UC Santa Barbara
Econ 196 Honors Thesis

Title
Privatization and Economic Freedom: Another Look at the Privatization of Electric Utilities

Permalink
https://escholarship.org/uc/item/1300280t

Author
Pardini, Connor

Publication Date
2019

Undergraduate

Author: Connor Pardini

Advisor: Alisa Tazhitdinova
Professor: Heather Royer

Privatization and Economic Freedom:

Another Look at the Privatization of Electric Utilities

18 March 2019

Abstract

This paper examines the relevance of economic freedom and elements of privatization reforms—provisions in the law, including new private entry, consumer choice, price regulation, and fuel subsidies—to the calculation of privatization's effect on outcome variables such as the price of electricity, access to electricity, and average costs of electricity. Evidence from this paper suggests that privatization without controls or interaction terms increases all of the outcomes, but when economic freedom and the elements of privatization reforms are taken into account, prices decrease, access to electricity increases, and average costs decrease.

Introduction

Privatization is a controversial policy reform with various effects. The literature has examined privatization reforms across the world and across industries (Pollitt 1995, *Competition in Electricity Markets* 2001, Kitchens 2016). Broadly, the mission of this research is to inform policy-makers about the effectiveness of privatizing public services. It also aims to form a criterion for constructing different types of privatization reforms. Concomitantly, this paper will explore the effectiveness of privatization reforms in their political environments.

I address the controversy head on by analyzing the effect of a key theme which motivates privatization reforms: economic freedom. Privatization is typically classed as a policy of economic liberalization which carries with it some weight and bears upon the ideologies of policy-makers. Though privatization reforms are typically considered freedom-oriented, they often take place in countries which are not relatively economically free. The motivation for

reform may not spring from the intentions of partisans, but from pragmatism or some other reason. This leads to the question: would it matter if a privatization reform took place in a freer country?

I use the fixed effects model—for electric utilities and for years—and include a control for economic freedom and privatization. I also include interaction terms which demonstrate the importance of a country's level of economic freedom to the outcomes of its privatization reform and the importance of certain key elements in those reforms which can also influence outcomes.

In the literature, there is little attention paid to the relevance of various elements of privatization reforms. For example, reforms are often treated the same whether they contain provisions for price regulation or not (Pollitt 1995, *Competition in Electricity Markets* 2001, Kitchens 2016). But it is clear that price regulation would have an effect on the price of electricity set by electric utilities (Auriol 2006). Conventional theory suggests that utilities, which are often structured as monopolies, would have a great degree of market power, enabling them to set prices above perfectly competitive levels. So if privatization has a negative effect on prices, we can reasonably infer that price regulation plays a role. For these reasons, I include the controls for four elements found in privatization reforms: the allowance of new private entry, consumer choice of electric utility, price regulation, and fuel subsidies. I have chosen these because they relate to government involvement in the industry post-privatization, which would be the responsible agent in altering the structure of the utilities from what they would be in a free market.

This paper will focus on electric utilities in Latin American countries. I will analyze the effect of privatizing public utilities on the price of electricity measured in megawatts per hour (MWh), costs of electricity per MWh, and access to electricity measured in two types of

connections to electrical power. The case of electricity will provide evidence for the overall effectiveness of privatization reforms in similarly structured industries.

I hypothesize that the privatization of electric utilities would produce better results along the aforementioned lines if they took place in an environment supportive of economic freedom. Validating this hypothesis is one objective of this paper. I further hypothesize that, controlling for economic freedom and the specified elements of reforms, privatization will decrease prices, decrease average costs, and increase access to electricity.[1]

Literature Review

Public utility privatization has been examined across populations, with research conducted on Latin America. Representative of this research is Pollitt (1995). It concludes that there is very little difference in the effect of private vs public ownership on prices, with the empirical evidence being mixed and the theoretical evidence predicting no substantial difference (185-186). This work provides the basis for cost considerations in the evaluation of privatization as an effective policy. I use as a proxy for efficiency lower costs per unit of electricity sold, including costs for capital and operations. Conversely, *Competition in Electricity Markets* reviews the existing empirical evidence in 2001, concluding that privatization results in lower prices and greater efficiency (23-24). The prior research has not undertaken to consider the influence of a country's economic freedom on the effectiveness of privatization reforms, and neither has it considered privatization in any way but as an average effect. I include four elements of privatization reforms—new private entry allowed, consumer choice, price regulation, and fuel subsidies—which allows me to differentiate between reforms instead of measuring only the average effect of privatization.

---

[1] If I refer to "privatization" only, I mean unspecified or unqualified privatization. That is, privatization without considering a specific element of the reforms.

Author: Connor Pardini

Advisor: Alisa Tazhitdinova
Professor: Heather Royer

Auriol and Picard (2006) provide a theoretical justification for selection of certain elements in privatization reforms as constituting a distinctive type of privatization. For example, the effect of privatizing a public utility on the prices paid by consumers for their product will depend upon the inclusion of price regulation in the reform. Even if privatization led to decreasing costs, these efficiency-benefits might not be passed on to the consumer in the form of lower prices. A private utility free to set its own prices may exploit its monopoly and hold prices constant together with lower costs yielding a higher profit. Auriol and Picard propose a criterion of optimization between consumer welfare and the government's fiscal health. When a country is poor, it may be in its interests to privatize a utility without imposing price controls. This affords the poor government the ability to impose taxes on the profitable monopoly. In this situation, the government is incapable of obtaining sufficient revenue from other sectors of the economy, but in any scenario other than this, it is preferable for the government to impose price controls on private utilities or operate a utility itself. Heretofore, the distinctions between types of privatization reforms have not been applied to an empirical study. In my study, I recognize the heterogeneity of privatization reforms and account for it by including in my model interaction terms for new private entry, consumer choice, price regulation, and fuel subsidies. These variables are all informed by Auriol and Picard (2006).

An empirical treatment of privatization's impact on the prices of electricity is performed in Kitchens and Jaworski (2016). This paper uses price data from directly before and after the United States' New Deal. Government involvement in electric utilities increased during this period, resulting in a greater amount of public ownership in the industry. Kitchens and Jaworski find that the discrepancy in prices offered by public and private utilities pre-reform were relatively small and post-reform negligible. The absence of a significant price discrepancy is

contrary to conventional economic theory. Municipal governments may have threatened to convert privately owned electric utilities to public ownership, enforcing price discipline. This provides insight into how a privatization reform will impact prices, especially with respect to price controls. My research isolates the effect of price regulation, sanctioning the prediction that prices may fall if they are controlled by the government.

My research extends or incorporates the concepts developed in the literature. It moves beyond Pollitt (1995) with a wider focus than the efficiency aspect of utility privatization. Variables accounting for prices and access to electricity are more informative with regard to the total effect of utility privatization on consumer welfare. Consideration of utility privatization's relation to consumer welfare is provided by Auriol and Picard (2006). Selection of control variables related to elements of privatization reforms are largely derived from this paper. My research adopts their theoretically derived distinctions between kinds of privatization and applies them to an empirical study using regression analysis. Kitchens and Jaworski (2016) supplies the empirical framework for analysis of privatization reforms' effects on prices. It achieves this indirectly, with the reverse case of private to public reforms considered in their paper and public to private considered in my own. It also furnishes the expectation that prices do not substantially change with a change from private to public ownership. It does not address access to electricity or costs of electricity, although it does speculate that private utilities are more efficient than public utilities. My research will consider the effect of privatization on three general variables: costs, prices, and access. It will also include proxy variables for privatization types. This amounts to a novel empirical investigation of the effects of diverse privatization reforms on the aforementioned outcome variables.

Author: Connor Pardini

Advisor: Alisa Tazhitdinova
Professor: Heather Royer

In addition to a more nuanced examination of privatization policies, my research investigates the effectiveness of reforms in their political-economic context. Using an Index of Economic Freedom from the Fraser Institute, I am able to estimate the importance of economic freedom. This is the context in which a utility is situated, and I anticipate that it effects the performance of utilities, and it is a completely novel approach as it pertains to privatization.

Data

The dataset is compiled from multiple sources. Information regarding specific privatization reforms from the 1990's, particularly in Latin America, was obtained from the World Bank page entitled "Electricity Regulation Database." Information regarding specific utilities was obtained from the World Bank page entitled "Latin America and Caribbean - Utility Benchmarking Database." This dataset provides most of the information which is used in the empirical analysis. Information related to the economic freedom of countries to which electric utilities belong was obtained from the Fraser Institute's "Index of Economic Freedom."

Data from the Groningen Growth and Development Centre page entitled "The Database: Penn World Table version 9.0" contains information on local consumer price indices and exchange rates. For the primary regressions, I adjust for price inflation with a country's own CPI and transform price variables into logs.

Many variables must be generated in accordance with the empirical methodology. In the final dataset, relevant variables include the utility identification number, the year, residential & non-residential connections to power, average operating, capital, and total costs, the average price of electricity, an interpolated set of economic freedom ranks corresponding to a country in a given year, a dummy variable for whether an electric utility is private, and dummy variables for different elements of privatization reforms (including the allowance of new private entry into the

market, consumer choice of utility, price regulation, and fuel subsidies). The dummy variables of the privatization elements are essentially interaction terms, as they are only every equal to one when the privatization dummy is equal to one.

The data is fairly aggregated because it looks at the utility level rather than the consumer or household level. Each utility is a large organization covering many people and resources. Observations correspond to a utility—designated by an identification code—in a given year, so all data refers to a particular utility in a particular year. A limitation of this dataset is in the total number of observations it affords. For example, although it contains over four-thousand data points for electric utilities in various years, it is missing data on the price of electricity for over three-quarters of these data points. When estimating regressions with price as the dependent variable, the sample will be limited to just over eight-hundred. Fortunately, the high degree of aggregation makes the small dataset more powerful. The sample size of the regressions are ultimately limited by the availability of the dependent variables, whether they be price of electricity, access to electricity, or costs of producing electricity. This information was not collected in many instances for these Latin American utilities.

Ideally, the Fraser Institute's Index of Economic Freedom would contain a unique rank for each year pertaining to a country. The higher the rank, the less free the country is. However, prior to the year 2000, economic freedom ranks are assigned only to years which are multiples of five. I solve this by interpolating between these years. Unfortunately, this does not fill in all of the missing data, making the size of this variable smaller and its contribution less significant.

In addition to the variables described in Table 1, the dataset contains data from two-hundred and sixty one electric utilities in twenty-seven countries, including Antigua and Barbuda, Argentina, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominica, the

Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Uruguay, and Venezuela. The utility statistics in Table 1 are constructed using their identification numbers, making the statistics other than observations meaningless. Average costs are calculated by the aggregate of a utility's expenditures—either operating, capital, or total—divided by total MWh's sold. The sample size available to each regression is determined by the variable with the minimum number of observations. In the case of regressions concerning the price of electricity, the sample size will be no more than eight-hundred and fifteen.

Figure 1 demonstrates the frequency with which the four privatization elements appear in the reforms. Fuel subsidies is not as significant as the other four elements, which appear with similar frequency. Figure 2 demonstrates the distribution of economic freedom ranks across the countries in the sample, taken from the Fraser Institute's Index of Economic Freedom. Economic freedom ranks are not centered on the mean, so countries will tend to be primarily free or primarily unfree.

Empirical Analysis

The basic regression specification is:

$$\log(Y_{it}) = \gamma_i + \lambda_t + \beta_1 \text{Privatization}_{it} + \beta_2 \text{Economic Freedom Rank*Privatization}_{it} + \beta_3 \text{Economic Freedom Rank}_{it} + \varepsilon_{it}$$

The dependent variable, Y, signifies six separate dependent variables. These are inflation adjusted prices for electricity in megawatts per hour, inflation adjusted operating expenditures per unit of electricity, inflation adjusted capital expenditures per unit of electricity, inflation adjusted total expenditures per unit of electricity, the number of residential connections to power,

8

and the number of residential & non-residential connections to power. The model has fixed effects for each individual utility (γi) and for each year (λt). Privatization is a dummy variable (1 = private) for whether a particular utility is private or not in a given year. Economic Freedom Rank specifies a country's rank on the Index of Economic Freedom—the lower the rank, the freer the country. β_1 is the effect of a utility being private on one of the dependent variables, conditional upon a country's economic freedom rank—or level of economic freedom.

The method of this analysis is difference-in-difference using fixed effects for individual utilities and for time by year. To strengthen the parallel trends assumption, the sample is restricted to electric utilities in the same region, Latin America.

Privatization and economic freedom may or may not be exogenous to the model. I will examine some reasons why we might consider these variables as safely exogenous; I will also consider some threats to this exogeneity and then attest to the plausibility of these threats.

Firstly, the economic freedom rank of each country may be considered exogenous to the model. It is unlikely that there is any unified force which causes a country to be more or less economically free. Policy-makers could be motivated by economic efficiency or well-being but also for reasons relating to ideology, political expedience, etc. Since the causes of a country's level of economic freedom are so diverse, we may treat this independent variable as practically random.

A simple linear regression of economic freedom rank on the year a utility was privatized reveals a low level of correlation, just 0.0347, statistically significant at the 5% level. Because of this, we can assume that the cause of economic freedom and the cause of privatization reforms

are not the same. This means that the cause of privatization reforms are probably less diverse than the causes of a country's level of economic freedom. I speculate that the reforms are caused primarily by a desire for economic efficiency. According to Auriol and Picard (2006), poorer countries find it in their interests to privatize utilities, relieving the government of a large drain on its finances.

There is a possibility that the privatization dummy variable, along with the variables representing the elements of privatization reforms, are endogenous. A plausible cause of privatization reforms would be the poor performance of public utilities. This performance could manifest as excessively high electricity prices, bloated costs, and low levels of output. These all relate to the dependent variables of my regressions, and they are therefore a threat to the credibility of the results. Potentially, the effect of these variables are not as worrisome if we assume that the response time of government to these variables is slow. Since the operations of government require some time from the recognition of a problem to the implementation of a solution, the actual implementation of the reform is detached from the initial causes of the reform. In the data obtained from the World Bank, the year that private enterprises actually entered the market for electricity was often distinct from the year of the privatization reform. The year of the reform can be considered the year in which the privatization bill became law. It is sometimes the case that private enterprises would enter the market before or after this date. It is also plausible that some of the dependent variables constitute less of a threat than others. I would contend that average costs would be more endogenous than price or connections to power. Governments are primarily concerned with their budgets, and public utilities can be a drain on

Author: Connor Pardini

Advisor: Alisa Tazhitdinova
Professor: Heather Royer

their resources. Prices and access to electricity through connections to power affect consumers.

Costs affect the government. I imagine the democratic systems of these Latin American countries

would not be very efficacious in producing sweeping policy reforms, chiefly because these

democracies often do not function as they are ideally supposed to.[2] We might also consider that

the methods by which policy-makers make decisions are not based on the performance of the

electric utilities or more generally economic efficiency and well-being, but by political-

expediency or ideology. Although it is more plausible that decisions would be made along the

lines of economic efficiency and well-being, if policy-makers did make decisions from the latter

motivations, then privatization would be more exogenous to the model.

Unfortunately, there is a persistent threat of endogeneity concerning the privatization

variables, even with the counter-objections defending the exogeneity of the privatization. This

makes the results of this paper somewhat tenuous, and it must be taken into consideration when

evaluating this research. I have, however, attempted to reduce this endogeneity problem by

including in the model fixed effects for utilities, including controls for economic freedom and for

elements of privatization reforms, and looking at the pre-trends of the dependent variables in

Figures 3 through 8.

The estimate for privatization without controls or interaction terms—I call this the

average, uncontrolled estimate—uses fixed effects for year and for utility and measures the effect

of privatization on each of the six dependent variables. This overstates the effect of

---

[2] This is attested to by the economic freedom ranks of these countries, which are always below the top ten (see Figure 2 for a distribution of economic freedom ranks). A free economy is associated with the rule of law or the proper functioning of the government (see the Fraser Institute's methodology for how they determine a country's level of economic freedom).

undifferentiated privatization if I am correct in assuming that privatization is a heterogenous variable. It will also overstate the effect of privatization for some countries and understate the effect for others based on those countries' relative levels of economic freedom. For these reasons, I include controls for elements of privatization reforms as well as interaction terms between privatization-related variables and economic freedom. The most complex models resemble this regression specification:

$\log(Y_{it}) = \gamma_i + \lambda_t + \beta_1 \text{Privatization}_{it} + \beta_2 \text{Economic Freedom Rank*Privatization}_{it} + \beta_3 \text{Economic Freedom Rank}_{it} + \beta_4 \text{New Private Entry}_{it} + \beta_5 \text{Consumer Choice}_{it} + \beta_6 \text{Price Regulation}_{it} + \beta_7 \text{Fuel Subsidies}_{it} + \beta_8 \text{New Private Entry*Economic Freedom Rank}_{it} + \beta_9 \text{Consumer Choice*Economic Freedom Rank}_{it} + \beta_{10} \text{Price Regulation*Economic Freedom Rank}_{it} + \beta_{11} \text{Fuel Subsidies*Economic Freedom Rank}_{it} + \varepsilon_{it}$

Inclusion of the control variables is needed to test a hypothesis of this paper, that privatization reforms will vary in their success because of a country's relative level of economic freedom. They vary because it is easier to engage in enterprise and productive activity in a country which promotes private property rights, has efficient and just judicial systems, effectively prevents crimes, etc. It is supposed that a relatively freer country will be able to implement a better privatization reform. The interaction terms serve as conditional statements such that a reform's average effectiveness will be increased or decreased depending on the economic freedom rank of the country. Controls obtained directly from the original data are the dummy for privatization and the economic freedom ranks of countries. The dummy variables for privatization elements—including new private entry, consumer choice, price regulation, and fuel

subsidies—are only equal to one when the dummy for privatization is equal to one, making them implicit interaction terms, and this is why I list them as interaction terms in Table 4. I use this framework for unspecified privatization and all of the elements of privatization bills included in the model.

Figures 3 to 8 show the change of the dependent variables across time, respectively. A balanced panel is used for each of them. These graphs include only those countries which underwent privatization during the period of time available in this data; any inferences which are made from these graphs must take into consideration that fixed effects and the control samples are not included, unlike with the regressions.

Figure 3 is a graph of average wholesale prices of electricity over a standardized unit of time. The y-axis measures the relative change of prices so as to standardize across different currencies. I use this approach for the graphs illustrating average costs over time in Figures 6, 7, and 8. In Figure 3, there is very little variation in price before the time of privatization. After privatization, the trend remains similar, until later when prices increase. Kitchens and Jaworski (2016) reveals very little discrepancy in the prices offered by public utilities and those offered by private utilities. This initial evidence supports their findings.

Figures 4 shows the change of residential connections to power over time, and Figure 5 shows the change of residential & non-residential connections to power over time.[3] The trends for both are the same. Prior to privatization, both increase at a modest rate. At the time of

---

[3] Population is not controlled for in Figures 4 or 5, and so a steady increase in connections to power at the time of privatization (Time = 0) should be interpreted as little to no change effected by the act of privatization. Over time, however, privatization may bear fruit, and this is what can be revealed in the regression analysis.

privatization, the pre-trend continues at roughly the same slope. There does not appear to be any disturbance at the time of privatization, and so these variables may be influenced by factors other than privatization. Possibly, they are influenced by only one element of privatization while being unaffected by others, as is revealed in a subsequent section of this paper, in which the regressions in Table 4 show the statistical significance of fuel subsidies for both variables concerning connections to power.

As seen in Figure 6, average operating expenditures do not show a very disconnected trend before and after the time of privatization. After privatization, average costs increase slightly faster over time and then dip. In Figure 8, average total costs exhibit a similar trend as operating costs. For both of them, average costs decrease toward the end. That is, privatization may not have an immediate effect on these costs, but after private owners have been operating the utilities for a period of time the benefits may manifest.

Figure 7 shows the change of average capital costs over time. Confidence intervals in this graph are extremely small because the average capital costs in these years for many of the utilities in this sample were zero or close to zero. Consequently, inferences cannot confidently be made from this graph. Regardless, it shows higher average costs after privatization than before, similar to the graphs for average operating and total costs.

Results

As previously stated, my hypotheses concerning the results of this research are for prices of electricity—measured by the log of wholesale prices per MWh—to decrease, for average operating, capital, and total costs to decrease,—measured by the log of costs per unit of

electricity produced—and for the number of connections to power, both residential and residential & non-residential, to increase—measured with logs. Furthermore, I hypothesized that a privatization reform enacted in a relatively free country according to the Index of Economic Freedom would be more effective at achieving its aims. The preliminary evidence suggested that, absent controls for elements of privatization and levels of economic freedom, my initial hypotheses could be incorrect.

Referring to Table 2, privatization is shown to increase the price of electricity by 260.84% in the average, uncontrolled estimate, or regression (1). This result is statistically significant at the 1% level and contradicts the findings of Kitchens and Jaworski, which saw very little disparity between the prices of public and private utilities. The addition of control variables in regression (2) increases the adjusted R^2, strengthening the explanatory power of the model. Both the estimate of the dummy for privatization and the interaction term between privatization and economic freedom are significant at the 1% level in this regression.

For an average level of economic freedom,—a rank of 67.32—privatization decreases prices by 99.65%, using regression (1) in Table 4. This result differs strongly from the average, uncontrolled estimate. The results also reveal that in freer countries, the negative effect of privatization is stronger. In more authoritarian countries, the negative effect of privatization is non-existent. For a country with a rank on the Index of Economic Freedom of 12, prices are expected to decrease by 788.38%. For a country with a rank of 139, prices are expected to increase by 792.77%. The economic freedom interval is therefore (-788.38%, 792.77%). The gap between my estimate of privatization's effect on prices and Kitchens and Jaworski's (2016) is

explained through the incorporation of the economic freedom control and interaction with privatization, since this prior literature examined only a single country with a relatively uniform level of economic freedom throughout.

I measure access to electricity as the number of connections to power, both residential and the combination of residential & non-residential. Referring to Table 2, in the average, uncontrolled estimate, or regression (3), unspecified privatization increases residential connections by 3.62%. Residential & non-residential connections increase by 5.07%. Both of these estimates are statistically significant at the 1% level. Economic freedom and its interaction with privatization are added in regression (4) and (6). Both are significant at the 1% level for residential connections, but for residential & non-residential connections, only the interaction term is significant.

For the dependent variables representing access to electricity in regressions (2) and (3) of Table 4, the effect of privatization in a mean-ranked country is a 10.71% increase in residential connections and a 9.75% increase for residential & non-residential connections. All of the coefficients used to make this calculation are significant at the 1% level. The economic freedom interval for residential connections is (27.86%, -11.51%) and for residential & non-residential connections is (22.47%, -6.74%). These intervals demonstrate that privatization reforms are more successful in achieving the goal of greater access to electricity when they take place in freer countries.

As opposed to the regressions using the price and access dependent variables, the regressions estimating the effect of privatization on costs per unit of electricity in regressions (1),

(3), and (5) of Table 3 are not adequately statistically significant until control variables are added. When the control variables are added to average operating expenditures, all variables in regression (2) become significant at the 1% level. Using regression (4) of Table 4, privatization is shown to increase this cost by 28.09% for an average country. However privatization's effect on average capital expenditures is only significant at the 5% level if economic freedom and the interaction term are included. Although operating costs do increase for the average country, the economic freedom interval is (-98.59%, 192.24%), meaning this variable follows the hypothesized pattern that privatization reforms would be more effective in freer countries. Since Pollitt (1995) does not control for economic freedom and instead estimates a form of average efficiency, the results of my research lend him support. However, since privatization does decrease costs for some countries—namely, those which are economically free—it can be said that privatization sometimes reduces costs and leads to greater efficiency, according with the results of *Competition in Electricity Markets* (2001).

Average capital expenditures are not significant at all in the average, uncontrolled estimate, and only achieve significance at the 5% level in the other regressions. In regressions (4), (5), and (6) of Table 4, only one of the interaction terms related to the elements of privatization reforms is statistically significant, and so the estimates of the effect of privatization on average capital costs do not change very much with the addition of these other variables. A weak estimation of privatization's effect on average capital expenditures is an increase of 41.87% for utilities in a mean-ranked country—refer to regression (5) of Table 4. A similar pattern emerges with regard to average total expenditures. The coefficient of the average,

uncontrolled estimate in regression (5) of Table 3 is only significant at the 10% level. Privatization is shown to reliably increase average total expenditures by 28.09% for a mean-ranked country, calculated with regression (6) of Table 4. This is very similar to the estimate of privatization's effect on average operating expenditures, likely because total expenditures is primarily composed of operating expenditures. The results on costs show that, for utility in a country ranked average on the Index of Economic Freedom, average costs will increase, contrary to my hypothesis that privatization would cause utilities to become more efficient and thereby reduce average costs. However, the economic freedom interval for capital costs is (-64.34%, 179.5%) and (-98.59%, 192.24%) for total costs, in accordance with my original hypothesis that privatization reforms are more effective in freer countries.

Table 4 contains regressions for each of the dependent variables and includes all controls and interaction terms. For regression (1) concerning the price of electricity, almost all of the interaction terms are statistically significant at the 1% level. Only the interaction of economic freedom with privatization and fuel subsidies is completely insignificant. The magnitudes of the coefficients for new private entry, consumer choice, and price regulation are quite large. Of particular interest is price regulation, which when combined with its corresponding interaction term is shown to dramatically reduce prices for more economically free countries and raise prices for more economically authoritarian countries—the economic freedom interval is (-1540.55%, 328.89%). This makes sense if average costs drop in more economically free countries, making it feasible for governments to set price controls that track these lower costs. Another large and significant estimate is that of new private entry allowed into the market for electricity, as well as

18

Author: Connor Pardini

Advisor: Alisa Tazhitdinova
Professor: Heather Royer

its corresponding interaction term. The economic freedom interval is (2780.97%, -1379.55%), demonstrating a wide discrepancy between the element's effect in freer and less free countries. The allowance of new private entry actually increases prices in freer countries and decreases them in less free countries.[4]

Interaction terms representing the elements of privatization reforms for regressions (2) and (3) of Table 4 concerning access to electricity are for the most part not statistically significant. Only fuel subsidies are significant at the 1% level for either. This is similar to the element-variables in regressions (4) through (6) related to costs, where there is almost no statistical significance. In contrast, the element-variables are quite significant for regression (1), meaning the differentiation of certain characteristics for privatization reforms is pertinent to privatization's effect on the price of electricity, but not as much for its effect on access to electricity or average costs. This is intuitive for average costs,—a metric to test for efficiency— for all that should matter in incentivizing efficiency is the introduction of the profit motive. In line with Pollitt (1995), of importance is whether or not the utility is private at all, not how it is private. That fuel subsidies are statically significant for access to electricity makes sense, since the utility will likely only undertake to expand production and output if it receives a financial incentive. If prices are low, utilities will not be able to expand without savings of their own, and

---

[4] While this may seem surprising, Auriol and Picard (2006) provides a theoretical explanation for why this is so. Heavily regulated or public electric utilities are generally most productive of consumer welfare, and so the introduction of a market characterized by free entry will likely not yield the benefits that it would in countries with already relatively well-run utilities. In countries with relatively poor-run utilities —which I assume are the less economically free countries—a market characterized by free entry may be a step up from their status quo.

so they will require government assistance. If prices are high, perhaps because of an absence of price regulation, there will be no incentive to expand production.

The elements concerning new private entry, consumer choice, and price regulation in regression (1) of Table 4 are, together with their respective interactions with economic freedom, significant at the 1% level. A higher economic freedom rank—meaning the country is more authoritarian—makes the contribution of new private entry to lower prices more negative. Furthermore, a higher rank makes the contributions of consumer choice and price regulation more positive. For the freest country, new private entry will increase prices, but consumer choice and price regulation will decrease prices. These results indicate that Kitchens and Jaworski's method of treating privatization as an average did not capture the whole truth, as the intricacies of the reforms makes a difference in the outcome concerning the price of electricity.

Conclusion

The hypotheses of this paper are somewhat supported by the results. For electric utilities in countries with an average rank on the Index of Economic Freedom, it is shown that privatization, without considering any of the possible elements in privatization reforms, decreases the price of electricity and increases access through more connections to power. Although average costs are not shown to decrease for the average ranked country, they do decrease for utilities in more economically free countries. The second part of the hypothesis, that privatization is more effective at achieving its aims in freer countries, is strongly indicated by the results. Privatization is shown to be more effective with every single dependent variable if it takes place within a relatively economically free country.

The results of this paper can be used as tools in thinking about privatization policy. Evidence that privatization can decrease prices, decrease average costs, and increase access to electricity—tangible metrics for human welfare—is useful to the policy-maker. It is also useful as a basis for further research, which would ideally incorporate more sophisticated techniques for measuring efficiency and consumer welfare. Perhaps the strongest conclusion of this paper is that it is generally better to pursue economic freedom.

Author: Connor Pardini   Advisor: Alisa Tazhitdinova
                                         Professor: Heather Royer

Bibliography

Auriol, Emmanuelle and Pierre M. Picard. "Infrastructure and Public Utilities Privatization in

      Developing Countries." World Bank Policy Research Working Paper, 2006. Web.

Competition in Electricity Markets. Paris: International Energy Agency, 2001. Print.

"Consumer Price Index: Total All Items for the United States." *Economic Research: Federal

      Reserve Bank of St. Louis*. <https://fred.stlouisfed.org/series/CPALTT01USA661S>. Web.

"Economic Freedom." *Fraser Institute*. <https://www.fraserinstitute.org/economic-freedom/

      map? geozone=world&page=map&year=2016>. Web.

"Electricity Regulation Database." *The World Bank*. <https://datacatalog.worldbank.org/dataset/

      electricity-regulation-database>. Web.

Feenstra, Robert C., Robert Inklaar and Marcel P. Timmer (2015), "The Next Generation of the

      Penn World Table" American Economic Review, 105(10), 3150-3182, <www.ggdc.net/

      pwt>. Web.

Kitchens, Carl T. and Talylor Jaworski. "Ownership and the Price of Residential Electricity:

      Evidence from the United States, 1935-1940." Massachusetts: National Bureau of

      Economic Research, 2016. Web.

"Latin America And Caribbean - Utility Benchmarking Database." *The World Bank*. <https://

      datacatalog.worldbank.org/dataset/latin-america-and-caribbean-utility-benchmarking-

      database-2008>. Web.

Pollitt, Michael G. *Ownership and Performance in Electric Utilities*. Oxford: Oxford University

      Press, 1995. Print.

Table 1: Summary Statistics

	Observations	Mean	S.D.	Min	Max
Regressors:					
Privatization	3704.000	0.435	0.496	0.000	1.000
Economic Freedom Rank	3587.000	67.318	32.060	12.000	139.000
Privatization Elements					
New Private Entry	4073.000	0.201	0.401	0.000	1.000
Consumer Choice	4073.000	0.196	0.397	0.000	1.000
Price Regulation	4073.000	0.190	0.392	0.000	1.000
Fuel Subsidies	4073.000	0.061	0.239	0.000	1.000
Fixed Effects Variables					
Year	4073.000	1998.736	5.597	1973.000	2008.000
Utility	4064.000	115150.000	92597.050	108.000	304013.000
Dependent Variables:					
Price of Electricity					
Wholesale Price per MWh	815.000	123986.400	263401.400	0.393	1940039.000
Access to Electricity					
Residential and Non-Residential Connections	2905.000	609610.900	1681441.000	62.000	26300000.000
Residential Connections	2920.000	534214.400	1470200.000	0.000	23200000.000
Costs of Electricity					
Average Operating Expenditures	1253.000	101510.800	299987.000	0.000	2743820.000
Average Capital Expenditures	1120.000	11236.780	35010.150	0.001	422593.200
Average Total Expenditures	1253.000	101510.800	299987.000	0.000	2743820.000

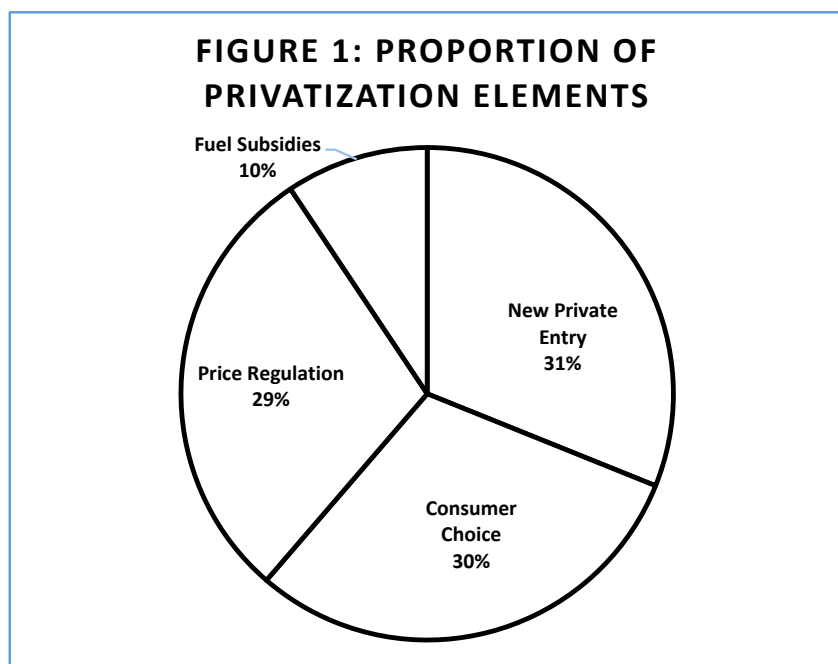All prices are in local nominal currencies and adjusted for inflation. The economic freedom rank is interpolated.
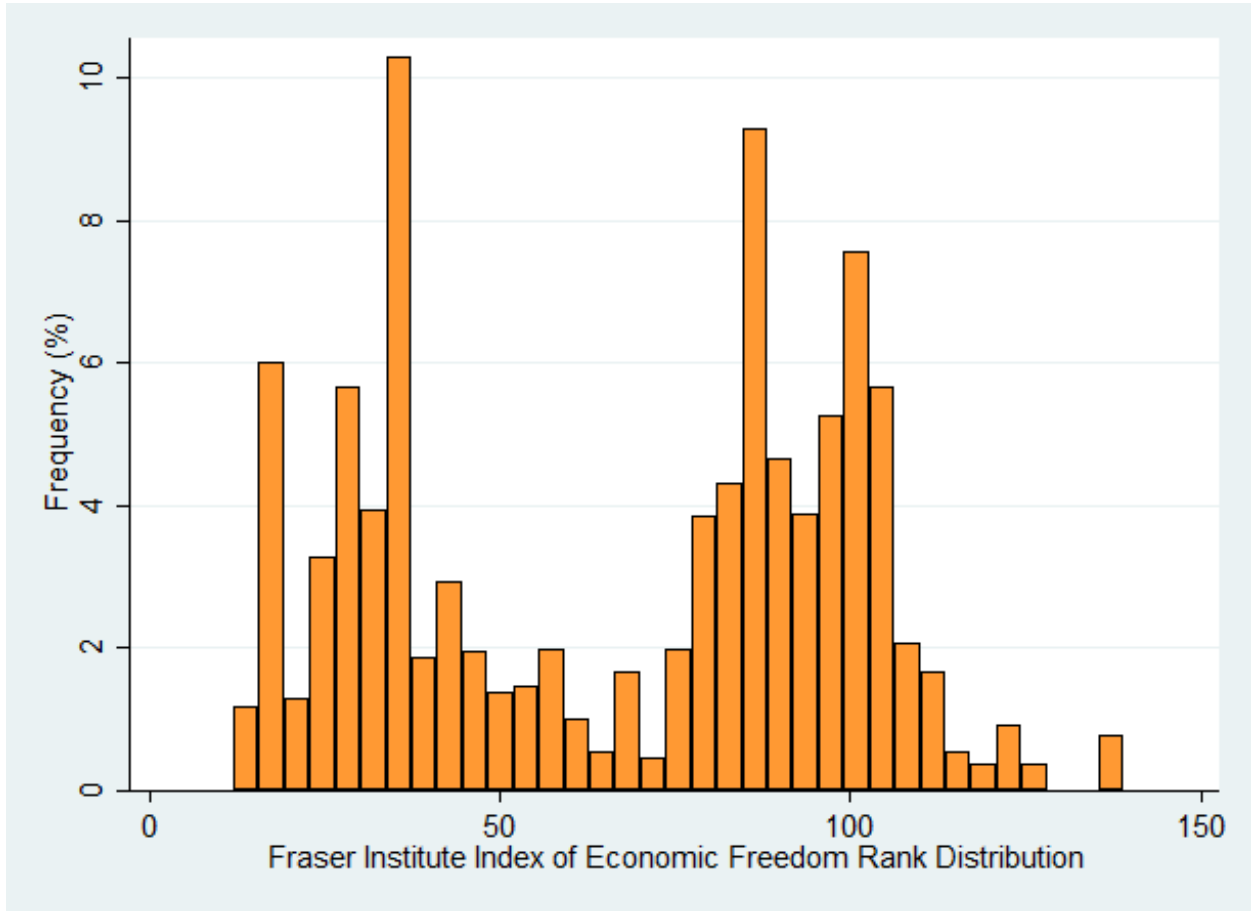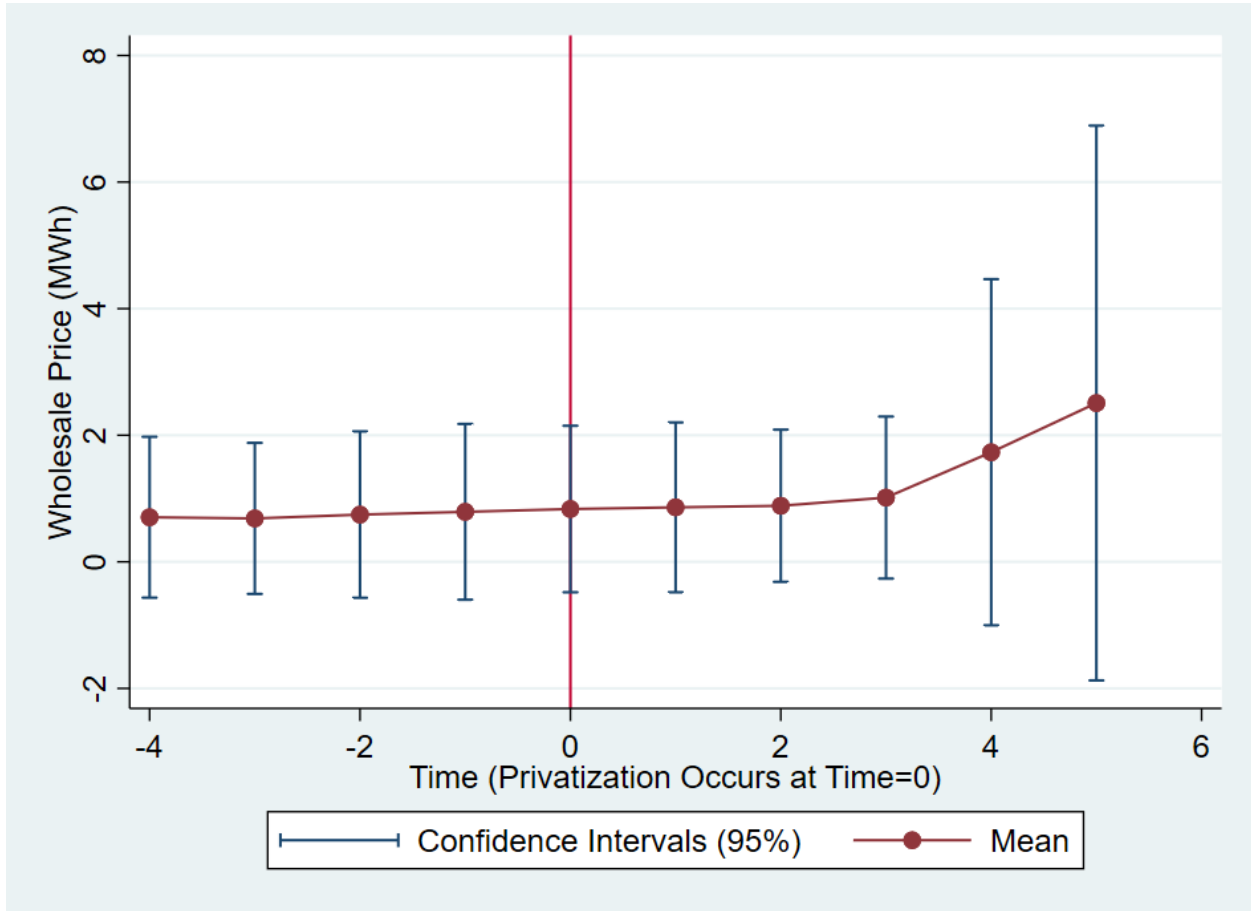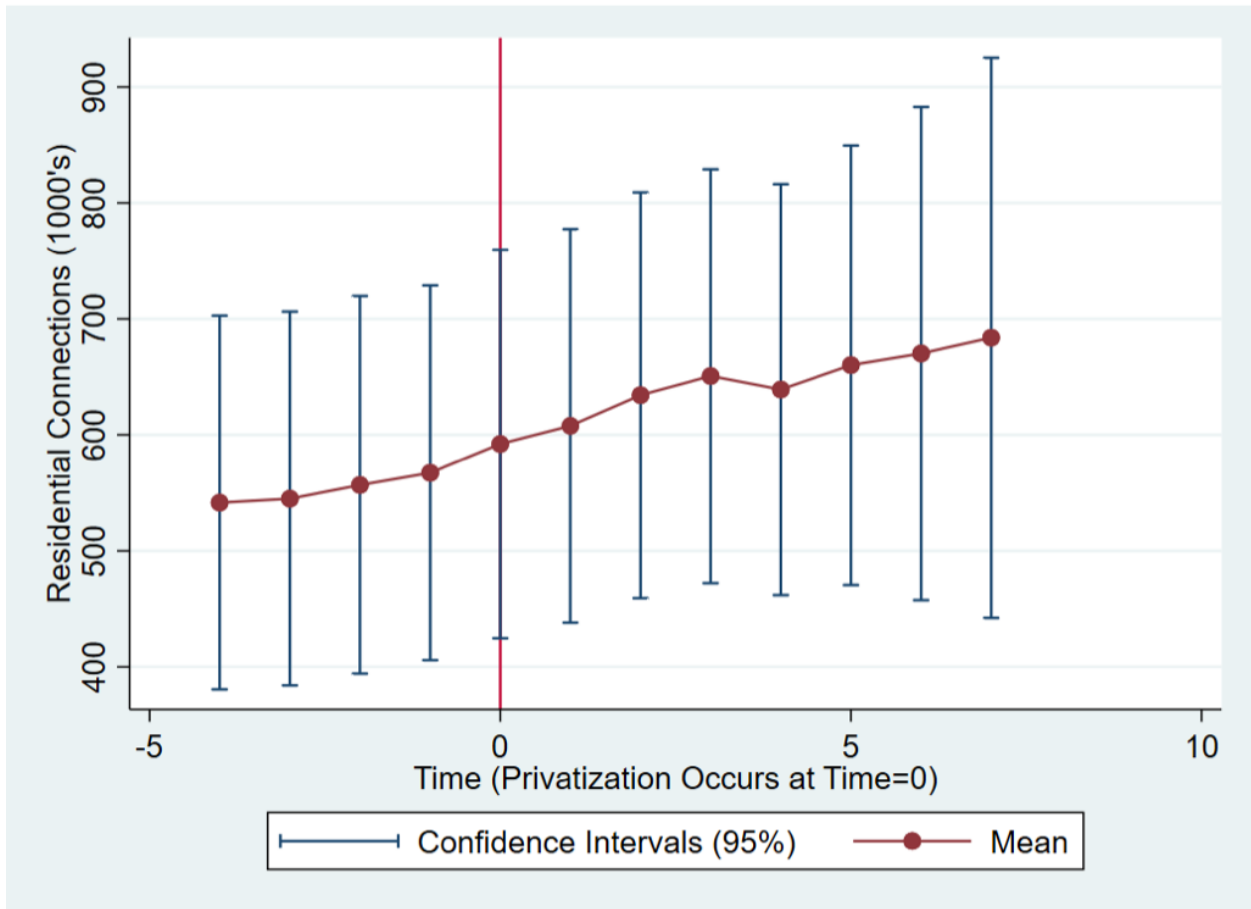

FIGURE 1: PROPORTION OF PRIVATIZATION ELEMENTS

- Fuel Subsidies 10%
- New Private Entry 31%
- Price Regulation 29%
- Consumer Choice 30%

Figure 2

Figure 3

Figure 4

Figure 5
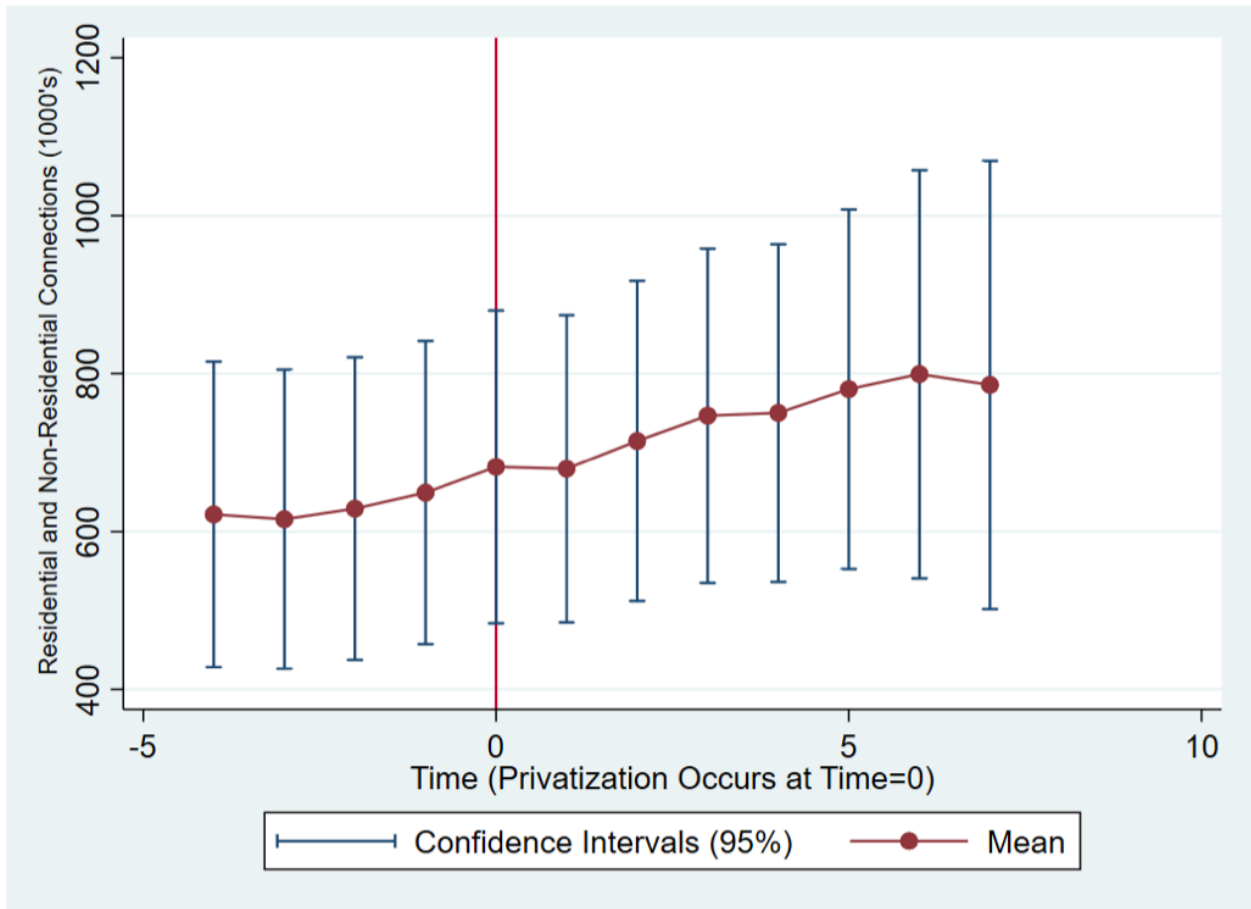
Figure 6

Figure 7

Figure 8

Author: Connor Pardini
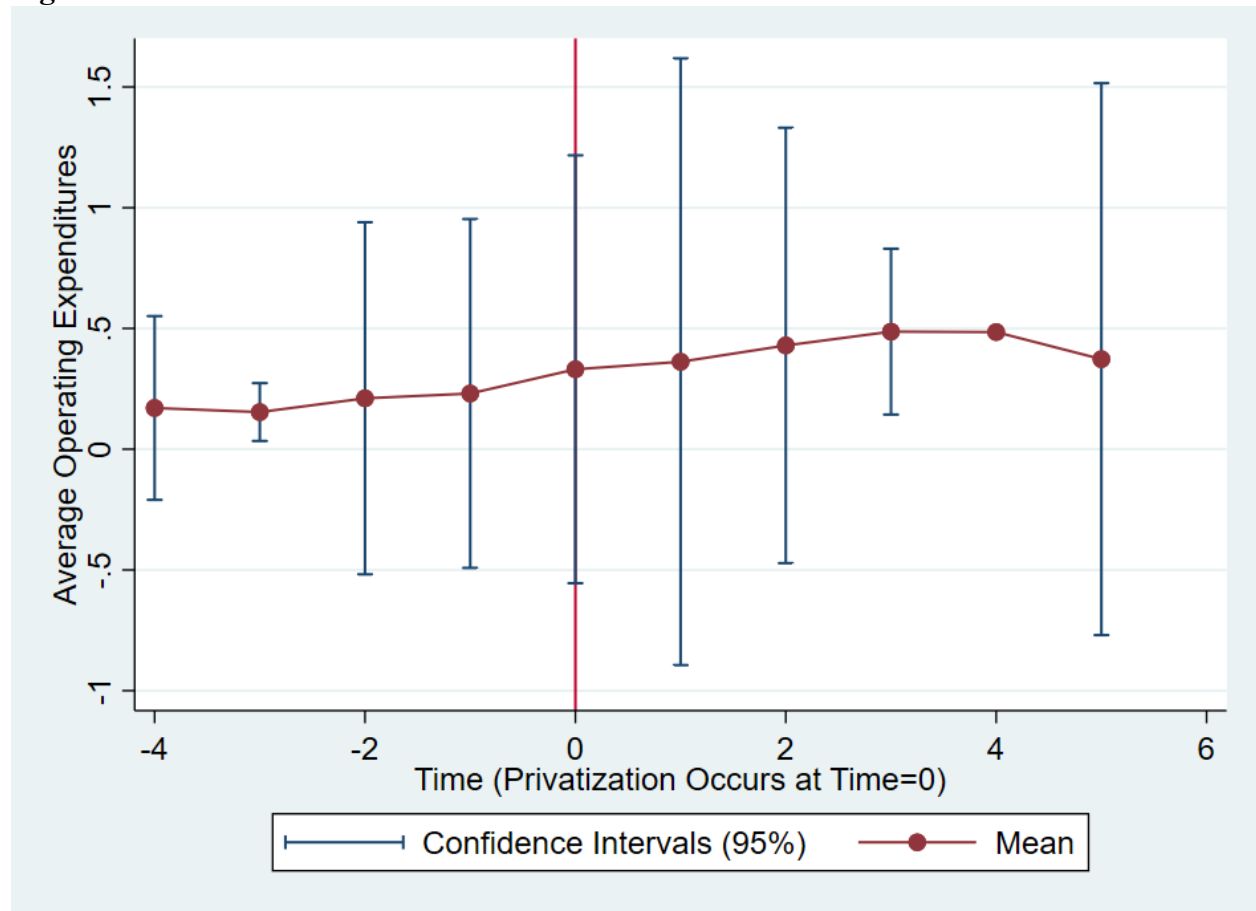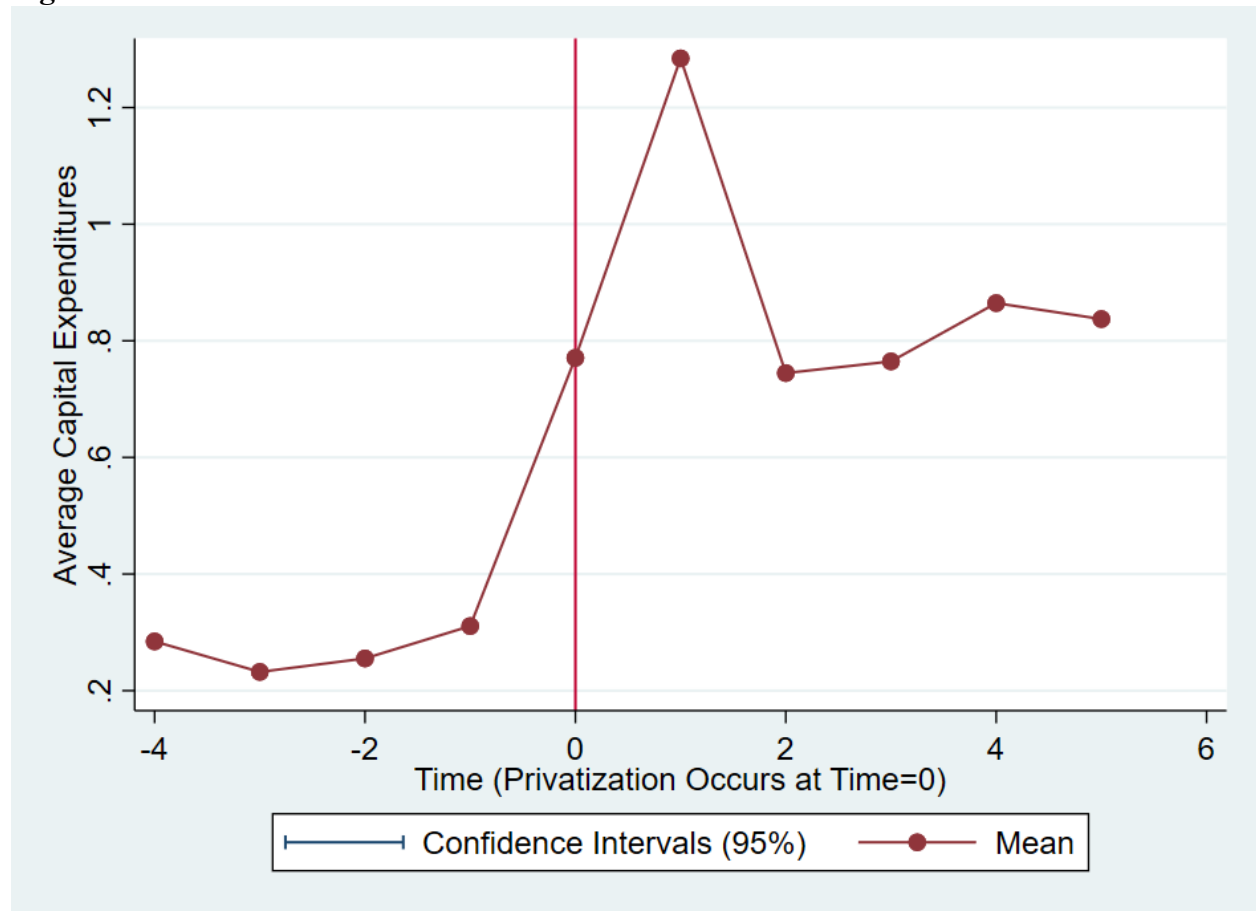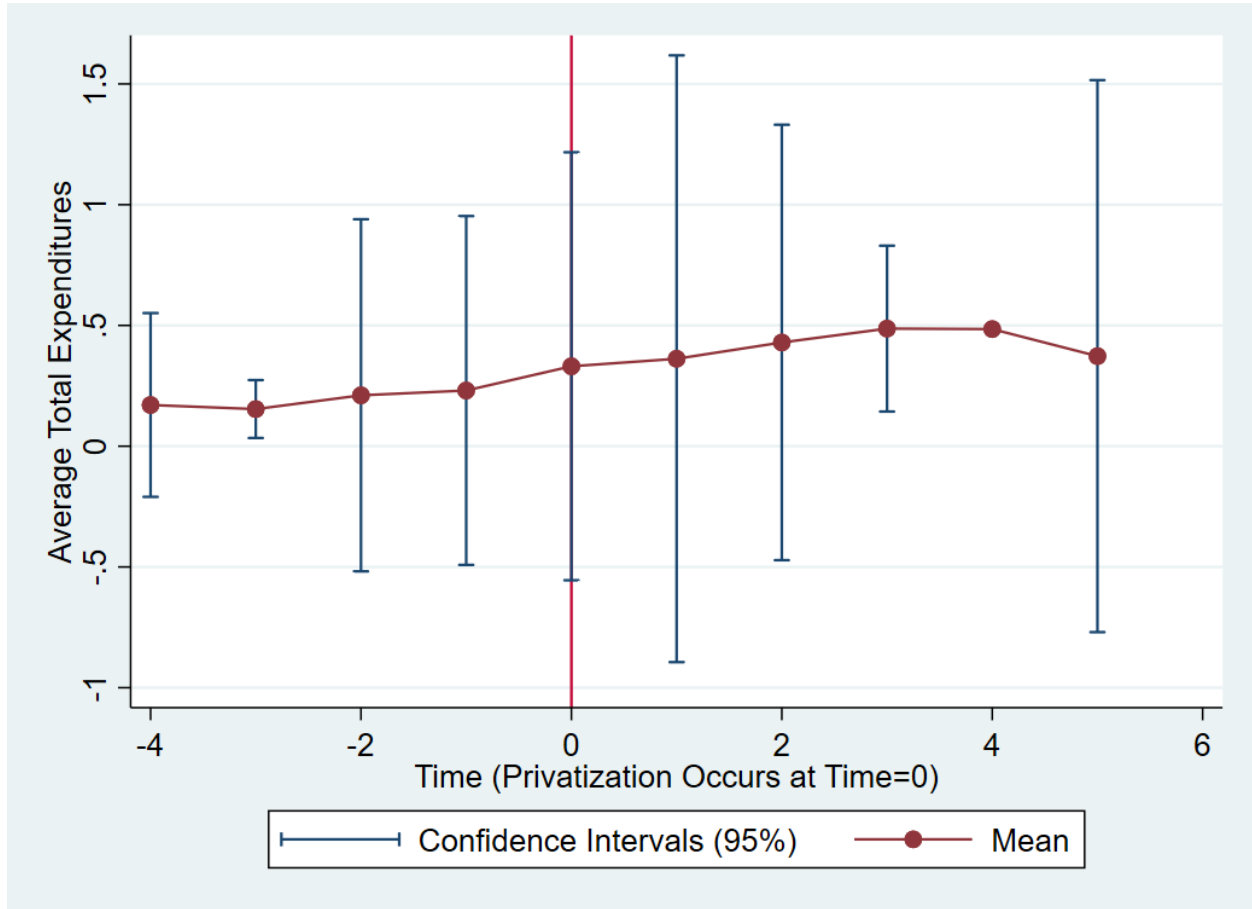
Advisor: Alisa Tazhitdinova
Professor: Heather Royer

Table 2: Basic Estimates for Price and Access to Electricity

Regressors	Log of Wholesale Price (CPI Adjusted)		Log of Residential Connections to Power		Log of Residential and Non-Residential Connections to Power	
	(1)	(2)	(3)	(4)	(5)	(6)
Privatized or not	2.6084***	-4.8650***	0.0362***	0.1875***	0.0507***	0.1487***
	(0.3758)	(1.4989)	(0.0100)	(0.0220)	(0.0093)	(0.0205)
Privatization*Economic Freedom		0.0755***		-0.0020***		-0.0014***
		(0.0172)		(0.0002)		(0.0002)
Economic Freedom Rank		-0.1207***		0.0006***		0.0001
		(0.0052)		(0.0002)		(0.0002)
Constant	5.8419***	17.6129***	9.7420***	9.7965***	10.2576***	10.3004***
	(0.6208)	(0.8256)	(0.0256)	(0.0286)	(0.0398)	(0.0396)
Utility Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	790	745	2,770	2,483	2,736	2,472
Adjusted R-squared	0.7088	0.8327	0.9949	0.9952	0.9948	0.9953

Robust standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Each column is a separate regression. Variables on the left are regressors. Fixed effects for utility and year are included for all regressions. Asterisks are degrees of significance.

Table 3: Basic Estimates for Average Costs of Electricity

Regressors	Log of Average Operating Expenditures (CPI Adjusted)		Log of Average Capital Expenditures (CPI Adjusted)		Log of Average Total Expenditures (CPI Adjusted)	
	(1)	(2)	(3)	(4)	(5)	(6)
Privatized or not	0.3833*	-1.2442***	0.2490	-0.8764**	0.3833*	-1.2442***
	(0.2051)	(0.3293)	(0.2003)	(0.4300)	(0.2051)	(0.3293)
Privatization*Economic Freedom		0.0226***		0.0158***		0.0226***
		(0.0052)		(0.0047)		(0.0052)
Economic Freedom Rank		-0.0376***		-0.0011		-0.0376***
		(0.0083)		(0.0043)		(0.0083)
Constant	7.9428***	13.6325***	7.3344***	8.9958***	7.9428***	13.6325***
	(0.8915)	(1.4705)	(1.2499)	(2.0686)	(0.8915)	(1.4705)
Utility Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,167	1,101	1,057	1,011	1,167	1,101
Adjusted R-squared	0.8962	0.9016	0.9261	0.9263	0.8962	0.9016

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Each column is a separate regression. Variables on the left are regressors. Fixed effects for utility and year are included for all regressions. Asterisks are degrees of significance.

Author: Connor Pardini

Advisor: Alisa Tazhitdinova
Professor: Heather Royer

Table 4: Estimates with Controls and Interaction Terms for all Outcome Variables

Regressors	Log of Wholesale Price (CPI Adjusted)	Log of Residential Connections to Electricity	Log of Residential and Non-Residential Connections to Electricity	Log of Average Operating Expenditures (CPI Adjusted)	Log of Average Capital Expenditures (CPI Adjusted)	Log of Average Total Expenditures (CPI Adjusted)
	(1)	(2)	(3)	(4)	(5)	(6)
Privatized or not	-9.3778***	0.3158***	0.2523***	-1.2607***	-0.8738**	-1.2607***
	(1.4098)	(0.0278)	(0.0245)	(0.3246)	(0.4394)	(0.3246)
Privatization*Economic Freedom	0.1245***	-0.0031***	-0.0023***	0.0229***	0.0192***	0.0229***
	(0.0157)	(0.0003)	(0.0003)	(0.0054)	(0.0048)	(0.0054)
Economic Freedom Rank	-0.1215***	0.0013***	0.0005**	-0.0376***	-0.0018	-0.0376***
	(0.0052)	(0.0002)	(0.0002)	(0.0087)	(0.0042)	(0.0087)
Privatized*New Private Entry	31.7409***	0.1451	0.3138	51.1177	-8.2121	51.1177
	(5.9389)	(0.1938)	(0.1980)	(39.8702)	(7.4715)	(39.8702)
Privatized*Consumer Choice	-16.1678***	-0.1781*	-0.1768	-26.9517	-3.2189***	-26.9517
	(3.0168)	(0.0993)	(0.1684)	(19.9443)	(1.0009)	(19.9443)
Privatized*Price Regulation	-17.1719***	-0.0868	-0.2235	-29.2717	8.5896	-29.2717
	(4.4764)	(0.1706)	(0.1425)	(19.9615)	(7.4010)	(19.9615)
Privatized*Fuel Subsidies	-5.2120***	-0.2065***	-0.2306***	-22.8239	0.6756	-22.8239
	(1.2301)	(0.0347)	(0.0497)	(19.9238)	(1.2335)	(19.9238)
Interaction of Specified Privatization Interaction Term with Economic Freedom						
Privatization*New Private Entry	-0.3276***	0.0009	0.0000	-0.5343	0.0870	-0.5343
	(0.0791)	(0.0022)	(0.0021)	(0.4186)	(0.0725)	(0.4186)
Privatization*Consumer Choice	0.2087***	0.0004	0.0008	0.2629	0.0117	0.2629
	(0.0625)	(0.0019)	(0.0033)	(0.2096)	(0.0130)	(0.2096)
Privatization*Price Regulation	0.1472**	-0.0021	-0.0016	0.2884	-0.0999	0.2884
	(0.0687)	(0.0020)	(0.0016)	(0.2099)	(0.0719)	(0.2099)
Privatization*Fuel Subsidies	-	0.0011	0.0013	0.2472	-0.0218	0.2472
		(0.0012)	(0.0021)	(0.2091)	(0.0171)	(0.2091)
Constant	18.9874***	9.6463***	10.0602***	13.6267***	8.9224***	13.6267***
	(0.7997)	(0.0435)	(0.0354)	(1.4884)	(2.0286)	(1.4884)
Utility Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	745	2,483	2,472	1,101	1,011	1,101
Adjusted R-squared	0.8369	0.9956	0.9956	0.9019	0.9301	0.9019

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Each column is a separate regression. Variables on the left are regressors. Fixed effects for utility and year are included for all regressions. Asterisks are degrees of significance.