pursue similar objectives (utility maximization) and employ the same rational-choice calculus to select the alternative that yields the greatest personal benefit net of cost (Buchanan, 1972). This assumption of universal self-interest coupled with the logic of collective action (Olson, 1965) implies that the individuals responsible for formulating and executing public policies toward business will have powerful incentives, not selflessly to promote the public interest, but to enhance their own wellbeing by catering to the demands of politically well-organized special-interest groups.

The central economic argument for regulation of an industry is that it is characterized by ‘natural monopoly’ (Viscusi et al., 2005). The traditional notion of natural monopoly is based on the existence of economies of scale throughout the relevant range of production on the market. Such scale economies were typically taken to mean that competition might lead to greatly inefficient and even wildly fluctuating, unstable prices so that government intervention of some sort was necessary. However, economic research has demonstrated that even if an industry is characterized by natural monopoly in the sense that there is no room for

*competition within a market*, under some circumstances *competition for the market* may succeed in allocating resources quite efficiently in the absence of regulation (see Demsetz (1968), Stigler (1968), and Posner (1972)). From a political view, perhaps the most significant feature of regulation is that it redistributes income, creating winners and losers, thereby shaping interest groups and coalitions. Thus, it is not surprising that there is a large literature on regulation addressing reasons for regulation far broader than natural monopoly. Joskow and Noll (1981) and Noll and Owen (1983) provide excellent discussions on this topic. To sum up, economics research on regulation has three main themes. The first and oldest deals with market failures and the corrective actions that government can undertake to ameliorate them. The second examines the effects of regulatory policies, and asks whether government intervention is efficient or more efficient than doing nothing. The third investigates the political causes of regulatory policy (Noll, 1989).

Within this context, two general theories of regulation have been developed to explain the regulation of markets. The first of these, called the public interest theory, argues that the reason for regulation is to avoid market failure when an industry is naturally monopolistic. This theory presumes that the goal of regulation is to simulate competition where it is allegedly impossible because of economies of scale, and that this intention will, in fact, be carried out by the regulatory process. The second approach, promoted by George Stigler and Sam Peltzman, is the economic theory of regulation. The essence of this approach is that regulators and politicians, like *homo economicus*, weigh the benefits and costs of various courses of action in a political framework where the attainment of a voting majority determines success. So, in some sense, the economic theory of regulation is the application of public choice approach to domain of regulation. In its broadest interpretation, this approach emphasizes a balancing of interest group strengths and weaknesses at the margin, with the

outcome determined by the stake that the various groups have in it and the efficiency by which they can influence the regulatory process (Wenders, 1988).

Conventional wisdom, put forward by Pigou's (1920) classic work on welfare, holds that state action is necessary to reduce the impact of externalities, with taxes used to reduce harmful effects and subsidies to encourage beneficial ones. Ronald Coase, in a classic article published in 1960, challenged the conventional wisdom in economics regarding externalities, taxes, and subsidies. Coase argues that the existence of an external effect associated with a given activity does not inevitably require government intervention in the form of taxes and subsidies. Pareto-optimal resolutions of externality situations can be and often are worked out between the affected parties without the help of the government (Coase, 1960). The Coase theorem may be summarized as "*in the absence of transaction and bargaining costs, affected parties to an externality will agree on an allocation of resources that is both Pareto optimal and independent of any prior assignment of property rights*". This implies that when transaction costs are zero, all collective choices that promise a Pareto improvement are made; no public good with benefits greater than costs goes unprovided; no Pareto-relevant external effect is left unaltered; no firm that would make a profit fails to get started, no matter how large the number of participants needed to bring about the optimal collective choice (Mueller, 2003).

Stigler (1971) modelled regulation largely as a struggle between producers and consumers for access to the rents associated with conditions of natural monopoly. He challenged the two most popular notions of economic regulation, namely that (i) regulation is for public benefit, and (ii) rationality cannot be used to understand politics. Given that the members of the regulated industry normally would be better informed about the regulatory process, have greater financial stakes in regulatory outcomes, and, owing to their smaller numbers and more cohesive objectives, be better organized and, hence, more effective in bringing influence to

bear on the regulatory agency, regulators would tend to favour their interests over those of consumers (Shughart, 2004). The essence of the ‘capture’ theory of regulation is that *‘consumers are the least organized and therefore typically the least effective interest group; the long-run consumer interest in particular has no lobby’* (Posner, 1969).

Stigler and Friedland (1962) reported cross-sectional regression results for electricity prices across U.S. states for 1922. Their results suggested that state regulation of electricity prices had no detectable effect on the level of these prices; prices in regulated states were statistically the same as prices in unregulated states, *ceteris paribus*. Besides, their findings suggested that the regulatory bodies could not reduce the amount of price discrimination between domestic users and industrial users. Therefore, they concluded that regulation is ineffective. According to Stigler and Friedland, the reasons for regulation being ineffective are: (1) an individual utility system does not possess any significant amount of long-run monopoly power, and (2) regulatory bodies are incapable of forcing the utility to operate at a specified combination of output, prices, and costs. These results later provided the basis for the Stigler-Peltzman theory of economic regulation, which predicts that regulatory decisions will tend to be determined by the relative strengths of various opposing interest groups, such as buyers, sellers, competitors, legislators, bureaucrats and so on without necessarily being able to predict, a priori, which particular group (if any) will dominate a given decision (Upadhyaya et al., 1997).

In an important extension of Stigler’s argument, Peltzman (1976) supplies a more general framework for thinking about the problem. In that more general theory, the regulators themselves are portrayed as rational, self-interested actors whose objective is to maximize their own political support. Where they hold elective office, ‘political support’ can be defined in terms of votes, campaign contributions, or both, in which case regulators are assumed to be

motivated by the goal of maximizing their probability of re-election. Where they hold appointive office, regulators strive to maximize their probability of reappointment or some other index of job security. An even more universal behavioural assumption is utility (wealth) maximization, which includes the regulator's salary and perquisites of public office as well as income received from post-government employment.

In Peltzman's framework, the regulator's pursuit of self-interest is not unconstrained. The regulator selects the price the regulated firm is permitted to charge. This price can be set at the competitive level, in which case the regulated firm earns a normal profit and consumers enjoy all of the gains associated with regulation. The price can also be set at the monopoly profit-maximizing level, in which case producers are regulation's sole beneficiaries. In general, however, the politically self-interested regulator must weigh the demands of both groups. While an increase in price (and profit) means greater political support from the regulated firm(s), it also invites greater opposition from consumers. Lower prices invoke the opposite reactions. If the political returns to higher profit or lower price are diminishing at the margin, neither group will get all that it wants from regulation. From the regulator's point of view, the optimal price will lie somewhere between the extremes of competition and monopoly. Where the balance is struck in any particular case depends on the configurations of the costs and benefits of bringing political influence to bear on the regulatory process facing the groups having stakes in the outcome (Shughart, 2004).

Becker (1983) presented a theory of competition among pressure groups for political influence that built on Peltzman's analysis. Political equilibrium was shown to depend on the efficiency of each group in producing pressure, the effect of additional pressure on the influence of the group, the number of persons in different groups, and the deadweight cost of taxes and subsidies.

De Alessi (1995) also argued that the demand and supply of regulation are driven by considerations other than alleviating market limitations. He stated that the evidence suggests that regulation typically is established and operated for the benefit of the industries and occupations being regulated and of the regulatory agencies. Entrepreneurs have incentive to demand state support to restrict entry, enforce collusion, and pursue other wealth-increasing activities. Correspondingly, politicians and other government employees have incentive to favour organized pressure groups, extort tribute, and expand their activities. Evidence from a variety of industries indicates that regulation results in higher prices, lower output and greater wealth for the firm's owners. On the other hand, De Alessi (2001) maintained that although those to be regulated may be successful in capturing the regulatory mechanism, it does not follow that they reap the full monopoly rents. Among other reasons, transfer of control from the market to the political arena admits other rent seekers to the decision-making process. As a result, regulated firms typically are subject to a profit constraint, attenuating owners' property rights and increasing managers' discretionary authority.

As we summarized above, the theory of public choice and economic theory of regulation underline that individuals, whether politicians, regulators or voters, will make political decisions based on their own self-interest because it is votes that count in the political process, which often produces an outcome damaging to general economic welfare. One of the reasons for this undesirable outcome is that the voter simply finds it costly to determine the relative costs and benefits of alternative courses of political action and to make his/her political power felt. Thus, the cost of getting information about alternatives and then acting on this information plays a large role in political behaviour. This conclusion explains the desire of OECD countries to reduce the role of the state in utility sectors in the 1980s and 1990s.

## 1.4 Connections among the papers

As mentioned before, the thesis consists of three independent but related stand-alone papers. The papers have three characteristics in common. First of all, all papers focus on electricity reforms and analyse a specific feature of it. Second, they have a cross-country macro approach; that is, we do not concentrate on a specific country or region. Instead, we adopt a global approach in all papers. The papers analyse the global electricity experiment, which many other authors have noted, like Pollitt (1997). Finally, the analysis in the papers is predominantly empirical. In other words, we do not just point to spectacular reform failures (e.g. the California disaster) or try to get general conclusions from some success stories of a few reforming countries (e.g. NordPool). We believe that what is really needed is a complete study of the impact of reforms within the context of a well-defined model construction.

Apart from the similarities mentioned above, the papers differ from each other in terms of the reform dimension analysed, the relevant related literature, methodology, data and, of course, the results. The first paper<sup>3</sup> focuses on the impact of power market reforms on electricity price-cost margins and industrial/residential price ratios. Adopting a New Institutional Economics (NIE) perspective, the second paper explores the relationship between reform progress and institutional quality. The third paper<sup>4</sup> has a political economy focus and attempts to discover the impact of political economic variables on the liberalization process in electricity markets. Since NIE may be regarded as a subset of political economy literature, the second and third papers overlap in some areas in terms of the literature. Besides, some variables in the second and third papers seem to be similar but, in fact, we use them in the

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<sup>3</sup> The *first paper* is published in Energy Policy (ISSN: 0301-4215, Volume 39, Issue 3, March 2011, pages 1080-1092, doi:10.1016/j.enpol.2010.11.023).

<sup>4</sup> The *third paper* was granted one of the top 4 best paper awards (out of 160 papers) at 30<sup>th</sup> USAEE/IAEE North American Conference (9-12 October 2011, Capital Hilton Hotel, Washington, DC).

second and third papers for quite different reasons. For instance, NIE emphasizes the concept of “path dependency”, which implies that the head of electricity market regulatory agency and the minister responsible for energy related issues when the reforms initiated are important for the subsequent progress of the reforms. In line with this concept, like most of other similar analyses; we assume that experience in the industry, length of term, education level and educational background reflect personalities of policy makers and implementers. Of course, there may be some other aspects of the personalities. However, due to lack of data, we cannot include them into our analysis. So, in the second paper, we use variables related to the characteristics of the chairperson of the regulatory agency and energy minister when reforms started. In the third paper, however, we focus on the professional and educational background of the chief executive (prime minister or president) as the political economy literature suggests that the decision to initiate, develop, suspend or cancel a reform process may be affected by the personal backgrounds of the political leaders. In short, although we use data on key people in the second and third papers, the persons we concentrate on and the reasons for concentrating on them are quite different. Moreover, in terms of data and methodology, the second and third papers differ completely. Like the first paper, the third paper analyses a panel data set using panel data estimation methods (mainly fixed/random effects models). On the other hand, the second paper has a cross-section data; and since the dependent variable in the analysis is a count variable, which can take on nonnegative integer values only, we use Poisson regression methods in the second paper. Naturally, the total number of maximum observations for each variable is quite different for each paper. In the first and third papers, we have 1,764 and 1,540 maximum observations for each variable, respectively, while the total number of maximum observations for the second paper is 115.

As a final point, in the first and third papers, we divide countries into various groups and report the results for each country group separately. In the first paper, we have three country

groups, namely (1) developed countries, (2) developing countries in America, and (3) other developing countries. In the third paper, we have two country groups, namely (1) OECD countries, and (2) non-OECD countries. In both papers, we do not prefer to carry out a regression that includes observations from all countries in our datasets and report an overall result from it because pooling variables from samples that appear to be different and have different coefficients in the separate regressions does not seem to contribute to the papers much. In the second paper, we do not classify countries; therefore, we do not naturally report results based on country groups.

### **1.5 Contribution of the papers into the existing literature**

Three decades have elapsed since the introduction of the first reforms and there is now a need for a detailed evaluation of the reforms as they appear to be costly and there seems to be a growing controversy about their benefits. A number of empirical studies have analysed electricity market reforms in a variety of ways but they focused generally on a single country or a few countries, as reviewed in Mota (2004) and Pollitt (2009). A number of scholars have made a contribution in conducting cross-country analysis of the impact of reforms in the electricity industries. However, in these studies, analyses were usually conducted using very limited data and the number of countries analysed was small. As summarized by Schiantarelli (2005), there are some other empirical contributions that use cross-country data to study the effect of product market regulation and reform on a country's macroeconomic performance. They provide cross-country evidence on the effect of product market regulation on mark-ups, firm dynamics, investment, employment, innovation, productivity and output growth. However, in these studies, electricity industry has not been among the industries examined. So, there is a research gap in this important area. Using original panel and cross-section data

sets, this thesis attempts to fill this gap to a certain degree. In addition, to the best of our knowledge, the present study is the most extensive one in terms of both scale and scope.

Within this context, the expected contributions of the papers are as follows. The first paper focuses on the impact of power market reforms on electricity price-cost margins and industrial/residential price ratios. It tries to answer: (i) what is the impact of electricity market reforms on electricity price-cost margins? (ii) does liberalization cause a change in industrial/residential electricity price ratios? (iii) what are the other factors that influence electricity price-cost margins and industrial/residential electricity price ratios and how much are they influential relative to reform process? The second paper investigates the relationship between reform progress and the quality of institutions. It attempts to find out: (i) do differences in institutional structures of countries play an important role in explaining how far reforms have gone in these countries? (ii) if they do, how do specific institutional endowments of a country affect its reform performance? (iii) does the background of the chairperson of the regulatory agency when reforms started or were considered or that of the governor or minister responsible for energy policy at that time have an impact on reform progress? The third paper constitutes an endeavour to reveal the impact of political economic structure of a country on the liberalization process in its electricity market. It aims at answering the following questions: (i) what is the impact of industrial electricity consumers (as an interest group) on the reform progress in power sector? (ii) does foreign influence resulting from the dependence on foreign financial support have an influence on the electricity market liberalization process? (iii) do the ideology of ruling party and professional/educational background of the chief executive (prime minister or president) constitute important determinants of the reform progress? If yes, what is the direction of the influences originated from these variables?

The analyses in the three papers of the thesis cover 93 countries in total. The list of countries and their distribution to the samples of the papers are given in Table 1.1 while Figure 1.1 presents their reform score based on the scale developed in the second paper. The countries in our dataset have introduced at least one reform step (e.g. introduction of IPPs into their electricity market), so there is no country in our dataset with a reform score of zero. Electricity market reform score assigns a score to each country for each year based on the reform status of that country. It is an indicator of reform progress, rather than reform success. It does not give an idea about reform success and clearly does not present a full picture of the situation in each country; however, it still successfully groups countries in terms of reform progress. For instance, Chile and Argentina<sup>5</sup> get reform score of 7 as there is no retail competition for households and small industrial consumers. In the UK, even households are able to choose their suppliers so the UK gets the full score of 8. If we assign a full score to Chile and Argentina, they will seem to be the same as the UK in terms of reform progress. However, this is not the case. That is, reform score measures the distance between actual market structure of a country and an ‘ideal’ one where electricity industry is unbundled, privately-owned and fully competitive. The score of each country differs since the distance of each country from this ‘ideal’ point is different. In short, reform score is a useful indicator for our purposes because we focus on reform progress, rather than reform success, in this thesis and it provides us with a tool to measure reform progress in each country and each year. Besides, this approach to measuring reform impact is common and used also by international agencies like OECD (Conway and Nicolett, 2006).

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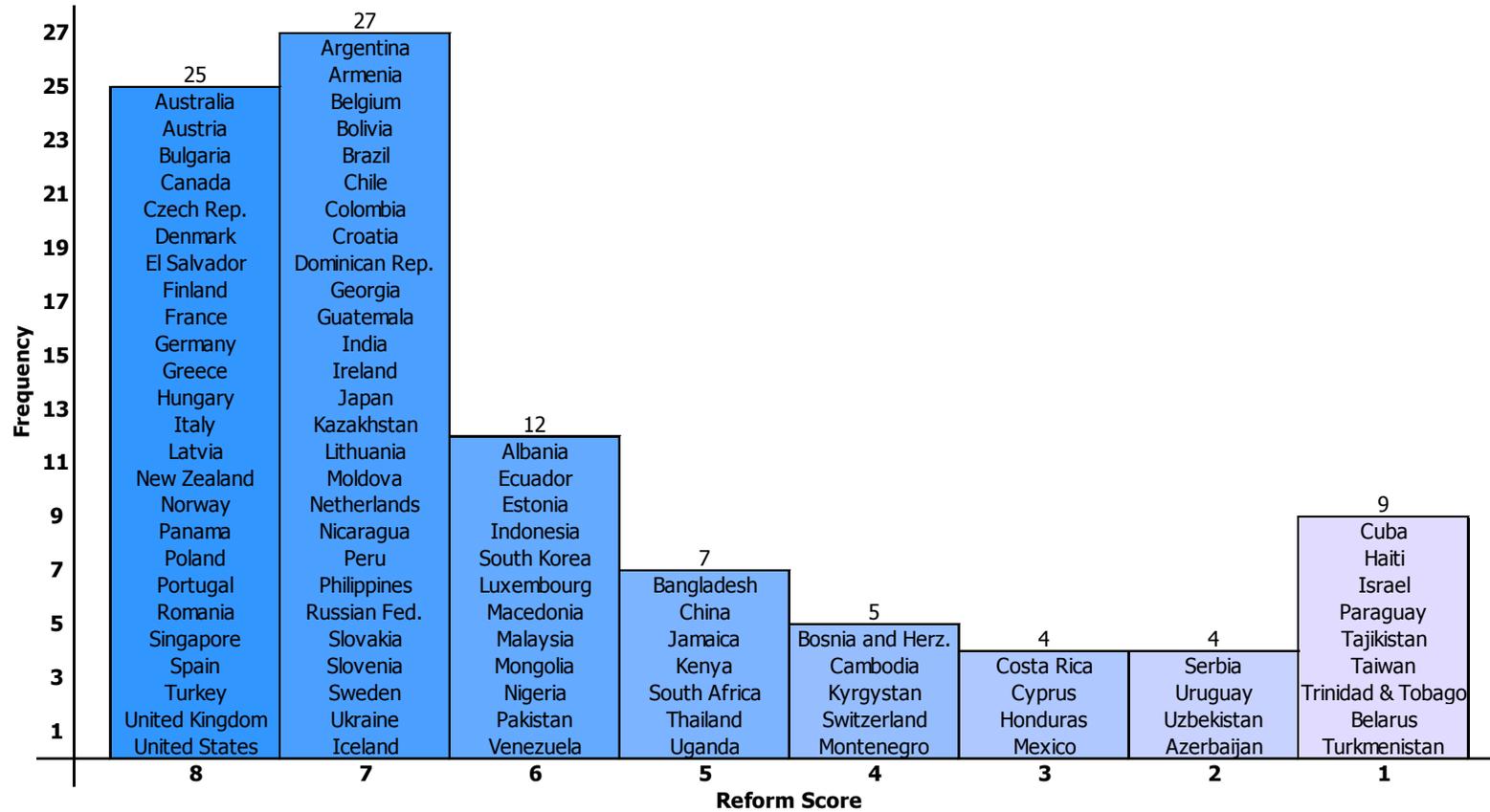
<sup>5</sup> For a more detailed discussion on the electricity market reforms in Chile and Argentina, please see Section 2.1.2.

**Table 1.1** Countries analysed in the PhD thesis

In the samples of three papers (26 countries)	Australia*, Austria, Belgium, Canada*, Croatia, Czech Republic, Denmark*, Finland*, France*, Germany*, Greece*, Ireland, Italy*, Luxembourg, Mexico, Netherlands, New Zealand*, Norway*, Poland*, Portugal, Romania*, Russian Federation*, Spain*, Turkey*, United Kingdom*, United States*
In the samples of 1 <sup>st</sup> and 2 <sup>nd</sup> papers only (10 countries)	Argentina*, Brazil*, China*, Colombia, Cyprus, India*, Jamaica, Singapore, South Africa*, Thailand
In the samples of 2 <sup>nd</sup> and 3 <sup>rd</sup> papers only (9 countries)	Albania, Armenia*, Bosnia and Herzegovina, Bulgaria, Estonia, Latvia, Lithuania, Macedonia, Serbia
In the samples of 1 <sup>st</sup> and 3 <sup>rd</sup> papers only (7 countries)	Hungary, Japan*, Kazakhstan*, Korea*, Slovak Republic, Sweden*, Switzerland
In the sample of 1 <sup>st</sup> paper only (20 countries)	Bolivia*, Chile*, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Indonesia, Israel, Nicaragua, Panama, Paraguay, Peru*, Taiwan (Chinese Taipei), Trinidad & Tobago, Uruguay, Venezuela
In the sample of 2 <sup>nd</sup> paper only (8 countries)	Bangladesh, Cambodia, Kenya, Malaysia, Nigeria*, Pakistan, Philippines*, Uganda
In the sample of 3 <sup>rd</sup> paper only (13 countries)	Azerbaijan*, Belarus, Georgia*, Iceland, Kyrgyz Republic, Moldova, Mongolia, Montenegro, Slovenia*, Tajikistan*, Turkmenistan, Ukraine*, Uzbekistan

\* The reform experience in these countries is summarized in Chapter 2.

**Figure 1.1** Reform scores of the countries analysed in the thesis



Another important point regarding the score of each country is that we only account for whether a step is taken or not, which may not reflect the full extent of the reform step. Market choice in Bulgaria and El Salvador or retail competition in France and UK may be different but since they took all 8 reform steps, we assign the same score to them. Although the countries with a reform score of, for instance, 8 are not the same, they are still within a range and this range is different from the range for countries with a reform score of 7. In other words, reform scores represent a specific reform progress range and all countries with the same reform score are between the upper and lower limits of this range. That is, in terms of the number of reform steps taken, the categories are quite homogeneous. For example, in Sweden, there is almost no privatization at all but all other reform steps are taken. So, it gets a reform score of 7. On the other hand, in Denmark, there are some privatizations (though not on a large scale) and it took all other reform steps too; so, Denmark gets a full reform score of 8. In the Section “6.4 Limitations of the research”, we clearly acknowledge the problem associated with measuring the true scale and scope of electricity market reforms in our papers. On the other hand, we carried out an extensive literature review but could not identify any other study that is clearly more successful in measuring the scale and scope of reform progress than ours.

The final point that we would like to mention about the score of each country is about federal countries. Federal countries (Australia, Canada, India etc.) are problematic in terms of data collection. In our papers, our level of analysis is the country. That is, the main units we get our data are countries, not individuals, cities, states, regions and so on. However, in some federal countries, individual states may be free to decide whether to introduce a reform program and therefore reform progresses in different parts of a federal country may be quite different. In the second paper, we included individual states of US and provinces in Canada as separate observations. However, analysing individual states and provinces together with

countries also create some other practical and econometric problems. To avoid these problems, in the second paper, we also provide results without states in US and provinces in Canada. In the first and third papers, we regard the state with the highest level of reform progress as the representative unit for the whole country. That is, we assign a reform score of 8 to a federal country if any of its states has taken all reform steps even if some states have not taken any step at all. We do not prefer to assign the score of the lowest scoring state to the whole country as all federal countries would get a reform score of 0 if we did so. We also do not prefer to determine a “median state” and assign its score to the whole country because it is almost impossible to agree on the criteria to determine such “median states” and any effort to specify such criteria will be random and cannot be defended theoretically. Still, we acknowledge that our approach is not ideal and the results should be evaluated taking into account this fact.

The thesis is structured as follows. Chapter 2 briefly summarizes the reform experience in 37 countries that have novel characteristics in terms of the reform process. Chapters 3, 4 and 5 present the first, second and third papers, respectively. Final section concludes with policy implications of the findings of the three papers.

# Chapter 2

## 2 The Reforms So Far

In most of the European countries, US, Canada, Australia and some countries in Latin America, power sector reforms are already highly developed. On the other hand, countries in Africa and the Middle East have been late in implementing reforms and reforms have been gradually taking effect in Eastern Europe and Asia. This chapter briefly summarizes the reform experience in 37 countries analysed in the three papers of the thesis. We start from countries that have reformed most and then mention those with less reform progress.

### 2.1 Countries highly progressed in reforms

#### 2.1.1 The United Kingdom

British electricity market reform has been generally regarded as the example that other countries should follow. Consultants, encouraged by the World Bank and other international financial institutions, have recommended the adoption of the “British model” in countries with as diverse needs as India, Ukraine and Brazil; while the British model was clearly the inspiration for the European Commission’s directives. In the UK, vertically integrated state owned power utility (CEGB) was restructured in 1990 to separate out transmission (as the

National Grid Company) and three generation companies: National Power, PowerGen, and Nuclear Electric. All except Nuclear Electric were privatized, although the modern stations of Nuclear Electric were subsequently sold as British Energy in 1996 (Newbery and Pollitt, 1997). In the very first years of regulation, Littlechild (1992) reviewed the major reforms and concluded that the new arrangements had proved entirely workable.

Shortly prior to privatisation, 12 regional electricity distribution companies (RECs) replaced the 12 area boards and transmission became the responsibility of the National Grid Company (NGC), a company fully owned by the RECs (Jamassb and Pollitt, 2007). Also, a mandatory-pool system was introduced in 1990. Since then, the British market has gone through two more stages of reform: one by New Electricity Trading Arrangements (NETA) introduced in 2001 and second by the British Electricity Trading and Transmission Arrangements (BETTA) in 2003.

The British electricity reform involved all the elements of a full sector reform including restructuring, privatisation, regulation, and competition. At present, the UK market is fully liberalised. All consumers can choose their own supplier. Since the starting of reforms, prices have fallen in real terms by about 25 per cent, system reliability has been maintained at high levels (Thomas, 2004). Although a competitive market is achieved through further asset divestiture and new entry, vertical integration has not disappeared.

### **2.1.2 Chile and Argentina**

Electricity reforms in Chile and Argentina were the deepest and the most radical (Pollitt, 2004). Chile was the first country in the world that introduced reforms in its power industry. In Chile, the electricity power law was enacted and a wholesale market was created in 1982.

The state-owned electricity enterprise was privatised without its transmission systems being unbundled, leading to emergence of a private company with a virtual monopoly on the transmission sector. More specifically, new private company group (Endesa group) held a share of more than 90% in transmission network, controlled 80% of generating capacity and was the distributor for 43% of all customers in Chile (Nagayama, 2007). So, one group controlled generation, transmission and distribution, giving it sufficient leverage to exert market power. Today, the Chilean power sector is comprised of 31 generating companies, 5 transmission companies, and 36 distribution utilities, most of which are privately owned. Power generation and transmission operations have been liberalised, allowing free entry to and withdrawal from these businesses. Since no restrictions are imposed on foreign capital companies, numerous businesses have entered the market (Nagayama and Kashiwagi, 2007). As expected, the biggest challenges in Chile's power sector are issues related to reducing market power and promoting competition. The problems originated from the fact that a pool market model was adopted when there were a few big generation companies with market power. The inadequate unbundling of the generation and transmission sectors resulted in the transmission company being owned by a specific generation company, which worsened the situation. Finally, as result of an acute electricity crisis caused by a collapse of hydro output in 1998-1999 and ahead of an election, Chilean government intervened in the functioning of the market and assumed a greater decision making role in strategic investment and regulation.

Argentina was also one of the first countries in the world to implement an electricity market reform. Besides, market reform in Argentina has been regarded as one of the most successful ones as it achieved significant reductions in system losses and improvements in quality of supply (Haselip and Potter, 2010). The Argentine power sector reform was designed based on the lessons learned from privatisation and reforms in Chile and the United Kingdom. Especially, full-scale unbundling in Argentina was in response to the problems that had been

experienced in Chile, where insufficient unbundling and limitations on competition had damaged reforms. The electricity sector in Argentina was considerably restructured in 1992 as part of the reorganisation and privatisation programme. That is, the power sector reform was performed as part of the wider structural changes in the overall Argentine economy. It was also an attempt to address the impending energy crisis. In reform process, more than 80% of the generation, all of the transmission and 60% of the distribution sector were transferred into private ownership. Remaining public ownership was limited to the state owned nuclear power generating company and two hydro-electric plants (with part foreign ownership) in the generation sector and some provincially owned distribution companies (Pollitt, 2008a). The vertically integrated state owned company was restructured into 5 generation and 3 distribution companies. A system operator (CMMESA) was established with equal equity participation by all interested parties in the market except for small customers and generators. The generation market was very successful and the most competitive one probably in the world in the late 1990s.

One rather novel aspect of reforms in Argentina is the arrangements for transmission expansion. With the reforms, transmission expansions in Argentina were no longer the responsibility of the transmission owner or regulator, but of the users of the transmission system. The public contest method required users to propose, approve and pay for major expansions. Approved expansions were then put out to competitive tender (Littlechild and Ponzano, 2008; Littlechild and Skerk, 2008a, b, c, d, e).

Until the macroeconomic crisis of 2002, power sector reforms in Argentina proved successful. This is illustrated by the decrease in electricity tariffs and the improved investment situation for generators in the decade between reforms being implemented and the economic crisis (Nagayama and Kashiwagi, 2007). With the devaluation of the peso in 2002, retail prices for

electricity were frozen, which stopped investments and caused generators and distribution companies to suffer from losses as they could not pass-through price increases to customers. To balance the disequilibrium between demand and supply caused by the tariff freeze, the government pursued a policy of price controls, subsidies and demand-side management measures. So, the politicisation of tariff setting process resulted in the setting of electricity tariffs at a level at which cost recovery was not feasible, which interfered with the functioning of the market.

Although after the crisis the achievements of the reforms were severely limited by the government's poor energy policy and intervention into the market for political reasons; today the framework of liberalization is sustained and still functional in Argentina. Pollitt (2008a) draws two sets of lessons from Argentina's electricity reforms. First, comprehensive electricity reform can work in a developing country. Second, well organised markets and effective network regulation are undermined if there is unnecessary political interference in the pricing of electricity.

### **2.1.3 Nordic countries**

Norway was the first among the Nordic countries to liberalise its electricity market in 1991, in line with British model but without privatisation. Today, the Norwegian electricity industry remains almost entirely in public hands. In Sweden, reform process was initiated in 1996. The retail market was fully opened and since 1996 the consumers can choose their own supplier. The transmission system remained in a non-profit public monopoly regime. The Finnish case is unique in the sense that even before the reform the market was very open (Pineau and Hämäläinen, 2000). Finland decided to reform the sector in 1995 and since then the market was progressively liberalized. In 1997, the consumers got the right to choose their supplier.

The reform also established the separation between the transmission and generation firms although the distribution companies are not fully unbundled. The reform experience in Denmark was similar to that of the other Nordic countries and begun in 1996 and was completed in 2001 when consumers were granted the right to choose the supplier and the industry was totally unbundled. In Denmark, electricity sector is characterized by the presence of public local companies and, in spite of some privatization, the overall ownership structure still remains mostly public.

Rather than implementing the reforms on their own, the Nordic countries chose to reform by merging their electricity markets. Nord Pool, the electricity power exchange with equity participation from each country's system operators, was founded by Norway and Sweden in 1996. Finland joined the NordPool in 1998 and Denmark in 1999. Reforms in the Nordic region seem to have been relatively successful, merging the four countries' (Norway, Sweden, Finland and Denmark) systems into one market. This success is apparent in the fact that unlike the California electricity market that collapsed following from severe demand and supply shocks in 2000-2001, the "lights have stayed on" in the Nordic market in spite of similar adverse supply and demand shocks in 2002-3 (Amundsen and Bergman, 2006). However, electricity prices in the region have increased as a result of a rise in electricity taxes and the introduction of the European system of CO<sub>2</sub> emission permits, which limited the popularity of the reforms in the region. Since the decisions to raise electricity taxes and to introduce emission permits have nothing to do with reform process, Nordic electricity market seems to work quite well so far. Amundsen and Bergman (2006) conclude that the main factors behind the relatively successful electricity market reform in the Nordic countries include (i) a simple but sound market design, to a large extent made possible by the large share of hydropower, (ii) successful dilution of market power, attained by the integration of the four national markets into a single Nordic market, (iii) strong political support for a

market-based electricity market, (iv) voluntary, informal commitment to public service by the power industry. They also argue that the second and third of these factors are “transferable”, while the first and fourth to a large extent are country-specific.

Littlechild (2006) questions the ability of regulation to substitute for retail competition in the context of Nordic residential electricity markets (Norway, Sweden and Finland) after they opened to retail competition in 1998. Although they, he argues, have not been subject to regulatory controls on prices or other contract terms; competition is developing well, and between 11% and 32% of residential customers have switched to other suppliers, and a further 19% or more have chosen new terms with their local supplier. He also underlines that the use of new products in the Nordic electricity markets is increasing over time, and there is considerable product innovation.

## **2.2 Countries with limited reforms**

### **2.2.1 North America**

For most of its history the US electricity sector has been dominated by large, vertically integrated, and heavily regulated private utilities. The US has never implemented a mandatory comprehensive federal electricity market reform program, leaving the most significant reform decisions to the states. As a result, many states in the US have introduced only limited liberalization without fundamental electricity sector restructuring (Joskow, 2008).

Beginning in the late 1970s, some steps were taken in the US to reform the traditional structure. By the late 1990s, extensive disintegration, considerably looser regulation, and more market-oriented operation were characteristics of the new US electricity industry. The

reforms were mainly intended to bring competition to wholesale market. Competition among independent generators was supposed to create a framework for wholesale power transactions so that retail customers and local distribution utilities could purchase power from a wide range of alternative suppliers. The result was supposed to be lower wholesale costs and thus lower retail prices. By the year 2000, about half of the states either had restructured their electricity sectors or was planning to do so (Kwoka, 2008).

Paul L. Joskow argues that there are fairly dramatic differences in the electricity prices across US states and, in high-price states, there are strong incentives for consumers, and certainly for new producers, to press for reforms that provide competitive entry and possibility of price reductions (White, 1996). So, he maintains that states only with high electricity prices have an incentive to introduce reforms in the US. Those with relatively low prices do not have such an incentive and therefore do not introduce reforms. That is, for him, the differences in electricity prices among US states explain why some US states introduce reforms and why others do not (Joskow, 2006). Besides, Joskow (2000) points out that average real electricity prices in the US fell rapidly from the early 1900s until the early 1970s; from the mid-1970s until the mid-1980s, however, real prices for electricity increased sharply in response to increases in basic energy prices, high interest rates, tightened environmental standards, and investments in capital-intensive nuclear power plants. In the mid-1980s, he continues, average real electricity prices began to fall again as input prices declined, and they continued to fall during the 1990s; in some areas of the country, however, electricity costs and prices remained well above their historical low values. Joskow (2000) argues that these continuing high prices became an impetus for restructuring in several states. He maintains that the average price of electricity in the US in 1997, before major reforms were implemented, was 6.85 cents a kilowatt hour. The average price charged to residential customers was about 8.4 cents/kWh, and the price to industrial customers was about 4.5 cents/kWh. Although these prices were at the low end of

the range of prices for developed countries, there were large interstate and interregional differences in electricity prices. He claims that the states in the Northeast and California had much higher prices than the average for the rest of the country; and therefore, they were the first states to restructure their power sectors in 1996 and 1997. White (1996) also provides evidence that the states with relatively high electricity prices introduced reforms and differential prices explain the pattern of electricity reform in the US. White (1996) concentrates on the price gap between the regulated price in a given state compared with the prices that arise from allowing competitive new entry in power generation. Then, he examines the causes of this price gap and estimates its magnitude for different states. His estimates reveal fairly dramatic differences in the price gap across states. He concludes that in high-cost states they suggest strong incentives for consumers and new producers to demand competition in the power market.

Sioshansi (2008) argues that the pace of growth in retail competition has slowed in recent years in the US and the transition to a national competitive electricity market has stalled. He cites the reasons for this as (i) the spectacular failure of the California market, (ii) mixed results in a number of states that have introduced retail competition, (iii) problems in some wholesale markets that have not performed as expected, and (iv) a lack of interest by the US Congress to push retail competition at the national level.

Among the reasons above, California crisis needs further focus. The California electricity market reform had promised to deliver reliable service at low and stable prices. The California electricity deregulation process was put into effect in 1998. In the period prior to reform, there was a considerable excess generation capacity and electricity prices were above normal. As we mentioned before, there were large differences in prices across the US states and California had much higher prices than the average for the rest of the country. Joskow (2000,

Table 4-1, p.136) shows that price of electricity for residential and industrial consumers were 11.50 and 6.95 cents per kilowatt hour in California, respectively, while the US average was 8.43 cents per kilowatt hour for residential consumers and 4.53 for industrial ones. So, he argues, high electricity rates became a major issue in California in the early 1990s, where general concerns about the future of the state's economy were exacerbated by a severe recession. Within this context, California become the first state to respond to pressures from industrial customers to reduce the price of electricity and from independent power producers to increase opportunities to widen the markets for their power; and introduced a reform program into its power market. The program included the introduction of new institutional arrangements such as power exchange and independent system operator, restructuring, fixing end-user prices at 1996 levels and a ban on new long-term power purchase contracts. Public power companies were excluded from the deregulation process but had to continue providing cheap electricity.

The summer of 1998 showed tendencies to excessive wholesale prices but apart from this there was no particular problem and the market seemed to function fairly well until 2000. Prices on the wholesale market started to increase in the early summer of 2000 and continued to do so in the following months. The first of several forced blackouts took place in June 2000. During this period, the three major companies started to lose money on a large scale and became unable to pay for their power purchases. Consequently, the power generation companies became reluctant to sell power on the power exchange as their contracts were not honoured. The cap on end-user prices effectively hindered that rising wholesale prices transformed into rising end-user prices that would otherwise result in a reduction of consumption. Also, the restrictions on the long-term power contracts implied lacking hedging opportunities. Finally, the power exchange broke down and was declared bankrupt in March 2001 (Amundsen and Bergman, 2006).

Woo (2001) identifies the major factors that contributed to California crisis as follows: poor market design, market power, demand growth (due to extremely warm weather during the summer of 2000) not matched by new capacity, a sizable reduction of hydro power generation (due to dry weather conditions), rising marginal cost (due to an increase in the price of natural gas by some 70 percent from April to November 2000), and financial insolvency (for further details, see Sweeney (2002)). The problems in California and elsewhere brought further restructuring to a halt in the US but many states were irreversibly committed to deregulation. At present, electricity restructuring is substantially complete in some regions of the US, although other regions are much less affected.

In Canada, electricity reform started in the province of Alberta in 1996 where competition was introduced into power generation, and a wholesale electric pool was created. Alberta had a positive experience with reform leading to substantial new investment and reduction and stabilisation of prices. On the other hand, in Ontario, political mismanagement of a power crisis led to reform being abandoned and government interference into prices (Sioshansi, 2008).

### **2.2.2 Australia and New Zealand**

The 1990s witnessed a substantial reform in the Australian electricity sector. Since 1991, the industry has been broken up into its constituent parts; a national wholesale market for electricity was created, competition was introduced to electricity generation and retail supply sectors. The reform process was initiated in the State of Victoria for the first time. Victoria's vertically integrated electricity company was divided into generation, transmission and distribution/retail. Later, distribution/retail was further divided into five companies with

separate franchise areas and generation was broken up into seven separate generation companies. Until 1997, these companies were privatized. In 1994, a wholesale electricity pool was established in Victoria and it was merged with the New South Wales wholesale market in 1998, creating the national wholesale electricity market. After the creation of national wholesale market, ownership and operation of the transmission system was separated and a public company was made responsible for the operation of the system. As a whole, the introduction of competition and privatization led to substantial improvements in productive efficiency. Capital utilization rates greatly increased and staff numbers reduced. The largest gainers from the reform process were the large industrial and commercial consumers, who were able to take advantage of competition among retailers. Households saw little change in the real average price of electricity (Abbott, 2006). Today, the progress of liberalization varies from state to state in Australia. New South Wales, Victoria, and Queensland have achieved liberalization in the retail sector while West Australia still maintains a vertically integrated structure.

From 1992 to 1995, significant reforms took place in New Zealand electricity market. In 1992, an electricity law was passed and provided liberalization of the market and regulation of transmission and distribution segments. In 1998, another law was enacted and required forced ownership unbundling of electricity distribution from the rest of the electricity industry. Until 2001, there was no explicit sector regulator and the regulation was left to general competition authority. In 2001, a specific sector-focused regulation was introduced and electricity market regulatory commission became operational in 2003. Nillesen and Pollitt (2011) examined the impact of the policy of forced ownership unbundling of electricity distribution on electricity prices, quality of service and costs. They found that ownership unbundling did not achieve its objective of facilitating greater competition in the electricity supply industry but that it led to

lower costs and higher quality of service. They concluded that this experience indicated the potential benefits of ownership unbundling but also the danger of unintended consequences.

### **2.2.3 European Union**

Traditionally, electricity utilities were vertically integrated in many European countries, with state or municipally owned enterprises playing an important role. The market was highly regulated with very limited opportunities for users to switch to alternative suppliers. There was no third party access to the transmission grid (Fiorio et al., 2007). After the pioneering experiences of some member and neighbour states such as the UK and Norway in the 1980s, the European Union (EU) began an effort of gradual electricity liberalization starting with the first Directive in 1996. The first directive was a compromise between countries that had started liberalization and those that contemplated it as a very remote possibility (Trillas, 2010). EU directive of 1996 required 15 member countries to open their retail markets at least partially by 2000. By 2000, all EU member countries, except Greece, had opened their retail markets (Jamassb and Pollitt, 2005; Pollitt, 2009). The other objectives in the directive include account separation between potentially competitive and monopolistic segments; freedom of choice for large consumers; and increasing autonomy of transmission networks. However, it still accepted negotiated third party access to networks. The directive was criticised for allowing countries too many ways of avoiding complying with the spirit of the reforms; not requiring a wholesale market or a market regulator to be set up. The unbundling requirements did not guarantee independence of access to the network and the negotiated third party access (TPA) option offered the incumbent companies a way to keep out competitors. Retail competition was restricted, with no more than a few thousand consumers able to choose by 2003 even in the largest countries (Thomas, 2006a).

The new Electricity Directive was agreed in 2003 and it placed more stringent requirements on member states to disintegrate their electricity industries and introduce competition in generation and retail supply. EU directive of 2003 required all member states to open the retail market to all customers excluding residential users by July 1, 2004 and to achieve complete liberalization by July 1, 2007. The negotiated TPA and single buyer options were withdrawn and access to the network has to be via regulated TPA. Member States are also required to appoint an independent sector regulator. Other key objectives to be achieved by 1 July 2007 in each member state include the legal unbundling of transmission and distribution businesses from competitive generation and supply, free entry into generation markets and regular monitoring of the progress of supply competition.

European Commission adopted a third package of energy market reforms in 2009; however the new electricity directive/regulation came into force in 2011. This new package aims at extending earlier reform packages in 1996 and 2003. At the centre of the third legislative package, there are consumer choice, fairer prices, cleaner energy and security of supply. In order to reach those goals, the Commission proposes to separate production and supply from transmission networks; to facilitate cross-border trade in energy; to improve the effectiveness of national regulators; to promote cross-border collaboration and investment; to increase market transparency on network operation and supply and to increase solidarity among the EU countries.

Overall, all directives aimed at creating a strongly market-based system and a single European electricity market. However, many of the EU member states are reluctant in implementing these measures. A particular problem in the EU is the lack of will among member states and the EU Commission to reduce the market power of dominant companies. They prefer to maintain or allow the emergence of “national champions” in the electricity sector. At present,

in most of the European countries, the incumbents' shares lie between 85 and 95 per cent and the incumbents are not challenged by competition from new entrants. In Italy, Denmark, France, Germany, the Netherlands and Belgium, switching rates remain below 10 per cent. They are slightly above 10 per cent in Finland and Spain. Only three countries exhibit net switching rates exceeding 20 per cent: Great Britain, Sweden and Norway (Defeuilley, 2009). Today, a number of electricity market models coexist in Europe and they are different from one another in terms of the type of ownership, degree of openness, market concentration, and the degree of vertical integration. So, it is very difficult to argue that a unique European pattern of reform is emerging.

The French electricity market is extraordinary in terms of its input mix to generate electricity and its market structure can be considered as opposite of the British model. In France, in 2008, 77% of the electricity was generated by nuclear plants, 14% came from hydro and renewable sources and just 9% from fossil fuels (US EIA, 2010c). In contrast to the UK, France was one of the latecomers in initiating reform and implementing the EU directives. Also, the reform in France has not led to a major change in the structure of the sector. Reform process in France begun only in 2000 when France approved a law to implement EC Directive of 1996. The reform included creation of a sector regulator, a regime of regulated third party access, introduction of a wholesale market and a progressive opening of the sector with the possibility for the consumer to choose the retailer. However, today, there is still a vertically integrated public monopoly or near-monopoly (EdF) in France operating at all stages from generation to sales.

Prior to the reform, there were a regime of private regional monopolies in Germany with nine vertically integrated regional companies, then merged in four groups which, in 2000, still controlled 80% of production, 40% of distribution and all transmission (Florio, 2007). In

1998, Germany adopted EU directives regarding the liberalisation of the sector. Since then, Germany has realized overall liberalization but without reorganization of vertically integrated power companies. The reform introduced full market opening, an electricity exchange and a regulatory body. Today, the German electricity market is still characterised by a high degree of vertical and horizontal integration dominated by a few large companies, which prevents competition and keeps barriers for new entrants and investments.

In 1999, Italy adopted EU directive of 1996 and liberalized its electricity sector by unbundling state owned vertically integrated company (ENEL), creating a state-owned transmission system operator, and privatizing some power stations of ENEL (a total capacity of 15,000 MW) to limit its market share to 50% after 2003. Today, the main problem in Italian power market is the dominant position of ENEL in basically all segments of the business. An additional obstacle to the development of effective competition is the majority stake of government in ENEL, which translates into significant political interference on the definition of the objectives as well as the management of the company (Ferrari and Giulietti, 2005). Today, ENEL still controls about 40% of the generation and the entire distribution network with the exception of few cities where the local municipalities own the distribution companies.

The reform of the energy sector begun in Spain with a law enacted in 1994 with the aim of liberalizing electricity sector. It mandated the legal unbundling of the transmission network and created an independent joint public-private transmission system operator (REE), which offered regulated TPA to both the transmission and the distribution networks. A new law was adopted in 1997 to accelerate the process of liberalization. Full market opening has been implemented in Spain since 2003. In 2006, the Iberian Electricity Market (MIBEL) was founded and aimed at creating an integrated electricity wholesale market with Portugal,

notably by creating a single market operator for the wholesale Iberian pool market. Today, although there exists a market regulator, what consumers end up paying and firms receiving is ultimately determined by regulated tariffs, which are set by the government on an annual basis, and in a non-transparent manner. Also, the new system has failed in attracting new entry, and in promoting the efficient amount of investment needed to guarantee adequate reserve margins. Entry has been dissuaded by the incumbent firms. This has mainly been achieved by the strategic announcement of new investment plants that have never been carried out (Crampes and Fabra, 2005). The most relevant outcome of the electricity reform in Spain so far has been the emergence of some big firms that consolidated their generation assets. The market is mostly controlled by the three largest companies.

In Poland, electricity reforms took place within the context of Poland's post-Cold War transition from socialist to market economy. Before the reform, whole energy sector was controlled by a single vertically integrated company. Between 1987 and 1990, electricity was separated from this structure, but remained a vertically integrated industry. In Poland, electricity tariffs were massively subsidized through housing subsidies; tariffs paid by residential consumers recovered only 1% of the cost of supply (Williams and Ghanadan, 2006). In 1990, the electricity sector was unbundled both vertically and horizontally into autonomous state-owned enterprises and a transmission company (PSE) was set up. In 1993, all distribution utilities and a number of generators were turned into joint stock companies, which were to be privatized through stock sales (with a limit of 50% on foreign ownership). PSE operated the grid as a single buyer based on power purchase agreements with the generators. In 1997, a wholesale market was created and replaced the single-buyer model. A spot market was also set up in 2000. Reform process has raised tariffs to near 90% of full cost recovery, but at a high cost in public support for reforms. At present, Polish market witnesses rebundling and vertical reintegration. Two big state-owned utilities (representing almost half

of Poland's electricity market) were created by merging a number of generation, distribution companies and some coal mines (Williams and Ghanadan, 2006). This move reflects a growing view in many small EU member states that large, state-supported utilities will be more competitive in a unified EU market than small unbundled companies. The same trend has been witnessed in Slovenia as well. As a new member state of the EU, Slovenia has been required to adopt EU legislation in full and opened its electricity market fully in 2007 when all consumers became eligible. Electricity reforms in Slovenia included market liberalization, unbundling of activities, allowing regulated TPA, formation of an organized power market, adoption of incentive-based price cap regulation and the establishment of an independent regulatory body. Like Poland, Slovenia has merged the majority of the state owned power plants into a holding of electricity companies (HSE) in 2001 (Hrovatin et al., 2009).

Electricity market in Greece was also dominated by a vertically integrated, state owned company (PPC) until the reforms. Greece embarked on electricity market liberalization in 2001 both to comply with EU directives and to encourage private investments. PPC was converted to a share company but remained under state control. A mandatory pool system was set up and full market opening has applied since 2007. At present, PPC still holds a highly dominant position in both electricity generation and power supply markets. Customer tariffs applied by PPC, which holds 98% of consumers, are regulated by the state and their structure still includes large cross-subsidizations among customer categories. It is also claimed that the level of regulated electricity prices is below power generation costs in Greece (Iliadou, 2009). Besides, compliance with the EU legislation on unbundling has been delayed in Greece and is still poorly developed. Legal unbundling was introduced only in relation to transmission, while PPC remains the exclusive owner of the transmission and the distribution networks.

In Romania, the vertically integrated, state owned monopoly was divided into five separate state owned enterprises over the 1998-2000 period: one each for nuclear generation, hydro generation, thermal generation, transmission, and distribution. Since then the distribution function has been further divided into eight regional companies, five of which were privatized. The wholesale market has been operating in Romania since 2000 and the market was fully liberalized in 2007 and all consumers can choose their supplier since then (Diaconu et al., 2009).

#### **2.2.4 Turkey**

Being a candidate for EU membership since 1960s, Turkey has also closely followed EU directives. Before the reforms, as was the case in many European countries, the Turkish electricity industry was dominated by a state-owned vertically integrated company (TEK). In 1982, public monopoly on generation was abolished and the private sector was allowed to build power plants and sell their electricity to TEK. In 1984, TEK was restructured and gained the status of state-owned enterprise. In 1993, TEK was incorporated into privatization plan and split into two separate state-owned enterprises, one for generation and transmission (TEAS) and other for distribution (TEDAS). In 2001, the reform process in electricity market was initiated. TEAS was restructured to form three new state-owned public enterprises: a transmission company (TEIAS), a generation company (EUAS) and a wholesale company (TETAS) (Erdogdu, 2007, 2009, 2010). Turkey's electricity distribution network was further divided into 21 distribution regions. TEDAS, which owns 20 of the 21 regions, was included in the privatization programme, and a separate distribution company was established in each of these 20 regions. As of the beginning of 2012, multiple rounds of divestments of state electricity distribution companies have been completed, and the privatisation authority of Turkey is due to release the tender for the privatisation of large coal and hydropower plants.

Bagdadioglu et al. (2007) focus on creation of 21 distribution companies in Turkey, 18 of them by merger. Their paper investigates the potential production efficiency gains using a methodology to assess the potential effect of the mergers and whether the mergers are efficiency enhancing. This is performed by comparing the actual efficiency levels of observed distribution companies with the merger of proposed aggregated companies. The model is calibrated on panel data from 1999 to 2003 which include measures of physical capital and labour inputs, as well as customer and energy related outputs. Their results indicate potential for considerable efficiency gains from the proposed mergers in Turkey.

### **2.2.5 Japan, South Korea and Philippines**

Electricity reforms in the Japanese electricity industry started in 1995 and for the first time IPPs were allowed to enter into the generating market by introducing the competitive bidding in the wholesale market. The government also introduced yardstick regulation, under which the electricity price of each electricity company is determined partly by comparing its performance with that of other companies. Companies with higher costs than others suffer losses, while those with smaller costs generate profits. Therefore, this system is expected to promote the cost cutting competition (Nakano and Managi, 2008). Partial liberalization in retail markets was introduced for large consumers in 2000 when power producers and suppliers were allowed to enter the market and use networks. Although the liberalization is limited in part by the fact that the retail power market has only about 30% share of total electricity demand, the eligible customers now have a choice among the nine major utilities and ten new entrants (Asano, 2006). Besides, Ida et al. (2007) found that first-period reforms, implemented in 1996-1999, were able to reduce costs by 7.5%; while second-period reforms,

during the period of 2000 to 2002, effectively cut costs by 11.8% in Japanese electricity market with respect to the base costs before regulatory reforms.

South Korea began transforming the structure of its electricity industry from public monopoly to market competition in 1998. Until then, the electricity industry of the country had been dominated by a state-owned vertically integrated company (KEPCO). The restructuring plan aimed at introducing market competition and privatization to the power industry, which was accompanied by the vertical unbundling and horizontal divestiture of KEPCO. As the first step of this plan, in 2001, the power generation function of KEPCO was divided into five thermal and hydropower generation companies and one company for nuclear power generation. Five companies were planned to be privatized over the next several years. However, in 2004, the Korean government suspended its electricity market reform based on the recommendation of a joint study team, which concluded in their final report that the alleged benefits of reform are theoretical and uncertain, while the real costs and risks are substantial. This suspension effectively interrupted the original plan adopted in 1998 by the previous administration to divest and privatize KEPCO's generation assets and introduce wholesale and retail competition (Lee and Ahn, 2006).

In Philippines, reform process initiated in 2001 when the government focused on introducing structural reform and market mechanism principles into the electric power sector. Reform objectives included full privatization of state-owned electricity utility, promotion of private participation in power market, establishment of a wholesale spot market and full liberalization of the market. However, in practice, many of these steps are behind schedule. The power prices were distorted due to the take-or-pay contracts with IPPs. Today, the sector reform is still on-going in the Philippines and electricity prices are still among the highest in Asia. A wholesale electricity spot market was launched in 2006. Since there is no sufficient number of

market participants to create a competitive environment, wholesale prices have not decreased. Toba (2007) reports an empirical investigation into the welfare impacts of introduction of private sector participation into the Philippine electricity generation sector and privatization of the distribution company (Manila Electric Company, *Meralco*). The study uses a social cost and benefit analysis. According to results, the main benefits came from IPPs, which contributed to resolving the power crisis and promoted economic and social development. Consumers and investors are net gainers, while the government lost and an air pollution cost was incurred. The paper concludes that reform with private sector participation increased social welfare.

#### **2.2.6 Brazil, Bolivia and Peru**

Reforms in Brazil were cautious and gradual (Gabriele, 2004). Brazil started to reform its power sector in 1995 with privatization of its major electricity utility (Eletrobras). IPPs were allowed to enter the Brazilian market and generation companies were privatized. Besides, a nationwide power grid operator and a wholesale electricity market were established. However, the vast complexity of the Brazilian electricity industry, incompletely defined regulatory structure, a lack of effective planning and an unstable economy hindered the flow of investments necessary to guarantee the system's expansion. As a result, the Brazil experienced a rationing of electrical energy that lasted from June 2001 to February 2002 (De Souza and Legey, 2010). The 2001 crisis vividly demonstrated Brazil's vulnerability to drought due to an excessive dependence on hydro-power and its low reserve margins (Lock, 2005). In response to this crisis, after 2004, Brazil shifted its electricity policy to emphasize long-term stability instead of free market. Brazilian government established a new regulatory framework for electricity. This new framework has three broad objectives: (1) to create an efficient mechanism for the contracting of electricity on behalf of captive consumers; (2) to

ensure security of supply at the lowest possible prices; and (3) to provide universal access to electricity to consumers around the country (Dutra and Menezes, 2005). The 2004 revision introduced new practices in Brazilian power market. To begin with, two distinct contract environments are defined. The first environment is the regulated contracting environment (ACR) and second one is free contracting environment (ACL). The former has the purpose of protecting captive (small) consumers, while the latter allows for “free” (large) customers to choose their electricity suppliers. Within the ACR, a distinction is made between “new” and “existing” electricity. The aim is for final consumers to pay a combination of a higher price associated with new plants and a lower price associated with existing, partially, or fully depreciated plants. In this contracting environment, distributors are required to contract their entire forecast demand for captive consumers with generators, importers, and retailers. Contracts will be auctioned off over time with different auctions for new and existing electricity under a lowest-tariff criterion. Other new practices included the revitalization of mid- and long-term planning, the introduction of long-term agreements to guarantee the return of investments in new plants, and the uncoupling of distribution services from any other activities.

In the period 1995-2000 approximately 60% of the Brazilian electricity distribution market has been privatised. Mota (2003) assesses the social welfare impact of the privatization process for the distribution and supply markets using a social cost-benefit methodology. The results show that net benefits are significant, but producers absorb most of the gains. The study also concludes that if the regulation had been tougher since the beginning, consumers could have benefited more from the privatization.

Bolivia’s electricity reforms occurred in the context of a debt crisis. Electricity reform was a component of wider economic reform. Even before reform, generation and distribution were

already partly unbundled with diverse ownership. However, vertically integrated state utility (ENDE) controlled 80% of generation and operated the grid. The power sector in general and ENDE in particular provided satisfactory service, operated efficiently with relatively low system losses and were profitable at the time of reforms as tariffs were set above cost recovery levels. In 1994, the sector was fully unbundled. ENDE was turned into three private generation companies and a private transmission company. Privatization of the sector was completed by 1998. A wholesale market was created and consisted of regulated contracts supplemented by a competitive spot market, with distribution utilities required to buy 80% of expected demand on 3-year contracts. These arrangements have so far resulted in significant investment in expansion and upgrades. The World Bank closely involved in Bolivia's electricity reform and considered it a success in terms of sector finance and operations, and the government's fiscal goals (Williams and Ghanadan, 2006).

Peru also implemented neo-liberal market reforms in the electricity sector in the early 1990s, as part of a broader economic restructuring and in response to a crisis in its electricity system from 1986 to 1990 (Pérez-Reyes and Tovar, 2009). In 1990, the electricity rates were increased and the state electricity utility (Electro Peru) was restructured. Moreover, several state-owned companies were privatized but a significant important group of privatized companies were renationalized in 2002. The reforms were an attempt to attract private capital to finance the expansion of the power supply mainly in the generation sector. As a result of the reforms, electrification levels increased from 45 percent in 1992 to 75 percent by 2002. Service quality also improved markedly (Cherni and Preston, 2007).

Anaya (2010) assesses the social welfare impact of the restructuring and privatisation of the electricity market in Peru. The results show that privatisation was worthwhile and that the

social welfare of being connected has an important contribution on it. Government and producers benefited the most and consumers the least due to price increases.

## **2.3 Countries with suspended or partial reforms**

### **2.3.1 China and India**

China has the second largest electricity industry in the world and is playing an important role within the global economy. In the past two decades, it has experienced a series of regulatory reforms in its electricity industry. With the development of the economy since the 1980s, the demand for electricity grew rapidly and power shortage became more serious than ever. In order to attract more investments to develop the electricity industry and relieve the bottleneck of power shortage, the investments from local governments, domestic enterprises and foreign investors in generation sector have been allowed since 1985. The Ministry of Electric Power was abolished in 1998, with its business functions transferred to the newly formed vertically integrated public utility (SPC), which was corporatized shortly. In 2002, SPC was divested and the generation sector was separated from the transmission and distribution sectors. Generation function was allocated to five big generation corporations. A regulatory body was set up in 2003 and the introduction of the wholesale electricity market is also in process (Du et al., 2009). Currently, the Chinese electricity industry has evolved into a dual system, with dominant state planning at the core, and a decentralised generation system at the periphery, owned by state organisations at different levels and by private enterprises. While the generation sector has some market competition, the transmission and distribution sectors are heavily state-controlled. There is still a chronic electricity shortage, with industrial consumers are frequently asked to shut down production during peak times and arrange production schedules at nights or weekends (Cherni and Kentish, 2007). As also concluded by Yeoh and

Rajaraman (2004), China still has a huge task ahead of it to complete reform process. Because it places a higher value on political and economic stability than economic efficiency, and because of its unfamiliarity with a market economy, the transition to a competitive market could take many more years in China.

In India, electricity theft, corruption, and a highly cross-subsidized pricing structure have made it nearly impossible for the utilities to improve power service. By early 2001, State Electricity Boards (SEBs) as a whole faced an average 50 per cent level of technical plus non-technical losses (Ruet, 2005). The quality and reliability of electricity have been so low that industrial consumers across India exit the state-run system and rely on their own on-site power generation (Joseph, 2010). India initiated power sector reforms in 1991 when the country was facing a political and economic crisis and was under pressure to open up the economy as part of a reform package agreed with the International Monetary Fund (IMF) and World Bank. IPPs were allowed to enter the power generation business and were offered attractive incentives. Although the initial interest was overwhelming, the enthusiasm was short-lived as only a few projects actually materialised. Second wave of significant attempts for reform came in the late 1990s. During this period, the State Electricity Boards (SEBs) began to be unbundled and even State of Orissa fully privatized its generation, transmission, and distribution assets. Besides, regulatory commissions were set up at the central and state levels and single buyer model was introduced. Soon, it was argued that deeper reforms were required to manage, regulate and co-ordinate development of the electricity industry in India. New legislative framework was adopted in 2003. The new act has de-licensed generation (except hydro), provided for the separation of system operation and transmission activities, allowed trading at wholesale and retail levels and permitted multiple licensing at transmission and distribution levels (Singh, 2006). However, despite the enactment of a comprehensive legal framework for governing the electricity industry, limited progress has been made in

terms of achieving widespread sector liberalisation and privatisation in India (Bhattacharyya, 2007b). At present, the electricity sector continues to perform poorly. There are still peak capacity shortages and energy deficits. Some consumers, like those in the agricultural sector, receive subsidized electricity and pay little or nothing for the electricity they consume.

### **2.3.2 Eurasia**

In Eurasia region, each country's power sector consisted of a vertically integrated public sector monopoly immediately following the break-up of the Soviet Union. Since then, each country has adopted a different strategy with respect to industry structure. These strategies have included different types of vertical unbundling, regulation, privatisation and restructuring. In Russia, reforms were adopted more as an ideological undertaking than as a result of economic necessity. Reforms in general aimed at diminishing the power of party-state in general and incumbents in particular. Actually, the electricity sector in Russia was doing better than many other countries and was as developed as those in the US or UK (Yi-chong, 2006). Without serious problems, changes were not so radical. The reform's another objective was to attract domestic and foreign private investment to modernise and develop the electricity system (Engoian, 2006). The restructuring of Russia's power generation sector will be complete when state monopoly (RAO UES) dissolves. The country's transmission grid will remain under state control. The reform has created a generation sector divided into multiple wholesale electricity companies, which participate in a new competitive wholesale market. The creation of six wholesale electricity companies was completed in 2006. Today, there are seven separate regional power systems in the Russian electricity sector. RAO UES, which is 52 percent owned by the Russian government, controls most of the transmission and distribution in Russia. It owns 96 percent of the transmission and distribution system, and the wholesale electricity market (FOREM).

Electricity reform in Ukraine started in 1996. Vertically integrated national companies were unbundled and single-buyer model with compulsory pool market was adopted. Privatization process of the electricity companies began in 1997 but was cancelled in 1999 due to corruption.

Berg et al. (2005) conducts an empirical analysis of 24 Ukraine electricity distribution companies from 1998 to 2002 and conclude that privately owned firms respond to incentives that add to net cash flows (associated with reducing commercial and non-commercial network losses); however, they also respond more aggressively than do state-owned distribution utilities to mark-up (cost-plus) regulatory incentives that increase shareholder value but decrease cost efficiency.

The reforms in Armenia, Georgia and Azerbaijan were in general in the form of privatization and aimed at attracting foreign investment. Armenia began power sector reform in 1997. Unbundling and privatization in distribution were carried out, and foreign capital introduction was realized. In Georgia, unbundling was introduced in 1997 along with privatization of the power generation company and the distribution companies (Nagayama, 2007). In Azerbaijan, key restructuring initiative was to separate electricity distribution from generation and transmission, and to auction concessions to the private sector for the management of its four distribution companies (Mehta et al., 2007). At present, transmission and generation assets are held by vertically integrated state-owned enterprise. Further vertical unbundling is unlikely to proceed.

Kazakhstan initiated unbundling and privatization in 1996. The government first unbundled power generation from transmission, and privatized most of the power generation capacity.

Transmission and distribution were remained under public domain but performed by separate government-run companies. In 1998, the power wholesale market was established. Today, Kazakhstan has multiple generators that sell bulk power at unregulated prices and wholesale prices are negotiated between suppliers and buyers, who may choose which generators to contract with (Nagayama, 2007). In Tajikistan, vertically integrated public utility was corporatized in 2001 to facilitate further structural changes and improve the commercial performance of the sector. But, apart from this, no reform steps has been taken so far. Kyrgyzstan also corporatized its vertically integrated electricity utility but it also unbundled it into several generation companies, a transmission company, and four distribution companies in 2001. Each of these companies is currently publicly owned but has managerial autonomy.

### **2.3.3 Africa**

The reforms in Africa were very limited in terms of scope and scale and almost in all reform cases the main motive was to encourage foreign private direct investment in power markets. In Africa, only few countries introduced a substantial reform program in their electricity industries. In South Africa, under the apartheid government, prior to 1994, government policies were geared at serving the needs of the minority white population group. Energy policies, including electricity provision, focused on ensuring sufficient supply for the mining, chemical and agricultural industries, which formed the backbone of the South African economy. When the new, democratic government came into power in 1994, South Africa's energy policy saw a fundamental shift in focus. In 1995, the government established the National Electricity Regulator as a successor to the Electricity Control Board that had been established in 1987. Electricity generation in South Africa has been dominated by Eskom, the state-owned electricity utility. Eskom owns, operates and maintains the national transmission grid and is thus a de facto monopolist on both the generation and transmission level. In 2002,

Eskom was converted into a public company pursuant to the Eskom Conversion Act of 2001. At present, Eskom is regulated by the National Energy Regulator of South Africa (NERSA) in accordance with the Electricity Regulation Act of 2006. However, as suggested by Newbery (2009), little progress has been made in South Africa in terms of electricity sector reform. Privatisation process was abandoned; regulator was created but the prices are still based on historic costs and, most importantly, demand has predictably outstripped the capacity. Today, Eskom continues to generate approximately 95% of the electricity in South Africa.

In Nigeria, state owned power utility (NEPA) was commercialized in 1988. In 2005, the monopoly of NEPA in electricity industry was broken and wholesale competition model was put into practice. NEPA was divided into 18 companies, including 6 generators, 11 distributors and one transmission company. Currently, the government holds the shares in the successor companies but it is planned that these companies would gradually be privatized (Ikeme and Ebohon, 2005).

# Chapter 3

## 3 Paper One

**The impact of power market reforms on electricity price-cost margins and industrial/residential price ratios: a cross country panel data analysis\***

### 3.1 Introduction

Relevant economic theories that we summarized in Chapter 1 (theory of regulation and public choice theories) and previous empirical research listed in Section 3.2 predict that electricity prices are affected by the reforms in power industry. In this paper, we try to find out whether this connection holds true when we take into account the fuel costs. In the course of the paper, we develop a measure, called “*electricity price-cost margin*”, to represent the difference between end-user electricity prices and fuel import costs. Although this term is not a standard

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one, we still prefer to use it as it is the best term that we can find to represent the end-user electricity prices net of fuel import costs. To avoid any misunderstanding, we clearly define this term in Section 3.5.

The expected direction of price changes in different countries are different, depending on whether prices were set at below or above long run marginal costs (LRMC) in the pre-reform period. If they are set above LRMC, then we expect a reduction in prices, and therefore in price-cost margins. On the other hand, if prices were below LRMC in pre-reform period, then prices (and price-cost margins) may increase as a result of reforms. So, we cannot suggest a link between reforms and direction of price-cost margins; but we expect that electricity price-cost margins are affected as the market moves further from monopoly and closer to competition. In our analysis, we look at the industrial and residential electricity prices separately. Besides, in this paper, we also try to find out whether there is a correlation between electricity reform and industrial/residential price ratio. Electricity reforms are expected to influence industrial/residential price ratio; however, the expected direction of industrial/residential electricity price ratio changes due to reform depends on the starting point and cannot be hypothesized theoretically. Therefore, we cannot suggest a link between reforms and direction of changes in industrial/residential electricity price ratio; but we expect that power market reforms have a statistically significant impact on industrial/residential electricity price ratios.

The paper also aims at clarifying whether the effects of power sector reform on electricity price-cost margins and industrial/residential electricity price ratios are different between industrial and residential consumers and between developed and developing countries. Empirical econometric models are estimated and analysed to observe the impact of electricity market reform process on price-cost margins and industrial/residential electricity price ratios.

The econometric models are designed using panel data from 63 countries<sup>6</sup>. The dataset covers the period from 1982 to 2009.

We try to answer following research questions: (i) what is the impact of electricity market reforms on electricity price-cost margins? (ii) does liberalization cause a change in industrial/residential electricity price ratios? (iii) what are the other factors that influence electricity price-cost margins and industrial/residential electricity price ratios and how much are they influential relative to reform process?

In point of fact, the fluctuations in fossil fuel prices constitute one of the most important determinants of final electricity prices and, therefore, price-cost margins. However, to our surprise, this variable has been ignored so far in almost all cross country econometric studies trying to explain the impact of reforms on electricity prices (see Ernst & Young (2006), Fiorio et al. (2007), Nagayama (2007, 2009), Steiner (2001) and Thomas (2006b)). Since fuel costs are probably the most important component of end user prices, any study excluding this variable destined to fall short. In view of the fact that our study is the first to take into account variations in fuel costs in the explanation of impact of reforms, it not only is an important contribution to the existing literature but also fills an important gap in this area.

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<sup>6</sup> ***Developed countries (32):*** Australia, Austria, Belgium, Canada, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovak Republic, Spain, Sweden, Switzerland, Taiwan (Chinese Taipei), Trinidad and Tobago, United Kingdom, United States.

***Developing countries in America (21):*** Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, Venezuela.

***Other developing countries (10):*** China, India, Indonesia, Kazakhstan, Poland, Romania, Russian Federation, South Africa, Thailand, Turkey.

The paper proceeds as follows. Next section provides a literature review on the impact of electricity sector reform process on electricity prices. Section 3.3 develops research hypotheses. Section 3.4 summarizes the methodological framework. Section 3.5 describes data. Following two sections present empirical analysis and discuss the results. The last section concludes after considering possible policy implications of the results.

## **3.2 Literature review**

In this section, we review empirical literature on the impact of electricity sector reform process on electricity prices. There is an extensive volume of literature on electricity market reforms but most of it is in the form of opinion and discussion and not based on detailed econometric analysis. In line with our objectives, we focus only on those studies which aim at revealing the relationship between power market reforms and electricity prices by analysing cross-country data or developing a logical framework to evaluate cross-country evidence.

Electricity prices are also expected to be influenced indirectly by any factor that affects the reforms, such as institutional structure of a country or political economic environment. In this paper, we only concentrate on the factors that directly have an impact on the prices. Some of the indirect factors are covered in the second and third papers. For instance, the impact foreign influence originating from foreign financial aid and/or assistance by international donor agencies (e.g. World Bank) is investigated in the third paper.

Steiner (2001) carried out the first study focusing on the effect of electricity market reform on final electricity prices. She studied the effect of regulatory reforms on the retail prices for large industrial customers as well as the ratio of industrial price to residential price, using

panel data for 19 OECD countries for the period 1986-1996. In her analysis, she used electricity price, ratio of industrial to residential electricity price, capacity utilization rate and reserve margin as variables. The study found that electricity market reforms generally induced a decline in the industrial price and an increase in the price differential between industrial customers and residential customers, indicating that industrial customers benefit more from the reform. She also found that unbundling is not associated with lower prices but is associated with a lower industrial to residential price ratio and higher capacity utilization rates and lower reserve margins. Hattori and Tsutsui (2004) also examined the impact of the regulatory reforms on prices in the electricity industry. Like Steiner (2001), they used panel data for 19 OECD countries but for the period 1987-1999. They found, first, that expanded retail access is likely to lower the industrial price, while at the same time increasing the price differential between industrial and household customers. Additionally, they concluded that unbundling of generation did not necessarily lower the price and may have possibly resulted in higher prices. Like Steiner (2001), their estimation showed that the effect of unbundling on the level of industrial price is statistically insignificant. Besides, they found that introduction of a wholesale power market did not necessarily lower the price, and may indeed had resulted in a higher price. Their estimates showed, without exception, that establishing a wholesale power market resulted in statistically significantly higher prices and also increased the ratio of industrial price to household price, although not in a statistically significant manner.

Pollitt (2009) mentions two other empirical studies that examine the price impacts of reform by Ernst & Young (2006) and Thomas (2006b). Ernst & Young (2006) prepared a report for the UK government's Department of Trade and Industry (DTI). In their study, they used a sample of EU-15 countries and produced some policy suggestions for electricity and gas industries with a large number of simple regressions. As a result of their study, they concluded that liberalization lowers prices; liberalization lowers costs and price-cost margins;

and liberalized markets increase price volatility. Thomas (2006b) examined a number of reports including those of European Commission which look at (or comment on) electricity prices. Although these studies, he argued, suggest that reforms in the EU have been associated with lower prices for consumers, the evidence does not support these assertions. The price reductions, he continued, that have occurred in the past decade took place mostly in the period 1995-2000, before liberalization was effective in most of the European Union and since then, prices have risen steeply, in many cases wiping out the gains of the earlier period. For him, other factors, not properly accounted for, such as fossil fuel price movements, technological innovations and changes to regulatory practices were more likely to have led to the price reductions that occurred in the period 1995-2000 than reforms that had not then taken effect. He also underlined that the EU reform model's real test is whether it can deliver timely investment to meet the emerging investment gap following the elimination of short run inefficiency and initially high reserve margins.

Fiorio et al. (2007) questioned the widespread beliefs that public ownership can be an impediment to other reforms and that it leads to production inefficiency. To test for this and the reform paradigm in general, they considered electricity prices and survey data on consumer satisfaction in the EU-15. Their empirical findings rejected the prediction that privatization leads to lower prices, or to increased consumer satisfaction. They also found that country specific features tend to have a high explanatory power, and the progress toward the reform paradigm is not systematically associated with lower prices and higher consumer satisfaction.

Other two studies on econometric modelling of electricity market reforms come from two papers by Nagayama (2007, 2009). Nagayama (2007) used panel data for 83 countries covering the period 1985-2002 to examine how each policy instrument of the reform

measures influenced electricity prices for countries in Latin America, the former Soviet Union, and Eastern Europe. The study found that variables such as entry of independent power producers (IPP), unbundling of generation and transmission, establishment of a regulatory agency, and the introduction of a wholesale spot market have had a variety of impacts on electricity prices, some of which were not always consistent with expected results. The research findings suggested that neither unbundling nor introduction of a wholesale pool market on their own necessarily reduces the electricity prices. In fact, contrary to expectations, there was a tendency for the prices to rise. He argued, however, coexistent with an independent regulator, unbundling may work to reduce electricity prices. He found that privatization, the introduction of foreign IPP and retail competition lower electricity prices in some regions, but not in all regions. In his second paper, Nagayama (2009) aimed at clarifying whether the effects of power sector reforms should be different either across regions, or between developing and developed countries. He analysed an empirical model to observe the impact of power prices on the selection of a liberalization model in the power sector. This was achieved by the use of ordered response, fixed effect and random effect models. An instrument variable technique was also used to estimate the impact of the liberalization model on the power price. These econometric models were designed using panel data from 78 countries in four regions (developed countries, Asian developing countries, the former Soviet Union and Eastern Europe, and Latin America) for the period from 1985 to 2003. The research findings suggested that higher electricity prices are one of the driving forces for governments to adopt liberalization models. However, the development of liberalization models in the power sector does not necessarily reduce electricity prices. In fact, contrary to expectations, the study found that there was a tendency for the prices to rise in every market model.

### **3.3 Hypothesis development**

This section of the paper develops two hypotheses as to the impact of power market reforms on electricity price-cost margins and industrial/residential electricity price ratios, which are then tested empirically in the next sections of the paper.

#### **3.3.1 Hypothesis on price-cost margins**

Electricity industry reforms are multi-dimensional activities with interrelating dimensions and a variety of impacts, and the process generally involves a set of specific steps or measures based on the reform model. The predictive power of theory is limited with regard to the outcome of the reform of natural monopolies (such as the electricity sector) as this is dependent on how the sector is structured and regulated (Jamash et al., 2005). The reforms are expected to result in short and medium term cost savings (through privatization) and cost reductions (through competition), and to lower real prices in those countries where electricity prices have been set at compensatory levels in the pre-reform period (Joskow, 1998). Although the size of cost savings and reductions may differ from one country to another, the primary sources of cost savings are identified and extensively discussed in the literature. In this context, two important streams of thought that are relevant to forming a hypothesis of the impact of reforms on economic performance (including performance of prices) are agency and public choice theories (Boycko and Vishny, 1996; Niskanen, 1971; Zeckhauser and Horn, 1989). According to them, the reforms (and especially privatization) is expected to enhance economic efficiency by (i) changing the allocation of property rights, which leads to a different structure of incentives for management and hence to changes in managerial behaviour; (ii) removing the ‘soft budget’ constraint of taxpayer support and exposing enterprises to the disciplines of the private capital market (De Alessi, 1980); (iii) introducing

more precise and measurable objectives, thus reducing transaction costs, especially associated with principals monitoring management (agent) behaviour; and (iv) removing political interference in the management of enterprises and capture by special interest groups (Zhang et al., 2008). For electricity sector, other sources of potentially significant short term and medium term cost savings are associated with changes in policies that favour high-cost domestic fuels when lower-cost alternatives are available; the performance improvements including increases in generating unit availability, as well as savings in both physical and financial losses (theft of service) on the distribution system. However, we should also be aware that in some cases electricity reform may raise prices because they were set ‘too low’ (i.e. below LRMC) in the pre-reform period.

The literature we summarized in the previous section focuses on the relationship between reforms and electricity prices and provides us with various insights on this relationship. Since this paper may be regarded as an extension to the literature investigating reform-price relationship, we need a hypothesis focusing on this relationship with the extension that we concentrate on price-cost margins, rather than prices only. In short, relevant economic theories (theory of regulation, agency and public choice theories) and previous empirical investigations indicate that electricity prices are affected by the reforms in power industry. In this paper, we try to find out whether this relationship holds true when we take into account the fuel costs. The expected direction of price changes in different countries is different, depending on the starting point at the beginning of the reforms. That is, it is mainly determined by whether prices were set at below or above the long run marginal costs (LRMC) in the pre-reform period. If they are set above LRMC, then we expect a reduction in prices, and therefore in price-cost margins. However, if prices are below LRMC in pre-reform period, then prices (and price-cost margins) may increase as a result of the reforms. Therefore,

we cannot hypothesize a particular connection between reforms and the direction of price-cost margins. From the above arguments the following hypothesis is derived:

***Hypothesis 1:** Electricity price-cost margins are affected as countries introduce reform steps (that is, as the market moves further from monopoly and closer to competition).*

This hypothesis is both an immediate application of the relevant economic theory (theory of regulation, agency and public choice theories) and a direct parallel with the empirical findings reported in the literature we summarized in the previous section. While investigating the relationship between reforms and price-cost margins, the latter (dependent variable) is represented by the variables “price-cost margin for industry” and “price-cost margin for households”. On the other hand, six dummy variables (*independent power producers, wholesale electricity market, choice of supplier, unbundling, privatization, electricity market regulator*) and their cross-products (*privatization and regulator, privatization and unbundling, unbundling and regulator*) constitute causal variables that represent electricity market reforms. The details of these variables are provided in the following sections.

Before proceeding to the development of the second hypothesis, let me comment on the potential impact of causal variables on the prices, and therefore price-cost margins, if prices are set above LRMC in the pre-reform period. *Independent power producers (IPPs)* promote competition, which is expected to lower electricity prices. However, introduction of IPPs may also result in price increases if ‘high’ electricity prices are guaranteed to IPPs with power purchase agreements in order to promote investment (especially in developing countries). *Wholesale electricity markets* are expected to lead to lower prices through the lower wholesale prices induced by competition. However, as found by Nagayama (2007), if a

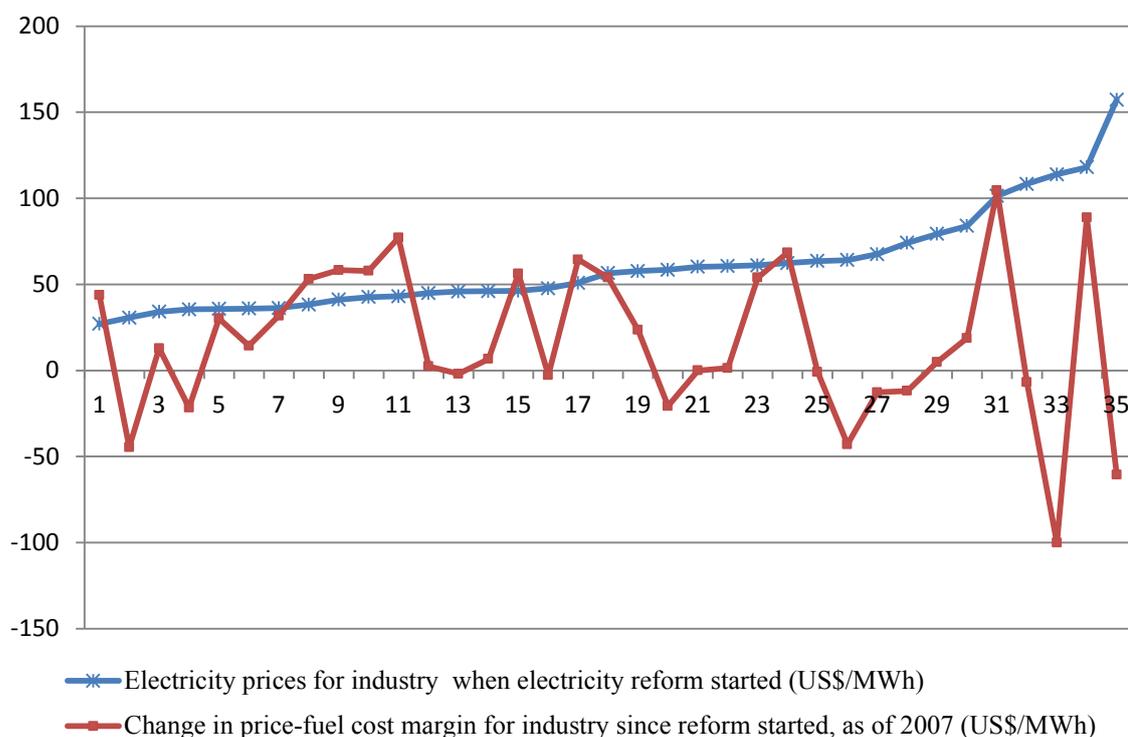
wholesale power market is vulnerable to the market power of large generators, prices may go up. Similarly, *choice of supplier* usually means competition among potential electricity service providers and therefore puts a downward pressure on prices; but when number of suppliers is limited then prices may go upward due to oligopolistic nature of the market. Also, *unbundling* is required to separate competitive and uncompetitive segments of the electricity industry and subject competitive segments to competition, which reduces prices. However, if *unbundling* is not effectively carried out, as in the situation where a specific firm exercises market power, prices may rise. Moreover, *privatization* usually results in capital investment and advanced technology to increase management efficiency, which is expected to lower electricity prices. However, if the investing company requires guarantees on the expected return on its investment and this return is assured, then electricity prices may rise. Finally, the electricity price is expected to be lowered with the establishment of an *independent regulatory agency*, which makes transparent power market rules to promote competition (Nagayama, 2007). Nevertheless, a captured (by the industry) or incompetent regulator may easily result in an increase in electricity prices. Also, if the regulatory institution is not independent, politics may influence decisions on electricity prices and prices may go up.

Actually, we would also like to test the impact of initial electricity price level on price-cost margin by including a dummy variable representing whether initial level of price (that is, electricity prices when reforms started) was above or below the LRMC. We have data on 63 countries in our dataset but, due to missing observations, we are able to calculate price-cost margins for industry and households when reforms started for 44 countries. As shown in Appendix I-1, both industrial and residential prices seem to be above the fuel import costs in all of these countries when the reforms started. Since we do not have data on LRMC in countries, we find it difficult to assign a country to one of two categories of the dummy variable. So, due to the difficulty of establishing whether the initial prices are above or below

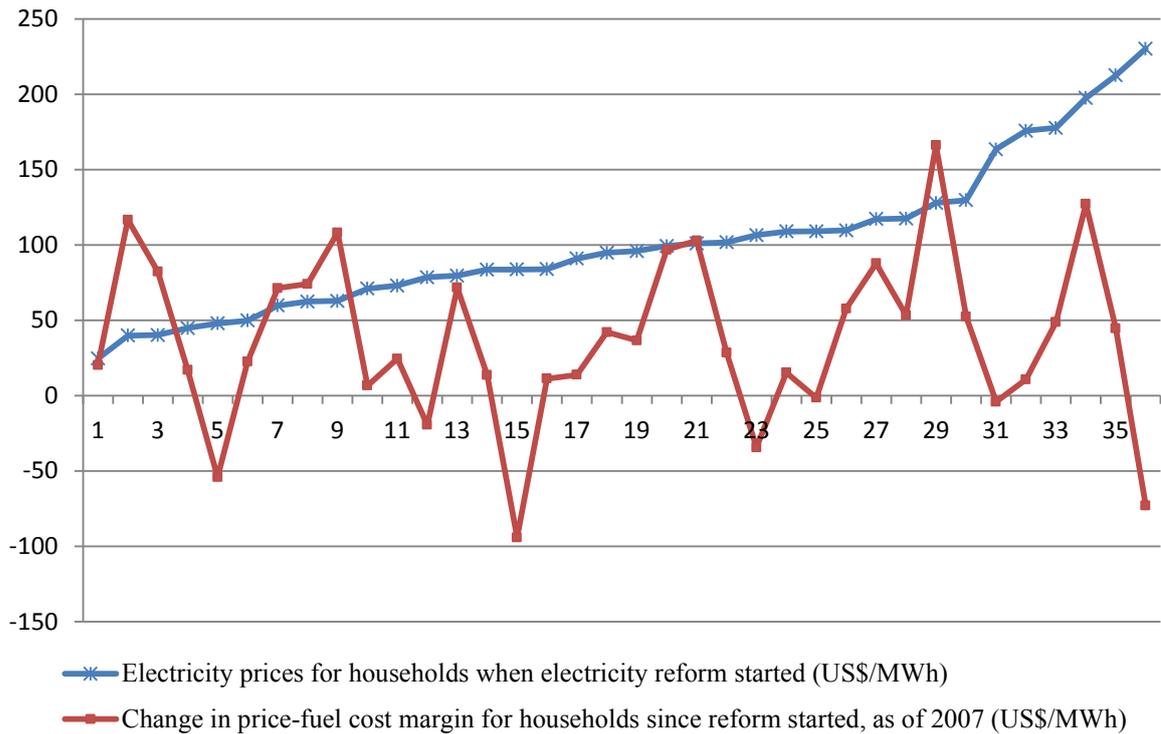
LRMC, we do not include the dummy variable representing whether initial price level was above or below LRMC when electricity reforms started. Although initial prices are above the fuel import costs for both households and industrial consumers in 44 countries in our dataset, it does not necessarily mean that they are also above LRMC or that this is the case in all other countries. If necessary data become available in the future, the analysis of initial price levels may produce interesting results. However, due to limited nature of our dataset, we cannot carry out such an analysis in this study.

To investigate possible impact of the initial prices on subsequent price-cost margins further, we focus on the relationship between initial prices and the change in price-cost margins from the year when reforms started to 2007. Using data from our dataset, Appendix I-2 and Appendix I-3 present electricity prices for industry and households, respectively, when electricity reform started **and** the change in price-fuel cost margin between the year the

**Figure 3.1** Change in price-fuel cost margins for industry



**Figure 3.2** Change in price-fuel cost margins for households



reform started and 2007. In Appendix I-2 and Appendix I-3, the countries are ranked based on electricity prices when electricity reform started in ascending order. Figure 3.1 and Figure 3.2 provide the visual plot of the data in Appendix I-2 and Appendix I-3, respectively. As a result of a visual inspection of Figure 3.1 and Figure 3.2, we could not detect a uniform relationship between initial prices and the change in price-cost margins. To sum up, initial electricity price levels do not seem to be an effective explanatory determinant of price-cost margins.

### 3.3.2 Hypothesis on relative price of electricity for industry and households

Cross-subsidization refers to the financing of the cost of electricity service provision to a particular consumer group(s) by another consumer group(s). Through cross-subsidization, instead of following the rule of attributing costs properly to each consumer group to make each of them pay for the electricity they consumed, an electricity utility allows a consumer

group to finance another one. Traditionally, electricity tariffs have been used to engage in cross-subsidization, benefitting some interest groups and burdening others. In some countries, for social and economic policy reasons, electricity prices are uniform across the country despite the fact that there are regional variations in supply costs. Some other countries have provided direct and indirect subsidies to electricity supplied to farms, residences and small businesses in rural areas. In some countries, electricity tariffs either provide lower prices for low-income consumers or specify price structures so that consumers with low-consumption levels pay prices below the cost of providing them with service under the assumption that there is a high correlation between income and electricity consumption (Joskow, 1998).

As we mentioned in Section 1.3, the economic theory of regulation may be regarded as the application of public choice approach to domain of regulation. The essence of this approach is that regulators and politicians, like economic man, weigh the benefits and costs of various courses of action in a political framework where the attainment of a voting majority determines success. In its broadest interpretation, this approach emphasizes a balancing of interest group strengths and weaknesses at the margin, with the outcome determined by the stake that the various groups have in it and the efficiency by which they can influence the regulatory process. Within the framework suggested by economic theory of regulation, the strength of various interest groups determines the outcome of electricity market reforms (including the change in relative electricity prices). In pre-reform period, residential customers are subsidised by industrial users in some countries while the reverse holds true in some other countries. The expected direction of industrial/residential electricity price ratio changes due to reform depends on the starting point, county-specific conditions and the relative strength of interest groups; and therefore cannot be hypothesized theoretically. The following hypothesis is therefore relevant on the effect of reform on industrial/residential electricity price ratio.

***Hypothesis 2:** Power market reforms have a statistically significant impact on industrial/residential electricity price ratio.*

As mentioned above, electricity reforms are expected to influence industrial/residential price ratios. In this context, the change in industrial/residential price ratio constitutes a possible outcome and the electricity reform is the possible cause of this outcome. By developing this second hypothesis, we try to find out whether there is a correlation between electricity reform and industrial/residential price ratio. We may think about a causal link in the event that the coefficients of the variables representing reform steps turn out to be statistically significant.

While considering the relationship between reforms and industrial/residential price ratio, the latter (dependent variable) is represented by the variable “industrial/residential price ratio”. As in the previous case, six dummy variables and their cross-products constitute causal variables that represent electricity market reforms. The details of these variables are provided in the following sections.

### **3.3.3 Control variables**

Control variables are independent variables not directly related to electricity market reforms but still may explain a portion of the variations in price-cost margins and industrial/residential price ratios. In addition to electricity reforms, we expect that prices are affected by consumption levels, income level and transmission and distribution (T&D) losses. It is a very basic economic knowledge that prices are influenced by demand (consumption) and income. In some countries with high T&D loss levels, it may be necessary to raise electricity prices to secure some receipts. As a result of such considerations, we include following variables into

our analysis as control variables: electricity consumption by industry, electricity consumption by households, electricity losses in total supply, and GDP per capita. The details of these variables are presented in the following sections, too.

### 3.4 Methodology

It is almost impossible to observe the real impact of power market reforms on prices without separating the effects of market reform from variations in fuel costs and other country specific features. Therefore, instead of using prices directly in our analysis, we calculate electricity price-cost margins for each country and for each year and use this variable in our models as dependent variable. However, it is important to remember that what we refer as “price-cost margin” in this study is actually “electricity end use price - fuel cost margin”; it is *not* a measure of “economic profit”<sup>7</sup> and, therefore, *not* expected to be zero. Electricity price-cost margin in this study includes items such as capital costs, transmission and distribution costs, accounting profit of the electricity utilities and so on. Since fuel costs are usually external to electricity industry (that is, fuel prices are determined by international markets), they should be separated from final electricity prices to observe the real impact of reforms on electricity price trends. Therefore, we deduct fuel prices from final electricity prices. We take into account only coal and natural gas import costs in the calculation of fuel costs because the cost of all remaining inputs (like those for nuclear and renewable power plants) are so low that they can be ignored. Additionally, apart from electricity prices, we also look at the impact of power market reforms on industrial/residential electricity price ratios.

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<sup>7</sup> Economic profit refers to the difference between the revenue received from the sale of an output and the opportunity cost of the inputs used. In the calculation of economic profit, opportunity costs are deducted from revenues earned. Therefore, at an optimum level, economic profits are expected to be zero.

We specify price-cost margins and industrial/residential electricity price ratios as a function of (i) electricity market reform indicators (dummy variables for individual reform steps and their cross-products), (ii) a set of controls (electricity consumption, transmission and distribution losses and income level), (iii) country-specific effects (these are assumed to be exogenous and to exist independently of reform process, but may explain a portion of the variation in electricity prices) and (iv) other unobserved variables that influence electricity price-cost margins and industrial/residential price ratios. These variables are then used in panel regressions to assess their impact on price-cost margins and industrial/residential price ratios. In panel regressions, the exploitation of both cross-country and time-series dimensions of the data allows for control of country-specific effects. Apart from reform process, price-cost margin and industrial/residential price ratio in a specific country and year are expected to be influenced by some other variables like electricity consumption, income level, transmission & distribution losses and so on. In our models, we include these variables in order to isolate the effect of the reforms on price-cost margins and industrial/residential price ratios. Besides, prices for industrial consumers are usually supposed to be more cost-reflective than prices for households. Hence, in our analysis, we make a distinction between industrial and residential electricity prices.

Panel data analysis has three more-or-less independent approaches: (i) independently pooled panels, (ii) random effects models, (iii) fixed effects models. The selection between these methods depends upon the objective of our analysis and relevant tests developed to determine which one is the most appropriate. We start with the standard panel data regression equation below to analyse the impact of electricity industry reforms on industrial and residential electricity price-cost margins and industrial/residential price ratios.

$$Y_{it} = \beta_1 + \sum_{j=2}^k \beta_j X_{jit} + \sum_{p=1}^s \gamma_p Z_{pi} + \delta t + \varepsilon_{it} \quad (3.1)$$

In the model,  $i$  and  $t$  represent unit of observation and time period, respectively.  $j$  and  $p$  are indices used to differentiate between observed and unobserved variables.  $X_{ji}$  and  $Z_{pi}$  represent observed and unobserved variables, respectively.  $X_{ji}$  includes both reform indicators and control variables.  $Y_{it}$  is dependent variable (that is, electricity price-cost margins and industrial/residential price ratios).  $\varepsilon_{it}$  is the disturbance term and  $t$  is time trend term. Because the  $Z_{pi}$  variables are unobserved, there is no means of obtaining information about the  $\sum \gamma_p Z_{pi}$  component of the model. For convenience, we define a term  $\alpha_i$ , known as the unobserved effect, representing the joint impact of the  $Z_{pi}$  variables on  $Y_{it}$ . So, our model may be rewritten as follows:

$$Y_{it} = \beta_1 + \sum_{j=2}^k \beta_j X_{jit} + \alpha_i + \delta t + \varepsilon_{it} \quad (3.2)$$

Now, the characterization of the  $\alpha_i$  component is crucially important in the analysis. If control variables are so comprehensive that they capture all relevant characteristics of the individual, there will be no relevant unobserved characteristics. In that case, the  $\alpha_i$  term may be dropped and pooled data regression (OLS) may be used to fit the model, treating all the observations for all time periods as a single sample. However, since we are not sure whether control variables in our models capture all relevant characteristics of the countries, we cannot directly carry out a pooled data regression of  $Y$  on  $X$ . If we were to do so, it would generate an omitted variable bias. Therefore we prefer to use either a Fixed Effects (FE) or Random Effects (RE) regression. In FE model, the country-specific effects ( $\alpha_i$ ) are assumed to be the

fixed parameters to be estimated. In RE model, the country-specific effects ( $\alpha_i$ ) are treated as stochastic. The fixed effect model produces consistent estimates, while the estimates obtained from the random effect model will be more efficient. There are more than 90 countries in the world where a reform process has been initiated but data is available only for 63 countries. That is, our sample is limited by data availability. Besides, electricity prices may or may not be country specific as in some regions there are regional electricity markets where prices are determined across countries. Therefore, we cannot be sure whether the observations in our model may be described as being a random sample from a given population; and cannot directly decide which regression specification (FE or RE) to use. It will be decided in the course of the analysis based on Hausman test.

### **3.5 Overview of data**

Our data set is based on a panel of 63 countries for a period beginning in 1982 and extending through 2009. Year 1982 is selected as the starting date for the study because at that time electricity market reform was initiated for the first time in Chile. The final date, 2009, represents the last year for which data are available at the time the research is conducted. The data on electricity prices are not available for many countries for the period before 1982. That is, data availability also dictates the starting year. Besides, Chile initiated a large scale privatization program only in its electricity industry for the first time in 1982; but the reforms started in real sense in the UK in 1989. If we assume that the UK implemented the first reform program in full sense, our dataset has 7 years as base case. The countries in our sample are determined by data availability, especially by data on electricity prices for residential and industrial consumers and fuel costs in electricity generation. Since our panel dataset includes data on 63 countries for 28 years, the total number of maximum observations is 1,764 (63x28). Because of the missing observations, our panel is unbalanced.

The variables used in the study are dummy variables representing individual reform steps and their cross-products, price-cost margin for industry and households, industrial/residential price ratio, electricity consumption by industry and households, electricity losses and income level (GDP per capita). We also divided all countries in our dataset into three groups (developed countries, developing countries in America and other developing countries) based on classification made by World Bank (2010a) and included a dummy variable for each group of country into our dataset.

The dummy variables representing the existence of individual reform steps are as follows: (1) independent power producers (IPPs), (2) wholesale electricity market, (3) choice of supplier, (4) unbundling, (5) privatization, (6) electricity market regulator. In addition to these variables, we also include the cross-products of the last three variables into our analysis as we expect that combination of them may have different impact than when they exist alone. So, our additional three variables are (7) privatization and regulator, (8) privatization and unbundling, (9) unbundling and regulator. The dummy variables for reform steps are created using data collected and cross-checked from various international and national energy regulators' web sites<sup>8</sup>.

Data on electricity prices are obtained from International Energy Agency (IEA, 2010c) and Latin-American Energy Organization (OLADE, 2010). The unit of observation is current US\$/kWh. Electricity price data are available separately for residential and industrial users and cover 63 countries.

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<sup>8</sup> The full list of sources from which data are obtained can be found at IERN web site (<http://www.iern.net>).

Fuel cost data are taken from IEA and consist of two sets of data on natural gas import costs (USD/MBtu) and coal import costs (USD/tonne) (IEA, 2010a, b). For US, Japan and South Korea, we use LNG import costs as natural gas import cost data while pipeline import costs are used for the rest. Also, we utilized average EU natural gas pipeline import prices as a proxy for natural gas import costs in the countries for which the natural gas import cost data are not available. *Coking coal* is required for production of coke used in steel industries and *steam coal* is used in thermal power plants for steam production. Since we are concentrating on electricity generation costs in our study, we used steam coal import costs in our analysis. Coal data is missing for some countries in our sample. We used average EU steam coal import costs as a proxy for coal import cost for Norway, Switzerland and EU member or candidate countries for which data are missing. For other countries with missing observations, we used OECD averages. As we take into account the fact that energy markets (including natural gas and coal markets) have been internationalized in the last two decades, utilization of average EU or OECD import prices as a proxy for import costs in other countries seems to be justified.

Having collected data on end-user electricity prices and fuel import costs, we calculated price-cost margins as follows. First of all, we converted electricity prices into US\$/MWh by multiplying prices in US\$/kWh by 1,000. Then, we converted the data on fuel import costs into a common unit, USD/MBtu. In the conversion process, we used the equation  $1 \text{ MBtu} \approx 0.036 \text{ tonne of coal equivalent}$ . After conversion, we weighted these two variables by *both* the output of electricity from natural gas and coal within each country and year *and* heat rate<sup>9</sup> of

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<sup>9</sup> The term “heat rate” refers to a power plant’s efficiency in converting fuel to electricity. Heat rate is expressed as the number of British thermal units (Btu) required generating a kilowatt hour (kWh) of electricity. Lower heat rates are associated with more efficient power generating plants. In the literature, **spark spread** refers to the theoretical gross income of a gas-fired power plant from selling a unit of electricity, having bought the fuel required to produce this unit of electricity. All other costs (operation and maintenance, capital and other financial

these two fuels. Data on electricity production from natural gas and coal are obtained from IEA (2010d). For instance, if we assume that data for a specific country and a specific year are as follows, price-cost margin for industry in this country and year is calculated as 82.2 US\$/MWh, as shown below.

- Electricity price for industry: 145 US\$/MWh
- Natural gas import cost: 9 USD/MBtu
- Coal import cost: 5 USD/MBtu
- Electricity generation from natural gas: 175 TWh
- Electricity generation from coal: 125 TWh
- Heat rate for gas-fired plants: 8,000 Btu/kWh (= 8000/1000 Btu/MWh)
- Heat rate for coal-fired plants: 10,000 Btu/kWh (= 10000/1000 Btu/MWh)

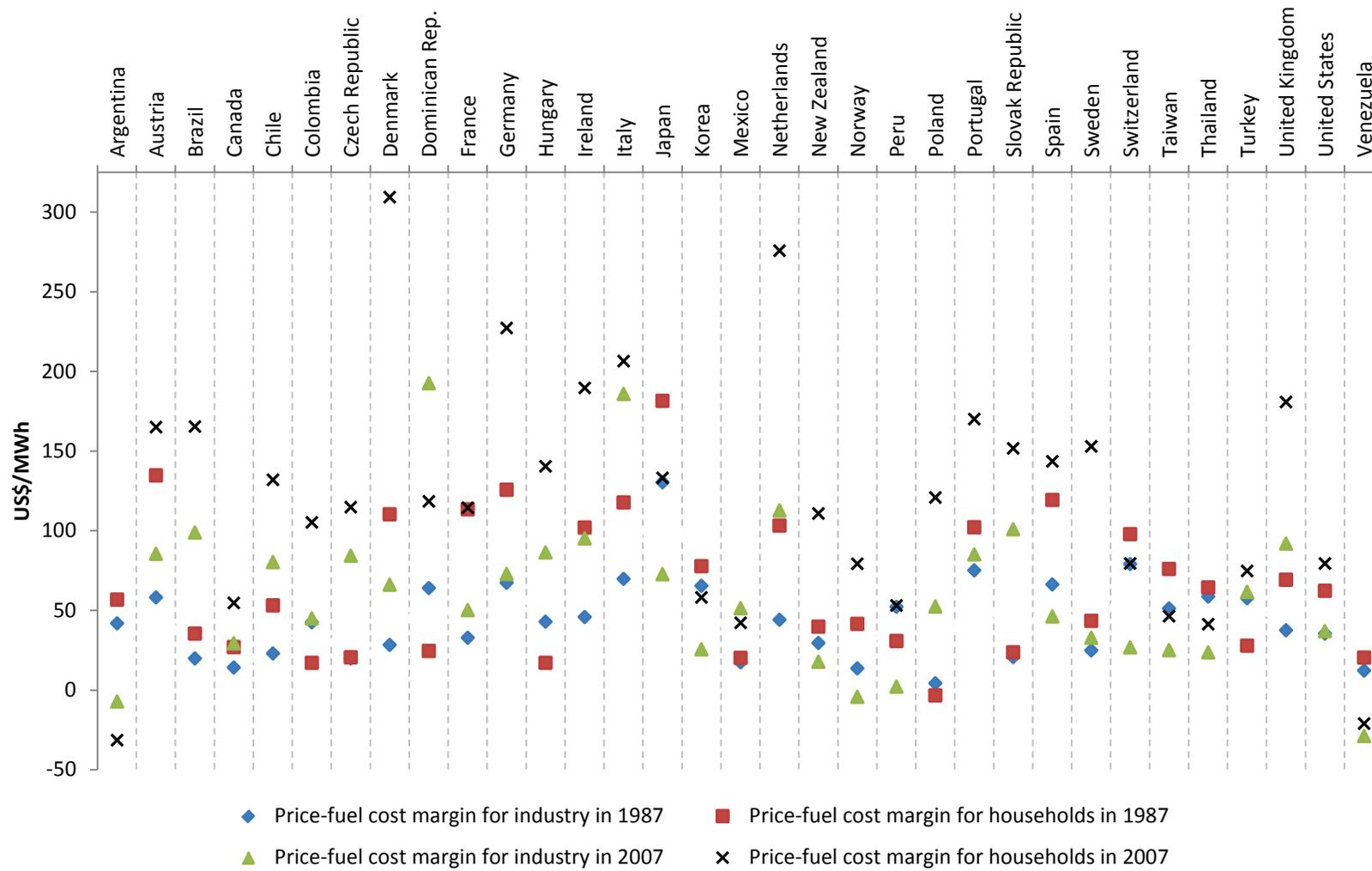
$$145 - \frac{9 * (8000/1000) * 175 + 5 * (10000 / 1000) * 125}{(175 + 125)} \approx 82.2 \quad (3.3)$$

In 2007, on average, 42.3% of total electricity generation came from natural gas and coal in our sample countries (IEA, 2010d) and in 20 of them, gas and coal were responsible for more than 65% of total generation. Nuclear, hydro and other renewable sources accounted for most

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costs) must be covered from the spark spread. The term **dark spread** refers to the similarly defined difference between cash streams (spread) for coal-fired power plants. In short; spark/dark spread is the difference between the wholesale price of electricity and the cost of the fuel used to generate it taking into account the heat rate of each fuel. In our study, however, we calculate price-cost margin as the difference between end-user (not wholesale) electricity prices and fuel costs. Actually, price-cost margin varies between plants using different fuels and may vary even between plants using the same fuels. However, for simplicity, we assume a heat rate of 10,000 Btu/kWh for coal-fired plants and 8,000 Btu/kWh for gas-fired ones (For more details see US EIA, 2010a. Average Operating Heat Rate for Selected Energy Sources. U.S. Energy Information Administration.).

**Figure 3.3** Electricity end user price - fuel cost margins in 1987 and 2007



**Table 3.1** Descriptive statistics of the variables

<b>Variables (Units)</b>	<b># of obs.</b>	<b># of countries</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
<b>Dependent Variables</b>						
Price-cost margin for industry (US\$/MWh)	1,127	54	40.90	28.12	-32.03	212.55
Price-cost margin for households (US\$/MWh)	1,179	54	74.18	50.77	-33.13	344.40
Industrial/residential electricity price ratio	1,428	61	0.81	0.43	0.20	3.86
<b>Explanatory Variables</b>						
Independent power producers (IPPs)	1,764	63	0.49	0.50	0	1
Wholesale electricity market	1,764	63	0.27	0.44	0	1
Choice of supplier	1,764	63	0.21	0.41	0	1
Unbundling	1,764	63	0.37	0.48	0	1
Privatization	1,764	63	0.35	0.48	0	1
Electricity market regulator	1,764	63	0.40	0.49	0	1
Privatization and regulator	1,764	63	0.29	0.45	0	1
Privatization and unbundling	1,764	63	0.29	0.45	0	1
Unbundling and regulator	1,764	63	0.33	0.47	0	1
<b>Control Variables</b>						
Electricity consumption by industry sector (GWh)	1,614	63	68,257	159,064	41	1,867,656
Electricity consumption by households (GWh)	1,614	63	43,490	137,925	0	1,392,241
Proportion of losses in total supply (%)	1,614	63	11.05	7.52	0	55.87
GDP per capita (current thousand US\$)	1,650	63	11.81	13.61	0.20	109.90

of the remaining generation. Since the fuel costs in nuclear power plants and renewable electricity generating facilities constitute a very limited portion of the total cost, we focus only on the fuel cost in natural gas or coal-fired power plants where fuel costs have the largest share in total cost. Figure 3.3 shows the changes in price-cost margins for industry and households during the last two decades in countries for which data are available.

In our study, we created industrial/residential electricity price ratio variable to measure the relative price of electricity for industrial and residential consumers. This variable is obtained by dividing industrial electricity prices by residential prices.

Data on electricity consumption and transmission & distribution losses come from IEA (2010e). Data on GDP per capita are obtained from World Bank (2010b). Table 3.4 shows descriptive statistics of the variables in our analysis.

### **3.6 Empirical analysis**

Throughout our analysis, we estimate three groups of models to explain electricity price-cost margins for industry & households and industrial/residential price ratios. Each group includes three models for specific country groups<sup>10</sup>. In total, we estimate 9 models.

Since using logarithms of variables enables us to interpret coefficients easily and is an effective way of shrinking the distance between values, we transform price-cost margin, electricity consumption and income level variables into logarithmic form and use these new transformed variables in our models. Although using logs and fixed or random effects models may have important repercussions on the quantitative interpretation of the results, they do not have an impact on the interpretation of the results as we concentrate on the sign of the coefficients only. That is, we do not concentrate on the quantitative impact of an explanatory variable on the dependent variable; instead, we focus on the sign of the relationship (positive or negative) between the dependent and explanatory variables.

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<sup>10</sup> FE estimation results do not let us detect the differences between country groups as variables that do not vary over time (like dummies for separating country groups) are dropped in FE estimation. In order to observe possible differences between country groups, we estimate separate models for each country group.

We perform the empirical analysis by estimating the specification given in Equation 3.2 for each model<sup>11</sup>. However, as mentioned before, we cannot directly decide which regression specification (FE or RE) to use. Therefore, we apply Hausman test for fixed versus random effects in each model. To perform this test, we first estimate the fixed effects model (which is consistent) and store the estimates, then estimate the random-effects model (which is efficient) and run the test. Since we prefer 5% significance level, any p-value less than 0.05 implies that we should reject the null hypothesis of there being no systematic difference in the coefficients. In short, Hausman test with a p-value up to 0.05 indicates significant differences in the coefficients. Therefore, in such a case, we choose fixed effects model. However, if p-value from Hausman test is above 0.05, we cannot reject the null hypothesis of there being no systematic difference in the coefficients at 5% level. In such cases, Hausman test does not indicate significant differences in the coefficients. Therefore, we provisionally choose random effects. After that, we apply Breusch and Pagan Lagrangian Multiplier (BPLM) test for random effects in order to decide on using either pooled OLS or random effects in our analysis. This test is developed to detect the presence of random effects. In this test, the null hypothesis is that variances of groups are zero; that is, there is no unobserved heterogeneity, all groups are similar. If the null is not rejected, the pooled regression model is appropriate. That is, if the p-value of BPLM test is below 0.05, we reject the null, meaning that random effects specification is the preferred one. If it is above 0.05, we prefer pooled OLS specification to carry out our regression. Table 3.5 shows a summary of estimation results that present statistically significant coefficients and their standard errors. Full details of estimation results are provided in Appendix I-4 including estimation output, number of observations and countries included in each model estimation, results of Hausman and BPLM tests and preferred specifications based on these tests.

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<sup>11</sup> Throughout the paper, model estimations are carried out and cross-checked by Stata 11.1 and Eviews 7.1.

**Table 3.2** Summary of estimation results

Dependent Variables	Log of price-cost margin for industry			Log of price-cost margin for households			Industrial/residential price ratio		
	Developed Countries	Developing Countries in America	Other Developing Countries	Developed Countries	Developing Countries in America	Other Developing Countries	Developed Countries	Developing Countries in America	Other Developing Countries
Existence of IPPs	-0.116*** (0.045)	-0.641*** (0.180)						0.126** (0.061)	
Wholesale Electricity Market		0.746** (0.293)	-0.361* (0.200)			-0.474*** (0.152)			
Choice of Supplier						0.951*** (0.174)	0.099*** (0.031)	0.245** (0.143)	-0.367*** (0.125)
Unbundling			0.533*** (0.190)		0.695* (0.370)		-0.1*** (0.036)		-0.217** (0.116)
Privatization	0.188** (0.074)			0.172*** (0.057)	1.030* (0.574)		-0.108*** (0.035)		-0.314** (0.146)
Existence of Market Regulator	-0.238** (0.100)				-0.579** (0.235)		-0.099** (0.047)		

Privatization and Regulator	0.193* (0.103)								
Privatization and Unbundling	-0.280*** (0.105)				-1.512* (0.793)				
Unbundling and Regulator			-0.913*** (0.284)						
Log of electricity consumption by industry	-0.947*** (0.076)		-1.295*** (0.179)	NV	NV	NV	0.201*** (0.047)	0.137** (0.067)	
Log of electricity consumption by households	NV	NV	NV	-1.217*** (0.069)	-0.649*** (0.176)	-0.806*** (0.144)		0.143** (0.075)	
Electricity losses in total supply (% 0-100)	-0.094*** (0.013)		0.049** (0.022)	-0.039*** (0.009)	0.030** (0.012)	0.126*** (0.018)			-0.05*** (0.014)
Log of GDP per capita	0.617*** (0.046)	0.865*** (0.177)	1.263*** (0.164)	0.925*** (0.041)	1.361*** (0.145)	0.926*** (0.146)	-0.107*** (0.026)	-0.277*** (0.066)	-0.394*** (0.088)
Constant	12.592*** (0.767)	5.470*** (2.052)	15.555*** (1.861)	14.088*** (0.625)	7.608*** (1.469)	9.035*** (1.279)	-1.525*** (0.402)	-0.911** (0.534)	-1.907** (1.026)

Coefficient that is significant at \*\*\* 1% level, \*\* 5% level, \* 10% level.

Standard errors are shown in parentheses () under coefficients.

NV: Not a variable in this model.

It is not easy to draw conclusions about the impact of extensive electricity market reforms in various countries from empirical work that focuses on a single market or from other country-specific anecdotal discussion of reform processes because neither type of study distinguishes the effects of reform from country-specific features. Therefore, our empirical approach was to take advantage of the diversity in electricity reform patterns in various countries and to control for a number of potential explanatory variables to predict three indicators: *electricity price-cost margin for households*, *electricity price-cost margin for industry* and *industrial/residential price ratio*. Panel analysis of price-cost margin and industrial/residential price ratio trends (using reform indicators, country macroeconomic and other structural features) offers objective evidence on the observed impact of reforms at a macro level.

### **3.7 Discussion of the results**

The empirical results presented above are consistent with our hypotheses. So, we fail to reject our hypotheses. Reviewing our findings in more detail and in relation to the research hypotheses, we find that individual reform steps have statistically significant impact not only on price-cost margins for both industrial and residential consumers (Hypothesis 1) but also on industrial/residential electricity price ratio (Hypothesis 2). When we look at the results, we see that the signs of the coefficients for variables representing various reform steps differ in each model, meaning that we cannot observe a uniform pattern concerning the impact of individual reform steps on price-cost margins and industrial/residential price ratios, that is, different reform steps seem to have different impacts on price-cost margins and industrial/residential price ratios. The interpretation of the results in detail and their policy implications are provided in the following sub-sections.

### **3.7.1 Impact of reforms on price-cost margins for industry**

In the first group of models, our empirical findings suggest, first, that existence of independent power producers (IPPs) and electricity price-cost margins are negatively correlated for industrial users, meaning that participation of IPPs into generation market decreases price-cost margins, especially in developed countries and developing countries in America. Second, existence of wholesale electricity markets seems to decrease price-cost margins in developing countries in America while it has an increasing effect in other developing countries. Third, we could not detect statistically significant results for choice of supplier and unbundling. Only exception is that unbundling alone is found to increase industrial price-cost margins in other developing countries. However, with regulator, it has a decreasing effect. Similarly, unbundling alone does not have a statistically significant impact on industrial price-cost margins in developed countries; however, with privatization, it has a decreasing impact. Fourth, our analysis reveals that privatization and market regulator have statistically significant impacts only in developed countries. On their own, privatization increases industrial price-cost margins while existence of an electricity market regulator decreases them. If they exist together, they raise industrial price-cost margins in developed countries.

Based on results from the first group of models, we clearly fail to reject Hypothesis 1 for industrial electricity price-cost margins. That is, industrial electricity price-cost margins are clearly affected as countries introduce reform steps. Since Hypothesis 1 is both an immediate application of the relevant economic theory (theory of regulation, agency and public choice theories) and a direct parallel with the empirical findings reported in the literature we summarized in Section 3.2, we may conclude that theory of regulation, agency and public choice theories are applicable to the study of the impact of reforms on price-cost margins and

that our findings confirm and strengthen the empirical findings reported in the previous literature that the reforms are correlated with price movements in electricity markets.

The policy implications of these results may be summarized as follows. If a developed country wishes to reduce price-cost margins for industrial consumers, it should introduce IPPs and set up a market regulator in its power market and implement privatization and unbundling together. In developed countries, privatization without unbundling results in an increase in price-cost margins for industry. On the other hand, a developing country in America with the same objective should concentrate on introduction of IPPs, as this is the only reform step that reduces price-cost margins for industry; and definitely avoid setting up a wholesale market, which rises price-cost margins for industry. However, in other developing countries, existence of a wholesale electricity market seems to reduce price-cost margins for industry. Besides, in other developing countries, unbundling with regulator also reduces the margins while unbundling alone increases them.

### **3.7.2 Impact of reforms on price-cost margins for households**

Unlike the first group of models, we could not detect any significant impact of IPPs on price-cost margins for households in the second group of models. This result suggests that IPPs affect industrial prices only. When we take into account the fact that IPPs usually sell the electricity they produced to large industrial consumers, this result seems reasonable. Second, the establishment of wholesale electricity markets has a decreasing effect on residential price-cost margins in other developing countries. Third, choice of supplier seems to increase residential price-cost margins in other developing countries. Fourth, on their own, unbundling and privatization raise residential price-cost margins. However, with privatization, unbundling has a decreasing effect on residential price-cost margins in developing countries in America.

Fifth, existence of a market regulator reduces residential price-cost margins in developing countries in America.

Similar to the results from the first group of models, those from the second group of models fail to reject Hypothesis 1 for residential electricity price-cost margins. That is, residential electricity price-cost margins are also affected as countries introduce reform steps. Again, the results from the second group of models imply that theory of regulation, agency and public choice theories are relevant to the study of the impact of reforms on price-cost margins and that our findings verify and reinforce the empirical findings reported in the previous literature that the reforms are associated with price movements in power markets.

The main policy implication from the results of the second group of models is that neither unbundling nor privatization alone reduces price-cost margins in developing countries in America. However, if they exist together, they cause a decline in price-cost margins for residential consumers. Existence of a market regulator further contributes to this trend. In other developing countries, wholesale electricity market again seems to be the key step to reduce price-cost margins for households.

### **3.7.3 Impact of reforms on industrial/residential price ratio**

The signs of the coefficients for variables representing various reform steps and their cross-products are important as they show how reforms have influenced the relative price of electricity for industrial and residential consumers. Any statistically significant positive coefficient for a specific reform step variable implies that this reform step resulted in an increase in the relative price of electricity for industrial consumers and a decline in the relative price of electricity for residential consumers. Likewise, a statistically significant

negative coefficient for a specific reform step variable means that this reform step resulted in a change in the relative price of electricity for the benefit of industrial consumers and at the expense of households.

Our results do not suggest a statistically significant impact of the existence of wholesale electricity market on industrial/residential price ratio. On the other hand, the results show that the existence of IPPs changes industrial/residential price ratio for the benefit of residential consumers in developing countries in America. In developed countries and developing countries in America, choice of supplier alters price ratio for the benefit of residential consumers while it reduces relative price of electricity for industrial consumers in other developing countries. Besides, unbundling or privatization changes industrial/residential price ratio for industrial consumers and against residential ones in developed countries and other developing countries. Market regulator also results in a change in price ratio for the benefit of industrial consumers in developed countries.

Based on results from the third group of models, we clearly fail to reject Hypothesis 2. Explicitly, power market reforms seem to have a statistically significant impact on industrial/residential electricity price ratios. So, according to our results, we confirm the correlation between electricity reform and industrial/residential price ratio. When we evaluate these results within the framework suggested by economic theory of regulation, it seems that the relative strength of industrial and residential consumers may be one of the determinants of the outcome of electricity market reforms. However, our results imply that different reform steps influence industrial/residential electricity price ratio differently. For instance, in developed countries, the existence of an electricity market regulator reduces the relative price of electricity for industrial consumers, which may mean that industrial consumers in developed countries have more influence on the regulator than residential ones and therefore

may manipulate it to put into practice policies that reduce the relative price of electricity for industrial consumers. On the other hand, our results show that choice of supplier reduces the relative price of electricity for residential consumers in developed countries, meaning that residential consumers may be more powerful in retail markets than the industrial consumers in developed countries.

The results above may have important policy implications. They present whether and in what direction a specific reform step affects industrial/residential price ratio. For instance, if the government of a developed country wishes to alter industrial/residential price ratio for the benefit of industrial consumers, it should introduce unbundling, privatization and market regulator into its power market and avoid choice of supplier.

#### **3.7.4 Results from control variables**

We observe a negative relationship between industrial electricity consumption and industrial price-cost margin. This result implies that as industrial electricity consumption rises industrial price-cost margins decline. Similarly, we see a negative relationship between residential electricity consumption and residential price-cost margins, which suggests that residential price-cost margins decline as electricity consumption by households increases. From a public policy perspective, the last two results imply that regulators should be vigilant and take corrective measures, if necessary, when electricity consumption declines as in such a case both industrial and residential price-cost margins tend to increase, signalling possible excess profits made by the regulated electricity utilities.

The results also show that any increase in electricity consumption changes industrial/residential price ratio for the benefit of residential consumers and at the expense of

industrial consumers in developed countries and developing countries in America. Electricity consumption does not have a statistically significant impact on price ratios in other developing countries.

We see a positive relationship between income level and industrial and residential price-cost margins in all countries, meaning that an increase in income level causes price-cost margins to increase. So, the regulators should be watchful when income level increases in a country as in such a case both industrial and residential price-cost margins tend to increase, indicating possible excess profits made by the regulated electricity utilities. Besides, income level is negatively correlated with industrial/residential price ratio in all countries. This result signals that an increase in income level changes relative electricity price for the benefit of industrial consumers and at the expense of households.

Proportion of electricity losses in total power supply has different impacts on industrial price-cost margins in developed and developing countries. In developed countries, it decreases industrial price-cost margins while the opposite holds true in developing countries. As for the impact of electricity losses on residential price-cost margins, it seems to have an increasing impact for developing countries and decreasing one in developed ones. The last two points show that it is more costly to decrease losses in developing countries. Any effort by an electricity utility in a developing country to reduce losses may mean a decline in profit (i.e. price-cost margins). In order to encourage electricity utilities to reduce losses, regulators in developing countries should take additional measures as electricity utilities are very unlikely to take measures to reduce losses if there is no additional motivation provided by the regulators.

Our findings also reveal that the proportion of electricity losses in total supply is negatively correlated with industrial/residential price ratios in other developing countries. So, any increase in electricity losses in total supply changes price ratios for the benefit of industrial consumers in other developing countries.

It should also be mentioned that dummy variables representing various reform steps have relatively weaker impact on price-cost margins and industrial/residential price ratios in almost all models. Based on our results, we may argue that electricity consumption, income level and network losses are more influential in explaining price-cost margins and industrial/residential price ratios than reform process. Finally, we see that country specific features tend to have a high power in explaining price-cost margins and industrial/residential price ratios.

We considered adding another variable into our analysis, called “number of years passed since reforms started”, to measure the impact of the time since reforms were implemented. However, when we do so we face with two important problems. First of all, since our dataset is panel and covers the period 1982-2009, the values of this variable for pre-reform periods is not clear. For instance, the reforms started in the UK in 1989; therefore such a new variable takes the values 1 for 1990, 2 for 1991 and so on for the UK. However, for 1982, it should take either -7 (meaning 7 years left until reforms started) or 0 (representing reforms have not started yet). Second problem relates to the problem of multicollinearity. Since the new variable increases each year, it is highly correlated with other variables that usually increase year by year such as electricity consumption and income level; and therefore its inclusion results in multicollinearity problem in our models. When we estimate our regressions twice by adding two versions of this new variable, one for each method to deal with pre-reform years; in both cases, we noticed not only that the coefficient of this new variable is not significant

even at 10% significance level but also that inclusion of this variable makes some of the previously significant variables insignificant. Multicollinearity may explain why the inclusion of new variable makes some of the previously significant variables insignificant. Therefore, based on the results from re-estimated regressions, we decided not to include this new variable into our analysis.

To summarize, based on our results, we could not argue that the reform process as a whole decreases or increases price-cost margins and changes industrial/residential price ratios towards a specific direction. Individual reform steps have diverse impacts on the price-cost margins and industrial/residential price ratios in different countries. However, our results clearly show that reform steps have a statistically significant impact on both price-cost margins and industrial/residential price ratios.

### **3.8 Conclusion**

The true value of electricity reform is a matter of empirical testing rather than theoretical debate. Opponents of the reform may point to spectacular reform failures (e.g. California disaster), or its advocates may try to get general conclusions from some success stories of a few reforming countries (e.g. NordPool). However, what is really needed is a complete study of the impact of reforms within the context of a well-defined model construction. Besides, today, there are data on electricity market reforms going back about three decades and available data start to let us meaningfully establish which market model and industry structure optimize social welfare. This study tried to fill the gap by offering a macro level econometric analysis on the possible effects of reform process on electricity price-cost margins and industrial/residential price ratios.

Relevant economic theories and previous empirical research indicate that electricity prices are affected by the reforms. In this paper, we tried to find out whether this connection holds true when we take into account the fuel costs. Moreover, we also investigated whether there is a correlation between electricity reform and industrial/residential price ratio. Throughout the study, we focused on these issues by using empirical econometric models to observe the impact of electricity market reforms on price-cost margins and industrial/residential price ratios. Panel data from 63 countries covering the period from 1982 to 2009 were employed. As a result of the study, we could not detect a uniform pattern for the impact of reform process as a whole on price-cost margins and industrial/residential price ratios. Our results suggest that each individual reform step has different impact on price-cost margins and industrial/residential price ratios for each consumer and country group. In a word, our findings imply that similar reform steps may have different impacts in different countries, which supports the idea that reform prescription for a specific country cannot easily be transferred to another one with similar success. Therefore, while deciding whether to initiate a reform process *or* in the process of making decisions on the direction of an already initiated reform process, policy makers should take into account the fact that each reform step has a specific impact in each country based on each country's specific circumstances. More than that, countries that try to adopt the power market structure of another country (for example, the adoption by developing countries of electricity industry model similar to the UK) will have very different performance characteristics than the original country because their country-specific conditions will be different. The main implication of our results is that transferring the formal and economic structure of a successful power market in a developed country to developing countries is not a sufficient condition for good economic performance of the electricity industries in developing countries.

Our conclusions do not necessarily involve a judgement on the overall success *or* failure of the reform process. The change in electricity price-cost margins and industrial/residential price ratios is just one of the impacts of the reform and the process should be judged based on its overall impact (not only its impact on price-cost margins and industrial/residential price ratios). What's more, it may well be argued that the reform process has just started or is still under progress in many countries and today it is too early to measure its impact on price-cost margins and industrial/residential price ratios.

Electricity reform is also usually a part of wider economic liberalization program in general and energy industry reform 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. That is, power sector reform is highly inter-dependent with wider reforms in other sectors of the economy and failure to harmonize inter-sector reforms may lead to power sector reform measures being ineffective. The success of power sector reforms especially in developing countries largely depend on the extent to which inter-sector reforms in the economy are synchronized. We did not take into account possible spill-over effects from or to other energy and non-energy sectors in this research mainly due to lack of essential data. It may however be argued that our results are not comprehensive because of the lack of investigation of the impact of inter-reform relationship on electricity price-cost margins and industrial/residential price ratios.

The arguments above and similar ones cannot be rejected straight away. Moreover, it is obvious that present econometric evidence on the impact of the reform process is quite limited. So, there is a definite need for the continued analyses of the effect of reforms in the electricity industry. Much work needs to be done and there are ample opportunities for

research in this area. In many countries, power market reform is still an on-going process, a fact that also underlines the need for continued and up-to-date study. We believe that panel datasets rather than simple cross-section models should be used in future studies, preferably including pre- and post-reform data. Furthermore, so far, most of the studies have focused on a single reform element or outcome (e.g. reform steps, prices, performance, costs and so on) but there is a need for cross-country econometric studies measuring overall impact of the reform process.

We admit that power market reform is complex and the evidence is difficult to evaluate. We also recognize that it is too early to reach any concrete judgment for future policy suggestions based on the results from this paper and other comparable studies. An exact reckoning of the long-term effects of reforms on price-cost margins and industrial/residential price ratios will require much additional study over longer periods of time.

# Chapter 4

## 4 Paper Two

### **A cross-country analysis of electricity market reforms: potential contribution of New Institutional Economics**

#### **4.1 Introduction**

One of the main objectives of any economic reform is to bring changes in the institutional arrangement so that economic activities can be performed more efficiently. Besides, reforming any sector in an economy requires changing the institutional environment, changing the organisational structure and modifying the governance mechanism. Since the late 1980s, power market reform has become the standard prescription of the multilateral donor agencies like the IMF and the World Bank and the reform program has been implemented vigorously for about three decades now. Although the content of each reform program has differed from one country to another, the policy of functional disintegration, the establishment of regulatory authorities, the formation of wholesale and retail power markets and the privatization of the electricity industry have been generally regarded as the natural

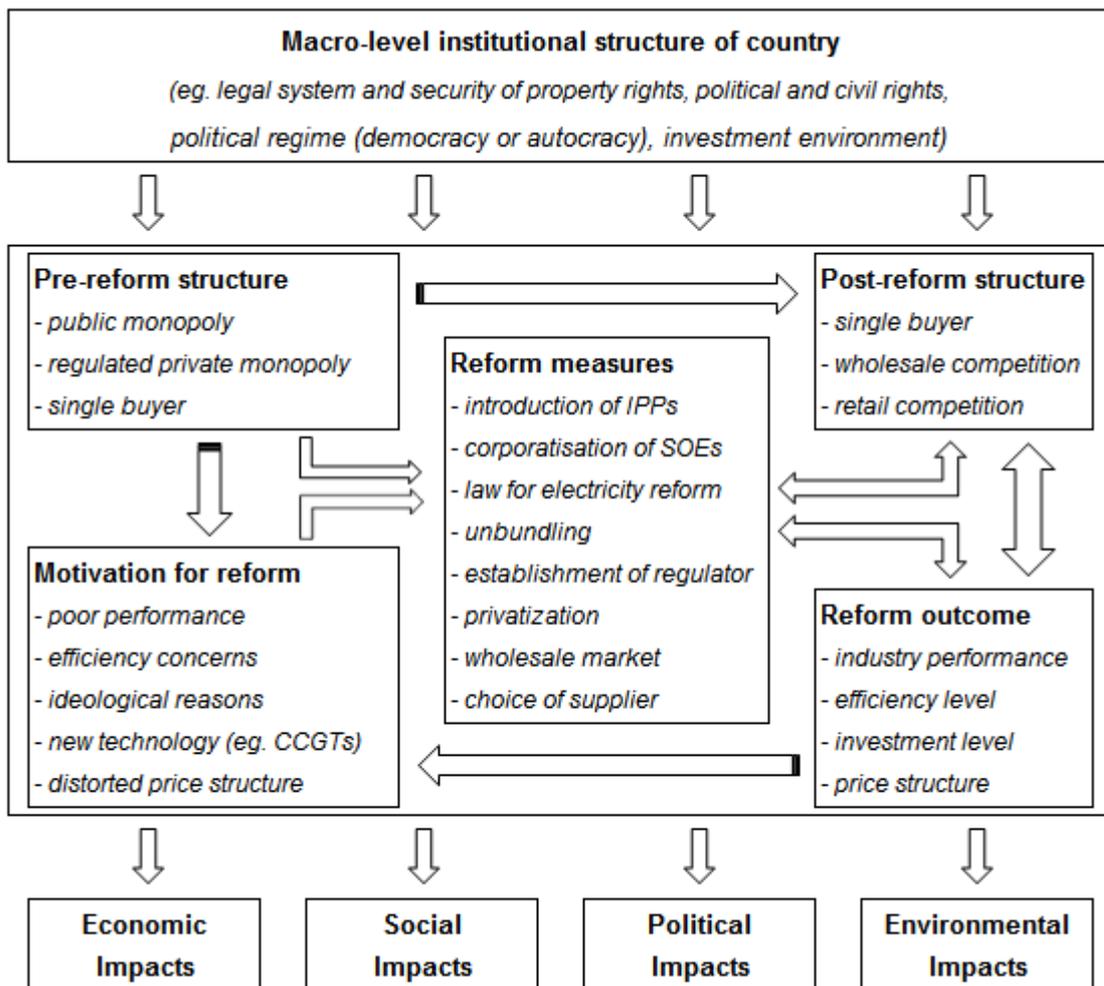
components of a reform program without paying much attention to the institutional environment of the country.

Figure 4.1 presents the relationship between institutional structure and reform process. As can be seen in Figure 4.1, whole reform process takes place and is directly affected by the macro level institutional structure of the country in which the reforms are put into practice. The examples of macro level institutional structure of a country include its legal system, measures that guarantee security of property rights in this country, the degree of political and civil rights provided by the political regime, investment environment in the country and so on. Through reform measures, the pre-reform structure of a power market is transformed into post-reform structure. In general, pre-reform structure corresponds to public monopolies or regulated private monopolies and post-reform structure refers to a competitive electricity market where competition at retail or, at least, wholesale level is possible. Throughout the paper, the concept of “reform” refers to a specific process started in Chile in 1982 for the first time; so, we consider “regulated private monopoly” in pre-1982 period as a form of regulation, not reform. Usually, post-reform structure has some undesirable features that trigger further reforms in the power market. So, post-reform structure of the previous wave of reforms constitutes the pre-reform structure of the latter wave of reforms and the process goes on as such. These cycles of reforms produce economic, social, political and environmental impacts, which may have an impact on the decisions concerning the direction of reforms.

Today, most countries have initiated some reform of their power sector despite the fact that not much progress has been made in many parts of the world, especially in developing countries. As reform pauses or progresses slowly, developing countries in particular face problems such as lack of adequate funding for new capacity addition, neglect of utility operation and management, and increase in government involvement in the management and

decision-making of the industry, contrary to the expected objectives of the reform (Bhattacharyya, 2007a).

**Figure 4.1** The relationship between institutional structure and reform process



The purpose of this paper is to find out whether the question of why some countries are able to implement more extensive reforms is closely related to the question of why some countries have better institutions than others. This paper develops the empirical case that differences in institutions are the fundamental cause of differences in the extent of the reforms implemented in each country. In this paper, we focus only on the impact of institutional factors on the reform progress while the third paper investigates the impact of political economic environment on the reform progress. For instance, the impact foreign influence originating

from foreign financial aid and/or assistance by international donor agencies (e.g. World Bank) is studied in the third paper.

The interest and motivation for this topic arises from the relatively recent agreement that has emerged among scholars in regarding institutions as a key factor shaping the outcome of an economic transformation. This objective is pursued by discussing implications of the conceptual framework proposed by the New Institutional Economics for power market reform. Besides, evidence resulting from an econometric empirical analysis that investigates the relationship between institutions and reforms is presented as well.

The reform experience so far (especially in developing countries) suggests two consistent findings. First, institutional endowments of a country (such as judicial independence, integrity of the legal system, protection of property rights, legal enforcement of contracts and degree of polity) largely determine the extent of the reforms (Acemoglu et al., 2008; Acemoglu et al., 2001, 2005). Second, despite the different approaches in the design of regulatory institutions, a separate agency from the government with reasonable levels of autonomy and technical expertise has emerged as the preferred model for a regulatory institution. Due to path dependency, the chairperson of electricity market regulatory agency when reforms started or were considered and the governor/minister responsible for energy policy at that time may play a critical role in the process. Therefore, in this study, we focus on general institutional endowments and backgrounds of the chairperson and the minister/governor as key factors explaining differences in the extent of the reforms implemented in various countries.

We try to answer the following research questions: (i) do differences in institutional structures of countries play an important role in explaining how far reforms have gone in these countries? (ii) if they do, how do specific institutional endowments of a country affect its

reform performance? (iii) does the background of the chairperson of the regulatory agency when reforms started or were considered or that of the governor or minister responsible for energy policy at that time have an impact on reform progress?

At this point, it is important to note that we focus on “reform progress” rather than “reform success” in our study. In our analysis, the term “progress of reform” does not indicate an assessment of success; and the phrase “progress in reform process” constitutes an evaluation of the extent of the reform at one point in time, rather than the change in the extent of the reform over a period of time.

The paper proceeds as follows. The next section provides a conceptual framework and literature review on the New Institutional Economics. Section 4.3 develops research hypotheses. Section 4.4 summarizes the methodological framework. Section 4.5 and Section 4.6 describes data and presents empirical analysis, respectively. Following section discusses the results. The last section concludes.

## **4.2 Conceptual framework and literature review**

In recent years the role of institutions in promoting and sustaining economic change has been an issue of interest for both theoretical and empirical analyses. The main question is “what determines the divergent patterns of evolution of countries or economies over time?” Africa’s disappointing economic performance, the East Asian financial crisis, and the weak record of the former Soviet Union have also contributed to an increasing focus on the role of institutions in determining a country’s economic growth and performance (Aron, 2000). Within this context, New Institutional Economics (NIE) has emerged as the body of economic thought that considers institutions to be relevant to economic theory, and criticizes the neo-

classical mainstream for having pushed them out of the discipline; it deals especially with the nature, origin and evolution of institutions, and their effects on economic performance (Chavance, 2009).

The increasing focus on NIE is also evident in World Bank publications. World Bank (1997, 2002) recommends that states develop strong regulatory mechanisms to encourage legal accountability, minimize corruption, and foster competition via privatization. The World Bank regards privatization as a solution to rent-seeking behaviour of corrupt officials. In response to the bureaucracy's drain on public resources, competition, it is argued, will raise the transaction cost of seeking protection and subsidy from the state, and henceforth promote efficiency between firms.

Presenting an extensive literature review on NIE is both outside the scope of this paper and not possible given limitations on the length of the study. Therefore, in this section, we summarize the main characteristics of NIE, mention its difference from "old" institutional economics, review central themes in NIE (such as property rights, transaction costs, path dependency and the difference between institutions and organizations) and cite main criticisms against it. Appendix II-1 presents some examples of empirical work based on NIE. Although there is some academic work that investigates the impact of institutions on electricity market reform practices (e.g. Haney and Pollitt, 2011); to the best of our knowledge, this study constitutes the first empirical work that focuses on the possible implications of NIE for electricity market reform.

Oliver Williamson is the inventor (in 1975) of the term 'new institutional economics', which from the 1990s on came to refer to idea that 'institutions matter' and that these can be analysed (Chavance, 2009). New institutional economics abandons the standard neoclassical

assumptions that individuals have perfect information and unbounded rationality and that transactions are costless and instantaneous (Ménard and Shirley, 2008). The NIE starts from the reality that information is rarely complete, and transactions thus have costs associated with them, such as costs of finding out what the relevant prices are, of negotiating and of concluding contracts, and then of monitoring and enforcing them. Institutions are broadly defined as means of reducing these information and transaction costs (Harriss et al., 1997). So, the NIE can be seen as a development of neo-classical economics to include the role of transaction costs in exchange and so to take account of institutions as critical constraints on economic performance. For new institutionalists, the performance of a market economy (or scale and scope of an economic reform process) depends upon the formal and informal institutions and modes of organization that facilitate private transactions and cooperative behaviour.

Douglass North is a particularly significant exponent of the NIE. The main message stemming from North's analysis is that institutions affect economic performance by influencing the level of transaction costs and, hence, the feasibility and profitability of engaging in economic activity. In other words, institutions determine the opportunity set and provide a stable structure to human interaction by reducing uncertainty (North, 1990). For him, institutions are not necessarily or even usually created to be socially efficient; rather they are created to serve the interests of those with greater political and economic power (Acemoglu et al., 2005).

The NIE is 'new' because there is an older school of institutionalism in economics. The old institutionalists (e.g. Thorstein Veblen, John R. Commons, Wesley Mitchell, Clarence Ayres) did not attribute so significant and beneficial a role to rational choice, scarcity and competition as orthodox economic theory did. The assumption of standard economic theory that transaction costs were zero was a great analytical convenience and, for a long time, went

largely unquestioned. Upon pushing the logic of zero transaction costs to completion, however, serious gaps, errors, and anomalies were exposed by Ronald Coase, who was the first to perceive and demonstrate the conceptual problems that resided therein (Ghertman and Ménard, 2009). Therefore, according to many scholars, the origins of NIE can be traced back to Coase (1937), whose most important message was that when it is costly to transact, institutions matter (Gagliardi, 2008). While the new institutionalists reject the neoclassical assumption of perfect information and instrumental rationality, they put more emphasis on orthodox assumptions of scarcity and competition than the old institutionalists did.

Having briefly mentioned the basic idea behind NIE let me focus on central themes in it. NIE assumes the existence of a fundamental relationship between property rights and transaction costs, on the one hand, and property rights and institutions, on the other. The establishment and maintenance of property rights entail transaction costs and property rights are institutions by themselves (Musole, 2009). So, property rights, which define the use, income rights and transferability of assets, constitute the core of the economic institutions; and the concept of transaction costs is central to the discussion of property rights. When rights are not clearly defined, transaction costs increase and market failures occur. For new institutionalists, the aim of institutions is to reduce transaction costs so as to allow agents to seize on economic opportunities, and an efficient institution is simply an arrangement that minimizes such costs, or one which maximizes the joint wealth of all the parties concerned net of transaction costs (Brousseau and Glachant, 2008).

Actually, there is no consensus on how transaction costs should be defined. Instead, several definitions exist in the literature. For example, transaction costs have variously been defined as the cost of using the price mechanism; the costs of exchanging ownership titles; the costs of running the economic system; the costs associated with the transfer, capture and protection

of rights; the costs of measuring valuable attributes of that which is being exchanged, as well as the costs of monitoring and enforcing agreements; the ex-ante costs of drafting, negotiating and safeguarding an agreement and the ex-post costs of haggling, contract governance, and bonding costs to secure commitment, the resources used to establish and maintain property rights; or simply the ‘economic equivalent of friction in physical systems’ (Musole, 2009).

North (1990) considers transaction costs as partly market costs and partly the costs of time that each party must devote to gathering information, to searching, and so on. In addition to this categorisation, North mentions a type of transaction cost that does not go through the marketplace, called “non-market transaction costs”. This type of transaction cost includes not only the high costs of searching where information is not efficiently distributed, and the substantial costs of undertaking economic activity in compliance with rules and regulations; but also the costs of queuing, bribing officials, cutting through red tape, time involved in obtaining permits to do business, and so forth. Besides, it is argued that transaction costs not only exist but also they are huge. It is thought that transaction costs may represent about 50-60% of net national product of modern market economies. In less developed economies, transaction costs are thought to make up an even higher fraction of the overall GDP, and sometimes no exchange takes place due to these high costs (Musole, 2009).

Another central theme in NIE is path dependency. For institutionalists, the process of institutional change is incremental and largely path dependent. Path dependence implies that if the process that leads to the emergence of a particular set of institutions is relevant and constrains future choice, then not only history matters but, more important, poor performance and long-run divergent patterns of development are determined by the same source. Path dependence may explain why some countries succeed and others do not (Gagliardi, 2008). So, path dependency is a process that can lead either to good or bad outcomes. Therefore, getting

the institutions right is critical because getting them wrong can lead to path-dependency, whereby inefficient economic systems persist. Relatively inefficient paths can, for example, be persistently followed over fairly long historical periods. In fact, according to North, this is the case most frequently found in history (North, 1990). The NIE approach suggests that the differences in economic performance are related to institutional endowments. The economic performance of a country depends on whether an independent judiciary, clearly defined property rights, control structures for enforcing property rights and enforceable contracting arrangements exist or not. Given the institutional environment, the opportunities provided by the institutional environment will be reflected in the nature and performance of organisations that develop. Hence transition from one state to another is constrained by the institutional arrangements (Bhattacharyya, 2007a). In short, NIE maintains that once an economy is on an “inefficient” path that produces stagnation it can persist (and historically has persisted) because of the nature of path dependence.

Unlike ‘old’ institutional economics, North (1990) states that it is essential to distinguish institutions from organizations. For him, if institutions are the rules of the game, organizations and their entrepreneurs are the players. Organizations are groups of individuals bound by some common purpose to achieve objectives. They include political bodies (e.g. political parties), economic bodies (e.g. firms, trade unions, regulatory agencies), social bodies (e.g. clubs, associations) and educational bodies (e.g. schools, universities). Moreover, North (1990) argues that institutions and organizations are interdependent entities. The institutional framework determines the opportunities in a society and the emergence and evolution of certain organizations. In turn, organizations influence how institutions evolve, thus being agents of institutional change.

As mentioned before, there is no previous empirical study that applies NIE approach to the analysis of power market reforms, so we cannot provide a review of previous studies similar to this one. Appendix II-1 presents details of some examples of applied work based on the NIE approach, including hypotheses tested, dependent variables, explanatory variables, results, data and methodology. Appendix II-2 classifies these studies by their focus. Besides, in applied NIE studies, various variables are used to measure different aspects of institutional structure. Basically, there are three aspects of institutions: the presence of institutions, the organization (or form) of institutions or the outcome of institutions. The presence of institutions concerns whether specific institutions exist, without paying attention to their organization or outcome. The organization (or form) of institutions is to do with the way institutions are actually operated. The outcome of institutions is to do with an overall assessment of the impact of the institutions on the performance of the countries or industries (Green et al., 2009). Variables in previous studies either measure one of these aspects or are used as control variables. Appendix II-3 presents variables employed in previous econometric studies by what they measure.

The examples of the previous studies listed in Appendix II-1 show 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 provided by NIE.

### **4.3 Hypothesis development**

The literature that we summarized above 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, as we mentioned in the previous section, 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), Keefer and Knack (1997), Persson and Tabellini (1994), Spindler (1991) and Vanssay and Spindler (1994). In short, the NIE approach suggests that the differences in performances of different reform processes are related to institutional endowments. This section of the paper develops three hypotheses derived from the NIE approach, which are then tested empirically in the next sections of the paper.

#### **4.3.1 Hypothesis on the background of key policy makers and implementers**

One of the main repercussions 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.

The ministers responsible for energy-related issues in countries or governors in US states or Canadian provinces 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 and 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. To sum up, the educational and professional backgrounds of energy minister and regulator played an important role in the reform progress in Argentina and the UK, respectively.

As summarized in Dreher et al. (2009), there is also a growing literature connecting personal traits of policy makers and implementers with policy outcomes. Jones and Olken (2005) find that unpredictable changes in a country’s leadership due to the incumbent’s death can trigger changes in gross domestic product growth. Göhlmann and Vaubel (2007) provide recent empirical evidence on the impact of education and profession on policy. Their results show that education and profession of the central bank’s governing council members matter for the effectiveness in controlling inflation. Regarding education of policy makers, Duflo (2005) shows that reservation of political power for historically disadvantaged groups and women in India does not come at the expense of the quality of decision making, even though reservation brings to power a group of relatively inexperienced and less educated politicians. Besley et al. (2005), to the contrary, use household survey data from India and find that differences in the performance of Indian village politicians are systematically linked to politicians’ education. This evidence leads a corresponding World Bank (2005) report to conclude “that more educated politicians are better” adding to “a growing appreciation among economists that education [of politicians] may be important because of its role in inculcating civic values.” Besides, previous research suggests that policy outcomes may depend on the time a politician

spends in office. For example, Roubini and Sachs (1989) suggest that there is a tendency towards larger deficits in countries characterized by a short average tenure of government.

To sum up, policy makers decide on policies and reform strategies and policy implementers put them into practice. When it comes to designing and implementing a reform policy, politicians' education and professional experience is likely to be important. As Kotsogiannis and Schwager (2006) maintain, "the implementation of new and unknown policies is more demanding than running 'business as usual' since it requires imaginative leadership on the part of a governor, rather than operational routine." Politicians with a certain educational or professional background may be more likely than others to demonstrate such kind of leadership. These politicians thus may have an advantage in fostering reforms. According to Rajan (2004), for example, the "gains from reform are never as clear to the wider public as they are to economists." Hence, reforms might be delayed due to a lack of understanding and education. Some background education in economics could be advantageous for politicians in implementing reforms as they are more likely to distinguish good from bad advice and might be more able to resist the pressure of lobbying groups preferring the status quo. This knowledge might bring them into a better bargaining position as well. They might also have an advantage in communicating the consequences of reforms to the public and the parliament, thus decreasing uncertainty and overcoming the deadlock (Dreher et al., 2009). These considerations lead us to posit the following hypothesis.

***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 have an impact on overall reform progress.*

The New Institutional Economics and the literature summarized above suggest that personal qualifications may matter for the reform progress and some applied studies mentioned above confirm this. In our analysis, we check whether this is also the case for the electricity industry. We do not support or oppose the idea that personal qualifications are important determinants of any reform progress. Hence, Hypothesis 1 is both an immediate application of the NIE and a direct parallel with the empirical findings reported in the literature we cited above. While examining the relationship between the backgrounds of policy makers and implementers and electricity market reforms, the latter (dependent variable) is represented by the electricity market reform score variable. On the other hand, variables on experience, length of term, education level and educational background of chairpersons and ministers constitute causal variables that represent backgrounds of policy makers and implementers. The details of these variables are provided in the following sections. Like most of other similar analyses; we assume that experience in the industry, length of term, education level, educational background reflect personalities of policy makers and implementers. Of course, there may be some other relevant aspects of the personalities that cannot be measured. However, since we cannot measure such aspects, we cannot include them into our analysis.

We expect a statistically significant relationship between the backgrounds of policy makers and implementers and electricity market reform progress; however, direction of this relationship cannot be predicted theoretically. So, we do not develop hypotheses on the direction of this relationship.

Appointment of regulators, their term time, salaries and additional benefits, rules concerning their removal and other characteristics of the office of regulators may be important determinants of the reform progress. However, these are usually not determined freely by countries. In the case of developing countries, establishment of regulatory institutions are

usually requested by international donor agencies (like World Bank and IMF); and in the case of EU member states, the EU requires them to set up regulatory agencies. Both international donor agencies and the EU also specify the characteristics of the office of regulators (their appointment, removal, term time, salaries, other benefits and so on). So, since characteristics of the office of regulators do not reflect genuinely the political attitudes in specific countries, we prefer not to include them into our analysis.

#### **4.3.2 Hypothesis on the impact of democracy on the reforms**

According to the NIE theory, institutions are means of reducing information and transaction costs related to reform design and implementation; and they may easily turn into critical constraints on reform performance if not taken into account properly. So, 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. Besides, the NIE approach maintains a fundamental relationship between property rights, transaction costs and institutions. Institutional environments that fail to offer credible commitments against arbitrary changes in the rules of the game, including expropriation, raise transaction costs throughout the economy. Also, when property rights are not clearly defined in the course of an electricity market reform, transaction costs increase and reforms may fail. In this context, democracy is one of the most important institutions in a country that determines the credibility of commitments concerning property rights and transaction costs; and therefore, is expected to influence power market reforms. Based on the considerations above, we develop the hypothesis below.

***Hypothesis 2:** The level of democracy in a country has an impact on reform progress.*

This hypothesis is an immediate application of the New Institutional Economics. According to NIE approach, the progress in electricity market reforms constitutes a possible outcome and the level of democracy in a country may be one of the determinants of this outcome. By developing this hypothesis, we check whether this correlation actually exists. While examining the relationship between the level of democracy and electricity market reforms, reform progress is represented by the electricity market reform score variable while the level of democracy is signified by two variables, namely political rights score and civil liberties score. The details of these variables are provided in the following sections.

Democracy is a form of government in which all eligible citizens have an equal say in the decisions that affect their lives. Democracy allows eligible citizens to participate equally - either directly or through elected representatives- in the proposal, development, and creation of laws. So, democracy enables both pro- and anti-reform groups to voice their concerns about power market reforms. Therefore, the direction of the impact of democracy on electricity market reforms depends on the composition and relative strength of interest groups in each country, and therefore, cannot be established theoretically.

#### **4.3.3 Hypothesis on the impact of corruption on the reforms**

NIE suggests that the standard neoclassical assumptions that we have perfect information and unbounded rationality and that transactions are costless and instantaneous should be abandoned while analysing reforms in electricity markets. 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. NIE pays attention also to non-market transaction costs faced by the firms. In addition to the costs of searching where information is not efficiently distributed and undertaking economic activity in compliance with rules and regulations; this type of transaction cost includes the cost associated with corruption in a country (e.g. bribing officials to cut through red tape). Besides, the literature on the factors that influence the decision to reform an infrastructure industry by introducing competition has emphasized the role of corruption of the political system. For instance, Emerson (2006) develops a model where rent seeking firms agree to pay bribes to policy makers to limit market entry. Since corruption increases transaction costs in a country, we expect a negative relationship between the level of corruption and reform progress. Therefore, we suggest the following hypothesis.

***Hypothesis 3:** Countries with relatively high corruption tend to introduce less electricity market reforms.*

This hypothesis is also an immediate application of the New Institutional Economics. While examining the relationship between corruption and electricity market reforms, reform progress is represented by the electricity market reform score variable while corruption perceptions index represents the level of corruption in a country. The details of these variables are also provided in the next sections.

#### **4.3.4 Control variables**

Control variables are independent variables not directly related to the background of key policy makers and implementers, level of democracy or corruption; but still may explain a portion of the variations in reform progress. Along with the background of key policy makers and implementers, level of democracy and corruption; we expect that reforms may be affected

by the size of population, income level, investment environment, the level of authoritarianism and security of property rights in a country. We also expect that OECD membership may have an impact on the reform progress, and therefore include a dummy variable representing OECD membership into our analysis. The details of these variables are presented in the following sections, too.

#### **4.4 Methodology**

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) corruption perceptions index, civil liberties and political rights scores;
- (d) control variables (i.e. population, GDP per capita, dummy variable for being an OECD country, investment freedom index, polity score and property rights index).

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

$$\mathbf{E}(y | x_1, x_2, \dots, x_k) = \exp(\beta_0 + \beta_1 x_1 + \dots + \beta_k x_k) \quad (4.1)$$

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 4.1 shows that

$$\log[\mathbf{E}(y | x_1, x_2, \dots, x_k)] = \beta_0 + \beta_1 x_1 + \dots + \beta_k x_k \quad (4.2)$$

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

$$\% \Delta \mathbf{E}(y | x) \approx (100 \beta_i) \Delta x_i \quad (4.3)$$

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

Because Equation 4.1 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  $k = 0, 1, 2, \dots$

$$\Pr(Y = k) = \frac{\exp(-\lambda)\lambda^k}{k!} \quad (4.4)$$

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

$$\mathbf{E}(Y) = \text{var}(Y) = \lambda \quad (4.5)$$

Figure 4.2 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  $\mathbf{E}(y|x)$ . Then, the probability that  $y$  equals the value  $k$ , conditional on  $x$ , is (for  $k = 0, 1, 2, \dots$ )

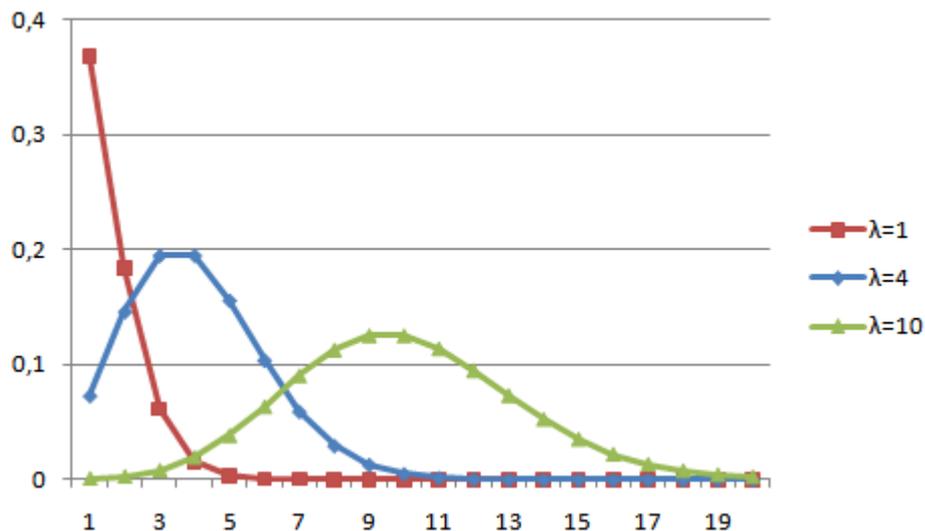
$$\Pr(Y_i = k | X_i) = \frac{\exp(-\lambda_i)\lambda_i^k}{k!} \quad (4.6)$$

$$\lambda_i = \mathbf{E}(Y_i | X_i) = \exp(\beta_0 + \beta_1 X_i) \quad (4.7)$$

$$\ln(\lambda_i) = \beta_0 + \beta_1 X_i \quad (4.8)$$

Here, the interpretation of  $\beta_1$  is that when there is a one unit increase in  $X_i$ , the percentage change of  $\mathbf{E}(Y | X)$  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 4.2** 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

$$\ln L(\beta_0, \beta_1; \{Y_i | X_i\}_{i=1}^N) \quad (4.9)$$

$$= \sum_{i=1}^N \ln \Pr(Y_i = y_i | X_i) \quad (4.10)$$

$$= \sum_{i=1}^N [-\exp(\beta_0 + \beta_1 X_i) + Y_i(\beta_0 + \beta_1 X_i) - \ln(Y_i!)] \quad (4.11)$$

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

$$= \sum_{i=1}^N [-\exp(\beta_0 + \beta_1 X_i) + Y_i(\beta_0 + \beta_1 X_i)] \quad (4.12)$$

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  $\beta_i$ .

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.

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).

#### **4.5 Overview of data**

Our data set is cross-section and covers 51 states in US, 13 provinces in Canada and 51 other countries<sup>12</sup>. In total, we have 115 potential observations for each variable. The sample countries and states in our analysis are determined by data availability. We have some missing observations in our dataset. We acknowledge that the states in US and provinces in Canada are not comparable to other countries. We are aware of the fact that analysing individual states and provinces together with countries create some practical and econometric problems.

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<sup>12</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.

To avoid these problems, we provide results with and without states in US and provinces in Canada separately.

The variables used in the study are electricity market reform score in 2011; 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; civil liberties score in 2011, political rights score in 2011; corruption perceptions index in 2010; population in 2010, GDP per capita in 2010, dummy for being an OECD country, investment freedom index in 2011, polity score in 2010, and property rights index in 2011. Table 4.1 shows descriptive statistics of the variables.

**Table 4.1** 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

<b>Variables</b>	<b># of obs.</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
<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>Other explanatory variables</b>					
Civil liberties score in 2011	115	1.60	1.15	1	6
Political rights score in 2011	115	1.62	1.32	1	7
Corruption perceptions index in 2010	115	6.37	2.06	2	9
<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
Investment freedom index in 2011	115	70.83	12.94	25	95
Polity score in 2010	114	8.79	3.13	-10	10
Property rights index in 2011	115	72.61	22.33	20	95

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

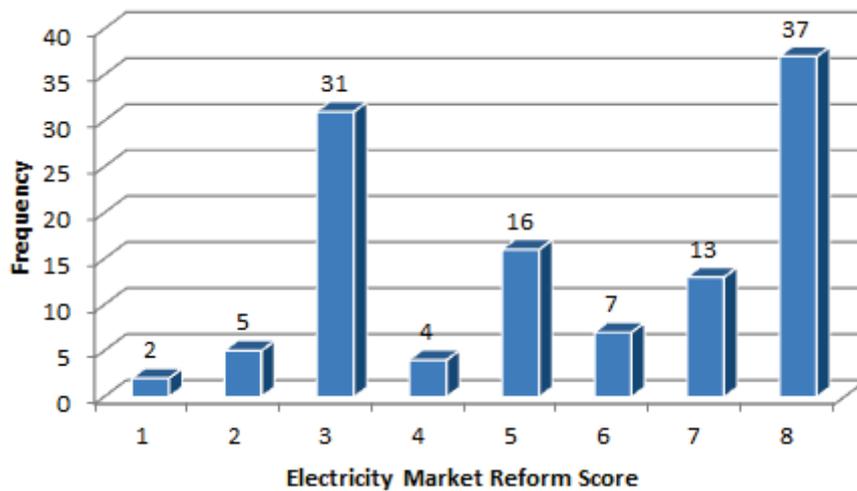
\*\* *Energy minister/governor* refers to the governor or minister who was responsible for energy policy when reforms started or were considered.

Electricity market reform score in 2011 variable 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>13</sup>. Figure 4.3 provides the histogram of the reform score variable

<sup>13</sup> The full list of sources from which data are obtained can be found at IERN web site (<http://www.iern.net>).

showing the frequency of observations while Figure 4.4 shows current status of electricity reform in US states (US EIA, 2010b). When we evaluate Figure 4.3, 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.

**Figure 4.3** Histogram of reform score variable



**Figure 4.4** Electricity reform in US states as of 2011

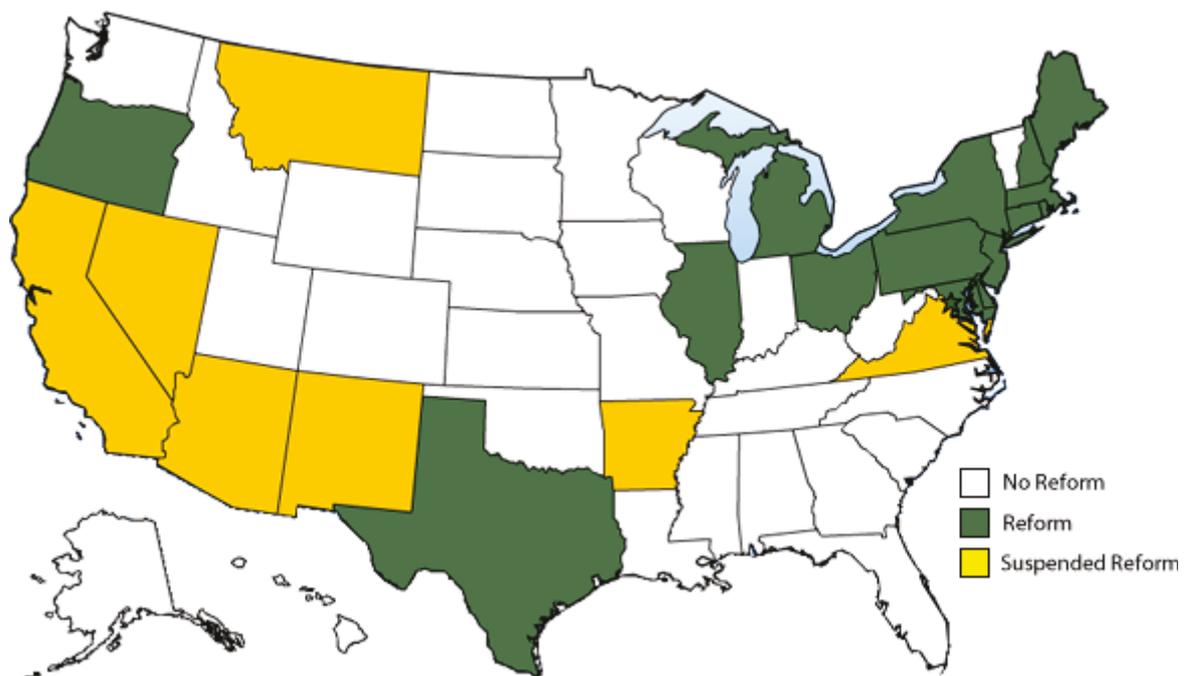


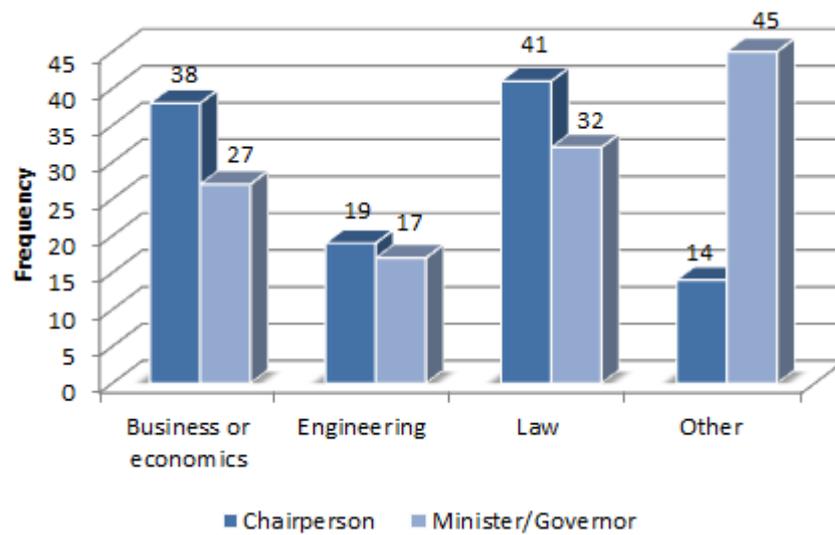
Figure 4.4 seems to confirm Paul L. Joskow's argument that the differences in electricity prices among US states explain why some US states introduce reforms and why others do not. As we mentioned in Section 2.2.1, Joskow argues that there are fairly dramatic differences in the electricity prices across US states and, in high-price states, there are strong incentives for consumers, and certainly for new producers, to press for reforms that provide competitive entry and possibility of price reductions (White, 1996). So, he maintains that states only with high electricity prices have an incentive to introduce reforms in the US and those with relatively low prices do not have such an incentive and therefore do not introduce reforms. Joskow (2000) shows that the states in the Northeast and California had much higher prices than the average for the rest of the country; and therefore, they were the first states to restructure their power sectors in 1996 and 1997. White (1996) also provides evidence that the states with relatively high electricity prices introduced reforms and differential prices explain the pattern of electricity reform in the US.

Some countries considered introducing electricity market reforms but decided not to implement such reforms in their power markets. Some other countries also considered implementing reforms and decided to do so. For reforming countries, we collected data on the background of the chairperson of electricity market regulatory agency **when reforms started**, and the governor or minister who was responsible for energy policy at that time. For non-reforming countries, we collected data on the background of the chairperson of electricity market regulatory agency **when reforms 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). Here, two points are important. First, in our study, the length of term refers to time period that the regulator or minister/governor remained in office after the reforms started or were considered. Second, we are only interested in the regulators or ministers/governors when the reforms started or were considered; and collected data on their background. We are not interested in the regulators or ministers/governors in office when the data were collected, and our dataset do not include observations on them.

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. In a very limited number of countries and for the last few years, there is a chief executive in regulatory institutions together with the chair of the agency. Since we concentrate on the chairperson of the regulatory agency when reforms started (which is usually 1990s), there was almost no chief executive at that time in regulatory institutions. In very few cases, there were chief executives when reforms started, and in these cases, we ignore them and concentrate on the chairs. Figure 4.5 shows the number of chairpersons and ministers/governors in the sample countries by their educational background while Figure 4.6 presents this by education level.

**Figure 4.5** Educational backgrounds of chairpersons and ministers/governors



**Figure 4.6** Education level of chairpersons and ministers/governors

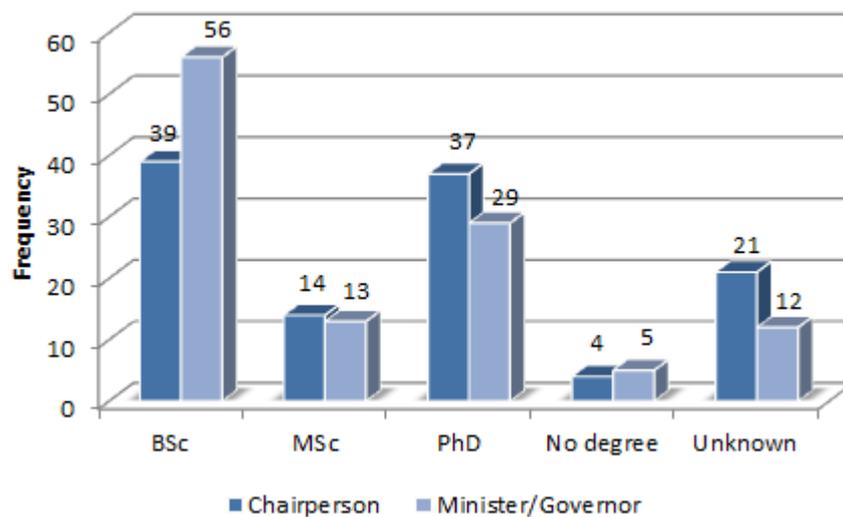
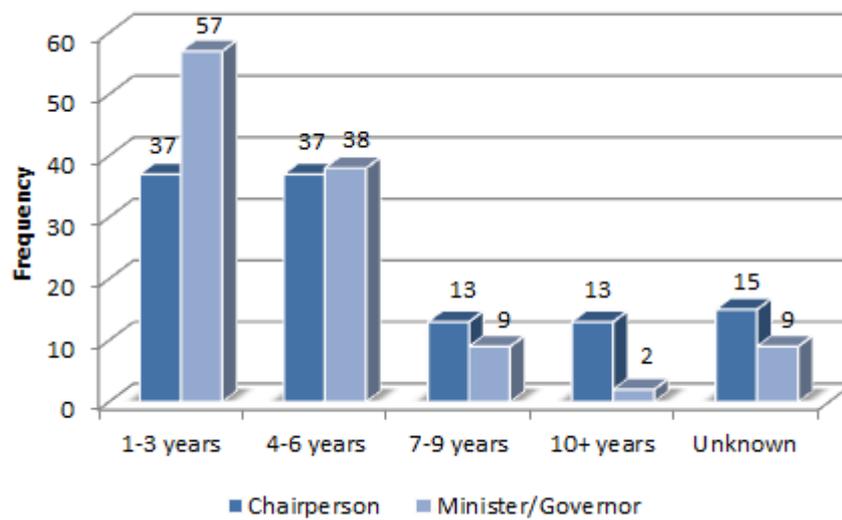


Figure 4.7 provides the number of chairpersons and ministers/governors in the sample countries by their length of term. While evaluating Figure 4.7, it is important to keep in mind that length of term refers to length of term after the reforms started or were considered.

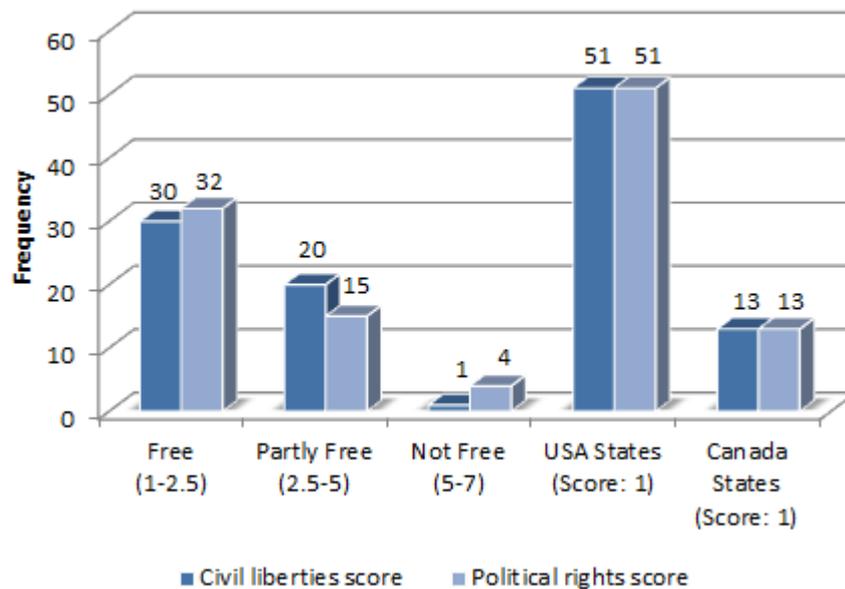
**Figure 4.7** Length of term of chairpersons and ministers/governors



Civil liberties and political rights scores for 2011 are taken from Freedom House (2011). The Freedom in the World survey conducted by Freedom House provides an annual evaluation of the state of global freedom as experienced by individuals. The survey measures freedom -the opportunity to act spontaneously in a variety of fields outside the control of the government and other centres of potential domination- according to two broad categories: political rights and civil liberties. Political rights enable people to participate freely in the political process, including the right to vote freely for distinct alternatives in legitimate elections, compete for public office, join political parties and organizations, and elect representatives who have a decisive impact on public policies and are accountable to the electorate. Civil liberties allow for the freedoms of expression and belief, associational and organizational rights, rule of law, and personal autonomy without interference from the state. Political rights and civil liberties scores range from 1 to 7, with 1 representing the highest and 7 the lowest level of freedom. Since civil liberties and political rights are two important but different components of democracy, Freedom House does not provide a composite variable. A composite variable may be created by taking the average of these two scores, but then it cannot be argued that new variable represents democracy and therefore we do not prefer to use it in our analysis. Figure

4.8 shows the number of countries and states in the sample by their civil liberties and political rights scores.

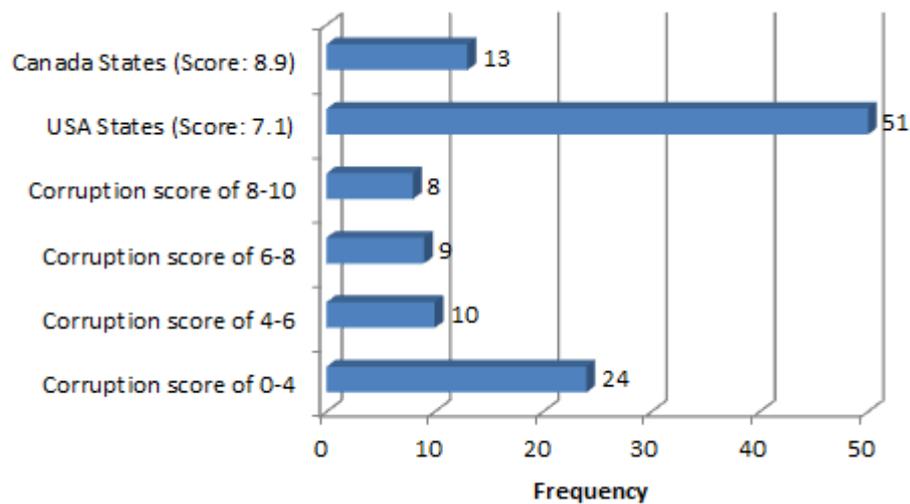
**Figure 4.8** Civil liberties and political rights scores for the sample countries in 2011



Corruption perceptions index for 2010 is taken from Transparency International (2011). It ranks countries according to their perceived levels of public sector corruption on a scale of 0 (highly corrupt) to 10 (very clean). Perceptions are used because corruption is to a great extent a hidden activity that is difficult to measure. The index is an aggregate indicator that combines different sources of information about corruption, making it possible to compare countries. The index draws on assessments and opinion surveys carried out by independent and reputable institutions. These surveys and assessments include questions related to the bribery of public officials, kickbacks in public procurement, embezzlement of public funds, and the effectiveness of public sector anti-corruption efforts. Figure 4.9 provides a visual plot of corruption perceptions index for 2010.

Standardization of the scales for institutional variables does not change the results, but changes the coefficients. Since we transform coefficients into Incident Rate Ratios (IRRs) in our analysis before commenting on them, standardization does not contribute to our analysis and the results. So, we do not prefer to standardize the scales for institutional variables in this study.

**Figure 4.9** Corruption perceptions index for 2010

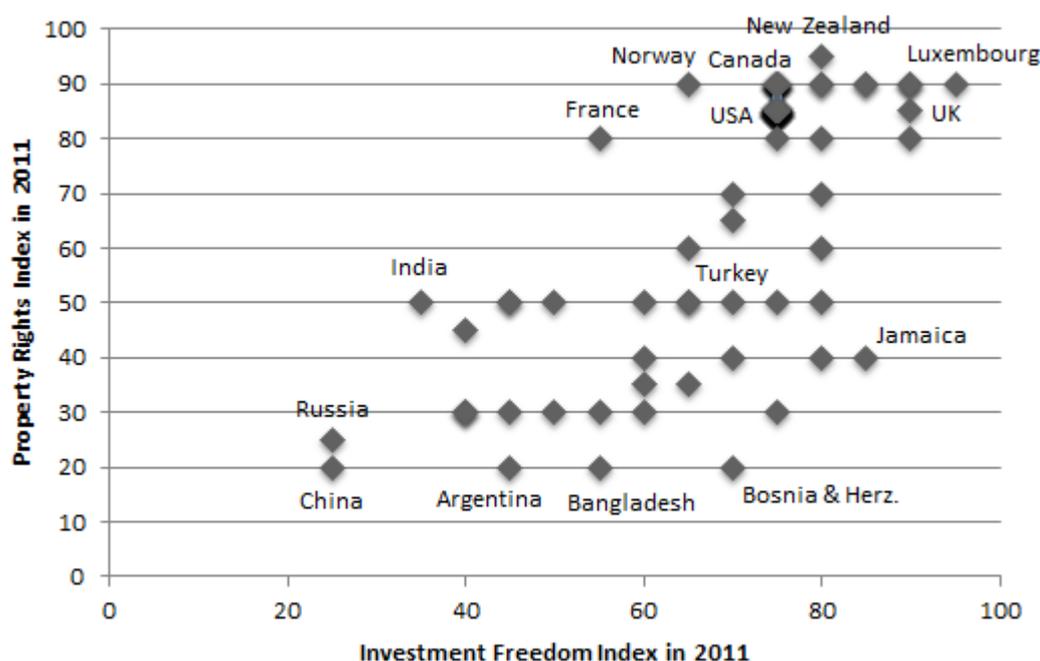


Data on populations and GDP per capita of the countries and the states in 2010 are taken from World Bank (2010b), Statistics Canada and US Census Bureau. Since using the logarithm of a variable enables us to interpret coefficients easily and is an effective way of shrinking the distance between values, we transform population and GDP per capita variables into logarithmic form and use these transformed variables in our model. We also include a dummy variable into our dataset to represent OECD member countries.

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 property, secured by clear laws that are fully enforced by the government. It measures the degree to which a country's laws protect private property rights and the degree to which its government enforces those laws. It also assesses the

**Figure 4.10** Scatter plot of investment freedom index and property rights index



likelihood that private property will be expropriated and analyses the independence of the judiciary, the existence of corruption within the judiciary, and the ability of individuals and businesses to enforce contracts. The more certain the legal protection of property, the higher a country's score; similarly, the greater the chances of government expropriation of property, the lower a country's score. Figure 4.10 presents a scatter plot of investment freedom index and property rights index.

#### **4.6 Empirical analysis**

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) corruption perceptions index, civil liberties and political rights scores, 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>14</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 4.2 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

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<sup>14</sup> Throughout the paper, model estimations are carried out and cross-checked by Stata 12.0 and Eviews 7.1.

**Table 4.2** Poisson regression estimation results for the full sample

<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>Other explanatory variables</b>							
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
Corruption perceptions index in 2010	Explanatory	0.203***	0.0772	2.63	0.008	0.0520	0.3546
<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
Investment freedom index in 2011	Control	0.012***	0.0043	2.87	0.004	0.0039	0.0207
Polity score in 2010	Control	0.045	0.0328	1.38	0.167	-0.0189	0.1097
Property rights index in 2011	Control	-0.021***	0.0062	-3.43	0.001	-0.0332	-0.0090
Constant	Constant	-0.772	0.8297	-0.93	0.352	-2.3986	0.8539

Coefficient that is significant at \*\*\*1% level, \*\*5% level, \*10% level.

**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

**Table 4.3** Poisson regression estimation results for the full sample 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>Other explanatory variables</b>							
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
Corruption perceptions index in 2010	Explanatory	1.225***	0.0946	2.63	0.008	1.0534	1.4256
<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
Investment freedom index in 2011	Control	1.012***	0.0043	2.87	0.004	1.0039	1.0210
Polity score in 2010	Control	1.046	0.0343	1.38	0.167	0.9812	1.1159
Property rights index in 2011	Control	0.979***	0.0060	-3.43	0.001	0.9674	0.9910
Constant	Constant	0.462	0.3833	-0.93	0.352	0.0908	2.3489

Coefficient that is significant at \*\*\*1% level, \*\*5% level, \*10% level.

**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

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 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. Since interpretation of coefficients from a Poisson regression is not straightforward, the incidence rate ratios (IRR) are obtained by exponentiating the Poisson regression coefficients. Table 4.3 shows Poisson estimation results as incident rate ratios. The output tables also present 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.

## **4.7 Discussion of the results**

The empirical results presented above are in line with our hypotheses. So, we fail to reject our hypotheses. Reviewing our findings in relation to the research hypotheses, we find that the background of the chairperson of the regulator and that of the governor or minister responsible for energy policy when reforms started have a statistically significant impact on overall reform progress (Hypothesis 1). Besides, we see that the democracy has also an impact on reform progress (Hypothesis 2). Finally, our results show that countries with relatively high corruption tend to introduce less electricity market reforms (Hypothesis 3). The interpretation of the results in detail and their policy implications are provided in the sub-sections below.

### **4.7.1 Impact of the background of key persons on the reforms**

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 (see Table 4.3). 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 4.3). One difficulty with our analysis here is that the perception among the majority of the economics profession of what sound economic policy actually is did change substantially since the 1980s. The impact of education on market

reforms might thus change over time. That is, most of those with a degree in business or economics may regard the vertical integration as the best model for electricity markets if they were educated in pre-1980s period as this was the dominant view at that time.

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.

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 two 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 (see Table 4.3). 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 (see Table 4.3). 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 4.3).

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 might be explained by the difference between educational backgrounds of two governors. However, it is important to keep in mind that this result is valid *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*. If these assumptions are removed, then there may be some other explanations for the difference between the reform scores of two states. For instance, as we mentioned before, Paul L. Joskow argues that the differences in electricity prices among US states explain why some US states introduce reforms and why others do not (White, 1996). Joskow (2000, Table 4-1, page 135) shows that in Pennsylvania the electricity prices for residential and industrial consumers were 9.90 and 5.89 cents per kilowatt hour in 1997,

respectively. In the same year, prices for residential and industrial consumers were 5.58 and 2.80, respectively, in Kentucky. So, it may easily be concluded that the difference between the reform scores of two states is explained by the difference between different electricity prices in these two states. From Joskow's point of view, Pennsylvania had relatively higher prices than Kentucky did and therefore introduced more reform steps. In short, it is important to remember that our results are valid under a set of assumptions and there may be alternative explanations that are valid under another set of assumptions.

Based on the results above, we clearly fail to reject Hypothesis 1. That is, 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 seem to have a statistically significant impact on overall reform progress. Since Hypothesis 1 is both an immediate application of the New Institutional Economics and a direct parallel with the empirical findings reported in the literature we summarized in Section 4.3.1, our results not only imply that NIE may be a useful approach to explain differences among various countries in terms of reform progress but also contribute to the literature connecting personal traits of policy makers and implementers with policy outcomes. Our findings confirm one of the main assumptions of NIE that the process of any economic reform (e.g. electricity market reform) is largely path dependent; 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. Therefore, 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.

Overall, our results show that the background of policy makers and policy implementers are associated with the progress in liberalizing reforms in electricity markets. We also

acknowledge the possibility of reverse causation; that is, a country may be more likely to choose a regulator or minister/governor with a specific background if it is contemplating reform.

The most important policy repercussion of these results is that, to secure a rapid reform progress, right people should set up reform policies and structures; and right people should put them into practice. Therefore, while appointing regulators and policy makers, their backgrounds should be taken into account.

#### **4.7.2 Impact of democracy on the reforms**

Our results imply that any improvement in civil liberties score of a country results in a decline in the 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 4.3). We could not detect a statistically significant relationship between political rights score and reform progress.

Based on these results, we clearly fail to reject Hypothesis 2, meaning that the level of democracy in a country seems to have a statistically significant impact on reform progress. Since Hypothesis 2 is also an immediate application of the New Institutional Economics, the results above reconfirm that NIE may be a useful approach to explain the differences among various countries in terms of reform progress. The findings in this sub-section verify another main assumption of NIE that institutional structure of a country (like democracy) is one of the determinants of the extent of an economic reform program (such as electricity market reform) in that country.

This result may imply that some dimension(s) of democratic systems may obstruct or interrupt reforms, which is in line with the empirical evidence provided by World Bank (1995). They may be in the form of prolonged legislation periods due to opposition in the parliament, frequent changes in government (and therefore, reform policy), and the negative impact of anti-reform pressure groups or populist policies that damage reform progress especially in election times. Therefore, policy makers and implementers in countries with strong democratic traditions should take into account these factors, and design and carry out reforms accordingly.

#### **4.7.3 Impact of corruption on the reforms**

Our results indicate 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 (see Table 4.3).

This result clearly suggests that we fail to reject Hypothesis 3. That is, our results indicate that countries with relatively high corruption tend to introduce less electricity market reform, which reinforces another key assumption of NIE that non-market transaction costs (like corruption) is one of the determinants of the reform progress. This result also constitutes another confirmation that NIE may be a valuable approach to explain the differences among various countries in terms of reform progress.

Our findings clearly show that reforms go much further in corruption-free countries. So, countries should do their best to reduce and, if possible, eliminate all structures, rules and procedures that may cause or tolerate corruption.

#### **4.7.4 Results from 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 statistically 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 4.3). Although we cannot conclude this from the econometric analysis in this paper, 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. We also see that reform progress is highly correlated with investment freedom index. 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 (see Table 4.3). We could not detect a statistically significant relationship between reform score and polity score. Additionally, 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 (see Table 4.3).

The results above imply that wealthier and highly-populated countries progress faster in the reform process. So, middle and low income countries with limited population should be cautious in designing power market reforms and should take into account income and size effects during reform implementation. Besides, an appropriate investment environment seems to be one of the important determinants of the reform progress. So, countries wishing a rapid reform progress may consider putting into practice measures to set up and maintain a proper investment climate.

#### **4.7.5 Results without the states in US and provinces in Canada**

In our analysis so far, we used observations from countries together with those from the states in US and provinces in Canada. The states in US and provinces in 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 provinces in Canada constitute more than half of the observations in our dataset (64 of 115 observations), our results may be dominated by common characteristics of the states in US and provinces in Canada that may or may not be relevant to reform process. Therefore, re-estimating our models without the states in US and provinces in Canada may produce useful insights into our analysis. In this second phase of estimation, we look at the impact of the backgrounds of policy makers/implementers and democracy & corruption on reforms separately. Table 4.4 presents Poisson regression estimation results without the states in US and provinces in Canada as Incident Rate Ratios (IRR) for the impact of the backgrounds of chairpersons and ministers on the reforms while Table 4.5 does the same for the impact of democracy and corruption.

The empirical findings from the second phase of estimation (that is, the results without the states in US and provinces in Canada) 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 4.4** Poisson regression estimation results without the states in US and provinces in Canada as IRR (Micro Model)

Variables	Variable Type	IRR	Robust Std. Err.	p-value (P> z )
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
- 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

Coefficient that is significant at \*\*\*1% level, \*\*5% level, \*10% level.

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

**Table 4.5** Poisson regression estimation results without the states in  
US and provinces in Canada as IRR

Variables	Variable Type	IRR	Robust Std. Err.	p-value ( $P> z $ )
Electricity market reform score	Dependent			
<b>Explanatory variables</b>				
Civil liberties score in 2011	Explanatory	1.339***	0.097	0.000
Political rights score in 2011	Explanatory	0.870	0.076	0.110
Corruption perceptions index in 2010	Explanatory	1.054*	0.032	0.081
<b>Control variables</b>				
Log of population in 2010	Control	1.094***	0.291	0.001
Log of GDP per capita in 2010	Control	1.413***	0.099	0.000
Dummy (1: OECD country, 0: non-OECD country)	Control	0.989	0.168	0.949

*Coefficient that is significant at \*\*\*1% level, \*\*5% level, \*10% level.*

*Note: Log pseudolikelihood: -110.86, Number of obs: 51*

*Wald chi2(5): 3979.59, Prob > chi2: 0.000*

*Deviance goodness-of-fit: 32.16, Prob > chi2(43): 0.9072*

*Pearson goodness-of-fit: 33.90, Prob > chi2(43): 0.8642*

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.

The results from Table 4.5 confirm that variables representing civil liberties and corruption perceptions have a strong impact on the reform progress. As in the case of the first phase of estimations, the results from the second phase verify that any improvement in civil liberties score of a country results in a decline in the reform score of that country. As mentioned before, 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 1.339 (see Table 4.5).

As we mentioned before, the data on macro variables (i.e. civil liberties score, political rights score and corruption perceptions index) are provided on country level and not available for specific states in US and provinces in Canada. Therefore, we cannot estimate our regressions for states in US and provinces in Canada alone. Nonetheless, it is possible to estimate our regressions to detect the impact of the backgrounds of regulators and governors on the reform progress in US states and Canadian provinces only. However, when we estimate our regressions with data from US states and Canadian provinces only, we see that the coefficients of all variables are statistically not significant even at 10% level with the exception that a governor with an engineering degree seems to decrease the reform score by a factor 0.647. It seems that the impact of the backgrounds of regulators and governors on the reform progress is quite limited in the states in US and the provinces in Canada. Since almost all coefficients are not significant, we do not provide the further details of the estimation table here.

Table 4.6 compares the results from the first and second phase of estimations. It presents statistically significant coefficients only. As can be seen in Table 4.6, the results from two groups of estimations are similar in general with some slight differences in details. When we take into account the fact that number of observations are quite different for the first (115 observations) and second (51 observations) group of estimations, the similar results confirm the robustness of our results. In both groups of estimations, we see that backgrounds of chairperson and minister/governor and variables representing democracy and corruption levels have a statistically significant impact on reform progress. The only noteworthy

difference between two groups of estimations is the impact of OECD membership on the reforms. The results from the observations *with* the states in US and provinces in Canada indicate that OECD membership negatively affects the reform progress while those from the observations *without* the states in US and provinces in Canada imply that OECD membership has a positive impact on reform progress. When we evaluate these two results together, we may conclude that OECD membership contributes to reform progress in reforming countries other than US and Canada. When we include observations from US and Canada into our analysis, some common features of the states in US and provinces in Canada (that may or may not be relevant to reform process) seem to distort the impact of OECD membership on the reform progress. Removing observations from the states in US and provinces in Canada makes the true impact of OECD membership clear.

**Table 4.6** Results with and without the states in US and provinces in Canada as IRR

Variables	Coefficient <i>(with US and Canada)</i>	Coefficient <i>(without 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**	

Variables	Coefficient (with US and Canada)	Coefficient (without US and Canada)
<b>Institutional variables</b>		
Civil liberties score in 2011	1.325 <sup>***</sup>	1.339 <sup>***</sup>
Political rights score in 2011		
Corruption perceptions index in 2010	1.225 <sup>***</sup>	1.054 <sup>*</sup>
<b>Control variables</b>		
Log of population in 2010	1.194 <sup>***</sup>	1.094 <sup>***</sup>
Log of GDP per capita in 2010	1.370 <sup>***</sup>	1.413 <sup>***</sup>
Dummy (1: OECD country, 0: non-OECD country)	0.736 <sup>*</sup>	1.471 <sup>**</sup>

*Coefficient that is significant at \*\*\*1% level, \*\*5% level, \*10% level.*

#### 4.7.6 Impact of initial conditions and initial price levels on the reforms

As we mentioned in Section 2.2.1, Paul L. Joskow argues that states only with high electricity prices have an incentive to introduce reforms in the US; and those with relatively low prices do not have such an incentive and therefore do not introduce reforms. In short, the differences in electricity prices among US states may explain why some US states introduce reforms and why others do not (White, 1996). So, for him, price is an effective explanatory determinant of electricity reform in the US. In this sub-section, we would like to investigate whether price is an equally effective explanatory determinant of electricity reform internationally as it is in the US.

Starting point of the countries in terms of reform steps are not the same. Some countries have a tradition of private participation in electricity industry (IPPs, private distribution and transmission utilities and so on) and long-established regulatory commissions, so they have higher reform scores at the beginning of the reform process. On the other hand, most of the countries do not have such traditions and structures in their power industry, so they have very low reform scores (0 or 1) at the beginning of the reforms. We would also like to investigate

whether the differences in initial conditions in terms of reform steps at the beginning of the reform process have an impact on the subsequent reform progress.

In order to carry out two investigations we summarized above, we include three new variables into our analysis, namely “electricity prices for industry when electricity reform started”, “electricity prices for households when electricity reform started” and “reform score when the reforms in electricity market started”. The first two variables represent the impact of initial price level on the reform progress while the last one accounts for the impact of starting point of the countries in terms of reform steps. The data on initial price levels are taken from the first paper, and the data on reform scores when the reforms in electricity market started are collected by the author.

As indicated in Table 4.2 and Table 4.3, the main analysis in this paper includes data from 86 countries, states or provinces. However, data on initial price levels are extremely limited and available only for 18 countries. In order **not** to significantly reduce the number of observations in our analysis, we prefer not to include these three new variables directly into our main analysis. Besides, we have 23 explanatory or control variables in our main model, which is not a problem when we have 86 observations. However, when the number of observations is reduced to 18 and there new explanatory variables are added to the analysis; Stata drops some variables (including new ones) to avoid various problems associated with over specification problem. So, in practice, it is also not possible to include these three new variables directly into our main analysis.

To overcome two problems mentioned above, we specify a new Poisson regression including three new variables but excluding some of the explanatory or control variables we used in our main model. Table 4.7 presents estimation results of our new Poisson regression. Since we

**Table 4.7** Poisson regression estimation results for the full sample including initial conditions and initial price levels

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	0.004	0.28	0.782	0.994	1.008
Length of term	Explanatory	1.034 <sup>***</sup>	0.010	3.47	0.001	1.015	1.054
Education level (1: BSc, 2: MSc, 3: PhD)	Explanatory	0.888 <sup>**</sup>	0.041	-2.59	0.010	0.811	0.971
<b>Energy minister/governor when reforms started/considered</b>							
His/her experience in electricity industry	Explanatory	1.005	0.012	0.44	0.662	0.982	1.029
Length of term	Explanatory	0.969 <sup>*</sup>	0.016	-1.88	0.060	0.938	1.001
Education level (1: BSc, 2: MSc, 3: PhD)	Explanatory	0.972	0.055	-0.50	0.614	0.870	1.086
<b>Other explanatory variables</b>							
Reform score when the reforms in electricity market started	Explanatory	0.988	0.027	-0.44	0.663	0.937	1.042
Electricity prices for industry when electricity reform started	Explanatory	1.013 <sup>***</sup>	0.004	3.24	0.001	1.005	1.021
Electricity prices for households when electricity reform started	Explanatory	0.999	0.002	-0.44	0.662	0.996	1.002
Civil liberties score in 2011	Explanatory	0.712 <sup>***</sup>	0.061	-3.98	0.000	0.603	0.842
Political rights score in 2011	Explanatory	0.915	0.087	-0.93	0.352	0.759	1.103
Corruption perceptions index in 2010	Explanatory	0.900 <sup>***</sup>	0.024	-3.98	0.000	0.855	0.948

Variables	Variable Type	IRR	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
<b>Control variables</b>							
Log of population in 2010	Control	0.864 <sup>***</sup>	0.019	-6.68	0.000	0.827	0.902
Log of GDP per capita in 2010	Control	0.770 <sup>*</sup>	0.104	-1.93	0.054	0.591	1.005
Constant	Constant	66.702 <sup>***</sup>	47.131	5.94	0.000	16.699	266.432

*Coefficient that is significant at \*\*\* 1% level, \*\* 5% level, \* 10% level.*

*Note: Log pseudolikelihood: -34.85, Number of obs: 18*

*Wald chi2(14): 76965.55, Prob > chi2: 0.000*

*Deviance goodness-of-fit: 0.74, Prob > chi2(3): 0.8648*

*Pearson goodness-of-fit: 0.74, Prob > chi2(3): 0.8649*

have quite different number of observations and use different variables in this limited model and the main model, it is natural that the results may also be different. The limited model in this section is developed to give an idea about the impact of initial price levels and initial conditions on the reform progress using the limited dataset we have.

As can be seen in Table 4.7, variables representing the backgrounds of the chairperson and the minister/governor, democracy and corruption are still significant, meaning that they still seem to be important determinants of how far reforms have gone in a country. Out of three new variables, only one of them is significant. Our results indicate that initial industrial electricity prices are positively correlated with reform progress, which verifies Joskow's argument. So, we find that countries with high initial electricity prices for industry progress rapidly in the reform process. On the other hand, we could not detect a relationship between initial residential prices or initial conditions and the reform progress.

As a result of the analysis in this sub-section, we find out that electricity prices (especially for industrial consumers) are an effective explanatory determinant of electricity reform internationally as it is in the US. Besides, even after allowing for differences in prices, the factors suggested by the New Institutional Economics are still significant determinants of the extent of reform.

As we mentioned before, the concept of interest group competition has its roots in the economic theory of regulation (Peltzman, 1976; Stigler, 1971), which predicts that different interest groups try to capture policy-makers during the reform process and the direction of the reform process is shaped by the relatively strong interest groups. Our findings imply that reform progress is affected by high initial electricity prices for industrial consumers but not by those for households. When we take into account the fact that industrial consumers are much

more organized (and therefore powerful) than the residential ones, the results from our analysis seem to be in conformity with the predictions of economic theory of regulation.

Overall, our results clearly show that both the backgrounds of the chairperson and the minister/governor, democracy and corruption are important determinants of how far reforms have gone in a country. The negative relationship between reform progress and democracy indicate that democracy may delay or hinder the reforms by magnifying the voices of anti-reform interest groups, and therefore, 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. It should also be noted that any reduction in corruption level or improvement in the investment environment positively contributes to the scope of reforms in a country.

#### **4.8 Conclusion**

This study offered an analysis that focuses on the possible contribution of New Institutional Economics to the study of electricity market reforms. In the course of the study, we checked the validity of three important arguments of NIE for the power market liberalization process. The first argument is the "path-dependency". To test its impact on the reform progress, we tried to explain 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 the subsequent reform progress. The second argument is the impact of "democracy" as an institution on the reform progress. We looked at the effect of two important indicators of democracy (i.e., civil liberties and political rights) on the reform progress. The final argument of NIE we tested in this study is about transaction costs. We

concentrated on the level of corruption in a country as one of the key factors that determine transaction costs and tried to explore its impact on the reforms.

To observe the impact of these variables, we constructed empirical econometric models using cross-section data from 51 states in US, 13 provinces in Canada and 51 other countries. As a result of the study, we found that the backgrounds of the chairperson and the minister/governor, and the level of democracy and corruption in a country are significantly correlated with how far reforms have gone in that country. Although we tested the applicability of only three arguments of NIE to the study of reform process in electricity markets, the results from our study confirm that NIE as a school of thought has the potential to provide a useful framework that can possibly be used to investigate power market reforms. Besides, we have many variables in our analysis but our cross-section dataset is limited due to lack of data. Although current number of observations in our study let us investigate the impact of the backgrounds of key persons on the reform progress, we cannot carry out a regression and get meaningful results when we divide our already limited dataset into two set of observations as one on “developed countries” and another on “developing countries”. Actually, a study looking at the impact of backgrounds on reform progress separately in developed and developing countries may produce useful results; but due to limited nature of our dataset, we cannot do this in this study. Finally, as a result of the analysis of a limited model, we also discovered that initial electricity prices (especially for industrial consumers) are an effective explanatory determinant of electricity reform.

# Chapter 5

## 5 Paper Three

### **The political economy of electricity market liberalization: a cross-country approach\***

#### **5.1 Introduction**

Since the 1980s, the structure of electricity industry has shifted from a vertically integrated (and usually state-owned) monopoly towards unbundled (and usually privately owned) regulated utilities. This shift has also been strongly encouraged by the World Bank, IMF and other international financial institutions (Williams and Ghanadan, 2006). The power sector reform began in Chile in 1982 for the first time and then spread through various countries in the world especially after the 1990s. Therefore, the last three decades have witnessed widespread power market reforms in both developed and developing countries that cost

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\* This paper was presented at 30<sup>th</sup> USAEE/IAEE North American Conference (9-12 October 2011, Capital Hilton Hotel, Washington, DC) and granted one of the **top 4 best paper awards** (out of 160 papers) at this conference.

billions of dollars. Today, reforms are on-going in many countries and the reform process in power sector is regarded as not only possible and necessary, but also inevitable.

In all reforming countries (whether developed or developing), reforms take place in a political economic environment and are directly affected by the developments taking place in it. In most cases, political structure of a country largely determines the extent of the reforms in that country. In the United Kingdom, for example, privatization of state owned electricity utility reflected the ideology of the Thatcher government and its interest in reducing the costs of domestic coal subsidies, among other things. Similar ideological and political explanations can be found from Norway to New Zealand (Hogan, 2002). There is no doubt that without political support the reforms cannot go further in any country. This paper attempts to discover the impact of political economic variables on the liberalization process in electricity markets.

We try to answer the following research questions: (i) what is the impact of industrial electricity consumers (as an interest group) on the reform progress in power sector? (ii) does foreign influence resulting from the dependence on foreign financial support have an influence on the electricity market liberalization process? (iii) do the ideology of ruling party and professional/educational background of the chief executive (prime minister or president) constitute important determinants of the reform progress? If yes, what is the direction of the influences originated from these variables?

The paper proceeds as follows. Next section presents a literature review regarding the applied empirical studies focusing on the political economy of liberalization processes. Section 5.3 develops the hypotheses tested in the study. Section 5.4 summarizes the methodological framework. Section 5.5 describes data. Following two sections present empirical analysis and discuss the results. The last section concludes.

## 5.2 Literature review

Presenting an extensive literature review on the political economy of economic reform is both outside the scope of this paper and not possible given the limitations on the length of the study. Although there is some preliminary academic work that investigates the impact of political economic variables on electricity market reform outcome (Pollitt, 2012); to the best of our knowledge, this study constitutes one of the first empirical applied investigations that focus on the possible implications of political economic environment for electricity market reform process. So, there is a gap in the empirical literature with regard to the analysis of the possible repercussions of the political economic variables for the power market reforms. This is quite surprising given the economic importance of the sector for both individual countries and the world economy in general, as well as the significant number of reform programs that have already initiated in many power sectors.

In this section, we will mention only applied studies on the relationship between economic reform processes and political economic variables. The studies presenting an anecdotal discussion of the political economy of the various reform programs without any applied analysis are outside the scope of this section. Within this framework, we will concentrate on three groups of studies: (1) those providing applied evidence from power industry; (2) those on the political economy of reform process in telecommunications industry; (3) studies presenting the results of applied work from non-infrastructure industries. Appendix III-1 presents details of the econometric studies mentioned here including hypotheses tested, dependent variables, explanatory variables, results, data and methodology. Appendix III-2 classifies previous econometric studies by their focus.

The first group of studies (those focusing on the political economy of electricity market reforms) include only two papers by Chang and Berdiev (2011) and Cubbin and Stern (2006). Chang and Berdiev (2011) examine the effect of government ideology, political factors and globalization on energy regulation in electricity and gas industries using the bias-corrected least square dummy variable model in a panel of 23 OECD countries over the period 1975-2007. They find that left-wing governments promote regulation in gas and electricity sectors; and less politically fragmented institutions contribute to deregulation of gas and electricity industries. Their results also suggest that long tenures of incumbent government have limited impact on regulation in electricity sector, while it is associated with an increase in regulation of gas sector. Further, they conclude that higher political constraints and more globalization lead to deregulation in electricity and gas sectors; and economic and social integration are the forces that promote deregulation in the gas industry, whereas political integration advances deregulation in the electricity industry. Cubbin and Stern (2006) assess whether a regulatory law and higher quality regulatory governance are associated with superior outcomes in the electricity industry. Their analysis, for 28 developing economies over 1980–2001, draws on theoretical and empirical work on the impact of telecommunications regulators in developing economies. Their study show that, controlling for privatization and competition and allowing for country-specific fixed effects, both regulatory law and higher quality regulatory governance are positively and significantly associated with higher per capita generation capacity.

The studies providing applied evidence from telecommunications industry are Duso and Seldeslachts (2010), Gasmi et al. (2009), Gasmi and Recuero Virto (2010) and Li and Xu (2002). Duso and Seldeslachts (2010) empirically investigate the cross-sectional and temporal variation in entry liberalization in the mobile telecom industries of OECD countries during the 1990s. Their findings indicate that majoritarian electoral systems are important drivers for

change, while independent industry regulators slow down such reforms. They conclude that powerful industry incumbents hold up the liberalization process and governing bodies that favour a small welfare state accelerate it. Taking the view that political accountability is a key factor linking political and regulatory structures and processes, Gasmi et al. (2009) empirically investigate its impact on the performance of regulation in telecommunications using a time-series cross-sectional data set for 29 developing and 23 developed countries during 1985–99. They provide empirical evidence on the impact of the quality of political institutions and their modes of functioning on regulatory performance. Their analysis finds that the impact of political accountability on the performance of regulation is stronger in developing countries.

The paper by Gasmi and Recuero Virto (2010) has two related objectives. First, it seeks to identify the key determinants of policies that have been at the heart of the reforms of the telecommunications industry in developing countries, namely, liberalization, privatization, and the (re)structuring of regulation. Second, it attempts to estimate the extent to which these policies have translated into actual deployment of telecommunications infrastructure. They conduct this simultaneous investigation by means of an econometric analysis of a 1985-1999 time-series cross-sectional database on 86 developing countries. Their study finds that sectoral as well as institutional and financial factors are important determinants of the actual reforms implemented. They uncover that countries facing increasing institutional risk and financial constraints are more likely to introduce competition in the digital cellular segment and to privatize the fixed-line incumbent, these policies being economically attractive to both investors and governments. Finally, Li and Xu (2002) examine the political economy of privatization and liberalization in the telecommunications sector in recent decades. They find that countries with stronger pro-reform interest groups, namely the financial services sector and the urban consumers, are more likely to reform in more democratic countries. However,

their result suggest that less democratic countries are more likely to maintain the public sector monopoly when the government benefits more from such a governance mode, e.g., when the fiscal deficit is higher.

The final group of studies presents the results of applied investigations from non-infrastructure industries. The examples from this group include Alesina et al. (2006), Boschini (2006), Dreher et al. (2009), Duval (2008), Fredriksson and Wollscheid (2008), Goldberg and Pavcnik (2005), Huang (2009), Ickes and Ofer (2006), Kim and Pirttilä (2006), Olper (2007), Volscho (2007) and Wagner et al. (2009). We will briefly mention them while their details are presented in Appendix III-1.

Alesina et al. (2006) question why countries delay stabilizations of large and increasing budget deficits and inflation and what explains the timing of reforms. They find that stabilizations are more likely to occur during crisis, at the beginning of term of office of a new government, in countries with “strong” governments (i.e. presidential systems and unified governments with a large majority of the party in office), and when the executive faces less constraints. Boschini (2006) analyses how incentives under different sets of political institutions map into policies that promote industrialisation. The results show that a flat wealth distribution and skilled political elite enhance development the most in elitist regimes, while democracies perform as well as elitist regimes in terms of industrialisation. Dreher et al. (2009) analyse whether the educational and professional background of a head of government matters for the implementation of market-liberalizing reforms. Their results show that reforms are more likely during the tenure of former entrepreneurs. Duval (2008) provides an empirical attempt to determine whether macroeconomic policies determined as a result of political processes influence reform patterns in labour and product markets.

Fredriksson and Wollscheid (2008) seek to explain the implications of corruption and political instability for firm investment in abatement technology. Their results suggest that political instability raises abatement technology investment. Goldberg and Pavcnik (2005) exploit drastic trade liberalizations in Colombia in the 1980s and 1990s to investigate the relationship between protection and industry wage premiums. Huang (2009) focuses on the forces that induce governments to undertake financial sector reform. Ickes and Ofer (2006) examine changes in the industrial structure of employment across Russian regions and assess the importance of legacy factors, political factors, and success factors in explaining this process. They find that initial conditions such as natural resource potential, climate, and industrial specialization explain more of the variation in industrial restructuring than political variables. Using data from transition economies, Kim and Pirttilä (2006) examine linkages between political constraints and economic reforms. Their results suggest that progress in reform is positively associated with public support for reforms, which is affected by income inequality and expected individual performance during future reforms. They also find evidence to support reform sequencing starting with a reform that is both popular and stimulatory to other reforms.

Olper (2007) presents an empirical investigation of how agricultural land ownership inequality and government ideology (right-wing vs. left-wing) affect agricultural protection. Their data show, overall, that protection is decreasing in land inequality and with left-wing government orientation, but not in a linear fashion: left-wing governments tend to support agriculture in more unequal societies. Using data on 160 US metropolitan statistical areas from the 2000 census, Volscho (2007) examines how quintile shares of size-adjusted family income are impacted by union density and federal, state, and local government employment. Finally, Wagner et al. (2009) analyse how institutional factors affect satisfaction with democracy. They find that high-quality institutions like the rule of law, well-functioning

regulation, low corruption, and other institutions that improve resource allocation have a positive effect on average satisfaction with democracy.

### 5.3 Hypothesis development

Acemoglu et al. (2005) maintain that “[e]conomic institutions ... are determined as collective choices of the society, in large part for their economic consequences. However, there is no guarantee that all individuals and groups will prefer the same set of economic institutions because different economic institutions lead to different distributions of resources. Consequently, there will typically be a conflict of interest among various groups and individuals over the choice of economic institutions.” So, among other factors, whether a country liberalizes its power sector depends on its political structure and the configuration of interest groups. While the liberalization in an electricity market may result in huge efficiency gains, the distribution of benefits and costs from the reform is usually determined politically. In this study, we use public choice and private interest theories that incorporate the political economy as one of the theoretical frameworks to explain the reform progress.

As we mentioned in Section 1.3, the public choice and private interest theories view policy outcomes as equilibrium results from competition in the policy market (Becker, 1983; Peltzman, 1976; Stigler, 1986). Politicians supply and constituents demand policies. Politicians seek elected public offices and their votes increase with campaign contributions from interest groups. However, public officials are also agents of their constituents. With imperfect information and imperfect public oversight, their private interest, i.e., preference differing from those of their constituents, has the potential to shape policy outcomes. Private interest theory implies that efficient policies are the exception rather than the rule. Indeed, the

politicians may pursue private interests or may be captured by special interest groups at the expense of the general public (Li and Xu, 2002).

In this section, we apply this theoretical framework to develop some of our hypotheses regarding the determinants of power market liberalization. Our study is based upon the idea that, while political ideology (Olson, 1965; Romer and Rosenthal, 1987) and the relative power of interest groups (Peltzman, 1976; Stigler, 1971) shape the direction of power market reforms; foreign influence and the background of the chief executive are also among the determinants of the reform progress. Hence, we argue that power market reform policies are set as a result of, *inter alia*, pressure by interest groups and politicians pursuing their private interests and ideologies, subject to foreign influence. We bring together different data sets which enables us to take into account all of the above dimensions. The explanation of each hypothesis in detail is provided below.

### **5.3.1 Hypothesis on industry sector**

The concept of interest group competition has its roots in the economic theory of regulation (Peltzman, 1976; Stigler, 1971). This literature emphasizes the role of non-market competition among interest groups that face distributive conflicts with one another in determining policy outcomes. Within this context, political actors are viewed as maximizing political gain by balancing electoral support in the form of votes, campaign contributions and the like from competing interest groups to whom they “sell” policy. The economic theory of regulation also emphasizes the relative strength of competing interest groups in determining policy outcomes. That is, the members of more concentrated groups receive higher per capita net benefits from favourable policies, and also suffer from a lower incidence of free-riding than do members of less concentrated groups. As a result, more concentrated groups are a

more powerful source of political influence than are less concentrated groups, *ceteris paribus*. In this context, Peltzman et al. (1989, page 13) list some of the important characteristics of regulation that emerge from the literature on the economic theory of regulation, and the first is that compact, well-organized groups will tend to benefit more from regulation than broad, diffuse groups, which probably creates a bias in favour of a coalition of producer groups, because they are usually well organized relative to all consumers. Peltzman et al. (1989) also argues that regulatory policy will seek to preserve a politically optimal distribution of rents across this coalition.

The economic theory of regulation predicts that different interest groups try to capture policy-makers during power market reform process, which is confirmed in empirical studies such as Kroszner and Strahan (1999) and Duso (2005). If all parties are equally represented, competition is tougher and the policy outcome should be more efficient (Becker, 1983). Generally though, the industrial consumers have higher stakes and are better organized in shaping power market reform policies. As we know, industrial electricity consumers have a greater concentration relative to residential and smaller commercial customers. Also, industrial consumers tend to have a greater stake in electricity pricing policies because they typically consume more electricity than do residential and small commercial users, both in absolute terms and as a fraction of income. Moreover, industrial consumers are typically well-organized through their affiliations with industry associations and trade groups. These factors suggest that the level of interest group pressure for politicians to shape the direction of electricity market reforms is greater when industrial consumers constitute a larger fraction of the customers. In short, due to reasons summarized above, we look at the impact of industrial consumers as the most organized consumer group with substantial electricity consumption on the reform progress. Although agricultural consumers are subsidized in many countries; this is because of more practical reasons than political ones. Besides, given that residential and

agricultural consumers face a typical free rider problem (Olson, 1965), they are often not a relatively powerful interest group.

Depending on the perceptions of the industrial consumers regarding the benefits/losses from the liberalization process, countries with a larger industrial sector would be more likely to *push for* or *oppose* liberalization of the electricity sector. For instance, in some countries, the most important beneficiaries (and therefore potential supporters) of the reform programs may be large industrial consumers because increased efficiency and careful regulation in the sector may transfer huge benefits to them in the form of reduced electricity prices and better service. Therefore, it is reasonable to expect that industry sector in these countries supports the reform initiatives in the power industry; and as its size gets bigger and bigger so does its influence. On the other hand, in some other countries, industrial electricity prices are highly subsidized by the government so industrial consumers may regard liberalization policies as a threat to their self-interest since liberalization usually means removal of such subsidies. Taking into account these concerns, we formulate our first hypothesis as follows.

***Hypothesis 1:** Industry sector has a significant impact on the extent of electricity market reform. As its size gets larger, so does its influence.*

This hypothesis is an immediate application of the economic theory of regulation. While investigating the impact of industrial consumers on reform progress, the latter (dependent variable) is represented by an “overall electricity market closeness index” and three other sub-indicators, namely “entry barriers in electricity market”, “public ownership in electricity market” and “vertical integration in electricity market”. On the other hand, “industry value added (% of GDP)” constitutes the causal variable that represents the size of industry sector. The details of these variables are provided in the following sections.

### 5.3.2 Hypothesis on foreign financial aid

In 1992, the World Bank officially changed its lending policy for electricity development from traditional project lending to policy lending (the Washington consensus). That is, any country borrowing from the Bank on power projects would have to agree to move away from a “single national electricity utility as a public monopoly” and adopt ownership, structural and regulatory reforms (Yi-chong, 2006). Other international financial institutions, such as the Asian Development Bank, European Bank for Reconstruction and Development, and the Inter-American Development Bank have followed suit (Williams and Ghanadan, 2006). Today, the liberalization of the infrastructure (including electricity) industries is one of the preconditions of any financial support program. So, we expect that countries receiving foreign financial support are likely to initiate a reform program in their power markets. Therefore, our next hypothesis is formulated as below.

***Hypothesis 2:** Foreign financial aid and/or assistance increase the extent of electricity market reform.*

As mentioned above, electricity reform progress is expected to be influenced by international donor agencies through financial aid or assistance. In this context, the change in reform progress constitutes a possible outcome and foreign financial aid and/or assistance is one of the possible causes of this outcome. By developing this second hypothesis, we try to find out whether there is a correlation between electricity reform progress and foreign financial aid and/or assistance. We may think about a causal link in the event that the coefficient of the variable representing foreign financial aid and/or assistance turns out to be statistically significant. As in the case of the first hypothesis, the reform progress is represented by an

overall indicator and three sub-indicators while foreign financial aid and/or assistance is signified by the variable “net official development assistance and official aid received”, the details of which is presented in the following sections.

### **5.3.3 Hypothesis on government ideology**

If we assume that politicians are perfect agents of their constituents and act based entirely on constituent interests, ideology should not affect the policy outcomes. However, in practice, politicians’ interests are not perfectly aligned to that of their constituents and their ideologies may affect policy outcomes. Parties with different ideologies may prefer different policies. Actually, empirical literature shows that party appears to matter (Alt and Lowry, 1994; Clarke and Cull, 2002; Jones et al., 2000). Alesina (1987), Hibbs (1977) and Pearce (2006) explain that political parties promote policies in line with their ideological preferences. Political ideological differences may therefore explain the reform progress in electricity industry.

Although the literature has documented that political parties develop and follow policies in line with their ideology (Hibbs, 1977), there is a controversy on the possible direction of the ruling party ideology on the reform programs. On the one hand, it is usually assumed that right-wing governments favour privatization and liberalization process, and left-wing governments prefer government involvement (Bjørnskov, 2005; Duval, 2008; Pitlik, 2007; Potrafke, 2010). In line with this assumption, some empirical studies have found that market-oriented and right-wing governments pursue privatization and liberalization (Bjørnskov and Potrafke, 2011; Bortolotti and Pinotti, 2008; Duso, 2002; Pitlik, 2007; Potrafke, 2010). On the other hand, some other studies have concluded that left-wing governments are associated with more liberalization and regulation in infrastructure industries (Chang and Berdiev, 2011). Dreher et al. (2009), for instance, show that reforms are more likely during the tenure of

former entrepreneurs, and entrepreneurs belonging to a left-wing party are more successful in inducing reforms than a member of a right-wing party with the same previous profession.

In short, the ideological orientation of the political parties may be critically important in explaining the power market reform process in a country (Bortolotti and Pinotti, 2008; Duso, 2002); however, it is not possible to determine the direction of this impact analytically. These considerations lead us to the following hypotheses.

***Hypothesis 3:** Government ideology is one of the determinants of the extent of electricity market reform.*

This hypothesis is a direct parallel with the empirical findings reported in the literature we summarized above. By developing this hypothesis, we try to find out whether the suggested correlation between a reform process and government ideology is valid for electricity markets, too. We may think that the findings of the previous literature hold true also for electricity markets if the coefficients of the variables representing government ideology turn out to be statistically significant. In this framework, as we mentioned before, reform progress is represented by an overall indicator and three sub-indicators while government ideology is indicated by three dummy variables that represent party orientation with respect to economic policy, namely “right”, “left” or “center”. The details of these variables are provided in the following sections.

#### **5.3.4 Hypothesis on the background of chief executive**

As we discussed in Section 4.3.1, there is a growing literature within political economy framework connecting personal traits of policy makers and implementers with policy

outcomes<sup>15</sup>. In the second paper, we have employed variables related to the characteristics of the chairperson of the regulatory agency and energy minister when reforms started. In this paper, on the other hand, we focus on the professional and educational background of the chief executive (prime minister or president) as the literature summarized in Section 4.3.1 suggests that the decision to initiate, develop, suspend or cancel a reform process may also be affected by the personal backgrounds of the chief political leaders. So, although we use data on the backgrounds of key people in the second paper and this paper, the persons we concentrate on are different. Moreover, in terms of data, the second and third papers are also different. This paper analyses a panel data set with 1,540 maximum possible observations while the second paper has a cross-section dataset with 115 observations. Besides, due to lack of data, we could not focus on the professional backgrounds in the second paper; however, in this paper we investigate the impact of professional backgrounds of political leaders on the reform progress as well. In summary, the prior knowledge, education and experience of the chief executive regarding the power market liberalization process may encourage or discourage the reform measures. Hence, our final hypothesis is as follows.

***Hypothesis 4:** Educational and professional background of the chief executive matters for the extent of electricity market reform.*

This hypothesis is a direct parallel with the empirical findings reported in the literature we summarized in Section 4.3.1. Throughout our analysis, as in the case of previous hypotheses, reform progress is represented by an overall indicator and three sub-indicators on reform progress. On the other hand, the backgrounds of the chief executives are represented by ten dummy variables, six of which are for professional background of the chief executive and

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<sup>15</sup> Since we have already provided the details of this literature in Section 4.3.1, we do not duplicate it here.

four for educational background. The details of these variables are available in the following sections.

### 5.3.5 Control variables

Control variables are independent variables not directly related to the size of industry sector, foreign financial aid, government ideology and the background of the chief executive, but may still explain a portion of the variations in reform indicators. However, we acknowledge that there are no clear-cut criteria to decide which variables to include as part of hypotheses and which ones as control variables. In some cases, the impacts of some variables are so well known that formulating them as hypotheses would be pointless so we relegate them to control variables. In some other cases, the impact of some variables is not known but these variables might be important; so we include them as control variables. Finally, we try to avoid testing too many hypotheses in a single paper and therefore limit the maximum number of hypotheses to four. Hence, if there are more than four variables as potential hypotheses, we include the first four most important ones as hypotheses and categorize the remaining as control variables. In addition to explanatory variables discussed above, whether and how much a country reforms its electricity industry depends also on other factors such as the state of economic development, history, political structure and so on. To improve the accuracy of our estimates, we control for these factors in our empirical analysis using a rich set of control variables, namely *the size of rural population, the fairness of income distribution, the level of authoritarianism, party structure, political stability, electoral system, EU and OECD membership status, existence of electricity market reform idea, population density, electricity consumption, income level, average education level in the country and dependence on foreign trade*. We briefly summarize the link between the control variables in our analysis and power

market reform progress below while the details of these variables are given in the following sections.

Compared with rural consumers, urban consumers are more likely to benefit from reforms that reduce cross-subsidization and increase electricity service offerings in densely populated areas. One indicator of the relative gains of urban consumers is the tariff rebalancing associated with liberalization. In addition to gains from tariff rebalancing, liberalization usually results in an improvement in electricity service (e.g. fewer interruptions), especially in urban areas. Since urban consumers tend to have larger electricity consumption volumes than rural residents, partly due to income effect, they should benefit more from liberalization than rural consumers; and therefore support liberalization in electricity markets. However, in some countries, urban consumers may object to reform process if the price of electricity for urban consumers is subsidized in pre-reform period and the reforms mean removal of these subsidies. The *share of rural population (as % of total population)* may be used as a proxy for the relative effectiveness of the urban consumers in influencing policies.

We also expect that consumers are better organized in less authoritarian and more egalitarian societies; and therefore have more tools to affect reform policies in these societies. Hence, we also use the fairness of income distribution and the level of authoritarianism as control variables in our analysis. *Gini coefficient* represents the fairness of income distribution while *polity score* indicates the level of authoritarianism in a country. However, the direction of the relationship between these variables and reform progress cannot be established analytically.

Political stability in a country constitutes another factor with the potential to affect power market reforms. However, again, its impact on the reform progress cannot be predetermined theoretically. On the one hand, subjecting a reform program to the scrutiny of both the ruling

and the opposition parties may increase the credibility of the power market reform program for private investors (Levy and Spiller, 1996), thus increasing the possibility of success in implementing the program. Moreover, the division of power may help counterbalance ruling politicians' discretion to pursue self-interest, creating a more competitive environment in policy-making (Li and Xu, 2002). On the other hand, implementation of reforms may require a stable political environment in the form of single-party governments (rather than coalition governments), presidential regimes (rather than parliamentary ones) and chief executives with longer years in office. Therefore, we include three additional control variables that represent political stability into our analysis, namely *party structure (single-party or coalition)*, *the years the chief executive has been in office*, and *electoral system (presidential or parliamentary)*.

It is quite possible that countries prefer to liberalize their power markets after reforms are implemented successfully in other countries. The dummy variable *the existence of electricity market reform idea* represents the impact of previous international experience on subsequent reforms in other countries. It takes the value 1 after 1989 when the electricity market reform was implemented, for the first time, in a full scale in a developed country (i.e. the UK); the years before 1989 take the value 0.

Indicators of economic development and population structure are also expected to affect reforms as they may have implications for the demand for power market reforms. So, we also include control variables representing them, namely dummy variables for *EU and OECD membership status*, *population density*, *electricity consumption*, *GDP per capita*, *average number of years of education* and *imports of goods and services*.

## 5.4 Methodology

As underlined by Jamasb et al. (2006), there is a lack of generally accepted and measured indicators for monitoring the progress, impacts, and performance of electricity sector reforms. Since the aim of this paper is to propose a framework for analysing the power market reforms from a political economy perspective, we face with the same problem. That is, we need to, first, evaluate possible impact of political economic environment of a country on electricity market reform process in this country; second, decide which indicators to use in our study and; finally, specify methods to measure them. Let me focus on these tasks one by one.

Many scholars have studied many aspects of power market reforms. For instance, Stigler and Friedland (1962) analysed the effects of regulation of electricity rates and concluded that regulation had not resulted in lower electricity rates. Some other scholars discussed the impact of political economic environment on the reforms. However, to the best of our knowledge, no econometric study has been done so far on the relationship between political economic environment and power market reform progress. Therefore, we cannot find empirical evidence in the applied literature concerning the direction of this relationship. To carry out our analysis, we need to decide which indicators to be used in the study. Since we are interested in the impact of political economic variables on power market reform process, we need variables representing political economic environment of a country and those representing the scale and intensity of the reform process. In addition to these variables, we also utilize a set of control variables which are assumed to be endogenous to reform process and explain a portion of the variations in reform progress. Another challenge we face in this study relates to the measurement of the variables. For an indicator to be useful it needs to be based on a clear definition and to be measurable. This is equally important whether it is expressed in physical, monetary or qualitative terms. In fact, most of the economic and

industry indicators in our study are measured in some form of monetary or physical unit; and therefore, easy to include into the study. However, the extent and scope of electricity reforms are not quantifiable in physical or monetary units. The main electricity reform measures, such as privatization, unbundling of functions, wholesale markets and independent regulation, are generally established gradually and have a qualitative dimension. Accounting for these measures with the use of dummy variables, as sometimes done, does not reflect extent or intensity. To overcome this problem, we used electricity market reform indicators constructed by international organizations (namely, OECD and EBRD).

We specify our dependent variables (that is, reform indicators) as a function of (i) political economic variables (comparable cross-country indicators), (ii) a set of controls, (iii) country-specific effects (these are assumed to be exogenous and to exist independently of reform process, but may explain a portion of the variation in reform progress) and (iv) other unobserved variables that influence the reform process. These variables are then used in panel regressions to assess their impact on variables we are interested in. In panel regressions, the exploitation of both cross-country and time-series dimensions of the data allows for control of country-specific effects.

We start with the standard panel data regression equation below.

$$Y_{it} = \beta_1 + \sum_{j=2}^k \beta_j X_{jit} + \sum_{p=1}^s \gamma_p Z_{pi} + \delta t + \varepsilon_{it} \quad (5.1)$$

In the model,  $i$  and  $t$  represent unit of observation and time period, respectively.  $j$  and  $p$  are indices used to differentiate between observed and unobserved variables.  $X_{ji}$  and  $Z_{pi}$  represent observed and unobserved variables, respectively.  $X_{ji}$  includes both political economic

variables and control variables.  $Y_{it}$  is dependent variable (that is, electricity market reform indicators).  $\varepsilon_{it}$  is the disturbance term and  $t$  is time trend term. Because the  $Z_{pi}$  variables are unobserved, there is no means of obtaining information about the  $\sum \gamma_p Z_{pi}$  component of the model. For convenience, we define a term  $\alpha_i$ , known as the unobserved effect, representing the joint impact of the  $Z_{pi}$  variables on  $Y_{it}$ . So, our model may be rewritten as follows:

$$Y_{it} = \beta_1 + \sum_{j=2}^k \beta_j X_{jit} + \alpha_i + \delta t + \varepsilon_{it} \quad (5.2)$$

Now, the characterization of the  $\alpha_i$  component is crucially important in the analysis. If control variables are so comprehensive that they capture all relevant characteristics of the individual, there will be no relevant unobserved characteristics. In that case, the  $\alpha_i$  term may be dropped and pooled data regression (OLS) may be used to fit the model, treating all the observations for all time periods as a single sample. However, since we are not sure whether control variables in our models capture all relevant characteristics of the countries, we cannot directly carry out a pooled data regression of  $Y$  on  $X$ . If we were to do so, it would generate an omitted variable bias. Therefore we prefer to use either a Fixed Effects (FE) or Random Effects (RE) regression. In FE model, the country-specific effects ( $\alpha_i$ ) are assumed to be the fixed parameters to be estimated. In RE model, the country-specific effects ( $\alpha_i$ ) are treated as stochastic. The fixed effect model produces consistent estimates, while the estimates obtained from the random effect model will be more efficient. There are more than 90 countries in the world where a reform process has been initiated so far but data are available only for 55 countries. That is, our sample is limited by data availability. Therefore, we cannot be sure whether the observations in our model may be described as being a random sample from a given population; and cannot directly decide which regression specification (FE, RE or OLS)

to use. It will be decided in the course of the analysis based on Hausman test and Breusch and Pagan Lagrangian Multiplier (BPLM) test.

## **5.5 Overview of data**

Our data set is based on a panel of 55 countries for a period beginning in 1975 and extending through 2010. List of countries in our data set is available in Figure 5.1 and Figure 5.2. Years 1975 and 2010 represent, respectively, the earliest and the last year for which data are available at the time the research is conducted. The countries in our sample are determined by data availability, especially by data on electricity market reform indicators. In this study, we assume that countries are comparable to each other; however, we also acknowledge the possible lack of comparability among countries. The total number of maximum observations for each variable is 1,540. Because of missing observations, our panel is unbalanced.

In total, we use 37 variables in our study. Out of 37 variables, 4 of them are used as dependent variables, 15 as explanatory variables and remaining 18 as control variables. Since reform progress may be affected by many factors, it seems worth using 33 variables as explanatory or control variables. The variables used in the study are entry barriers, public ownership and vertical integration in electricity market; overall electricity market closeness index; industry value added (% of GDP); net official development assistance and official aid received (current billion US\$); party orientation with respect to economic policy (right, left or centre); professional background of the chief executive (entrepreneur, scientist (economist), military, politician, scientist (other) or unknown/other); educational background of the chief executive (economics, natural science, other university or unknown/other); party structure (single-party or coalition); the years the chief executive has been in office; electoral system (parliamentary or presidential regime); rural population (% of total population); gini coefficient; polity score

(-10,+10); dummy variables representing EU members, OECD members or the existence of electricity market reform idea; population density (people per square km of land area); electricity consumption (MWh per capita); GDP per capita (PPP, current thousand international \$); average number of years of adult (15+) education; imports of goods and services as % of GDP. Table 5.1 shows descriptive statistics of the variables in our analysis.

**Table 5.1** Descriptive statistics of the variables

<b>Variables (units)</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min</b>	<b>Max</b>	<b># of Obs.</b>	<b># of Ctrys</b>
<b>Dependent Variables</b>						
Entry barriers in electricity market (0-6)	4.59	2.26	0	6	990	30
Public ownership in electricity market (0-6)	4.56	1.80	0	6	990	30
Vertical integration in electricity market (0-6)	4.65	2.03	0	6	990	30
Overall electricity market closeness index (0-6)	4.46	1.61	0	6	1,540	55
<b>Explanatory Variables</b>						
Industry value added (% of GDP)	32.39	7.43	10.29	69.92	1,415	55
Net official development assistance and official aid received (current billion US\$)	0.11	0.28	-0.46	3.79	1,408	55
<i>Party orientation with respect to economic policy</i>						
- Right	0.40	0.49	0	1	1,218	51
- Left	0.44	0.50	0	1	1,218	51
- Center	0.15	0.36	0	1	1,218	51
<i>Professional background of chief executive</i>						
- Entrepreneur	0.06	0.24	0	1	1,429	54
- Scientist (Economist)	0.04	0.21	0	1	1,429	54
- Military	0.07	0.25	0	1	1,429	54
- Politician	0.63	0.48	0	1	1,429	54
- Scientist (Other)	0.27	0.45	0	1	1,429	54
- Unknown/other	0.37	0.48	0	1	1,429	54
<i>Educational background of chief executive</i>						
- Economics	0.25	0.43	0	1	1,429	54
- Natural science	0.18	0.38	0	1	1,429	54
- Other university	0.47	0.50	0	1	1,429	54
- Unknown/other	0.14	0.35	0	1	1,429	54

<b>Variables (units)</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min</b>	<b>Max</b>	<b># of Obser.</b>	<b># of Ctrys</b>
<b>Control Variables</b>						
Party Structure (1: single-party, 0: coalition)	0.46	0.50	0	1	1,493	53
The years the chief executive has been in office	4.35	3.84	1	35	1,437	54
Electoral system (parliamentary regimes)	0.68	0.47	0	1	1,475	55
Rural population (% of total population)	33.95	14.47	2.66	73.60	1,514	55
Gini coefficient (0-100)	30.43	6.75	16.63	57.40	760	54
Polity score (-10,+10)	6.31	6.13	-10	10	1,357	53
EU member (0-1)	0.30	0.46	0	1	1,540	55
OECD member (0-1)	0.56	0.50	0	1	1,540	55
Existence of electricity market reform idea (0-1)	0.73	0.45	0	1	1,540	55
Population density (people per sq. km of land area)	101.26	104.35	1.40	499.96	1,428	55
Log of population density	4.00	1.34	0.33	6.21	1,428	55
Electricity consumption (MWh per capita)	5.90	4.99	0.34	36.85	1,450	54
Log of electricity consumption	1.47	0.80	-1.07	3.61	1,450	54
GDP per capita (PPP, current thousand int. \$)	14.34	10.83	0.73	84.41	1,307	55
Log of GDP per capita	2.32	0.92	-0.32	4.44	1,307	55
Average number of years of education received by people ages 15 and older	9.27	1.68	2.92	12.75	1,364	47
Imports of goods and services (% of GDP)	41.33	21.00	5.88	143.72	1,427	55
Log of imports of goods and services	3.59	0.53	1.77	4.97	1,427	55

Appendix III-4 presents the correlation among explanatory and control variables. As can be seen in Appendix III-4, independent variables are not highly correlated with each other. Out of 196 correlations (between 15 explanatory and 14 control variables) shown in Appendix III-4, 159 correlations are between -0.3 and +0.3. When we look at the limited number of more correlated variables, we could not see a counter intuitive or contradictory relationship. Almost all high correlations are understandable. For instance, the correlation between OECD membership and GDP per capita is +0.6403, which is quite natural if we take into account the fact that OECD countries are usually the wealthy ones. So, from an econometric point of view, correlation among independent variables does not constitute a problem in our analysis.

Data on overall electricity market closeness index are obtained from Conway and Nicolett (2006) and EBRD<sup>16</sup> (2011). Conway and Nicolett (2006) provide data for 30 OECD countries. They also provide data on sub indicators of reform process; namely entry barriers, public ownership and vertical integration. Indicators for **entry barriers** focus on terms and conditions for third party access (TPA) and the extent of choice of supplier for consumers. In the electricity sector this is supplemented by information on the existence of a liberalised wholesale market for power, which is an important issue in most OECD countries. Indicators for **public ownership** record the prevailing ownership structure in the various segments of the electricity sector, ranging from fully private to fully public. The scoring allows for mixed ownership arrangements in which the natural monopoly segments remain under public hand. Indicators for **vertical integration** focus on whether competitive activities such as generation and supply of electricity are separated from natural monopoly activities such as the national grid and/or local distribution. The degree of separation ranges from full integration to mere legal/accounting separation to separation into different companies owned by different shareholders. The assumption here, reflecting industrial organisation theory, is that the scope for anti-competitive behaviour is largest when an electricity company simultaneously controls the network and operates in upstream or downstream competitive markets. Table 5.2 shows the composition of the electricity market closeness index (Conway and Nicolett, 2006). As can be seen in Table 5.2, the index ranges from 0 to 6 where 0 represents the fully open market in which entry barriers, public ownership and vertical integration are minimized and a score of 6 is given to a closed market.

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<sup>16</sup> European Bank for Reconstruction and Development.

**Table 5.2** Composition of the electricity market closeness index

	Weights by theme (b <sub>j</sub> )	Question Weights (c <sub>k</sub> )	Coding of Data					
<b>Entry regulation:</b> ○ How are the terms and conditions of third party access (TPA) to the electricity transmission grid determined? ○ Is there a liberalised wholesale market for electricity (a wholesale pool)? ○ What is the minimum consumption threshold that consumers must exceed in order to be able to choose their electricity supplier?	1/3	1/3	Regulated TPA 0		Negotiated TPA 3		No TPA 6	
		1/3	Yes 0			No 6		
		1/3	No threshold 0	<250 gigawatts 1	Between 250 and 500 gigawatts 2	Between 500 and 1000 gigawatts 3	More than 1000 gigawatts 4	No consumer choice 6
<b>Public ownership:</b> ○ What is the ownership structure of the largest companies in the generation, transmission, distribution, and supply segments of the electricity industry?	1/3	1	Private 0	Mostly Private 1.5	Mixed 3	Mostly Public 4.5	Public 6	
<b>Vertical Integration:</b> ○ What is the degree of vertical separation between the transmission and generation segments of the electricity industry? ○ What is the overall degree of vertical integration in the electricity industry?	1/3	1/2	Separate Companies 0		Accounting separation 3		Integrated 6	
		1/2	Unbundled 0		Mixed 3		Integrated 6	
<b>Country scores (0-6)</b>			$\sum_j b_j \sum_k c_k \text{ answer}_{jk}$					

EBRD (2011) provides a similar indicator for additional 25 developing countries where it operates. The data from EBRD are available on a 1-4 scale. EBRD ratings are based on the following scale:

Score 1: Power sector operates as government department with few commercial freedoms or pressures. Average prices well below costs, with extensive cross-subsidies. Monolithic structure, with no separation of different parts of the business.

Score 2: Power company distanced from government, but there is still political interference. Some attempt to harden budget constraints, but effective tariffs are low. Weak management incentives for efficient performance. Little institutional reform and minimal, if any, private sector involvement.

Score 3: Law passed providing for full-scale restructuring of industry, including vertical unbundling through account separation and set-up of regulator. Some tariff reform and improvements in revenue collection. Some private sector involvement.

Score 4: Separation of generation, transmission and distribution. Independent regulator set up. Rules for cost-reflective tariff-setting formulated and implemented. Substantial private sector involvement in distribution and/or generation. Some degree of liberalisation.

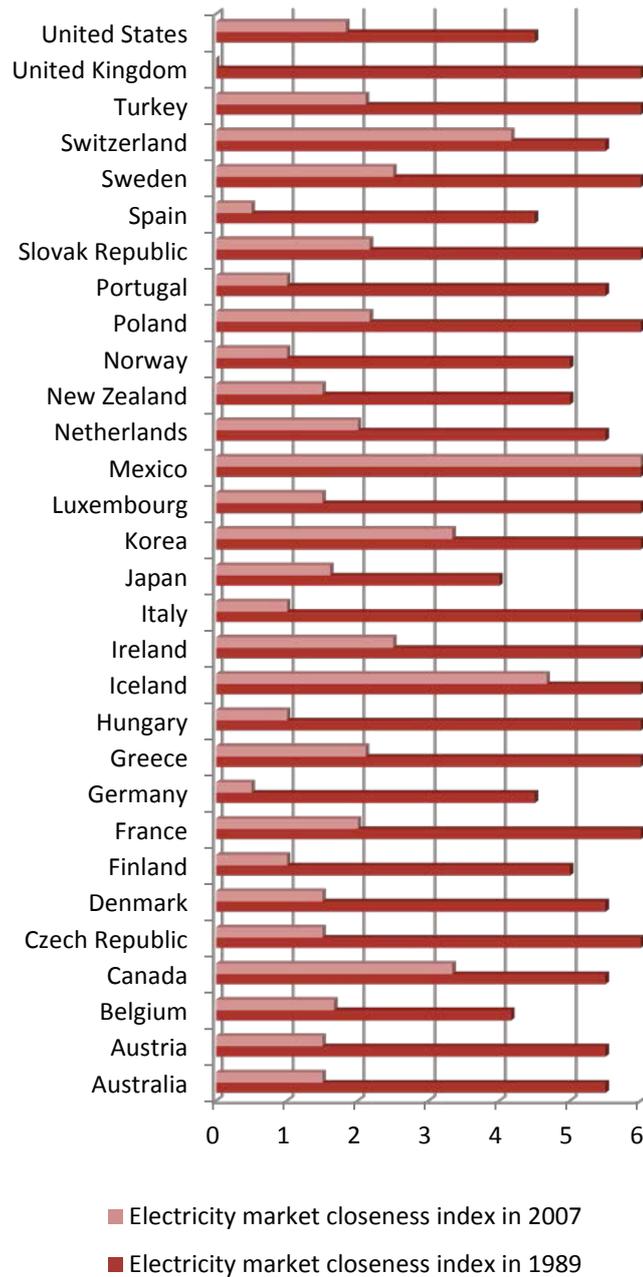
Score 4+: Tariffs cost-reflective and provide adequate incentives for efficiency improvements. Large-scale private sector involvement in the unbundled and well-regulated sector. Fully liberalised sector with well-functioning arrangements for network access and full competition in generation.

To establish uniformity between two data sets, the data from EBRD (2011) are converted into 6-0 scale. Figure 5.1 and Figure 5.2 provide the change in electricity market closeness index from 1989 to 2007 for the countries in our dataset.

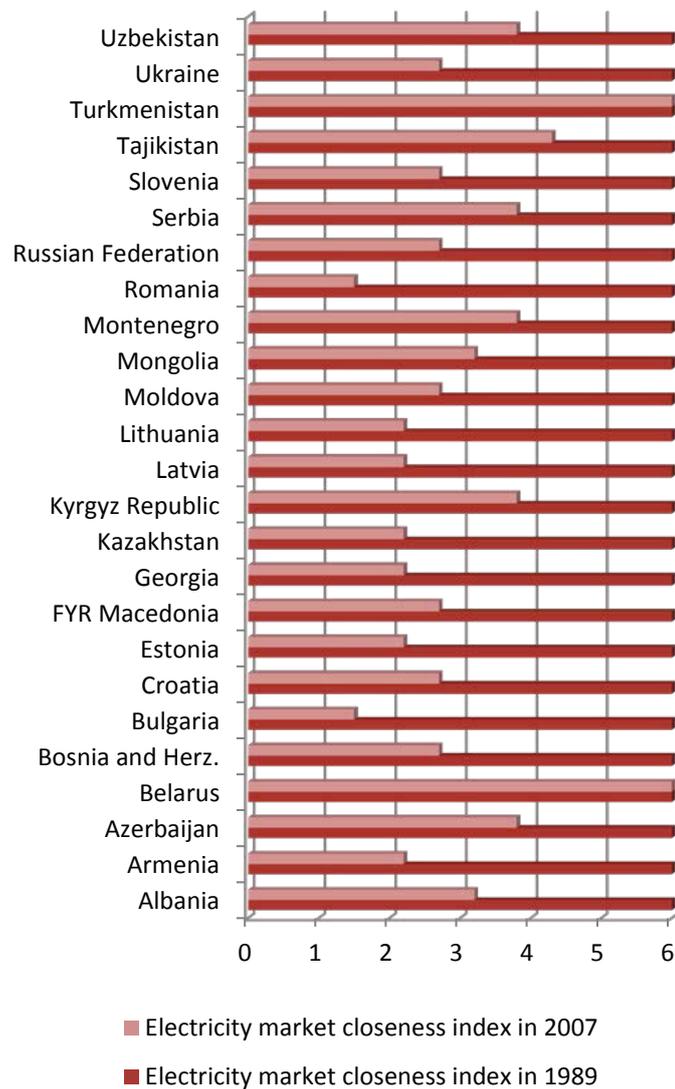
Electricity market closeness index assigns a score to each country for each year based on the reform status of that country in that year. It is an indicator of reform progress, rather than reform success. Table 5.3 classifies 55 countries in our dataset into four groups based on their market closeness index in 2000. This classification does not give an idea about reform success and clearly does not present a full picture of the situation in each country; however, it still successfully groups countries in terms of reform progress. For instance, one of the criteria used to determine market closeness score is private participation into electricity industry. In 2000, Norway had probably much more competitive (and therefore successful) power market structure than Germany; but it is placed into the second group while Germany is placed into the first one in Table 5.3. The main reason for this is the fact that Norway prefers a market model based on “competition without privatization” while Germany has a long tradition of private participation in its electricity industry, which enables Germany to get a higher score than Norway. That is, electricity market closeness index measures the distance between actual market structure of a country and an ‘ideal’ one where electricity industry is unbundled, privately-owned and fully competitive. The score of each country differs since the distance of each country from this ‘ideal’ point is different. However, the evidence so far does not fully confirm that this ‘ideal’ structure is also the most successful one. As we mentioned before, in

Norway, there has not been a large scale privatization program but still its market is probably much more successful than those of many countries that implemented such a privatization program in their power industries. In short, electricity market closeness index is a useful

**Figure 5.1** Electricity market closeness index in OECD countries (1989, 2007)



**Figure 5.2** Electricity market closeness index in countries where EBRD operates (1989, 2007)



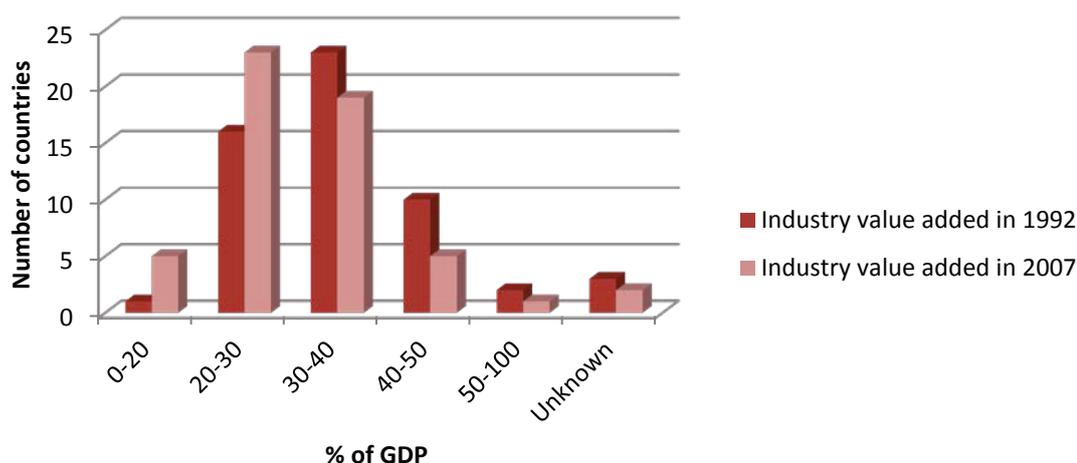
indicator for our purposes because we focus on reform progress, rather than reform success, in this thesis and it provides us with a tool to measure reform progress in each country and each year. Apart from this, it should not and cannot be used to measure reform success or a similar phenomenon in other studies.

**Table 5.3** Country groups based on electricity market closeness index in 2000

<b>Score</b>	<b>Score</b>	<b>Score</b>	<b>Score</b>
<b>0-1.5</b>	<b>1.5-3.0</b>	<b>3.0-4.5</b>	<b>4.5-6.0</b>
<b>(Group 1)</b>	<b>(Group 2)</b>	<b>(Group 3)</b>	<b>(Group 4)</b>
United Kingdom	New Zealand	Czech Republic	Canada
Spain	Norway	Ukraine	Luxembourg
Germany	Australia	Denmark	Korea
Finland	Armenia	Italy	Slovak Republic
Estonia	Bulgaria	Albania	Greece
	Georgia	Bosnia And Herzegovina	Switzerland
	Moldova	Croatia	Iceland
	Portugal	FYR Macedonia	Mexico
	United States	Kyrgyz Republic	Turkey
	Sweden	Austria	Belarus
	Netherlands	France	Mongolia
	Kazakhstan	Ireland	Montenegro
	Latvia	Poland	Tajikistan
	Lithuania	Azerbaijan	Turkmenistan
	Romania	Russian Federation	Uzbekistan
	Slovenia	Serbia	
	Belgium	Hungary	
	Japan		

The data regarding industry value added as % of GDP, net official development assistance and official aid received in current billion US\$ and rural population as % of total population are taken from World Bank (2011). Figure 5.3 shows histogram of industry value added variable. Figure 5.4 presents total development assistance and aid received between 1990 and 2007. Countries that did not receive any aid or assistance during this period are excluded from Figure 5.4. We prefer to use absolute values of aid/assistance in our analysis instead of the size of aid as a percentage of GDP because when we express the size of aid as a percentage of GDP we get very small (very close to zero) values for many countries, which may create serious econometric problems. Also, for aid-receiving countries, what is really important is usually not the size of the aid or assistance but the credibility provided by donor agencies

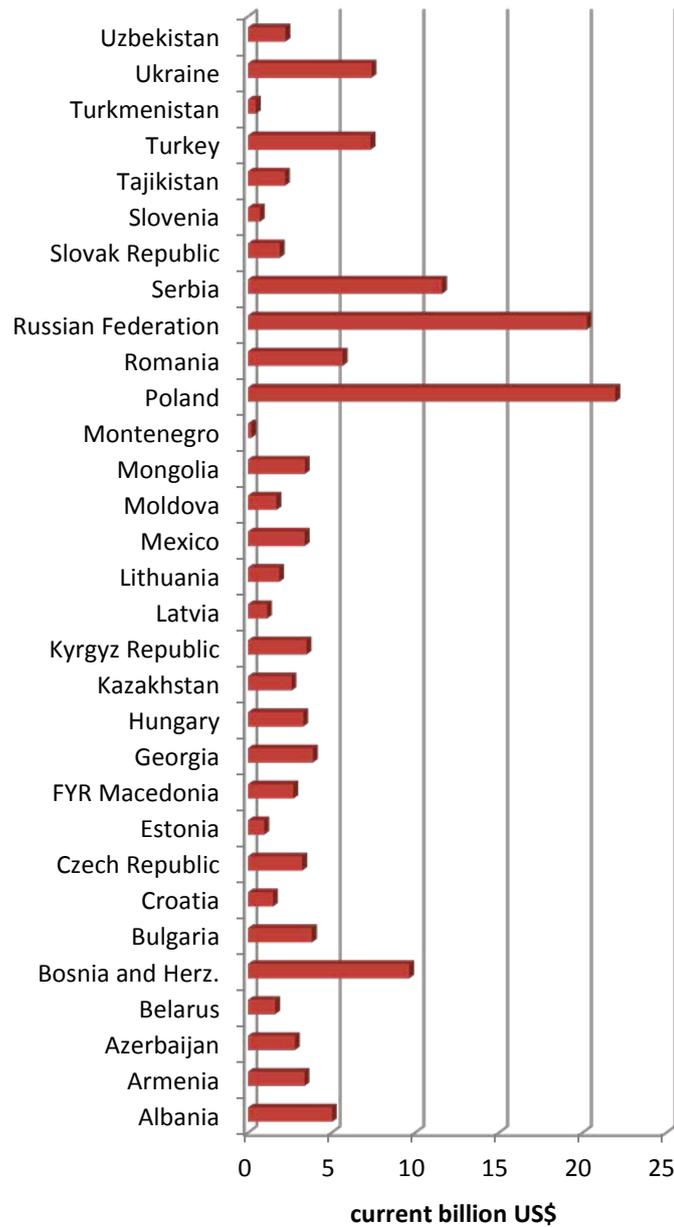
**Figure 5.3** Histogram of industry value added variable



(IMF, World Bank etc.) by qualifying them for the aid/assistance, which usually enables aid-receiving countries to get further low cost credit from international private financial institutions. Besides, the absolute values of aid/assistance may measure financial significance and willingness to be open to reform recommendations of donor countries.

Data on party orientation with respect to economic policy, party structure, the years the chief executive has been in office, and electoral system originate from Keefer (2010). In this study, chief executive refers to the head of the executive branch. In some countries, chief executive is “prime minister” while it is called “president” in some other countries. Professional and educational background of the chief executive data are partly collected by the author and partly provided by Dreher et al. (2009). While deciding on which educational and professional backgrounds to include into our analysis, we selected top five most common professional backgrounds (entrepreneur, scientist (economist), military, politician and scientist (other)) and top three educational backgrounds (economics, natural science and other university). Many chief executives (prime ministers or presidents) especially in developing countries come from a military background; so, we include a dummy variable to represent this background as well. Besides, the chief executives with a military background may worry relatively more about

**Figure 5.4** Total development assistance and aid received, 1990-2007



energy security and have a specific (usually negative) attitude towards the reforms. In our dataset, political leaders may have two or more professional or educational qualifications at the same time. However, this does not amount to double-counting as we believe that the impact of a chief executive on the reform progress is determined by his/her entire professional or educational background, not by one of them only. For instance, if we assume that a prime minister has an undergraduate degree in economics and a graduate degree in law, it is quite natural that his/her decisions on power market reform are affected by his/her knowledge in

both economics and law. Therefore, we had to specify both economics and law as the educational background of this prime minister, which clearly may not be regarded as double-counting. We also created “unknown/other” category to represent other educational and professional backgrounds.

Gini coefficient<sup>17</sup> and polity score data come from UNU-WIDER (2011) and Center for Systemic Peace (CSP, 2010), respectively. The EU has the sustained commitment of the European Commission within a wider single market agenda (which encompasses all industrial sectors) and a political system where energy reforms can become a part of the international bargaining process, which maintains the pressure for further electricity market reforms (Pollitt, 2008b). EU directives are expected to have an influence on the reform progress especially in EU member countries. They are usually decided as a result of a political process among member countries; that is, they are not pure technical documents. So, we put a dummy variable for the EU countries. Dummy variables representing being an EU member, an OECD member and the existence of electricity market reform idea are constructed by the author. In our dataset, OECD membership is a variable in a set of OECD countries because our panel dataset covers 1975-2010 period and some of current OECD members became a member after 1975. For instance, Mexico joined OECD on 18 May 1994. So, for Mexico, “OECD membership” variable takes the value of “0” for 1975-1993 period and “1” for 1994-2010 period. The dummy variable for the existence of electricity market reform idea takes the value 1 after 1989 when the electricity market reform was implemented, for the first time, in a full scale in a developed country (i.e. the UK); the years before 1989 take the value 0.

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<sup>17</sup> The Gini coefficient is a measure of the inequality of a distribution, a value of 0 expressing total equality and a value of 1 maximal inequality.

World Bank (2011) provides data on population density (people per sq. km of land area), electricity consumption (MWh per capita), GDP per capita (PPP, current thousand int. \$) and imports of goods and services as % of GDP. Average number of years of adult (15+) education is taken from Barro and Lee (2010). The data from Barro and Lee (2010) are available with 5-year intervals; to ensure conformity with other data, we converted them into yearly data by linear interpolation.

## **5.6 Empirical analysis**

Our analysis is composed of estimation of three main groups of models to test our hypotheses. Each main group includes two sub-groups of models: one for sub-indicators (entry barriers, public ownership and vertical integration in OECD countries) and another for overall indicator (OECD countries and non-OECD countries). In total, we estimate 15 models. Since using logarithms of variables enables us to interpret coefficients easily and is an effective way of shrinking the distance between values, we transform population density, electricity consumption per capita, GDP per capita and imports of goods and services as % of GDP variables into logarithmic form and use these transformed variables in our models.

We start our analysis by applying Hausman test for fixed versus random effects in each model<sup>18</sup>. As usual, we prefer 5% significance level so any p-value less than 0.05 from Hausman test implies that we should reject the null hypothesis of there being no systematic difference in the coefficients. In other words, Hausman test with a p-value up to 0.05 indicates significant differences in the coefficients. Therefore, in our analysis, if we get a p-value less than 0.05, we choose fixed effects model. However, if p-value from Hausman test is above 0.05, we cannot reject the null hypothesis of there being no systematic difference in the

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<sup>18</sup> Throughout the paper, model estimations are carried out and cross-checked by Stata 11.2 and Eviews 7.1.

coefficients at 5% level. In such a case, we apply Breusch and Pagan Lagrangian Multiplier (BPLM) test for random effects in order to decide on using either pooled OLS or random effects in our analysis. This test is developed to detect the presence of random effects. In this test, the null hypothesis is that variances of groups are zero; that is, there is no unobserved heterogeneity, all groups are similar. If the null is not rejected, the pooled regression model is appropriate. That is, if the p-value of BPLM test is below 0.05, we reject the null, meaning that random effects specification is the preferred one. If it is above 0.05, we prefer pooled OLS specification to carry out our regression. Tables below show a summary of estimation results that present statistically significant coefficients and their standard errors. Full details of

**Table 5.4** Estimation results for the models testing Hypothesis 1 (sub-indicators)

Dependent Variables	Entry barriers	Public Ownership	Vertical integration
	(0-6)	(0-6)	(0-6)
	<i>(OECD countries) (OECD countries) (OECD countries)</i>		
Explanatory variable			
Industry value added (% of GDP)	0.129 <sup>***</sup> (0.027)	0.076 <sup>***</sup> (0.015)	0.128 <sup>***</sup> (0.025)
Control variables			
Rural population (% of total population)	<i>NS</i>	<i>NS</i>	<i>NS</i>
Gini coefficient (0-100)	<i>NS</i>	<i>NS</i>	<i>NS</i>
Polity score (-10,+10)	0.178 <sup>***</sup> (0.046)	<i>NS</i>	0.109 <sup>***</sup> (0.042)
EU member (0-1)	-1.61 <sup>***</sup> (0.319)	<i>NS</i>	-1.407 <sup>***</sup> (0.294)
OECD member (0-1)	1.717 <sup>***</sup> (0.419)	<i>NS</i>	0.907 <sup>**</sup> (0.386)
Existence of electricity market reform idea (0-1)	1.078 <sup>***</sup> (0.274)	<i>NS</i>	0.521 <sup>**</sup> (0.252)
Log of population density	<i>NS</i>	9.221 <sup>***</sup> (1.357)	<i>NS</i>
Log of electricity consumption per capita (MWh)	2.566 <sup>***</sup> (0.796)	-1.188 <sup>***</sup> (0.423)	<i>NS</i>
Log of GDP per capita (PPP, cur. thousand int. \$)	-5.201 <sup>***</sup> (0.536)	-1.157 <sup>***</sup> (0.285)	-3.679 <sup>***</sup> (0.494)
Average number of years of adult (25+) education	<i>NS</i>	<i>NS</i>	<i>NS</i>
Log of imports of goods and services (% of GDP)	-2.415 <sup>***</sup> (0.582)	-0.936 <sup>***</sup> (0.31)	-1.444 <sup>***</sup> (0.536)
Constant	<i>NS</i>	-25.833 <sup>***</sup> (5.876)	17.055 <sup>*</sup> (10.177)

*Standard errors are shown in parentheses () with coefficients.*

*"NS": The coefficient is not significant even at 10% level.*

*Coefficient that is significant at <sup>\*\*\*</sup>1% level, <sup>\*\*</sup>5% level, <sup>\*</sup>10% level.*

estimation results are provided in Appendix III-3 including the full estimation output, the number of observations and the countries included in each model, results of Hausman and BPLM tests and preferred specifications based on these tests.

**Table 5.5** Estimation results for the models testing Hypothesis 1 (overall indicator)

Dependent Variables	Overall indicator	Overall indicator
	(0-6)	(0-6)
	(OECD countries)	(Non-OECD countries)
<b>Explanatory variable</b>		
Industry value added (% of GDP)	0.111 <sup>***</sup> (0.018)	0.057 <sup>***</sup> (0.012)
<b>Control variables</b>		
Rural population (% of total population)	NS	-0.157 <sup>*</sup> (0.082)
Gini coefficient (0-100)	NS	NS
Polity score (-10,+10)	0.091 <sup>***</sup> (0.03)	NS
EU member (0-1)	-0.927 <sup>***</sup> (0.21)	0.463 <sup>*</sup> (0.25)
OECD member (0-1)	0.889 <sup>***</sup> (0.275)	(omitted)
Existence of electricity market reform idea (0-1)	0.569 <sup>***</sup> (0.18)	(omitted)
Log of population density	3.153 <sup>*</sup> (1.675)	NS
Log of electricity consumption per capita (MWh)	NS	4.001 <sup>***</sup> (0.568)
Log of GDP per capita (PPP, cur. thousand int. \$)	-3.345 <sup>***</sup> (0.352)	-3.009 <sup>***</sup> (0.351)
Average number of years of adult (25+) education	NS	NS
Log of imports of goods and services (% of GDP)	-1.598 <sup>***</sup> (0.382)	NS
Constant	NS	NS

Standard errors are shown in parentheses () with coefficients.

"NS": The coefficient is not significant even at 10% level.

Coefficient that is significant at <sup>\*\*\*</sup>1% level, <sup>\*\*</sup>5% level, <sup>\*</sup>10% level.

**Table 5.6** Estimation results for the models testing Hypothesis 2 (sub-indicators)

Dependent Variables	Entry barriers	Public Ownership	Vertical integration
	(0-6)	(0-6)	(0-6)
	(OECD countries)	(OECD countries)	(OECD countries)
<b>Explanatory variable</b>			
Net official assistance and aid received	-0.628** (0.311)	NS	NS
<b>Control variables</b>			
EU member (0-1)	-1.06*** (0.234)	0.227* (0.119)	-1.171*** (0.214)
OECD member (0-1)	2.136*** (0.287)	-0.371** (0.147)	1.125*** (0.262)
Existence of electricity market reform idea (0-1)	1.125*** (0.178)	NS	0.626*** (0.162)
Log of population density	NS	7.314*** (0.73)	2.843** (1.307)
Log of electricity consumption per capita (MWh)	2.984*** (0.408)	-0.354* (0.208)	1.297*** (0.373)
Log of GDP per capita (PPP, cur. thousand int. \$)	-5.987*** (0.347)	-1.273*** (0.177)	-4.536*** (0.316)
Average number of years of adult (25+) education	-0.226** (0.103)	-0.226*** (0.052)	NS
Log of imports of goods and services (% of GDP)	-2.491*** (0.399)	-0.621*** (0.203)	-2.002*** (0.364)
Constant	23.5*** (5.198)	-16.994*** (2.651)	7.825* (4.747)

Standard errors are shown in parentheses () with coefficients.

"NS": The coefficient is not significant even at 10% level.

Coefficient that is significant at \*\*\*1% level, \*\*5% level, \*10% level

**Table 5.7** Estimation results for the models testing Hypothesis 2 (overall indicator)

Dependent Variables	Overall indicator	Overall indicator
	(0-6)	(0-6)
	(OECD countries)	(Non-OECD countries)
<b>Explanatory variable</b>		
Net official assistance and aid received	-0.334* (0.202)	-0.557** (0.252)
<b>Control variables</b>		
EU member (0-1)	-0.668*** (0.152)	NS
OECD member (0-1)	0.964*** (0.187)	(omitted)
Existence of electricity market reform idea (0-1)	0.576*** (0.116)	(omitted)
Log of population density	3.429*** (0.933)	NS
Log of electricity consumption per capita (MWh)	1.309*** (0.266)	2.208*** (0.309)
Log of GDP per capita (PPP, cur. thousand int. \$)	-3.932*** (0.226)	-1.898*** (0.219)
Average number of years of adult (25+) education	-0.115* (0.067)	-1.353*** (0.209)
Log of imports of goods and services (% of GDP)	-1.705*** (0.26)	NS
Constant	NS	11.222* (6)

Standard errors are shown in parentheses () with coefficients.

"NS": The coefficient is not significant even at 10% level.

Coefficient that is significant at \*\*\*1% level, \*\*5% level, \*10% level.

**Table 5.8** Estimation results for the models testing Hypotheses 3 and 4 (sub-indicators)

Dependent Variables	Entry barriers (0-6) <i>(OECD countries)</i>	Public Ownership (0-6) <i>(OECD countries)</i>	Vertical integration (0-6) <i>(OECD countries)</i>
<b>Explanatory variables</b>			
<i>Economic policy orientation of ruling party</i>			
- Right	NS	NS	-0.526** (0.211)
- Left	-0.423* (0.246)	NS	-0.38* (0.214)
- Center	(omitted)	(omitted)	(omitted)
<i>Professional background of chief executive</i>			
- Entrepreneur	NS	-0.457*** (0.161)	-0.591** (0.264)
- Economics	1.333*** (0.389)	NS	1.982*** (0.335)
- Military	NS	NS	NS
- Politician	0.482** (0.213)	-0.201* (0.117)	0.443** (0.191)
- Scientist, Other	0.446* (0.243)	-0.484*** (0.132)	NS
- Unknown/other	0.516** (0.227)	-0.302** (0.124)	0.725*** (0.202)
<i>Educational background of chief executive</i>			
- Economics	NS	NS	0.814* (0.468)
- Natural science	NS	1.123*** (0.33)	1.75*** (0.541)
- Other university	NS	NS	NS
- Unknown/other	NS	NS	NS
<b>Control variables</b>			
Single-party government (0-1)	NS	-0.144* (0.085)	-0.229* (0.139)
The years the chief executive has been in office	0.042** (0.018)	0.033*** (0.009)	0.044*** (0.015)
Parliamentary regimes (0-1)	NS	-0.407* (0.231)	NS
EU member (0-1)	-0.829*** (0.233)	NS	-1.282*** (0.206)
OECD member (0-1)	1.697*** (0.327)	-0.474*** (0.181)	0.966*** (0.293)
Existence of electricity market reform idea (0-1)	0.749*** (0.181)	NS	0.384** (0.158)
Log of population density	0.606*** (0.14)	NS	0.47** (0.218)
Log of electricity consumption per capita (MWh)	2.886*** (0.318)	NS	1.778*** (0.349)
Log of GDP per capita (PPP, cur. thousand int. \$)	-5.73*** (0.321)	-0.638*** (0.187)	-4.266*** (0.299)
Average number of years of adult (25+) education	-0.24*** (0.085)	-0.333*** (0.055)	NS
Log of imports of goods and services (% of GDP)	-1.202*** (0.272)	NS	-1.484*** (0.296)
Constant	16.661*** (1.214)	9.582*** (0.972)	14.172*** (1.352)

*Standard errors are shown in parentheses () with coefficients.*

*"NS": The coefficient is not significant even at 10% level.*

*Coefficient that is significant at \*\*\*1% level, \*\*5% level, \*10% level.*

**Table 5.9** Estimation results for the models testing Hypotheses 3 and 4 (overall indicator)

Dependent Variables	Overall indicator (0-6) <i>(OECD countries)</i>	Overall indicator (0-6) <i>(Non-OECD countries)</i>
<b>Explanatory variables</b>		
<i>Economic policy orientation of ruling party</i>		
- Right	NS	(omitted)
- Left	-0.268* (0.159)	NS
- Center	(omitted)	NS
<i>Professional background of chief executive</i>		
- Entrepreneur	-0.431** (0.196)	NS
- Economics	1.195*** (0.248)	NS
- Military	NS	NS
- Politician	0.262* (0.141)	NS
- Scientist, Other	NS	NS
- Unknown/other	0.342** (0.149)	NS
<i>Educational background of chief executive</i>		
- Economics	NS	NS
- Natural science	0.948** (0.402)	NS
- Other university	NS	NS
- Unknown/other	NS	NS
<b>Control variables</b>		
Single-party government (0-1)	NS	NS
The years the chief executive has been in office	0.038*** (0.011)	NS
Parliamentary regimes (0-1)	NS	NS
EU member (0-1)	-0.752*** (0.152)	NS
OECD member (0-1)	0.791*** (0.215)	(omitted)
Existence of electricity market reform idea (0-1)	0.465*** (0.117)	(omitted)
Log of population density	0.272* (0.141)	NS
Log of electricity consumption per capita (MWh)	1.696*** (0.249)	2.266*** (0.43)
Log of GDP per capita (PPP, cur. thousand int. \$)	-3.628*** (0.218)	-1.245*** (0.37)
Average number of years of adult (25+) education	-0.169*** (0.063)	-1.613*** (0.292)
Log of imports of goods and services (% of GDP)	-0.954*** (0.212)	NS
Constant	13.918*** (0.94)	NS

*Standard errors are shown in parentheses () with coefficients.*

*"NS": The coefficient is not significant even at 10% level.*

Coefficient that is significant at \*\*\*1% level, \*\*5% level, \*10% level.

## **5.7 Discussion of the results**

Our empirical analysis yields findings that are broadly consistent with our hypotheses. Accordingly, we fail to reject our hypotheses. We find that industry sector has a significant impact on the pace of power market liberalization process; and as its size gets larger, so does its influence (Hypothesis 1). Our results also reveal that foreign financial aid and/or assistance make liberalization in electricity industry more likely (Hypothesis 2). Moreover, our findings imply that government ideology is one of the determinants of the progress in electricity market reform process (Hypothesis 3). Finally, based on the results from our analysis, we may conclude that educational and professional background of the chief executive matters for electricity market liberalization (Hypothesis 4). Below we interpret the results in detail and comment on their policy implications.

### **5.7.1 Impact of industry sector on the reforms**

When we look at the results presented in Table 5.4 and Table 5.5, we notice a significant negative relationship between electricity market liberalization and the size of industry sector, meaning that countries with larger industry sectors tend to liberalize less. As industry value added (as % of GDP) increases in a country, power market structure of that country becomes less liberal. For example, if industry value added of an OECD country increases from 40% to 50% of GDP; entry barriers, public ownership and vertical integration scores (on a 0-6 scale) of that country increase by 1.29, 0.76 and 1.28 points, respectively. So, our study confirms the previous works on market liberalization in showing that interest groups have a significant influence on the reform progress and may slow it down.

To illustrate the impact of the industry sector on the reform progress, we can use data from our dataset. For instance, Turkey and Portugal are OECD countries and their overall electricity market closeness indexes (on a 0-6 scale) for 2007 are 2.1 and 1.0; and industry value added (as % of GDP) in these countries was 28.3 and 24.9 in the same year, respectively. Our results suggest that if industry value added (as % of GDP) increases by one unit, electricity market closeness index is expected to rise by 0.111 point (see Table 5.5). Therefore, holding all other variables constant and assuming that two countries are the same apart from their industry value added figures and electricity market closeness indexes, our results suggest that Portugal's electricity market closeness index might be 1.38  $[1+0.111*(28.3-24.9)]$  if Portugal's industry value added figure were to be equal to that of Turkey (i.e. 28.3). So, our findings imply that 0.38 of 1.1 points difference between the electricity market closeness indexes of two countries may be explained by the difference between their industry value added figures.

Based on the results above, we clearly fail to reject Hypothesis 1. Our findings show that industry sector may have a significant impact on the pace of power market liberalization process; and, as its size gets larger, so does its influence. Since Hypothesis 1 is an immediate application of the economic theory of regulation, our results also imply that economic theory of regulation is a practical and valuable tool that can be used in the analysis of electricity market reform processes. According to our results, we can conclude that the relative strength of interest groups is important in determining the outcome of electricity market reform programs.

Although the preferences of industrial consumers cannot directly be deduced from this research, our findings may be an indication that industrial consumers prefer guaranteed subsidized prices in a closed market to the possibility of future reduced prices in a liberal

market. Hence, taking into account this result, reform designers and implementers should do their best to reduce the opposition from industrial consumers by informing them of the benefits of the reform programs for them.

### **5.7.2 Impact of foreign financial aid on the reforms**

The results from Table 5.6 and Table 5.7 clearly show that countries that receive foreign financial aid or assistance are more likely to liberalize their electricity markets and especially tend to reduce entry barriers to their power sector. So, our analysis reveals that countries that receive foreign financial assistance or aid tend to liberalize their electricity market more than a country that does not receive any assistance or aid. This finding holds true for both OECD and non-OECD countries. However, the tendency of liberalization in OECD countries is towards reducing entry barriers to their electricity markets. The results suggest that if an OECD country receives foreign financial assistance or aid, its entry barriers score (on a 0-6 scale) reduces by 0.6 point. We could not detect any statistically significant impact of assistance or aid on public ownership or vertical integration.

We can use data from our dataset once more to illustrate this result. Our results show that if foreign financial aid and/or assistance in a non-OECD country increase by \$1 billion, overall electricity market closeness index (on a 0-6 scale) of that country decreases by 0.557 point (see Table 5.7). Azerbaijan and Armenia are non-OECD countries and, for 2009, their overall electricity market closeness indexes (on a 0-6 scale) are 3.8 and 2.2; and foreign financial aid and/or assistance to these countries in that year was \$0.23 and \$0.53 billion, respectively. Hence, holding all other variables constant and assuming that two countries are the same apart from the amount of foreign financial aid and/or assistance and electricity market closeness indexes, our results suggest that Azerbaijan's electricity market closeness index might be 3.64

$[3.8 - 0.557 * (0.53 - 0.23)]$  if Azerbaijan's foreign financial aid and/or assistance were to be equal to that of Armenia (i.e. 0.53). So, our findings imply that 0.16 of 1.6 points difference between the electricity market closeness indexes of two countries may be explained by the difference between the amount of foreign financial aid and/or assistance received by each country.

Our results show that we fail to reject Hypothesis 2. That is, foreign financial aid and/or assistance seem to make liberalization in electricity industry more likely. Our findings indicate that the proactive involvement of the World Bank and other donor agencies helps diffusing the pro-market ideology of the Washington Consensus.

Taking into account this conclusion, reform implementers should be very cautious while putting market reforms into practice and do their best to avoid creating a public perception that the reforms are imposed by foreign third parties, which may create very important problems related to internalization of the reforms by general public.

Since one of the objectives in this paper is to capture the impact of foreign assistance and aid on the reform progress; we do not prefer to evaluate aid-receiving and non-receiving countries separately. Evaluating aid receiving and non-receiving countries together enables us to capture this impact from a richer dataset. However, we acknowledge that analysing two groups separately in future studies may provide interesting results.

### **5.7.3 Impact of government ideology on the reforms**

As for economic policy orientation of ruling party, our results imply that right wing governments do not have a statistically significant overall effect on the reform process.

However, we see that they reduce vertical integration in OECD countries. On the other hand, left wing governments seem to speed up the reform process in OECD countries. Economic policy orientation of the ruling party does not affect the reform process in non-OECD countries. Left wing governments in OECD countries reduce entry barriers and vertical integration scores (on 0-6 scales) by 0.42 and 0.38 points, respectively. So, our results provide evidence that government ideology considerably influences electricity market reform progress, especially in OECD countries.

The results above suggest that we fail to reject Hypothesis 3, meaning that government ideology may be one of the determinants of the progress in electricity market reform process and the ideological orientation of the political parties may be important in explaining the power market reform process. Our results confirm that the findings of the previous literature we mentioned in Section 5.3.3 hold also true for electricity markets; that is, we detect the suggested correlation between a reform process and government ideology for electricity markets too.

As a result of our analysis, we did not identify any economic policy orientation that slows down the reform progress. That is, our findings imply that during the terms of political parties with some specific ideologies reforms may go further but none of them remarkably slows the reforms down. So, the most important policy implication of this result is that reform designers may wait for the suitable political environment to introduce a specific reform step. For instance, our results show that the best time to reduce entry barriers to the electricity market of an OECD country is during the term of a party with left ideological orientation.

#### **5.7.4 Impact of the background of chief executive on the reforms**

Throughout the paper, we have also analysed whether the educational and professional background of the chief executive (prime minister or president) matters for the implementation of reforms, and found that it has a very significant impact on reform process in OECD countries. The background of the chief executive does not seem to have a statistically significant impact on reform progress in non-OECD countries.

In OECD countries, leaders' background in economics or natural sciences influences the reform process. We could not detect such an effect for other university degrees. The same influence holds true for leaders with a professional background as businessman, scientist (economist and others), or politician. Our results do not indicate significant results for military officers.

We observe a negative relationship between an educational background in economics or natural sciences and the vertical integration score in OECD countries. This relationship is much stronger with an educational background in natural sciences. Our findings suggest that if the chief executive of a country has an educational background in economics or natural sciences, vertical integration score (on a 0-6 scale) of that country increases by 0.81 and 1.75 points, respectively. As for entry barriers and public ownership, we could not detect a meaningful relationship for an educational background in economics but leaders with a background in natural sciences seem to increase public ownership by 1.1 points.

As for professional backgrounds, our study finds that businessmen speed up the regulatory reform in OECD countries while scientists (economists) and politicians slow the liberalization process down. If the chief executive of a country has a professional background as

entrepreneur, then public ownership and vertical integration scores (on a 0-6 scale) of that country reduce by 0.45 and 0.59 points, respectively. On the other hand, if s/he has a professional background as scientist (economist), entry barriers and vertical integration scores increase by 1.33 and 1.98 points, correspondingly.

In OECD countries, the chief executives with a professional background as politicians decrease public ownership but increase entry barriers and vertical integration. On the other hand, those with a background as scientists (other than economists) have a tendency to increase entry barriers but to reduce public ownership.

The following example illustrates the impact of the background of the chief executive on reform progress. Our findings suggest that if the chief executive has a professional background as entrepreneur in an OECD country, electricity market closeness index decreases by 0.431 point in that country; and if s/he has a background as economist (scientist), the index increases by 1.195 points (see Table 5.9). Hungary and Canada are OECD countries and, in 2007, the professional backgrounds of the chief executives were entrepreneur and economist in these countries, respectively. Electricity market closeness indexes were 1 for Hungary and 3.3 for Canada for the same year. Holding all other variables constant and assuming that two countries are the same apart from the professional backgrounds of the chief executives and electricity market closeness indexes, our results suggest that Canada's electricity market closeness index might be 1.67  $[3.3-1.195-0.431]$  if the professional background of Canada's chief executive were to be the same as that of Hungary (i.e. entrepreneur). So, our findings imply that 1.63 of 2.3 points difference between the electricity market closeness indexes of two countries may be explained by the difference between the professional backgrounds of the chief executives in two countries.

The results above show that we fail to reject Hypothesis 4. It seems that educational and professional background of the chief executive matters for electricity market liberalization; and the prior knowledge, education and experience of the chief executive regarding the power market liberalization process may encourage or discourage the reform measures. Since Hypothesis 4 is a direct parallel with the empirical findings reported in the literature connecting personal traits of policy makers and implementers with policy outcomes (summarized in Section 4.3.1), our results contribute to this literature as well.

Taking into account these results, it is clear that the professional and educational backgrounds of the chief executives constitute another determinant of the reform progress, especially in OECD countries; and should be taken into account during reform design and implementation. Since it is not likely that a particular chief executive (prime minister or president) is elected by the public or the legislative body based mainly on this country's policies regarding the extent of electricity market reform, reverse causation does not constitute a potential limitation in this study. However, we acknowledge that some variables and results regarding the background of the chief executive may apply to only one or two countries, whereas others may apply to many countries.

#### **5.7.5 Results from control variables**

The results from the control variables may also explain some variations in reform progress across countries. First of all, in Table 5.8 and Table 5.9, we see that government structure (coalition or single-party) has an impact on the reform process in OECD countries but does not seem to affect liberalization process in non-OECD countries. In OECD countries, single-party governments accelerate the reform process by reducing public ownership and vertical integration. Moreover, we detect a negative relationship between the years the chief executive

has been in office and the reform progress in OECD countries. Again, the same relationship is not observed in non-OECD countries. Therefore, it may be the case that political stability is not an indispensable feature of a reform-enhancing political economic environment in OECD countries, and reforms may be put into practice successfully even in a politically unstable environment. Besides, electoral system (majoritarian or presidential) does not seem to influence liberalization process much while entry barriers seem to be lower in countries with parliamentary systems. Public ownership score (on a 0-6 scale) of a country with a parliamentary system tends to be 0.4 point less than that of one with a presidential system.

The results from Table 5.4 and Table 5.5 indicate that urbanization and income equality have almost no significant impact on regulatory reform in electricity markets. The only statistically significant impact is that an increase in rural population in non-OECD countries (as % of total population) seems to speed up liberalization process in electricity industry; however this impact is quite limited. For instance, if rural population in a non-OECD country increases from 20% to 30% of total population, overall indicator (on a 0-6 scale) of that country decreases by 1.57 points.

Although there seems to be no relation between public ownership and polity score, overall we detect a negative correlation between polity score and power sector liberalization in OECD countries, meaning that politically more liberal OECD countries prefer to liberalize their electricity markets less. Polity score does not seem to be an important factor explaining the reform process in non-OECD countries. For example, if polity score (on a -10 to +10 scale) of an OECD country increases from 3 to 8, entry barriers and vertical integration scores (on a 0-6 scale) of that country increases by 0.89 and 0.55 points, respectively.

Out of 15 models we estimate, 9 models suggest that being an EU member country considerably contributes to efforts for electricity market liberalization. In most cases, this effect is large and statistically significant even at 1% level. The reverse holds true for being an OECD country. The results from 9 models imply that being an OECD country slows down electricity market liberalization process. The relative magnitude of these effects changes from one model to another. Therefore, being a member of both EU and OECD does not have a uniform effect on the reform process. This result indicates the importance of institutional policy for reform progress. EU not only encourages its member countries to introduce reforms but also requires them to carry out various reform programs in their electricity industries within an institutionalized framework.

The existence of electricity market reform idea seems to limit the reform progress, which is consistent with the view that the early reformers had an advantage than the late comers in terms of reform implementation. This result may be explained by reform failures in some countries (e.g. California disaster). Therefore, policy makers and implementers in reforming countries should be able to explain what went wrong in some countries and the measures they took to avoid these problems in their markets.

Population density and electricity consumption per capita seem to have a negative correlation with liberalization process in power industry, meaning that densely populated countries with higher per capita electricity consumption tend to liberalize their electricity markets less. So, this result implies that reforms may go further in countries with a higher rural population and higher income inequality as well.

On the other hand, per capita income, education level and imports of goods and services (% of GDP) tend to have a positive correlation with liberalization process. Countries with higher per

capita income and education level that import a higher portion of goods and services from abroad seem to introduce more reform elements in their electricity markets. This result clearly shows that countries in the higher income group are more likely to progress more in the reform process. Therefore, countries in the low or middle income groups should be careful while importing the market structure of a developed country into their electricity industry as market structure of a developed country may not be suitable for a developing country. Finally, we see that country specific features tend to have a high power in explaining regulatory reform in electricity industries.

#### **5.7.6 Impact of initial conditions, initial price levels and California crisis on the reforms**

In Paper 2 (Section 4.7.6), we tested Paul L. Joskow's argument that states only with high electricity prices have an incentive to introduce reforms in the US and those with relatively low prices do not have such an incentive and therefore do not introduce reforms (White, 1996); and found that electricity prices (especially for industrial consumers) are an effective explanatory determinant of electricity reform internationally as it is in the US. Besides, in the same section, we also investigated whether the differences in initial conditions in terms of reform progress at the beginning of the reform process have an impact on the subsequent reform progress; but could not detect a relationship between initial conditions and the reform progress. In this section, using a different dataset, we would like to investigate again the impact of initial conditions and initial price levels on the reform progress.

As we indicated in Section 2.2.1, the reform process in California resulted in several blackouts in 2000, which may have a profound impact on the decisions whether to initiate an electricity market reform process in other countries. Cross-section dataset in the second paper did not allow us to investigate the impact of so-called "California crisis" on the reform

progress in other countries; however, panel dataset in this paper lets us do so. So, in addition to initial conditions and initial price levels; in this paper, we also try to discover the impact of California crisis on the reform progress.

To perform three investigations we mentioned above, we include four new variables into our analysis, namely “electricity market closeness index when reforms started”, “electricity prices for industry when reforms started”, “electricity prices for households when reforms started” and a dummy variable representing “California crisis” effect. The first variable represents the impact of starting point of the countries in terms of market closeness index on the reform progress while the second and third variables account for the impact of initial price levels. The last variable signifies the impact of “California crisis” on the reform process in other countries.

The main analysis presented in this paper includes data from 55 countries. However, data on initial price levels are quite limited and available only for 28 of them. In order **not** to lose a significant number of observations, we prefer not to include these new variables directly into our main analysis. Instead, we prefer to develop two new but limited models to test the impact of initial conditions, initial price levels and California crisis on the reform processes in various countries. Besides, the data on our new variables are not compatible with fixed-effects estimation techniques that we have extensively used in the analysis of the main model. The variables representing “electricity market closeness index when reforms started”, “electricity prices for industry when reforms started” and “electricity prices for households when reforms started” have a separate value for each country but this value is naturally the same across all years. For instance, Finland and Hungary had an electricity market closeness index of 3.4 and 6.0 when they initiated a reform program in their power markets, respectively. We have 33 observations for each variable and for each country; and each observation represents a

specific year during 1975-2007 period. So, 33 observations representing “electricity market closeness index when reforms started” for France are the same and equal to 3.4. Similarly, those for Hungary are the same and equal to 6.0. In other words, the observations on these three variables vary across countries but not years. When we include these new variables into our analysis and try to perform a fixed-effects estimation, Stata drops all of them to avoid collinearity. So, in practice, it is not possible to include these new variables directly into our main analysis, which is mostly based on fixed-effects estimation methods.

To overcome the problems mentioned above, we specify two new models including all explanatory and control variables we used in our main model and four new variables we mentioned above; and estimate them using random-effects estimation methods. Table 5.10 and Table 5.11 present estimation results from two new regressions. Compared to the main one, these new models are limited in the sense that we have much less data to estimate equations based on them. Table 5.10 shows estimation results for the limited model testing Hypotheses 1 and 2 while Table 5.11 presents estimation results for the limited model testing Hypotheses 3 and 4. Since we have quite different number of observations in these models and the main model and use additional variables in these models, it is natural that the results may be different. The limited models in this section are formulated to give an idea about the impact of initial conditions, initial price levels and California crisis on the reform progress using the limited dataset we have.

As can be seen in Table 5.10 and Table 5.11, the empirical analysis in this section yields results quite similar to those from our main models. Coefficients of the variables representing industry value added, net official assistance and aid received, economic policy orientation of ruling party and professional background of the chief executive are still significant and have

**Table 5.10** Estimation results for the limited model testing Hypotheses 1 and 2

<b>Electricity market closeness index (0-6)</b>	
<i>(Dependent variable)</i>	
<b>Explanatory variables</b>	
Industry value added (% of GDP)	0.09*** (0.015)
Net official assistance and aid received	-0.397* (0.233)
Electricity market closeness index when reforms started (0-6)	0.478*** (0.117)
Electricity prices for industry when reforms started (US\$/MWh)	-0.047*** (0.011)
Electricity prices for households when reforms started (US\$/MWh)	0.021*** (0.006)
California crisis (dummy, =1 after 2000)	-1.294*** (0.146)
<b>Control variables</b>	
Rural population (% of total population)	NS
Gini coefficient (0-100)	NS
Polity score (-10,+10)	0.081*** (0.027)
EU member (0-1)	-1.167*** (0.184)
OECD member (0-1)	NS
Existence of electricity market reform idea (0-1)	NS
Log of population density	NS
Log of electricity consumption per capita (MWh)	NS
Log of GDP per capita (PPP, cur. thousand int. \$)	-1.34*** (0.346)
Average number of years of adult (25+) education	-0.148* (0.083)
Log of imports of goods and services (% of GDP)	NS
Constant	4.594*** (1.681)

*Standard errors are shown in parentheses () with coefficients.*

*"NS": The coefficient is not significant even at 10% level.*

*Coefficient that is significant at \*\*\*1% level, \*\*5% level, \*10% level.*

*Number of countries: 28, number of observations: 456.*

**Table 5.11** Estimation results for the limited model testing Hypotheses 3 and 4

<b>Electricity market closeness index (0-6)</b>	
<i>(Dependent variable)</i>	
<b>Explanatory variables</b>	
<i>Economic policy orientation of ruling party</i>	
- Right	-0.753 <sup>***</sup> (0.144)
- Left	-0.719 <sup>***</sup> (0.146)
- Center	(omitted)
<i>Professional background of chief executive</i>	
- Entrepreneur	NS
- Economics	0.826 <sup>***</sup> (0.242)
- Military	NS
- Politician	0.245 <sup>**</sup> (0.114)
- Scientist, Other	-0.414 <sup>***</sup> (0.128)
- Unknown/other	NS
<i>Educational background of chief executive</i>	
- Economics	NS
- Natural science	NS
- Other university	NS
- Unknown/other	NS
Electricity market closeness index when reforms started (0-6)	0.338 <sup>***</sup> (0.04)
Electricity prices for industry when reforms started (US\$/MWh)	-0.019 <sup>***</sup> (0.003)
Electricity prices for households when reforms started (US\$/MWh)	0.009 <sup>***</sup> (0.002)
California crisis (dummy, =1 after 2000)	-1.749 <sup>***</sup> (0.128)
<b>Control variables</b>	
Single-party government (0-1)	-0.288 <sup>***</sup> (0.091)
The years the chief executive has been in office	0.03 <sup>**</sup> (0.012)
Parliamentary regimes (0-1)	-0.279 <sup>*</sup> (0.162)
EU member (0-1)	-0.83 <sup>***</sup> (0.131)
OECD member (0-1)	0.449 <sup>**</sup> (0.193)
Existence of electricity market reform idea (0-1)	-0.254 <sup>**</sup> (0.125)
Log of population density	NS
Log of electricity consumption per capita (MWh)	NS
Log of GDP per capita (PPP, cur. thousand int. \$)	-1.344 <sup>***</sup> (0.25)
Average number of years of adult (25+) education	NS
Log of imports of goods and services (% of GDP)	NS
Constant	7.446 <sup>***</sup> (0.764)

*Standard errors are shown in parentheses () with coefficients.*

*"NS": The coefficient is not significant even at 10% level.*

*Coefficient that is significant at \*\*\*1% level, \*\*5% level, \*10% level.*

*Number of countries: 27, number of observations: 674.*

signs mostly similar to those of the main model. The findings from limited models still confirm (i) industry sector has a significant impact on the pace of power market liberalization process; and as its size gets larger, so does its influence (Hypothesis 1), (ii) foreign financial aid and/or assistance make liberalization in electricity industry more likely (Hypothesis 2), (iii) government ideology is one of the determinants of the progress in electricity market reform process (Hypothesis 3) and (iv) the background of the chief executive matters for electricity market liberalization (Hypothesis 4). The similarity of the results from limited model and the main model confirms the robustness of our results.

In addition to verifying the robustness of our previous findings, the results from this section show that initial conditions, initial price levels and California crisis have a statistically significant impact on the reform progress. That is, we see that four new variables are significant. Our results indicate that market closeness index when reforms started and initial residential electricity prices are positively correlated with market closeness index (and therefore, negatively correlated with reform progress), meaning that reform progress may be limited in countries where the market has a closed structure at the beginning of the reforms and where residential electricity prices were relatively higher when reforms started. On the other hand, we detect a negative relationship between market closeness index and initial industrial electricity prices, implying that the reforms advance more rapidly in countries where industrial electricity prices were relatively higher at the beginning of the reform, confirming Joskow's argument. Finally, we also observe a negative relationship between market closeness index and California crisis. That is, our results show that California crisis has not had a negative effect on the reform progress in other countries. Positive reform experiences in successfully reforming countries (e.g. UK and Norway) have probably dominated the negative effect of the California experience.

As a result of the analysis in this sub-section, we find out that initial market conditions, initial price levels and California crisis are effective explanatory determinants of electricity reform. Even after allowing for differences in these variables, the political economic factors are still significant determinants of the extent of reforms. Our findings imply that reform progress is positively affected by high initial electricity prices for industrial consumers, but negatively influenced by those for households. This outcome is partially in conformity with Joskow's argument. That is, high initial electricity prices for industry seem to speed up reform process as suggested by Joskow; but high initial prices for households are likely to slow down the reform process. Besides, similar to the results from the second paper, when we take into account the fact that industrial consumers are much more organized (and therefore influential) than the residential ones, the results from our analysis seem to be in conformity with the predictions of economic theory of regulation.

## **5.8 Conclusion**

This paper examined the political economy of liberalization in the electricity industries in the last decades. We empirically analysed the political economy of reform in the electricity industries of 55 countries during the period 1975–2010 with the aim of shedding light on the differing paces of reform in different countries. The use of a unique data set obtained by merging different data sources on political, government and reform structures as well as private interests and government ideologies allowed us to explore time-series and cross-sectional variation in the political process of economic liberalization. Our findings are consistent with the rationale that the structure of political economic system has a strong effect on reform outcomes, and that the relative strength of economic and political variables matters for the implementation of the reforms.

Consistent with public choice theory and economic theory of regulation, our results suggest that a portion of the differences in the reform experiences of reforming countries in the past three decades can be explained by differences in the relative strength of interest groups. In the course of the study, we discover that industry sector has a significant impact on the pace of power market liberalization process; and as its size gets larger, so does its influence. Besides, our results imply that countries receiving foreign financial support are more likely to liberalize their electricity markets, which underlines the point that reforms may not be always voluntary. In addition, our findings suggest that government ideology is one of the determinants of the progress in electricity market reform process. We identify a decrease in vertical integration in electricity industry during the terms of parties with “right” or “left” ideologies in OECD countries. The ruling parties with “left” ideology seem also to reduce entry barriers in OECD countries.

The study also questions whether politicians’ education and profession matter for the electricity market reforms. Overall, our results show that they do. According to our results, reforms are more likely to occur if the head of government has been an entrepreneur before entering into politics. Personal capabilities required to manage a company thus seem to be advantageous in promoting economic reform. Moreover, during the tenure of former professional economists, reforms are less likely. This result may also be plausible if we take into account the fact that many economists educated before the 1990s are taught that electricity industry is a natural monopoly and, therefore, an unbundled power sector may result in inefficiency in the provision of electricity service. We also provide evidence that the reforms seem to progress slower in OECD countries if the chief executive has an educational background in economics or natural science. Especially, those with a background in economics increase vertical integration while those with a background in natural science increase both vertical integration and public ownership in the sector. In summary, our analysis

confirms that the personal background of political leaders may be important. Clearly, other characteristics of politicians also matter for successful policy, and profession and education alone do not guarantee success. Besides, the focus of our analysis is restricted to economic reforms. Arguably, other policy dimensions are as equally important as the economic policy. Whether and to what extent those types of education and profession identified here as being supportive for market-oriented liberal reforms are also successful in other areas remain for future research.

As a final point, by means of the estimation of a limited model, we also found that initial market conditions, initial price levels and California crisis are effective explanatory determinants of electricity market reform progress.

The most important single policy implication that can be derived from these findings for the electricity industry and, to some extent, for other infrastructure industry reform is that future liberalization programs should give due attention to the political economic environment of the countries.

# Chapter 6

## 6 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, 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 thesis contributes to efforts to analyse electricity market reforms with an applied macro level cross-country approach.

This concluding chapter has five sections. First of all, we discuss whether we have answered the research questions asked in the introductory chapter. Then, we mention main policy repercussions of the results from the three papers. The third section of this chapter aims at providing key policy suggestions either to a country that seriously considers implementing or redesigning a reform program in its electricity market or to a consultant that advises such a country. A discussion of the limitations of the research constitutes the fourth section. The final section in this chapter discusses what we have done and what still needs to be done.

## 6.1 Have research questions been answered?

Let me start by discussing whether we have answered all research questions that we asked in Chapter 1. The first two questions were “*what is the impact of electricity market reforms on electricity price-cost margins?*” and “*does liberalization cause a change in industrial/residential electricity price ratios?*” The analysis in the first paper shows that there isn’t a uniform pattern for the impact of reform process as a whole on price-cost margins and industrial/residential price ratios. Each individual reform step has different impact on price-cost margins and industrial/residential price ratios for each consumer and country group. That is, similar reform steps may have different impacts in different countries. The third question was “*what are the other factors that influence electricity price-cost margins and industrial/residential electricity price ratios and how much are they influential relative to reform process?*” In the course of the analysis in the first paper, we find that that power consumption, income level, electricity losses and country specific features constitute other important determinants of electricity price-cost margins and industrial/residential price ratios; and compared with reform process, they are more significant.

The fourth and fifth research questions were “*do differences in institutional structures of countries play an important role in explaining how far reforms have gone in these countries?*” and “*if they do, how do specific institutional endowments of a country affect its reform performance?*” The results from the second paper show that institutional endowments of countries are important determinants of how far reforms have gone in different countries. Our findings suggest that the level of democracy and corruption in a country is significant in terms of reform progress. We see a positive relationship between reform progress and corruption perceptions index (which increases as corruption declines in a county), underlining the fact

that reforms go further in corruption-free countries. We also identify a negative relationship between reform progress and civil liberties, which may prove that reforms may be limited in democratic 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.

The sixth research question was “*does the background of the chairperson of the regulatory agency when reforms started or were considered or that of the governor or minister responsible for energy policy at that time have an impact on reform progress?*” Our empirical findings suggest that the educational background and education level of the chairperson and governor/minister are important for reform progress. We could not detect any statistically significant relationship between experience or length of term of the chairperson or governor/minister and the scope of reforms.

The seventh research question was “*what is the impact of industrial electricity consumers (as an interest group) on the reform progress in power sector?*” The findings of the third paper imply that the structure of interest groups in a country has an impact on the reform progress. The findings suggest that there is an inverse relationship between the size of the industry sector and electricity market liberalization process. That is, as industry value added (as % of GDP) increases in a country, power market structure of that country becomes less liberal. The eighth question was put forward as “*does foreign influence resulting from the dependence on foreign financial support have an influence on the electricity market liberalization process?*” Our analysis reveals that a country that receives foreign financial assistance or aid tends to liberalize its electricity market more than a country that does not receive any assistance or aid.

The final research question was “*do the ideology of ruling party and professional/educational background of the chief executive (prime minister or president) constitute important determinants of the reform progress? If yes, what is the direction of the influences originated from these variables?*” In the course of our analysis, we found that right wing governments do not have a statistically significant overall effect on the reform process but they reduce vertical integration in OECD countries. On the other hand, left wing governments seem to speed up the reform process in OECD countries. Economic policy orientation of the ruling party does not affect the reform process in non-OECD countries. Besides, we also found that the educational and professional background of the chief executive (prime minister or president) has a very significant impact on reform process in OECD countries. The background of the chief executive does not seem to have a statistically significant impact on reform progress in non-OECD countries.

## **6.2 Policy repercussions of the results**

In this section, we mention main policy repercussions of the results only while detailed results are available from the specific papers. Although each paper has its own specific results, the results from the thesis as a whole may be grouped into eight main policy implications. However, the validity of our results are limited by some factors specified in Section “6.4 Limitations of the research”. Besides, our results are obtained by analysing a specific dataset covering a limited number of countries and a limited period of time. In the future, other scholars using different datasets may get different conclusions than ours. The policy recommendations below should be evaluated taking into account this fact.

After briefly mentioning the reform progress in some of the countries we focus on in this thesis in Chapter 2, we explored the impact of power market reforms on electricity price-cost

margins and industrial/residential price ratios in the first paper. To observe the impact of electricity market reforms on electricity price-cost margins and industrial/residential price ratios, we used empirical econometric models with panel data from 63 countries covering the period from 1982 to 2009. The results from the first paper indicate that there is not a uniform pattern for the impact of reform process as a whole on price-cost margins and industrial/residential price ratios; and, each individual reform step has different impact on price-cost margins and industrial/residential price ratios for each consumer and country group. That is to say, the results suggest that similar reform steps may have different impacts in different countries. So, the *first* policy implication of the results from this thesis is that *reform prescription for a specific country cannot easily be transferred to another one with similar success*. Thus, while deciding whether to initiate a reform program or in the process of making decisions on the direction of an already initiated reform program, policy makers need to take into account the fact that each reform step has a specific impact in each country based on each country's specific circumstances. Also, countries that try to adopt the power market structure of another country (for example, the adoption by developing countries of an electricity industry model similar to the UK) may have very different performance characteristics than the original country because their country-specific conditions will be different. In short, the first policy implication states that transferring the formal and economic structure of a successful power market in a developed country to a developing country is not a sufficient condition for good economic performance of the electricity industries in developing countries.

The results from the first paper also underline the fact that power consumption, income level, electricity losses and other country specific features constitute important determinants of electricity price-cost margins and industrial/residential price ratios. So, the *second* policy implication of the results from this thesis is that *electricity price-cost margins and*

*industrial/residential price ratios are partly a function of country specific features such as power consumption, income level and so on; therefore, policy makers need to pay due attention to specific characteristics of the country while formulating policies on electricity prices and industrial/residential price ratios.*

The second paper 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. It focused on these issues by using an empirical econometric model with cross-section data from 51 states in US, 13 provinces in Canada and 51 other countries to observe the impact of institutional variables on the reform progress. Based on the results from the second paper, we have three more policy implications. The **third** policy implication of the results from this thesis is that ***the background of the chairperson and the minister/governor and institutional endowments of a country are important indicators of how far reforms will go in a country.*** Therefore, while designing electricity market reform programs, institutional structure of a country and qualifications of the policy makers/implementers need to be taken into account.

The **fourth** policy implication, based on the results from the second paper, is that ***reforms go further in corruption-free countries.*** So, countries that want to implement more extensive electricity markets reforms need to do their best to reduce and, if possible, eliminate all structures, rules and procedures that may cause or tolerate corruption. The **fifth** policy implication suggests that ***there is a negative relationship between reform progress and civil liberties.*** This result points to the possibility that democracy may delay or hinder the reforms

by magnifying the voices of anti-reform interest groups. Hence, to lessen the negative impact of democracy on the reforms, a public awareness campaign may be launched concerning the objectives and benefits of the reforms.

The third paper examined the political economy of liberalization in the electricity sector using data from 55 countries for the period 1975–2010 with the aim of shedding light on the differing pace of reforms in different countries. The main conclusion of the third paper is that the structure of political economic system is strongly correlated with reform outcomes; so, the relative strength of economic and political variables seems to matter for the implementation of the reforms. Based on this conclusion, the *sixth* policy implication of the results from this thesis is that *a portion of the differences in reform experiences of countries can be explained by differences in the political structure, in the ideology of the government and in the professional and educational backgrounds of the political leaders.*

The *seventh* policy implication, provided by the third paper, states that *countries with larger industry sectors tend to liberalize less.* Although the preferences of industrial consumers cannot directly be deducted from our research, this conclusion may indicate a lack/shortcoming of trust by industrial consumers concerning the positive implications of the reforms for them. The fact that large industrial consumers tend to be subsidized in the pre-reform period in many countries may also explain the negative attitude of industry sector towards the reforms. So, policy makers need to take additional measures to improve the confidence in benefits of the reforms among industrial consumers. The *eighth* policy implication stipulates that *countries receiving foreign financial support are more likely to liberalize their electricity markets.* Countries receiving foreign financial aid or assistance need to be careful in designing and implementing market reforms and do their best to avoid creating a public perception that the reforms are imposed by foreign third parties on the

country, which may create important internalization problems in the course of reform implementation.

### **6.3 Policy suggestions**

As stated before, another aim of this chapter is to provide policy suggestions either to a country that seriously considers implementing or redesigning a reform program in its electricity market or to a consultant that advises such a country. The results from the thesis may be used as guidelines by policy makers in the process of formulating, implementing, evaluating and redesigning electricity market liberalization programs. The six main policy advises from the three papers are as follows: (1) do not copy or totally transfer the formal and economic structure of a successful power market of another country into your country without paying due attention to local conditions; (2) institutions matter, so take into account all institution-related variables while deciding on any aspect of the reforms; (3) people also matter; so the right people in the right positions are required for a successful reform progress; (4) political economic conditions and structure of interest groups have a substantial impact on the reform outcome, so try to implement reforms under appropriate political conditions with support from key interest groups; (5) democracy may delay or hinder the reforms by magnifying the voices of anti-reform interest groups, so launch a public awareness campaign about the objectives and benefits of the reforms; (6) countries receiving foreign financial support are more likely to liberalize their electricity markets, so be careful in designing and implementing market reforms and do your best to avoid creating a public perception that the reforms are imposed by foreign third parties.

Policy suggestions above are derived from testing of hypotheses that we formulated. However, we used many control variables in our analyses but didn't formulate them as

hypotheses. We acknowledge that the results from control variables are as plausible as those from testing of hypotheses, and most of the results from the control variables can be rationalized in terms of political economy or NIE literature.

#### **6.4 Limitations of the research**

The doctoral research presented in this thesis may have a number of limitations that we acknowledge. In fact, we have no reason to believe that any of these limitations should undermine our analyses, but cannot of course rule them out. The issue of endogeneity, the limited nature of our datasets and the qualitative nature of electricity market reform indicator data constitute three potential limitations of the analyses presented in this thesis.

To begin with, like all other econometric studies on reform, the issue of endogeneity may be raised in our papers too. In the context of electricity reform, it is likely that just as non-reform variables (e.g. institutional variables, political economic structure and so on) have an impact on reform variables; reform process can also affect non-reform variables in a country. Besides, some variables in our models may be endogenously determined. In other words, some explanatory variables in our models may influence each other as well as the electricity market reform progress. Actually, instrumental variable (IV) methods allow consistent estimation when the explanatory variables (covariates) are correlated with the error terms of a regression relationship. Such correlation may occur when the dependent variable causes at least one of the covariates (“reverse” causation), when there are relevant explanatory variables which are omitted from the model, or when the covariates are subject to measurement error. There are two main requirements for using an IV: (1) the instrument must be correlated with the endogenous explanatory variables, conditional on the other covariates, (2) the instrument cannot be correlated with the error term in the explanatory equation, that is, the instrument

cannot suffer from the same problem as the original predicting variable. Credibility of the estimates from a regression using IV methods hinges on the selection of suitable instruments that do not violate these two conditions. If these conditions are violated then IV method may create more problems than it solves. Since we could not find suitable instrumental variables in our analyses, we prefer not to use IV methods in our papers. The analyses in the first and third papers deal to some extent with this potential problem by including country and year fixed effects. The country fixed effects control for country-specific propensities to reform and year fixed effects control for any general trend in the reform of electricity sector.

The second shortcoming may originate from the limited nature of our data sets. In the first and third papers, our samples are composed of 63 and 55 countries, respectively, for which we could obtain data on all variables in our models. There will 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. Moreover, different countries may have different classifications and reporting conventions, so observations in a given data series may not have the same meaning across all countries. Taken together, any measurement error and omission of explanatory variables may bias estimates of all coefficients in the models. However, in the first and third papers, omitted variables may be captured at least in part by the country-specific effects, mitigating the potential for bias. In the second paper, the sample is composed of 51 states in US, 13 provinces in Canada and 51 other countries. There are two main reasons for the limited nature of the dataset in the second paper. First, since our analysis in the second paper 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. Here, it is important to note that we include all countries where a kind of regulation exists via an independent commission or a government department into our analyses; that is, we do not exclude countries where regulation is made via a government department. We only

exclude those countries where there is not any kind of regulation. We could detect the existence of such regulatory agencies in 135 countries. Second, out of these 135 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. Moreover, we considered including dummy variables for ex-Communist countries and former colonies. However, when we repeat our analyses including dummy variables for ex-Communist countries and former colonies, the results showed that the coefficients of these dummies are not significant even at 10% level. Besides, there is not a strong argument in the literature on the relationship between reform progress and being an ex-Communist country or a former colony. Therefore, we prefer not to include additional dummies into our analyses.

**Figure 6.1** Reform score frequencies of reported and non-reported countries in the second paper

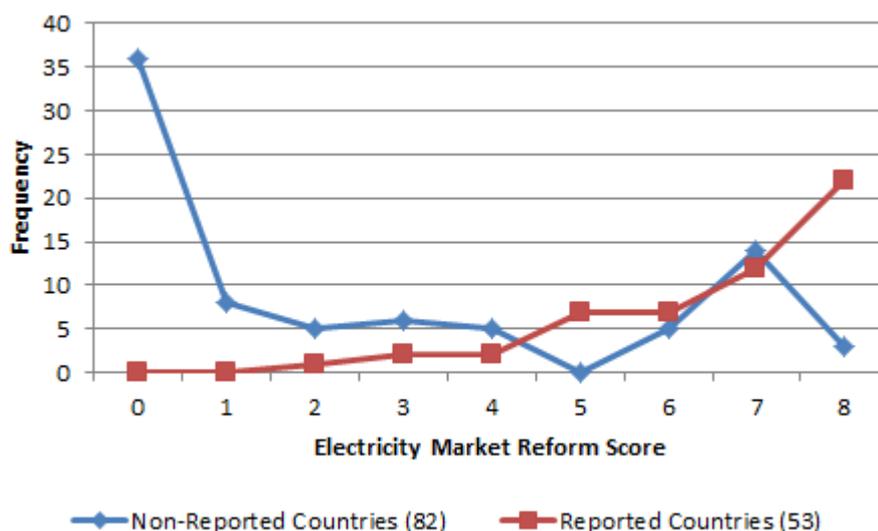


Figure 6.1 provides electricity market reform score frequencies of reported and non-reported countries in the second paper. As can be seen in Figure 6.1, more than half of the non-

reported countries have a reform score of either 0 or 1. A *de facto* reform program refers to one that is put in practice but not necessarily ordained by law. That is, there may or may not be a specific law for the reform but a *de facto* reform program is implemented in practice and transforms the power market structure. On the other hand, a *de jure* reform program refers to one designed on paper and “in law” but usually not put into practice due to various problems related to reform implementation (Acemoglu et al., 2005). In our case, most of the non-reported countries have highly inefficient and corrupted institutional structures that are capable of organizing neither a *de facto* reform program nor a *de jure* one. That is, they do not have necessary means and capabilities both to set up a proper legal basis for the reform and to put the reforms in practice. However, we acknowledge that our dataset is limited by data availability and some of the missing countries have high reform scores. We did our best to collect as much data as possible and include as many countries as possible; however, this is the best that we can do with available resources. For instance, we would like to include much more data into our dataset and investigate the determinants of reform progress in African countries; however, countries in Africa are the most problematic ones in terms of data collection. In most cases, ministries and regulators do not have proper web sites. When they do, their web sites are not available in English. We sent many e-mails to get data but very few are replied. In short, current data available on African countries do not let us carry out any kind of meaningful regression on reform progress in African countries.

Due to lack of data, we could not properly account for the impact of some other variables on dependent variables in our analyses. For instance, in the first paper, we could not properly account for the impact of some variables on electricity price-cost margins like technological innovations, changes to regulatory practices, market power and so on. Besides, problems associated with price conversions using exchange rates tend to reduce the usefulness of cross-country data in the first paper. In the first paper, we use electricity prices in national

currencies converted by IEA and OLADE into US\$/kWh using the exchange rates to the U.S. dollar. As we know, if two countries have differing rates of inflation, then the relative prices of goods in the two countries, such as electricity, will change. The relative price of goods is linked to the exchange rate through the theory of Purchasing Power Parity (PPP), which states that the exchange rate between one currency and another is in equilibrium when their domestic purchasing powers at that rate of exchange are equivalent. Purchasing power parities take into account different rates of inflation among different economies and equalise the purchasing power of different currencies. In other words, they eliminate the differences in price levels between countries in the process of conversion. However, due to problematic nature of calculation process of PPPs, we do not use them in the first paper. Although our approach ignores the inflation in the US, it does so consistently and uniformly across countries. Therefore, it does not pose an important limitation to our analysis.

Another limitation in our papers is the problem associated with measuring the true scale and scope of electricity market reforms. To lessen the impact of problems related to qualitative nature of electricity market reform indicator, we adopt a different approach in each paper. In the first paper, we use separate dummy variables for each reform step; in the second paper, we construct an aggregate reform score variable to reflect the extent of the reform process and, in the third paper, we do not construct a reform indicator ourselves and use various electricity market reform indicators constructed by OECD and EBRD. Nonetheless, we cannot claim that any of our reform indicators fully reflects all characteristics and intensity of the reforms in various countries.

## **6.5 What still needs to be done**

Our final purpose in this chapter is to discuss what we have done and what still needs to be done. In the first paper, we used panel data to explain the impact of reforms on electricity price-cost margins and industrial/residential price ratios. In the second paper, we employed cross-section data to observe the relationship between quality of institutions and the reform progress. In the third paper, we aimed at investigating the impact of political economic variables on the reform outcome. In short, this thesis tried to fill the gap in the applied literature concerning the analysis of electricity market liberalization programs. Our results do not allow a judgement on success or failure of the reform processes. Even with the results from this thesis, the present econometric evidence on the impact of the reforms is still limited.

In many countries, power market reform is still an on-going process; so, there is a definite need and ample opportunities for continued analyses of the reforms in the electricity industries. The hope is 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 focus 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. Second, in the first paper, we investigate the impact of reforms only on electricity price-cost margins and industrial/residential price ratios. These are just two dimensions of reform outcome and the reform process should be judged based on its overall impact (not only its impact on price-cost margins and industrial/residential price ratios). Therefore, there is clearly a need for further analysis regarding the impact of reforms on other dimensions such as efficiency in electricity industry, security of supply, private investments into power sector

(especially in developing countries), sustainable development and so on. Third, although some academic work on the social cost-benefit analysis of the reforms exist, they mostly use data from one country or few countries and only deal with a single reform step (usually privatization). However, what is needed is a comprehensive social-cost benefit analysis that takes into account as many countries as possible and all reform elements. Without such a study, no one can truly talk about reform success or failure.

The fourth possible extension in future research may be the identification of suitable instrumental variables (IV) to overcome the possible endogeneity problem. In spite of our efforts, we could not find any suitable instrumental variable in our analyses and, therefore, did not use IV methods in our papers. 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 fifth 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 the first, second and third papers, we employed data from 63, 53 and 55 countries, respectively. 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 dependent variables in our analyses. For instance, we could not properly account for the impact of technological innovations, changes to regulatory practices, market power and so on in our analyses. Future research should focus on developing techniques to overcome these data-related problems.

The sixth 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. 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, in the second and third papers, we studied certain aspects of institutional quality and political economic variables. Of course, there remain many other characteristics of institutions and political economic structure 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 I-1: Price-fuel cost margins when electricity reforms started

No	Countries	The year electricity reform started	Electricity prices for industry when electricity reform started (US\$/MWh)	Electricity prices for households when electricity reform started (US\$/MWh)	Fuel cost when electricity reform started (US\$/MWh)	Price-fuel cost margin for industry when electricity reform started (US\$/MWh)	Price-fuel cost margin for households when electricity reform started (US\$/MWh)
1	Argentina	1992	113.90	83.70	21.04	92.86	62.66
2	Australia	1992	45.81	73.92	17.81	28.00	56.11
3	Austria	2000	38.25	117.51	5.89	32.36	111.63
4	Belgium	1999	55.49	152.08	15.76	39.72	136.31
5	Bolivia	1994	71.80	72.20	19.05	52.75	53.15
6	Brazil	1997	50.90	129.60	16.56	34.34	113.04
7	Canada	1989	34.12	49.74	17.61	16.51	32.13
8	Chile	1982	41.10	79.50	19.16	21.94	60.34
9	Colombia	1994	74.10	40.20	17.29	56.81	22.91
10	Czech Republic	2001	42.61	59.71	16.17	26.44	43.54
11	Denmark	2000	57.69	197.44	15.15	42.54	182.29
12	Dominican Republic	1998	118.00	95.90	14.19	103.81	81.71
13	Finland	1995	60.22	108.86	17.87	42.35	90.99
14	France	2000	35.76	101.66	15.81	19.95	85.85
15	Germany	2005	83.98	212.42	29.94	54.04	182.48
16	Greece	1999	50.28	90.08	12.68	37.60	77.40
17	Hungary	1994	46.23	39.86	16.12	30.11	23.74
18	India	1998	82.04	29.01	14.65	67.39	14.36

19	Indonesia	2000	35.92	24.62	16.53	19.39	8.09
20	Ireland	1999	56.55	117.15	15.23	41.32	101.92
21	Israel	1998	63.53	90.88	14.19	49.34	76.69
22	Italy	1996	101.38	177.67	20.07	81.31	157.60
23	Japan	1996	157.23	230.11	24.00	133.24	206.11
24	Korea	2001	47.71	70.96	19.47	28.23	51.49
25	Luxembourg	2000		99.26	22.28		76.98
26	Mexico	1995	27.00	44.79	19.60	7.41	25.19
27	Netherlands	1998	62.38	127.86	18.20	44.18	109.66
28	New Zealand	2003	45.84	94.81	26.08	19.76	68.73
29	Norway	1991	35.47	72.95	18.25	17.23	54.70
30	Peru	1994	64.10	106.50	19.05	45.05	87.45
31	Poland	1997	36.19	62.41	15.68	20.52	46.73
32	Portugal	1996	108.32	175.68	16.42	91.90	159.26
33	Romania	1998	44.66	31.71	16.07	28.59	15.64
34	Slovak Republic	2001	43.10	62.83	19.28	23.82	43.55
35	South Africa	2004	21.63	59.91	19.92	1.70	39.99
36	Spain	1997	60.57	163.41	15.81	44.76	147.60
37	Sweden	1996	44.88	109.59	14.49	30.39	95.09
38	Switzerland	2001	67.52	108.95	28.12	39.40	80.83
39	Taiwan (Chinese Taipei)	1999	58.47	78.54	12.81	45.65	65.73
40	Trinidad And Tobago	1999	23.14	27.43	15.04	8.10	12.39
41	Turkey	2001	79.31	83.61	22.59	56.72	61.02
42	United Kingdom	1989	61.01	100.92	23.10	37.91	77.82
43	United States	1996	46.00	83.90	15.78	30.22	68.12
44	Venezuela	1999	30.62	47.89	15.04	15.58	32.85

## Appendix I-2: Change in price-fuel cost margins for industry

No	Countries	Electricity prices for industry when electricity reform started (US\$/MWh)	Change in price-fuel cost margin for industry since reform started, as of 2007 (US\$/MWh)
1	Mexico	27.00	43.84
2	Venezuela	30.62	-44.56
3	Canada	34.12	12.84
4	Norway	35.47	-21.61
5	France	35.76	30.17
6	Indonesia	35.92	14.36
7	Poland	36.19	31.79
8	Austria	38.25	53.11
9	Chile	41.10	58.31
10	Czech Republic	42.61	57.80
11	Slovak Republic	43.10	77.10
12	Sweden	44.88	2.43
13	New Zealand	45.84	-2.00
14	United States	46.00	6.62
15	Hungary	46.23	56.22
16	Korea	47.71	-2.70
17	Brazil	50.90	64.40
18	Ireland	56.55	53.89
19	Denmark	57.69	23.54
20	Taiwan (Chinese Taipei)	58.47	-20.69
21	Finland	60.22	-0.06
22	Spain	60.57	1.34
23	United Kingdom	61.01	53.94
24	Netherlands	62.38	68.47
25	Israel	63.53	-0.82
26	Peru	64.10	-42.89
27	Switzerland	67.52	-12.74
28	Colombia	74.10	-11.88
29	Turkey	79.31	4.88
30	Germany	83.98	18.83
31	Italy	101.38	104.49
32	Portugal	108.32	-6.83
33	Argentina	113.90	-100.14
34	Dominican Republic	118.00	88.78
35	Japan	157.23	-60.60

### Appendix I-3: Change in price-fuel cost margins for households

No	Countries	Electricity prices for households when electricity reform started (US\$/MWh)	Change in price-fuel cost margin for households since reform started, as of 2007 (US\$/MWh)
1	Indonesia	24.62	20.24
2	Hungary	39.86	116.60
3	Colombia	40.20	82.29
4	Mexico	44.79	16.99
5	Venezuela	47.89	-54.07
6	Canada	49.74	22.45
7	Czech Republic	59.71	71.26
8	Poland	62.41	74.04
9	Slovak Republic	62.83	108.16
10	Korea	70.96	6.55
11	Norway	72.95	24.47
12	Taiwan (Chinese Taipei)	78.54	-19.44
13	Chile	79.50	71.61
14	Turkey	83.61	13.59
15	Argentina	83.70	-94.17
16	United States	83.90	11.29
17	Israel	90.88	13.79
18	New Zealand	94.81	42.05
19	Dominican Republic	95.90	36.60
20	Luxembourg	99.26	96.69
21	United Kingdom	100.92	102.89
22	France	101.66	28.52
23	Peru	106.50	-34.37
24	Finland	108.86	15.27
25	Switzerland	108.95	-1.50
26	Sweden	109.59	57.72
27	Ireland	117.15	87.72
28	Austria	117.51	53.30
29	Netherlands	127.86	166.03
30	Brazil	129.60	52.37
31	Spain	163.41	-4.12
32	Portugal	175.68	10.74
33	Italy	177.67	48.75
34	Denmark	197.44	127.06
35	Germany	212.42	44.63
36	Japan	230.11	-72.94

#### Appendix I-4: Estimation results for Paper One

Models	Dependent variable (country group)	Explanatory variables	Coef.	Std. Err.	t-stat.	p value	Number of countries	Number of observations	Hausman Test		BPLM Test		Preferred Specification
									Statistic	p-value	Statistic	p-value	
Model 1.1	Log of price-fuel cost margin for industry (Developed countries)	Log of electricity consumption by industry	<b>-0.947</b>	0.076	-12.420	<b>0.00</b>	31	659	77.60	0.0000	-	-	Fixed Effects
		Electricity loses in total supply (% 0-100)	<b>-0.094</b>	0.013	-7.410	<b>0.00</b>							
		Log of GDP per capita	<b>0.617</b>	0.046	13.300	<b>0.00</b>							
		Existence of IPPs	<b>-0.116</b>	0.045	-2.590	<b>0.01</b>							
		Wholesale Electricity Market	-0.059	0.058	-1.020	0.31							
		Choice of Supplier	0.056	0.066	0.840	0.40							
		Unbundling	-0.021	0.077	-0.270	0.79							
		Privatization	<b>0.188</b>	0.074	2.530	<b>0.01</b>							
		Existence of Market Regulator	<b>-0.238</b>	0.100	-2.380	<b>0.02</b>							
		Privatization and Regulator	<b>0.193</b>	0.103	1.860	<b>0.06</b>							
		Privatization and Unbundling	<b>-0.280</b>	0.105	-2.660	<b>0.01</b>							
		Unbundling and Regulator	0.065	0.106	0.610	0.54							
	Constant	<b>12.592</b>	0.767	16.410	<b>0.00</b>								
Model 1.2	Log of price-fuel cost margin for industry (Developing countries in America)	Log of electricity consumption by industry	-0.293	0.219	-1.340	0.18	13	241	65.84	0.0000	-	-	Fixed Effects
		Electricity loses in total supply (% 0-100)	0.009	0.017	0.550	0.58							
		Log of GDP per capita	<b>0.865</b>	0.177	4.880	<b>0.00</b>							
		Existence of IPPs	<b>-0.641</b>	0.180	-3.550	<b>0.00</b>							
		Wholesale Electricity Market	<b>0.746</b>	0.293	2.540	<b>0.01</b>							
		Choice of Supplier	(omitted)										
		Unbundling	-0.431	0.445	-0.970	0.33							
		Privatization	0.575	0.681	0.840	0.40							
		Existence of Market Regulator	0.309	0.288	1.070	0.28							
		Privatization and Regulator	-0.762	0.609	-1.250	0.21							
		Privatization and Unbundling	-0.250	0.943	-0.270	0.79							
		Unbundling and Regulator	(omitted)										
	Constant	<b>5.470</b>	2.052	2.670	<b>0.01</b>								

Models	Dependent variable (country group)	Explanatory variables	Coef.	Std. Err.	t-stat.	p value	Number of countries	Number of observations	Hausman Test		BPLM Test		Preferred Specification
									Statistic	p-value	Statistic	p-value	
Model 1.3	Log of price-fuel cost margin for industry (Other developing countries)	Log of electricity consumption by industry	<b>-1.295</b>	0.179	-7.250	<b>0.00</b>	10	149	177.34	0.0000	-	-	Fixed Effects
		Electricity loses in total supply (% 0-100)	<b>0.049</b>	0.022	2.240	<b>0.03</b>							
		Log of GDP per capita	<b>1.263</b>	0.164	7.710	<b>0.00</b>							
		Existence of IPPs	0.124	0.142	0.870	0.38							
		Wholesale Electricity Market	<b>-0.361</b>	0.200	-1.800	<b>0.07</b>							
		Choice of Supplier	0.286	0.221	1.290	0.20							
		Unbundling	<b>0.533</b>	0.190	2.810	<b>0.01</b>							
		Privatization	0.175	0.244	0.720	0.48							
		Existence of Market Regulator	0.081	0.185	0.440	0.66							
		Privatization and Regulator	-0.019	0.526	-0.040	0.97							
		Privatization and Unbundling	0.228	0.549	0.420	0.68							
		Unbundling and Regulator	<b>-0.913</b>	0.284	-3.210	<b>0.00</b>							
	Constant	<b>15.555</b>	1.861	8.360	<b>0.00</b>								
Model 2.1	Log of price-fuel cost margin for households (Developed countries)	Log of electricity consumption by households	<b>-1.217</b>	0.069	-17.550	<b>0.00</b>	31	714	247.20	0.0000	-	-	Fixed Effects
		Electricity loses in total supply (% 0-100)	<b>-0.039</b>	0.009	-4.270	<b>0.00</b>							
		Log of GDP per capita	<b>0.925</b>	0.041	22.440	<b>0.00</b>							
		Existence of IPPs	-0.001	0.034	-0.040	0.97							
		Wholesale Electricity Market	0.020	0.043	0.460	0.64							
		Choice of Supplier	-0.035	0.049	-0.720	0.47							
		Unbundling	0.053	0.060	0.880	0.38							
		Privatization	<b>0.172</b>	0.057	3.010	<b>0.00</b>							
		Existence of Market Regulator	0.016	0.079	0.210	0.84							
		Privatization and Regulator	0.020	0.081	0.250	0.80							
		Privatization and Unbundling	-0.095	0.081	-1.170	0.24							
		Unbundling and Regulator	-0.018	0.083	-0.220	0.83							
	Constant	<b>14.088</b>	0.625	22.520	<b>0.00</b>								
Model 2.2	Log of price-fuel cost margin for households (Developing countries in	Log of electricity consumption by households	<b>-0.649</b>	0.176	-3.680	<b>0.00</b>	13	244	85.26	0.0000	-	-	Fixed Effects
		Electricity loses in total supply (% 0-100)	<b>0.030</b>	0.012	2.540	<b>0.01</b>							
		Log of GDP per capita	<b>1.361</b>	0.145	9.390	<b>0.00</b>							

Models	Dependent variable (country group)	Explanatory variables	Coef.	Std. Err.	t-stat.	p value	Number of countries	Number of observations	Hausman Test		BPLM Test		Preferred Specification
									Statistic	p-value	Statistic	p-value	
	<i>America)</i>	Existence of IPPs	-0.104	0.154	-0.680	0.50							
		Wholesale Electricity Market	0.093	0.228	0.410	0.68							
		Choice of Supplier	(omitted)										
		Unbundling	<b>0.695</b>	0.370	1.880	<b>0.06</b>							
		Privatization	<b>1.030</b>	0.574	1.790	<b>0.07</b>							
		Existence of Market Regulator	<b>-0.579</b>	0.235	-2.460	<b>0.02</b>							
		Privatization and Regulator	0.767	0.504	1.520	0.13							
		Privatization and Unbundling	<b>-1.512</b>	0.793	-1.910	<b>0.06</b>							
		Unbundling and Regulator	(omitted)										
		Constant	<b>7.608</b>	1.469	5.180	<b>0.00</b>							
Model 2.3	Log of price-fuel cost margin for households <i>(Other developing countries)</i>	Log of electricity consumption by households	<b>-0.806</b>	0.144	-5.600	<b>0.00</b>	9	157	113.35	0.0000	-	-	Fixed Effects
		Electricity loses in total supply (%; 0-100)	<b>0.126</b>	0.018	6.820	<b>0.00</b>							
		Log of GDP per capita	<b>0.926</b>	0.146	6.330	<b>0.00</b>							
		Existence of IPPs	0.134	0.125	1.070	0.29							
		Wholesale Electricity Market	<b>-0.474</b>	0.152	-3.110	<b>0.00</b>							
		Choice of Supplier	<b>0.951</b>	0.174	5.480	<b>0.00</b>							
		Unbundling	0.269	0.207	1.300	0.20							
		Privatization	0.121	0.216	0.560	0.58							
		Existence of Market Regulator	-0.249	0.172	-1.440	0.15							
		Privatization and Regulator	0.109	0.470	0.230	0.82							
		Privatization and Unbundling	0.037	0.488	0.080	0.94							
		Unbundling and Regulator	-0.119	0.281	-0.420	0.67							
		Constant	<b>9.035</b>	1.279	7.060	<b>0.00</b>							
Model 3.1	Industrial/residential price ratio <i>(Developed countries)</i>	Log of electricity consumption by industry	<b>0.201</b>	0.047	4.300	0.00	31	682	43.49	0.0000	-	-	Fixed Effects
		Log of electricity consumption by households	0.040	0.056	0.710	0.48							
		Electricity loses in total supply (%; 0-100)	0.004	0.006	0.650	0.52							
		Log of GDP per capita	<b>-0.107</b>	0.026	-4.090	0.00							
		Existence of IPPs	-0.022	0.021	-1.040	0.30							
		Wholesale Electricity Market	-0.011	0.027	-0.420	0.68							

Models	Dependent variable (country group)	Explanatory variables	Coef.	Std. Err.	t-stat.	p value	Number of countries	Number of observations	Hausman Test		BPLM Test		Preferred Specification
									Statistic	p-value	Statistic	p-value	
		Choice of Supplier	<b>0.099</b>	0.031	3.200	0.00							
		Unbundling	<b>-0.100</b>	0.036	-2.800	0.01							
		Privatization	<b>-0.108</b>	0.035	-3.090	0.00							
		Existence of Market Regulator	<b>-0.099</b>	0.047	-2.120	0.03							
		Privatization and Regulator	0.035	0.048	0.720	0.47							
		Privatization and Unbundling	0.015	0.049	0.300	0.77							
		Unbundling and Regulator	0.026	0.049	0.540	0.59							
		Constant	<b>-1.525</b>	0.402	-3.800	0.00							
Model 3.2	Industrial/residential price ratio (Developing countries in America)	Log of electricity consumption by industry	<b>0.137</b>	0.067	2.030	0.04	21	517	68.51	0.0000	146.41	0.0000	Fixed Effects
		Log of electricity consumption by households	<b>0.143</b>	0.075	1.910	0.06							
		Electricity loses in total supply (% 0-100)	-0.001	0.004	-0.260	0.80							
		Log of GDP per capita	<b>-0.277</b>	0.066	-4.210	0.00							
		Existence of IPPs	<b>0.126</b>	0.061	2.070	0.04							
		Wholesale Electricity Market	0.008	0.117	0.070	0.94							
		Choice of Supplier	<b>0.245</b>	0.143	1.710	0.09							
		Unbundling	-0.059	0.390	-0.150	0.88							
		Privatization	-0.095	0.223	-0.430	0.67							
		Existence of Market Regulator	-0.088	0.076	-1.170	0.24							
		Privatization and Regulator	0.051	0.262	0.190	0.85							
		Privatization and Unbundling	-0.058	0.190	-0.310	0.76							
		Unbundling and Regulator	-0.298	0.387	-0.770	0.44							
		Constant	<b>-0.911</b>	0.534	-1.710	0.09							
Model 3.3	Industrial/residential price ratio (Other developing countries)	Log of electricity consumption by industry	0.116	0.192	0.600	0.55	9	157	-1.07	0.0000	-	-	Fixed Effects
		Log of electricity consumption by households	0.273	0.175	1.560	0.12							
		Electricity loses in total supply (% 0-100)	<b>-0.050</b>	0.014	-3.560	0.00							
		Log of GDP per capita	<b>-0.394</b>	0.088	-4.490	0.00							
		Existence of IPPs	-0.052	0.086	-0.600	0.55							
		Wholesale Electricity Market	0.089	0.107	0.830	0.41							
		Choice of Supplier	<b>-0.367</b>	0.125	-2.940	0.00							

Models	Dependent variable (country group)	Explanatory variables	Coef.	Std. Err.	t-stat.	p value	Number of countries	Number of observations	Hausman Test		BPLM Test		Preferred Specification
									Statistic	p-value	Statistic	p-value	
		Unbundling	<b>-0.217</b>	0.116	-1.880	0.06							
		Privatization	<b>-0.314</b>	0.146	-2.160	0.03							
		Existence of Market Regulator	-0.012	0.110	-0.110	0.92							
		Privatization and Regulator	-0.204	0.306	-0.670	0.51							
		Privatization and Unbundling	0.461	0.321	1.430	0.15							
		Unbundling and Regulator	0.194	0.168	1.150	0.25							
		Constant	<b>-1.907</b>	1.026	-1.860	0.07							

Note: The coefficients that are significant at 10% level are shown in **bold**.

**Appendix II-1:** Summary of previous econometric studies adopting a NIE approach

<b>Study</b>	<b>Hypothesis (H)</b>	<b>Dependent Variable(s)</b>	<b>Explanatory Variable(s)</b>	<b>Result(s)</b>	<b>Data &amp; Methodology</b>
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)	<b>H:</b> 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 Geográfico Agustín 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)	<b>H:</b> Democracy enhances economic growth.	<ul style="list-style-type: none"> <li>- 10 year output growth rate by sector</li> <li>- 10 year value-added growth rate by sector</li> <li>- 10 year employment growth rate by sector</li> </ul>	<ul style="list-style-type: none"> <li>- Democracy</li> <li>- The distance to the technological frontier</li> <li>- Log of GDP per capita</li> <li>- Executive de facto independence</li> <li>- Constraints on executive power</li> <li>- Effectiveness of legislature</li> <li>- Government effectiveness</li> <li>- Competition in the legislative nominating process</li> <li>- Autocracy</li> <li>- Political rights average 1972-99</li> <li>- Civil rights average 1972-99</li> </ul>	<ul style="list-style-type: none"> <li>- Democratic institutions and political rights enhance growth of more advanced sectors.</li> <li>- 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.</li> <li>- 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.</li> </ul>	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- Industry employment and value-added data from the Industrial Statistics Database collected by the UNIDO (for 180 countries for the period 1963 to 2003)</li> <li>- Polity IV database and the Freedom House measures of civil liberties and political rights</li> <li>- Penn World Table</li> </ul> <p><b>Methodology:</b> OLS estimation, fixed-effects model</p>

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
Alesina and Rodrik (1994)	<b>H:</b> 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 ratio in 1960 - Dummy variable for democratic governments	- 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. 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.	<b>Data:</b> - Cover 35 countries for 1960-85 period - Heston and Summers dataset - Barro and Wolf 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	- 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:	<b>Data:</b> - Cover 113 countries for 1950-1982 period - Summers and Heston dataset - Jodice and Taylor dataset

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
			<ul style="list-style-type: none"> <li>- Percentage of school age population enrolled in primary school</li> <li>- Dummy variable for countries in South American and Latin America</li> <li>- Dummy variable for countries in Africa</li> <li>- Dummy variable for industrial countries</li> </ul>	<p>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.</p> <ul style="list-style-type: none"> <li>- The occurrence of government changes in the recent past increases the probability of observing future collapses.</li> </ul>	<ul style="list-style-type: none"> <li>- World Bank Economic and Social Data Base</li> </ul> <p><b>Methodology:</b> OLS estimation</p>
Assane and Grammy (2003)	<b>H:</b> The “quality” of the institutional framework positively affects economic development.	- Level of income, 1985	<ul style="list-style-type: none"> <li>- Physical capital formation</li> <li>- Labour force growth</li> <li>- Human capital formation</li> <li>- Economic freedom</li> <li>- Institutional efficiency</li> <li>- Institutional quality</li> <li>- Economic freedom-institutional efficiency interaction</li> <li>- Economic freedom-institutional quality interaction</li> </ul>	<ul style="list-style-type: none"> <li>- “Good” institutions improve efficiency and accelerate growth.</li> <li>- The positive effect of institutional “quality” is more pronounced with mutually reinforcing support of economic freedom.</li> <li>- “Good” institutions help developing countries grow faster to achieve conditional convergence.</li> <li>- Economic development</li> </ul>	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- Cover 110 countries</li> <li>- Business International Corporation</li> <li>- Human development index</li> <li>- International Country Risk Guide</li> </ul> <p><b>Methodology:</b> OLS estimation</p>

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
				requires not only physical and human capital formation, but also freedom to choose and institutional support.	
Barro (1996)	<b>H:</b> Economic freedoms, in the form of free markets and small governments that focus on the maintenance of property rights, encourage economic growth.	- Growth rate of real per capita GDP over 1965-75 period - Growth rate of real per capita GDP over 1975-85 period - Growth rate of real per capita GDP over 1985-90 period	- Log of GDP - Male schooling - Female schooling - Log of life expectancy - Log of GDP x human capital - Log of fertility rate - Government consumption ratio - Public educational spending ratio - Black-market premium - Rule-of-law index - Terms-of-trade change - Investment ratio - Democracy index - Democracy index squared - Democracy index dummy	- The favourable effects on growth include maintenance of the rule of law, free markets, small government consumption, and high human capital. - 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. - 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. - Improvements in the standard	<b>Data:</b> - Summers-Heston data set - World Bank - Barro-Lee data set (Economics Department, Harvard University) - Gastil measures of political rights <b>Methodology:</b> - Instrumental-variable technique - OLS estimation

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
				of living—measured by GDP, health status, and education—substantially raise the probability that political freedoms will grow.	
Barro (2000)	<b>H:</b> Income inequality has an effect on macroeconomic performance, as reflected in rates of economic growth and investment.	<ul style="list-style-type: none"> <li>- Average growth rate (1965 to 1975)</li> <li>- Average growth rate (1975 to 1985)</li> <li>- Average growth rate (1985 to 1995)</li> <li>- Ratio of real investment to real GDP</li> </ul>	<ul style="list-style-type: none"> <li>- Log of per capita GDP</li> <li>- Log of per capita GDP squared</li> <li>- Government consumption/GDP</li> <li>- Rule-of-law index</li> <li>- Democracy index</li> <li>- Democracy index squared</li> <li>- Inflation rate</li> <li>- Years of schooling</li> <li>- Log of total fertility rate</li> <li>- Investment/GDP</li> <li>- Growth rate of terms of trade</li> </ul>	<ul style="list-style-type: none"> <li>- Evidence from a broad panel of countries shows little overall relation between income inequality and rates of growth and investment.</li> <li>- For growth, higher inequality tends to retard growth in poor countries and encourage growth in richer places.</li> <li>- 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.</li> </ul>	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- Deininger and Squire dataset</li> </ul> <p><b>Methodology:</b></p> <ul style="list-style-type: none"> <li>- Conditional convergence</li> <li>- Panel estimation (fixed effects model)</li> </ul>

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
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 primary levels in 1960 - GDP per capita in 1960 - The number of revolutions and coups per year - The number per million population of political assassinations per year - Mortality rates for children aged 0-4 - Student-teacher ratio - Adult literacy rate - The total fertility rate - Dummy variables for Africa and Latin America	- The growth rate of real per capita GDP is positively related to initial human capital (proxied by school-enrolment rates) and negatively related to the initial level of real per capita GDP. - Countries with higher human capital have lower fertility rates and higher ratios of physical investment to GDP. - Growth is inversely related to the share of government consumption in GDP, but insignificantly related to the share of public investment. - Growth rates are positively related to measures of political stability and inversely related to a proxy for market distortions.	<b>Data:</b> - Cover 98 countries in the period 1960-1985 - Summers and Heston dataset - United Nations - World Bank <b>Methodology:</b> OLS estimation
Besley and Kudamatsu (2008)	<b>H1:</b> Autocratic regimes do not always perform badly, at least as judged by economic indicators, such as the growth	- Life expectancy - Gross primary school enrolment ratio - Economic growth	- Per capita income - Ethnic fractionalization - European settlers' mortality - French legal origin	- Democracies can be better or worse than autocracies in terms of accountability. - Successful autocracies are	<b>Data:</b> - World Bank's World Development Indicators - UNESCO Institute for

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
	rate of income per capita or other components of the human development index. <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.		- Socialist legal origin - German legal origin - Oil price boom - Decade dummies - Region dummies - Number of leadership changes per year	those where poor-quality leadership leads to removal of leaders from office. - The forces shaping leadership replacement may be at work in successful autocracies. Leadership turnover is greater in successful compared to unsuccessful autocracies.	Statistics <b>Methodology:</b> OLS estimation
Caselli et al. (1996)	<b>H:</b> There are two sources of inconsistency in existing cross-country empirical work on growth: correlated individual effects and endogenous explanatory variables.	- Change in growth rate	- GDP per capita in previous year - Male education - Female education - I/GDP - G/GDP - ln(1+BMP) - Revolutions - Life expectancy - Assassinations - Terms of trade	- 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. - The results reject both the standard and the augmented version of the Solow model.	<b>Data:</b> - Maddison dataset - Summers and Heston dataset <b>Methodology:</b> - Regressions using a generalized method of moments estimator.
Clague et al. (1996)	<b>H1:</b> Any incentive an autocrat has to respect property and contract rights comes from his	- ICRG index - BERI index - Credit risk	- The number of consecutive years that a country has been a democracy	- There is a compelling empirical relationship between property and contract rights and	<b>Data:</b> - The Gurr and Banks database (1986-90)

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
	<p>interest in future tax collections and national income and increases with his planning horizon.</p> <p><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.</p>	<ul style="list-style-type: none"> <li>- Currency depreciation</li> <li>- Black market exchange premium</li> </ul>	<ul style="list-style-type: none"> <li>- The number of years that the chief executive has been in office in a democracy</li> <li>- The number of consecutive years that the chief executive in an autocratic nation has been in power</li> <li>- The duration of the ruling group</li> <li>- The amount of contract-intensive money</li> <li>- Indexes from two firms evaluating risks to foreign investors</li> <li>- Credit rating variable</li> <li>- The rate of currency depreciation</li> <li>- Per capita income</li> </ul>	<p>an autocrat's time in power.</p> <ul style="list-style-type: none"> <li>- 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.</li> <li>- 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.</li> </ul>	<ul style="list-style-type: none"> <li>- Gastil indexes</li> <li>- Europa Yearbook</li> <li>- The International Country Risk Guide (ICRG), published since 1982</li> <li>- Business Environmental Risk Intelligence (BERI), published since 1972</li> <li>- Report titled "Institutional Investor"</li> </ul> <p><b>Methodology:</b> OLS estimation</p>
Drury et al. (2006)	<p><b>H:</b> One of democracy's indirect benefits is its ability to mitigate the detrimental effect of corruption on economic growth.</p>	<ul style="list-style-type: none"> <li>- Growth of GDP</li> </ul>	<ul style="list-style-type: none"> <li>- Level of corruption</li> <li>- Life expectancy</li> <li>- Trade openness</li> <li>- Population growth</li> <li>- Log of GDP per capita</li> </ul>	<ul style="list-style-type: none"> <li>- Corruption has no significant effect on economic growth in democracies, while non-democracies suffer significant economic harm from corruption.</li> </ul>	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- Time-series cross-section data for more than 100 countries from 1982 to 1997</li> </ul>

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
			- Tropical climate - Government spending		- 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)	<b>H1:</b> Higher levels of ethnic diversity encourage poor policies, poor education, political instability, inadequate infrastructure, and other factors associated with slow growth. <b>H2:</b> There is a direct effect of ethnic diversity on economic growth and an indirect effect	- Average annual growth rate of GDP per capita in the 1960s, 1970s, and 1980s	- Initial income - Ethnolinguistic diversity - School attainment - Political stability - Financial development - Black market premium - Fiscal surplus - Infrastructure development - Dummy variables for Africa and Latin America	- 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.	<b>Data:</b> - Barro and Lee dataset - World Bank - IMF - Pick's Currency Yearbook - Political Risk Services - World Resources Institute

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 - 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 have projects with an economic rate of return 8-22	<b>Data:</b> - World Bank's Operations Evaluation Department - Freedom House's civil liberties index - UN's Humana index <b>Methodology:</b> OLS and probit regressions

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
				percentage points higher than countries with the weakest civil liberties. - The strong effect of civil liberties holds true even when controlling for the level of democracy.	
Keefer and Knack (1997)	<b>H:</b> Poor countries are falling back rather than catching up with wealthy countries. Deficient institutions underlie this divergence.	- Average real per capita growth in GDP, 1960-1989	- GDP/Capita, 1960 - Country Risk Index - Business Risk Index - Executive Constraints - Primary School Enrolment - Secondary School Enrolment - Labour Force Growth - Price Changes - Income Gap - Institutional Variable - Institution x Income Gap	- 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. - 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 wealthier countries, these potential advantages appear to be squandered in countries with poor institutional frameworks.	<b>Data:</b> - International Country Risk Guide (ICRG) - Business Environmental Risk Intelligence (BERI) <b>Methodology:</b> OLS estimation

<b>Study</b>	<b>Hypothesis (H)</b>	<b>Dependent Variable(s)</b>	<b>Explanatory Variable(s)</b>	<b>Result(s)</b>	<b>Data &amp; Methodology</b>
Keefer and Knack (2002)	<b>H:</b> Social polarization reduces the security of property and contract rights and, through this channel, reduces growth.	- International Country Risk Guide Index (ICRG), 1986–95 - Annual growth in per capita income over the 1970–92 period	- Ethnic tensions (0-6 scale) - The percent of a country’s population belonging to the largest ethnic group - Log of 1985 GDP per capita - Per capita growth, 1980-85 - Aggregate GDP, 1985 - Gini: income inequality - Gini: land inequality - Ethnic homogeneity - Political violence - Regime type - Continent dummy - Log of 1970 GDP per capita - Mean years of education, 1970 - Property rights index, 1982	- 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. - Social polarization may directly undermine the security of rights. - 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.	<b>Data:</b> - International Country Risk Guide (ICRG), published by Political Risk Services (from 1982 onwards) <b>Methodology:</b> OLS estimation

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.	<ul style="list-style-type: none"> <li>- Average annual growth in per capita income over the 1980-1992 period for 29 countries</li> <li>- Log of output/worker</li> <li>- Log of capital/worker</li> <li>- School/worker</li> <li>- Log of total factor productivity</li> </ul>	<ul style="list-style-type: none"> <li>- TRUST (the percentage of respondents in each nation replying “most people can be trusted”)</li> <li>- CIVIC (the strength of civic norms)</li> <li>- Per capita GDP in 1980</li> <li>- Labour force growth</li> <li>- (Exports + Imports )/GDP</li> <li>- M2/GDP</li> <li>- Black market premium</li> <li>- Property rights (ICRG)</li> <li>- Currency depreciation</li> <li>- Investor credit rating</li> <li>- Gini (income)</li> <li>- Confidence in government</li> <li>- Ethnic homogeneity</li> </ul>	<ul style="list-style-type: none"> <li>- Trust and civic cooperation are associated with stronger economic performance.</li> <li>- Associational activity is not correlated with economic performance.</li> <li>- 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.</li> </ul>	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- The World Values Surveys containing data on thousands of respondents from 29 market economies</li> <li>- International Country Risk Guide (ICRG)</li> <li>- Business Environmental Risk Intelligence (BERI)</li> </ul> <p><b>Methodology:</b> OLS, 2SLS estimation</p>
Mauro (1995)	<b>H:</b> Efficient government institutions foster economic growth. Corruption and other institutional factors affect economic growth.	<ul style="list-style-type: none"> <li>- Total Investment/GDP</li> <li>- Equipment investment/GDP</li> <li>- Nonequipment investment/GDP</li> <li>- Equipment</li> </ul>	<ul style="list-style-type: none"> <li>- Index of ethnolinguistic fractionalization</li> <li>- Bureaucratic efficiency index (BE) for 1980-1983</li> <li>- Political Change</li> <li>- Political Stability</li> </ul>	<ul style="list-style-type: none"> <li>- Corruption lowers private investment, thereby reducing economic growth.</li> <li>- Bureaucratic efficiency may be at least as important a determinant of investment and</li> </ul>	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- Business International (BI) indices on corruption, red tape, and the efficiency of the judicial system for the</li> </ul>

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
		investment/Nonequipment investment - Private investment/GDP - Public investment/GDP - Private investment/Public investment	Probability of Opposition 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	growth as political stability.	period 1980-1983 for 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,

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
					Penn World Table - Population density and land data are from Harvard Centre for International Development's Geography Database <b>Methodology:</b> OLS estimation
Persson and Tabellini (1994)	<b>H:</b> Inequality is harmful for growth.	- Annual average growth rate of GDP per capita	- Income Distribution - Political Participation - Average Skills - The Level of Development - Initial GDP	- There is a significant and large negative relation between inequality and growth. - This relation is only present in democracies.	<b>Data:</b> - Cover 1830-1985 period for 9 countries - Summers and Heston dataset - U.S. Department of Commerce - World Bank - OECD <b>Methodology:</b> - Model building - OLS estimation - 2SLS estimation

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
Persson and Tabellini (2008)	<b>H:</b> There is a positive relation between democracy and growth.	- Per capita income	- Length of sample - Income relative to the United States - War years - Domestic democratic capital - Foreign democratic capital - Initial value of polity score	- Transitions from autocracy to democracy are associated with an average growth acceleration of about 1 percentage point, producing a gain in per capita income of about 13% by the end of the sample period. - 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.	<b>Data:</b> - Annual per capita income data from Penn World Tables (1960-2000) <b>Methodology:</b> Semi parametric methods, difference-in-difference methods, propensity-score methods, OLS
Scully (1988)	<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.	- Economic growth over the period 1960-80 - Economic efficiency - Change in economic efficiency	- The compound growth rate of real per capita GDP - The compound growth rate in the capital-labour ratio - Politically liberal - Politically not liberal - Civil liberty - Limited civil liberty	- The institutional framework has significant and large effects on the efficiency and growth rate of economies. - Politically open societies, which subscribe to the rule of law, to private property, and to the market allocation of	<b>Data:</b> - Cover 115 countries for 1960-1980 period - Gastil measures of liberty - Summers and Heston dataset <b>Methodology:</b> OLS

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
			- Economic liberty	resources, grow at 3 times the rate and are 2.5 times as efficient as societies in which these freedoms are abridged.	estimation
Spindler (1991)	<b>H:</b> There is apposite 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)	<b>H:</b> There is a relationship between per-capita income, the entrenchment of various rights in a country's constitution and	- GNP per capita	- Education - Economic freedom - Political structure - Specific protections against	- Entrenchment of any single right seldom has a significant general economic effect, while the effect of economic freedom	<b>Data:</b> - Cover 100 countries for 1988 - UNDP Human

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
	the level of economic freedom in a country.		tyranny - Social Rights	is significant and substantial. - Education, economic freedom, population growth and the saving ratio together explain more than 75% of the cross-country variation in per capita income. - The entrenched elements of “Political structure”, “Protections from tyranny”, or “Social Charter” are not revealed as important explanatory variables.	Development Report 1991 - Scully and Slottje dataset - Taubenfel dataset <b>Methodology:</b> OLS estimation

## Appendix II-2: Summary of previous econometric studies based on NIE by their focus

Focus of the study	Major Explanatory Variable(s)	Data Sources	Examples
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> <li>- Probability of opposition group takeover</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 and Taylor dataset	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>- 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>		
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> <li>- CIVIC (the strength of civic norms)</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), Keefer and Knack (2002)

Focus of the study	Major Explanatory Variable(s)	Data Sources	Examples
	<ul style="list-style-type: none"> <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> <li>- Mortality rates for children aged 0-4</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 Slotje 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>- 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 II-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)	

### Appendix III-1: Summary of previous applied econometric studies adopting a political economy approach

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
Alesina et al. (2006)	<b>H:</b> It is easier to stabilize an economy more decisively in times of crisis than in times of more “moderate” economic problems	<ul style="list-style-type: none"> <li>- Deficit/GDP ratio</li> <li>- Inflation rate</li> </ul>	<ul style="list-style-type: none"> <li>- Number of executive constraints</li> <li>- Election year</li> <li>- Political orientation of the ruling government</li> <li>- Assembly or parliamentary system</li> <li>- Executive control of absolute majority</li> <li>- Number of years left in the current term for the executive</li> <li>- Total government deficit as a share of GDP and inflation</li> <li>- The real per capita GDP</li> <li>- The ratio of exports and imports to GDP</li> <li>- The dummy taking value 1 if the country is currently in crisis</li> <li>- Participation to IMF programs</li> </ul>	<ul style="list-style-type: none"> <li>- Stabilizations are more likely to occur during crisis, at the beginning of term of office of a new government, in countries with “strong” governments (i.e. presidential systems and unified governments with a large majority of the party in office), and when the executive faces less constraints</li> <li>- The role of external inducements like IMF programs has at best a weak effect</li> </ul>	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- Yearly data on a large sample of developed and developing countries covering from 1960 to 2003</li> </ul> <p><b>Source(s):</b> Polity IV project, World Bank's Database of Political Institutions, IMF's International Financial Statistics (IFS) database, Penn World Table</p> <p><b>Methodology:</b></p> <ul style="list-style-type: none"> <li>- OLS</li> </ul>

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
Boschini (2006)	<p><b>H-1:</b> The skills of the political elite and political institutions play a crucial role for industrialisation to occur</p> <p><b>H-2:</b> The government (controlled by elite or through a pivotal voter) must have the ability as well as the incentives to promote the industrialisation process</p>	<ul style="list-style-type: none"> <li>- Industrialisation index</li> <li>- GDP growth 1820-1913</li> </ul>	<ul style="list-style-type: none"> <li>- Political regime</li> <li>- Enrolment in primary education</li> <li>- Index of the favourableness of attitudes toward entrepreneurship</li> <li>- Index of concentration in landholdings</li> </ul>	<ul style="list-style-type: none"> <li>- A flat wealth distribution and skilled political elite enhance development the most in elitist regimes, while democracies perform as well as elitist regimes in terms of industrialisation</li> </ul>	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- 23 countries from 1820 to 1913</li> <li>- Source(s): Comparative Patterns of Economic Development 1850–1914, John Hopkins University</li> </ul> <p><b>Methodology:</b></p> <ul style="list-style-type: none"> <li>- Partial sums of squares</li> </ul>
Chang and Berdiev (2011)	<p><b>H:</b> Government ideology, political factors and globalization are crucial for energy regulation in electricity and gas industries</p>	<ul style="list-style-type: none"> <li>- The growth rate of regulation indicator in energy industry</li> </ul>	<ul style="list-style-type: none"> <li>- Government ideology</li> <li>- Herfindahl index to proxy for government fragmentation</li> <li>- Number of years that the incumbent government has been in office</li> <li>- Index of political constraints</li> <li>- Globalization index</li> <li>- Energy demand</li> <li>- Real GDP per capita (constant in 2000)</li> </ul>	<ul style="list-style-type: none"> <li>- Left-wing governments promote regulation in gas and electricity sectors</li> <li>- Less politically fragmented institutions contribute to deregulation of gas and electricity industries</li> <li>- Long tenures of incumbent government have limited impact on regulation in electricity sector, while it is associated with an increase in regulation of gas sector</li> </ul>	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- 23 OECD countries over the period 1975-2007</li> <li>- Source(s): Conway and Nicoletti (2006), Potrafke (2009), Beck et al. (2001), Henisz (2000), World Bank, BP</li> </ul> <p><b>Methodology:</b></p> <ul style="list-style-type: none"> <li>- The bias-corrected least square dummy variable model</li> </ul>

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
				<ul style="list-style-type: none"> <li>- Higher political constraints and more globalization lead to deregulation in electricity and gas sectors</li> <li>- Economic and social integration are the forces that promote deregulation in the gas industry, whereas political integration advances deregulation in the electricity industry</li> </ul>	
Cubbin and Stern (2006)	<b>H:</b> A regulatory law and higher quality regulatory governance are associated with superior outcomes in the electricity industry	- Per capita generation capacity	<ul style="list-style-type: none"> <li>- Electricity (or energy) regulatory law</li> <li>- Autonomous or ministry regulator</li> <li>- License fee or government budget regulatory funding</li> <li>- Free or mandatory civil service pay scales for regulatory staff</li> <li>- Real GDP per capita</li> <li>- Debt payments as a proportion of national income</li> <li>- Industry value added as proportion of GDP</li> </ul>	<ul style="list-style-type: none"> <li>- Controlling for privatization and competition and allowing for country-specific fixed effects, both regulatory law and higher quality regulatory governance are positively and significantly associated with higher per capita generation capacity</li> </ul>	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- 28 developing economies over 1980-2001</li> </ul> <p>- Source(s): U.S. Energy Information Agency, World Bank</p> <p><b>Methodology:</b></p> <ul style="list-style-type: none"> <li>- Panel data modelling, error correction models</li> </ul>

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
Dreher et al. (2009)	<b>H:</b> The educational and professional background of a head of government matters for the implementation of market-liberalizing reforms	<ul style="list-style-type: none"> <li>- Composite index of economic freedom</li> <li>- Size of government index</li> <li>- Legal structure and security of property rights index</li> <li>- Access to sound money index</li> <li>- Exchange with foreigners index</li> <li>- Regulation of credit, labour and business index</li> </ul>	<ul style="list-style-type: none"> <li>- Profession of heads of governments</li> <li>- Education of heads of governments</li> <li>- Economic freedom</li> <li>- Economic growth</li> <li>- Civil liberties</li> <li>- Aid</li> <li>- Linguistic fractionalization</li> <li>- Currency crises</li> <li>- Government fractionalization</li> <li>- Coalition government</li> </ul>	<ul style="list-style-type: none"> <li>- Reforms are more likely during the tenure of former entrepreneurs</li> <li>- Entrepreneurs belonging to a left-wing party are more successful in inducing reforms than a member of a right-wing party with the same previous profession</li> <li>- Former professional scientists also promote reforms, the more so, the longer they stay in office</li> <li>- The impact of politicians' education is not robust and depends on the method of estimation</li> </ul>	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- Panel data over the period 1970–2002</li> <li>- Profession and education of more than 500 political leaders from 72 countries</li> <li>- Source(s): Gwartney and Lawson (2004), World Bank, Alesina et al. (2003), Freedom House, Beck et al. (2001), Dreher (2006)</li> </ul> <p><b>Methodology:</b></p> <ul style="list-style-type: none"> <li>- Pooled time-series cross-section (panel data) regressions</li> <li>- Feasible generalized least squares</li> </ul>
Duso and Seldeslachts (2010)	<b>H:</b> Differences in political, government and regulatory environments explain the differing speed of reforms in	<ul style="list-style-type: none"> <li>- Degree of liberalization in the digital mobile industry</li> </ul>	<ul style="list-style-type: none"> <li>- Share of incumbent operator in long-distance telecom</li> <li>- Annual revenues in the mobile telecommunications industry</li> </ul>	<ul style="list-style-type: none"> <li>- Majoritarian electoral systems are important drivers for change, while independent industry regulators slow down the</li> </ul>	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- 24 OECD countries</li> <li>- Source(s): OECD regulation database,</li> </ul>

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
	the mobile telecom industries at the beginning of the 1990s		<ul style="list-style-type: none"> <li>- Dummy variables for regulatory independence</li> <li>- Number of parties in the opposition</li> <li>- Percentage seats in the legislature held by government parties</li> <li>- Government's programmatic position: Pro market regulations</li> <li>- Government's programmatic position: Pro welfare state limitation</li> <li>- Population</li> <li>- Share of active population aged between 15 and 64 years</li> <li>- Annual income per capita</li> </ul>	<ul style="list-style-type: none"> <li>reforms</li> <li>- Powerful industry incumbents hold up the liberalization process and governing bodies that favour a small welfare state accelerate it</li> </ul>	<ul style="list-style-type: none"> <li>Persson and Tabellini (1999), Woldendorp et al. (1998), Budge et al. (2001), Lijphart (1999)</li> <li><b>Methodology:</b></li> <li>- Ordered probit model with country random-effects</li> </ul>
Duval (2008)	<b>H:</b> Macroeconomic policies and ideology influence reform patterns in labour and product markets	- Policy index	<ul style="list-style-type: none"> <li>- Unemployment</li> <li>- Output gap</li> <li>- Crisis years</li> <li>- Small country</li> <li>- Ideology</li> <li>- Fractionalisation</li> <li>- Degree of sustainability of</li> </ul>	<ul style="list-style-type: none"> <li>- Sound public finances and fiscal expansions help foster reforms</li> <li>- The effect of fiscal expansion may also be greater for countries that pursue fixed exchange-rate regimes</li> </ul>	<ul style="list-style-type: none"> <li><b>Data:</b></li> <li>- 21 OECD countries over the period 1985–2003</li> <li>- Source(s): OECD</li> <li><b>Methodology:</b></li> <li>- Multivariate probit and</li> </ul>

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
			public debt - Fiscal expansion		linear econometric models
Fredriksson and Wollscheid (2008)	<b>H:</b> Corruption and political instability are important determinants of firm investment in pollution control technology	- Level of investment in clean technology in the steel industry	<ul style="list-style-type: none"> <li>- The respect that institutions and citizens use to govern their interactions</li> <li>- The degree to which business transactions involve corruption</li> <li>- The perception of the quality of public service provision</li> <li>- Political instability</li> <li>- Social and Institutional Capacity index</li> <li>- The size of the steel market</li> <li>- Per capita steel production</li> <li>- Total steel exported as a percentage of total steel produced</li> <li>- Total trade as a share of GDP</li> <li>- Gastil index</li> <li>- Government commitment</li> <li>- Per capita gross domestic product</li> </ul>	<ul style="list-style-type: none"> <li>- Greater corruptibility increases the level of abatement technology investment because the strategic incentive to underinvest in pollution control technology declines when policymakers become more corruptible</li> <li>- Political instability raises abatement technology investment</li> </ul>	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- Steel-sector panel data from 41 countries for the years 1992–1998</li> <li>- Source(s): International Iron and Steel Institute, Kaufman et al. (1999), Banks (1995), CIESIN of Columbia University, Freedom House, World Bank</li> </ul> <p><b>Methodology:</b></p> <ul style="list-style-type: none"> <li>- Panel data estimation (fixed and random effects models)</li> </ul>

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
Gasmi et al. (2009)	<b>H:</b> There is a strong relationship between the quality of political institutions and the performance of regulation in telecommunications sector	<ul style="list-style-type: none"> <li>- Mainline coverage</li> <li>- Cellular subscription</li> <li>- Mainlines per employee</li> <li>- Price of monthly subscript to fixed-line service</li> <li>- Price of cellular service</li> </ul>	<ul style="list-style-type: none"> <li>- Regulatory governance index</li> <li>- Corruption</li> <li>- Bureaucracy</li> <li>- Law and order</li> <li>- Expropriation</li> <li>- Currency risk</li> <li>- Institutional environment index</li> <li>- Checks and balances</li> <li>- Privatization</li> <li>- Competition in fixed and cellular line services</li> <li>- Rural population</li> <li>- Population density</li> </ul>	<ul style="list-style-type: none"> <li>- The impact of political accountability on the performance of regulation is stronger in developing countries</li> <li>- Future reforms in these countries should give due attention to the development of politically accountable systems</li> </ul>	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- Panel data for 29 developing countries and 23 developed countries during 1985–99</li> </ul> <p>- Source(s): Gasmi, Nounba, and Recuero Virto (2006)</p> <p><b>Methodology:</b></p> <ul style="list-style-type: none"> <li>- Differenced generalized method-of-moments estimation</li> </ul>
Gasmi and Recuero Virto (2010)	<b>H:</b> Sectoral, institutional and financial factors are important determinants of the reforms implemented in telecommunication industry	<ul style="list-style-type: none"> <li>- Fixed-line deployment</li> <li>- Cellular competition (analogue)</li> <li>- Counter (analogue)</li> <li>- Cellular competition (digital)</li> <li>- Counter (digital)</li> <li>- Fixed-line competition (local)</li> <li>- Separate regulator</li> </ul>	<ul style="list-style-type: none"> <li>- Corruption</li> <li>- Institutional index</li> <li>- Democracy index</li> <li>- Risk index</li> <li>- Total debt service</li> <li>- Net taxes on products</li> <li>- Aid per capita</li> <li>- Population density</li> <li>- Rural population</li> <li>- Imports</li> </ul>	<ul style="list-style-type: none"> <li>- Sectoral as well as institutional and financial factors are found to be important determinants of the actual reforms implemented</li> <li>- There is a positive relationship between the decision to introduce competition in the digital cellular segment and the growth of the fixed line segment</li> <li>- Countries facing increasing</li> </ul>	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- 1985-1999 panel data on 86 developing countries</li> </ul> <p>- Source(s): Available from the authors upon request</p> <p><b>Methodology:</b></p> <ul style="list-style-type: none"> <li>- Duration methodology</li> <li>- System Generalized</li> </ul>

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
		- Privatization	<ul style="list-style-type: none"> <li>- Telecommunications staff</li> <li>- Checks and balances</li> <li>- English legal origin</li> <li>- French legal origin</li> <li>- Share of protestant (1980)</li> <li>- Latitude</li> <li>- Average schooling years (1980)</li> <li>- Ethno linguistic fractionalization</li> <li>- Africa</li> <li>- Crop and forest land</li> <li>- Political constraints</li> <li>- Free press</li> <li>- Ethnic tensions</li> <li>- Law and order</li> </ul>	<ul style="list-style-type: none"> <li>institutional risk and financial constraints are more likely to introduce competition in the digital cellular segment and to privatize the fixed-line incumbent</li> <li>- Competition in the analogue cellular segment and the creation of a separate regulator seem to be relatively less attractive policies</li> </ul>	Method of Moments (SYS-GMM)
Goldberg and Pavcnik (2005)	<b>H:</b> Worker industry affiliation plays a crucial role in how trade policy affects wages in many trade models	- Wage differentials	<ul style="list-style-type: none"> <li>- Worker characteristics</li> <li>- Occupation indicators</li> <li>- Job type indicators</li> <li>- Place of work characteristics</li> </ul>	<ul style="list-style-type: none"> <li>- Without industry fixed effects, workers in protected sectors earn less than workers with similar observable characteristics in unprotected sectors</li> <li>- Allowing for industry fixed</li> </ul>	<b>Data:</b> <ul style="list-style-type: none"> <li>- Data on 21 industries of Colombia</li> <li>- Source(s): Colombian National Planning Department</li> </ul> <b>Methodology:</b>

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
				effects reverses the result: trade protection increases relative wages - Because tariff reductions were proportionately larger in sectors employing a high fraction of less-skilled workers, the decrease in the wage premiums in these sectors affected such workers disproportionately	- 2SLS - OLS
Huang (2009)	<b>H-1:</b> Political structure of a country has a substantial influence on policy change in financial sector <b>H-2:</b> Policy change in a country is positively correlated with the initial level of liberalization	- Level of financial liberalization	- Balance of payments crisis - Banking crisis - Recession - High inflation - Drastic political change - Political orientation of ruling party - IMF program - Democracy	- Policy change in a country is negatively rather than positively associated with the initial extent of liberalization level, and the distance behind the regional leader - Countries with highly repressed financial sectors have more potential to embark on reform, while countries with a highly liberalized financial sector have greater status quo bias	<b>Data:</b> - 35 countries for the period 1973–1996 - Source(s): IMF, World Bank, Polity IV project <b>Methodology:</b> - Common correlated effect pooled (CCEP) modelling

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
				- Economic and political structure and ideology can have a substantial influence on policy change, and the extent of democracy has a significantly negative effect on policy reform	
Ickes and Ofer (2006)	<b>H:</b> Changes in the industrial structure of employment across Russian regions are mainly determined by legacy factors, political factors, and success factors	- Structural change in industry	<ul style="list-style-type: none"> <li>- The natural resource potential</li> <li>- The initial employment share</li> <li>- The rate of urbanization</li> <li>- The specialization of industry</li> <li>- Average January (1997) temperature</li> <li>- Change in population</li> <li>- Change in the number of employed</li> <li>- Change in the number of small enterprises</li> <li>- Change in gross regional product per capita</li> <li>- FDI per 1000 employed</li> <li>- Change in the crime rate</li> <li>- Democracy index</li> <li>- Legislative quality</li> <li>- Political environment</li> <li>- Social environment</li> </ul>	- Initial conditions such as natural resource potential, climate, and industrial specialization explain more of the variation in industrial restructuring than political variables	<p><b>Data:</b></p> <ul style="list-style-type: none"> <li>- Data on various industrial sectors of Russia during 1990s</li> <li>- Source(s): CEFIR database, RSS, Russian Statistical Office, World Bank</li> </ul> <p><b>Methodology:</b></p> <ul style="list-style-type: none"> <li>- OLS</li> </ul>

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
Kim and Pirttilä (2006)	<b>H:</b> Both ex post and ex ante political constraints are instrumental in determining the extent of progress in welfare-enhancing reforms	- Liberalization index	- Support for reforms - Inflation rate - Unemployment rate - GDP growth - Gini coefficient - Government's budget balance - Capital formation - Future loss - Index of political freedom	- Progress in reform is positively associated with public support for reforms, which is affected by income inequality and expected individual performance during future reforms - Reform sequencing should start with a reform that is both popular and stimulatory to other reforms	<b>Data:</b> - 14 transition countries for 1990-97 period - Source(s): EBRD, United Nations University, World Institute for Development Economics Research <b>Methodology:</b> - Generalized Method of Moments (GMM) - 2SLS - Static fixed effects - Dynamic fixed effects
Li and Xu (2002)	<b>H-1:</b> Countries with a larger financial sector, a higher urban population, and a lower income inequality are more likely to privatize and liberalize <b>H-2:</b> A higher government budget deficit makes privatization and liberalization	- Non-state ownership of telecommunications sector	- Urban/total population - Gini coefficient - Financial depth - Deficit/GDP - Profitability - Ideology - World Bank project - Democracy - Party polarization	- Countries with stronger pro-reform interest groups, namely the financial services sector and the urban consumers, are more likely to reform in more democratic countries - Less democratic countries are more likely to maintain the public sector monopoly when	<b>Data:</b> - 50 countries over the period from 1990 to 1998 - Source(s): World Bank, Gurr (1999) <b>Methodology:</b> - Fixed/random effects models - OLS

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
	less likely, while a larger government debt has the opposite implications <b>H-3:</b> Countries with a right-of-centre government and countries that receive World Bank assistance in the telecommunications sector are more likely to privatize and liberalize		- Number of veto players - The number of main lines per 100 inhabitants - Real GDP per capita - Illiteracy rate - The ratio of manufacturing value added over GDP - The share of population in the largest city - The share of government debt in GDP	the government benefits more from such a governance mode - Democracy affects the pace of reforms by magnifying the voices of interest groups in more democratic countries and by moderating politicians' discretion in less democratic countries	
Olper (2007)	<b>H-1:</b> Agricultural protection is influenced directly by land inequality and ideology <b>H-2:</b> The effect of land inequality is conditional to the ideological orientation of the government	- Aggregated producer subsidy equivalent	- Land inequality (land gini) - Ideological orientation of the government - Amount of agricultural land per capita - Share of agricultural export to total export - Agricultural share in employment and in GDP - Gastil index of political rights - Index of quality of institutions	- Protection is decreasing in land inequality and with left-wing government orientation, but not in a linear fashion: left-wing governments tend to support agriculture in more unequal societies - The relationship holds better in democracies than in dictatorships	<b>Data:</b> - 40 countries for 1982-2000 period - Source(s): IFAD, Keefer and Knack (1995), FAO, Database on Political Institutions, OECD, USDA, World Bank, Freedom House, International Country Risk Guide <b>Methodology:</b> - OLS

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
Volscho (2007)	<b>H:</b> Quintile shares of size-adjusted family income are impacted by union density and federal, state, and local government employment	- Family income	- Union density - Federal government employment - State government employment - Local government employment - Mean establishment size - Manufacturing employment - Unemployment rate - Female labour force participation - Female-headed families - Dispersion in education - Dispersion in age	- Union density has a progressive effect that benefits middle and upper-middle income families - Federal government employment has a strong progressive effect on the entire income distribution - State government employment has a progressive effect on middle and upper-middle income families - Local government employment mainly impacts families in the bottom forty percent of the income distribution	<b>Data:</b> - Data on 160 US metropolitan statistical areas from the 2000 census - Source(s): USA 2000 Census Data <b>Methodology:</b> - Seemingly unrelated regression estimation (SURE)
Wagner et al. (2009)	<b>H:</b> Institutional factors affect satisfaction with democracy	- Average yearly satisfaction with democracy	- Inflation - GDP per capita - Growth in GDP - Unemployment rate - BERI composite index - Quality of monetary policy - Regulatory quality	- High-quality institutions like the rule of law, well-functioning regulation, low corruption, and other institutions that improve resource allocation have a positive effect on average satisfaction with democracy	<b>Data:</b> - A panel of observations from Eurobarometer in the time span 1990–2000 - Source(s): Business Environment Risk Intelligence (BERI),

Study	Hypothesis (H)	Dependent Variable(s)	Explanatory Variable(s)	Result(s)	Data & Methodology
			<ul style="list-style-type: none"> <li>- Rule of law</li> <li>- Control of corruption</li> <li>- Size of the shadow economy</li> <li>- Checks and balances</li> <li>- Left/right placement</li> <li>- Inequality</li> </ul>		Database of political institutions (DPI), Eurobarometer <b>Methodology:</b> - Random effects panel regressions

### Appendix III-2: Summary of previous econometric studies based on political economy by their focus

Focus of the study	Major Variable(s)	Primary Data Sources	Examples
Political economy of liberalization in electricity industry	<ul style="list-style-type: none"> <li>- Regulation indicator in power industry</li> <li>- Government ideology</li> <li>- Government fragmentation</li> <li>- Number of years that the incumbent government has been in office</li> <li>- Index of political constraints</li> <li>- Globalization index</li> <li>- Energy demand</li> <li>- Real GDP per capita</li> <li>- Per capita generation capacity</li> <li>- Debt payments as a proportion of national income</li> <li>- Industry value added as proportion of GDP</li> </ul>	<ul style="list-style-type: none"> <li>- World Bank</li> <li>- US Energy Information Agency</li> <li>- BP</li> </ul>	Chang and Berdiev (2011), Cubbin and Stern (2006)
Political economy of liberalization in telecommunications industry	<ul style="list-style-type: none"> <li>- Degree of liberalization</li> <li>- Share of incumbent operator</li> <li>- Regulatory independence</li> <li>- Government's programmatic position</li> <li>- Share of population aged between 15-64 years</li> <li>- Mainline coverage &amp; cellular subscription</li> <li>- Mainlines per employee</li> <li>- Price of fixed-line, cellular services</li> <li>- Regulatory governance index</li> </ul>	<ul style="list-style-type: none"> <li>- OECD regulation database</li> <li>- World Bank</li> </ul>	Duso and Seldeslachts (2010), Gasmi et al. (2009), Gasmi and Recuero Virto (2010), Li and Xu (2002)

<b>Focus of the study</b>	<b>Major Variable(s)</b>	<b>Primary Data Sources</b>	<b>Examples</b>
	<ul style="list-style-type: none"> <li>- Corruption</li> <li>- Bureaucracy</li> <li>- Law and order</li> <li>- Expropriation</li> <li>- Currency risk</li> <li>- Institutional environment index</li> <li>- Checks and balances</li> <li>- Privatization</li> <li>- Competition in fixed and cellular</li> <li>- Democracy index</li> <li>- Total debt service</li> <li>- Aid per capita</li> <li>- Ethno linguistic fractionalization</li> <li>- Free press</li> <li>- Ownership of telecommunications sector</li> <li>- Urban/total population</li> <li>- Gini coefficient</li> <li>- Financial depth</li> <li>- Deficit/GDP</li> <li>- World Bank project</li> <li>- Real GDP per capita</li> </ul>		
Political economy of economic reforms in non-infrastructure industries and other areas	<ul style="list-style-type: none"> <li>- Deficit/GDP ratio</li> <li>- Inflation rate</li> <li>- Number of executive constraints</li> </ul>	<ul style="list-style-type: none"> <li>- Polity IV project</li> <li>- World Bank's Database of Political Institutions</li> </ul>	Alesina et al. (2006), Boschini (2006), Dreher et al. (2009), Duval (2008), Fredriksson and Wollscheid (2008),

<b>Focus of the study</b>	<b>Major Variable(s)</b>	<b>Primary Data Sources</b>	<b>Examples</b>
	- Election year	- IMF's International Financial Statistics (IFS) database	Goldberg and Pavcnik (2005), Huang (2009), Ickes and Ofer (2006), Kim and Pirttilä (2006), Olper (2007), Volscho (2007), Wagner et al. (2009)
	- Political orientation of the ruling government	- Penn World Table	
	- Assembly or parliamentary system	- Freedom House	
	- Executive control of absolute majority	- OECD	
	- Number of years left in the current term for the executive	- National Statistical Offices	
	- Total government deficit as a share of GDP and inflation	- EBRD	
	- The real per capita GDP	- United Nations University	
	- The ratio of exports and imports to GDP	- World Institute for Development Economics Research	
	- Crisis years	- International Country Risk Guide	
	- Countries' participation to IMF programs	- Business Environment Risk Intelligence (BERI)	
	- Industrialisation index	- Eurobarometer	
	- Index of the favourableness of attitudes toward entrepreneurship		
	- Index of concentration in landholdings		
	- Size of government index		
	- Legal structure and security of property rights index		
	- Regulation of credit, labour and business index		
	- Profession of heads of governments		
	- Education of heads of governments		
	- Aid		
	- Degree of sustainability of public debt		

Focus of the study	Major Variable(s)	Primary Data Sources	Examples
	<ul style="list-style-type: none"> <li>- The degree to which business transactions involve corruption</li> <li>- The perception of the quality of public service</li> <li>- Political instability</li> <li>- Level of financial liberalization</li> <li>- The rate of urbanization</li> <li>- Support for reforms</li> <li>- Gini coefficient</li> <li>- Satisfaction with democracy</li> </ul>		

### Appendix III-3: Estimation results for Paper Three

Models	Dependent variable	Explanatory variables	Coef.	Std. Err.	t-stat.	p value	# of countries	# of observations	Hausman Test		BPLM Test		Preferred Specification
									Statistic	p-value	Statistic	p-value	
1.1.1	Entry barriers (0-6) (OECD countries)	Industry value added (% of GDP)	0.129	0.027	4.720	0.00	28	456	499.40	0.0000	-	-	Fixed Effects
		Rural population (% of total population)	0.091	0.058	1.580	0.12							
		Gini coefficient (0-100)	-0.022	0.023	-0.930	0.35							
		Polity score (-10,+10)	0.178	0.046	3.910	0.00							
		EU member (0-1)	-1.610	0.319	-5.040	0.00							
		OECD member (0-1)	1.717	0.419	4.100	0.00							
		Existence of electricity market reform idea (0-1)	1.078	0.274	3.930	0.00							
		Log of population density	0.427	2.552	0.170	0.87							
		Log of electricity consumption per capita (MWh)	2.566	0.796	3.220	0.00							
		Log of GDP per capita (PPP, cur. thousand int. \$)	-5.201	0.536	-9.700	0.00							
		Average number of years of adult (25+) education	-0.282	0.182	-1.550	0.12							
		Log of imports of goods and services (% of GDP)	-2.415	0.582	-4.150	0.00							
	Constant	14.124	11.049	1.280	0.20								
1.1.2	Public Ownership (0-6) (OECD countries)	Industry value added (% of GDP)	0.076	0.015	5.200	0.00	28	456	72.18	0.0000	-	-	Fixed Effects
		Rural population (% of total population)	-0.015	0.031	-0.500	0.62							
		Gini coefficient (0-100)	-0.012	0.012	-0.980	0.33							
		Polity score (-10,+10)	-0.013	0.024	-0.550	0.58							
		EU member (0-1)	0.235	0.170	1.380	0.17							
		OECD member (0-1)	0.043	0.223	0.190	0.85							
		Existence of electricity market reform idea (0-1)	0.107	0.146	0.730	0.46							
		Log of population density	9.221	1.357	6.790	0.00							
		Log of electricity consumption per capita (MWh)	-1.188	0.423	-2.810	0.01							
		Log of GDP per capita (PPP, cur. thousand int. \$)	-1.157	0.285	-4.060	0.00							
		Average number of years of adult (25+) education	-0.120	0.097	-1.240	0.22							
		Log of imports of goods and services (% of GDP)	-0.936	0.310	-3.020	0.00							
	Constant	-25.833	5.876	-4.400	0.00								

Models	Dependent variable	Explanatory variables	Coef.	Std. Err.	t-stat.	p value	# of countries	# of observations	Hausman Test		BPLM Test		Preferred Specification
									Statistic	p-value	Statistic	p-value	
1.1.3	Vertical integration (0-6) (OECD countries)	Industry value added (% of GDP)	0.128	0.025	5.080	0.00	28	456	60.18	0.0000	-	-	Fixed Effects
		Rural population (% of total population)	-0.084	0.053	-1.570	0.12							
		Gini coefficient (0-100)	0.005	0.021	0.210	0.83							
		Polity score (-10,+10)	0.109	0.042	2.590	0.01							
		EU member (0-1)	-1.407	0.294	-4.780	0.00							
		OECD member (0-1)	0.907	0.386	2.350	0.02							
		Existence of electricity market reform idea (0-1)	0.521	0.252	2.060	0.04							
		Log of population density	-0.187	2.351	-0.080	0.94							
		Log of electricity consumption per capita (MWh)	0.266	0.733	0.360	0.72							
		Log of GDP per capita (PPP, cur. thousand int. \$)	-3.679	0.494	-7.450	0.00							
		Average number of years of adult (25+) education	-0.076	0.168	-0.450	0.65							
		Log of imports of goods and services (% of GDP)	-1.444	0.536	-2.690	0.01							
Constant	17.055	10.177	1.680	0.10									
1.2.1	Overall indicator (0-6) (OECD countries)	Industry value added (% of GDP)	0.111	0.018	6.180	0.00	28	456	74.78	0.0000	-	-	Fixed Effects
		Rural population (% of total population)	-0.003	0.038	-0.070	0.94							
		Gini coefficient (0-100)	-0.010	0.015	-0.640	0.52							
		Polity score (-10,+10)	0.091	0.030	3.050	0.00							
		EU member (0-1)	-0.927	0.210	-4.430	0.00							
		OECD member (0-1)	0.889	0.275	3.240	0.00							
		Existence of electricity market reform idea (0-1)	0.569	0.180	3.160	0.00							
		Log of population density	3.153	1.675	1.880	0.06							
		Log of electricity consumption per capita (MWh)	0.548	0.522	1.050	0.30							
		Log of GDP per capita (PPP, cur. thousand int. \$)	-3.345	0.352	-9.510	0.00							
		Average number of years of adult (25+) education	-0.160	0.120	-1.330	0.18							
		Log of imports of goods and services (% of GDP)	-1.598	0.382	-4.180	0.00							
Constant	1.782	7.251	0.250	0.81									
1.2.2	Overall indicator (0-6) (Non-OECD countries)	Industry value added (% of GDP)	0.057	0.012	4.550	0.00	17	150	80.09	0.0000	-	-	Fixed Effects
		Rural population (% of total population)	-0.157	0.082	-1.910	0.06							
		Gini coefficient (0-100)	-0.023	0.015	-1.470	0.14							
		Polity score (-10,+10)	-0.033	0.025	-1.300	0.20							
		EU member (0-1)	0.463	0.250	1.850	0.07							
		OECD member (0-1)	(omitted)										
		Existence of electricity market reform idea (0-1)	(omitted)										

Models	Dependent variable	Explanatory variables	Coef.	Std. Err.	t-stat.	p value	# of countries	# of observations	Hausman Test		BPLM Test		Preferred Specification
									Statistic	p-value	Statistic	p-value	
		Log of population density	2.136	2.667	0.800	0.43							
		Log of electricity consumption per capita (MWh)	4.001	0.568	7.050	0.00							
		Log of GDP per capita (PPP, cur. thousand int. \$)	-3.009	0.351	-8.580	0.00							
		Average number of years of adult (25+) education	-0.246	0.296	-0.830	0.41							
		Log of imports of goods and services (% of GDP)	0.038	0.329	0.110	0.91							
		Constant	3.938	11.972	0.330	0.74							
2.1.1	Entry barriers (0-6) (OECD countries)	Net official assistance and aid received	-0.628	0.311	-2.020	0.04	30	764	83.97	0.0000	-	-	Fixed Effects
		EU member (0-1)	-1.060	0.234	-4.530	0.00							
		OECD member (0-1)	2.136	0.287	7.430	0.00							
		Existence of electricity market reform idea (0-1)	1.125	0.178	6.340	0.00							
		Log of population density	0.131	1.431	0.090	0.93							
		Log of electricity consumption per capita (MWh)	2.984	0.408	7.310	0.00							
		Log of GDP per capita (PPP, cur. thousand int. \$)	-5.987	0.347	-17.280	0.00							
		Average number of years of adult (25+) education	-0.226	0.103	-2.200	0.03							
		Log of imports of goods and services (% of GDP)	-2.491	0.399	-6.250	0.00							
		Constant	23.500	5.198	4.520	0.00							
2.1.2	Public Ownership (0-6) (OECD countries)	Net official assistance and aid received	-0.120	0.159	-0.760	0.45	30	764	123.73	0.0000	-	-	Fixed Effects
		EU member (0-1)	0.227	0.119	1.910	0.06							
		OECD member (0-1)	-0.371	0.147	-2.530	0.01							
		Existence of electricity market reform idea (0-1)	-0.024	0.091	-0.270	0.79							
		Log of population density	7.314	0.730	10.020	0.00							
		Log of electricity consumption per capita (MWh)	-0.354	0.208	-1.700	0.09							
		Log of GDP per capita (PPP, cur. thousand int. \$)	-1.273	0.177	-7.200	0.00							
		Average number of years of adult (25+) education	-0.226	0.052	-4.310	0.00							
		Log of imports of goods and services (% of GDP)	-0.621	0.203	-3.050	0.00							
		Constant	-16.994	2.651	-6.410	0.00							
2.1.3	Vertical integration (0-6) (OECD countries)	Net official assistance and aid received	-0.252	0.284	-0.890	0.37	30	764	19.84	0.0189	-	-	Fixed Effects
		EU member (0-1)	-1.171	0.214	-5.480	0.00							
		OECD member (0-1)	1.125	0.262	4.290	0.00							
		Existence of electricity market reform idea (0-1)	0.626	0.162	3.860	0.00							
		Log of population density	2.843	1.307	2.180	0.03							
		Log of electricity consumption per capita (MWh)	1.297	0.373	3.480	0.00							
		Log of GDP per capita (PPP, cur. thousand int. \$)	-4.536	0.316	-14.330	0.00							

Models	Dependent variable	Explanatory variables	Coef.	Std. Err.	t-stat.	p value	# of countries	# of observations	Hausman Test		BPLM Test		Preferred Specification
									Statistic	p-value	Statistic	p-value	
		Average number of years of adult (25+) education	0.108	0.094	1.160	0.25							
		Log of imports of goods and services (% of GDP)	-2.002	0.364	-5.500	0.00							
		Constant	7.825	4.747	1.650	0.10							
2.2.1	Overall indicator (0-6) (OECD countries)	Net official assistance and aid received	-0.334	0.202	-1.650	0.10	30	764	855.87	0.0000	-	-	Fixed Effects
		EU member (0-1)	-0.668	0.152	-4.380	0.00							
		OECD member (0-1)	0.964	0.187	5.140	0.00							
		Existence of electricity market reform idea (0-1)	0.576	0.116	4.980	0.00							
		Log of population density	3.429	0.933	3.680	0.00							
		Log of electricity consumption per capita (MWh)	1.309	0.266	4.920	0.00							
		Log of GDP per capita (PPP, cur. thousand int. \$)	-3.932	0.226	-17.410	0.00							
		Average number of years of adult (25+) education	-0.115	0.067	-1.710	0.09							
		Log of imports of goods and services (% of GDP)	-1.705	0.260	-6.560	0.00							
		Constant	4.777	3.387	1.410	0.16							
2.2.2	Overall indicator (0-6) (Non-OECD countries)	Net official assistance and aid received	-0.557	0.252	-2.210	0.03	17	271	140.97	0.0000	-	-	Fixed Effects
		EU member (0-1)	0.480	0.398	1.200	0.23							
		OECD member (0-1)	(omitted)										
		Existence of electricity market reform idea (0-1)	(omitted)										
		Log of population density	1.823	1.354	1.350	0.18							
		Log of electricity consumption per capita (MWh)	2.208	0.309	7.150	0.00							
		Log of GDP per capita (PPP, cur. thousand int. \$)	-1.898	0.219	-8.650	0.00							
		Average number of years of adult (25+) education	-1.353	0.209	-6.480	0.00							
		Log of imports of goods and services (% of GDP)	-0.104	0.204	-0.510	0.61							
		Constant	11.222	6.000	1.870	0.06							
3.1.1	Entry barriers (0-6) (OECD countries)	Single-party government (0-1)	0.053	0.162	0.330	0.74	29	710	3.40	1.0000	326.16	0.0000	Random Effects
		The years the chief executive has been in office	0.042	0.018	2.360	0.02							
		Economic policy orientation of ruling party: Right	-0.306	0.242	-1.270	0.21							
		Economic policy orientation of ruling party: Left	-0.423	0.246	-1.720	0.09							
		Economic policy orientation of ruling party: Centre	(omitted)										
		Parliamentary regimes (0-1)	0.538	0.361	1.490	0.14							
		Prof. bgr. of chief executive: Entrepreneur	-0.326	0.309	-1.060	0.29							
		Prof. bgr. of chief executive: Economics	1.333	0.389	3.430	0.00							
		Prof. bgr. of chief executive: Military	0.344	0.415	0.830	0.41							
		Prof. bgr. of chief executive: Politician	0.482	0.213	2.260	0.02							

Models	Dependent variable	Explanatory variables	Coef.	Std. Err.	t-stat.	p value	# of countries	# of observations	Hausman Test		BPLM Test		Preferred Specification
									Statistic	p-value	Statistic	p-value	
		Prof. bgr. of chief executive: Scientist, Other	0.446	0.243	1.840	0.07							
		Prof. bgr. of chief executive: Unknown/other	0.516	0.227	2.270	0.02							
		Educ. bgr. of chief executive: Economics	-0.085	0.556	-0.150	0.88							
		Educ. bgr. of chief executive: Natural science	-0.235	0.640	-0.370	0.71							
		Educ. bgr. of chief executive: Other university	-0.519	0.579	-0.900	0.37							
		Educ. bgr. of chief executive: Unknown/other	-0.042	0.605	-0.070	0.94							
		EU member (0-1)	-0.829	0.233	-3.560	0.00							
		OECD member (0-1)	1.697	0.327	5.190	0.00							
		Existence of electricity market reform idea (0-1)	0.749	0.181	4.140	0.00							
		Log of population density	0.606	0.140	4.340	0.00							
		Log of electricity consumption per capita (MWh)	2.886	0.318	9.070	0.00							
		Log of GDP per capita (PPP, cur. thousand int. \$)	-5.730	0.321	-17.860	0.00							
		Average number of years of adult (25+) education	-0.240	0.085	-2.830	0.01							
		Log of imports of goods and services (% of GDP)	-1.202	0.272	-4.420	0.00							
		Constant	16.661	1.214	13.730	0.00							
3.1.2	Public Ownership (0-6) (OECD countries)	Single-party government (0-1)	-0.144	0.085	-1.690	0.09	29	710	14.85	0.8687	2929.78	0.0000	Random Effects
		The years the chief executive has been in office	0.033	0.009	3.660	0.00							
		Economic policy orientation of ruling party: Right	0.074	0.129	0.570	0.57							
		Economic policy orientation of ruling party: Left	-0.203	0.131	-1.550	0.12							
		Economic policy orientation of ruling party: Centre	(omitted)										
		Parliamentary regimes (0-1)	-0.407	0.231	-1.760	0.08							
		Prof. bgr. of chief executive: Entrepreneur	-0.457	0.161	-2.840	0.00							
		Prof. bgr. of chief executive: Economics	0.056	0.204	0.270	0.79							
		Prof. bgr. of chief executive: Military	0.103	0.230	0.450	0.65							
		Prof. bgr. of chief executive: Politician	-0.201	0.117	-1.720	0.09							
		Prof. bgr. of chief executive: Scientist, Other	-0.484	0.132	-3.670	0.00							
		Prof. bgr. of chief executive: Unknown/other	-0.302	0.124	-2.430	0.02							
		Educ. bgr. of chief executive: Economics	0.163	0.285	0.570	0.57							
		Educ. bgr. of chief executive: Natural science	1.123	0.330	3.410	0.00							
		Educ. bgr. of chief executive: Other university	0.126	0.295	0.430	0.67							
		Educ. bgr. of chief executive: Unknown/other	0.120	0.313	0.380	0.70							
		EU member (0-1)	-0.016	0.127	-0.130	0.90							
		OECD member (0-1)	-0.474	0.181	-2.610	0.01							

Models	Dependent variable	Explanatory variables	Coef.	Std. Err.	t-stat.	p value	# of countries	# of observations	Hausman Test		BPLM Test		Preferred Specification
									Statistic	p-value	Statistic	p-value	
		Existence of electricity market reform idea (0-1)	0.114	0.097	1.180	0.24							
		Log of population density	-0.118	0.181	-0.650	0.51							
		Log of electricity consumption per capita (MWh)	0.232	0.228	1.020	0.31							
		Log of GDP per capita (PPP, cur. thousand int. \$)	-0.638	0.187	-3.410	0.00							
		Average number of years of adult (25+) education	-0.333	0.055	-6.050	0.00							
		Log of imports of goods and services (% of GDP)	0.196	0.191	1.030	0.31							
		Constant	9.582	0.972	9.860	0.00							
3.1.3	Vertical integration (0-6) (OECD countries)	Single-party government (0-1)	-0.229	0.139	-1.650	0.10	29	710	16.93	0.7153	1075.26	0.0000	Random Effects
		The years the chief executive has been in office	0.044	0.015	2.970	0.00							
		Economic policy orientation of ruling party: Right	-0.526	0.211	-2.500	0.01							
		Economic policy orientation of ruling party: Left	-0.380	0.214	-1.770	0.08							
		Economic policy orientation of ruling party: Centre	(omitted)										
		Parliamentary regimes (0-1)	0.078	0.365	0.210	0.83							
		Prof. bgr. of chief executive: Entrepreneur	-0.591	0.264	-2.240	0.03							
		Prof. bgr. of chief executive: Economics	1.982	0.335	5.920	0.00							
		Prof. bgr. of chief executive: Military	-0.173	0.373	-0.460	0.64							
		Prof. bgr. of chief executive: Politician	0.443	0.191	2.330	0.02							
		Prof. bgr. of chief executive: Scientist, Other	-0.043	0.215	-0.200	0.84							
		Prof. bgr. of chief executive: Unknown/other	0.725	0.202	3.590	0.00							
		Educ. bgr. of chief executive: Economics	0.814	0.468	1.740	0.08							
		Educ. bgr. of chief executive: Natural science	1.750	0.541	3.230	0.00							
		Educ. bgr. of chief executive: Other university	0.659	0.486	1.360	0.18							
		Educ. bgr. of chief executive: Unknown/other	0.507	0.513	0.990	0.32							
		EU member (0-1)	-1.282	0.206	-6.220	0.00							
		OECD member (0-1)	0.966	0.293	3.300	0.00							
		Existence of electricity market reform idea (0-1)	0.384	0.158	2.430	0.02							
		Log of population density	0.470	0.218	2.150	0.03							
		Log of electricity consumption per capita (MWh)	1.778	0.349	5.090	0.00							
		Log of GDP per capita (PPP, cur. thousand int. \$)	-4.266	0.299	-14.280	0.00							
		Average number of years of adult (25+) education	0.047	0.087	0.540	0.59							
		Log of imports of goods and services (% of GDP)	-1.484	0.296	-5.010	0.00							
		Constant	14.172	1.352	10.480	0.00							

Models	Dependent variable	Explanatory variables	Coef.	Std. Err.	t-stat.	p value	# of countries	# of observations	Hausman Test		BPLM Test		Preferred Specification
									Statistic	p-value	Statistic	p-value	
3.2.1	Overall indicator (0-6) (OECD countries)	Single-party government (0-1)	-0.113	0.103	-1.090	0.28	29	710	14.82	0.8698	988.55	0.0000	Random Effects
		The years the chief executive has been in office	0.038	0.011	3.400	0.00							
		Economic policy orientation of ruling party: Right	-0.191	0.156	-1.230	0.22							
		Economic policy orientation of ruling party: Left	-0.268	0.159	-1.690	0.09							
		Economic policy orientation of ruling party: Centre	(omitted)										
		Parliamentary regimes (0-1)	0.118	0.265	0.450	0.66							
		Prof. bgr. of chief executive: Entrepreneur	-0.431	0.196	-2.200	0.03							
		Prof. bgr. of chief executive: Economics	1.195	0.248	4.810	0.00							
		Prof. bgr. of chief executive: Military	0.111	0.275	0.400	0.69							
		Prof. bgr. of chief executive: Politician	0.262	0.141	1.860	0.06							
		Prof. bgr. of chief executive: Scientist, Other	0.021	0.159	0.130	0.90							
		Prof. bgr. of chief executive: Unknown/other	0.342	0.149	2.290	0.02							
		Educ. bgr. of chief executive: Economics	0.328	0.348	0.940	0.35							
		Educ. bgr. of chief executive: Natural science	0.948	0.402	2.360	0.02							
		Educ. bgr. of chief executive: Other university	0.130	0.362	0.360	0.72							
		Educ. bgr. of chief executive: Unknown/other	0.268	0.381	0.700	0.48							
		EU member (0-1)	-0.752	0.152	-4.940	0.00							
		OECD member (0-1)	0.791	0.215	3.670	0.00							
		Existence of electricity market reform idea (0-1)	0.465	0.117	3.980	0.00							
		Log of population density	0.272	0.141	1.920	0.05							
Log of electricity consumption per capita (MWh)	1.696	0.249	6.830	0.00									
Log of GDP per capita (PPP, cur. thousand int. \$)	-3.628	0.218	-16.610	0.00									
Average number of years of adult (25+) education	-0.169	0.063	-2.700	0.01									
Log of imports of goods and services (% of GDP)	-0.954	0.212	-4.510	0.00									
Constant	13.918	0.940	14.810	0.00									
3.2.2	Overall indicator (0-6) (Non-OECD countries)	Single-party government (0-1)	0.137	0.156	0.880	0.38	14	194	142.00	0.0000	-	-	Fixed Effects
		The years the chief executive has been in office	-0.002	0.023	-0.100	0.92							
		Economic policy orientation of ruling party: Right	(omitted)										
		Economic policy orientation of ruling party: Left	-0.041	0.213	-0.190	0.85							
		Economic policy orientation of ruling party: Centre	0.002	0.267	0.010	1.00							
		Parliamentary regimes (0-1)	-0.504	0.567	-0.890	0.38							
		Prof. bgr. of chief executive: Entrepreneur	0.276	0.363	0.760	0.45							
		Prof. bgr. of chief executive: Economics	-0.418	0.336	-1.240	0.22							

Models	Dependent variable	Explanatory variables	Coef.	Std. Err.	t-stat.	p value	# of countries	# of observations	Hausman Test		BPLM Test		Preferred Specification
									Statistic	p-value	Statistic	p-value	
		Prof. bgr. of chief executive: Military	0.080	0.414	0.190	0.85							
		Prof. bgr. of chief executive: Politician	-0.341	0.369	-0.920	0.36							
		Prof. bgr. of chief executive: Scientist, Other	0.139	0.343	0.400	0.69							
		Prof. bgr. of chief executive: Unknown/other	-0.028	0.238	-0.120	0.91							
		Educ. bgr. of chief executive: Economics	-0.234	0.540	-0.430	0.67							
		Educ. bgr. of chief executive: Natural science	-0.273	0.479	-0.570	0.57							
		Educ. bgr. of chief executive: Other university	-0.357	0.505	-0.710	0.48							
		Educ. bgr. of chief executive: Unknown/other	-0.174	0.792	-0.220	0.83							
		EU member (0-1)	0.515	0.393	1.310	0.19							
		OECD member (0-1)	(omitted)										
		Existence of electricity market reform idea (0-1)	(omitted)										
		Log of population density	1.379	2.110	0.650	0.51							
		Log of electricity consumption per capita (MWh)	2.266	0.430	5.280	0.00							
		Log of GDP per capita (PPP, cur. thousand int. \$)	-1.245	0.370	-3.370	0.00							
		Average number of years of adult (25+) education	-1.613	0.292	-5.530	0.00							
		Log of imports of goods and services (% of GDP)	-0.098	0.228	-0.430	0.67							
		Constant	14.494	10.103	1.430	0.15							

**Appendix III-4: Correlation among explanatory and control variables**

**Correlation among explanatory variables**

Variables	ind va	aid	hg_por	hg_pol	hg_poc	hg_prep	hg_prse	hg_prmt	hg_prpo	hg_prso	hg_prot	hg_edec	hg_edns	hg_edou	hg_edot
ind va	1														
aid	-0.0178	1													
hg_por	-0.0165	-0.0972	1												
hg_pol	0.0215	0.0223	-0.7387	1											
hg_poc	-0.007	0.1033	-0.3572	-0.3657	1										
hg_prep	-0.0613	0.0431	0.0702	-0.124	0.0749	1									
hg_prse	-0.0423	0.0387	0.0612	0.0041	-0.0901	-0.0488	1								
hg_prmt	0.1085	0.0123	0.0529	-0.0203	-0.0449	-0.0498	-0.0469	1							
hg_prpo	0.0484	0.1557	-0.036	-0.0673	0.143	0.0065	-0.1628	-0.1528	1						
hg_prso	0.0423	0.0482	0.0124	-0.0415	0.0405	-0.0048	-0.1388	-0.1416	-0.1267	1					
hg_prot	0.0119	0.0575	-0.0847	0.0431	0.0572	0.0345	-0.1325	0.0483	-0.1914	-0.3846	1				
hg_edec	-0.0497	0.0211	-0.0111	0.1632	-0.2108	-0.011	0.3683	-0.0499	-0.1227	-0.2793	0.1499	1			
hg_edns	0.0414	0.1493	-0.0305	-0.0115	0.058	0.1002	-0.0935	-0.0955	0.1515	0.1012	0.1263	-0.1492	1		
hg_edou	-0.089	-0.1408	0.0956	-0.1257	0.0421	-0.0949	-0.2044	-0.057	0.0806	0.2776	-0.2642	-0.5106	-0.3633	1	
hg_edot	0.1349	0.0391	-0.0654	-0.0096	0.1036	0.0779	-0.0889	0.2184	-0.0357	-0.1977	0.0289	-0.2414	-0.1809	-0.3955	1

### Correlation among control variables

Variables	hg_sp	cexyrs	hg_epr	rural	gini	polity	eu	oecd	refid	pop_den	elcon	gdppc	educ	imp
<b>hg_sp</b>	1													
<b>cexyrs</b>	0.0013	1												
<b>hg_epr</b>	0.1981	0.1049	1											
<b>rural</b>	-0.0487	0.045	0.2544	1										
<b>gini</b>	0.3222	-0.0499	0.5225	0.1435	1									
<b>polity</b>	-0.1737	-0.2988	-0.5602	-0.4218	-0.3023	1								
<b>eu</b>	-0.1189	0.1124	-0.4147	-0.2192	-0.1712	0.3276	1							
<b>oecd</b>	0.0351	0.0484	-0.4485	-0.5038	-0.1968	0.5693	0.4615	1						
<b>refid</b>	-0.1959	0.0342	0.0671	0.1708	0.1022	-0.048	0.0391	-0.2258	1					
<b>pop_den</b>	-0.0679	0.0147	-0.0929	-0.1159	-0.1111	0.0786	0.3636	0.1497	-0.0241	1				
<b>elcon</b>	-0.0409	-0.0328	-0.2662	-0.3852	-0.3395	0.3344	-0.072	0.4577	-0.0861	-0.3002	1			
<b>gdppc</b>	-0.1344	0.0459	-0.4125	-0.4661	-0.2438	0.499	0.4853	0.6403	0.2057	0.1242	0.5746	1		
<b>educ</b>	-0.1098	-0.0709	-0.0087	-0.3103	-0.1212	0.1908	-0.2079	0.1256	0.1341	-0.0952	0.4052	0.3607	1	
<b>imp</b>	-0.3022	-0.085	-0.0529	0.3117	-0.1146	-0.1076	0.0347	-0.398	0.2892	0.0572	-0.2736	-0.1582	0.1804	1

## Abbreviations

<b>Variables</b>	<b>Abbreviation</b>
<b>Explanatory Variables</b>	
Industry value added (% of GDP)	ind_va
Net official development assistance and official aid received (current billion US\$)	aid
<i>Party orientation with respect to economic policy</i>	
- Right	hg_por
- Left	hg_pol
- Center	hg_poc
<i>Professional background of chief executive</i>	
- Entrepreneur	hg_prep
- Scientist (Economist)	hg_prse
- Military	hg_prmt
- Politician	hg_prpo
- Scientist (Other)	hg_prso
- Unknown/other	hg_prot
<i>Educational background of chief executive</i>	
- Economics	hg_edec
- Natural science	hg_edns
- Other university	hg_edou
- Unknown/other	hg_edot
<b>Control Variables</b>	
Party Structure (1: single-party, 0: coalition)	hg_sp
The years the chief executive has been in office	cexyrs
Electoral system (parliamentary regimes)	hg_epr
Rural population (% of total population)	rural
Gini coefficient (0-100)	gini
Polity score (-10,+10)	polity
EU member (0-1)	eu
OECD member (0-1)	oecd
Existence of electricity market reform idea (0-1)	refid
Population density (people per sq. km of land area)	pop_den
Electricity consumption (MWh per capita)	elcon
GDP per capita (PPP, current thousand int. \$)	gdppc
Average number of years of education received by people ages 15 and older	educ
Imports of goods and services (% of GDP)	imp