

Fuel Subsidies Limit Democratization: Evidence from a Global Sample, 1990–2014

RESEARCH NOTE

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Oil wealth tends to impede democracy, but scholars disagree about both why and under what conditions. This note helps answer these questions by evaluating the field's foundational theory of the rentier state, which claims that oil wealth finances generous societal benefits that reduce citizens' demands for representation and hinder the emergence of democratic regimes. I create a new measure of such benefits, focusing specifically on the size of domestic gasoline subsidies in dollars per capita. I then use a global sample from 1990 through 2014 to demonstrate that greater spending on these subsidies significantly reduces the likelihood of a transition toward democracy. The impact on democratization is as consequential in practical terms as are large increases in the rate of economic growth. Moreover, including the measure of fuel subsidies helps account for the autocratic effect of oil income. I conclude by highlighting how this fuel subsidy data can shed light on a number of other political economy questions.

A large literature concludes that oil wealth generally impedes democracy (Aslaksen 2010; Ahmadov 2014; Wiens, Poast, and Clark 2014; Ross 2015; Lall 2017). Nevertheless, scholars disagree as to when or why this political resource curse materializes. Important studies by Haber and Menaldo (2011), Liou and Musgrave (2014), and Menaldo (2016) use novel methodological approaches to suggest that oil does not always hinder democratization and in some instances can act as a "resource blessing." Others stress that the impact of oil on democracy is conditional on various societal or political institutions (Dunning 2008; Jones Luong and Weinthal 2010).

Even when scholars agree on the direction of the effect, the theories linking oil wealth to lower probabilities of democratization point to different, and even inconsistent, reasons. Some emphasize the ability of oil-wealthy incumbents to co-opt regime insiders (Wright, Frantz, and Geddes 2015, 296–99). Andersen and Aslaksen (2013, 97) demonstrate that oil prolongs the tenure of authoritarian leaders. Alternatively, Girod, Steward, and Walters (2016, 9) argue that oil-rich autocracies quell popular protests through repression. By contrast, Ross (2012, 67–71) contends that oil revenues enable autocracies to provide more societal benefits than they collect through taxation, thus forestalling mass demands for democratization. Similarly, Paler (2013, 715) draws on experimental data from Indonesia to suggest that citizens in oil-wealthy states are less willing to monitor government expenditures and exercise oversight.

How should we view these contradictions? Methodological and measurement differences explain some of the debate (Brunnschweiler and Bulte 2008, 254–7). Andersen

and Ross (2014, 995–96), for instance, argue that Haber and Menaldo's (2011) evidence of a resource blessing stems largely from their sample and regression design. On the theoretical side, it seems likely that some of these effects operate in different subsets of resource-wealthy countries (Herb 2017, 5). Nothing precludes multiple pathways from being present in a single case. Nevertheless, we can acknowledge this causal complexity while still trying to more precisely measure specific pathways. As Smith (2017, 599) notes, the resource curse literature will remain at a state of immature development until scholars bridge the gap between the theoretical sophistication of existing arguments and the operational terms in which they are evaluated.

This note attempts to bridge this gap by reexamining the field's foundational theory of rentier states, which first emerged from the study of a small number of oil-producing countries (Luciani 1987; Crystal 1995; Chaudhry 1997). With little need to tax citizens, rulers of rentier states generate legitimacy through oil-financed spending programs. This helps reduce societal demands for representation and prevents the emergence of protodemocratic institutions (Karl 1997; Vandewalle 1998). In general, these arguments emphasize the easy access to massive revenues as the root cause of oil's autocratic effects, while remaining mindful that the distribution of these resources for political gain is not some mechanistic outcome of resource abundance (Okruhlik 1999, 308).

In the large-N context, research on the rentier thesis falls into "demand-side" and "supply-side" versions (Ulfelder 2007, 997). In the former, oil states substitute external rents for tax revenue and thus circumvent a key avenue by which citizens develop demands for greater representation (Bates and Lien 1985). By contrast, the supply-side variant holds that resource wealth enables governments to prevent the emergence of domestic political challengers. Most studies here invoke a "spending effect" (Ross 2001, 333) whereby resource rents fund patronage and other societal benefits that increase political support for existing leaders.

A number of studies provide empirical support for various parts of these claims. On the demand side, recent

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work demonstrates that increased hydrocarbon revenues correlate with lower levels of taxation (Lucas and Richter 2016), that higher taxes relative to services correlate with increases in the level of democracy (Ross 2004), and that increased oil rents correlate with reduced levels of transparency (Vadlamannati and De Soysa 2016). Similarly, innovative studies by Paler (2013) and McGuirk (2013)¹ use microlevel data to demonstrate that windfall-spending reduces citizens' demands for accountability. Recent subnational studies from the United States (Goldberg, Wibbels, and Mvukiyehe 2008), Argentina (Diaz-Rioseco 2016), and Iran (Mahdavi 2015) also provide support for the supply-side versions of this rentier thesis. Each demonstrates that increased oil and gas revenues tend to reduce political competition and increase incumbency advantage when leaders have discretion over how these rents are used.

At the country level, however, evidence for this spending mechanism proves scarce. Disagreement over what constitutes relevant societal benefits, as well as the absence of data measuring their size, is partly to blame. Consequently, the few studies that attempt to evaluate this mechanism use overly blunt instruments. Morrison (2015, 71–77), for instance, focuses on aggregate levels of government spending and demonstrates that these tend to stabilize regimes. However, general government-spending data are especially problematic for evaluating the behavior of oil states. Off-budget spending mechanisms mean such measures underestimate the extent of service provision, while corruption that prevents designated spending from reaching targeted populations means such measures simultaneously overestimate spending levels (Mazaheri 2017, 187).

The absence of such evidence certainly cannot be explained by disinterest in the underlying logic of this argument. To the contrary, dynamics associated with increased spending play a central role in a number of prominent arguments, such as Ross's (2012, 67–71) theory of how oil forestalls democratic transitions and Lowi's (2009, 12–16) emphasis on leaders' choices in these resource-dominant settings. Moreover, scholars continue to refine the logic of the rentier state. For example, Burma (2014) distinguishes between their rent-generation and rent-distribution activities. It is also consistent with theory and evidence from a number of other research areas in the discipline. Bueno de Mesquita, Smith, Siverson, et al.'s (2005) selectorate model expects that regimes will provide goods strategically in order to retain power, and Liou and Musgrave (2016) apply it to the unique politics of oil states. These authors show that, the more visible and costlier the public good, the lower the chance of any would-be challenger outbidding the incumbent, and thus the more secure the incumbent's hold on power. Viewed through this supply-side lens, spending on public goods reduces the chance that a domestic political opposition emerges.

It is also consistent with the broad literature on distributive politics, particularly recent findings that programmatic policies, such as conditional cash transfers and agricultural subsidies, generate similar electoral rewards for incumbents as do discretionary or clientelistic spending (De La O 2013; Labonne 2013; Zucco 2013; Dionne and Horowitz 2016). Such policies are programmatic in the sense that they are not subject to direct manipulation by politicians; they target a broad class of citizens rather than identifiable core supporters or potential swing voters. Nevertheless, mounting

evidence suggests that such policies also benefit incumbent governments, either through a retrospective voting process (that is, programs that improve citizens' material well-being yield political rewards) or voting reciprocity (that is, voters select politicians based on past behaviors and outcomes, rather than promises of future policies). This emphasis on programmatic goods is most applicable to the rentier setting. Many of the societal benefits of oil-wealth funds—such as health care, education, or, as this note describes below, subsidized gasoline—take the form of nonexcludable public goods, even if citizens consume them in different quantities. These varied theoretical connections make it even more important to carefully examine evidence for and against this spending mechanism.

The remainder of this note takes up this task. I develop a new measure of one such benefit, namely the size of consumer fuel subsidies in annual dollars per capita, which is available for most countries starting in the year 1990. A variety of regression approaches all demonstrate a consistently negative and significant correlation between fuel subsidies on the likelihood of democratization episodes. More importantly, the impact is large; more spending on fuel subsidies reduces the likelihood of transitions with the same impact as high rates of economic growth. Including this measure also helps account for some of the autocratic effect of oil wealth generally, suggesting that the classic rentier mechanism remains a likely explanation for the political resource curse.

Fuel Subsidies as Rentier Spending: Theory and Measurement

I measure the fiscal resources governments devote to keeping domestic gasoline prices low. Many petrostates—which almost invariably have nationalized oil industries—sell gasoline domestically at rates far below their international comparison. In some instances, they are almost comically low; in 2014, a liter of gasoline in Venezuela cost less than \$0.02, roughly eighty-seven times lower than the world average for the year.² Though an extreme example, oil producers sell gasoline at lower rates than non-oil producers more generally (Cheon, Urpelainen, and Lackner 2013, 387).

In some instances, easy oil extraction explains the low domestic prices, though this decision costs governments billions in forgone revenue. In oil-producing states that lack sufficient refinement capacities, governments also provide suppliers of gasoline with direct payments from central (or in some case, subnational or local) budgets. Iran's National Oil Company receives government compensation to cover the difference between the costs of imported gasoline and the (artificially low) mandated domestic price for consumers (IMF 2008). Central governments also absorb key costs of gasoline production directly, through stabilization funds offsetting price gaps between imported gasoline and the raw material costs, as in Brazil through the 1980s, or currently in Nigeria. Unsurprisingly, these crowd out other spending priorities and can result in crippling deficits. For instance, Yemen spends more subsidizing domestic gasoline consumption (14 percent of gross domestic product in 2008) than on all other infrastructure and social services combined (Clements, Coady, Fabrizio, et al. 2013, 96).

¹Paasha Mahdavi, "No Taxation, No Representation? Oil-to-Cash Transfers and the Dynamics of Government Responsiveness." Unpublished manuscript, available at <http://paashamahdavi.com/Alaska-responsiveness-jul2018.pdf>.

²These figures are reported by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ, or German Corporation for International Cooperation), a development agency that frequently works in cooperation with the German Federal Ministry for Economic Cooperation and Development. This agency serves as the main data source described below.

Why focus on fuel subsidies specifically, as opposed to the various other private and public goods survival-minded leaders might provide? First, as noted above, fuel subsidies are particularly easy to implement in oil-producing nations and therefore represent a useful way to evaluate the underlying theoretical argument that oil and autocracy are linked through a rentier spending mechanism. Second, end-use consumer fuel subsidies are high-profile policies easily attributable to governments, which is necessary if citizens are to reward incumbents with political support through the retrospective or reciprocity mechanisms emphasized above. Indeed, citizens are acutely aware that the size and impact of subsidies and changes to the subsidy regime can be politically costly. Citizens responded to Nigeria's 2012 decision to raise the domestic price of gasoline to a cost-recovery level with widespread social unrest and paralyzing strikes. The government reversed the policy a mere two weeks later. Protests, often violent, have also accompanied recently planned subsidy reforms in at least a dozen other nations, including Sudan, Jordan, Bolivia, and Indonesia (Lockwood 2015, 475–76).³ Even when the response is not violent, reform is always politically controversial, so it is unsurprising that governments seldom fully implement such plans (Sivaram and Harris 2016, 1).

The focus on fuel subsidies also accords with the general logic of the selectorate model. Fuel subsidies are a public good that all citizens can consume, though ample evidence suggests that they are most frequently consumed by segments of the population whose continued loyalty is most critical for regimes seeking to remain in power. Urban, relatively well-off segments of a society are more likely to consume gasoline than are less affluent or rural constituencies (Arze del Granado, Coady, and Gillingham 2012, 2240; Coady, Gillingham, Ossowski, et al. 2010). Energy policy scholars also recognize that these subsidies are common political tools for generating political support, particularly among influential societal groups (Rentschler and Bazilian 2016). Finally, there are clear pragmatic advantages; a measure of fuel subsidies can be constructed without relying on notoriously sparse (and inaccurate) data on government spending, particularly in autocracies.

I follow prior scholarship on energy subsidies to construct this variable. Specifically, I adopt the “price-gap” approach, which compares the domestic price of a good to a benchmark price the good would fetch in a competitive market (Kojima and Koplow 2015, 6). Subsidies exist whenever the benchmark price exceeds the domestic price. Though this approach does not capture all distortionary energy subsidies, such as those that increase revenues retained by resource owners or reduce production costs, it is a useful way to capture subsidies whose main goal is to reduce costs for end-use consumers (Coady et al. 2010, 5).

The specific variable measures governments' total fiscal burden of domestic gasoline subsidies, reported in per-capita US dollar terms (hereafter *fuel subsidies per capita*). I first measure the extent to which a single liter of gasoline is subsidized in a country, multiply this by an estimate of the total liters consumed annually, and finally divide this by population so the variable is reported in per-capita terms.⁴ Starting with the price-gap approach allows me to measure the fiscal burden of these subsidies across a variety of subsidy-delivery methods, including forgone revenue from

price ceilings, transfer payments, or direct-cost absorption by governments.⁵

Constructing the first part of this variable requires measures of domestic gasoline prices and a benchmark price for comparison. Data recently collected by the IMF (Coady et al. 2010), supplemented by additional biennial data from the German Corporation for International Cooperation (Deutsche Gesellschaft für International Zusammenarbeit 2005, 2007, 2009, 2010/2011, 2012/2013, 2014) allows for the construction of panel data reporting annual per-liter costs of gasoline for a large sample of countries from 1990 to 2014. Prices are measured in November of each year and are reported in constant US cents per liter.⁶

I use the price per liter in the United States as the benchmark price. US prices represent a “revenue neutral” international benchmark, meaning that prices cover transportation and distribution costs along with industry margins, though do not include sufficient taxes to offset the environmental or health costs associated with fossil fuel usage (Deutsche Gesellschaft für International Zusammenarbeit 2010, 3). For countries that import oil, I follow the IMF's approach (e.g., Coady et al. 2010, 6) and add twenty cents per liter to the US price to cover additional transportation and distribution costs.⁷ I then subtract the domestic price paid per liter from the US-based benchmark price. Positive values indicate the per-liter subsidy in a given country for a given year. These price gaps are calculated in constant US cents per liter, but I divide by one hundred so that the value is denominated in dollars. Negative values indicate that domestic prices are higher than benchmark prices, which I interpret as the absence of a subsidy. I follow convention and set the per-liter value to 0 in such instances.⁸

Next, I multiply these yearly per-liter subsidy values by a measure of that years' total liters of gasoline consumed, using the United States' Energy Information Administration cross-national time-series data on fuel consumption.⁹ Finally, I divide this total by population so the variable becomes weighted in per-capita terms. The resulting variable, *fuel subsidies per capita*, ranges from \$0 to \$801 (Saudi Arabia in 2012) in the estimation sample. Subsequent empirical analyses employ a log transformation of the measure to address a highly skewed distribution.¹⁰

Of course, artificially low prices for gasoline encourage excessive consumption. Why do I multiply the per-liter subsidy by the total volume of fuel consumption? First, this ensures the variable measures the total value of a subsidy (Kojima and Koplow 2015, 14) and thus government's total fiscal burden. Relatedly, it is fair to assume that regime insiders understand how low prices drive up

⁵ Cheon, Lackner, and Urpelainen (2015) examine the impact of national oil companies on the size of subsidies. However, their measurement of subsidies is simply the observed gasoline price in a country, so they cannot capture the fiscal resources necessary to maintain low prices.

⁶ Like nearly all sources of cross-national time-series data, both sources contains significant missing values. Part B of the supplementary files details how these missing values were replaced with country-specific interpolated values to maximize the coverage of the final variable *fuel subsidies per capita*. This section also demonstrates that the results are robust to using multiple imputation methods as an alternative solution to the missing data issues.

⁷ I use Ross' (2012) data to distinguish oil importer status.

⁸ Even when prices are equal to the world benchmark price, governments are in effect subsidizing gasoline consumption, since the prices are insufficient to cover the (sizable) negative environmental and public health externalities. Exploring why some countries offset the negative externalities of fuel consumption with higher taxes is an important area for future research, but outside the scope here.

⁹ Available from United States Energy Information Administration (2018).

¹⁰ I follow Ross' (2012) and add 1 to the zero values of subsidies before computing the natural log.

³ Herrera (2017, 112–14) documents a similar dynamic in response to increases in the price of water in Mexico.

⁴ Part B of the supplementary files describes the variable construction in detail.

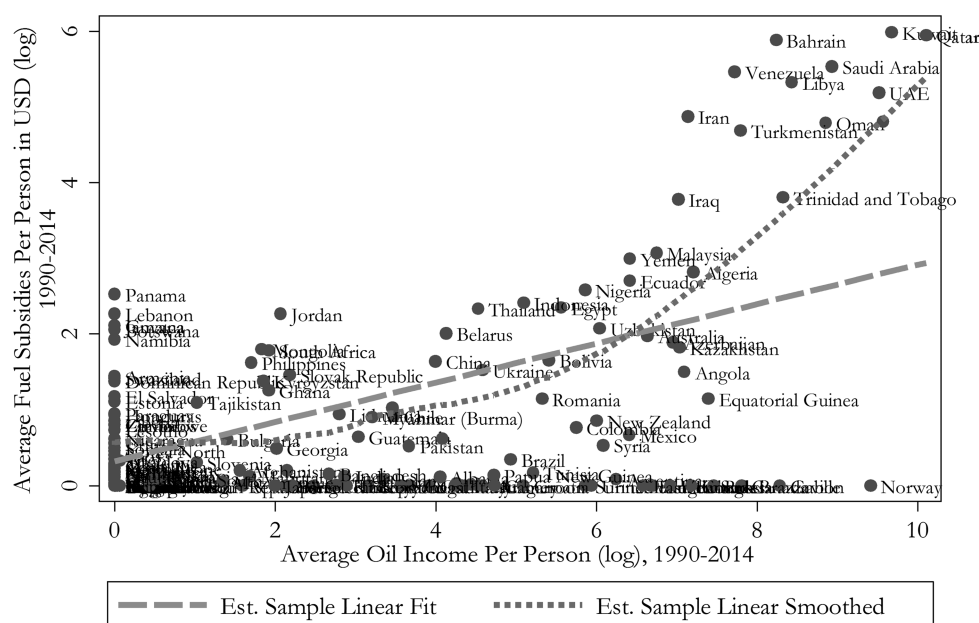


Figure 1. Oil income and fuel subsidies

consumption—indeed, the logic of rentier theory suggests that policy makers fully understand and depend on this consequence. My measure, therefore, best corresponds to the theoretical concept emphasized throughout the rentier literature. Nevertheless, I show in the supplementary files that the main results are robust to using the per-liter price gap as the measure of fuel subsidies.

Figure 1 demonstrates the relationship between my measure of fuel subsidies and a measure of oil wealth. The vertical axis reports *fuel subsidies per capita (log)*, averaged over the years 1990 to 2014, which is the full temporal span for which the variable can be constructed. The horizontal axis reports Ross's (2012) variable *oil income per capita (log)* averaged over these same years.

I include a linear fit regression line and a locally weighted, smoothed line for the estimation sample. Each demonstrates a positive relationship between oil wealth and subsidies. Oil is neither necessary nor sufficient for subsidizing gasoline consumption; Norway is a major oil producer but does not subsidize domestic consumption of gasoline, and a number of non-oil-producing countries devote considerable amounts of revenue to keeping prices low. Nevertheless, oil income and gasoline subsidies are closely linked.

Empirical Approach

I now evaluate whether greater spending on fuel subsidies reduces the likelihood that a country experiences a transition toward a more electorally democratic regime. I use a quantitative model with a global sample of countries from 1990 to 2014. The model specification draws on Bermeo's (2016) recent study, though I utilize the measure of electoral democracy from the Varieties of Democracy project (Teorell, Coppedge, Skaaning, et al. 2016) as the dependent variable instead of polity scores. This measure, referred to as the *polyarchy index*, includes five components: the election of officials, the existence of free and fair elections, freedom of expression, associational autonomy, and inclusive citizenship. The measurement process aggregates these into a single index, ranging from 0.0 to 1.0.

To analyze whether fuel subsidies impact transitions toward electoral democracy, I follow Lindberg's (2015, 10–

11) approach and create a five-part ordinal version of the *polyarchy index*: closed autocracies, autocracies, ambivalent, minimally democratic, and democratic. I then measure the dependent variable as a binary indicator of whether a regime experienced at least a one-step increase in this ordinal variable (i.e., minimally democratic to democratic) in a given year. This coding rule means that the sample excludes country-years coded fully democratic.¹¹ This measure avoids some of the problems that can arise when using a binary measure based on a certain size increase in the *polity2* score, such as uncertainty as to what specific component of a polity score accounted for the change. Nevertheless, the supplementary files demonstrate that the results are robust to measuring transitions with a polity-based variable. To match the timing of this measure, I lag independent variables by one period. I also exclude from the sample any country-years where regimes are not fully autonomous. This prevents foreign-imposed regime changes from counting as democratization episodes.

Control variables include measures of *income per capita (log)* and the rate of *economic growth*. Both of these variables are taken from the World Development Indicators. I also use Ross's aforementioned measure of oil wealth, *oil income per capita (log)*, to account for the conventional findings of the resource curse. The models also include a country's lagged *polyarchy index (ordinal)* score, as higher scores reduce the possibility of further positive change, and a sum of the past transitions toward democracy from 1960 onward. All models include yearly dummy variables to account for common temporal effects including changing oil prices and the international environment more broadly, regional dummy variables, and time polynomials of the years since the last increase in the *polyarchy index (ordinal)* score (*age*, *age*², and *age*³) to account for temporal dependence (Carter and Signorino 2010).

I first estimate the model with a conventional probit regression with standard errors clustered on countries. This method, however, cannot distinguish whether differences in

¹¹ The coding rule also means that country-years where regimes experienced democratic backsliding are not distinguished from those that remained stable. However, Table 7A in the supplementary files demonstrates that the results are robust to excluding these backsliding regimes from the sample.

Table 1. Probit regressions results

	(1) Standard probit	(2) Standard probit	(3) Between-within	(4) Between-within
Oil income per capita (log)	-0.11*** (0.03)	-0.07** (0.03)	-	-
Fuel subsidies per capita (log)	-	-0.09* (0.05)	-	-
Oil income per capita - cm	-	-	-0.10*** (0.03)	-0.06** (0.03)
Oil income per capita - deviation from cm	-	-	-0.08 (0.07)	-0.05 (0.06)
Fuel subsidies per capita (log) - cm	-	-	-	-0.13* (0.07)
Fuel subsidies per capita (log) - deviation from cm	-	-	-	0.00 (0.06)
Mean of dependent variable (DV)	-	-	5.28* (2.74)	4.68* (2.77)
Income per capita (log)	0.13 (0.09)	0.10 (0.10)	0.15* (0.09)	0.13 (0.09)
Economic growth	-0.01* (0.01)	-0.02*** (0.01)	-0.01 (0.01)	-0.02** (0.01)
Polyarchy Index	-1.92*** (0.35)	-1.79*** (0.37)	-1.85*** (0.34)	-1.78*** (0.39)
Sum of past transitions	0.39*** (0.05)	0.38*** (0.06)	0.27*** (0.07)	0.28*** (0.07)
Observations (clusters)	2387 (122)	2214 (120)	2497 (123)	2333 (121)

Notes: (1) Probit regression coefficients with standard errors clustered on countries in parentheses. (2) Dependent variable equals 1 if the *polyarchy index* (ordinal) score increased by at least one step (0.25) from the prior year. (3) Each model also includes year fixed effects, regional dummy variables, time polynomials measuring years since last DV change (age, age², and age³), and a constant, but these are not reported to save space. (4) cm = country mean. (4) Statistical significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

the level of subsidies between countries, or changes within countries over time, explain their varying propensities to experience transitions. Moreover, this approach may not sufficiently account for unit effects. Fixed effects, which model unit heterogeneity directly and isolate the within-country variation, would solve these issues at the cost of dropping all observations that did not experience a measured regime change, effectively biasing downward the estimates (Wright et al. 2015). This is particularly problematic if those stable political systems dropped from the analysis happen to have high oil wealth or generous fuel subsidies, as the theory above anticipates.

My approach models the between-country and within-country effects concurrently by conditioning the marginal effects of the independent variables on country-specific mean values of these covariates. This approach—described as the “between-within” model—is recommended by Bell and Jones (2015) and, specific to the resource curse literature, employed in recent studies by Wright et al. (2015) and Smith (2017). Functionally, this approach replaces the single variable *fuel subsidies per capita* with country-specific measures of the mean of this variable (designated as *fuel subsidies per capita—country means*) to capture the between-country effect and a country-year specific measure of the deviation from the country mean (designated as *fuel subsidies per capita—deviation from country mean*) to capture the within-country effect.¹² I include the country mean of the dependent variable to further account for unit heterogeneity.

Results

Table 1 reports the results of the standard probit approach (Models 1 and 2) and the between-within approach (Models 3 and 4) described above. As my argument claims that spending on fuel subsidies helps account for the political resource curse, the first model in each set (Models 1 and 3) excludes the measure of fuel subsidies. Including the measures of fuel subsidies in Models 2 and 4 should reduce the impact of the oil-income variable.

The results of both regression approaches strongly support these expectations. In Model 1, greater levels of oil income per capita demonstrate the expected negative impact on the likelihood of a democratization episode. However, including the fuel subsidy measure in Model 2 considerably reduces the magnitude of this impact. Importantly, the measure of fuel subsidies itself has a negative and statistically significant impact on the probability of a transition.

Models 3 and 4 follow this same logic while employing the between-within approach. Though a relatively simple test, the results are stark: higher levels of fuel subsidies are associated with significantly lower prospects of transitions toward democracy, and this negative effect operates through the large differences in fuel subsidies between countries as represented by the country-mean measures. Moreover, these effects hold even when controlling for factors that may be associated with the level of fuel subsidies or the otherwise unobserved tendency of countries to experience transitions toward more electorally democratic regimes. Importantly, including the fuel subsidy

¹² The results are identical when replacing all time-variant variables with these decomposed versions. I retain the decomposed oil-income variables given their centrality in the literature.

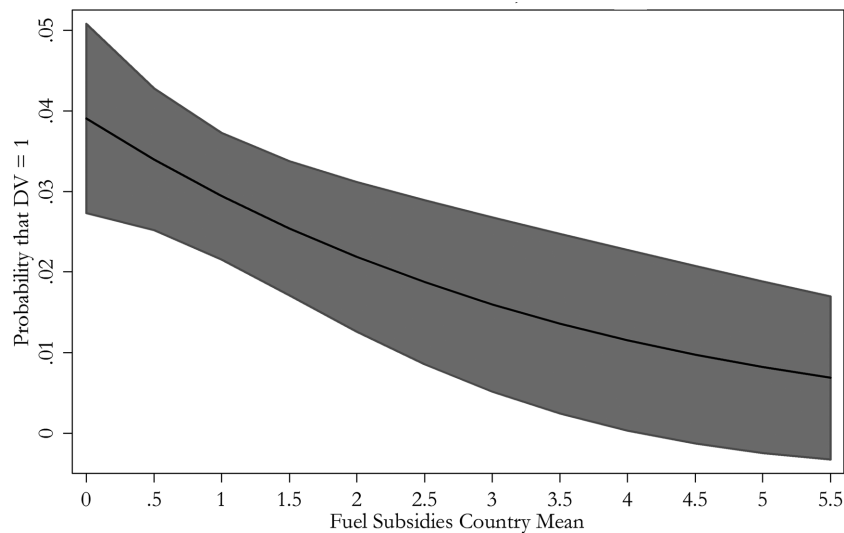


Figure 2. Substantive effect of fuel subsidies (country means), full range
Note: All other variables held at mean; 90 percent confidence intervals reported.

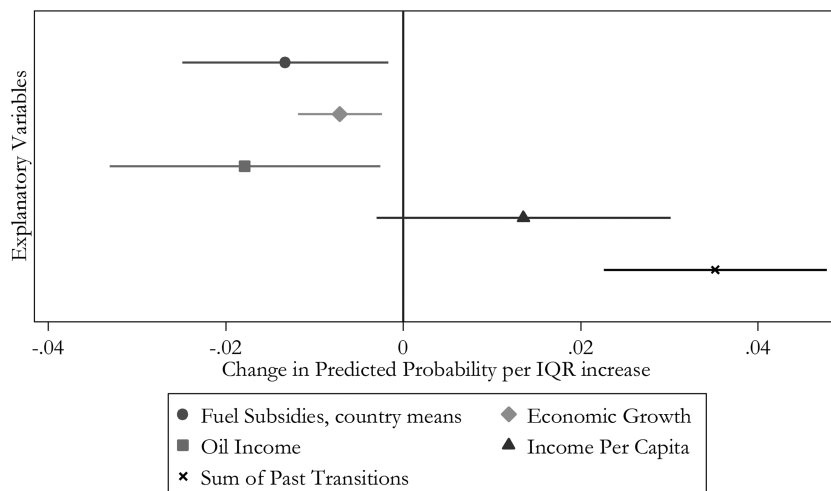


Figure 3. Estimates of parameters of interest from Model 4

Note: Estimates are expressed as 90 percent confidence intervals of the change in the predicted probability of a democratic transition per interquartile range increase in each explanatory variable. Predicted probabilities calculated while holding all other explanatory variables at mean values.

measures continues to reduce the impact of oil income on democratization.¹³

Figures 2 and 3 address the practical impact of these findings in graphical form. Figure 2 plots the changes in the predicted probability of a transition, along with 90 percent confidence intervals, as a function of the variable *fuel subsidies per capita—country means*, that is, as a function of the variable capturing the between effect of the key independent variable. These results are based on Model 4, with all other variables held to their mean values. The figure shows a steep decline in the predicted probability, and these changes are statistically significant. For instance, a country that does not subsidize domestic gasoline consumption has a roughly 4 percent probability of an increase in electoral democracy in

a given year, all else equal. If the level of fuel subsidies increased to 90 percent of the variables' distribution (a value of 2.5 on the X axis), the predicted probability is halved. Though modest in absolute terms, this represents a substantial impact. The baseline probability of democratization in the sample is only 3 percent. Moreover, the substantive impact of fuel subsidies compares favorably to other variables in the model. For instance, a shift in the annual rate of economic growth from the tenth percentile of the distribution (a rate of -2.7 percent) to the ninetieth percentile (a rate of 7.6 percent) would result in almost the exact same reduction in the probability of democratization: from roughly 4 percent to 2 percent.

Figure 3 provides a more general view. This figure draws on Gross's (2015) recommendations and compares five parameters of interest. Specifically, the figure displays the change in the predicted probability of a transition toward

¹³Table 1A in the supplementary materials demonstrates that this main result is robust to matching sample sizes across Models 1 and 2 and to excluding the measure(s) of oil income from the models.

democracy resulting from an interquartile range (IQR) increase in the measures of *fuel subsidies*, *oil income*, *economic growth*, *income per capita*, and *past transitions*. As these are estimates of the change in predicted probability, the figure also includes confidence intervals. The figure demonstrates that an IQR increase in *fuel subsidies* has a larger negative impact than a similar change in the rate of *economic growth* and almost as large an impact as the level of oil income in a country. Figure 3 demonstrates that a history of past transitions toward democracy is an important predictor of future transitions—the estimated change in predicted probability per IQR increase is about 3.5 percent—though this is less than two times the size of *fuel subsidies*' negative impact. Put differently, a relatively small increase in the size of *fuel subsidies* (from the twenty-fifth percentile to the seventy-fifth percentile) would effectively offset the positive impact of a past transition.

Of course, government spending on fuel subsidies may be endogenous to regime dynamics. The fact that the results so far emphasize the country-means of the subsidy variable, calculated over many years, minimizes the clearest example of endogeneity, namely an autocratic regime on the verge of a transition to democracy suddenly reducing domestic fuel prices in an attempt to thwart regime change. Nevertheless, the findings above warrant a more careful approach to identification.

Several prior studies rely on instrumental variables (IV) to deal with related concerns (for instance, Ramsay 2011, 514–15), and there are many factors that both explain why governments want to keep prices low and account empirically for some of the variation in fuel subsidies globally. For example, subsidies are positively correlated with the price of oil; governments of resource-wealthy states ratchet up subsidies to prevent passing along the full costs of rising oil prices to their domestic consumers (Victor 2009).¹⁴ Subsidies also compensate for episodes of high inflation or periods of low economic growth, offset the need for broader infrastructure projects in urban environments, or even emerge as a response to low state capacity (e.g., Arze del Granado et al. 2012; Kim and Urpelainen 2015; Cheon et al. 2013). Each of these factors, however, are linked to political regimes so would violate the exclusion restriction of traditional IV methods. Going further afield theoretically may eventually identify an instrument that does not violate the exclusion restriction, but if it comes at the expense of a weaker instrument, then the cure may be worse than the disease, as Young (2017) has recently demonstrated.

As an alternative, I follow Lewbel (2012) and identify two-equation systems by constructing “instruments” as a simple function of the model's data. This approach, which requires only that errors in a linear projection of the endogenous regressor on the other regressors in the main equation be heteroskedastic, can serve as a source of identification when instruments meeting the standard exclusion restriction are unavailable. For instance, consider the stylized version of the two-equation model considered here, where fuel subsidies is an endogenous (or mismeasured) predictor of democratic transitions. In the standard IV approach, Z is an instrument for fuel subsidies but unrelated to the outcome in

equation (1), democratic transitions.

$$\text{Democratic transition} = \beta_1 X + \gamma_1 \text{Fuel subsidies} + \varepsilon_1 \quad (1)$$

$$\text{Fuel subsidies} = \beta_2 X + \gamma_2 Z + \varepsilon_2 \quad (2)$$

Lewbel (2012) demonstrates that the residuals from this first-stage regression (equation 2) can be used to construct instruments that are orthogonal to the equation (1) error process, so long as the errors in equation (2) are heteroskedastic. These instruments are described as “internal,” given that they are constructed from the data used to estimate the model as opposed to some external design feature or theory. Lewbel shows that this approach increases the efficiency of traditional IV estimation and, critically, provides a source of identification in the absence of a satisfactory instrument, that is, when no Z is available as a plausibly exogenous instrument for *fuel subsidies*. Since these internal instruments are constructed using heteroskedasticity in the first-stage regression, the main equation can be identified without threats to inference.

In practical terms, these internal instruments are constructed by calculating the residuals from a first-stage regression of the endogenous regressor on all other regressors in the main model, then multiplying these residuals by each exogenous variable in the model in a demeaned version (i.e., $X_{it} - \bar{X}$). This creates a set of internal instruments (one for each exogenous variable in the model) constructed from information in the first stage and thus capable of identifying the main outcome equation. The greater the degree of heteroscedasticity, the stronger the correlations between these generated instruments and the endogenous regressor. Importantly, conventional diagnostics on the strength of these constructed instruments (F statistics) and whether they are independent of the errors in the outcome model (J statistics) still apply. Though relatively new, this method has been recently employed in the political science literature by Dietrich and Wright (2015, 223) and Wilson and Wright (2017), who use the approach to assist in identification for their respective studies on foreign aid allocation and democratic change in Africa and autocratic legislatures and expropriation risk.

Table 2 uses these internal instruments to reanalyze two of the models discussed above. I follow the specifications in Models 2 and 4. As these are two-stage regression models, each column reports a number of diagnostic test statistics, including measures of the first-stage correlation (the F statistic) and the J statistic confirming that the instruments generated through Lewbel's (2012) process are independent of the errors in the outcome model and sufficiently correlated with the endogenous measure of fuel subsidies.¹⁵

Table 2 estimates these regressions via linear probability models. Current implementation of Lewbel's (2012) procedure is limited to this approach (Baum and Schaffer 2012), as opposed to the probit models presented in Table 1. Consequently, the estimated regression coefficients differ from those in the probit model, thought note that Table 1A in the supplementary files provides a source of comparison by reestimating the regressions in Table 1 via linear probability models.

¹⁴ More generally, Smith (2017, 601) argues that any measure of oil production is endogenous to political regimes, as oil companies, and particularly the multinationals responsible for production globally, must have longtime horizons in order to justify the huge sunk costs involved in oil exploration and production, time horizons which are likely impacted by the perceptions of the regime in place.

¹⁵ Table 5A in the supplementary files reports the results of Pagan-Hall tests of heteroscedasticity in the models—a necessary component for the Lewbel (2012) approach. Each model generates a test statistic far larger than necessary to reject the null hypothesis of homoscedastic errors.

Table 2. IV estimates using Lewbel (2012) instruments

	(5) Standard	(6) Between-within
Oil income per capita (log)	-0.005* (0.003)	-
Fuel subsidies per capita (log)	-0.013* (0.007)	-
Oil income per capita (log) - cm	-	-0.005* (0.003)
Oil income per capita (log) - deviation from cm	-	-0.001 (0.005)
Fuel subsidies per capita (log) - cm	-	-0.015** (0.007)
Fuel subsidies per capita (log) - deviation from cm	-	0.001 (0.005)
Mean of dependent variable (DV)	-	0.619* (0.350)
Income per capita (log)	0.012 (0.010)	0.016 (0.010)
Economic growth	-0.003** (0.001)	-0.003** (0.001)
Polyarchy Index	-0.199*** (0.034)	-0.196*** (0.032)
Sum of past transitions	0.048*** (0.006)	0.034*** (0.008)
Kleibergen-Paap rk Wald F statistic	16.97	30.68
10 percent max relative bias	11.32	11.27
J statistic (<i>p</i> value)	25.6 (0.65)	33.2 (0.45)
Observations (clusters)	2214 (120)	2333 (122)

Notes: (1) Linear probability model regression coefficients with standard errors clustered on countries in parentheses. (2) Dependent variable equals 1 if the *polyarchy index* (ordinal) score increased by at least one step (0.25) from the prior year. (3) *Fuel subsidies per capita (log)* and *fuel subsidies per capita (log) - country means* are instrumented using Lewbel internal instruments. (4) Each model also includes year fixed effects, regional dummy variables, time polynomials measuring years since last DV change (age, age², and age³), and a constant, but these are not reported to save space. (5) cm = country mean. (6) Statistical significance: ****p* < 0.01, ***p* < 0.05, **p* < 0.10.

However, the main findings are substantively identical to those in Table 1. In Model 5, increasing fuel subsidies has a statistically significant negative impact on the likelihood of a regime transition in the following year, while Model 6 demonstrates that the between-country differences drive this effect, which persists even when the model accounts for unit heterogeneity. The coefficients of interest are roughly the same size as those reported in the naïve linear probability models reported in Table 2A in the supplementary files, as are the marginal effects.

Finally, note that these results are robust to a number of measurement and model specification changes as reported in the supplemental files, part A. Table 3A replicates the core findings using changes in a country's *polity2* score as the measure of regime transition. Table 4A demonstrates that these results are robust to replacing the measure of *fuel subsidies per capita* with a simple measure of per-liter price gaps. Table 6A reestimates the main while including a measure of total social expenditures, using data described in Lucas and Richter (2016), in order to probe the specific consequences of fuel subsidy spending versus more general levels of expenditures. Data limitations restrict the sample considerably, but the negative effects of fuel subsidies persist. Finally, section 3 (part B) of the supplementary files demonstrates that the results are consistent even when using multiple imputation to deal with a variety of missing data issues that are common in this type of analysis generally and that Lall (2017) shows are particularly important in this literature.

Conclusions

Further maturation of the resource curse literature requires matching the theoretical sophistication of the field with careful analysis that can evaluate and compare the effects of various mechanisms. This note approaches this challenge by measuring the fiscal resources regimes devote to keeping gasoline prices low. Using the measure in a quantitative analysis of transitions toward more electorally democratic regimes confirmed a core insight of rentier theory, namely that, as these benefits increase, the likelihood of a change toward a more democratic government decreases. Though the continued significance of oil income in the regression models validates Herb's (2017) argument about causal complexity in the resource curse, it does appear that citizens in nondemocracies pay a high political price for their cheap gasoline.

Nevertheless, scholars should continue chasing this mechanism further back. For instance, what kinds of political behaviors do these sorts of benefits discourage? Do citizens benefiting from these low prices demand less accountability (a hypothesis that could be evaluated with cross-national survey data)? The results should also encourage further exploration of subsidies as a programmatic distributive policy. Do greater subsidies generate specific electoral benefits for incumbents, such as increased turnout or vote share? Such effects may prove particularly important in understanding the dynamics of hybrid or competitive authoritarian regimes, where regimes

do not completely eliminate the domestic opposition but maintain power by tilting the electoral playing field to their own advantage. What other sorts of spending programs correlate with generous fuel subsidies? Regimes that subsidize fuel are also likely to spend more on other benefits. A better accounting of these processes will shed further light on the role of rentierism in understanding regime dynamics.

The new measure of fuel subsidies also opens up a number of additional avenues of inquiry. For instance, the cost and inefficiencies of fuel subsidies make them common targets for elimination under IMF lending programs. Do borrowing nations actually reduce or eliminate these subsidies? Alternatively, are fuel subsidies modified when the price of oil—and therefore the revenues petrostates receive and the underlying need to subsidize domestic consumption—declines? Existing work suggests that reform efforts, even in light of diminished oil revenues, are rarely implemented (Lockwood 2015), though this may be changing as the oil-producing world enters a more sustained period of low prices. Recent announcements in countries as diverse as Saudi Arabia and Nigeria suggest that current leadership intends to reduce fuel subsidies. The risk of incomplete implementation or rollback remains high, however, in part because of public outcry over increased prices (Sivaram and Harris 2016). Recent work by Kyle (2018, 7) identifies an important political barrier to reform, namely that citizens may not trust the government to offset the pain of subsidy cutbacks with other welfare-enhancing policies. More generally, fuel subsidies sit squarely at the intersection of political, economic, and environmental consequences. This gives the topic a unique combination of scholarly and policy relevance. For these reasons alone, future work should take up the challenge to understand both the causes and consequences of these costly subsidies.

Supplementary Information

Supplementary information is available at <https://sites.google.com/oakland.edu/mfairs/research> and at the *International Studies Quarterly* data archive.

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