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

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More than half of the countries in the world have introduced a reform process in their power sectors since 1980s. Adapting a political economy perspective, this paper attempts to discover the impact of political economic variables on the liberalization process in electricity markets. Empirical models are developed using panel data from 55 developed and developing countries covering the period 1975–2010. The research findings clearly show that political variables have a significant impact on the reform progress. 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. 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. Or results also 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. Finally, the paper also questions whether politicians' education and profession matter for the electricity market reforms. Overall, the results show they do.

Keywords: Econometric modeling; institutions and the macroeconomy; international political economy

JEL Classification: C5, E02, F35, F5, L94

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 & Ghanadan, 2006a). 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 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

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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 3 develops the hypotheses tested in the study. Section 4 summarizes the methodological framework. Section 5 describes data. Following two sections present empirical analysis and discuss the results. The last section concludes.

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 empirically investigates the impact of some variables on electricity market reform outcome (e.g. Nagayama (2007, 2009); Zhang, Parker, and Kirkpatrick (2008)); to the best of our knowledge, this study constitutes one of the first empirical applied investigations that specifically 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.

The first group of studies (those focusing on the political economy of electricity market reforms) include only two papers by Chang and Berdiev (2011a) and Cubbin and Stern (2006). Chang and Berdiev (2011a) 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, Noumba Um, and Recuero Virto (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 favor 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 Alberto Alesina, Ardagna, and Trebbi (2006), Boschini (2006), Dreher, Lamla, Lein, and Somogyi (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, Schneider, and Halla (2009).

Alberto 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 industrialization. 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 industrialization. Dreher et al. (2009) analyze 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 labor 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) analyze 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.

The European Union (EU) coordinates and encourages (and sometimes enforces) the policies to set up a fully functioning competitive electricity market among its member states; and therefore, the literature focusing on the reforms in the Europe deserves a special focus. The power market reforms in Europe are probably one of the most investigated academic areas. Many scholars have provided numerous case studies from various countries in Europe (such as Amorim, Vasconcelos, Abreu, Silva, and Martins (2013); Arocena, Kühn, and Regibeau (1999); Diaconu, Oprescu, and Pittman (2009); Durakoglu (2011); Erdogdu (2007); Ferrari and Giulietti (2005); Iliadou (2009); Midttun (1996); Reisch and Micklitz (2006); Scholl (2009); and Bauby and Varone (2007)); and some others have contributed to this literature by presenting case studies at the regional level (such as Chang and Berdiev (2011b); Deitz, Stirton, and Wright (2009); Hattori and Tsutsui (2004); Hirschhausen and Waelde (2001); Hooper and Medvedev (2009); Jamasb (2006); Karova (2011); Newbery (2001); Pollitt (2009); Price and Pham (2009); Serrallés (2006); Tennbakk (2000); Trillas (2010); Williams and Ghanadan (2006b); Newbery (2002); and Anderson (1995)).

The power market reforms in Europe have also been investigated from a political economy perspective. Levi-Faur (1999) questioned whether politics has been influential in the governance of competition in electricity industry in Europe. Nicolaides (2004), on the other hand, investigated the political economy of multi-tiered electricity market regulation in Europe. Niklas Potrafke (2010) analyzed how government ideology influences deregulation of product markets (including electricity industry).

Rufin (2003) attempted to explain how two "economic institutions" -property rights and competition- are determined in the course of restructuring the electricity industry. Three explanatory variables, judicial independence, ideology, and distributional conflict, are subjected to theoretical, comparative, and empirical analysis in four case studies to determine their precise role in shaping the resulting ownership patterns and the degree of competitiveness in the electricity business. Henisz and Zelner (2006) examined the effects of interest group pressure and the structure of political institutions on infrastructure deployment by state-owned electric utilities in a panel of seventy-eight countries (including EU members) during the period 1970-94. They considered two factors that jointly influence the rate of infrastructure deployment: (1) the extent to which the consumer base consists of industrial consumers, which are capable of exerting discipline on political actors whose competing incentives are to construct economically inefficient "white elephants" to satisfy the demands of concentrated geographic interests, labor unions, and national engineering and construction lobbies; and (2) veto points in formal policymaking structures that constrain political actors, thereby reducing these actors' sensitivity to interest group demands. They found that a higher fraction of industrial customers provides political actors with stronger incentives for discipline, reducing the deployment of white elephants and thus the infrastructure growth rate, *ceteris paribus*. Finally, Clifton, Díaz-Fuentes, and Revuelta (2010) tested three political economy arguments on the relationship between liberalization and incumbent internationalization in electricity industry: (1) incumbents most exposed to domestic liberalization would internationalize most, (2) incumbents operating where liberalization was restricted could exploit monopolistic rents to finance internationalization, and (3) a diversity of paths will be adopted by countries and incumbents vis-à-vis liberalization and internationalization. Using correlation and cluster analysis of EU electricity incumbent multinationals, they found evidence in favor of the third hypothesis.

3   Hypothesis development

Acemoglu, Johnson, and Robinson (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.

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 & Xu, 2002). 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 & 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.

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 favorable 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, Levine, and Noll (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 favor 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 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.

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 & Ghanadan, 2006a). 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.

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 & Lowry, 1994; Clarke & Cull, 2002; M. P. Jones, Sanguinetti, & Tommasi, 2000). A. 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; N. Potrafke, 2010). In line with this assumption, some empirical studies have found that market-oriented and right-wing governments pursue privatization and liberalization (Bjørnskov & Potrafke, 2011; Bortolotti & Pinotti, 2008; Duso, 2002; Pitlik, 2007; N. 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 & Berdiev,

2011a). 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 & 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.

3.4 Hypothesis on the background of chief executive

As summarized in Dreher et al. (2009), there is a growing literature connecting personal traits of policy makers and implementers with policy outcomes. B. F. 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, Pande, and Rao (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).

In this paper, we focus on the professional and educational background of the chief executive (prime minister or president) as the literature summarized above 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. That is, 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 mentioned above. 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 four for educational background. The details of these variables are available in the following sections.

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 & 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 & 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 "UK example" 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.

Indictors 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.

4 Methodology

As underlined by Jamasb, Newbery, and Pollitt (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 analyzing 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) analyzed 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.

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

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). ε_{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 $\propto_i$, 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:

$$Y_{it}=\beta_1 + \sum_{j=2}^{k} \beta_j X_{jit} + \propto_i + \delta t + \varepsilon_{it} \tag{2}$$

Now, the characterization of the $\propto_i$ 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 $\propto_i$ 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 ($\propto_i$) are assumed to be the fixed parameters to be estimated. In RE model, the country-specific effects ($\propto_i$) 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 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 1 and Figure 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. Besides, there are more than 90 countries in the world where a reform process has been initiated but our sample is composed of 55 countries. That is, our sample is limited by data availability. We also acknowledge that 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. 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 center); 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 "UK example"; 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 1 shows descriptive statistics of the variables in our analysis.

Table 1. Descriptive statistics of the variables

Variables (units)	Mean	Std. Dev.	Min	Max	# of Obser.	# of Ctrys
Dependent Variables						
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
Explanatory Variables						
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
Party orientation with respect to economic policy						
- 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
Professional background of chief executive						
- 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
Educational background of chief executive						
- 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
Control Variables						
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
UK example, dummy =1 after 1989	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

Variables (units)	Mean	Std. Dev.	Min	Max	# of Obser.	# of Ctrys
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

Data on overall electricity market closeness index are obtained from Conway and Nicolett (2006) and EBRD[1] (2011). Actually, World Bank (2006, pp 21-22) also provides a similar classification of countries based on their electricity market structure. However, since we need a specific reform score for each country (rather than groups of countries) to conduct our econometric analysis, we prefer to use data provided by OECD and EBRD. 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 liberalized 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 organization theory, is that the scope for anti-competitive behavior is largest when an electricity company simultaneously controls the network and operates in upstream or downstream competitive markets. Table 2 shows the composition of the electricity market closeness index. As can be seen in Table 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.

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 liberalization.

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[1] European Bank for Reconstruction and Development

**Table 2.** Composition of the electricity market closeness index

	Weights by theme (b_j)	Question Weights (c_k)	Coding of Data					
Entry regulation: o How are the terms and conditions of third party access (TPA) to the electricity transmission grid determined?		1/3	Regulated TPA 0		Negotiated TPA 3		No TPA 6	
o Is there a liberalized wholesale market for electricity (a wholesale pool)?	1/3	1/3	Yes 0				No 6	
o What is the minimum consumption threshold that consumers must exceed in order to be able to choose their electricity supplier?		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
Public ownership: o 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	
Vertical Integration: o What is the degree of vertical separation between the transmission and generation segments of the electricity industry?		1/2	Separate Companies 0		Accounting separation 3		Integrated 6	
o What is the overall degree of vertical integration in the electricity industry?	1/3	1/2	Unbundled 0		Mixed 3		Integrated 6	
Country scores (0-6)			$\Sigma_j b_j \Sigma_k c_k \text{ answer}_{jk}$					

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 liberalized 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 1 and Figure 2 provide the change in electricity market closeness index from 1989 to 2007 for the countries in our dataset.
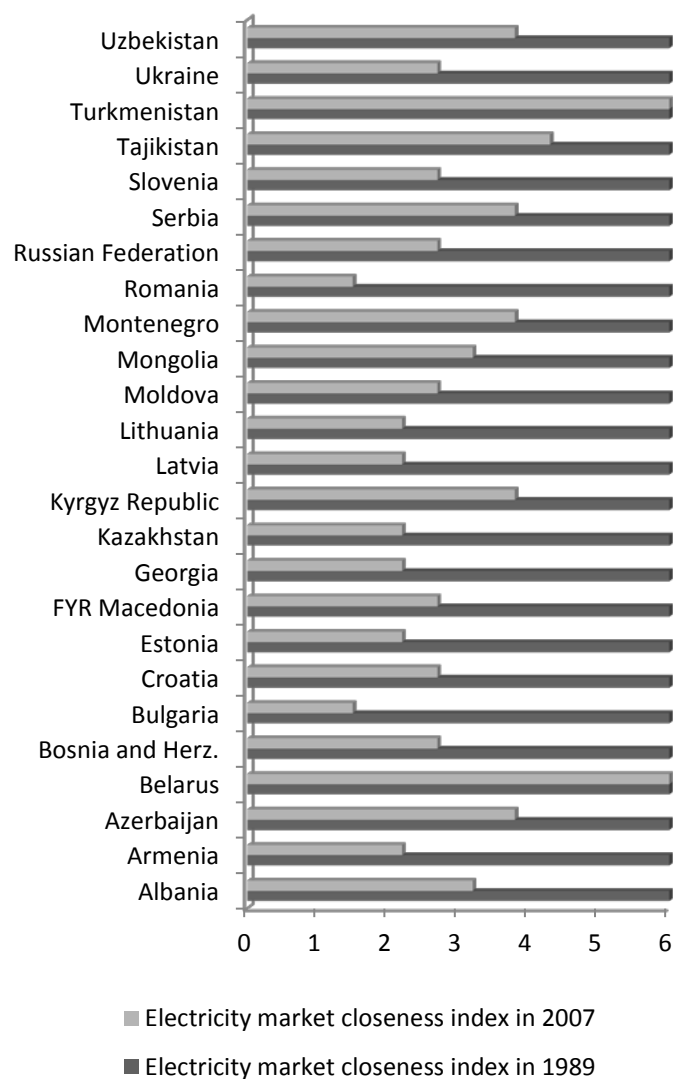
Figure 1. Electricity market closeness index in OECD countries (1989, 2007)

■ Electricity market closeness index in 2007

■ Electricity market closeness index in 1989
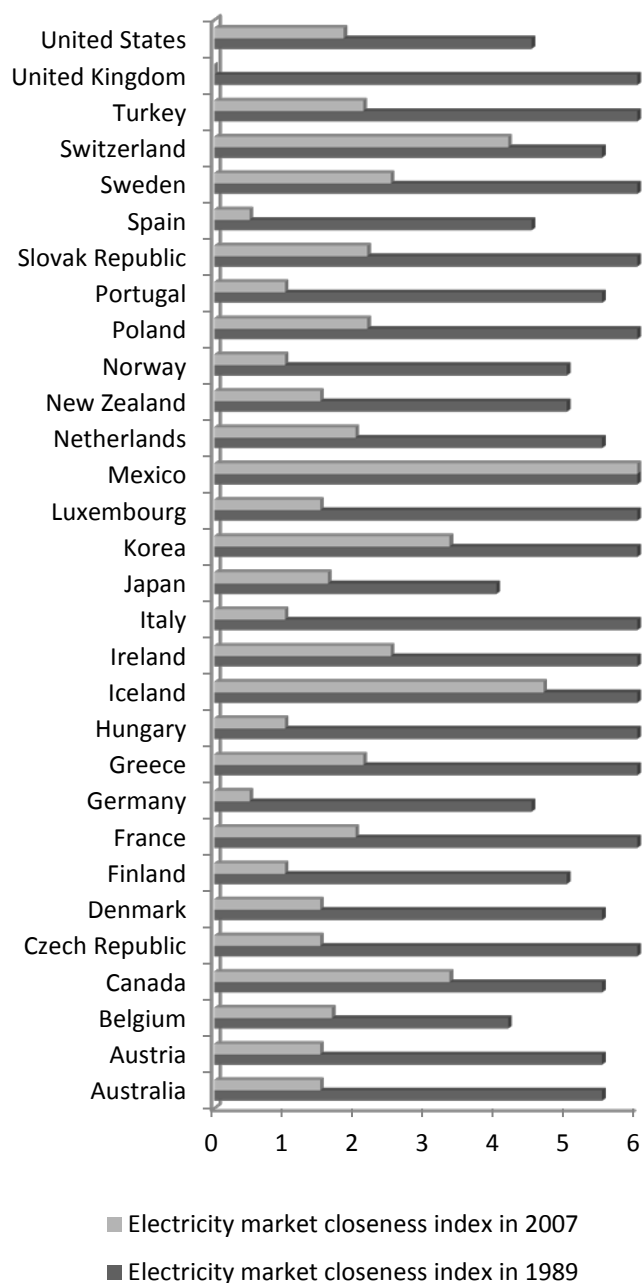
Electricity market closeness index assigns a score to each country for each year based on the reform status of that country in that year. It is an indicator of reform progress, rather than reform success. Table 3 classifies 55 countries in our dataset into four groups based on their market closeness 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 3. The main reason for this is

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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 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.

Figure 2. Electricity market closeness index in countries where EBRD operates (1989, 2007)

■ Electricity market closeness index in 2007

■ Electricity market closeness index in 1989

Table 3. Country groups based on electricity market closeness index in 2000

Score 0-1.5 (Group 1)	Score 1.5-3.0 (Group 2)	Score 3.0-4.5 (Group 3)	Score 4.5-6.0 (Group 4)
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). 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 (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.

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. 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 regarded as double-counting. We also created "unknown/other" category to represent other educational and professional backgrounds.

Gini coefficient[2] and polity score data come from UNU-WIDER (2011) and Center for Systemic Peace (CSP, 2010), respectively. EU directives are expected to have an influence on the reform progress especially in EU

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[2] 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.

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 "UK example" 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 "UK example" 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.

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.

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[3]. 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 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.

Table 4. Estimation results for the models testing Hypothesis 1 (sub-indicators)

Dependent Variables	Entry barriers (0-6) *(OECD countries)*	Public Ownership (0-6) *(OECD countries)*	Vertical integration (0-6) *(OECD countries)*
Explanatory variable			
Industry value added (% of GDP)	0.129*** (0.027)	0.076*** (0.015)	0.128*** (0.025)
Control variables			
Rural population (% of total population)	*NS*	*NS*	*NS*
Gini coefficient (0-100)	*NS*	*NS*	*NS*
Polity score (-10,+10)	0.178*** (0.046)	*NS*	0.109*** (0.042)
EU member (0-1)	-1.61*** (0.319)	*NS*	-1.407*** (0.294)
OECD member (0-1)	1.717*** (0.419)	*NS*	0.907** (0.386)
UK example, dummy =1 after 1989	1.078*** (0.274)	*NS*	0.521** (0.252)
Log of population density	*NS*	9.221*** (1.357)	*NS*
Log of electricity consumption per capita (MWh)	2.566*** (0.796)	-1.188*** (0.423)	*NS*
Log of GDP per capita (PPP, cur. thousand int. $)	-5.201*** (0.536)	-1.157*** (0.285)	-3.679*** (0.494)

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[3] Throughout the paper, model estimations are carried out and cross-checked by Stata 12 and Eviews 7.

Average number of years of adult (25+) education	*NS*	*NS*	*NS*
Log of imports of goods and services (% of GDP)	-2.415*** (0.582)	-0.936*** (0.31)	-1.444*** (0.536)
Constant	*NS*	-25.833*** (5.876)	17.055* (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 ***1% level, **5% level, *10% level.

Table 5. Estimation results for the models testing Hypothesis 1 (overall indicator)

Dependent Variables	Overall indicator (0-6) *(OECD countries)*	Overall indicator (0-6) *(Non-OECD countries)*
Explanatory variable		
Industry value added (% of GDP)	0.111*** (0.018)	0.057*** (0.012)
Control variables		
Rural population (% of total population)	*NS*	-0.157* (0.082)
Gini coefficient (0-100)	*NS*	*NS*
Polity score (-10,+10)	0.091*** (0.03)	*NS*
EU member (0-1)	-0.927*** (0.21)	0.463* (0.25)
OECD member (0-1)	0.889*** (0.275)	(omitted)
UK example, dummy =1 after 1989	0.569*** (0.18)	(omitted)
Log of population density	3.153* (1.675)	*NS*
Log of electricity consumption per capita (MWh)	*NS*	4.001*** (0.568)
Log of GDP per capita (PPP, cur. thousand int. $)	-3.345*** (0.352)	-3.009*** (0.351)
Average number of years of adult (25+) education	*NS*	*NS*
Log of imports of goods and services (% of GDP)	-1.598*** (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 ***1% level, **5% level, *10% level.

Table 6. Estimation results for the models testing Hypothesis 2 (sub-indicators)

Dependent Variables	Entry barriers (0-6) *(OECD countries)*	Public Ownership (0-6) *(OECD countries)*	Vertical integration (0-6) *(OECD countries)*
Explanatory variable			
Net official assistance and aid received	-0.628** (0.311)	*NS*	*NS*
Control variables			
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)
UK example, dummy =1 after 1989	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 7. Estimation results for the models testing Hypothesis 2 (overall indicator)

Dependent Variables	Overall indicator (0-6) *(OECD countries)*	Overall indicator (0-6) *(Non-OECD countries)*
Explanatory variable		
Net official assistance and aid received	-0.334* (0.202)	-0.557** (0.252)
Control variables		
EU member (0-1)	-0.668*** (0.152)	*NS*
OECD member (0-1)	0.964*** (0.187)	(omitted)
UK example, dummy =1 after 1989	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 8. Estimation results for the models testing Hypotheses 3 and 4 (sub-indicators)

Dependent Variables	Entry barriers (0-6) *(OECD countries)*	Public Ownership (0-6) *(OECD countries)*	Vertical integration (0-6) *(OECD countries)*
Explanatory variables			
Economic policy orientation of ruling party			
- Right	*NS*	*NS*	-0.526** (0.211)
- Left	-0.423* (0.246)	*NS*	-0.38* (0.214)
- Center	(omitted)	(omitted)	(omitted)
Professional background of chief executive			
- Entrepreneur	*NS*	-0.457*** (0.161)	-0.591** (0.264)
- Scientist, 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)
Educational background of chief executive			
- 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*
Control variables			
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)
UK example, dummy =1 after 1989	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 9. Estimation results for the models testing Hypotheses 3 and 4 (overall indicator)

Dependent Variables	Overall indicator (0-6)	Overall indicator (0-6)
	(OECD countries)	*(Non-OECD countries)*
Explanatory variables		
Economic policy orientation of ruling party		
- Right	*NS*	(omitted)
- Left	-0.268* (0.159)	*NS*
- Center	(omitted)	*NS*
Professional background of chief executive		
- Entrepreneur	-0.431** (0.196)	*NS*
- Scientist, 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*

Educational background of chief executive

- Economics	*NS*	*NS*
- Natural science	0.948** (0.402)	*NS*
- Other university	*NS*	*NS*
- Unknown/other	*NS*	*NS*
Control variables		
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)
UK example, dummy =1 after 1989	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.

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.

7.1 Impact of industry sector on the reforms

When we look at the results presented in Table 4 and Table 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). 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 deducted 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.

7.2 Impact of foreign financial aid on the reforms

The results from Table 6 and Table 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 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 analyzing two groups separately in future studies may provide interesting results.

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. Besides, our analysis does 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.

7.4 Impact of the background of chief executive on the reforms

Throughout the paper, we have also analyzed 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 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, 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.

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 8 and Table 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 4 and Table 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.

"UK example" seems to limit the reform progress, which implies 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.

7.6 Impact of Asian financial crisis, international experience, power system load size and corruption on the reforms

World Bank (2006) finds that power system load size, national per capita income and average value of the corruption index are good predictors of the extent of liberalization. Besides, international experience (that is, the effect of outcomes of liberalization in other countries) may have a substantial effect on the decision of a country to liberalize. Moreover, the Asian financial crisis in 1997 and 1998 interrupted liberalization by cutting off private capital for investment in many countries. In this section, we would like to investigate the impact of Asian financial crisis, international experience, power system load size and corruption on the extent of reforms. To do so, we include five new variables into our analysis, namely "UK example", "California crisis", "power system load size", "Asian financial crisis" and "corruption perceptions index".

Actually, we would like to get/construct a new variable that represents the international experience on electricity market reforms (that is, the effect of outcomes of liberalization in other countries). However, such a variable is non-existent and almost impossible to develop as reform success or failure is country specific and therefore it is not easy to develop a measure of it applicable to all countries. Therefore, we use two proxy variables to represent the effect of outcomes of electricity market liberalization in other countries. It is quite possible that countries prefer to liberalize their power markets after reforms are implemented successfully in other countries. The dummy variable "UK example" 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. Besides, 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. The dummy variable "California crisis" represents this impact. It takes the value 1 after 2000; the years before 2000 take the value 0.

The data on power system load size are taken from US EIA (2013). We also created a dummy variable that represents Asian financial crisis, which takes the value 1 for 1997 and 1998 and 0 for other years. Corruption perceptions index is taken from Transparency International (2013). It ranks countries according to their perceived levels of 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.

The main analysis presented in this paper includes data from 55 countries. However, data on new variables are limited and available for 45 of them. In order **not** to lose an important 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 Asian financial crisis, international experience, power system load size and corruption on the reform processes in various countries. We specify and estimate two new models including all explanatory variables we used in our main model and five new variables we mentioned above. Table 10 and Table 11 present estimation results from two new regressions. Compared to the main one, these new models are limited in the sense that we have less data to estimate equations based on them. Table 10 shows estimation results for the limited model testing Hypotheses 1 and 2 while Table 11 presents estimation results for the limited model testing Hypotheses 3 and 4. Since we have 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 Asian financial crisis, international experience, power system load size and corruption on the reform progress using the limited dataset we have.

As can be seen in Table 10 and Table 11, the empirical analysis in this section yields results similar to those from our main models with the exception that the coefficient of the variable representing net official assistance and aid received is not significant in the limited model. Coefficients of the variables representing industry value added, economic policy orientation of ruling party and professional background of the chief executive are still significant and have 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) government ideology is one of the determinants of the progress in electricity market reform process (Hypothesis 3) and (iii) 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 also confirms the robustness of our results.

Table 10. Estimation results for the limited model testing Hypotheses 1 and 2

Explanatory variables	Electricity market closeness index (0-6) *(Dependent variable)*
Industry value added (% of GDP)	0.040*** (0.012)
Net official assistance and aid received	*NS*
California crisis, dummy =1 after 2000	-0.676*** (0.111)
UK example, dummy =1 after 1989	*(omitted)*
Log of GDP per capita (PPP, cur. thousand int. $)	-0.580** (0.229)
Log of power system load size	-1.095*** (0.328)
Asian financial crisis, dummy =1 for 1997 and 1998	0.258** (0.106)
Corruption perceptions index	*NS*
Control variables	
Rural population (% of total population)	0.133*** (0.043)
Polity score (-10,+10)	0.111*** (0.029)
EU member (0-1)	-0.946*** (0.194)
Average number of years of adult (25+) education	-0.519*** (0.134)
Log of imports of goods and services (% of GDP)	-1.199*** (0.305)
Constant	11.919*** (2.555)

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: 45, number of observations: 508.

Table 11. Estimation results for the limited model testing Hypotheses 3 and 4

Explanatory variables	Electricity market closeness index (0-6) *(Dependent variable)*
Economic policy orientation of ruling party	
- Right	-0.599*** (0.164)
- Left	-0.451** (0.173)
- Center	*(omitted)*
Professional background of chief executive	
- Entrepreneur	-0.327* (0.186)
- Scientist, Economics	*NS*
- Military	-1.126** (0.454)
- Politician	-0.262* (0.150)
- Scientist, Other	*NS*
- Unknown/other	*NS*
Educational background of chief executive	
- Economics	*NS*
- Natural science	*NS*
- Other university	*NS*
- Unknown/other	*NS*
California crisis, dummy =1 after 2000	-1.094*** (0.114)
UK example, dummy =1 after 1989	*(omitted)*
Log of GDP per capita (PPP, cur. thousand int. $)	-0.347* (0.203)
Log of power system load size	-0.465*** (0.124)
Asian financial crisis, dummy =1 for 1997 and 1998	0.248** (0.115)
Corruption perceptions index	*NS*

Control variables	
Single-party government (0-1)	-0.330***(0.115)
EU member (0-1)	-0.691***(0.189)
Average number of years of adult (25+) education	-0.395***(0.098)
Log of imports of goods and services (% of GDP)	-1.277***(0.300)
Constant	15.760***(1.408)

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: 43, number of observations: 466.

In addition to verifying the robustness of our previous findings, the results from this section show that international experience, income level, power system load size and Asian financial crisis have a statistically significant impact on the reform progress. We could not detect a relationship between corruption level and the extent of reforms. We 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. Income level and power system load size are also negatively correlated with market closeness index (and therefore, positively correlated with reform progress), meaning that the reform advances more rapidly in relatively rich countries that have relatively more installed capacity. Finally, as expected, we detect a positive relationship between market closeness index and Asian financial crisis, implying that the reforms were interrupted during Asian financial crisis.

As a result of the analysis in this sub-section, we find out that international experience, income level, power system load size and Asian financial 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.

8 Conclusion

This paper examined the political economy of liberalization in the electricity industries in the last decades. We empirically analyzed 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 international experience, income level, power system load size and Asian financial 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.

Acknowledgements

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