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## THE TRANSFORMING POWER OF DEMOCRACY: REGIME TYPE AND THE DISTRIBUTION OF ELECTRICITY

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## Abstract

Large literatures in economics and political science examine democracy's impact on health, education, and other development indicators, but the political economy of electricity allocation has been ignored in previous work. Politicians determine electricity consumption patterns through state ownership and regulation (e.g. price subsidies). This study uses sectoral electricity consumption data for a panel of 750 country-years to examine democracy's impact on the distribution of electricity across three sectors that represent distinct political interests: industry, agriculture, and residential consumers. We find that in poorer countries, democratization produces significant increases in the residential share of electricity at the expense of industry, suggesting sectors with less per-capita financial clout, but a stronger voice in elections benefit under democracy.

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## I. Introduction

A well-established and yet still-growing literature seeks to evaluate democracy's impact on a range of different development outcomes: health, education, wages and economic performance (Rodrik 1999; Barro 1996; Przeworski, Alvarez et al. 2000; Leftwich 2002; John 2003). Despite having received so much attention, still missing from previous work is a concern for the state provision of a public good that can impact health, education, and economic growth simultaneously: electricity. Consumption patterns of electricity vary tremendously throughout the developing world: endowed with similar levels of per capita income, Brazil consumes in per capita terms roughly half the amount of electricity as South Africa (1,878 Kilowatt Hours per capita, compared to 3,745 Kilowatt Hours per capita).<sup>1</sup> Although more than a billion people in the developing world have gained access to electricity in the last 25 years, about 2 billion remain without access (Barnes and Halpern 2000). Extending use to the remaining 2 billion is critical. Access to electricity can help education by lighting a school room or by allowing a child to read after dark, it can help health-care provision by allowing the storage of perishable vaccines in health clinics, and it can increase productivity and save natural resources as less time is spent gathering cruder forms of fuel such as wood (Price 2000). Access to cheap and reliable energy can also directly affect economic growth by spurring industrial activity. Electricity is in excess demand in most of the developing world (as anyone who has experienced "load shedding" or the rationing of electricity in Calcutta, Dhaka or Nairobi would attest to), which makes the allocation of electricity across industrial or residential sectors a significant policy decision with important welfare consequences. Despite its economic impact, or rather because of its economic impact, the distribution of electricity is profoundly political.

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<sup>1</sup> (World Bank 2003).

This study examines the impact democracy has on the distribution of electricity among three sectors that represent distinct political interests: industry, agriculture, and the consumer. The underlying theoretical motivation of this paper concerns the relationship between democracy and the distribution of public benefits. Do politicians operating under electoral constraints adopt policies that benefit large segments of the population relative to their authoritarian counterparts? Using panel data for 90 countries covering the period 1973-1997, we estimate democracy's impact on the relative shares of electricity consumption going to industry, agriculture, and residential consumers. Although political economy theories of public good provision often model the distributive consequences of politics (e.g. Alesina and Rodrik 1994; Becker 1983), empirical papers on regime type and public goods typically examine the impact of democracy on only the quantities or types of public goods provided. The empirical work in this paper directly models the distribution of electricity across different sectors.

We posit that once factors associated with demand are controlled for (size of each sector as a share of GDP, GDP per capita), residual differences in electricity consumption patterns across groups are largely the result of allocation decisions made by politicians. Politicians ultimately determine patterns of electricity consumption through state ownership, regulation, or the decision not to regulate. Subsidizing one sector at the expense of another (cross-subsidization) is common. In India, for example, the rate of subsidy expressed as a proportion of the full cost-of-supply reference price amounted to 93% for agriculture and 58% for households in 2000 (Audinet and Verneyre 2002 p. 46). Special provisions in recent Russian law that govern the electricity sector favor households in the countryside. Experts estimate that the gap between industrial and residential prices have widened since the 1998 financial crisis in Russia, favoring households at the expense of industry (Lindseth 2002, p.

208). We interpret this as a problem of allocation, since decisions by the state have important impacts on the incentives each sector faces, ultimately determining consumption in each sector.

Using a grouped data multinomial logit model, we examine democracy's impact on the share of electricity allocated across three well-defined interest groups: industry, agriculture, and residences. The data were acquired from the International Energy Agency which reports the number of Gigawatt hours consumed by each sector (International Energy Agency 2000). We use yearly data with country fixed effects, so that the empirical inferences are based on inter-temporal movements in countries' democracy scores and associated changes in sectoral shares of electricity within countries, not simply cross-sectional variation across countries.

Gary Becker and George Stigler's interest group theory of regulation (Stigler 1971; Peltzman 1976; Becker 1983) predicts that more democratic decision-making would favor residential consumers – a group with less financial clout but a stronger voice in elections – over industry groups in resource allocation. Furthermore, we expect this effect to be stronger in areas where existing rates of residential electrification are lower. The strong empirical patterns that emerge from our analysis are consistent with these predictions. First, movements towards democracy are associated with an increase in the proportion of electricity allocated to residential consumers, and this increase comes entirely at the expense of industry. Second, the positive relationship between democracy and consumption in the residential sector is only found in the poorest countries. In the poorest half of our sample, a movement towards democracy increases the probability that an additional unit of electricity is allocated to residences by about 8 percentage points, while decreasing industry's allocation probability by 15 percentage points. The magnitude of these effects are considerably smaller

(4 and -3 percentage points respectively) but still significant once country fixed effects are added. Given both the size of the electricity sector and its impact on economic development, democracy has the potential to have large consequences for human welfare by affecting the pattern of electricity consumption.

Previous research that links democracy to economic growth, health or education services are typically susceptible to endogeneity problems since income growth engenders a demand for democracy. In our work, the endogeneity of democracy with respect to the pattern of electricity consumption across different groups is less of a concern.<sup>2</sup> To avoid other problems associated with aggregate cross-national work, an emerging literature takes a more ‘micro’ oriented approach by examining the effects of democracy at the local level on health and education (Betancourt and Gleason 2000; Foster and Ronsenzweig 2001). Studying a single case, however, comes at a cost: the relationships and empirical patterns observed in rural India may not necessarily hold in other countries or other regions. Our study minimizes the endogeneity problems while preserving the cross-national dimension, allowing us to complement the ‘micro’ work that is more geographically focused. Our study is also the first to examine democracy’s impact on electricity allocation patterns, and complements the literature on regime type and health and education services.

The paper is organized as follows. Section two discusses recent theories of democracy and its relationship to public service allocation, and it provides some background

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<sup>2</sup> One could argue that greater electrification leads to democratization, but our dependent variable is defined by the shares of electricity consumed by residences, agriculture and industry in a multinomial logit model where total amount of electricity consumed is included in the set of conditioning variables. Reverse causality would be a legitimate concern only if changes in the sectoral shares of electricity consumption have an impact of the type of political institution that emerges.

on electricity policy in developed and developing countries. Section three describes the data and estimation procedure and discusses the results. Section four concludes the paper.

## **II. Conceptual Background**

To motivate the empirical analysis, we first describe the context of electricity allocation, the major players, and the constraints under which they operate. To derive testable hypotheses, we borrow from the literature on the theory of regulation. Our goal is to draw direct connections between the incentives politicians face under alternative political institutions and the allocation of electricity among different sectors that represent distinct interests in society.

We conceive the problem as being one of allocation: politicians (regulators) make decisions—through subsidies or the degree of regulation—about which sectors to favor in the provision of electricity. We use as our point of departure Stigler’s theory of regulation in which the regulatory outcome is the result of competition between interest groups over income transfers: acquiring revenue by taxing others (Stigler 1971; Peltzman 1976; Becker 1983). Stigler argues that there are diminishing returns to group size in this game due to the costs of obtaining information about proposed legislation, and the costs of organization. The per-capita benefits of any piece of legislation are expected to be lower for large groups with diffuse interests. In addition to identifying their interests, groups must effectively lobby politicians to obtain protective legislation. Smaller, more concentrated interests will be able to mobilize the resources necessary for lobbying efforts and campaign contributions.

Stigler also posits that governments operating in relatively uncompetitive contexts will extract greater rents in exchange for protective legislation. Political parties that face effective political competition lower the price for protective legislation since competing

parties might attract support by promising protective legislation at lower prices. In the context of electricity consumption, such legislation takes the form of subsidies and regulatory structures that either raise or lower electricity prices for each interest group. The three groups we consider—industry, agriculture, residential—fall into distinct categories that vary along the dimensions Stigler analyzes. Industrial consumers of electricity have very high per capita stakes in the price they pay for electricity and are relatively small in number. Agricultural interests have a high per capita stake as well but are usually larger in number. Although smaller in number than residential consumers, because of the geographic logic under which the legislative branch is based, agriculturalists are usually over-represented in the legislative arena. Finally, residential consumers have very low per capita stakes and are very large in number.

Stigler's model implies that the degree of competition will determine the cost of protective legislation to each interest group. In our case, protective legislation comes in the form of subsidies or beneficial regulation that lowers the price of electricity to a given sector. Less competitive governments which have the ability to extract higher prices for protective legislation will more likely provide subsidies to groups that can afford the high price: concentrated interests whose stakes in the regulatory game are high. Relatively small in number but well-endowed financially, industrialists have both the means and small numbers to overcome informational and organizational costs. As political competition increases, the price for protective legislation decreases, favoring groups with less financial clout but a stronger voice in elections: consumers and agricultural interests. This leads to our first hypothesis:

*H1: Democracies provide subsidies and regulatory structures that favor residential and agriculture consumers of electricity.*

We expect democracy's impact on the distribution of electricity as hypothesized above to be more pronounced in the world's poorest countries. Throughout the world, the electricity sector has recently undergone rapid changes in its regulatory structure. Regulatory reform in industrialized countries focuses on providing a more efficient, cleaner, and cheaper source of electricity to customers, while in the developing world providing basic access to those without any electricity is the primary concern (Jamassb 2002). In OECD countries, over 99% of the population have access to electricity. Electrification rates in the Middle East, North Africa, East Asia/China and Latin America are all above 85%, while in the developing world, it averages around 64% (International Energy Agency 2002, p. 373). In South Asia and sub-Saharan Africa, the rates of access to electricity average around 30, and vary from 4.7% (Ethiopia) to 52.9% (Pakistan).

**[Figure I about here]**

The relationship between income levels and access to electricity (see Figure I) suggests that governments can make the largest gains in electrification in the poorest countries where there is currently the least supply. Four out of five people without access are residents of rural areas in low-income countries. Since the electricity needs of the majority of residential consumers in middle and high-income countries have already been met, a movement toward democracy in these countries would not necessarily lead to increases in the residential share of electricity consumption. We therefore expect democracy's impact on residential consumption to be most evident among the poorest countries in our sample. This suggests that in empirical work we should treat the *interaction* of income per capita and democracy as a potential determinant of sectoral electricity consumption patterns.

*H2: Democracy's impact on the share of electricity allocated to the residential sector is greater in poorer countries.*

### III. Estimation

#### A. The Empirical Model

Through regulatory policies (e.g. price subsidization or directed allotment), a government may choose to promote the consumption of electricity to one of four different consumer groups: Agriculture ( $A$ ), Industry ( $I$ ), Residential consumers ( $R$ ), and Others ( $O$ ). The utility the government in country  $i$  at time  $t$  derives from providing a unit of electricity to group  $G$  ( $G = A, I, R$  or  $O$ ) is assumed to depend linearly on regime type, proxied by a Democracy indicator ( $D_{it}$ ):

$$U_{Git} = D_{it} \delta_G.$$

The Stigler-Peltzman-Becker theory of interest groups and regulation outlined in the previous section suggests that  $\delta_R > \delta_I$ ; that we are more likely to observe  $U_{Rit} > U_{Iit}$  for  $D_{it} = 1$  rather than  $D_{it} = 0$ , because government utility would be more sensitive to residential consumers' voting behavior in a democratic regime. Based on its preference for one group over another (comparisons of  $U_R, U_I, U_A, U_O$  conditional on regime type), the government chooses a regulatory instrument such as discriminatory pricing to promote electricity to its preferred group(s). The price charged to group  $G$  is denoted  $P_{Git}$ , and it depends on government utility and therefore on regime type:

$$P_{Git} = \rho_G U_{Git} = D_{it} \cdot \rho_G \delta_G = D_{it} \beta_G.$$

The consumption outcome in the market,  $C_{Git}$  (i.e. the likelihood that group  $G$  actually consumes this unit of electricity) is not just a function of the government's regulatory instrument (i.e. the relative prices charged), but it also depends on demand conditions such as the size of each group or the extent of urbanization, and characteristics of the economy such as average incomes:

$$(1) \quad C_{G_{it}} = \mathbf{Y}_{it}\boldsymbol{\gamma}_G + D_{it}\beta_G + \varepsilon_{G_{it}} \quad G=A,I,R,O.$$

$C_{G_{it}}$  can be interpreted as the unobserved latent demand of group  $G$  for a particular unit of electricity.  $\mathbf{Y}_{it}$  is a vector of demand characteristics for each country in each time period, and it may include country-specific unobserved factors (i.e. a set of country fixed effects) and a time-specific effect. The random variable  $\varepsilon_{G_{it}}$  is an unobserved demand parameter for each consumer group, and it may contain a country-specific fixed component (i.e. errors clustered by country). The coefficients  $\boldsymbol{\gamma}$  and  $\beta$  vary by consumer groups ( $G$ ), but not by country ( $i$ ) or year ( $t$ ). The coefficient  $\beta$ , which is the primary coefficient of interest in this paper, captures the effect of government allocation preferences (based on regime type) on electricity consumption outcomes observed in the market, after demand conditions that affect consumption patterns are controlled for.

The probability that a particular unit of electricity is allocated to a residential consumer is defined by  $\Pr(C_{R_{it}} > C_{G_{it}})$  for all  $G \neq R$ . Using equation (1), we can solve for this probability:

$$\Pr[\varepsilon_{R_{it}} - \varepsilon_{G_{it}} > \mathbf{Y}_{it}(\boldsymbol{\gamma}_G - \boldsymbol{\gamma}_R) + D_{it}(\beta_G - \beta_R)], \quad G=A,I,O.$$

In this case, the unit of electricity is more likely to be allocated to a residential consumer if the government is democratic (through the government utility and regulatory instrument effect), and if demand conditions favor the residential group over other consumer groups (e.g. the size of the residential group is large relative to industry or agriculture). This unit-by-unit electricity allocation decision, while not actually observed, determine the proportion of electricity allocated to each of the four groups:  $E_{G_{it}}$  which is what we have data on for each country in each year. If  $\varepsilon_{G_{it}}$  is assumed to be independently

and identically distributed across countries with a Weibull distribution<sup>3</sup>, then the proportion  $E_{Git}$  provides an estimate of the probability that in country-year  $it$ , the marginal unit of electricity is allocated to group  $G$  ( $G=A,R,O$ ) rather than group  $I$ :

$$(2) \quad E_{Git} = \frac{e^{Y_{it}(\gamma_I - \gamma_G) + D_{it}(\beta_I - \beta_G)}}{\sum_G e^{Y_{it}(\gamma_I - \gamma_G) + D_{it}(\beta_I - \beta_G)}} .$$

Equation (2) defines multiple share equations (one for each consumer group) in a grouped-data multinomial logit model, which yield three sets of coefficients for each conditioning variable: the effect of (say) democracy on (a) the probability group  $A$  (i.e. Agriculture) receives the additional unit of electricity rather than group  $I$  (Industry), (b) the probability group  $R$  (Residences) receives electricity rather than group  $I$ , and (c) group  $O$  receives electricity rather than group  $I$ .

We implement this model using data from the International Energy Agency on the percentage shares of electricity consumed by Agriculture, Industry, Residential Consumers and Others for 750 country-year observations (see table I). These shares define our dependent variable in a grouped data multinomial logit model. For the conditioning variables in  $\mathbf{Y}$ , we collect data from the World Bank on the size of each consumer group in the economy (industrial share of GDP, agricultural share of GDP, total population), extent of urbanization, non-linear terms of average income (GDP per capita and its GDPpc squared), and total electricity production and consumption. The democracy indicator ( $D_{it}$ ) is constructed by subtracting “Autocracy” from “Democracy” scores producing a twenty-point

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<sup>3</sup> Assuming a Weibull distribution for the random variable is convenient because it yields a grouped-data multinomial logit model of electricity allocation across the four groups. The multinomial logit functional form is well suited to analyze the electricity share data we have.

ordinal scale for each country-year, ranging from  $-10$  to  $+10$  (Marshall 2003). Since a vast majority of authoritarian cases cluster around  $-10$  while democracies cluster around  $+10$ , to simplify the analysis and our interpretation of the coefficients we dichotomized the scale: cases that score above a combined (Democracy – Autocracy) score of 6 were coded as democratic.<sup>4</sup> We add country fixed effects to account for permanent unobserved differences in climate or the quality of institutions across countries that may affect the electricity share of each group. We also add year fixed effects to capture the impact of global energy shocks (such as the oil price shocks) that affected all countries in particular years. We allow a heteroskedasticity-corrected error term to be correlated across yearly observations for each country, in case there are unobserved factors that vary in a non-constant way over time within countries which are not picked up by the country fixed effects. Finally, we allow the impact of democracy to vary across income levels by including interaction terms between GDP per capita and the democracy indicator. This reflects the proposition that in richer countries where electrification is nearly universal, movements in democracy are less likely to be reflected in increased electricity allocation to residential consumers.

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<sup>4</sup> Following earlier work by Brown (1999) a country-year is coded as a ‘democracy’ if the value of the Democracy – Autocracy score exceeds 6 points. To check the stability of our results with respect to our measure of democracy, we varied the cutoff point between 5 and 7, and found that results are qualitatively similar. We also ran the regressions reported below with Alvarez et. al’s dichotomous measure of democracy (Alvarez, Cheibub et al. 1996) . Using the alternate measures of democracy had no substantial impact on the significance or magnitude of the results we report.

## B. Results

Table I reports sample characteristics. The 750 country-year observations in our sample represent 58 countries and span the period 1975-1997. The average GDP per capita is 3420 purchasing power parity adjusted dollars, which indicates that low and middle income countries are over-represented in this sample relative to the rest of the world. 30% of observations in our sample are coded as ‘Democracy,’ while 37% of all observations in the world are ‘democracies’ during the sample period, which again suggests that our sample over-represents poor and middle income countries.

On average across the sample, 48% of electricity is allocated to Industrial consumers. The second largest consumer group is ‘Residences’ with 26%. Agricultural consumers receive 8% while all others (transport, public sectors etc.) account for the remaining 19%. There is reasonable variation in the group-specific electricity consumption share figures across the sample. At the extremes, only 13% of electricity is allocated to industry in Saudi Arabia in 1995<sup>5</sup>, whereas industry receives 84% of electricity in Zambia in 1987. Variation across countries accounts for about 71% of the total variability in the relative residential to industrial electricity shares, while the remaining 29% is due to inter-temporal variation within countries. This, coupled with the fact that the democracy indicator exhibits greater variation across countries than over time, suggests that country fixed effects estimation will be a much

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<sup>5</sup> During the sample period, Saudi Arabian consumers enjoyed artificially low electricity prices driven by government mandated consumer subsidies (U.S. Department of Energy 2004). It is interesting to note that Saudi Arabia is a non-democracy promoting electricity to consumers, which is an exception to the general story and empirical results developed in this paper. Saudi Arabia is a somewhat unique case in that there is extreme inequality with which the country’s substantial oil revenues are shared, and subsidized power may be one way in which a portion of these riches are distributed.

more stringent test of the impact of democracy on electricity allocation compared to cross-sectional estimates or pooled estimators on the panel data.

**[Table I about here]**

Table II reports the coefficient estimates for the grouped data multinomial logit model (as defined by equation 2 above) of electricity allocation across the four groups. The consumption share of industry is treated as the omitted category, so the three columns in specification (1) reports, respectively, the effect on each independent variable on (a) the probability agricultural consumers receive the marginal unit of electricity rather than industry, (b) the probability residences receive the electricity rather than industry, and (c) the probability ‘others’ receive it rather than industry. Specification 1 reports results with errors clustered by country, and specification 2 adds a set of country fixed effects. Under both specifications, a movement towards democracy leads to a greater probability that an additional unit of electricity is allocated to residential consumers rather than industry. The coefficient estimate and corresponding marginal effect is smaller once country fixed effects are included, and the size of the effect varies across countries at different income levels. Table IIb reports the average marginal effect of the democracy indicator on electricity allocation across the entire sample. In specification 1, a movement towards democracy increases the probability that a residential consumer receives the marginal unit of electricity by 4 percentage points, but this effect reduces to 2 percentage points in the fixed effects model. At the mean residential electricity share in the sample (26%), the more conservative 2 percentage point impact translates into a 7.7% increase in the allocation of electricity to residences once a country democratizes.

Panel A of Figure II reports the variation in this marginal effect across different GDP per capita percentiles. As expected, the positive effect of democracy on residential

electricity allocation is largest among the poorest countries in the sample. Under specification 1, democratic countries are 8-9 percentage points more likely to give the marginal unit electricity to residences than non-democratic countries in the poorest 25% of our sample (countries with GDP per capita less than \$1200, PPP Adjusted). This effect is only about half as large in the fixed effects specification. Under both specifications, the impact of democracy on residential electricity allocation remains positive for the poorest 75% of the sample (countries with GDP per capita less than \$5000, PPP Adjusted), and reverses for the richest quarter.

**[Table II, Table IIb, and Figure II about here]**

The increase in electricity allocation to residential consumers in democracies comes entirely at the expense of the industrial sector. Under specification 1, the movement towards democracy reduces the probability that industry is allocated electricity by 7.7 percentage points. For the poorest quarter of the sample, this marginal effect of the democracy indicator is -18 percentage points, but the effect does reverse for the richest quarter. The average effect of regime type on industry across the entire sample is close to zero in the fixed effects model, but as panel B in Figure II shows, this masks a negative impact of democracy in the poorer half of the sample counter-balanced by a positive impact in the richer half.

In the poorer half of the sample, agriculture receives more electricity in democracies than in non-democracies, but in the richer half they get less. The average marginal effect of democracy on the agricultural share of electricity is positive but small. The other control variables in table II do not have strong impacts on electricity consumption patterns across the four groups. As expected, the industrial share of electricity tends to be larger in countries where the industrial sector contributes a larger share of GDP. Countries that produce a larger amount of electricity seem to allocate more to industrial consumers over

residential consumers. There is no robust impact of average income levels per se, except through its interaction effect with democracy.

Tables III and IV examine the sensitivity of the democracy results outlined above to changes in the sample and to the set of conditioning variables. In table III, we break the sample up into two groups: “rich” and “poor” countries, using a PPP adjusted GDP per capita cut-off of \$3000. As Figure II had made clear, the impact of democracy in allocating more electricity to residential consumers at the expense of industry only exists in the sample of poor countries. This effect is not statistically evident in the rich country sample. Specifications 5 and 6 in table IV divide up the sample by time period: before and after 1982. Democracy has comparable positive impacts on residential electricity allocation across the two periods.

**[Table III, Table IV about here]**

Specification 7 adds a set of institutional indicators available from the *International Country Risk Guide* to examine whether the democracy indicator merely picks up the effect of broader institutional quality measures, since democracies are more likely to be advanced countries with better institutions. The democracy indicator and its interaction term with GDP per capita remain statistically significant, and the marginal effects of democracy stay comparable to that computed from specification 1. It is therefore unlikely that the impact of democracy on electricity allocation patterns that we observe are merely the result of greater residential consumption in more advanced economies with better institutions. Of the ICRG indicators, countries that receive higher ratings on ‘Government Stability’ seem to provide more electricity to residences and agriculture over industry. None of the other ICRG indicators included in the model are statistically significant. Incidentally, ‘Government Stability’ is the only ICRG indicator that measures some aspect of the electoral process.

This gives further credence to the idea that democracy impacts electricity allocation through the interest group - regulation mechanism outlined in the Stigler-Becker-Peltzman models.

**[Table V, Table VI, Figure III about here]**

In the first three columns of table V, we use OLS logistic, fixed and random effects models to explore the determinants of electricity consumption by the residential sector *relative* to the industrial sector (ignoring movements in consumption by agriculture and others). The last three columns show the results of three analogous models of the relative consumption shares of residences to agriculture. The dependent variable in specifications 8-10 is defined as residential electricity consumption as a fraction of (residential+industrial) consumption. Since this measure varies between 0 and 1, we fit a logistic model to this data. Specification 8 reports the OLS results, while 9 and 10 add country fixed effects and random effects respectively. For each percentage point increase in the industrial share of GDP, the relative electricity consumption of residences over industry decreases by 1.6%. Consistent with the previous sets of results from tables I-IV, we again find that countries that produce more electricity tend to allocate more to industry.

The impact of democracy is to allocate more electricity to the residential sector relative to industry. The magnitude of this impact reduces considerably once country fixed or random effects are controlled for. This effect also varies with changes in GDP per capita. When a country democratizes, the share of electricity allocated to residences rather than industry increases by over 6 percentage points on average according to the OLS model. This effect reduces to 1.1 percentage points in the fixed effects model. Figure III plots these marginal effects across GDP per capita percentiles, and shows that democracy's beneficial effect on the residential consumer group only exists for the poorest 65% of the sample. In the poorest quarter of the sample, democracy increases the relative residential consumption

share by 4-6 percentage points in the fixed effects model, but in the richest quarter of the sample, democracy's impact is to reduce this share by about 2-3 percentage points. The magnitude of these impacts in the fixed versus random effects models are comparable.

Specifications 11-13 show that democracy's impact on the share of electricity allocated to the residential group rather than the agricultural sector follow similar patterns. In the fixed effects model, when a country democratizes, it increases the relative allocation to residences by 1.5 percentage points on average. Figure III shows that this effect is only positive for the poorest 70% of the sample, and it reverses for the richest 30%.

#### **IV. Conclusion**

Democratic political institutions hold important consequences for the consumption of electricity by different groups in society. Several significant findings emerge from the previous analysis. First, we find an important substantive and statistically significant relationship between regime type and the share of electricity consumed by the residential sector. We find that democratic governments increase the probability that each additional unit of electricity will be consumed by the residential sector at the expense of the industrial sector. The tradeoff between the residential sector and the industrial sector exists primarily among the poorest countries in our sample. The larger tradeoff within low-income countries is probably due to the fact that access to electricity is nearly universal in richer countries. In poor countries where not everyone has access to electricity, politicians in democracies pursue allocative strategies that favor residences over industry.

Although a strong relationship exists between regime type and the consumption of electricity by different sectors in the economy, it is important to recognize an important limitation of our study. Our explanation of the results relies on a number of intermediate

steps for which we have no data. The foundation of our argument rests on politicians and their decisions to favor one sector of the economy over others. We argue that politicians construct a variety of different regulatory instruments that have important effects on the price the various sectors pay for electricity. To help confirm our argument, examining price data by sector would be the next logical step to uncover the causal mechanisms at play. Although price data might help confirm our causal explanation, it may not disconfirm it. In addition to price, governments have a variety of means with which to affect consumption patterns. In other words, governments can manipulate both the nominal price and the real price in different ways: although the nominal price may be low, constant black-outs and general reliability of service may translate into higher real prices.

Another potential limitation of this work is that some unobserved factors possibly correlated with the democracy indicator, such as the degree of privatization of the electricity sector, may affect electricity consumption patterns. It is important to note, however, that our results concerning democracy's beneficial impact on electricity allocation to the residential sector continue to hold in models with country fixed effects and heteroskedasticity-corrected errors clustered by country. The effect of variation in privatization *across* countries should be picked up by the set of country fixed effects, while variation in the degree of privatization over-time is incorporated in the within-panel autocorrelation in disturbances. These are admittedly not perfect solutions, but data on all possibly relevant variables simply don't exist for our panel of 750 country-year observations, made up mostly of developing countries.

Despite the limitations, we have uncovered an important empirical pattern that holds important consequences both for economic development and democracy itself in a number of different ways. Noted earlier, access to electricity can affect a number of different

development outcomes: improved education (reading at night), improved health (refrigeration), improved communication (radio, television, telephony). Improving access to electricity may also help in an indirect but no less important way. Increasing access to electricity also requires a minimal level of property rights so that that electricity consumption by residences and small businesses can be accurately measured. Access to electricity demands the establishment of legal residences. Supplying electricity therefore provides an important incentive for communities to establish a minimal system of property rights. According to Hernando de Soto, establishing property rights is the most important factor in unleashing the economic potential of developing countries (De Soto 2000).

There is also a hidden cost incurred when people lack access to electricity: time spent gathering fuel. In many developing countries an inordinate amount of time and energy is spent collecting fuel for everyday use. Not only is the fuel inefficient, it often poses a number of health risks for those who depend on it. The most often cited example involves the respiratory problems that result from burning wood or charcoal indoors.

In closing, our results extend the growing literature linking democracy with important development outcomes (education, health, and spending on social programs) in a new direction. This study establishes an empirical link that may simultaneously affect developments in a majority of these areas. We also hope to have developed a methodological logic that will allow others to examine how politics affects the various tradeoffs politicians make in their allocative decisions. The framework we use to study electricity consumption patterns among different sectors can be applied, for example, to examine the tradeoffs politicians make between different budget expenditures. To conclude, we find that politicians operating under electoral constraints are more likely to favor sectors that directly affect a wide segment of the population. In the case of electricity, democracy's

role in compelling politicians to provide increased access among consumers at the expense of industrial interests could hold important unforeseen consequences for the quality of life for a large number of people in developing countries.

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**Table I. Variable Sources and Summary Statistics**

Variable	Source and Definition	Obs	Mean	Std. Dev.	Range
Agriculture, value added (% of GDP)	World Bank, World Development Indicators	750	19.85	12.48	0.16-56.54
Industry, value added (% of GDP)	World Bank, World Development Indicators	750	32.56	10.18	11.92-68.82
Population (in millions)	World Bank, World Development Indicators	750	78.25	211.47	0.54-1,230.08
Urban population (% of total)	World Bank, World Development Indicators	750	48.78	22.37	8.02-100
Democracy Indicator	Polity IV Project Indicator=1 if Democracy Score - Autocracy Score $\geq 7$	750	0.30	0.46	0-1
GDP per capita (1000 PPP Adjusted dollars)	World Bank, World Development Indicators	750	3.42	3.19	0.33-24.92
Electricity Production (1000 kwh per capita)	World Bank, World Development Indicators	750	1.40	1.58	0.02-9.34
Total Electricity consumption (in millions)	International Energy Agency	750	0.04	0.11	0.0003-0.84
Share of Electricity Used by Agriculture	International Energy Agency	750	0.07	0.07	0.00-0.43
Share of Electricity Used by Industry	International Energy Agency	750	0.48	0.16	0.13-0.84
Share of Electricity Used by Residences	International Energy Agency	750	0.26	0.11	0.04-0.63
Share of Electricity Used by Others	International Energy Agency	750	0.19	0.11	0.00-0.58
Quality of the Bureaucracy	ICRG, Political Risk Services	411	1.97	1.00	0-4
Corruption in Government	ICRG, Political Risk Services	411	3.17	1.07	0-6
Government Stability	ICRG, Political Risk Services	411	6.25	1.85	1-11
Socio-economic Conditions	ICRG, Political Risk Services	411	5.58	1.60	1.33-10.92

**Table II. Multinomial Logit Models of Electricity Allocation Across Four Groups**

	(1)			(2)		
	Agriculture	Residential	Other	Agriculture	Residential	Other
Agriculture, value added (% of GDP)	0.005 (0.36)	0.020 (2.27)**	0.014 (1.35)	-0.015 (1.15)	-0.010 (1.62)	-0.003 (0.32)
Industry, value added (% of GDP)	-0.016 (0.92)	-0.013 (1.36)	-0.016 (1.73)*	0.001 (0.07)	-0.017 (4.06)***	-0.010 (1.94)*
Population (in millions)	0.001 (1.53)	-0.001 (3.52)***	-0.001 (2.28)**	0.002 (1.48)	0.002 (1.49)	-0.003 (2.08)**
Urban population (% of total)	0.002 (0.17)	0.005 (1.08)	0.000 (0.05)	0.018 (0.48)	-0.002 (0.17)	-0.065 (2.58)***
Democracy Indicator	1.714 (4.71)***	0.956 (3.73)***	0.767 (2.51)**	-0.201 (0.95)	0.335 (2.34)**	0.035 (0.31)
GDP per capita (1000 PPP Adjusted dollars)	0.113 (0.39)	0.259 (2.28)**	0.392 (3.62)***	-0.325 (2.06)**	-0.042 (1.04)	-0.027 (0.35)
GDP per capita squared	-0.050 (1.48)	-0.009 (2.32)**	-0.013 (3.50)***	0.024 (1.54)	0.001 (1.30)	0.000 (0.01)
Democracy Indicator * GDP per capita	-0.908 (3.81)***	-0.264 (2.86)***	-0.192 (2.27)**	0.107 (0.86)	-0.136 (3.20)***	-0.087 (2.68)***
Democracy Indicator * GDP per capita squared	0.088 (2.78)***	0.012 (1.84)*	0.008 (1.55)	-0.014 (0.91)	0.010 (3.62)***	0.008 (3.77)***
Electricity Production (1000 kwh per capita)	0.383 (3.70)***	-0.161 (2.23)**	-0.109 (1.62)	0.221 (1.64)	-0.159 (1.96)**	-0.200 (2.05)**
Total Electricity consumption (in millions)	-1.138 (0.97)	-0.098 (0.14)	-0.636 (1.31)	-1.519 (1.53)	0.130 (0.12)	2.370 (2.32)**
Constant	-2.222 (2.46)**	-1.394 (2.62)***	-1.846 (3.00)***	-3.466 (1.50)	-3.552 (2.65)***	2.104 (1.30)
Year Effects	Yes			Yes		
Country Effects	Errors Clustered by Country			Country Fixed Effects Included, Error Clustered by Country		
Sample	All Country-Year Observations			All Country-Year Observations		
No. of Country-Year Observations	750			750		

Heteroskedasticity-corrected z statistics in parentheses

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

Allocation to "Industry" is the omitted category

**Table IIb. Average Marginal Effect of the Democracy Indicator in the Multinomial Logit Models (based on table II)\***

	Model 1 (clustered errors)	Model 2 (fixed effects and clustered errors)
Agriculture	1.6	-0.6
Industry	-7.7	-0.03
Residences	4.0	2.0
Other	2.1	-1.4

\*The value in each cell is the percentage point change in the probability of allocating an extra unit of electricity to that group in response to a unit change in the democracy indicator.

**Table III. Multinomial Logit Models of Electricity Allocation: Rich and Poor Samples Separately**

	(3)			(4)		
	Agriculture	Residential	Other	Agriculture	Residential	Other
Agriculture, value added (% of GDP)	-0.007 (0.44)	0.030 (2.68)***	0.029 (2.69)***	0.019 (1.22)	0.015 (0.99)	0.007 (0.42)
Industry, value added (% of GDP)	-0.039 (2.07)**	-0.007 (0.46)	-0.011 (0.87)	0.007 (0.54)	-0.015 (0.95)	-0.033 (2.28)**
Population (in millions)	0.002 (1.96)*	-0.003 (5.22)***	-0.001 (2.23)**	-0.005 (0.62)	-0.001 (0.25)	-0.001 (0.28)
Urban population (% of total)	0.000 (0.04)	0.010 (1.53)	0.007 (0.71)	0.001 (0.05)	0.003 (0.56)	-0.006 (0.84)
Democracy Indicator	1.196 (2.98)***	1.007 (2.75)***	0.524 (1.36)	-2.150 (3.13)***	0.395 (0.95)	0.312 (0.78)
GDP per capita (1000 PPP Adjusted dollars)	0.061 (0.23)	0.364 (2.16)**	0.621 (3.78)***	-0.416 (3.71)***	0.044 (0.67)	0.084 (1.36)
GDP per capita squared						
Democracy Indicator * GDP per capita	-0.433 (2.12)**	-0.327 (1.66)*	-0.165 (0.68)	0.314 (2.70)***	-0.049 (0.66)	-0.021 (0.32)
Democracy Indicator * GDP per capita squared						
Electricity Production (1000 kwh per capita)	0.782 (4.31)***	-0.409 (3.10)***	-0.267 (1.96)*	0.255 (2.66)***	-0.053 (0.74)	-0.002 (0.03)
Total Electricity consumption (in millions)	-2.177 (1.20)	2.799 (2.77)***	0.329 (0.41)	1.219 (0.66)	-1.103 (0.86)	-0.842 (0.80)
Constant	-1.483 (1.45)	-1.919 (2.79)***	-2.820 (4.30)***	-2.681 (1.79)*	-0.565 (0.59)	0.859 (0.82)
Year Effects	Yes			Yes		
Country Effects	Errors Clustered by Country			Errors Clustered by Country		
Sample	Poor (GDP per capita < 3000)			Rich (GDP per capita >= 3000)		
No. of Country-Year Observations	442			308		

Heteroskedasticity-corrected z statistics in parentheses

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

Allocation to "Industry" is the omitted category

**Table IV. Multinomial Logit Models of Electricity Allocation: Various Time Periods**

	(5)			(6)			(7)		
	Agri- culture	Resi- dential	Other	Agri- culture	Resi- dential	Other	Agri- culture	Resi- dential	Other
Agriculture, value added (% of GDP)	-0.001 (0.03)	0.032 (1.86)*	-0.011 (0.53)	0.006 (0.41)	0.020 (2.39)**	0.021 (2.18)**	-0.018 (1.18)	0.020 (1.81)*	0.023 (2.02)**
Industry, value added (% of GDP)	-0.036 (1.65)*	0.003 (0.23)	-0.013 (0.85)	-0.009 (0.59)	-0.019 (1.86)*	-0.023 (2.42)**	-0.033 (2.05)**	-0.024 (1.95)*	-0.028 (2.67)***
Population (in millions)	0.000 (0.19)	-0.003 (4.13)***	0.000 (0.49)	0.001 (1.36)	-0.001 (2.58)***	-0.001 (1.58)	0.000 (0.72)	-0.001 (2.01)**	-0.001 (2.78)***
Urban population (% of total)	0.004 (0.23)	0.009 (1.79)*	-0.009 (1.23)	0.002 (0.25)	0.004 (0.88)	0.002 (0.20)	0.006 (0.58)	0.006 (0.89)	-0.001 (0.17)
Democracy Indicator	1.405 (3.04)***	0.984 (2.13)**	0.394 (0.97)	2.262 (4.88)***	1.001 (3.32)***	0.667 (1.91)*	2.852 (7.88)***	1.020 (3.24)***	0.691 (2.26)**
GDP per capita (1000 PPP Adjusted dollars)	0.213 (0.32)	0.470 (1.64)	0.765 (2.42)**	0.246 (0.82)	0.277 (2.41)**	0.401 (4.06)***	0.061 (0.32)	0.229 (1.85)*	0.385 (3.35)***
GDP per capita squared	-0.086 (0.80)	-0.047 (1.39)	-0.065 (1.80)*	-0.067 (1.70)*	-0.010 (2.65)***	-0.013 (4.07)***	-0.025 (1.71)*	-0.009 (2.38)**	-0.012 (3.51)***
Democracy Indicator * GDP per capita	-1.194 (2.37)**	-0.461 (1.33)	0.015 (0.04)	-1.163 (4.17)***	-0.285 (2.75)***	-0.204 (2.00)**	-1.196 (6.83)***	-0.247 (2.22)**	-0.196 (1.98)**
Democracy Indicator * GDP per capita squared	0.205 (2.20)**	0.073 (1.30)	0.013 (0.20)	0.113 (2.97)***	0.013 (1.96)*	0.010 (1.56)	0.084 (5.58)***	0.011 (1.47)	0.009 (1.47)
Electricity Production (1000 kwh per capita)	-0.137 (0.67)	-0.344 (3.30)***	-0.156 (1.11)	0.411 (3.74)***	-0.117 (1.71)*	-0.085 (1.54)	0.146 (1.29)	-0.003 (0.03)	-0.081 (0.94)
Total Electricity consumption (in millions)	3.009 (0.61)	0.076 (0.03)	-5.722 (1.26)	-1.131 (0.99)	-0.488 (0.78)	-0.626 (1.54)	0.306 (0.28)	-0.479 (0.65)	0.489 (0.89)
Quality of the Bureaucracy (ICRG)							-0.030 (0.23)	-0.109 (0.97)	-0.061 (0.54)
Corruption in Government (ICRG)							0.148 (1.21)	-0.034 (0.35)	0.051 (0.57)
Government Stability (ICRG)							0.071 (1.70)*	0.062 (1.98)**	0.029 (0.92)
Socio-economic Conditions (ICRG)							-0.019 (0.22)	0.059 (1.12)	0.122 (2.49)**
Constant	-1.815 (0.98)	-2.335 (2.95)***	-1.051 (1.12)	-2.679 (3.18)***	-1.287 (2.30)**	-1.860 (3.16)***	-2.049 (2.15)**	-1.580 (2.37)**	-2.409 (3.54)***
Year Effects	Yes			Yes			Yes		
Country Effects	Errors Clustered by Country			Errors Clustered by Country			Errors Clustered by Country		
Sample	1975-1982			1982-1997			ICRG data available 1984-1997		
No. of country-year observations	217			533			411		

Heteroskedasticity-corrected z statistics in parentheses

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

Allocation to "Industry" is the omitted category

**Table V. Panel Data Models of Residential Electricity Consumption as a Fraction of (Residential + Industrial) or (Residential +Agricultural) Consumption**

Estimation Method	(8)	(9)	(10)	(11)	(12)	(13)
	<b>Residences over Industry</b>			<b>Residences over Agriculture</b>		
	OLS (Logistic)	Fixed Effects	Random Effects	OLS (Logistic)	Fixed Effects	Random Effects
Agriculture, value added (% of GDP)	0.019 (2.16)**	-0.008 (1.31)	-0.011 (3.59)***	0.021 (1.09)	0.003 (0.20)	-0.004 (0.72)
Industry, value added (% of GDP)	-0.015 (1.44)	-0.016 (3.48)***	-0.017 (6.90)***	-0.004 (0.26)	-0.022 (2.41)**	-0.024 (5.54)***
Population (in millions)	-0.001 (3.68)***	0.001 (1.22)	-0.001 (1.39)	-0.002 (2.78)***	0.002 (0.55)	-0.001 (0.57)
Urban population (% of total)	0.006 (1.15)	-0.005 (0.59)	0.009 (2.53)**	0.003 (0.16)	-0.019 (0.61)	0.013 (1.94)*
Democracy Indicator	0.919 (3.62)***	0.332 (2.05)**	0.316 (4.55)***	-0.354 (0.72)	0.391 (2.93)***	0.375 (3.16)***
GDP per capita (1000 PPP Adjusted dollars)	0.271 (2.17)**	-0.046 (1.07)	-0.037 (1.40)	0.544 (2.87)***	0.058 (0.80)	0.094 (2.04)**
GDP per capita squared	-0.009 (2.23)**	0.001 (1.26)	0.001 (1.35)	-0.007 (1.19)	0.002 (0.80)	0.001 (0.89)
Democracy Indicator * GDP per capita	-0.266 (2.92)***	-0.139 (3.03)***	-0.130 (5.55)***	0.374 (1.71)*	-0.138 (2.39)**	-0.120 (2.99)***
Democracy Indicator * GDP per capita squared	0.013 (2.12)**	0.010 (3.81)***	0.009 (5.52)***	-0.042 (2.36)**	0.007 (2.02)**	0.004 (1.53)
Electricity Production (1000 kwh per capita)	-0.170 (2.41)**	-0.153 (1.90)*	-0.128 (3.62)***	-0.501 (3.36)***	-0.325 (2.71)***	-0.358 (5.57)***
Total Electricity consumption (in millions)	0.170 (0.22)	0.705 (0.81)	1.177 (3.24)***	0.682 (0.42)	1.246 (0.61)	1.713 (2.60)***
Constant	-1.405 (2.52)**	0.002 (0.00)	0.000 (.)	0.678 (0.63)	3.540 (2.34)**	0.000 (.)
Errors	Robust, Clustered	Robust, Clustered	Robust	Robust, Clustered	Robust, Clustered	Robust
Year Effects	Yes	Yes	Yes	Yes	Yes	Yes
Sample	All Country-Year Observations (58 countries, 750 observations)					
R-squared	0.42	0.92		0.40	0.94	

Robust (Heteroskedasticity-corrected) t statistics in parentheses. Errors Clustered by Country

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

**Table VI. Average Marginal Effect of the Democracy Indicator in OLS and Fixed Effects models  
(based on table V)\***

	Fixed Effects (specifications 9 and 12)	OLS Logistic (specifications 8 and 11)
Residences over Industry	1.1	6.1
Residences over Agriculture	1.5	4.0

\*The value in each cell is the percentage point increase in the share of electricity allocated to residences in response to a unit increase in the democracy indicator

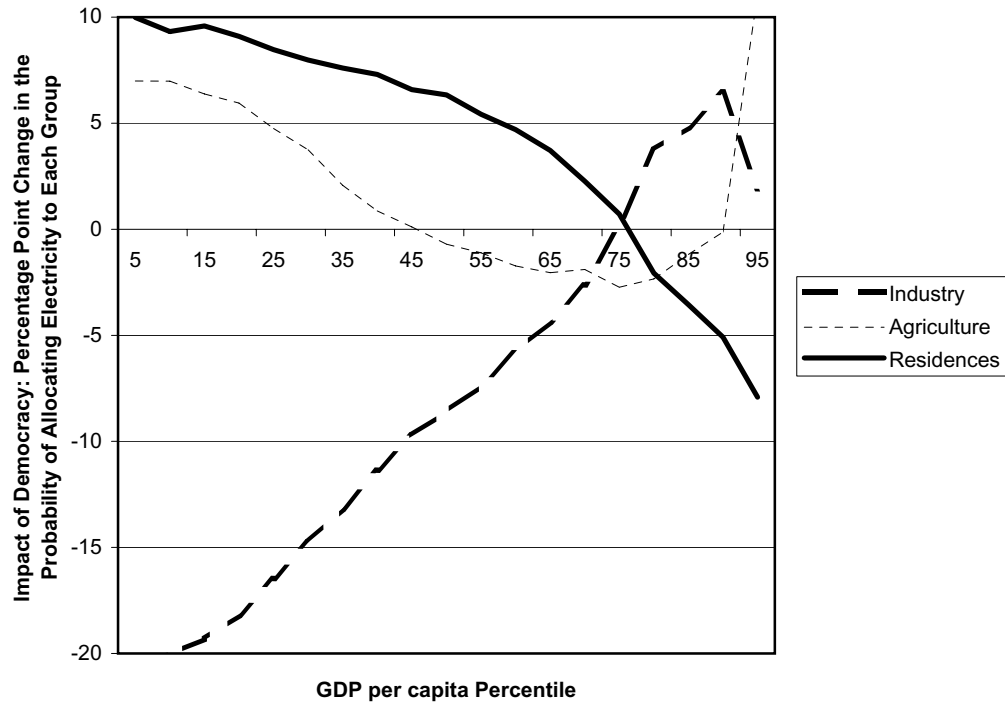
Figure I. Plot of “% of Population with Access to Electricity” against Log of Gross National Income\*



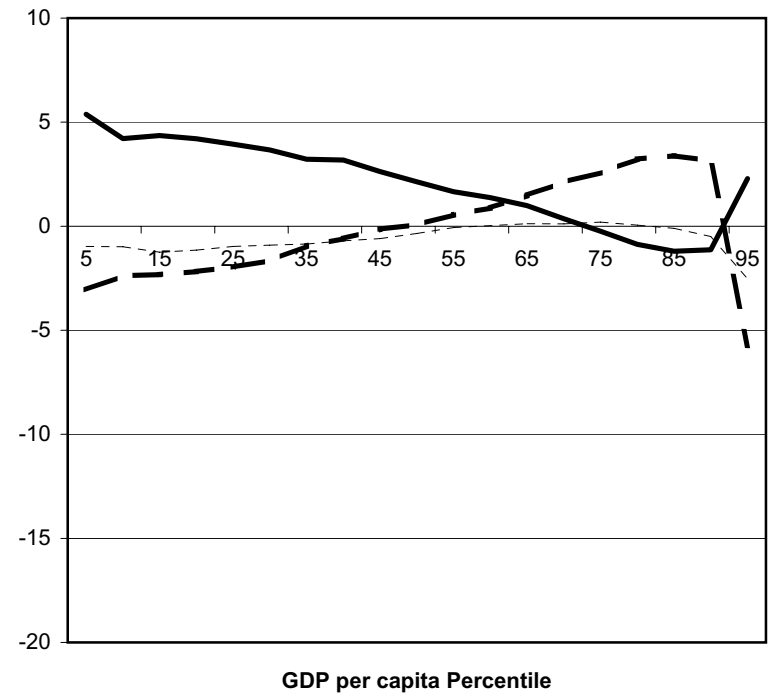
\* Data on the percentage of people with access to electricity comes from an updated source (International Energy Agency 2002), and the countries appearing on this plot are not the exact same set of countries that are in our regression sample

**Figure II. The Marginal Effect of Democracy as GDP per capita varies (based on Specifications 1 & 2)**

**A. Specification 1: Multinomial Logit Without Fixed Effects**



**B. Specification 2: Multinomial Logit With Fixed Effects**



**Figure III. The Marginal Effect of Democracy in Fixed Effects Models [specifications 9 and 12] in table V  
[Models of residential electricity consumption as a fraction of (residential+industrial) or (residential+agricultural)  
consumption]**

