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Energy Subsidies and Public Social Spending: Theory and Evidence

by Christian Ebeke and Constant Lonkeng Ngouana

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Energy Subsidies and Public Social Spending: Theory and Evidence[1]

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Abstract

This paper shows that high energy subsidies and low public social spending can emerge as an equilibrium outcome of a political game between the elite and the middle-class when the provision of public goods is subject to bottlenecks, reflecting weak domestic institutions. We test this and other predictions of our model using a large cross-section of emerging markets and low-income countries. The main empirical challenge is that subsidies and social spending could be jointly determined (e.g., at the time of the budget), leading to a simultaneity bias in OLS estimates. To address this concern, we adopt an identification strategy whereby subsidies in a given country are instrumented by the level of subsidies in neighboring countries. Our Instrumental Variable (IV) estimations suggest that public expenditures in education and health were on average lower by 0.6 percentage point of GDP in countries where energy subsidies were 1 percentage point of GDP higher. Moreover, we find that the crowding-out was stronger in the presence of weak domestic institutions, narrow fiscal space, and among the net oil importers.

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I. INTRODUCTION

Many studies have stressed the fiscal cost and environmental impact of energy subsidies (see, e.g., IEA (2011); IMF (2013a); Parry and others (2014); World Bank (2010), among others).[1] A comprehensive assessment by Clements and others (2013) suggests that pre-tax energy subsidies amounted to 0.7 percent of global GDP in 2011.[2] The figures are even more striking when the negative externalities from energy consumption are factored-in (post-tax energy subsidies were evaluated to about 2.9 percent of global GDP in 2011, equivalent to 8.5 percent of total government revenues (see Clements and others (2013)). In addition, generalized energy subsidies have important distributional effects—there is wide micro-based evidence that they benefit mostly the wealthy, given their higher energy consumption.[3] High energy subsidies, at least until the recent past, have been a major policy challenge, especially when energy prices were high and on the rise. Although the "symptoms of the disease" have faded somewhat with the recent sharp drop in international oil prices (see Coady and Shang (2015)), a price reversal cannot be ruled out, given the large uncertainty that has historically surrounded the outlook for commodity prices.[4]

From a political economy standpoint, many governments have often argued that energy subsidies help shelter the purchasing power of the poor. At the same time, under limited budgetary resources, energy subsidies may come at the cost of lower spending elsewhere in the budget, including priority social expenditures. A natural question is therefore why the poor would support energy subsidies, a form of redistribution that disproportionately benefits upper-income groups. Or put differently, under which conditions could high energy subsidies and low public social spending occur as equilibrium outcome of a political game determining the composition of public spending?[5] One may argue that the elite exploit imperfect information

[1] See also IEA and others (2010), a joint report on the scope of energy subsidies (with suggestions to phasing them out) for the 2010 G-20 Summit Meeting in Toronto.

[2] Pre-tax energy subsidies are generally higher among net oil exporters. They absorbed around 22 percent of government revenues in the MENA region in 2011 (see Regional Economic Outlook, Middle-East and Central Asia, IMF (2013b)).

[3] In a review of the evidence on the welfare impact of energy subsidy reform across twenty countries from Africa, Asia, the Middle East, and Latin America, Arze del Granado, Coady, and Gillingham (2012) finds that the top income quintile captures six times more in subsidies than the bottom, in absolute terms. These distributional effects vary substantially across products with the subsidies on gasoline being the most regressive. Also, a study by the International Energy Agency (see IEA (2011)) finds that the poorest 20 percent of households receive only about one-tenth of natural gas and electricity subsidies.

[4] Notwithstanding the recent sharp drop in international oil prices, they are still at about their pre-crisis level (see appendix, Figure 3), and crude oil futures show some signs of pick-up in the near term.

[5] IMF (2014) provides empirical evidence that public support for redistributive policies has grown in recent decades, partly due to rising inequality. Energy subsidies, however, disproportionately benefit upper-income groups and would not reduce inequality, which adds to the puzzle.

to make "sneaky" transfers to their constituency (see Coate and Morris (1995)). This explanation, however, seems hard to reconcile with long-lived energy subsidies, especially if they indeed crowd-out categories of public spending that are relevant to the poor.

Against this backdrop, we develop a simple political game between the elite and the middle-class to examine the (conflicting) allocation of public resources between energy subsidies and public social spending. We show that high energy subsidies and low social spending may indeed emerge in equilibrium when the delivery of the public good is subject to important bottlenecks, reflecting weak domestic institutions. Intuitively, the poor support that equilibrium because energy subsidies provide a small but certain benefit to consumption, whereas the delivery of the public good is subject to important leakages (e.g., through corruption).[6] The elite, internalizing this, sets a subsidy rate that is sub-optimally high, crowding-out public social spending, especially when fiscal space is narrow.[7] Another implication of the model is that resource wealth limits the severity of this "crowding-out" of public social spending, as the size of the pie is bigger.

We test the above predictions of our conceptual framework empirically, using a large cross-section of low and middle income countries. A key empirical challenge to identifying the crowding-out effect of energy subsidies on public social spending is that both aggregates may be jointly determined in the budget process. A simple OLS estimation would therefore deliver biased estimates. To address this simultaneity bias and other potential sources of endogeneity, we instrument subsidies in a given country by the level of subsidies in neighboring countries. In addition, we take into account political constraints on the executive, to capture how easily politicians can implement subsidy policies.

Our instrumental variable estimation results suggest that energy subsidies indeed crowd out public social spending. More specifically, we find that a 1 percentage point increase in energy subsidies to GDP leads, on average, to a reduction of public spending in education and health by 0.6 percentage point of GDP. Our estimations also point to important non-linearities: the crowing out is stronger in the presence of weak domestic institutions and narrow fiscal space. Moreover, the trade-off between energy subsidies and public social spending is stronger among the net oil importers.

[6] Economic agents may also favor energy subsidies over public social spending that potentially guarantee higher future earnings to their children if their degree of altruism or their discount factor are low enough, or if the perceived return to education/health is highly uncertain. This is more likely to be the case among lower-income groups, generally credit-constrained.

[7] The rich favor the high energy subsidies equilibrium because it implies large private savings on their energy bill (using public resources) and therefore more (private) resources left for non-energy consumption.

Our analysis is related to the existing literature along three important dimensions. On the theoretical front, very few papers have modeled the impact of energy subsidies on the economy. Acemoglu (2014, Chap. 13) surveys a number of (general) theories as to why inefficient forms of redistribution may occur in a political equilibrium. Energy subsidies, however, warrant a separate treatment, given their peculiar features—they are "generalized," highly regressive, and have become widespread over the recent past (see appendix, Figure 4). We model energy subsidies explicitly and examine how they conflict with the provision of public social services in an economy, contingent on the quality of its institutions. Plante (2014) uses an open economy dynamic general equilibrium model in which oil is used as an input into the production function of firms, and finds that fuel subsidies reduce aggregate welfare, mainly by distorting the relative price of non-tradable to tradable goods. Also, Strand (2013) develops a political economy model in which two interest groups value two different types of fuel (gasoline vs. kerosene). He then characterizes the conditions under which positive subsidies emerge in equilibrium for each type of fuel, in autocracies and young democracies.[8] But our paper is, to the best of our knowledge, the first one to model the tradeoff between energy subsidies and public social spending; moreover, with a link to domestic institutions.

On the role of domestic institutions in public finances, Abed and Gupta (2002) present a number of analyses on the role of governance and corruption on the composition of government expenditures (and on economic performance). Mauro (1998) finds, in a cross-section of countries, that corruption reduces government spending on education. Our conceptual framework complements those results, by providing a channel through which weak domestic institutions affect public social spending.[9]

Regarding our empirical strategy, the use of subsidies in neighbor countries in identifying the causal relationship between energy subsidies and social spending (both policy choices) builds on the literature on spatial spillovers in fiscal choices. For example, Keen and Lockwood (2010) find that the adoption of the Value Added Tax (VAT) in a given country depends on the share of neighbor countries that have already adopted it. Fatás and Mihov (2013) examines how domestic institutions (the constraints on the executive in particular) affect policy volatility and hence economic growth. But we are aware of no other study that applies the above empirical strategies to the cross-section variation in subsidies.[10]

[8] Pani and Perroni (2014) propose a political economy model whereby energy subsidy reform is hard to achieve because of a commitment problem: the adoption of energy-saving techniques weakened the motives to reduce energy subsidies as initially announced.

[9] Baqir (2002) also finds that democratization is a significant predictor of government spending on education and health in a large panel of countries.

[10] Ellis (2010) offers a review of models and empirical studies on the effects of fossil-fuel subsidy reform.

The remainder of the paper is organized as follows. Section II presents the political game and its main implications. Section III tests the predictions of the model, with emphasis on our identification strategy. Section IV concludes and draws policy implications, with reference to recent developments in international oil prices.

II. The Political Game

A. Economic Environment

We consider an economy populated by two types of agents: the rich with income y_r, and the poor with income y_p; $y_p < y_r$. One can think of the rich as representing the elite and the poor as representing the middle-class.[11] Each agent derives utility from a private good, c (aggregate of energy consumption, c_e, and non-energy consumption, c_n) and from a public good, k. The economy is endowed with a resource rent, z, and income is subject to proportional taxation at a fixed rate, $\bar{\tau}$. The common pool of resources is used to subsidize energy and undertake social spending. A peculiar feature of social expenditures—potentially valued differently by the rich and the poor—is that their delivery is subject to bottlenecks (the economy incurred a deadweight loss, ζ, for each dollar of public social spending), reflecting weak domestic institutions.

B. The Game and its Equilibrium

1. Set-up and Timing of Events

The model developed here is relatively simple, but provides a convenient way to examine the interplay between energy subsidies and public social spending. The utility function of agent i is given by:[12]

$$u_i(c_i,k) = ln(c_i) + v_i(k), \quad v_i' > 0, \quad v_i'' < 0, \tag{1}$$

[11]Throughout the paper, the subscript r denotes rich agents (or members of the elite) and p denotes poor agents (part of the middle-class).

[12]It is important to stress that our results do not depend heavily on the specification of the utility function—the adopted functional forms aim at developing the main intuitions of the model, through the lense of close-form solutions. For instance, we briefly discuss below the implications of adopting a functional form that is non-separable in c and k.

where the private good c is a Cobb-Douglas aggregate of the energy and non-energy goods:[13]

$$c_i = c_{i,e}^{\theta} c_{i,n}^{1-\theta}, \qquad 0 < \theta < 1 \tag{2}$$

Consider the following timing of events. At the beginning of the game, nature chooses the level of bottlenecks, ζ, in the economy.[14] This choice is observed by both the rich and the poor. The game then proceeds as follow: (i) the rich decide on the subsidy rate, δ; (ii) the poor choose how much to spend on the public good, k (public social spending); and (iii) the rich and the poor each decides how much of the subsidized private good (energy, c_e) and of the non-subsidized private good (non-energy, c_n) to consume. This structure of the game reflects the fact that the rich benefit the most from energy subsidies (as shown below and consistent with empirical evidence) and would therefore push for them, whereas the poor are *ex-ante* likely to favor social expenditures, given the high cost of market-provided services.[15]

2. Solving the Game (Backward Induction)

The political game can be solved backwards as follows.

Third stage of the game: each agent decides on the consumption of private goods

For a given subsidy rate δ, and a given provision of the public good k, each agent decides the amount of the private good he consumes. It is straightforward to show that the Cobb-Douglas specification, combined with the log utility on the aggregate private good induces each agent to devote a constant share of his disposable income to energy and non-energy consumption. The corresponding shares are θ for energy and $1-\theta$ for non-energy consumption. One has:

$$(1-\delta)p_w c_{i,e} = \theta y_i (1-\bar{\tau}) \tag{3)a}$$

$$c_{i,n} = (1-\theta) y_i (1-\bar{\tau}) \tag{3)b}$$

where δ is the subsidy rate—the agent only pays a fraction $1-\delta$ of the international energy price, p_w, normalized so that the price of the non-energy good equals unity.[16] Equation (3)

[13]The model assumes that the share of the energy good (and of the non-energy good) is the same in the consumption basket of the rich and the poor. It is straightforward to solve the model with different consumption shares across the two groups of agents.

[14]This is equivalent to assuming that the quality of domestic institutions is exogenous. In reality, however, public social spending would improve the human capital of the poor and perhaps their participation to the electoral process in a democracy. Our model is quasi-static in that sense.

[15]The timing of the game may be thought of as reflecting the fact that the middle-class forms the majority of the population, prompting the elite to internalize their "move" (see backward induction below). This timing is common in the political economy literature (see, e.g., the seminal paper by Acemoglu and Robinson (2001), and Acemoglu (2014, Chap. 13)).

[16]The amount of energy subsidy is a combination of the subsidy rate and the amount of energy that agents consume in equilibrium.

sheds some light on two interestingly features of our model specification. First, the constant consumption shares implies that energy consumption increases with the subsidy rate, for given disposable income and international energy price;[17] (ii) Second, the rich benefits the most from energy subsidies (to an extent that increases with its relative income y_r/y_p), consistent with micro evidence.[18]

Second-stage of the game: the poor chooses the amount of social spending

Taking the subsidy rate δ as given, the poor chooses the amount of public social spending. It is assumed that only a fraction $1-\zeta$ of social expenditures actually contributes to social infrastructure, due to bottlenecks of various nature, reflecting weak domestic institutions. Relatively bad institutions would translate into a high value of ζ. There are several practical interpretations of ζ. It can be viewed as the share of budgeted social expenditures that are diverted away from their intended purpose (e.g., through corruption). ζ may also reflect efficiency losses in the delivery of social spending. $1-\zeta$ could also be thought of as the perceived return to social infrastructure such as education.[19]

The amount of subsidies and public social spending (the latter adjusted for the deadweight loss incurred in the delivery of the public good) is naturally constrained by the available resources:[20]

$$\delta p_w\left(\lambda c_{p,e}+(1-\lambda)c_{r,e}\right)+\frac{k}{1-\zeta}\leq z+\bar{\tau}y, \tag{4}$$

where λ is the fraction of rich people in the population and $y=\lambda y_r+(1-\lambda)y_p$ is the aggregate income. Given Equation (3), the above equation boils down to:

$$\frac{\delta\theta}{1-\delta}(1-\bar{\tau})y+\frac{k}{1-\zeta}\leq z+\bar{\tau}y \tag{5}$$

The poor maximizes $u_p(c_p,k)=ln(c_p)+v_p(k)$, subject to (5), the economy's budget constraint. After some simple algebraic manipulations, and taking into account the results from

[17]International agencies such as the IEA, the IMF, and the World Bank have raised this concern over energy subsidies—not sending the right price signal to consumers may lead to an inefficiently high level of energy consumption and hence higher CO_2 emission.

[18]This holds partly because the demand for energy of the rich is more elastic to the price of energy (and therefore to the subsidy) than that of the poor. In fact, the demand for the energy good, e, by agent i writes:

$$c_{i,e}=\frac{\theta(1-\bar{\tau})y_i}{(1-\delta)p_w}\Rightarrow\frac{\partial c_{r,e}/\partial\delta}{\partial c_{p,e}/\partial\delta}=y_r/y_p$$

[19]The model may also be set-up in a way that ζ captures the probability that the politician will actually deliver on the public good's promise.

[20]Note that the non-energy good, n, does not enter the common pool budget constraint, given that it is entirely paid for by agents privately.

the third-stage of the game, one gets:

$$ln(c_p) = \alpha_p - \theta ln(1-\delta), \tag{6}$$

where the constant α_p is a non-linear combination of parameters, including the consumption share of energy, the disposable income, and the exogenous price of energy.[21] Interestingly the utility of the poor increases with the subsidy rate δ, a condition that we do not impose ex-ante. An expression similar to (6) holds for the rich. We can already anticipate that the optimal choice of the public good by the poor will reflect the interplay between the utility derives from energy subsidies and that provided by the public good.

The Lagrangian of a poor agent's maximization problem writes:

$$\mathscr{L}(k,\mu_p) = \left[\alpha_p - \theta ln(1-\delta) + v_p(k) + \mu_p\left(z + \bar{\tau}y - \frac{\delta\theta}{1-\delta}(1-\bar{\tau})y + \frac{k}{1-\zeta}\right)\right]$$

The optimal choice of k is dictated by the two following conditions, in addition to the non-negativity constraint on μ_p and the budget constraint:
(i): $v_p'(k) = \frac{\mu_p}{1-\zeta} \Rightarrow \mu_p = (1-\zeta)v_p'$
(ii): $\mu_p\left(z + \bar{\tau}y - \frac{\delta\theta}{1-\delta}(1-\bar{\tau})y + \frac{k}{1-\zeta}\right) = 0$
The first condition implies that $\mu_p > 0$, given that $v_p' > 0$ and $\zeta < 1$. Condition (ii) therefore yields the following optimal choice for k, denoted $k^\star$:

$$k^\star = (1-\zeta)\left(z + \bar{\tau}y - \frac{\delta}{1-\delta}\theta(1-\bar{\tau})y\right) \tag{7}$$

The optimal choice of social spending has some interesting features. The first term in the second brackets represents the common pool of resources in the economy and could be thought of as mirroring the available fiscal space. The second term captures the cost of energy subsidies.

Given that $\zeta, \bar{\tau}, \delta < 1$, one has:

$$\frac{\partial k^\star}{\partial \delta} = -\frac{(1-\zeta)}{(1-\delta)^2}\theta(1-\bar{\tau})y < 0 \tag{8}$$

A higher subsidy rate lowers the amount of resources available for public social spending. This was expected given that the total amount of subsidies increases with the subsidy rate and subsidies and social spending are the only uses of the common pool of resources in the model. Notwithstanding this negative marginal effect of subsidies on social expenditures,

[21] $\alpha_p = ln((1-\bar{\tau})y_p p_w) + \theta ln(\theta) + (1-\theta)ln(1-\theta)$

Equation (7) suggests that a sizeable resource endowment, or more generally, a large fiscal space would limit the impact of energy subsidies on public social spending. We test this implication of the model in the empirical section of the paper.

Interestingly, Equation (7) implies that the amount of public social spending (chosen by the poor) decreases with the extent of leakages in the delivery of the public good:[22]

$$\frac{\partial k^{\star}}{\partial \zeta} < 0$$

The above derivative is partial in the sense that it does not capture the indirect impact of ζ on $k^{\star}$, through δ. In fact, we show below that the choice of δ by the elite in the first stage of the game also depends on ζ, the bottlenecks that hamper the delivery of the public good.

First-stage of the game: the elite sets the subsidy rate

Taking into account the above choices, the utility function of the rich reads

$$\alpha_r - \theta ln(1-\delta) + v_r\left(k^{\star}(\delta,\zeta)\right),$$

where the constant α_r is the counterpart of α_p (see the second-stage of the game above). We write $k^{\star}(\delta,\zeta)$ to emphasize that the optimal level of the public good depends on the subsidy rate (and on the quality of domestic institutions), as shown above. The first order condition (with respect to δ), for an interior solution is:

$$\frac{\theta}{(1-\delta)} + \frac{\partial k^{\star}}{\partial \delta} v_r'(k^{\star}) = 0$$

Using Equation (8), and after some algebraic manipulations, the optimal choice of δ is given by:

$$\delta^{\star} = 1 - (1-\zeta)(1-\bar{\tau}) y v_r'(k^{\star}) \tag{9}$$

It follows that:

$$\frac{\partial \delta^{\star}}{\partial \zeta} = (1-\bar{\tau}) y v_r'(k^{\star}) > 0$$

The bottlenecks in the delivery of the public good lowers its benefit, leading to a second-best outcome of higher energy subsidies and lower public social spending. Equation (9) also suggests that the rich would choose a lower subsidy rate if the public good provides good quality services at the margin ($v_r'(k^{\star})$ high).

[22] Equation (7) suggests that this condition holds as long as the entire pool of common resources is not devoted to energy subsidies in equilibrium (which is highly likely).

Although we assume an exogenous tax rate, $\bar{\tau}$, the model provides some useful insights into the role of taxation: If the social contract was designed such that energy subsidies were contingent on a higher income tax rate (or a more progressive tax system), one would intuitively converge towards a "higher equilibrium" of low energy subsidies (see Equation (9)) and high priority social spending (see Equations (7) and (8)).

In summary, the transmission mechanism in the model is one whereby weak domestic institutions (and to some extent low-quality public services) induce the rich to choose a high subsidy rate. This in turn crowds-out public spending, especially under narrow fiscal space. Intuitively, the poor support that equilibrium because energy subsidies provide a small but certain benefit to consumption, whereas the delivery of the desirable public good is subject to important leakages. We test these predictions of the model in the empirical section below.

We have kept the model simple to develop the intuition, through the lense of closed form solutions. The model could be extended along several dimensions. First we assume that agents' utility is separable in public and private goods. In reality, however, both could be either strong complements or substitutes. Second, domestic institutions are assumed to be exogenous in our model. There is, however, a large body of the political economy literature that documents perverse effects of the natural resources endowment on domestic institutions. Our model could therefore be extended to account for that interplay (e.g., by setting $\zeta = \zeta(z)$, an increasing function of z). Third, for tractability and transparency, the model assumes that income is the main source of heterogeneity between the rich and the poor. Both types of agents may, however, have different intrinsic preferences over the energy and the non-energy goods. It is straightforward to extend the model developed in this paper to account for that particular feature, e.g., by allowing the share of the energy good (and of the non-energy good) to be different across the consumption baskets of the rich and the poor.

III. Empirical Analysis

The ultimate goal of this section is to develop an identification strategy to assess the causal relationship between energy subsidies and public social spending. Before turning to the econometrics, we present the data on energy subsidies and public social spending used throughout the paper. We then provide evidence on basic statistical association between energy subsidies and social spending, exploiting both the time and the cross-section dimensions of the dataset. Finally, we use the Instrumental Variable (IV) estimation method to evaluate the causal link between energy subsidies and public social spending, in a cross-section of low and middle income countries.

A. Data Description and Stylized Facts

1. Data Description: Energy Subsidies and Social Spending

The data on energy subsidies are drawn from Clements and others (2013) and are computed based on the "price gap" approach (see Koplow (2009)). The measure of energy subsidies includes subsidies on a wide-range of products (petroleum products, gas, coal, and electricity) for a panel of low and middle-income countries.[23] Consumer subsidies arise when the prices paid by consumers, including both firms (intermediate consumption) and households (final consumption), are below a benchmark price, while producer subsidies arise when prices received by suppliers are above this benchmark. Where an energy product is internationally traded, the benchmark price for calculating subsidies is based on the international price. When the energy product is mostly non-traded (such as electricity), the appropriate benchmark price is the cost-recovery price for the domestic producer, augmented with distribution costs and a normal return to capital. The advantage of the "price gap" approach is that it helps capture subsidies that are implicit, such as those provided by countries that supply petroleum products to their populations at prices below those prevailing on international markets. More formally, energy subsidies are computed as follows:

$$s_{i,t}^{e} = \sum_{e=1}^{m} (p_{w,t}^{e} - p_{i,t}^{e}) c_{i,t}^{e}, \tag{10}$$

where e denotes the energy product potentially subsidized (petroleum products, gas, or electricity), $c_{i,t}^{e}$ is the total domestic consumption of product e in country i in year t, p^{w} is the benchmark price (in local currency) and, p is the domestic price.[24]

Estimates of pre-tax energy subsidies based on this approach do suffer from some limitations. First, subsidies calculated here mostly reflect consumer subsidies, as producer prices are not available for a large number of countries. Second, consumption and prices data often come from different sources which are not necessarily comparable across countries. Second, benchmark prices by product (especially products which are traded internationally) rely on the as-

[23] The list of countries covered by the analysis is presented in the appendix Table 2.

[24] Given that pre-tax subsidies are positively defined by definition, S_{i}^{e} is censored and takes the value 0 whenever the price gap is negative.

sumption of similar transportation and distribution margins across countries. Such measurement errors in the data have implications for the choice of the econometric specification that we explore later in the text.

We obtain data on social spending from the World Development Indicators (2013) database. Despite some data limitations for earlier years (especially during the 1980s and the 1990s), there has been substantial efforts to recording public social spending over the last decade for a large number of countries. In that vein, Clements, Gupta, and Nozaki (2013) provide a comprehensive dataset on public spending in education and health, covering 140 countries. Their series, however, end in 2009. Because the recent episode (post-2008) over which energy subsidies have risen substantially (on the back of rising international oil prices) is key to our analysis, we use the WDI series. We adopt, for the purpose of this analysis, a narrow but relatively easy to capture concept of public social spending, defined as the sum of public expenditure in education and health (expressed in percentage of GDP for cross-country comparability).[25] many other control variables used in the estimations (see specification below) are also from the World Development Indicators (2013) database. The variable capturing the political constraints on the executive is from the Polity IV database.

2. Stylized Facts

We start with a panel dataset covering 109 low and middle income countries over 2000–11, the period for which energy subsidies data are available, from Clements and others (2013).[26] The estimate of energy subsidies for each country is normalized by its GDP in current prices.

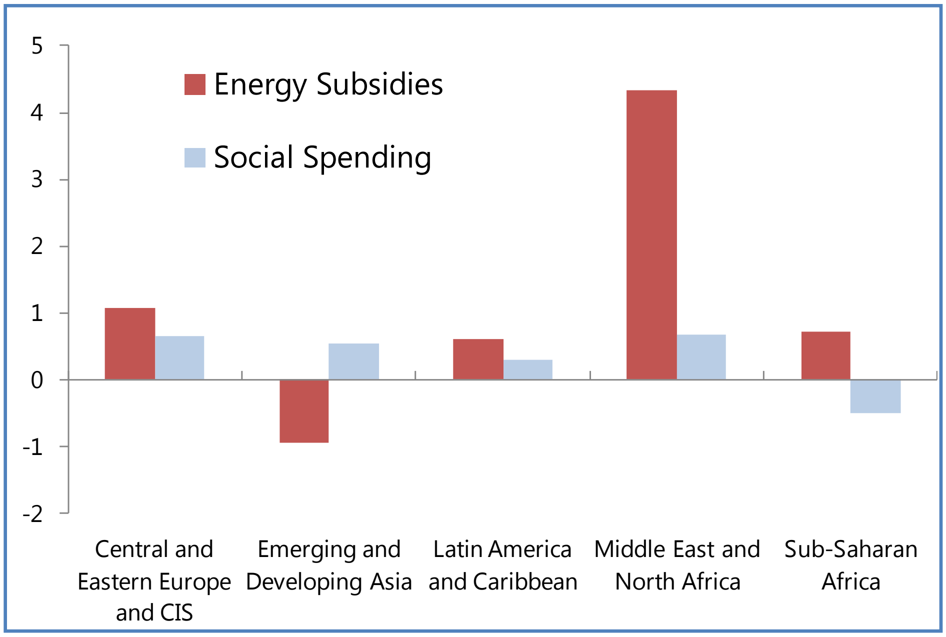
Figure 1 provides some insights into the question examined in the paper. It portrays the evolution of energy subsidies and social spending between two episodes (2002–2006 and 2007–2011) across different regions of the globe.[27] While subsidies did decrease in developing and emerging Asia between the two identified sub-periods, they did increase in Sub-Saharan Africa. Strikingly, social spending moved in opposite directions across (and in) both regions, pointing to a potential trade-off between energy subsidies and social spending. In contrast, social spending did not decline in the (resource-rich) MENA region, despite the sharp increase

[25] Clements, Gupta, and Nozaki (2013) adopt a similar definition.

[26] The countries covered in the sample are listed in Table 2 in appendix.

[27] We consider averages over sub-periods rather than yearly time series for robustness. In fact, changes in subsidies and social spending from one year to another could be arbitrary. The 2006–07 cut-off is chosen to reflect the dynamics in energy prices, but the point made here holds for alternative cut-off dates (and hence sub-periods).

Figure 1. Change in Subsidies and Social Spending across Regions Between 2002–2006 and 2007–2011



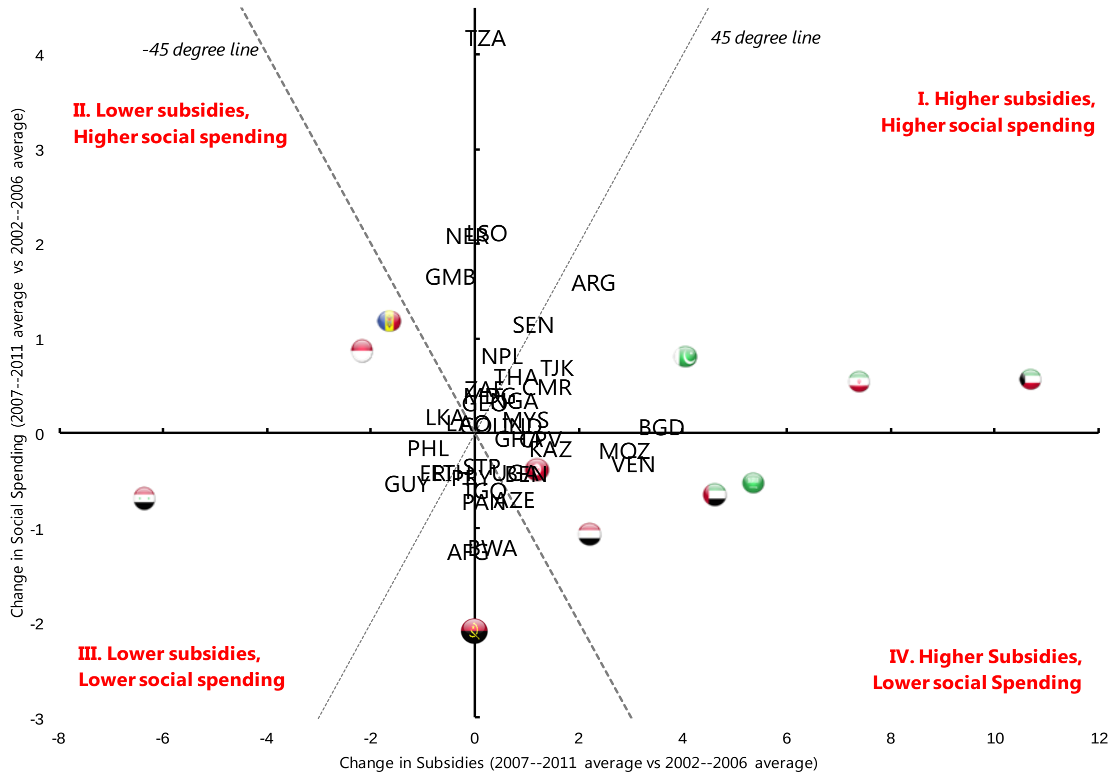
CIS refers to The Commonwealth of Independent States.
Source: Clements and others (2013), World Development Indicators (2013), and authors' calculations.

in energy subsidies in the region, suggesting that countries' endowment or resource space may condition the extent of crowding-out.

Figure 2 provides a more disaggregated picture (at the country level) and paints a quite similar story:[28] (i) energy subsidies rose around the globe between the two identified sub-periods (most countries in the sample are on the right of the vertical axis), but the evolution of social spending was uneven (countries are almost equally split below and above the horizontal axis); (ii) some resource-rich countries were somewhat able to afford higher subsidies without cutting public social spending (at face value), and when social spending did decrease in resources rich countries, the decline was much lower than the increase in subsidies (above the -45^o line); and (iii) In general, where social spending did increase, the increase was lower than the increase in subsidies (below the 45^o line). Consequently, only a handful of countries went through the virtuous circle of lower energy subsidies and higher public social spending (second quadrant) during the two identified sub-periods.

[28]MENA countries, Indonesia, and Moldova are represented on the figure with their flags.

Figure 2. Energy Subsidies and Social Spending across Countries: What has Happened?



Source: Clements and others (2013), World Development Indicators (2013), and authors' calculations.

It is worth noticing that the above patterns are based on a panel data structure, whereas we focus on the cross-section dimension of the data in the econometric analysis for the reasons discussed below. Nonetheless, these patterns provide useful insights into the link between subsidies and social spending. The main advantage of Figures 1 and 2 is that they illustrate how subsidies and social spending did change over the two sub-periods for a given grouping of countries (Figure 1) and for individual countries (Figure 2). Presenting a similar evidence in a pure cross-section setting requires controlling for other relevant countries' characteristics, including demographics. We do this more systematically in the econometric analysis below where we also elaborate on our choice of estimation method.

B. Econometric Analysis

1. Model Specification

We propose an empirical strategy to investigate the potential impact of energy subsidies on public social spending. Identifying the causal link between these two aggregates is complicated by a number of factors that would become clear below. We consider the following cross-section estimation:

$$\left(\frac{Social}{Y}\right)_i = \alpha + (\beta_1 + \beta_2 F_i)\left(\frac{Subsidies}{Y}\right)_i + \beta_3 F_i + X_i' \Gamma + \varepsilon_i, \qquad (11)$$

where "Social" is the sum of public spending in education and health, and "Subsidies" are total pre-tax energy subsidies as defined above (both series expressed in percent of GDP). The vector X comprises a battery of controls that have been identified as relevant determinants of public social spending in the literature (see, e.g., Baqir (2002), Clements, Gupta, and Nozaki (2013), IMF (2003), Mauro (1998), to name only a few). These include countries' demographic characteristics (dependency ratio and urbanization), macroeconomic aggregates such as the initial real per capita income, the government size, the degree of trade openness, and macroeconomic volatility (measured as the standard deviation of the annual growth rate of real GDP).[29] Importantly, and related to our conceptual framework, the vector X also contains measures of the quality of domestic institutions.

We also assess the extent to which the crowding-out, if any, depends on relevant countries' economic and political characteristics embodied in the vector Fi, namely the fiscal space (proxied by the public debt-to-GDP ratio), the natural resource dependency (measured by the oil rents-to-GDP ratio), and the quality of domestic institutions.[30] It is therefore useful to consider special cases in thinking about Equation (11). When $F_i = 0$ (linear case), the crowding-out coefficient is given by β_1. If $F_i \neq 0$ (non-linear case), the crowding-out depends on the level of the variable F_i and is given by $\beta_1 + \beta_2 F_i$.

The quality of domestic institutions is captured by the government effectiveness and the corruption indicators from the World Governance Indicators database. We re-scale these vari-

[29] It is worth emphasizing the necessity to control for the government size in the model. In fact, all categories of spending may also go down regardless what happens to energy subsidies (e.g., if tax revenues fall). We therefore control for the government size (spending-to-GDP, excluding subsidies) to make sure we isolate the marginal effect of subsidies on public social spending. We focus on social spending for political economy reasons, as highlighted in the introduction.

[30] All the variables are averages over the sample period (2000–11).

ables using the min-max transformation, to have them comprised between 0 and 1, with 0 indicating the lowest value of governance quality.

2. Why Adopt a Cross-sectional Specification?

While it is tempting to recourse to panel estimations in order to exploit the full structure of the dataset (time and cross-section dimensions), such an approach may not be desirable in our context for a number of technical reasons. First, the subsidy variable is likely to be contaminated with measurement errors, despite its careful derivation. These measurement errors may lead to an attenuation bias in the presence of country-fixed effects. This issue is even more relevant here because most of within-country variations (year-to-year) in the subsidies variable do not always represent a shift in the subsidy regime, but may reflect in some cases changes in the benchmark price if domestic prices are sticky across countries in the short-run. We therefore run the risk of identifying the impact of shocks to energy prices on social spending, rather than the crowding-out effect of subsidies on social spending, the focus of our analysis.

Second, the measure of energy subsidies used here captures implicit subsidies, not necessarily reflected in the budgets. Using yearly data could be misleading, potentially leading to a stronger attenuation bias, as the estimates of the crowding-out coefficient would be biased downward (in absolute terms). This arises because year-to-year changes in implicit subsidies are not necessarily "financed" by cutting public social spending, but might instead lead to "losses" incurred by SOEs, financed via arrears accumulation by SOEs or public debt at large. Using within-country averages over the period of analysis would limit this bias as subsidies would eventually lead to fiscal retrenchment: SOEs cannot run losses indefinitely (without bailout from the central government) nor debt can be built-up indefinitely without adjustment.

Third, the short-time period (2000–11) and the strong inertia characterizing the dependent variable (public social spending) and some of its determinants (such as demographics, institutions, and natural resource dependency, which change only slowly overtime) limits the information content of the time dimension of the data. This feature of the variables of interest, coupled with the short time dimension, exposes one to Fthethe risk that fixed-effects absorb almost all the variations in the data in panel estimations.

The country-specific averages of the energy subsidies-to-GDP ratios mostly reflect what could be referred to as "subsidy regimes" or "pricing regimes," meaning the extent to which some countries tend to subsidize energy products more than others.[31] The between-country variation is an appealing dimension of the data. Using cross-sectional estimates implies assessing questions like: Do countries more prone to subsidizing energy products also spend less on public social spending?

3. Identification Strategy: Addressing the Endogeneity of Subsidies

One of the main challenges associated with cross-sectional studies is how to properly control for unobservable factors, in order to limit the risks of endogeneity bias. One could easily control for a pair of fixed effects (country and time) to obtain clean parameter estimate of the effects of subsidies in panel data estimations. We discussed above the limits associated with the panel specification in our context.

The sources of endogeneity associated with energy subsidies may vary. First, because subsidies and social spending may be jointly, OLS estimates of β_1 and β_2 (see Equation (11)) would suffer from a simultaneity bias. Second, the fact that cross-sectional estimations cannot control for unobservable factors that may jointly affect the subsidy regime and the level of public social spending is yet another potential source of bias.

Against this backdrop, we propose an identification strategy based on the level of subsidies in neighbor countries. We also enrich the set of instruments to include the extent of political constraints on the executive as an "exogenous" source of variation in the level of energy subsidies across countries, conditional on a battery of covariates. Two main conditions should govern the relevance of these instruments: First, they should be strongly correlated with the subsidies-to-GDP ratio in the observed country. In other words, the instruments, even after controlling for other covariates, should be significant in the first-stage equations modeling the cross-country variation in energy subsidies. We gauge the strength of the instruments using the *F-stat* and *Shea* R^2 associated with the first-stage regressions. Second, the instruments should be correlated with the outcome of interest (here public social spending-to-GDP) only through their impact on the subsidies variable or through any other variable which is already controlled for in the econometric specifications. This criterion of orthogonality is tested using the *Sargan* over-identification test.

Another critical question is whether these instruments are economically relevant. What is the story behind their selection? The first instrumental variable records the average level of

[31] We are grateful to David Coady for bringing this useful interpretation to our attention.

subsidies (in percent of GDP) in neighbor countries. Our identification strategy is based on the intuition that countries are more likely to subsidize energy products if other countries in their neighborhood are doing the same. We also test the fact that this could be more likely if the country of interest is a net commodity exporter, as pressures to share the pie would be higher.[32] Various factors can justify the effects of neighbor subsidies regimes on countries' behaviors. One main argument is related to political economy. In the absence of informational asymmetries (we assume that citizens are aware of the policies adopted in neighbor countries over a 12-year horizon, the horizon over which our data are averaged), citizens are more likely to ask for energy subsidies if neighbor countries subsidize, and more so if the country is an oil producer, we hypothesize. This type of spatial spillovers in fiscal choices has been used to modeling fiscal policy choices in developing countries in the literature (see, e.g., Keen and Lockwood (2010) on VAT adoption).

We construct our instrumental variable as the weighted average of energy subsidies-to-GDP ratios over all neighbor countries, using the worldwide gravity database assembled by the Cepii.[33] More specifically, for each country i in the sample, the energy subsidy intensity in neighbor countries ($ESINC_i$) is evaluated as:

$$ESINC_i = \frac{1}{n}\sum_{j=1}^{n} s_j \times d_{i,j}, \tag{12}$$

where s_j is the subsidy-to-GDP ratio in country j and

$$d_{i,j} = \begin{cases} 1 & \text{if countries } i \text{ and } j \text{ are neighbors} \\ 0 & \text{otherwise} \end{cases} \tag{13}$$

As the instrument is built using neighbor countries data, it seems relatively exogenous to the level of public social spending in each country. One could argue that the subsidy intensity in neighbor countries (our main instrument) simply captures common shocks affecting countries. Because we also control for a wide range of variables, including trade openness, the latter risk is limited. The risk would be more severe if we were using yearly panel data, given that a common oil shock may trigger, at least in the short-run, synchronized fiscal policy responses, including decisions to subsidize partially or fully. By looking at averages of subsidies-to-GDP ratios, we are measuring to some extent, subsidies or pricing regimes across countries, devoting attention to the structural component of these regimes, instead of year-on-year shifts in implicit subsidies.

[32] To anticipate a bit on our estimation results, the extent of energy subsidies in neighbor countries alone accounts for one quarter of the total variation in energy subsidies across countries and for up to half of the variation among the net oil exporters.

[33] The database is available at: http://cepii.fr/CEPII/fr/bdd_modele/presentation.asp?id=6.

The second instrument we use is the degree of political constraints on the executive. Our assumption is that political constraints to the (policy) discretion of the executive are likely to limit his ability to develop and implement energy subsidy policies. The idea that political constraints limit fiscal policy discretion has been established empirically (e.g., Fatás and Mihov (2013) and Ebeke and Öçer (2013)). A potential issue with this instrument, however, is that if it is correlated with energy subsidies, one could expect it to also be correlated with other categories of expenditures, including public social spending. The instrument would then violate the fundamental exclusion restriction. This risk, however, is limited because our econometric specification (see above) controls for the overall government size (net of subsidies), both in the first and second-stage regressions. Moreover, public social spending are more traditional budgetary expenses than energy subsidies, and the constraints on the executive would, arguably, be more binding for the latter.

When the econometric specification involves interaction terms (subsidies crossed with some conditional variables) as is the case here, the instrumental variable approach is amended to account for the additional endogenous variables generated by the interaction terms—we therefore instrument not only the subsidies-to-GDP ratio, but also its interaction terms. The matrix of instruments therefore includes the additive term of the two instruments discussed above, including their respective interaction terms with each conditional variable.

4. Estimation Results

Baseline estimations (linear model)

Equipped with the above framework, we estimate the model using two-stage least squares with robust standard errors. Table 1 presents the results of the Instrumental Variable (IV) estimations. The second-stage estimates are reported in the upper panel of the table (Panel A) and the first-stage estimates are displayed in the lower panel (Panel B). The table displays the results of the linear effect of subsidies on public social spending, followed by non-linear effects, conditional on relevant countries' characteristics, including the fiscal space, the natural resource endowment, and the quality of domestic institutions. The average crowding-out effect of energy subsidies on public social spending is estimated (see Column 1) to be around 0.6 (less than unity). In addition, all the controls have the expected signs. In particular, the government size independently affects the level of social spending positively. The results are unaltered when the government size is replaced by total tax revenues.[34]

[34] The government size and tax revenues could not be included simultaneously in the regressions, due to their high correlation.

The first-stage regressions which use subsidies in the neighbors and political constraints on the executive as instruments for subsidies show the significance of the instrumental variables, indicating a strong association, even in the presence of the full set of controls. The *Hansen* test of over-identification also suggests that the instruments are not strongly uncorrelated with the residuals of the structural model at the 10 percent significance threshold. Although this level of significance may appear weak, allowing for interaction terms significantly improves the outcome of the test (see Column 2 onwards). We can therefore conclude that public social spending tend to be lower on average in countries with higher energy subsidies (all expressed in percent of GDP).

Accounting for non-linearities: Do the hydro-carbon status and fiscal space matter?

In columns 2 and 3, we modify the above baseline specification to include a battery of interaction terms characterizing the economic structure and the level of fiscal space. The econometric results displayed in Column 2 suggest that the marginal effect of energy subsidies on social spending tends to be significantly lower in resource-rich countries (the coefficient associated with the interaction term is positive and significant). In Column 3, we test for the existence of possible non-linearities in the levels of public debt-to-GDP, our measure of fiscal space. The interaction between the subsidies-to-GDP ratio and the public debt-to-GDP ratio is estimated to be negative and significant: this provides evidence of a stronger crowding-out effect from energy subsidies in more indebted countries, as tight financing constraints prompt them to adjust. For instance, the crowding-out coefficient rises to about 0.8 for countries with a debt-to-GDP ratio above the 75^{th}, percentile of the sample distribution, corresponding to a debt-to-GDP ratio of about 70.

Does the quality of domestic institutions matter?

One central implication of our theoretical model (see Section II) is that the quality of domestic institutions shapes the extent of crowding-out of energy subsidies on public social spending. We test that prediction here. The basic question we ask is the following: Is the crowding-out stronger in countries exhibiting a high level of institutional vulnerability? As it was done above, we present the results for specifications which allow for interaction terms between subsidies and institutional fragility. The baseline estimates (not reported) show that the interaction term is associated with a negative coefficient (as expected), though the estimates are not statistically significant. We therefore explore further the distribution of the governance quality variables and assess the level and the significance of the crowding-out coefficient for extreme values of governance fragility. We retain the range above the 75^{th} percentile of each variable as a good compromise. The results are striking: regardless of the indicator of gover-

Table 1. Energy Subsidies and Social Spending: The Role of Fiscal Space and Institutions

	(1)	(2)	(3)	(4)
Panel A (2nd stage): Dependent variable is public social spending-to-GDP				
Energy subsidies-to-GDP	-0.630**	-1.473*	-0.477	0.381
	(0.282)	(0.764)	(0.303)	(0.488)
Energy subsidies*Oil rents-to-GDP		0.055**		
		(0.022)		
Energy subsidies***1**[Corruption>75th perc.]			-1.956*	
			(1.068)	
Energy subsidies*Public debt-to-GDP				-0.022**
				(0.011)
Oil rents-to-GDP		-0.103***		
		(0.027)		
Net oil importer dummy				0.513
				(0.765)
1[Corruption>75th perc.]			1.495	
			(1.526)	
Public debt-to-GDP	-0.001	-0.004	-0.004	0.012
	(0.005)	(0.005)	(0.006)	(0.009)
Age dependency ratio	0.052	0.105*	0.056	0.074
	(0.046)	(0.057)	(0.056)	(0.052)
Corruption	-3.031**	-1.111		-2.234
	(1.546)	(1.650)		(1.844)
Urbanization rate	0.019	0.019	0.026	0.012
	(0.015)	(0.015)	(0.019)	(0.017)
Log initial real per capita income	2.534	0.991	1.560	1.198
	(2.496)	(2.486)	(2.806)	(2.944)
Openness	0.012*	0.020***	0.010	0.014*
	(0.006)	(0.007)	(0.008)	(0.008)
Output growth volatility	-0.150**	-0.072	-0.166*	-0.212**
	(0.073)	(0.093)	(0.094)	(0.095)
Government size	0.182***	0.177***	0.232***	0.191***
	(0.028)	(0.027)	(0.041)	(0.032)
Panel B (1st stage): Dependent variable is energy subsidies-to-GDP				
Energy subsidies intensity in neighbor countries (ESIN	0.076***	0.033	0.102***	0.116***
	(0.023)	(0.027)	(0.027)	(0.042)
ESINC*Oil rents-to-GDP		0.003***		
		(0.001)		
EINC***1**[Corruption>75th perc.]			-0.104*	
			(0.057)	
ESINC*Public debt-to-GDP				0.000
				(0.001)
Constraints on the Executive	-0.245***	-0.184**	-0.247***	-0.130
	(0.083)	(0.091)	(0.091)	(0.152)
Constraints*Oil rents-to-GDP		0.022**		
		(0.009)		
Constraints***1**[Corruption>75th perc.]			-0.121	
			(0.237)	
Constraints*Public debt-toGDP				-0.001
				(0.002)
N	109	109	109	108
Joint significance of subsidies coefficients: *P* -value		0.031	0.031	0.089
F -stat of first-stage	15.545	7.287	9.100	5.335
Sargan OID test: *P* -value	0.043	0.414	0.507	0.113

Notes: All the first-stage specifications include the full set of control variables as they appear in the second-stage. Standard errors in parentheses. $^{*}p < 0.1,\quad ^{**}p < 0.05,\quad ^{***}p < 0.01$.

nance considered (corruption or governance ineffectiveness), the coefficient associated with the interaction term enters the negative territory and is significant. This suggests that the marginal effect of energy subsidies on public social spending is larger when governance is particularly fragile—the crowding-out is almost one-to-one in countries with government ineffectiveness above the 75^{th} percentile of the sample distribution.

IV. Conclusion and Policy Implications

This paper examines the impact of energy subsidies on public social spending, both conceptually and empirically. We first show that high energy subsidies and low public social spending can emerge as equilibrium outcome of a political game between the elite and the middle-class when the delivery of the public good is subject to leakages, reflecting weak domestic institutions. The paper then proposes an empirical strategy to test this and other predictions of our model, using a large cross-section of low and middle-income countries. We document a negative statistical association between energy subsidies and public social spending before a more systematic examination of a potential causal relationship between these two aggregates. Because energy subsidies and public social spending may be jointly determined in the budget process, OLS estimates would suffer from a simultaneity bias. To address this concern and other potential sources of endogeneity in our cross-section estimations, we adopt an identification strategy whereby subsidies in a given country are instrumented by the level of subsidies in neighboring countries, and the political constraints on the executive. Our instrumental variable estimations indeed suggest a causal relationship between energy subsidies and public social spending. More specifically, we find that public spending in education and health were on average 0.6 percentage point of GDP lower in countries where energy subsidies were 1 percentage point of GDP higher. Moreover, the crowding-out is stronger when fiscal space is narrow, rising to about 0.8 when the debt-to-GDP ratio reaches 70 percent, and among the net oil importers. Also, consistent with a central prediction of our theoretical model, weak domestic institutions exacerbate the crowding-out, estimated to be almost one-to-one when the country's government ineffectiveness is above the 75^{th} percentile of the sample distribution.

Our findings have important policy implications. On the one hand, they suggest that non-resource-rich countries with a narrow fiscal space would have to move expeditiously with subsidy reform in order to relax the constraints weighting on public social spending. On the other hand, it will prove challenging to resource-rich economies to keep energy subsidies at their current high levels moving forward, in view of mounting social spending pressures, including from the youth, given the volatile nature of resource revenues. The recent sharp drop in global oil prices seems to vindicate this point. In fact, in line with our conceptual framework and empirical findings, resource-rich countries were somewhat able to afford high energy subsidies with relatively limited crowding-out of public social spending thanks to their large fiscal space at a time when oil prices were relatively high. Those subsidy regimes will clearly be harder to sustain at much lower oil prices, as existing fiscal buffers get eroded. On the positive spin, reforming energy subsidy is likely to pose less political headache at low international oil prices. The recent sharp drop in global oil prices therefore represents a golden opportunity for governments, resource-rich and non-resource rich alike, to durably reform energy subsidies. In that vein, depoliticizing domestic energy pricing, for instance by adopting an automatic pricing mechanism (see Coady and others (2012)), seems to be a good transition towards fully-deregulated energy prices.

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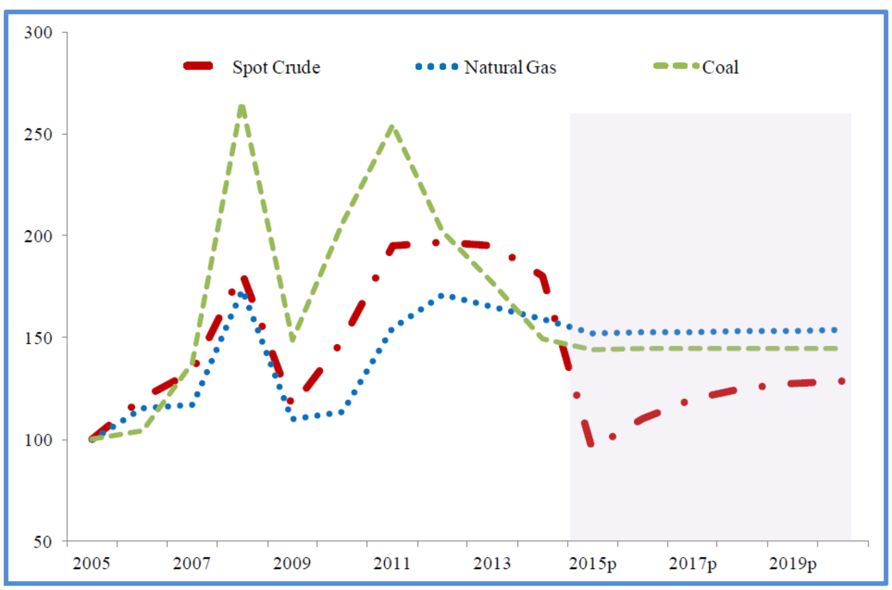
Table 2. List of Countries in the Sample

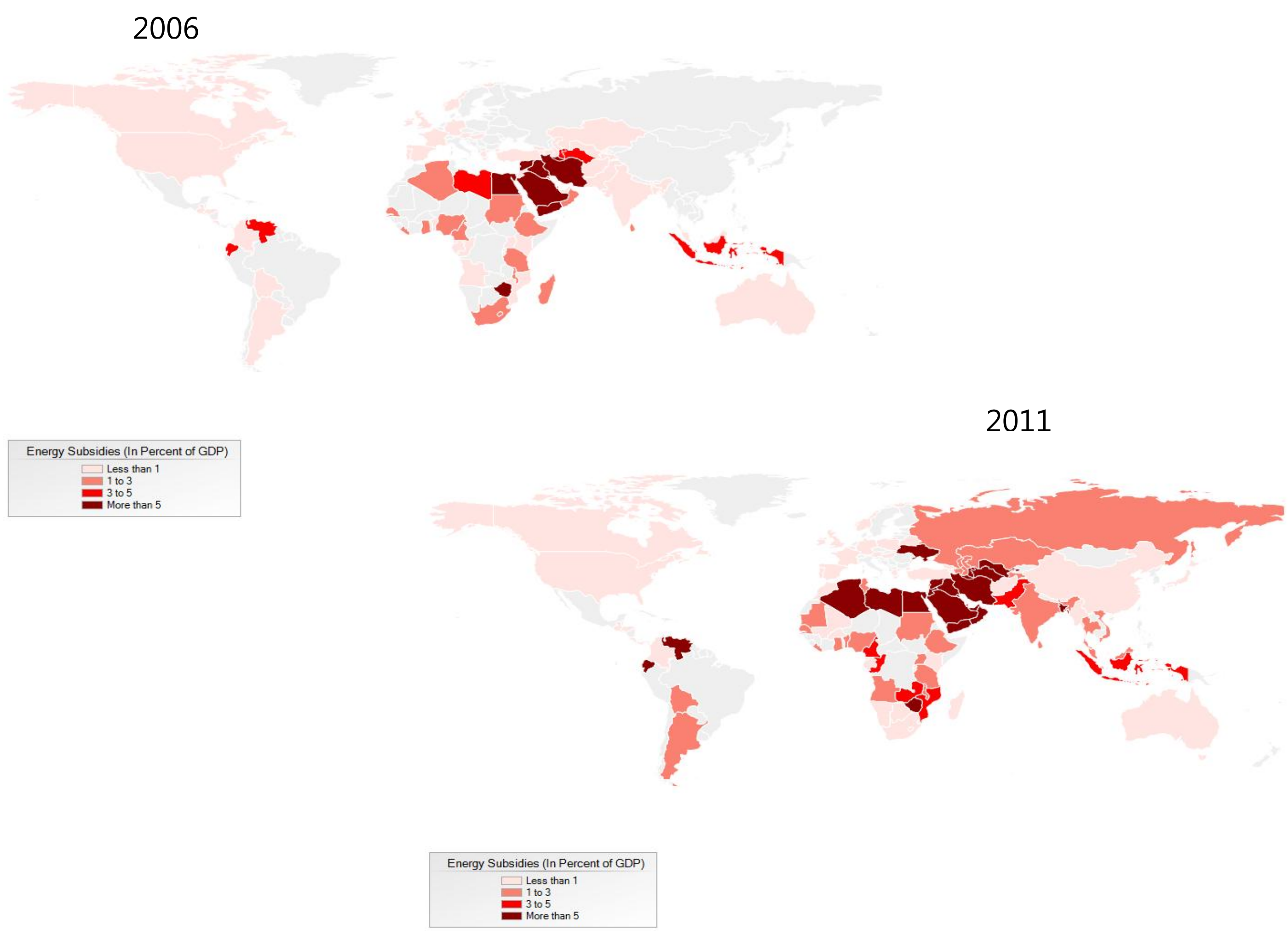
Albania	Colombia	Indonesia	Mozambique	Syria
Algeria	Comoros	Iran, I.R.	Namibia	Tajikistan
Angola	Costa Rica	Jordan	Nepal	Tanzania
Argentina	Croatia	Kazakhstan	Nicaragua	Thailand
Armenia	Cote d'Ivoire	Kenya	Niger	The Gambia
Azerbaijan	Congo , D.R.	Kuwait	Oman	Togo
Bahrain	Djibouti	Kyrgyz Rep.	Pakistan	Trinidad and Tobago
Belarus	Dominican Rep.	Lao P.D.R.	Panama	Tunisia
Benin	Ecuador	Latvia	Paraguay	Turkey
Bhutan	Egypt	Lebanon	Peru	Uganda
Bolivia	El Salvador	Lesotho	Philippines	Ukraine
Botswana	Equatorial Guinea	Liberia	Poland	United Arab Emirates
Brazil	Eritrea	Libya	Qatar	Uruguay
Bulgaria	Fiji	Lithuania	Rep. of Congo	Venezuela
Burkina Faso	Gabon	Madagascar	Romania	Vietnam
Burundi	Georgia	Malawi	Russia	Yemen
Cambodia	Ghana	Malaysia	Rwanda	Zambia
Cameroon	Guatemala	Mali	Saudi Arabia	
Cape Verde	Guinea	Mauritania	Senegal	
Central African Rep.	Guinea-Bissau	Mauritius	Sierra Leone	
Chad	Guyana	Mexico	Solomon Islands	
Chile	Hungary	Moldova	South Africa	
China	India	Morocco	Swaziland	

Figure 3. Evolution of Commodity Prices



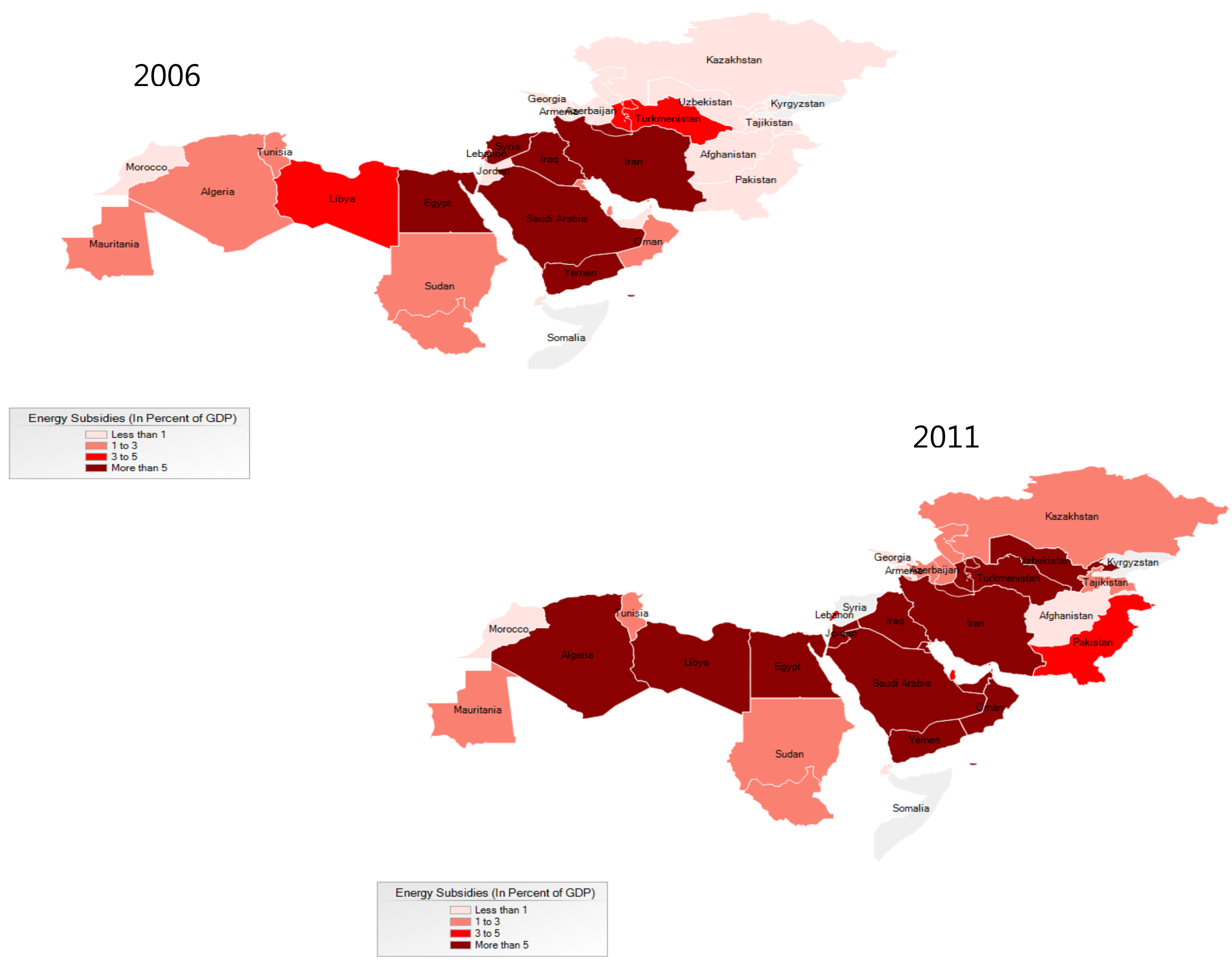
Source: IMF Primary Commodity Price System (January, 2015).

Figure 4. Energy Subsidies Intensity around the Globe (2006 vs. 2011)



Source: Clements and others (2013), World Development Indicators (2013), and authors' calculations.

Figure 5. Energy Subsidies Intensity: Zoom on the MENA Region (2006 vs. 2011)



Source: Clements and others (2013), World Development Indicators (2013), and authors' calculations.