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Political Determinants of Fossil Fuel Pricing

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Abstract

This paper provides an empirical analysis of economic and political determinants of gasoline and diesel prices for about 200 countries over the period 1991–2010. A range of both political and economic variables are found to systematically influence fuel prices, and in ways that differ systematically with countries' per-capita income levels. For democracies, the analysis finds that fuel prices correlate positively with both duration of democracy and tenure of democratic leaders. In non-democratic societies there is more often no such relationship or it is the opposite of that for democracies. Regime switches—transitions from non-democratic to democratic government, or vice versa—reduce fuel prices. Fuel prices are also lower for more corrupt, or more centralized, governments. Higher levels of gross domestic product per capita lead to higher fuel prices, while export income from selling fossil fuels reduces these prices dramatically. Higher motor fuel consumption also appears to reduce fuel prices, most for gasoline. Absolute "pass-through" of crude oil price changes to fuel prices is found to be high on average.

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Political Determinants of Fossil Fuel Pricing[1]

1. Introduction

Subsidies to end-users of fossil fuels are widespread, and a variety of reasons are offered by the countries using this practice. Two frequently offered justifications are promoting general economic development, and increasing lower-income groups' access to energy. IEA (2010: 578) estimates worldwide consumer subsidies to fossil fuels to be $ 312 billion in 2009. Consumer subsidies to oil and natural gas constitute more than two-thirds of this amount ($211 billion). A more recent study by the IMF (2013) sets the overall direct subsidy level at about $400 billion, of which about $270 billion are to oil and natural gas. More than 95% of global subsidized fossil-fuel consumption was in these years concentrated to 37 countries of which 35 were outside of the OECD area. There is some indication that fossil energy subsidy rates have been coming down globally in many countries over the last decade (Vagliasindi 2012a, 2012b). But for motor fuels this subsidy rate reduction has been countered by an increase in motor fuel consumption as the middle class has expanded dramatically in many of these countries.[2] So the overall problem in terms of sheer subsidy volume does not seem to be diminishing.

Such subsidies come with a range of burdens on the respective societies, which make them an important target for policies aimed at eliminating them. The most important types of problems are:

1. Fiscal costs (Coady *et.al*, 2010). Budgetary public outlays for energy subsidies either a) necessitate higher taxes than otherwise; or b) lead to reduced public outlays for other ends often including crucial sectors such as health and education.
2. Price distortions that lead to a range of welfare losses, including inefficiently low conservation activity, and waste in various forms such as rent-seeking, smuggling and contraband, adulteration, and resale in black markets.
3. Excessive consumption of fossil fuels, and consequently unnecessarily high carbon emissions, contribute to harmful global climate change.
4. Distributional anomalies. Very often, fuel subsidies are formally justified by providing relief for the poor, while in reality most of the subsidy amounts go to high-income groups. This is perhaps most obvious for gasoline subsidies which all benefit households with motor vehicles, often a small, high-income group.
5. Reduced energy security for fossil-fuel importers; and lower than desirable energy exports for net exporters.

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[2] See e g Ferreira et al (2012) for an analysis of some of these developments, with reference to Latin America.

In recognizing these problems, the G-20 nations, in their 2009 meeting in Pittsburgh, committed to phasing out, over the medium term, inefficient fossil fuel subsidies that encourage wasteful consumption.

Reforming energy subsidies has been subject to policy analysis research for at least some 15 years now (Ellis, 2010). The call for eliminating or reforming subsidies is, in principle, motivated by the five arguments just stated; hereunder to reduce carbon emissions, to make fossil fuel energy use more efficient, and to improve government finances and energy security. Most of the studies that deal with reforming fossil fuel energy subsidies pay attention at least in principle to these arguments.

Less attention is however usually paid to the bumpy political economy road to practical implementation of reform proposals, which is a main focus here. An important question is how to accomplish a phase-out in practice, or even better, achieving a path toward fully efficient energy pricing, which usually involves net energy taxes.

Our ambitions with this paper are more modest, namely to examine characteristics of political institutions and together with economic and geographical factors, their impacts on the level of fossil fuel end-user prices. We believe that an understanding of such processes and explanations can make it easier to attack the "problem at its roots", by potentially promoting economic, political and social factors favorable for subsidy removal, and by instituting policies for such ends.[3]

Issues of particular concern to us (admittedly, more for a positive understanding and less for normative policy) are the nature of the basic political regime: in terms of being democratic or authoritarian; and when focusing on (reasonably) democratic regimes, the degree and nature of political power distribution.

An important factor in this discussion and analysis is represented by the so-called "populist paradox", whereby the lowest fuel prices are often found in non-democratic countries including nations where governments are elected through restricted electoral competition (Andresen, 2008; Lachapelle, 2009; Victor, 2009). An argument here is that in order to stay in power in a country without popular referenda, an incumbent head of state may need to please the population by providing highly visible (and easily implementable) favors, which often includes low fossil fuel prices. Also in the political business cycle literature it is argued that in countries with elections or democracies politicians can meet credibility problems giving them an incentive to manipulate the electorate through clearly visible subsidies to fossil fuel energy consumption (Drazen and Eslava, 2008). This might be the case in younger democracies that just left behind a period of non-democracy (Keefer, 2007; Hanusch and Keefer, 2011). A related argument is that governments in "less democratic" countries, and younger and less established democracies, are often less competent and efficient at providing non-targeted spending or public goods to their citizens, when compared to governments in older and more established democracies (Deacon, 2009). Fossil fuel subsidies to consumers can in such circumstances constitute a clearly visible and targeted way to buy votes within the former types of regimes.

[3] See a preliminary discussion in Strand (2010).

The main results of our analysis, further discussed in the conclusions, can be summarized as follows. Democratic governments reduce their fossil fuel subsidies gradually over time as they mature. With non-democratic governments (including democracies with restrictions on electoral executive and legislative competition), by contrast, subsidies to diesel consumption appear to increase over time, while this effect appears to be weaker for gasoline subsidies. Switching from a non-democratic to a democratic government appears to temporarily increase fuel subsidies (and most so for diesel), and then gradually lead to subsidy phase-out as democracy matures. Competition for swing voters appears to increase fossil fuel energy subsidies; the same does concentration of political power in the hands of a small number of political parties. These effects are strongest in middle-income countries. Better control of corruption also seems to have a strong negative effect on fuel subsidies.

In the next section we consider some of the relevant literature. Section 3 discusses a model dealing with relevant determinants of fossil fuel end-user prices. The data are discussed in section 4. In section 5 we discuss with the help of the data the relationship between energy subsidies, public goods provision and the impact of political governance institutions on fossil fuel subsidies.

2. Fossil Fuel Subsidies, Public Good Provision and Governance Institutions

2.1 Demand for and supply of fossil fuel consumption subsidies

Subsidies to energy consumption, in particular fossil fuels on which we here concentrate, are still prevalent despite their many negative effects (as noted in the introduction), and exist for various official and unofficial reasons, such as stimulating economic growth through boosting industrial development; employment or poverty alleviation; and to avoid social unrest. Several suggestions for reforming subsidies have recently been discussed; see in particular IEA, (2010), Kojima (2012), Vagliasindi (2012a, b), IMF (2013). There is now some evidence that subsidy rates and amounts are being reduced in some countries; see Vagliasindi (2012a). But overall progress has been slow, and practical implementation of attempts at subsidy reform overall difficult.

The barriers against reform and hence the persistence of energy subsidies differ, in ways which depend on incidence points of the subsidies in the value chain (van Beers *et.al*, 2007: 2469). Upstream subsidies are provided to firms at the energy production stage. Energy suppliers are usually well-organized and therefore able to lobby effectively for subsidies (Olson, 1965; Stigler, 1971; Victor, 2009). Other work stresses that lobbies and specific interest groups are important factors behind energy subsidies (Commander *et al*., 2011: 44).

Subsidies are also demanded downstream at the consumption stage. Systematically organizing demanders, as described by Olson (1965), may be more difficult as the number of subsidy recipients is higher and interests are more dispersed (Victor, 2009). The persistence of downstream energy subsidies originates on their supply side, i.e. the kind and the structure of the political institutions behind the decisions to provide subsidies to fossil fuel use.

2.2 Governance institutions and fossil-fuel subsidies

A key aspect of political institutions, in the context of explaining energy subsidies, is whether governance is democratic or non-democratic, or rather the degree to which a country is in effect democratic. A key issue is whether or not the public has real influence on government decisions, with regard both to the provision of more standard public goods, and subsidies notably to energy; and whether the public or particular population groups perceive themselves as having such power. Deacon (2009) finds that non-democracies or authoritarian regimes tend to provide less regular public goods than democratic societies. Olson (1993) and McGuire and Olson (1996) argue that dictators often aim to maximize net "rents" in the form of the difference between tax revenues and government expenditure. The ruler knows that provision of a certain level of public goods like e.g. safety provides an incentive to more production and income by the workers/citizens, which increases the ruler's tax revenue. If a dictator is not alone but depends on a small elite group he or she are likely to focus government expenditures on benefits or goods favorable to the elite. Spending on a nonexclusive public good is restricted as it would benefit groups that do not belong to the elite and are not essential for maintaining his or her power. The opposite of a single individual dictator is the "redistributive" or ideal democracy in which power is shared by the entire population. In such a political regime government spending on public goods is beneficial because of economies of scale in supplying these goods to a larger population (Deacon, 2009: 242). Spending on direct transfers such as energy subsidies would lead to very limited benefits for the entire population due to their large size and the budget constraint.

Bueno de Mesquita *et al*. (2007) investigate how governance institutions affect public goods provisions and the tenure of the rulers. Governance institutions are here described by the ratio W/S, which is the size of the winning coalition (W) as a share of what they call the "selectorate" (S); the latter term describing the group that is key to the ruler's power or authority. The winning coalition is a subset of the selectorate, which in turn is a subset of the population and are all individuals that can influence the selection of the government. In a democracy the selectorate is the electorate and in an autocracy it consists of those who have the position to influence the tenure of the leader, e.g. being a member of the Communist Party. The winning coalition in a democracy is the coalition that achieves at least 50 % of the selectorate votes and in an autocratic system it is a small group of powerful people (e.g. army officers in a military dictatorship). In a democracy the selectorate is typically large as compared with non-democratic systems. If it is large and the winning coalition's share is high, leaders will tend to prefer to supply public goods – benefiting all members of society – over private goods that are available to specific members of the society; while widely available public goods will tend to be preferred less under other systems notably dictatorships with much narrower constituencies.[4] Providing all members of large winning coalitions with private goods can be much more expensive than providing them with particular public goods. As private goods are excludable their costs increase with the number of recipients, which is not the case with pure public goods; and often also with many impure public goods supplied by government. If W/S is low(er), and the (s)electorate large, leaders may need to buy loyalty in

[4] The condition that the selectorate is large should rule out the possibility that a high W/S can go together with a low selectorate like e.g. an absolute monarchy.

order to stay in power and the least expensive way to do it is through private goods provisions such as state granted monopolies or access to scarce commodities, to the winning coalition (Bueno de Mesquita *et al.*, 2002: 561-563).

In mass democracies with proper elections, also the way the winning coalition achieves its power is important, i.e. the electoral rules or the way the votes are counted. For example, direct election of the relevant political executive together with a strong political competitiveness means a candidate has to work hard for his votes and has an incentive to promise private goods to convince swing voters to back him. This becomes more important if less than 50 % of the electorate can lead to a winning coalition as is the case in a plurality voting system. For this reason Persson and Tabellini (1999, 2000 2004) argue that presidential systems lead to more targeted redistribution than parliamentary systems. The same is valid for plurality voting systems over proportional representation voting systems.

Lake and Baum (2001) emphasize the influence of political competition on the exchange of targeted or non-targeted spending for voting support. In democracies political competition means that the incumbent can be challenged by political competitors. His position is highly contestable as entry and exit costs for political challengers are relatively low. In non-democracies and particularly dictatorships these costs are higher, which means less competition for power. A higher level of political competitiveness in democracies – just like higher competitiveness in the markets for goods – leads to less rents for politicians (producers) and more supply of public goods (Deacon and Saha, 2005).

A complementary line of argument, which attempts to merge the related political economy and political science literatures, develops further the idea that democracies, including the political parties that stand behind particular politicians, tend to support and nurture vocal and politically active population groups that serve as checks against potentially abusive governments; cf e.g. Cruz and Keefer (2013); Keefer (2013; forthcoming). Such effects are stronger in more mature than in young democracies. Autocratic governments, by contrast, instead usually attempt to suppress potentially active population groups, in particular when these may be viewed as "dangerous" to their continued rule. The outcome is greater pressure on politicians to provide broader-based and more efficient public goods in democracies than in autocracies, and more so in more mature democracies. In autocracies, the preferred ruler policy is more often to satisfy a narrow selectorate. Our argument here would then be that low fuel prices is one such good.[5] Note that we in the empirical analysis attempt to correct for public health spending, thus attempting to isolate the effects of political system for given, major, supply of other public goods.

Focusing on fossil fuel energy subsidies as a private good supplied by the government, to a more or less broad or narrow slice of the overall population, one reasonable hypothesis is that, in a stable and well-established democratic system, the fuel subsidy rate will be low. Under such regimes, policies will have "matured" and taken other and better forms, thus making

[5] A point made to us by Phil Keefer is that this may not be an efficient policy for an autocratic ruler, since low general fuel prices will need to be shared by all fuel consumer (e g all who have cars) and not just the "selectorate". It may however be the best available option for rulers; e g when direct favoring of particular individuals is visible and thus difficult.

fossil fuel subsidies redundant. A very young democracy, by contrast, may be vulnerable to pressure by strong influence groups and tend to yield to these. For non-democracies, by contrast, there is less reason to expect less subsidies as the system "matures"; for at least two reasons. First, under such regimes there is less pressure to respond actively to wide population demands to provide better and more efficient public-good service; and instead focusing attention on a narrow "selectorate". Secondly, autocratic governments tend to have less internal capacity to provide complex goods; thus concentrating on simple policies such as subsidizing energy.

2.3 Public goods provision and fossil fuel subsidies

In subsection 2.2 the political governance institutions and the electoral rules in these institutions have been considered as important determinants of whether a winning coalition or leader will favor public goods provisions or targeted redistribution by means of private goods. How do fossil fuel consumption subsidies fit in these ideas?

A common view (see e g Commander *et.al* (2011) and Nikoloski (2011)) is that the dominant official justification for energy subsidies is to counteract poverty and inequity through targeted redistribution in favor of the less well-off members of society. It is usually justified as the favored "income redistribution" scheme in cases where more direct income transfer schemes, or schemes for increased supply of public goods, are not viewed as feasible or credible. Advantages of providing energy subsidies are at least threefold. First, they are clearly visible, which is particularly relevant for a government with limited policy instruments available. Second, fuel subsidies, as a policy applied in a political process to attract voters or political supporters, is often more credible than other available policies (since it is common knowledge that a promise to subsidize fuel will be kept, with high probability).[6] Third, little administrative capacity is required to implement fuel subsidy measures, which is an important concern for governments in countries with restricted administrative capacity.

In practice, the greatest benefits of these subsidies still most often end up in the pockets of higher-income groups, including (for electricity) those with grid connections, and (for motor fuels) those who own cars (IEA, 2010; Coady *et al.*, 2010; Vagliasindi 2012b). The groups that gain from energy subsidies tend to be politically resourceful and influential, and they tend to strongly resist fuel subsidy reform. In non-democracies, they can often mobilize fierce and systematic resistance against efforts to change subsidy policies. Even in democracies they often have disproportionate political clout through high voting propensities and by influencing other groups who aspire to influential ranks. Strand (2012) presents a model in which a distinction is made between middle class and lower class voters voting for politicians that provide them with gasoline respectively kerosene subsidies. Politicians' utilities are influenced by the probability of staying in power and by the provision of public goods to the middle and lower class citizens. Moreover, politicians face a trade-off between vote-getting and fiscal space when motor fuel subsidies are increased. This defines, and limits, the optimal subsidy

[6] This is in part due to the mechanisms by which fuel subsidy policies are enforced, which are in turn likely to be credible (as governments wish to avoid the populist uprisings that tend to follow from unexpected increases in fuel prices).

rate for politicians. In particular, when many voters have cars, a large amount of gasoline subsidy may be required to sway voters in their desired direction.

Drazen and Eslava (2009) argue that political budget cycles change the composition rather than the level of government expenditures. They test their claims on data of local public finances of municipalities in Colombia and find evidence in favor of electoral manipulation of the budget by shifting public spending towards the goods voters as a whole prefer in the attempt to seduce voters to vote for the incumbent. They also conclude that voters penalize the incumbent party for running large government deficits before elections and that voters reward the incumbent party for increasing the amount of targeted spending that is attractive to the voter. Another interesting observation of Drazen and Eslava (2009) is that spending of visible development projects like physical-infrastructure spending (roads, power- and water plants) expand significantly before elections while less visible spending category – interest payments, transfers to retirees, payments to temporary workers – contract.

2.4 Economic factors behind fossil-fuel pricing

Many traditional economic arguments also lie behind energy subsidies or taxation. A key factor is whether the country is a net exporter or importer of the type of energy that can be subsidized or taxed; or energy more generally. Fossil fuel exporting country governments may see less of a reason to resist subsidizing fuels, for fiscal or energy security reasons, in particular when such revenues are large; and they may be subject to more pressure to provide energy subsidies.[7] Similar explanations may follow from either a country's debt or energy security position. A high level of debt, or an insecure energy supply, may lead the country to reduce its fuel consumption by eliminating subsidies to fuels, or taxing it. There are also good reasons for many countries to tax its motor fuels when the (national average) level of negative externalities from motor vehicle traffic is high. Thus we might find lower than otherwise subsidy levels (or higher tax levels) for motor fuels such as gasoline and diesel, where externality costs of motor vehicle use are larger. Also here one however needs to be careful; a high externality cost level may namely also follow from high motor vehicle use which may in turn follow from low fuel prices. This implies that such externality costs may be endogenous, and thus a result of, and not a reason for, a particular policy for subsidizing or taxing fuels.

The relationship between the volume of motor fuel consumption on motor fuel subsidies (or taxes) is a similarly complicated one, as both variables are likely to be determined simultaneously in a fuller, appropriately specified, model. Considering however the partial effect of fuel consumption on fuel price or subsidy, we may think of two countervailing forces; see Strand (2012). On the one hand, a high level of gasoline or diesel consumption tends to indicate a high interest in or political attention to fuel subsidies, thus making them attractive to government. On the other hand, a large fuel volume makes a high subsidy level difficult to sustain because of the government budget constraint (at least in countries that are not major

[7] Strand (2010b) provides a model which seeks to explain fuel subsidies by energy exporters, based on fuel exporters' market power (domestic fuel consumption is stimulated through subsidies, which reduces exporters' supply to export markets thus leading to higher global fuel prices).

fuel producers). This should tend to limit subsidies as the public or national debt situation otherwise may sometimes become too precarious.

A further interesting question is the theoretical and empirical relationship between national per-capita income, and energy subsidies. On the face of it, one might argue that richer countries have more resources to subsidize fuels, and will do so more than poorer countries. But this reasoning leaves out much of the basic rationale for fuel subsidies in the first place. Richer countries have in most cases better public-good supplies, less need to or better means for directly compensating poor population groups, and more efficiently run governments and economic systems. Indeed, why countries are rich or poor is not random; richer countries tend to use their resources more efficiently. Thus also for that reason, wealth may be correlated with good policies, including fuel taxation. The pressure to subsidize fuels may also be less in richer countries; wide population groups may be better educated and better understand the reasons for appropriate fuel pricing. There is however no unique theoretical model that can be invoked, to explain the income-fuel pricing relationship.

Finally, we explore the relationship between fuel subsidies and public-goods supply, as represented by public health expenditures. A main hypothesis is that countries with democratic governments are better run in several ways, by supplying more public goods (such as health services) and by less subsidies to (or by taxing) fuels. This ought to speak for a positive correlation between fuel prices and public health expenditures. This issue is however complex due to endogeneity, as both variables are likely to be determined simultaneously from more fundamental "causal" variables; and as high fuel subsidies may eliminate fiscal space for health-related outlays.

3. The Empirical Model

Our empirical model is aimed to test the relationship between fossil fuel end-user pricing by country in 1991 – 2010, are public goods provision, political institutions, and some key economic variables as indicated above. We estimate single equations where the dependent variable is pump fossil-fuel price in US cents in country *i* at time *t* (p_{it}). The basic equation is:

$$p_{it} = \alpha_i + \beta p_t^w + \sum_k \gamma_k x_{k,it} + \sum_l \delta_l y_{l,it} + \epsilon_{it} \qquad (1)$$

α_i is here a country fixed effect, while p_t^w is the world market price for the relevant fuel. $x_{k,it}$ are k economic and geographical control variables for country i at time t. $y_{l,it}$ represent institutional and political variables for country i at time t. The disturbance term is ε_{it}. Prices and subsidies are strongly related as fossil fuel subsidies are calculated by the price gap method which means that in equation (1) coefficient $\beta = 1$ (see also section 5).

We now discuss the reasons for including different explanatory variables, and the expected effects of these variables on fuel prices and net subsidies. As a (single) representation of the world market price, we use the crude oil price per liter in US$. The impact of the crude oil price on the pump price is expected to be positive.

Socio-economic control variables

The explanatory variables $x_{k,it}$ consist of a set of socio-economic determinants of fossil fuel prices. The first variable describes the level of economic development measured by gross domestic product (GDP) per capita in purchasing power parity (PPP) terms. A higher level of economic development is expected to lead to higher fossil fuel prices, for a variety of possible reasons. One is that energy costs are a smaller part of total expenses for the average consumer in higher income countries, and therefore energy price reducing subsidies as an instrument of income support is less important. Moreover, higher-income nations generally have better alternative transfer mechanisms reducing the incentive for politicians to "buy votes" through fossil fuel subsidies. Also, higher-income countries are generally managed better, and tend to have a higher priority for environmental quality, thus seeking to avoid the waste of resources and high pollution levels implied by fuel subsidies. On the other hand (and potentially working in the opposite direction), in high-income countries car ownership is typically more widespread so that gasoline subsidies benefit a larger share of the population. However, this effect is expected not to be strong due to the first reason. Domestic net oil supply is the second variable. If it is positive (negative) a country is a net oil exporter (importer). For countries with huge fossil fuel endowments like for instance Iran, Kuwait, Qatar and Yemen the cost of energy subsidies is low if international oil and gas prices are low. Although the opportunity costs of the subsidies-induced rise in domestic fuel consumption increase with the world market fuel price, net energy exporting countries will still experience lower (opportunity) costs than the (real) costs that net energy importing countries have to pay. Often energy companies in net energy exporting nations are state companies. This offers the governments a direct and tempting instrument to influence domestic energy prices. Countries that import most of their fossil fuels from abroad will consider subsidizing these commodities to be expensive particularly when financed through the central government's fiscal budget. As a result other expenditures are crowded out, particularly in the least developed countries with limited ability to raise taxes. Another factor is high populist pressure to set fuel prices low in countries with high production and export of fuels (often on the premise that the fuel "belongs to the people"). A natural prior hypothesis is then that an increase in net oil output (and exports) in most cases will lead to lower fossil fuel prices. A country with a larger area in squared kilometers (*Land per km*^{2}) is expensive to supply and hence likely to raise the basic fuel price, but likely leads to pressure to subsidize fuel prices for private transport use such that the fuel price may increase by less than the increase in cost. *Openness* is the sum of exports and imports of goods and services as a share of GDP and describes the openness of a country. Higher *Openness* might lead to less fuel subsidy (and higher domestic fuel prices), as a more open country has to adapt itself more to competitive conditions in the outside world. On the other hand, lower domestic fossil fuel prices might also be the result if governments try to shield off (part of) their population from world market price influences by means of energy subsidies. Hence the impact of *Openness* on the fossil fuel pump prices is expected to be ambiguous. Another important determinant of the end-prices of fossil fuel at the pump is the consumption of gasoline or diesel specifically for road transport. These are the variables *road gasoline (diesel) consumption per million inhabitants.* Strand (2013) points at an ambiguous effect of this variable. On the one hand, increased gasoline consumption means

that many potential voters use it – in particular, that part of the middle class that uses cars – who have an interest in or demand for gasoline subsidies. On the other hand, higher motor fuel consumption implies that subsidizing it becomes more expensive for the government, and makes gasoline subsidies less attractive than supplying public goods (Deacon, 2009). In this case higher *road gasoline (diesel) consumption per million inhabitants* will increase the end-price of gasoline (diesel). *Central government public health expenditure as a % of GDP* is a proxy to describe the provision of non-targeted goods by the central government.

Political and institutional variables

With regard to the $y_{l,it}$ (political and institutional) variables we focus on the incentives for downstream subsidies or targeted spending through the structure and working of the political system. More specifically, we pay attention to four aspects:

1) Lack of administrative capability and corruption control

2) Stability of the political (democratic or non-democratic) system

3) Potential power distribution through organization of the political system

4) Actual power distribution.

Provision of targeted energy subsidies is often a substitute for providing public goods due to political factors as emphasized by among others Deacon (2009) and McGuire and Olson (1996) but can also be explained by inability to provide public goods due to an inappropriate functioning government with a weak administrative capacity. Particularly in non-democratic and less developed countries corruption can be an important barrier against the sufficient supply of public goods.[8] In countries with a high control of corruption we expect fossil fuel end-use prices to be higher than in countries with less control, or fossil fuel subsidies will be higher. The variable *control of corruption*$_{i,t}$ is an index between 0 (no control) to 100 (perfect control) and is one of the governance indicators developed by the World Bank (Kaufman *et.al,* 2010). A higher score of this variable is expected to result in higher fossil fuel prices.

The *tenure of a (non-) democratic system* can be considered as the presence of political stability, which in democratic systems is based on frequent elections in which voters have the feeling that their voice is heart. Longer tenure of a non-democratic system is expected to lead to more targeted spending like energy subsidies on gasoline and diesel in order to stay in power. The relevant empirical variable is the *number of years a country has been democratic or non-democratic*. A long continuous period as a democracy is likely to reduce energy subsidies or increase energy prices as compared with non-democracies. In non-democratic countries, particularly those without elections, political stability – or maintaining power by the incumbent – is purchased by providing targeted spending to winning coalitions or groups that guarantee the power of the leader. Longer tenure of a non-democratic system can lead to more energy subsidies in order to stay in power. In other words, a larger number of years as a

[8] The riots in Nigeria in January 2012 against reducing subsidies at fossil fuel prices were mainly motivated by distrust of politicians to provide public goods. See "Nigerians Protest Rises in Oil Prices" *New York Times*, January 9, 2012.

non-democracy will increase energy subsidies or lower energy prices as compared with democracies.

In democratic societies the *tenure of rulers*$_{i,t}$ is likely not to affect energy subsidies as (non-rigged) elections are a mechanism for voters to get their voice heard. But in non-democratic societies this variable is expected to lead to lower energy prices or more energy subsidies as it is a means to "buy votes" in order stay in power.

Keefer (2009) points out and finds empirical evidence that politicians in young democracies have problems in making credible promises and hence will prefer to spend government resources on targeted spending while in democracies with a long experience credibility of politicians' promises to provide public goods is high. Targeted spending as a means to convince voters becomes less important. A regime switch from non-democracy to democracy (*Regime change from non-democracy to democracy*$_{i,t}$) can therefore go together with increased energy subsidies or *ceteris paribus* lower energy prices. Regime change the other way around is also expected to go together with lower energy prices as a non-democratic system is expected to subsidize energy in order to stay in power.

The voting rules, however, can have an impact on energy subsidies. For example, if swing votes are essential to gain and stay in power, a more targeted redistribution through energy subsidies might be a visible way to affect the voters' behavior (Persson and Tabellini, 2004). Therefore we expect a priori that presidential systems lead to more energy subsidies or lower energy prices than parliamentary systems (*Presidential system*$_{i,t}$). The same is valid for plurality voting systems over proportional representation voting systems. In other words, politicians in countries with proportional representation voting systems will experience less incentives to supply energy subsidies (*proportional representation*$_{i,t}$). For both variables we expect these effects to be stronger in non-democratic systems than in democratic systems.

The actual power distribution in a country's political system is presented as running up to power through executive or legislative) elections are held (*Elections*$_{i,t}$) and as concentration of power. The variable *Power concentration in parliament*$_{i,t}$ is a Herfindahl index of the government shares in parliament and is calculated as the sum of the squared seat shares of all parties in the government. This measure reveals actual power distribution, which is particularly relevant in non-democracies that have a parliament and do hold (rigged) elections (Deacon, 2009: 242). An increase in this Herfindahl index implies more political power in the hands of a limited number of parties and is supposed to affect fossil fuel end-user prices negatively (more subsidies) particularly in non-democracies. An alternative measure is whether the party of the executive has an absolute majority in the houses with lawmaking powers.

In Table 1 we summarize the impact of the independent variables $x_{k,it}$ and $y_{l,it}$ on pump fossil fuel prices p_{it}.

Table 1. Expected signs of independent variables $x_{k,it}$ and $y_{l,it}$ on pump fossil fuel prices p_{it}.

Variable	Sign	Variable	Sign
GDP purchasing power dollars per inhabitant$_{i,t-1}$	+	Presidential system$_{i,t}$	–
Net oil surplus$_{i,t-1}$	–	Presidential system democracies$_{i,t}$	
Land in km$^2_{i,t}$	–	Presidential system non-democracies$_{i,t}$	
Openness$_{i,t}$	+/–	Voting system is proportional representation$_{i,t}$	+
Road gas consumption per million inhabitants$_{i,t-1}$	+/–	Voting system is proportional representation in democracies$_{i,t}$	
Public health % GDP$_{i,t-1}$	+	Voting system is proportional representation in non-democracies$_{i,t}$	
Control of corruption$_{i,t}$	+	Elections in democracies$_{i,t}$	0/–
/Years country has democratic or non-democratic system$_{i,t}$	+	Elections in non-democracies$_{i,t}$	–
Years country has democratic system$_{i,t}$	+	Legislative elections in democracies$_{i,t}$	0/–
Years country has non-democratic system$_{i,t}$	–	Legislative elections in non-democracies$_{i,t}$	–
Years of executive in office$_{i,t}$	–	Party of executive controls all houses in democracies$_{i,t}$	0/–
Years of executive in office in democracy$_{i,t}$	0/–	Party of executive controls all houses in non-democracies$_{i,t}$	–
Years of executive in office in non-democracy$_{i,t}$	–	Herfindahl Index of government party seats in parliament in democracies$_{i,t}$	0/–
Regime change from non-democracy to democracy$_{i,t}$	–	Herfindahl Index of government party seats in parliament in non-democracies$_{i,t}$	–
Regime change from democracy to non-democracy$_{i,t}$	–		

4. The Data

The data are assembled on the basis of several data sets, related to energy pricing, and to economic and political characteristics of countries. The data for the dependent variable in equation (1) are annual diesel and premium gasoline prices, measured in November, with up to 10 observations for each country during the 1991-2010 period (GTZ, several years). We have merged these with data for premium gasoline, diesel and kerosene prices, for a large set of countries, for the period 2002- 2008, from the IMF, some of which overlap with the GTZ data (Coady *et.al*, 2010). We also have a set of data for prices on regular gasoline, but these cover far fewer countries than those for premium gasoline, and will not be further analyzed in this paper.

Table 2 sums up our available fuel data. We see that mean fuel prices are highest in high income OECD nations, except that average prices of regular gasoline in OECD and non-OECD high-income countries are very close. Second, prices in middle income countries are below those in the least developing countries; the latter presumably have less means to subsidize (most often imported) fossil fuels. Third, net oil exporters (found in all income groups) generally have the lowest average prices, consistent with the arguments offered above.

Table 2. Summary statistics for different fossil fuel prices in US $ cents per liter[9]

	Diesel		Premium gasoline		Regular gasoline		Kerosene	
	n	Mean (sd)	n	Mean (sd)	n	Mean (sd)	n	Mean (sd)
All countries	1899	71.25 (43.03)	1941	85.55 (44.75)	691	65.80 (35.87)	460	52.06 (31.05)
OECD high income countries	260	86.95 (40.08)	262	124.13 (41.26)	171	86.95 (39.41)	0	-
Non OECD high income countries	180	74.05 (55.77)	187	89.81 (57.70)	70	87.59 (32.38)	25	14.66 (6.62)
Upper middle income countries	329	68.88 (42.32)	348	80.54 (42.79)	180	57.90 (34.73)	64	45.56 (24.64)
Lower middle income countries	558	56.93 (35.03)	567	72.38 (36.12)	239	49.86 (23.97)	148	49.73 (34.69)
Low income countries	572	68.96 (37.37)	577	82.61 (40.45)	31	68.71 (23.79)	223	59.67 (28.06)
Oil exporters	452	45.25 (39.32)	460	56.60 (41.45)	170	51.04 (35.58)	149	33.31 (24.51)

- *World Bank country classification based on 2010*
- *n = number of (country-year) observations; sd = standard deviation;*

Source: Deutsche Gesellschaft für technische Zusammenarbeit (GTZ) for diesel-, premium gasoline- and kerosene prices. Regular gasoline prices originate from International Energy Agency.

The data on fuel prices were merged with data on independent socio-economic variables from the World Bank, IMF and United Nations, governance indicators from the World Bank Governance Indicators (WGI)[10] and with institutional and political variables originating from the 2010 release of the *Database on Political Institutions* (DPI).[11] The resulting panel dataset consists of an unbalanced panel of 201 countries for the period 1991 – 2009.

5. Fossil Fuel Energy Subsidies, Public Good Provision and Governance Institutions: Empirics

5.1 Fossil fuel energy subsidies and public good provision

In order to get a notion of what the data can tell us on the relationship between the provision of public goods by the central government and fossil fuel subsidies we first averaged the panel data over time. For the fossil fuel variables the mean for the period 2006 – 2010 was

[9] In Table 1, means are arithmetic across countries in each group; not weighted by country-specific consumption levels.
[10] Kaufman et.al, 2006.
[11] Keefer, 2010; Beck *et.al*, 2000. These are objective indicators of political institutions.

calculated and for potential explanatory variables we calculated the mean values for the period 1991- 2005.[12]

Fossil fuel subsidies were calculated by the price gap method, which implies calculating the difference between a benchmark and the actual fossil fuel prices paid at the pump. Our benchmark is the average fuel pump price in the United States in US$ cents per liter. For oil importing countries this price is reduced by US$ 0.10 per liter to allow for the costs of shipping the fuel from the hub to the country. Then we use this price as the benchmark price and subtract the domestic gasoline (or diesel) prices in order to get the gasoline (or diesel) subsidy rate. For the oil exporting countries the benchmark dollar price is defined as the fuel pump price in the United States minus US$0.10 per liter to allow for cost of shipping the fuel from the hub to the country and an additional US$ 0.10 per liter to remove the internal distribution and retailing costs in the domestic market of the oil exporter. These price gaps are identified as subsidies per liter of gasoline or diesel in US dollar cents and defined as:[13]

$PG^{imp} = P^{usa} - P^{dom} - 10$ for importing countries,

$PG^{exp} = P^{usa} - P^{dom} - 20$ for exporting countries

where PG^{imp} is the price gap for net energy importing countries, PG^{exp} is the price gap for net energy exporting countries, P^{hub} is the price of a unit of energy at the nearest international hub, and P^{dom} is the retail pump price of a unit of energy in the domestic market.

With regard to the relationship between fossil fuel subsidies and public goods provision variables we examine the relationship between diesel- and premium gasoline subsidies and the public goods provisions as expressed by *central government public health expenditures as a percentage of GDP*.[14]

Figures 1 – 4 show relationships between central government health expenditures as average share of GDP for the 1991 – 2005 period, and subsidies to diesel and premium gasoline in 2006 – 2009 respectively, separately for democratic and non-democratic governments. The democratic/non-democratic distinction is identified by two variables related to "legislative and executive political competition" in the DPI dataset (see Appendix B). Both, Legislative Index of Electoral Competition (*LIEC*) and the Executive Index of Electoral Competition (*EIEC*), range from 1 (no legislature, no elections) to 7 (elections with largest party or executive gets less than 75 % of the votes). A country is considered democratic if both LIEC and EIEC take the value 7; otherwise it is considered a non-democracy.

[12] The difference between periods for dependent and independent variables comes from cross-section estimates that are not reported here for reasons of space.

[13] We also calculated subsidies with the method as used by Coady et.al (2010) who uses the international hub dollar prices as the benchmark and found hardly differences in the ranking of countries with regard to their subsidy rate as reported in Figures 1 – 4 below. We prefer the benchmark price as described in the main text to escape the limited availability of the relevant hub prices.

[14] In many low-income countries regular gasoline is consumed more than premium gasoline. However, the number of observations for regular gasoline prices is substantially less than for premium gasoline prices. As in equation (1) the focus is on price levels and not on subsidy levels, and a positive correlation between the prices of both kinds of gasoline exists, we expect premium prices to be a good substitute.

This is a restrictive definition of democracy, and a broader definition of non-democracy. In this latter group quite a number of countries exist that exhibit democratic tendencies, but are not considered a pure democracy where voter costs of removing the incumbent are lowest.[15]

Figures 1-4 indicate negative relationships between fuel subsidies and government expenditures in democracies, and positive relationships (albeit much weaker) for non-democracies. We see from the graphs that the relationships are however not particularly strong. The positive relationship is maintained (in weaker form) for gasoline in non-democracies when Kuwait (a clear outlier in both figures 2 and 4) is removed in Figure 4; while the relationship for diesel prices, in Figure 2, then becomes a horizontal line. It is thus difficult to find any such systematic relationships for non-democracies; this is overall a very heterogeneous group.

[15] This distinction between democratic and non-democratic countries is hardly perfect. Note in particular that, in Figures 1 and 3, Venezuela is formally a democracy as the objective institutional structure is such that both measures of electoral competition get its highest score. It is possible that the institutional rules are changed such that the chances of the incumbent increase. For these factors other variables are present in DPI.

Figure 1. Dieselsubsidies (2006 – 2010) with USA $ price as benchmark, and public health expenditure: 65 democracies

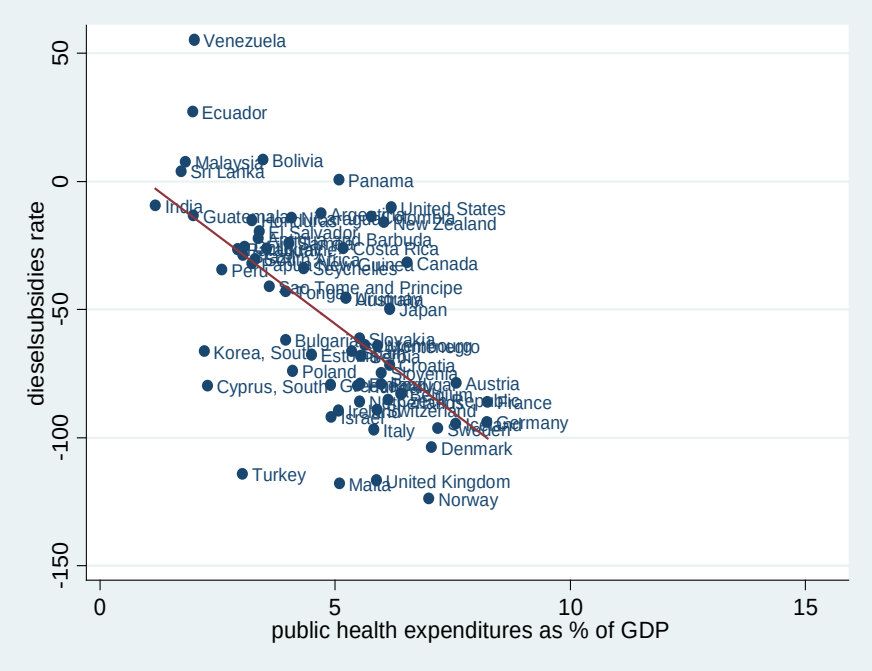

Figure 2 Dieselsubsidies (2006 – 2010) with USA $ price as benchmark, and public health expenditure: 105 non- democracies

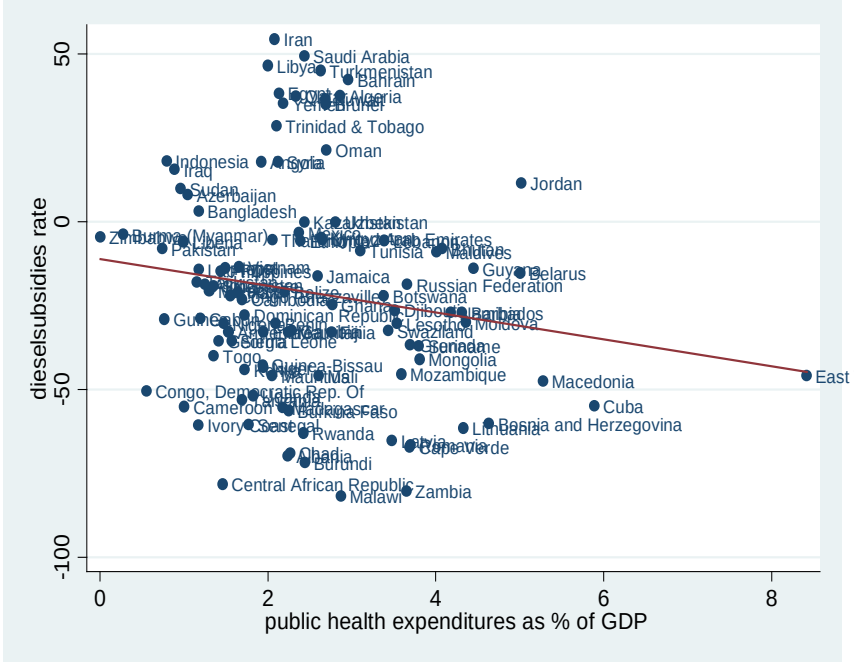

Figure 3 Gasolinesubsidies (2006 – 2010) with USA $ price as benchmark, and public health expenditure: 69 democracties

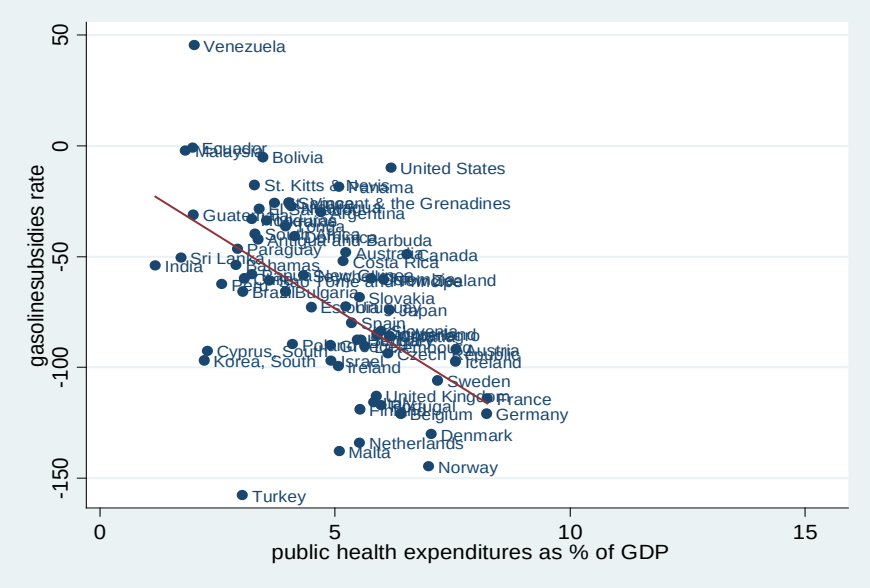

Figure 4 Gasolinesubsidies (2006 – 2010) with USA $ price as benchmark, and public health expenditure: 101 non- democracties

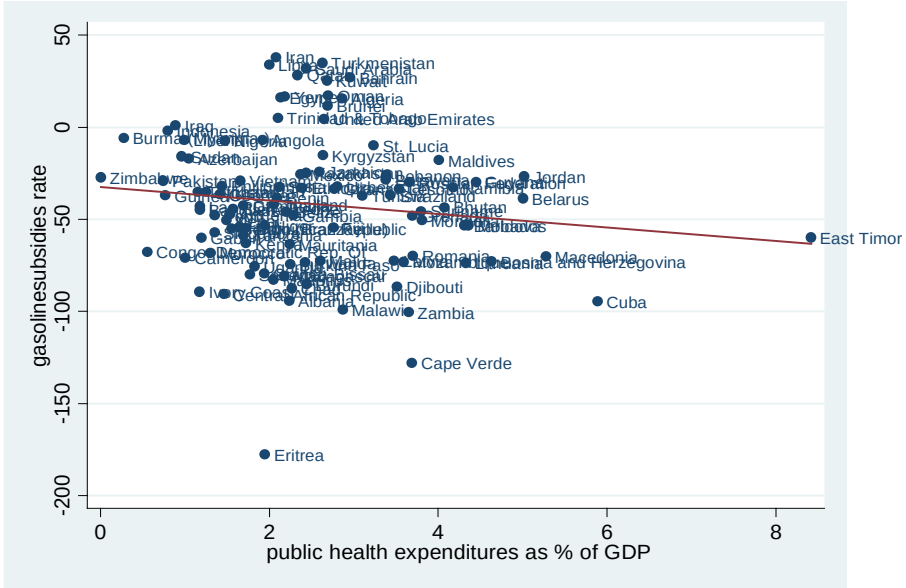

Table 3a: Determinants of gasoline prices: basic model without institutional and political variables, random effects

	GLS		2SLS			
	3.1	3.2	3.3	3.4	3.5	3.6
Crude oil price$_t$	1.225*** (0.077)	1.201*** (0.075)	0.853*** (0.119)	0.978*** (0.058)	0.858*** (0.120)	0.977*** (0.060)
GDP purchasing power dollars per inhabitant$_{i,t-1}$	0.0011*** (0.0003)	0.0007*** (0.0002)	0.0040*** (0.0008)	0.0007* (0.0004)	0.0032*** (0.0008)	0.0006 (0.0004)
Net oil surplus$_{i,t-1}$	-0.516*** (0.145)	-0.281** (0.122)	-0.586*** (0.163)	-0.578*** (0.124)	-0.414*** (0.142)	-0.486*** (0.117)
Land in km$^2_{i,t}$	-0.023** (0.009)	-0.021*** (0.008)	0.030 (0.022)	0.014 (0.015)	0.031 (0.021)	0.017 (0.016)
Openness$_{i,t}$	-0.113*** (0.038)	-0.086** (0.040)	-0.185*** (0.047)	-0.077** (0.047)	-0.108*** (0.041)	-0.084** (0.036)
Road gas consumption per million inhabitants$_{i,t-1}$	-0.062*** (0.013)	-0.069*** (0.011)	-0.325*** (0.083)	-0.107*** (0.083)	-0.276*** (0.072)	-0.106*** (0.028)
Public health % GDP$_{i,t-1}$, democracies		9.196*** (1.248)			8.808*** (1.112)	5.314*** (1.214)
Public health % GDP, correction for non-democracies$_{t-1}$		-4.959*** (0.815)			-3.561*** (1.171)	-2.152*** (0.934)
Constant included	Yes	Yes	Yes	Yes	Yes	Yes
R^2 within	0.582	0.589	0.503	0.586	0.535	0.592
R^2 overall	0.400	0.587	0.268	0.341	0.466	0.446
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,100	1,077	979	637	959	622

Notes: * = significant at 10 %; ** = significant at 5 %; *** = significant at 1 %; robust standard errors in parentheses

Table 3b: Determinants of diesel prices: basic model without institutional and political variables, random effects

	GLS		2SLS			
	3.7	3.8	3.9	3.10	3.11	3.12
Crude oil price$_t$	1.329*** (0.068)	1.319*** (0.067)	1.328*** (0.077)	1.100*** (0.050)	1.320*** (0.065)	1.045*** (0.060)
GDP purchasing power dollars per inhabitant$_{i,t-1}$	0.0009*** (0.0003)	0.0003 (0.0002)	0.0007 (0.0008)	0.0007 (0.0004)	0.0002 (0.0004)	0.0026** (0.0010)
Net oil surplus$_{i,t-1}$	-0.387*** (0.149)	-0.160 (0.124)	-0.415*** (0.150)	-0.297* (0.160)	-0.172 (0.109)	-0.024 (0.201)
Land in km$^2_{i,t}$	-0.029*** (0.008)	-0.030*** (0.007)	-0.028** (0.013)	0.002 (0.014)	-0.029*** (0.009)	0.007 (0.017)
Openness$_{i,t}$	-0.102*** (0.035)	-0.045 (0.039)	-0.111*** (0.042)	-0.093** (0.042)	-0.045 (0.043)	-0.017 (0.041)
Road diesel consumption per million inhabitants$_{i,t-1}$	-0.004 (0.007)	-0.006 (0.007)	0.015 (0.048)	-0.140*** (0.067)	0.001 (0.024)	-0.322*** (0.101)
Public health % GDP$_{i,t-1}$, democracies		8.786*** (1.206)			9.018*** (0.909)	3.726*** (1.343)
Public health % GDP, correction for non-democracies$_{t-1}$		-4.992*** (0.742)			-5.373*** (0.966)	-1.573 (0.989)
Constant included	Yes	Yes	Yes	Yes	Yes	Yes
R^2 within	0.639	0.642	0.601	0.656	0.606	0.626
R^2 overall	0.394	0.582	0.360	0.227	0.565	0.172
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,088	1,065	969	630	949	615

Notes: * = significant at 10 %; ** = significant at 5 %; *** = significant at 1 %; robust standard errors in parentheses

Due to simultaneity between the fuel prices at the pump and the quantity of the fuel (diesel or gasoline) consumed, we also report 2SLS estimates, where instruments used for the fuel consumption variables are *Population per km*^{2}, a *net-oil exporter dummy* and the *number of passenger cars per inhabitant*. (Higher population pressure is assumed to affect gasoline or diesel consumption negatively as more persons per km^2 leads to smaller travel distances and hence less demand for road fuels. Net-oil exporting countries are expected to have higher fuel consumption levels. More passenger cars relative to population also can be expected to increase per-capita motor fuel consumption levels.)[16]

In Tables 3a and 3b we present random-effects GLS and 2SLS regressions for a basic model without including any institutional or political variables. A first observation is the very strong effect of the crude oil price on gasoline and diesel prices in all regressions.[17] As the crude oil price is the basis for the fossil fuel prices at the pump this is of course as expected. Overall the partial effects are however in most cases greater than one, with exception of the 2SLS estimations for gasoline. This implies that an increase of crude oil by one cent leads to an increase in the gasoline or diesel price by more than one cent, when averaged over all countries. Note here however that fuel prices include the crude oil price but also costs and net profits in refining, distribution and transport. Systematic changes in these additional cost items with the basic crude price will then also influence the estimated coefficients for crude prices in these tables. One also needs to remember that motor fuels are subject to net taxes in many countries, and that some of these taxes take an ad valorem form (in particular, the VAT and sales taxes), leading to automatically higher unit fuel tax rates when the crude price increases.

All regressions (3.1) – (3.12) yield as expected positive and mostly significant impacts on fuel prices from increased GDP per capita.[18] Thus, countries with high average income also tend to have high fuel prices, and low fuel subsidies or high taxes. This confirms our expectation from the previous section. This variable is however sometimes not significant, which can to some degree be explained by the fact that the correlation between GDP per capita and road gas consumption per million inhabitants is very high.

Net oil surplus$_{i,t}$ shows a negative impact as expected. It shows that higher net oil surplus in a country reduces energy prices and ceteris paribus increases energy subsidies.

The GLS regressions show that a larger country (*Land in km*$^2_{i,t}$) has lower fuel prices. Interpretation is complex. A dispersed population could imply a low degree of negative externalities due to road traffic, which would naturally lead to low fuel taxes. But other factors may also be at work. Note in particular that estimating with 2SLS renders the country

[16] The first stage regressions are not reported but are available upon request. They show that the variables *Population per km*^{2} and *number of passenger cars per inhabitant* are strong instruments.

[17] We also estimate all models in this paper as a logarithmic specification and as a price ratio of pump price divided by crude oil price as dependent variable. The results of the price ratio were giving higher within R^2.

[18] In order to deal with simultaneity in the GLS regressions, GDP per capita, road gasoline and diesel consumption per capita are lagged by one year. In the 2SLS regressions fuel consumptions are the values generated in the first stage of estimation.

size impact insignificant in most cases. A country that is more open than other nations experiences lower energy prices and hence more energy subsidies (*Openness*$_{i,t}$). One interpretation of this result could be that governments attempt to shield off their citizens from world market influences by energy subsidies. Another factor may be tax competition which may hold back very open countries from taxing fuels.

Road gas consumption per million inhabitants$_{i,t-1}$ appears to affect gasoline prices negatively, so that gasoline subsidies are increased (or taxes reduced) when consumption is greater. This effect is highly significant also in the 2SLS estimation where simultaneity between the two variables is corrected for by instrumenting for the gasoline consumption level. It suggests that political leaders subsidize gasoline by more when gasoline consumption is larger; which is likely to represent a combination of a larger group of car owners, and larger gasoline consumption per car. A factor here is clearly the former: when the number of voters using gasoline and having an interest in subsidizing it, the political effect of subsidies is greater. This effect then seems to overshadow a possible countervailing effect, stressed by Strand (2012), whereby a larger gasoline volume to be subsidized could make subsidies more expensive for government and thus, potentially, less attractive as a fiscal measure. Note that, in regressions (3.4) and (3.6), the first stage regression includes the number of passenger cars per inhabitant as a determinant of the road gasoline consumption per inhabitant. The number of passenger cars in our dataset was only available for a restricted number of (mostly higher income) countries. This explains why the number of observations is substantially reduced. In regressions (3.3) and (3.5) the first stage regression was done without the passenger car variable. In Table 2b we can observe that in all regressions the *Road diesel consumption per million inhabitants*$_{i,t}$ is insignificant except when the number of passenger cars per inhabitant is used in the first stage of the 2SLS regressions (regressions (3.10) and (3.12).

A higher level of *public health expenditures as % of GDP*$_{i,t-1}$ provided by the central government as a measure of (non-targeted) public goods provision in the previous year, is associated with higher fossil fuel prices and ceteris paribus to less energy subsidies. This effect is strongly positive in democracies. The correction for non-democracies is downwards, which means that the effect is smaller (but still positive) in non-democracies. [19] The causal relationship is less clear. Central government public health expenditures are clearly a component of public expenditures. (Well-run) democratic countries are likely to have both good public health service systems, and low rates of fuel subsidies or, indeed, often substantial fuel taxes. This is in line with the picture presented by Figures 1 – 4 as well as the theoretical notions presented in section 2, i.e. democratic countries have less incentive than non-democratic nations to concentrate on targeted spending as a voters "buying" mechanism.

[19] A simple t-test shows that the estimates for the two variables are significantly different from each other. We also used the sum of public health and public education spending as % of GDP and this leads to the same conclusion although the estimated coefficients for non-democracies become insignificant.

Table 4a. Determinants of gasoline prices: basic model with variables on system stability: random effects.

	GLS				2SLS			
	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8
Crude oil price$_t$	1.205*** (0.079)	1.206*** (0.078)	1.251*** (0.079)	1.259*** (0.077)	0.959*** (0.096)	0.962*** (0.092)	1.033*** (0.089)	1.038*** (0.090)
GDP purchasing power dollars per inhabitant$_{i,t-1}$	0.00038* (0.00021)	0.00031 (0.00020)	0.00056** (0.00023)	0.00051** (0.00023)	0.0021*** (0.00053)	0.0020*** (0.00055)	0.0021*** (0.00054)	0.0021*** (0.00056)
Net oil surplus$_{i,t-1}$	-0.261** (0.106)	-0.234** (0.106)	-0.308*** (0.117)	-0.317*** (0.120)	-0.324*** (0.125)	-3.028** (0.124)	-0.324*** (0.125)	-0.387*** (0.132)
Land in km$^2_{i,t}$	-0.016** (0.008)	-0.019** (0.008)	-0.013* (0.008)	-0.014 (0.008)	0.020 (0.017)	0.019 (0.017)	0.019 (0.017)	0.023 (0.018)
Openness$_{i,t}$	-0.088** (0.038)	-0.081** (0.037)	-0.107*** (0.039)	-0.109*** (0.040)	-0.099*** (0.038)	-0.094** (0.037)	-0.122*** (0.037)	-0.124*** (0.039)
Road gas consumption per million inhabitants$_{i,t-1}$	-0.091*** (0.012)	-0.089*** (0.012)	-0.084*** (0.013)	-0.083*** (0.013)	-0.239*** (0.054)	-0.240*** (0.053)	-0.213*** (0.052)	-0.225*** (0.057)
Public health % GDP$_{i,t-1}$	4.738*** (1.209)	4.276*** (1.185)	6.642*** (1.168)	6.659*** (1.199)	3.413*** (1.270)	3.036*** (1.255)	5.862*** (1.104)	5.919*** (1.140)
Control of corruption$_{i,t}$	0.326*** (0.070)	0.297*** (0.071)	0.383*** (0.070)	0.387*** (0.070)	0.470*** (0.104)	0.457*** (0.105)	0.516*** (0.107)	0.541*** (0.113)
Years country has had democratic or non-democratic system$_{i,t}$	0.537*** (0.097)				0.648*** (0.134)			
Years country has had democratic system$_{i,t}$		0.653*** (0.100)				0.729*** (0.135)		
Years country has had non-democratic system$_{i,t}$		-0.019 (0.116)				0.053 (0.156)		
Years of executive in office$_{i,t}$	-0.475*** (0.126)				-0.574*** (0.153)			
Years of executive in office in democracy$_{i,t}$			-0.070 (0.160)				-0.216 (0.209)	
Years of executive in office in non-democracy$_{i,t}$			-0.198 (0.127)				-0.204 (0.150)	
Regime change from non-democracy to democracy$_{i,t}$				-4.389 (3.496)				-3.659 (7.164)
Regime change from democracy to non-democracy$_{i,t}$				-1.890 (3.942)				-2.738 (5.513)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 within	0.593	0.595	0.588	0.590	0.570	0.570	0.570	0.571
R^2 overall	0.609	0.614	0.588	0.578	0.566	0.569	0.566	0.532
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,074	1,074	1,074	1,076	957	957	957	958

Notes: * = significant at 10 %; ** = significant at 5 %; *** = significant at 1 %; robust standard errors in parentheses

Table 4b. Determinants of diesel prices: basic model with variables on system stability: random effects.

	GLS				2SLS			
	4.9	4.10	4.11	4.12	4.13	4.14	4.15	4.16
Crude oil price$_t$	1.330*** (0.071)	1.326*** (0.070)	1.366*** (0.071)	1.360*** (0.069)	1.337*** (0.072)	1.319*** (0.073)	1.374*** (0.069)	1.376*** (0.070)
GDP purchasing power dollars per inhabitant$_{i,t-1}$	0.00035 (0.00023)	-0.0005 (0.0002)	0.0002 (0.00024)	0.0002 (0.00024)	0.0001 (0.0005)	0.000004 (0.0005)	0.00004 (0.0005)	0.0001 (0.0005)
Net oil surplus$_{i,t-1}$	-0.159 (0.130)	-0.121 (0.129)	-0.195 (0.136)	-0.213 (0.138)	-0.190 (0.123)	-0.143 (0.127)	-0.209* (0.113)	-0.242*** (0.120)
Land in km$^2_{i,t}$	-0.032*** (0.008)	-0.035*** (0.008)	-0.028*** (0.007)	-0.027*** (0.008)	-0.030*** (0.010)	-0.034*** (0.011)	-0.027*** (0.009)	-0.026*** (0.010)
Openness$_{i,t}$	-0.055 (0.040)	-0.045 (0.040)	-0.068* (0.040)	-0.067* (0.041)	-0.062 (0.048)	-0.045 (0.049)	-0.074* (0.044)	-0.081* (0.047)
Road diesel consumption per million inhabitants$_{i,t-1}$	-0.005 (0.007)	-0.006 (0.007)	-0.004 (0.007)	-0.005 (0.007)	-0.005 (0.007)	-0.006 (0.031)	0.009 (0.026)	0.014 (0.028)
Public health % GDP$_{i,t-1}$	5.438*** (1.224)	4.850*** (1.195)	6.922*** (1.162)	6.912*** (1.191)	5.979*** (1.11)	5.282*** (1.132)	7.355*** (1.001)	7.439*** (1.035)
Control of corruption$_{i,t}$	0.130* (0.067)	0.089 (0.067)	0.180*** (0.064)	0.186*** (0.065)	0.110 (0.082)	0.063 (0.084)	0.160*** (0.079)	0.175** (0.080)
Years country has had democratic or non-democratic system$_{i,t}$	0.432*** (0.105)				0.382*** (0.118)			
Years country has had democratic system$_{i,t}$		0.607*** (0.110)				0.569*** (0.132)		
Years country has had non-democratic system$_{i,t}$		-0.148 (0.121)				-0.210 (0.139)		
Years of executive in office$_{i,t}$	-0.456*** (0.130)				-0.470*** (0.147)			
Years of executive in office in democracy$_{i,t}$			0.006 (0.167)				0.022 (0.200)	
Years of executive in office in non-democracy$_{i,t}$			-0.296** (0.138)				-0.401*** (0.143)	
Regime change from non-democracy to democracy$_{i,t}$				-13.776*** (3.496)				-11.203 (7.628)
Regime change from democracy to non-democracy$_{i,t}$				-2.893 (4.731)				-2.841 (5.437)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 within	0.647	0.650	0.642	0.645	0.610	0.614	0.605	0.606
R^2 overall	0.549	0.559	0.552	0.531	0.534	0.546	0.537	0.510
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,062	1,062	1,062	1,064	947	947	947	948

Notes: * = significant at 10 %; ** = significant at 5 %; *** = significant at 1 %; robust standard errors in parentheses.

5.2 Gasoline and diesel subsidies and governance institutions: Estimates on panel data

In Tables 4 – 6 we present the estimation results of equation (1) where political and other institutional variables are included as explanatory variables. These are empirically constructed along four characteristics:

1. Lack of corruption control
2. Stability of the political (democratic or autocratic) system
3. Potential power distribution through organization of the political system
4. Actual power distribution.

In Table 7 we distinguish between country groups: high income countries (HIC), upper middle income countries (UMC), lower middle income countries (LMC), and low income countries (LIC).

In Tables 4a and 4b, *Control of corruption*$_{i,t}$ affects gasoline and diesel prices positively and in most regressions significantly. Stronger control of corruption leads to higher fuel prices and to lower fossil fuel subsidies. This is in line with the idea of corruption leading to or being the result of inefficient governance, which reduces the government's credibility to provide public goods. Hence this provides an incentive to focus on visible and targeted transfers.

Years a country is democratic or non-democratic$_{i,t}$ is a measure of tenure irrespective of whether the system is democratic or not. In section 3 it was argued that a country with a political system that exists for a long period can be considered as stable, which increases fossil fuel prices and decreases subsidies.[20] Therefore the positive impact of tenure of a political institutional system in regressions (4.1), (4.5), (4.9) and (4.13) conforms to prior expectations. The longer a political system has persisted, the higher are gasoline and diesel prices. This holds in general, for pooled democratic and non-democratic regimes.

The variables *Years a country has a democratic system*$_{i,t}$ shows a significant positive coefficient for democracies, while the effect is insignificant for non-democratic nations. Thus the longer a country has remained a democracy, the higher gasoline and diesel prices are, and the lower gasoline and diesel subsidies are. We see that this result contrasts that for non-democratic regimes, where, from regressions (4.2), (4.6), (4.10) and (4.14), a longer non-democratic period generally impacts negatively on fuel prices (except in (4.6) where the effect is slightly positive). None of these effects is however significant; this contrasts effects for democratic governments which were all highly significant. To sum up, longer tenure of a democratic regime affects subsidies negatively, and strongly. For autocratic regimes, longer tenure affects subsidies positively, but only slightly and not significantly.

These results indicate a difference between tenure in a democracy where elections are a mechanism for voters to get their voice heard, and in autocracies where "voters" are likely to not be heard at all. An interesting insight emerges. A country that has just turned democratic

[20] The definition of a country being a (non-) democracy is reported in subsection 5.1.

is likely to have weak and unstable institutions, which here translates into a "weak" fuel pricing policy (low taxes, or subsidies). As democracy matures, politicians become less constrained and true preferences of broad voter groups are heard more clearly. This may often translate into less fuel subsidies. For non-democracies, no such mechanisms are at play. Here rulers are more likely to cater to narrow "selectorate" groups, where fuel subsidies may play more of a role even in the long run. Autocracies are also notoriously less capable of providing more valuable and complex public goods. Energy subsidies then become a key targeted spending instrument to "buy support", from key groups necessary to stay in power.

Another interesting finding is that regime switches, from democracy to non-democracy or the reverse, are in both cases found to affect fuel prices negatively, although the effects are generally weak. But this conclusion – particularly for the case of a regime switch from non-democracy to democracy - is more generally in line with other empirical evidence, e g that offered by Keefer (2009). The principal argument is that a "newly-born" democracy can be highly volatile and lack maturity, of both its political leadership and its central administration. This can prompt politicians to take "easy" actions in the short run, to minimize the likelihood of serious conflict that could upset regime stability. One such "easy" action is subsidizing fossil fuels.

Overall, our results regarding effects of regime switches and persistence display an interesting pattern. Once a switch from a non-democratic to a democratic regime occurs, we see an initial drop in fuel prices, and, subsequently, a gradual upward fuel price drift. When the opposite shift (from democratic to non-democratic government) occurs, there is also an initial drop in the price, but no subsequent systematic upward drift.

If we focus on the tenure of the executive politician, measured in number of years, we find results that are statistically significant. The longer an executive politician is in power the lower (higher) the fossil fuel prices (subsidies). The effect is strongest in non-democracies for diesel price relationships. If a non-democratic ruler stays longer in power, diesel prices are in this case lower and hence subsidies to diesel higher.

Tables 5a and 5b presents the results of the way the political system is organized. The first relevant variable *Presidential system*$_{i,t}$ is whether the system is parliamentary, or presidential. This variable runs from 0 to 2 and is defined for an Executive Index of Electoral Competition (*EIEC*) larger than 3 (see Appendix B). The value 0 is attributed to countries with a parliamentary system, i.e. with no president or where the legislature elects the chief executive (as e.g. in Germany) except when the legislature cannot easily recall the chief executive (e.g. 2/3 votes for impeachment or when legislation should be dissolved before forcing the chief executive out). In the latter case, and also then president is assembly-elected, the value is 1. Presidential systems with presidents elected directly or by an electoral college (e.g. USA) gets a value 2.

We find a negative and significant effect for a presidential system on both diesel- and gasoline prices. This is not unexpected, as direct voting of a president (as in the USA) makes swing votes essential (Persson and Tabellini, 1999). This stimulates a more targeted redistribution of public resources, which can often be done through clearly visible fossil fuel

Table 5a. Determinants of gasoline prices: basic model with variables on system organization: random effects.

	GLS				2 SLS			
	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8
Crude oil price$_t$	1.311*** (0.083)	1.305*** (0.083)	1.249*** (0.078)	1.242*** (0.078)	1.125*** (0.096)	1.131*** (0.095)	1.077*** (0.092)	1.068*** (0.092)
GDP purchasing power dollars per inhabitant$_{i,t-1}$	0.00108*** (0.00021)	0.00108*** (0.00021)	0.0009*** (0.00021)	0.0010*** (0.0002)	0.023*** (0.0005)	0.0022*** (0.0005)	0.0023*** (0.0005)	0.0023*** (0.0005)
Net oil surplus$_{i,t-1}$	-0.074 (0.123)	-0.069 (0.122)	-0.196 (0.132)	-0.186 (0.134)	-0.303* (0.182)	-0.283 (0.182)	-0.355** (0.155)	-0.355** (0.160)
Land in km$^2_{i,t}$	-0.021*** (0.008)	-0.022*** (0.008)	-0.016** (0.008)	-0.016** (0.008)	-0.006 (0.019)	-0.003 (0.019)	0.008 (0.017)	0.009 (0.017)
Openness$_{i,t}$	-0.134** (0.037)	-0.128** (0.037)	-0.103*** (0.038)	-0.107*** (0.038)	-0.143*** (0.038)	-0.139*** (0.038)	-0.123*** (0.038)	-0.126*** (0.038)
Road gas consumption per million inhabitants$_{i,t-1}$	-0.065*** (0.014)	-0.065*** (0.014)	-0.077*** (0.014)	-0.080*** (0.014)	-0.169*** (0.058)	-0.163*** (0.058)	-0.179*** (0.053)	-0.184*** (0.054)
Public health % GDP$_{i,t-1}$	4.074*** (1.197)	4.089*** (1.194)	5.355*** (1.210)	5.541*** (1.214)	4.176*** (1.176)	4.172*** (1.174)	4.754*** (1.129)	4.935*** (1.148)
Control of corruption$_{i,t}$	0.281*** (0.073)	0.260*** (0.072)	0.310*** (0.072)	0.319*** (0.072)	0.324*** (0.112)	0.301*** (0.112)	0.400*** (0.108)	0.412*** (0.109)
Presidential system$_{i,t}$	-5.297*** (1.959)				-4.658** (2.289)			
Presidential system democracies$_{i,t}$		-4.468*** (1.963)				-3.972* (2.315)		
Presidential system non-democracies$_{i,t}$		-8.981*** (2.389)				-7.986*** (2.816)		
Voting system is proportional representation$_{i,t}$			9.499*** (3.074)				5.068 (4.526)	
Voting system is proportional representation in democracies$_{i,t}$				5.733* (3.144)				2.646 (4.140)
Voting system is proportional representation in non-democracies$_{i,t}$				7.066* (3.688)				8.405 (7.169)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 within	0.630	0.631	0.616	0.613	0.630	0.629	0.613	0.611
R^2 overall	0.612	0.614	0.604	0.603	0.612	0.608	0.601	0.594
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	915	915	974	972	813	813	861	859

Notes: * = significant at 10 %; ** = significant at 5 %; *** = significant at 1 %; robust standard errors in parentheses.

Table 5b. Determinants of diesel prices: basic model with variables on system organization: random effects.

	GLS				2SLS			
	5.9	5.10	5.11	5.12	5.13	5.14	5.15	5.16
Crude oil price$_t$	1.456*** (0.076)	1.453*** (0.076)	1.389*** (0.072)	1.389*** (0.073)	1.494*** (0.081)	1.495*** (0.082)	1.405*** (0.077)	1.409*** (0.078)
GDP purchasing power dollars per inhabitant$_{i,t-1}$	0.001*** (0.0002)	0.001*** (0.0003)	0.0006** (0.0003)	0.0006** (0.0003)	0.0004 (0.0006)	0.0004 (0.0006)	0.0004 (0.0006)	0.0004 (0.0006)
Net oil surplus$_{i,t-1}$	0.130 (0.103)	0.134 (0.103)	0.003 (0.126)	0.021 (0.128)	0.069 (0.143)	0.071 (0.142)	-0.027 (0.141)	-0.009 (0.143)
Land in km$^2_{i,t}$	-0.032*** (0.007)	-0.033*** (0.006)	-0.029*** (0.007)	-0.030*** (0.007)	-0.031*** (0.010)	-0.032*** (0.010)	-0.029*** (0.020)	-0.029*** (0.020)
Openness$_{i,t}$	-0.097** (0.042)	-0.092** (0.042)	-0.060 (0.044)	-0.065 (0.044)	-0.131*** (0.047)	-0.128*** (0.047)	-0.088** (0.049)	-0.097* (0.050)
Road diesel consumption per million inhabitants$_{i,t-1}$	-0.010 (0.006)	-0.010 (0.006)	-0.007 (0.007)	-0.006 (0.007)	0.024 (0.026)	0.024 (0.026)	0.013 (0.028)	0.017 (0.029)
Public health % GDP$_{i,t-1}$	3.747*** (1.137)	3.762*** (1.138)	5.580*** (1.269)	5.799*** (1.274)	4.299*** (1.205)	4.310*** (1.204)	5.554*** (1.166)	5.906*** (1.183)
Control of corruption$_{i,t}$	0.100 (0.069)	0.083 (0.068)	0.144** (0.067)	0.153** (0.068)	0.068 (0.088)	0.058 (0.088)	0.125 (0.087)	0.139 (0.088)
Presidential system$_{i,t}$	-7.004*** (2.021)				-6.846*** (2.421)			
Presidential system democracies$_{i,t}$		-6.325*** (2.041)				-6.341*** (2.448)		
Presidential system non-democracies$_{i,t}$		-9.991*** (2.474)				-9.313*** (2.958)		
Voting system is proportional representation$_{i,t}$			9.987*** (3.158)				10.562*** (4.326)	
Voting system is proportional representation in democracies$_{i,t}$				4.962 (3.398)				4.538 (4.127)
Voting system is proportional representation in non-democracies$_{i,t}$				3.047 (3.637)				6.763 (7.260)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 within	0.690	0.691	0.672	0.670	0.657	0.658	0.642	0.639
R^2 overall	0.606	0.609	0.570	0.564	0.566	0.567	0.549	0.541
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	904	904	963	961	803	803	851	849

Notes: * = significant at 10 %; ** = significant at 5 %; *** = significant at 1 %; robust standard errors in parentheses.

Table 6a. Determinants of gasoline prices: basic model with variables on actual power distribution in system, 2SLS with random effects.

	GLS				2 SLS			
	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8
Crude oil price$_t$	1.258*** (0.077)	1.263*** (0.077)	1.279*** (0.089)	1.261*** (0.081)	1.032*** (0.090)	1.039*** (0.090)	1.085*** (0.096)	1.024*** (0.093)
GDP purchasing power dollars per inhabitant$_{i,t-1}$	0.00058** (0.00023)	0.00051** (0.00023)	0.0012*** (0.00021)	0.0006*** (0.0002)	0.0022*** (0.0006)	0.0022*** (0.0006)	0.0024*** (0.0005)	0.0023*** (0.0006)
Net oil surplus$_{i,t-1}$	-0.315*** (0.120)	-0.313*** (0.121)	-0.245* (0.145)	-0.274** (0.112)	-0.387*** (0.132)	-0.386*** (0.132)	-0.320** (0.159)	-0.376*** (0.127)
Land in km$^2_{i,t}$	-0.014* (0.008)	-0.013* (0.008)	-0.036*** (0.012)	-0.014* (0.008)	0.023 (0.018)	0.023 (0.018)	0.011*** (0.028)	0.025 (0.018)
Openness$_{i,t}$	-0.112*** (0.040)	-0.110*** (0.040)	-0.146*** (0.042)	-0.101** (0.041)	-0.128*** (0.039)	-0.124*** (0.039)	-0.148*** (0.040)	-0.120*** (0.039)
Road gas consumption per million inhabitants$_{i,t-1}$	-0.083*** (0.013)	-0.082*** (0.013)	-0.071*** (0.014)	-0.087*** (0.013)	-0.228*** (0.057)	-0.226*** (0.057)	-0.180*** (0.056)	-0.237*** (0.054)
Public health % GDP$_{i,t-1}$	6.618*** (1.202)	6.594*** (1.201)	4.134*** (1.257)	6.614*** (1.182)	5.862*** (1.142)	5.869*** (1.140)	4.040*** (1.129)	5.775*** (1.144)
Control of corruption$_{i,t}$	0.388*** (0.070)	0.386*** (0.070)	0.317*** (0.073)	0.354*** (0.072)	0.546*** (0.113)	0.542*** (0.113)	0.394*** (0.103)	0.528*** (0.112)
Elections in democracies$_{i,t}$	0.748 (1.536)				0.642 (1.724)			
Elections in non-democracies$_{i,t}$	-3.648 (2.350)				-3.759 (3.497)			
Legislative elections in democracies$_{i,t}$		1.192 (1.517)				1.207 (1.656)		
Legislative elections in nondemocracies$_{i,t}$		-2.487 (1.809)				-2.618 (2.616)		
Party of executive controls all houses in democracies$_{i,t}$			-1.875 (2.213)				-1.365 (2.414)	
Party of executive controls all houses in non-democracies$_{i,t}$			-6.579** (3.045)				-6.241* (3.346)	
Herfindahl Index of government party seats in parliament in democracies$_{i,t}$				-5.055 (3.574)				-5.079 (4.105)
Herfindahl Index of government party seats in parliament in non-democracies$_{i,t}$				-17.748*** (3.769)				-15.018*** (4.714)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 within	0.591	0.591	0.609	0.594	0.571	0.572	0.605	0.587
R^2 overall	0.578	0.578	0.606	0.603	0.530	0.532	0.593	0.537
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,077	1,077	940	1,024	959	959	839	908

Notes: * = significant at 10 %; ** = significant at 5 %; *** = significant at 1 %; robust standard errors in parentheses.

Table 6b. Determinants of diesel prices: basic model with variables on actual power distribution in system: random effects.

	GLS				2SLS			
	6.9	6.10	6.11	6.12	6.13	6.14	6.15	6.8
Crude oil price$_t$	1.358*** (0.069)	1.362*** (0.070)	1.388*** (0.076)	1.377*** (0.074)	1.372*** (0.070)	1.378*** (0.070)	1.394*** (0.078)	1.362*** (0.074)
GDP purchasing power dollars per inhabitant$_{i,t-1}$	0.002 (0.002)	0.0002 (0.0002)	0.001*** (0.0002)	0.0002 (0.0003)	0.0001 (0.0005)	0.0001 (0.0005)	0.001* (0.0006)	0.0003 (0.0005)
Net oil surplus$_{i,t-1}$	-0.212 (0.137)	-0.207 (0.137)	-0.013 (0.140)	-0.150 (0.124)	-0.240** (0.118)	-0.239** (0.120)	-0.041 (0.158)	-0.162 (0.118)
Land in km$^2_{i,t}$	-0.028*** (0.008)	-0.028*** (0.008)	-0.054*** (0.010)	-0.029*** (0.007)	-0.026*** (0.010)	-0.026*** (0.010)	-0.053*** (0.014)	-0.029*** (0.010)
Openness$_{i,t}$	-0.071* (0.041)	-0.070* (0.041)	-0.112*** (0.041)	-0.058 (0.040)	-0.081* (0.046)	-0.080* (0.047)	-0.127*** (0.047)	-0.047 (0.047)
Road diesel consumption per million inhabitants$_{i,t-1}$	-0.005 (0.007)	-0.005 (0.007)	-0.012* (0.007)	-0.004 (0.007)	0.013 (0.028)	0.013 (0.028)	-0.003 (0.025)	-0.113 (0.027)
Public health % GDP$_{i,t-1}$	6.871*** (1.191)	6.785*** (1.188)	4.068*** (1.190)	7.058*** (1.187)	7.438*** (1.028)	7.345*** (1.032)	4.477*** (1.145)	7.334*** (1.054)
Control of corruption$_{i,t}$	0.195*** (0.068)	0.193*** (0.065)	0.153** (0.067)	0.165*** (0.066)	0.180** (0.080)	0.176** (0.080)	0.126 (0.085)	0.134 (0.083)
Elections in democracies$_{i,t}$	-1.202 (1.560)				-1.154 (1.723)			
Elections in non-democracies$_{i,t}$	-0.734 (2.408)				-1.391 (3.452)			
Legislative elections in democracies$_{i,t}$		1.565 (1.484)				1.401 (1.662)		
Legislative elections in non-democracies$_{i,t}$		-2.534 (2.004)				-3.250 (2.562)		
Party of executive controls all houses in democracies$_{i,t}$			-2.227 (2.076)				-1.674 (2.386)	
Party of executive controls all houses in non-democracies$_{i,t}$			-6.183** (2.598)				-6.188* (3.333)	
Herfindahl Index of government party seats in parliament in democracies$_{i,t}$				-4.567 (3.427)				-4.448 (3.940)
Herfindahl Index of government party seats in parliament in non-democracies$_{i,t}$				-17.345*** (3.906)				-17.831*** (4.560)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 within	0.644	0.644	0.678	0.647	0.606	0.607	0.645	0.619
R^2 overall	0.531	0.533	0.598	0.583	0.511	0.513	0.576	0.564
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,065	1,065	930	1,012	949	949	830	898

Notes: * = significant at 10 %; ** = significant at 5 %; *** = significant at 1 %; robust standard errors in parentheses.

subsidies. A distinction between presidential systems in democracies and non-democracies reveals that this effect appears to be somewhat stronger in non-democracies, but the difference is not significant. Thus in both democracies and non-democracies, presidential systems result in higher fossil fuel subsidies.

A similar result is found when voting procedures are taken into account. Swing votes play an important role with respect to gaining or staying in power in plurality voting systems, but much less so in voting systems with proportional representation. The variable *Voting system is proportional representation*$_{i,t}$ is a dummy variable taking a value of 1 for a country characterized by proportional representation voting, and 0 otherwise. The empirical effect is significantly positive. Countries with proportional representation voting systems lead to higher diesel and gasoline prices – thus less subsidies – than countries characterized by plurality voting. This is in line with the findings of others such as Persson and Tabellini (1999); and with the political theory of Keefer (2013). Distinguishing democracies from autocracies leads to loss of significance, but the positive effects remain intact.

Tables 6a and 6b report estimation results of political institutional variables describing (running up to) the actual power distribution. Two notions are important. In order to gain a favorable power distribution by means of elections, visible measures such as fossil fuel energy subsidies in both democracies and non-democracies are an important mechanism to "buy votes". In an election year we do expect a priori downward pressure on fossil fuel prices.

The variables *Elections in (non-)democracies*$_{i,t}$ is a dummy with value 1 if the years for an incumbent executive politician left in a current term is zero, and 0 otherwise. The variables *Legislative elections in (non-) democracies*$_{i,t}$ is a dummy variable with value 1 in years in which a legislative election was held, and 0 otherwise.

The results in Table 6a for gasoline prices show that a negative sign is found for elections in non-democracies – and specifically executive elections – though insignificant. For diesel prices in Table 6b the effects are also negative and insignificant. These results show a tendency of downward pressure on fossil fuel prices but the effects are too weak to draw a strong conclusion that elections increase fossil fuel subsidies.

To incorporate the actual power distribution in the empirical analysis, we use two variables. The first is a dummy with value 1 if the party of the present executive has an absolute majority in houses with lawmaking powers, and 0 otherwise. The second is a Herfindahl index: the sum of squared seat shares of all parties in parliament (wherever applicable), a continuous variable ranging from 0 (no concentration) to 1 (all seats in the hands of one party).

The results in both Tables 6a and 6b show a similar pattern for the dummy and Herfindahl variables: a negative though insignificant effect for concentration of power in democratic countries; and a significant negative effect for non-democratic nations. In other words, in countries with a higher concentration of political power in the hands of government parties, gasoline and fossil fuel prices are lower or subsidies higher.

Table 7a. Determinants of gasoline prices: basic model with variables distinguished between low- and high-income categories: random effects.

	GLS				2 SLS			
	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8
Crude oil price$_t$	1.288*** (0.079)	1.254*** (0.078)	1.310*** (0.084)	1.279*** (0.084)	1.094*** (0.087)	1.049*** (0.087)	1.139*** (0.092)	1.105*** (0.080)
GDP purchasing power dollars per inhabitant$_{i,t-1}$	0.0001 (0.0002)	0.0005*** (0.0002)	0.0011*** (0.0002)	0.0004*** (0.0003)	0.002*** (0.0005)	0.002*** (0.001)	0.0022*** (0.005)	0.0016*** (0.0004)
Net oil surplus$_{i,t-1}$	-0.221** (0.104)	-0.302*** (0.117)	0.054 (0.132)	-0.282** (0.117)	-0.291** (0.116)	-0.372*** (0.126)	-0.120 (0.164)	-0.347*** (0.122)
Land in km$^2_{i,t}$	-0.015** (0.008)	-0.012 (0.008)	-0.020*** (0.007)	-0.012 (0.008)	0.017 (0.015)	0.018 (0.017)	0.019 (0.017)	0.015 (0.015)
Openness$_{i,t}$	-0.076** (0.037)	-0.105*** (0.039)	-0.128*** (0.036)	-0.102** (0.041)	-0.081** (0.036)	-0.119*** (0.038)	-0.136*** (0.037)	-0.115*** (0.038)
Road gas consumption per million inhabitants$_{i,t-1}$	-0.096*** (0.012)	-0.084*** (0.013)	-0.072*** (0.014)	-0.094*** (0.015)	-0.228*** (0.049)	-0.206*** (0.053)	-0.166*** (0.054)	-0.199*** (0.047)
Public health % GDP$_{i,t-1}$	4.613*** (1.169)	6.475*** (1.182)	4.510*** (1.167)	6.923*** (1.205)	3.265*** (1.247)	5.821*** (1.111)	4.630*** (1.155)	6.289*** (1.125)
Control of corruption$_{i,t}$	0.333*** (0.068)	0.377*** (0.071)	0.277*** (0.072)	0.373*** (0.072)	0.450*** (0.094)	0.500*** (0.106)	0.291*** (0.102)	0.467*** (0.096)
Years HIC country has democratic or non-democratic system$_{i,t}$	0.661*** (0.101)				0.805*** (0.141)			
Years UMC country has democratic or non-democratic system$_{i,t}$	-0.168 (0.216)				-0.095 (0.213)			
Years LMC country has democratic or non-democratic system$_{i,t}$	-0.301** (0.143)				-0.443** (0.188)			
Years LIC country has democratic or non-democratic system$_{i,t}$	0.618* (0.370)				0.351 (0.363)			
Years of executive in office in HIC countries$_{i,t}$		0.198 (0.196)				0.125 (0.244)		
Years of executive in office in UMC countries$_{i,t}$		-0.695** (0.300)				-0.537* (0.294)		
Years of executive in office in LMC countries$_{i,t}$		-0.221 (0.144)				-0.320 (0.217)		
Years of executive in office in LIC countries$_{i,t}$		-0.137 (0.291)				-0.216 (0.294)		
Presidential system HIC countries$_{i,t}$			7.602 (5.731)				11.365** (5.503)	
Presidential system UMC countries$_{i,t}$			-8.882*** (2.605)				-8.714*** (3.241)	
Presidential system LMC countries$_{i,t}$			-9.550*** (2.286)				-9.531*** (2.911)	

Presidential system LIC countries$_{i,t}$			-1.146 (2.962)				-2.150 (3.562)	
Herfindahl Index in HIC countries$_{i,t}$				4.684 (9.180)				9.244 (8.697)
Herfindahl Index in UMC countries$_{i,t}$				-10.429** (4.654)				-9.539** (5.113)
Herfindahl Index in LMC countries$_{i,t}$				-16.351*** (4.108)				-16.016*** (5.115)
Herfindahl Index in LIC countries$_{i,t}$				-2.424 (5.410)				-3.955 (6.898)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 within	0.598	0.510	0.631	0.591	0.580	0.576	0.628	0.596
R^2 overall	0.633	0.590	0.642	0.611	0.611	0.563	0.638	0.583
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,074	1,074	915	1.024	957	957	813	908

Notes: * = significant at 10 %; ** = significant at 5 %; *** = significant at 1 %; robust standard errors in parentheses.

Table 7b. Determinants of diesel prices: basic model with variables distinguished between low- and high-income categories: random effects.

	GLS				2 SLS			
	7.9	7.10	7.11	7.12	7.13	7.14	7.15	7.16
Crude oil price$_t$	1.409*** (0.076)	1.363*** (0.071)	1.448*** (0.078)	1.348*** (0.077)	1.428*** (0.076)	1.370*** (0.070)	1.488*** (0.081)	1.328*** (0.081)
GDP purchasing power dollars per inhabitant$_{i,t-1}$	0.0002 (0.0002)	0.0002 (0.0002)	0.0010*** (0.0002)	0.0004 (0.0003)	-0.0003 (0.0005)	-0.0001 (0.0001)	0.0004 (0.0006)	0.0006 (0.0006)
Net oil surplus$_{i,t-1}$	-0.133 (0.131)	-0.197 (0.137)	0.161 (0.126)	-0.181 (0.133)	-0.168 (0.126)	-0.215* (0.113)	0.104 (0.121)	-0.191 (0.124)
Land in km$^2_{i,t}$	-0.032*** (0.008)	-0.028*** (0.008)	-0.031*** (0.007)	-0.026*** (0.008)	-0.030*** (0.010)	-0.026*** (0.009)	-0.030*** (0.010)	-0.026*** (0.010)
Openness$_{i,t}$	-0.048* (0.040)	-0.068* (0.041)	-0.093** (0.041)	-0.067* (0.040)	-0.057 (0.049)	-0.076* (0.044)	-0.126*** (0.045)	-0.057 (0.050)
Road diesel consumption per million inhabitants$_{i,t-1}$	-0.005 (0.007)	-0.005 (0.007)	-0.010* (0.006)	-0.005 (0.007)	0.006 (0.029)	0.011 (0.025)	0.022 (0.028)	-0.013 (0.029)
Public health % GDP$_{i,t-1}$	5.420*** (1.214)	6.790*** (1.178)	4.081*** (1.112)	7.672*** (1.254)	5.976*** (1.128)	7.411*** (1.003)	4.592*** (1.182)	8.059*** (1.089)
Control of corruption$_{i,t}$	0.139** (0.066)	0.185*** (0.065)	0.130* (0.067)	0.244*** (0.069)	0.120 (0.082)	0.177** (0.079)	0.093 (0.088)	0.209** (0.084)
Years HIC country has democratic or non-democratic system$_{i,t}$	0.491*** (0.111)				0.453*** (0.136)			
Years UMC country has democratic or non-democratic system$_{i,t}$	-0.168 (0.231)				-0.257 (0.216)			
Years LMC country has democratic or non-democratic system$_{i,t}$	-0.189** (0.153)				-0.215 (0.190)			
Years LIC country has democratic or non-democratic system$_{i,t}$	0.274 (0.266)				0.082 (0.375)			
Years of executive in office in HIC countries$_{i,t}$		-0.069 (0.248)				-0.356 (0.235)		
Years of executive in office in UMC countries$_{i,t}$		-0.573* (0.321)				-0.458* (0.277)		
Years of executive in office in LMC countries$_{i,t}$		-0.129 (0.156)				-0.197 (0.211)		
Years of executive in office in LIC countries$_{i,t}$		-0.242 (0.190)				-0.162 (0.289)		
Presidential system HIC countries$_{i,t}$			-5.488 (7.298)				-4.980 (5.043)	
Presidential system UMC countries$_{i,t}$			-8.647*** (2.736)				-8.201** (3.348)	
Presidential system LMC countries$_{i,t}$			-9.462*** (2.323)				-9.119*** (3.060)	

Presidential system LIC countries$_{i,t}$			2.586 (2.864)				0.619 (3.759)	
Herfindahl Index in HIC countries$_{i,t}$				-19.865** (9.135)				-19.857** (8.150)
Herfindahl Index in UMC countries$_{i,t}$				-8.119* (4.705)				-8.953* (5.263)
Herfindahl Index in LMC countries$_{i,t}$				-10.092*** (3.790)				-9.425* (5.057)
Herfindahl Index in LIC countries$_{i,t}$				7.459 (5.010)				7.405 (6.795)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 within	0.648	0.644	0.690	0.649	0.610	0.605	0.657	0.621
R^2 overall	0.498	0.541	0.637	0.575	0.543	0.527	0.694	0.552
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,062	1,062	904	1,012	947	947	803	898

Notes: * = significant at 10 %; ** = significant at 5 %; *** = significant at 1 %; robust standard errors in parentheses.

In Tables 7a and 7b we picked from each of the Tables 4 – 6 relevant regressions and investigate what the effects are in high income, upper middle income, lower income and least income countries. The total number of observations is spread rather evenly across these groups, representing 28.1 % (HIC), 21.4 % (UMC), 30.5 % (LMC) and 19.9 % (LIC) of the total number of observations respectively.

Stability of the political system

First, we focused on the stability of the political system represented by the variables *years a country has democratic or non-democratic system*$_{i,t}$ and *years of executive in office*$_{i,t}$.

Regressions (7.1), (7.5), (7.9) and (7.13) indicate that the significantly positive impact of the *years a country has democratic or non-democratic system*$_{i,t}$ on gasoline and diesel prices, as found in Tables 4a and 4b, should be attributed primarily to high-income nations. The middle-income countries in fact seem to show an opposite, significantly negative, effect. In these countries the stability of the system seems to lead to greater fossil fuel subsidies. Note however that the lowest-income countries (whose new democracies we should perhaps expect to be most fragile) exhibit the same basic pattern as high-income countries (namely rising fuel prices over time for a given system), although effects are here not statistically significant. Table 4a and 4b also report negative effects for *years of executive in office*$_{i,t}$ on fossil fuel prices, which can be attributed to middle-income countries as shown in regressions (7.2), (7.6), (7.10) and (7.14). The high-income countries show insignificant results for both gasoline and diesel prices.

In other words, the length of the period an executive is in office does not significantly affect fossil fuel energy subsidies to gasoline and diesel use in high-income countries. In lower-income countries, a longer period of an executive in office reduces prices of (increases subsidies to) gasoline and diesel. The effect is stronger for gasoline than for diesel. This may, potentially, be due to more complex effects, including unobservable factors correlated with leadership tenure (perhaps, that long leadership tenure is a sign of a non-democratic real rule; or that rulers determined to stay in power by all means tend to resort to fuel subsidies as a main strategy). In middle-income countries a rising middle class is coming up and with regard to gasoline this group has an interest to introduce or maintain particularly gasoline subsidies (see also Strand, 2012).

Organization of the political system

Consider next the impact of a presidential system on fuel prices. We find significant differences, in particular for the impact on gasoline prices, between high-income and middle-income countries. For high-income countries, the impact of presidential system on gasoline prices is *positive* (and significant for the 2SLS estimations), but *negative* on diesel prices (although weaker and insignificant). For middle-income countries, we find significantly *negative* effects of a presidential system on both gasoline and diesel prices. Possibly, direct voting for a presidential candidate, which often may require capturing key swing votes,

induces political candidates to "buy" votes using highly visible fossil fuel subsidies; and most so in middle-income countries. In the least developed country group, by contrast, effects are much weaker, ambiguous, and not significant.

Overall, staying in power using a strategy of "buying votes" through low fuel prices, appears as more important in middle-income countries, than in either of low- or high-income countries. Possibly, in most low-income countries, the public ability to satisfy important groups through fuel subsidies could be less than in middle-income countries. The group of car owners in such countries, targeted by these subsidies, may also be too small to count as a means of satisfying important groups, in particular in democracies. In middle-income countries, by contrast, the gradual rise of a middle class over the last 20 years has led to a larger group of car owners, with large political influence, and hence increased political pressure to subsidize motor fuels. In high-income countries, fuel subsidies are again less important as governments have other, more efficient, ways of awarding their (s)electorates.

Power distribution within the political system

The political power distribution in democracies, as measured by the Herfindahl index of the seat shares of government parties in the parliament, is also shown by us to impact on fuel price setting. We find, in Tables 7a and 7b, for both fuels a significant negative impact on fuel prices in middle-income countries (regressions 7.4 and 7.8 for gasoline; and 7.12 and 7.16 for diesel). Thus in this country group, a larger concentration of parliament seats to the ruling party or party bloc leads to higher subsidies to both gasoline and diesel prices. But like for the other political institutional variables reported from Tables 6a and 6b, there are smaller effects for other country groups. For high-income countries, in particular, effects are opposite for gasoline prices (which increase with the Herfindahl index) and diesel prices (which all as in the middle-income group).

6. Conclusions

This paper has analyzed empirically a data set for gasoline and diesel prices, merged with a large set of economic and political variables, for a large group of countries (about 200) over the period 1991-2010. Our objective has been to identify key mechanisms by which countries' gasoline and diesel prices have been determined over this period. We have discussed a range of political and economic variables for which we have data that may serve partly to explain pricing patterns for such fuels, and how they differ between countries with different characteristics, and over time. The specified relationships are estimated using either Generalized Least Squares (GLS) or Two-Stage Least Squares (2SLS) estimation; the latter enabling us to correct for possible endogeneity of certain key explanatory variables (in particular, the amount of gasoline or diesel consumption). Some main findings are:

- Higher oil prices have, not surprisingly, strong positive effects on gasoline and diesel retail prices. In fact, as an average over all countries and time periods in our sample,

the variation in fuel prices is in most cases as great as that in the basic oil price, or greater; and more so for diesel than for gasoline prices (or in other words, "pass-through" of oil prices to fuel prices is, on average, approximately unity). This is a conclusion somewhat at odds with others in the literature, e g some of the work done in both the World Bank and the IMF; see e g Kojima (2012b).[21]

- A larger surplus from fossil fuel exports leads to lower domestic fuel prices, and higher average fuel subsidies. This effect is stronger for gasoline than for diesel.
- A higher GDP level leads to higher fuel prices and thus fewer subsidies (or more taxes). This effect is particularly significant for gasoline prices, using 2SLS estimation.
- Higher motor fuel consumption leads to lower fuel prices, so that the subsidy rate is higher (the tax rate lower) when more fuel is consumed. This effect however consistently significant only for gasoline. This implies that a high gasoline consumption level leads to pressure for more gasoline subsidies. Note that the identification of such a relationship is meaningful only when instruments are used for fuel consumption (fuel consumption is always negatively correlated to the fuel price via the demand relationship).
- A larger share of public health expenditure in GDP is associated with higher fuel prices, and lower subsidies. This effect is strong and highly significant for both gasoline and diesel. This result indicates that fuel subsidies and public-goods supply (represented by public health expenditures) are alternative, and not complementary, ways for politicians to satisfy their respective (s)electorates. While we expect this result to hold also in more appropriately specified and estimated relationships, we recognize the weakness for this result, that public health expenditure and expenditures on fuel subsidies are both likely to be endogenous variables, in a more completely specified model.
- A larger land area relative to population appears to lead to lower fuel prices, most notably for diesel. This could be due to a tendency for fuel consumption externalities (which are in some countries reflected through fuel taxes) are smaller in countries with more dispersed populations. Significance of this effect is lost in several cases where instrument variables are used, most so for diesel prices.
- Greater openness of the economy leads to lower fuel prices. It is unclear what mainly drives this relationship. One factor could be lower transport costs for oil products in more open economies. Another could be a tax competition effect for in countries that tax motor fuels, holding back taxes in more open economies.

Our underlying theoretical framework, in Strand (2012), stresses that motor fuel subsidies are clearly visible private goods, which act as a mechanism of targeted, albeit somewhat selective, income re-distribution. Within this theoretical line of reasoning we conclude that motor fuel subsidies and public health spending – the latter as a proxy for the ability to provide public goods – seem to correlate negatively (positively) in (non-) democratic

[21] Average pass-through for the 2009-2012 period was, by Kojima (2012b), measured at about 73% for both gasoline and diesel, for a similar (although not identical) set of countries. Kojima's time period was however shorter; and the adjustment period assumed (which was approximately one year in our study) was also shorter.

countries. This may underline the idea that public good spending is a readily available strategy for democracies, but less for non-democracies which instead resort much more to fuel subsidies as a "coping" strategy for mobilizing political support.

Turning now to the summing-up of the central theme of this paper, the impact of political and institutional determinants on consumer gasoline and diesel prices, we here wish to focus on four key elements:

1. Degree of corruption, or lack of corruption control
2. Whether the political system is democratic, or autocratic
3. Stability of the political (democratic or autocratic) system
4. Potential power distribution within the political system
5. Actual political power distribution.

The main conclusions on the relationships between motor fuel pricing and political variables are as follows:

- A more corrupt society and government reduces fuel motor fuel prices, and increases subsidies. The effect is far stronger for gasoline than for diesel, where it is often not significant. This is a non-surprising result. In more corrupt societies, visible favors (such as low fuel prices) to key groups will tend to play a larger role. Since gasoline is in most countries the primary fuel for private transport, one should expect the highest subsidy level for that fuel.
- With regard to effects of stability of the political system, longer tenure of a democratic political system tends to increase fuel prices. This effect is found to be strongest for high-income countries, while it is less important in other country groups. In particular, in middle-income country groups the conclusions appear to be the opposite. In autocratic countries we find no relation, or a weak negative relationship between tenure and motor fuel prices.
- When the political system changes from democratic to non-democratic, or vice versa, motor fuel prices in both cases immediately drop. Thus, for a country switching from non-democracy to democracy, the tendency is for fuel prices first to shift down and then gradually to drift upwards as the democracy matures. Considering democracies only, a presidential system – in which swing votes often are particularly important – leads to more subsidies than a parliamentary system.
- Considering effects of potential power distribution, our results show that a political system with a directly elected president and/or a plurality voting system reduce both gasoline and diesel prices significantly. This suggests that in political systems where swing votes are important to get (re-)elected (or in autocracies, where support from often small, key, population groups is important to stay in power), a more targeted redistribution of public resources through clearly visible fossil fuel subsidies takes place. The overall effect is stronger in autocracies than in democracies.

- More concentrated power in the hands of government parties in parliament leads to more motor fuel subsidies or lower fuel prices. This effect is particularly strong for middle-income countries, and is stronger for diesel than for gasoline.

When distinguishing effects between high-, middle- and low-income groups of countries, we have found that the significant subsidy-stimulating effects operate most effectively in middle-income countries, and less so in both high- and low-income nations. It is also, generally, in middle-income countries that subsidy levels and rates are most significant.

Many of our conclusions are novel, but clearly tentative and in need of scrutiny in future work, perhaps on improved data sets. Most of our conclusions however seem to fit rather well with economic theoretical and political thinking on re-distributing welfare through either providing public goods or targeted redistribution of public resources; some of this literature was summarized in Section 2 above.

Even though we have applied the best data set of this type that may be available today, our data still have its limitations. Many country/year observations are missing; our gasoline data are for premium grade while we are to a large extent lacking data for regular gasoline (possibly, the more interesting fuel in terms of subsidies); and our fuel data set itself has limitations (only one data point per year; and fuel price observations are typically taken from the country's capital the representativeness of which is unclear).

In future work, we seek to make improvements to this analysis, on several fronts, among which we here will mention two. First, the data set applied for this study still lacks key variables such as motor vehicle stocks and measures of optimal country-specific fuel pricing. We do however have access to data for motor vehicle stocks by country, for the period in question, but not for all these countries.[22] We intend, in the future, to pursue empirical work where such data are embedded. Secondly, we will seek to correct for possible problems of endogeneity of key variables, which may include public health expenditures, and some of the political variables employed (in particular, "corruption" could be endogenous and simultaneously determined with other features of the political system such as main governance type). These issues are among those we intend, as stated, to address in further work.

[22] This data set also has some other limitations, in terms of reliability, and with regard to the definition of motor vehicle classes.

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Appendix A: Data sources

Table A.1 Data Sources

Variable	Description	Source	Notes
Gasoline prices	Premium gasoline prices measured in November each year in dollarcents per liter	Deutsche Gesellschaft für technische Zusammenarbeit (GTZ)	
Diesel prices	Diesel prices measured in November each year in dollarcents per liter	Deutsche Gesellschaft für technische Zusammenarbeit (GTZ)	
Kerosene prices	Kerosine prices measured in November each year in dollarcents per liter	Deutsche Gesellschaft für technische Zusammenarbeit (GTZ)	
Regular gasoline prices	Regular gasoline prices. The prices are *annual* averages and they are unleaded regular gasoline prices in US Cents per liter.	Mainly from IEA---Energy Prices and Taxes http://www.oecd-ilibrary.org/energy/energy-prices-and-taxes_16096835	Many missing data
Gasoline subsidy rate	Gas Subsidy Rate. For oil import countries, we get the benchmark price by subtracting 10 cents from the U.S. price in the year. Then use the benchmark price minus the country price to find the country's gas subsidy rate for that year. For oil export countries, we subtract 10 cents from the benchmark price above (since no transportation, assumed the cost is 10 cents) and get the benchmark price which is U.S. price in the year minus 20 cents. Then use the benchmark price minus the country price in that year to find the country's gas subsidy rate for that year.	Calculation data such as U.S. and other countries' gas and diesel prices are from GTZ and Coady *et.al* (2010).	
Diesel subsidy rate	Diesel Subsidy Rate. The calculation method is the same as calculating gas subsidy rate above.	Calculation data such as U.S. and other countries' gas and diesel prices are from GTZ and Coady *et.al* (2010).	
Crude Oil Price	Weekly All Countries Spot Price FOB Weighted by Estimated Export Volume (Dollars per Barrel)	US Energy Information Administration http://tonto.eia.gov	For each year, we calculated the average price of November using all weekly price data in November (and translate it from dollars per barrel to dollarcents per liter; 1 barrel = 159 liters). http://tonto.eia.gov/dnav/pet UD&f=W
GDP in purchasing power dollars	PPP GDP is gross domestic product converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current international dollars.	World Bank, International Comparison Program database.	
Population	Total population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship--except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of their country of origin. The values shown are midyear estimates.	(1) United Nations Population Division. 2009. World Population Prospects: The 2008 Revision. New York, United Nations, Department of Economic and Social Affairs (advanced Excel tables). Available at http://esa.un.org/unpd/wpp2008/index.htm. (2) Census reports and other statistical publications from national statistical offices, (3) Eurostat: Demographic Statistics, (4) Secretariat of the Pacific Community: Statistics and Demography Programme, (5) U.S. Census Bureau: International Database, and (6) World bank estimates based on the data from the	

		sources above, household surveys conducted by national agencies, Macro International, the U.S. Centers for Disease Control and Prevention, and refugees statistics from the United Nations High Commissioner for Refugees.	
Oil Surplus	Oil supply mimus oil consumption Oil Supply = Annual data on total oil supply and the unit is Thousand Barrels Per Day. Oil consumption = Annual data on total petroleum consumption and the unit is Thousand Barrels Per Day.	EIA: http://www.eia.doe.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=5&pid=53&aid=1 EIA http://www.eia.doe.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=5&pid=5&aid=2	
Land per km^2	Land area is a country's total area, excluding area under inland water bodies, national claims to continental shelf, and exclusive economic zones. In most cases the definition of inland water bodies includes major rivers and lakes.	Food and Agriculture Organization, electronic files and web site.	
Openness	Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product.	World Bank national accounts data, and OECD National Accounts data files.	
Road gasoline consumption	Road sector gasoline fuel consumption (kt of oil .Gasoline is light hydrocarbon oil use in internal combustion engine such as motor vehicles, excluding aircraft.)	International Road Federation, World Road Statistics and electronic files, except where noted, and International Energy Agency (IEA Statistics © OECD/IEA, http://www.iea.org/stats/index.asp).	
Road diesel consumption	Road sector diesel fuel consumption (kt of oil equivalent. Diesel is heavy oils used as a fuel for internal combustion in diesel engines.	International Road Federation, World Road Statistics and electronic files, except where noted, and International Energy Agency (IEA Statistics © OECD/IEA, http://www.iea.org/stats/index.asp).	
Public health expenditures of central government as % of GDP	Total health expenditure is the sum of public and private health expenditure. It covers the provision of health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health but does not include provision of water and sanitation.	World Bank data	
Central government expenditures as % of GDP	Central government expenditures as % of GDP	World Bank data	
Control of corruption	Control of Corruption: index from 0 (no control of corruption) to 100 (full control of corruption)	Kaufman *et.al* (2010)	
years a country is democracy or non-democracy	Number of years country is democracy or non-democracy	Database on Political Institutions 2010	
Years an executive is in office	Years an executive is in office	Database on Political Institutions 2010	
Regime change	Dummy variable with value 1 if regime changed from democracy to non-democracy or the other way around	Calculated from Database on Political Institutions 2010	
Presidential system	0 (parliamentary), 1 (assembly-elected) and 2 (presidential)	Database on Political Institutions 2010	See also Appendix B
Voting system is proportional	Dummy = 1 if candidates are elected based on the percent of votes	Database on Political Institutions 2010	See also Appendix B

representation	received by their party and/or if our sources specifically call the system "proportional representation". 0 otherwise. Not Available if Legislative Index of Competition < 4.		
Democracy	Legislative and Executive Indices for Electoral Competition has value 7	Database on Political Institutions 2010	See also Appendix B
Non-democracy	Legislative or Executive Indices for Electoral Competition has value < 7	Database on Political Institutions 2010	See also Appendix B
Election	Dummy = 1 in year of election, 0 other wise (refers to legislative or executive elections)	Database on Political Institutions 2010	
Legislative election	Dummy = 1 in year of a legislative election in this year, 0 otherwise.	Database on Political Institutions 2010	
Party of executive controls all houses	Dummy = 1 if party of executive has absolute majority in lawmaking houses, 0 otherwise.	Database on Political Institutions 2010	
Herfindahl Index of government parties seat in Parliament	Sum of the squared seat shares of all parties in the government. Equals "Not Available (NA)" if there is no parliament. If there are any government parties where seats are unknown (cell is blank), the Herfindahl is also blank. No parties in the legislature results in a NA in the Herfindahl. In the case of "other" parties, Herfindahl divides the number of "other" seats by the number of "other" parties and uses this average for the size of the "other" parties. Independents are calculated as if they were individual parties with one seat each.	Database on Political Institutions 2010	
Passenger cars	The total number of passenger cars in each country for years of 1995, 1998, 1999-2010.	The data are taken from the Periodic Journal "International Marketing Data and Statistics 2012", Chapter 4: Automotives and Transport	
HIC	High-Income Countries	World Bank Definition	
UMC	Upper Middle-Income Countries	World Bank Definition	
LMC	Lower Middle-Income Countries	World Bank Definition	
LIC	Low-Income Countries	World Bank Definition	

Appendix B: Definition of the Legislative and Executive Indices of Electoral Competition, and Presidential System

Legislative Indices of Electoral Competitiveness (LIEC)

Scale: No legislature: 1
Unelected legislature: 2
Elected, 1 candidate: 3
1 party, multiple candidates: 4
multiple parties are legal but only one party won seats: 5
multiple parties DID win seats but the largest party received more than 75% of the seats: 6
largest party got less than 75%: 7

• In the case of "Front" parties (as in many Communist nations), the same criteria as in the legislature is used to separate single from multiple parties.

• Voting irregularities are picked up elsewhere, and are ignored here.

• If an elected legislature exists but parties are banned (i.e. a legislature made up of independents), the legislature gets a 4.

• Constituent assemblies, if convened for the *sole* purpose of drafting a constitution, are not counted as legislatures (i.e. system gets a 1 if there are no other assemblies).

• Appointed advisory councils (frequently used in the Middle East and North Africa) are given a 2, but only if they have legislative power.

• If it is unclear whether there is competition among elected legislators in a single-party system, a "3.5" is recorded.

• If multiple parties won seats but it is unclear how many the largest party got, a "6.5" is recorded.

• If it is not clear whether multiple parties ran and only one party won or multiple parties ran and won more than 75% of the seats, a "5.5" is recorded

• Assemblies that are elected with indefinite (or life-long) terms are scored based on their competitiveness, *then marked down by one*.

• Assemblies that are elected by other groups are scored based on the competitiveness of those groups.

• If an assembly is partly elected and party appointed, we score based on how the majority is decided.

• Assemblies operating under conditions of civil war or where there are power struggles within a country, with the result that its institutions do not control most of the territory or the most important parts of the territory, are scored as 1. This is irrespective of how competitively the assembly has been elected and its formal powers.
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• Even if the right to vote or the right to run for office is restricted to a small sub-group of the population, we still score according to the normal system and make a note.

Executive Indices of Electoral Competitiveness (EIEC)

• Uses same scale as Legislative IEC

• Executives who are:

1) Elected directly by population, or
2) Elected by an electoral college that is elected by the people **and** has the sole purpose of electing the executive, are scored on the above scale.
• Executives elected by bodies other than these are given the same score that the electing body would get. Even if the electing body is not the actual "legislature" that is tracked in the LIEC (such as an appointed electoral college), the competitiveness of that body is used to score the executive.

• This means that competitively elected prime ministers get 6 or 7. The chief executives of Communist nations (the chairman of the Communist Party) is given a 3, because they are elected by the Party Congress, electing bodies which they do not appoint. Executives elected by small, appointed juntas or by appointed electoral colleges get 2.

• Rival chief executives in one country, particularly in the setting of armed conflicts, are counted as No executives, and thus score a 1.

• Referenda and votes by "popular acclamation" on unelected executives are scored as 3.

• If executives unilaterally extend their terms of office, they get a 2 starting in the year they should have held elections. Any executive elected for life, even by the people or an elected assembly, gets a 2. This elected-for-life rule is slightly different from that followed for legislatures that unilaterally extend their rule.

• If chief executive takes office through a coup and remains office without an election, EIEC is 2 because the executive is unelected.

• If an elected president is impeached and the vice-president succeeds the presidency in a legal and proper way, EIEC remains as was. If EIEC was 7 under the old president, it remains 7 under the new president.

For "Electoral Rules" variables: all get an NA if the LIEC is 1. If LIEC is 2, then legislature is unelected and we infer that district magnitude is NA. If LIEC is less than or equal to 4, then PR is also NA irrespective of district magnitude. If LIEC is less than or equal to 3.5, then both PR and Plurality are NA.
In order to assess electoral rules we use the IPU website as well as the Europa Yearbook (and to a lesser extent Banks). IPU has the most recent information whereas Europa has information up to 1984, and from 1990 to 1994. If there are discrepancies between Europa (to 1984) and IPU (1998), we assume that changes have occurred, and only input the IPU information for 1995, leaving blanks from 1985 to 1994. If the IPU matched the Europa exactly, we assumed no changes took place, and filled in the intervening years. In the event that a system changed and then switched back, this introduces errors. Since this assumption was made only when institutions from 1984 matched those in 1998, these cases are limited to very stable democracies.

Presidential system$_{i,t}$

Parliamentary (0), Assembly-elected President (1), Presidential (2)

Systems with unelected executives (those scoring a 2 or 3 on the Executive Index of Political Competitiveness – to be defined below) get a 1. Systems with presidents who are elected directly or by an electoral college (whose *only* function is to elect the president), in cases where there is no prime minister, also receive a 2. In systems with both a prime minister and a president, we consider the following factors to categorize the system:

a) Veto power: president can veto legislation and the parliament needs a supermajority to override the veto.
b) Appoint prime minister: president can appoint *and* dismiss prime minister and / or other ministers.
c) Dissolve parliament: president can dissolve parliament and call for new elections.
d) Mentioning in sources: If the sources mention the president more often than the PM then this serves as an additional indicator to call the system presidential *(Romania, Kyrgyzstan, Estonia, Yugoslavia).*

The system is presidential if (a) is true, or if (b) **and** (c) are true. If no information or ambiguous information on (a), (b), (c), then (d).

Countries in which the legislature elects the chief executive are parliamentary (0), with the following exception: if that assembly or group cannot easily recall him (if they need a 2/3 vote to impeach, **or** must dissolve themselves while forcing him out) then the system gets a 1.