The Politics of Petroleum Prices: A New Global Dataset

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Abstract

The price of gasoline varies from country to country by almost two orders of magnitude, largely because of differences in government taxes and subsidies. Retail gasoline prices have far-reaching economic and environmental consequences but the reasons why they vary – and why countries sometimes enact reforms – are not well-understood. One reason is that data on fuel prices for every country have not previously been available below the annual level. We introduce a new dataset on retail gasoline prices at the monthly level for 157 countries, and use it to compute four measures useful in analyses of pricing policy. Among other descriptive observations, we find that from 2000 to 2012 there were two broad trends: toward reduced *ad valorem* gasoline taxes in almost all countries, and toward passing global prices on to local consumers. We also find that the only countries with significant subsidies are oil exporters, although not all oil exporters had subsidies. Finally, we report preliminary findings on cross-sectional and temporal variation in measures including price fixity and the degree to which countries pass global prices on to consumers.

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1 Introduction

All countries either subsidize or tax the sale of gasoline, resulting in large country-to-country variation in retail prices. In July 2015 a liter of gasoline ranged in price from $0.02 in Venezuela to $1.94 in Hong Kong, a difference of almost two orders of magnitude.[1] No other commercial product appears to be subject to such divergent pricing policies (Gupta and Mahler, 1995).

The taxes and subsidies that determine the price of gasoline have far-reaching consequences, including for global climate change. Road transportation – which relies on both gasoline and diesel consumption – generates about 13 percent of all carbon dioxide emissions and about 10 percent of all greenhouse gas emissions globally. Fuel price reform is one of the cheapest and simplest ways for countries to reduce their greenhouse gas emissions.

Fossil fuel price reforms have been strongly backed by major international institutions, including the International Monetary Fund (IMF), the World Bank, and the Intergovernmental Panel on Climate Change (see e.g. Gupta and Mahler, 1995; Bacon, 2001; Clements et al., 2013; Parry et al., 2014; Coady et al., 2015). Since 2009, members of the G-20 and Asian Pacific Economic Cooperation (APEC) have nominally committed themselves to reducing fossil fuel subsidies.

Climate change aside, there are compelling arguments for gasoline price reform: many governments spend large sums – in some cases over 20 percent of their budgets – to keep prices low[2]; many other governments set prices to cover the supply costs but do not levy sufficient taxes to offset the negative externalities of gasoline consumption.[3] Subsidies and low taxes hence tend to increase road congestion and traffic fatalities, boost local air pollution from nitrogen oxide emissions and ozone (Parry et al., 2014), and lead to deadweight economic losses (Davis, 2014). In low and middle income countries, most gasoline subsidies are captured by middle and upper class car owners (del Granado, Coady and Gillingham, 2012).

[1] See www.globalpetrolprices.com. Accessed July 21, 2015.

[2] Over the last decade about two dozen governments have at times kept retail gas prices below the international supply cost. Fattou and El-Katiri (2013) found that fuel subsidies in 2008 accounted for about 11 percent of all government expenditures in Syria, almost 18 percent in Egypt and 34 percent in Yemen; according to Chen, Liverani and Krauss (2014), Morocco's fuel subsidies in 2011 accounted for 17 percent of the total budget. The IMF estimates that petroleum subsidies will cost these governments about $135 billion in 2015 (Coady et al., 2015). These and most other subsidy estimates cover all petroleum products collectively (including gasoline, diesel, and kerosene) and do not report a separate figure for gasoline subsidies.

[3] The IMF identifies two classes of petroleum subsidies: "pre-tax subsidies," which represent the difference between the retail price and the international supply cost, and "post-tax subsidies" which are defined as the difference between the retail price and the sum of the supply cost, a basic consumption tax, and a Pigouvian tax that offsets the costs of local pollution, congestion, and carbon emissions (Coady et al., 2015). Post-tax subsidies are, by construction, larger than pre-tax subsidies. For 2015 they were projected to reach $1.497 trillion for all petroleum products, which is equivalent to 1.8 percent of global GDP or 5.5 percent of all government revenue worldwide (Coady et al., 2015). For clarity we use the term "subsidies" only to refer to pre-tax subsidies.

Higher gasoline prices are nonetheless politically unpopular. In the last decade, attempts to raise gasoline prices were quickly followed by protests in Latin America (Brazil, Chile, Bolivia, and Nicaragua), the Middle East (Yemen, Jordan, and Iran), South and Southeast Asia (India, Myanmar, and Indonesia), and Sub-Saharan Africa (Cameroon, Ghana, Nigeria Mozambique, Cameroon, Burkina Faso, Cote D'Ivoire, Uganda, and Niger). Protests that begin in this way can be politically consequential: demonstrations against higher gas prices in Indonesia in 1998 and Kyrgyszstan in 2010 became part of larger movements that led to the fall of both governments. The 2007 "Saffron Rebellion" in Myanmar was sparked by protests against gasoline price increases.

Which governments have enacted reforms - removing subsidies and increasing taxes - and why? Further, what factors explain the wide variation in price policies across countries and over time? Answering such questions has been difficult in part because data on both gasoline prices and gasoline price policies has been limited. This paper introduces an original data set on the retail price of gasoline in 157 countries from 1990 to 2013 that includes more than 30,000 country-month observations and opens the door to learning about both failed and successful reforms. Using these data we derive several new measures, that shed light on (1) net taxes and subsidies, (2) the degree of price fixing, (3) the degree to which a country passes on market prices to domestic consumers, and (4) the degree to which retail prices differ from those we'd expect had a country kept its pricing policy unchanged.

Understanding the sources of gas price reform is intrinsically important. But it may also cast light on energy price reforms more generally, particularly for other petroleum products (like diesel and kerosene) and other fossil fuels (like coal and natural gas). Compared to other types of energy policies, gasoline price policies are relatively easy to study: since it is sold in retail form in almost all countries gasoline has a consumer price that is both readily observable and frequently used by governments as a policy tool. Still, we must be cautious about extrapolating from one type of fuel to another since different constituencies with different levels of influence may support subsidies for different fuels (Victor, 2009).

We also hope to contribute more broadly to the study of energy politics (Hughes and Lipscy, 2013) and climate change (Bernauer, 2013). Javeline (2014) describes adaptation to climate change as "the most important topic political scientists are not studying," and Keohane (2015) points to a troubling gap between the real-world policy challenge of global climate change and the insights that political science has to offer. We seek to harness the tools of political science and data analysis to identify practical lessons about energy reform that may ultimately help countries reduce carbon emissions.

In the remainder of this paper we summarize earlier research on the politics of gasoline policies (Section 2), explain our data collection methods and models for deriving the variables of interest (Section 3), and offer an overview of patterns in price policies around the world from January 2000 to December 2012 (Section 4).

2 Previous Work

Our analysis seeks to build on earlier research on gas price policies. A seminal paper on the politics of fossil fuel subsidies by Victor (2009) argues that governments are more likely to subsidize gasoline prices when they are administratively weak and hence lack the capacity to distribute benefits through more targeted measures, and that authoritarian governments tend to favor these subsidies because they constitute "a readily-available means of supplying visible goods and services to unrest-prone populations (Victor, 2009, p8)."

Hochman and Zilberman (2013) develop several hypotheses about the correlates of gasoline and diesel prices and evaluate them using the Wagner (2013) data set that has biennial prices for up to 170 countries. They find that oil-exporting countries, particularly members of the Organization of Petroleum-Exporting Countries (OPEC), have lower prices while states with democratic institutions have higher prices. This suggests that "cheap fuel is used to buy political support, especially in countries that lack appropriate institutions to distribute wealth (Hochman and Zilberman, 2013, p2)." They also note that richer countries tend to have higher prices.

Cheon, Urpelainen and Lackner (2013) carry out a similar analysis using annual obervations of gasoline prices for 137 states from 2002 to 2009 from an IMF data set. Like Hochman and Zilberman (2013), they find that lower prices are correlated with OPEC membership, the absence of democracy, and low bureaucratic quality. The same authors report in a separate study that countries with national oil companies tend to have larger subsidies (Cheon, Lackner and Urpelainen, 2015).

Kyle (2015) argues that citizens may support gasoline subsidies, even if the subsidies bring them few benefits, when the government's promises to carry out reforms that bring them greater benefits are not credible. The argument is consistent with a household survey and administrative data on corruption in 527 villages across Indonesia.

The most important sources of research on gasoline subsidies have been the IMF and World Bank. While most of their research has focused on the economic properties and consequences of gasoline subsidies, Clements et al. (2013) carry out a qualitative analysis of subsidy reforms, based on case studies of 19 reform episodes in 14 countries. They conclude there is no single formula that determines the success of reforms in all countries, but that the likelihood increases with high economic growth, low inflation, gradually phased price increases, a far-reaching communications strategy, programs to compensate households that may be adversely affected, and a government that can make credible commitments to constituencies that incur short-term losses from reform.

Our project is designed to build on earlier studies by developing an original dataset on monthly gasoline prices that is more extensive than any previously available. Our decision to focus on sub-annual prices is based in part on two factors. First, several case studies highlight examples of multiple price policy changes occurring within a given calendar year.

The price increase of 65 naira ($0.40) per liter to 141 naira ($0.85) per liter in Nigeria on January 1, 2012, for instance, was immediately scaled back to 97 naira on January 17, 2012, after a series of devastating protests and labor strikes paralyzed the economy. Data based on annual observations would have missed the initial price change and only recorded the final change (or calculated an average of the two). Second, the sub-annual unit of analysis would allow researchers to more precisely estimate the impact of price policy shifts on important sub-annual outcomes, such as political protests, regime change, the onset of conflict, and changes in financial markets.

In addition to collecting sub-annual observations, we devise two new time-varying measures of price policies that can give analysts a more complete understanding of the global landscape of gas pricing policies and how they have changed over time. We hope these tools will ultimately enable scholars to learn more about factors associated with successful price reforms and their potential consequences.

3 Data

We collected data on the nominal price of gasoline in local currency units per liter at monthly intervals. For modeling and analysis we use nominal local currency units.[4] For visualizations and cross-country comparisons we convert these data to nominal (and sometimes real) US dollars.[5]

We attempted to collect data for all 162 sovereign states with populations greater than one million in 2012. We were unable to locate monthly price data for five countries – Cuba, Eritrea, North Korea, Turkmenistan, and Uzbekistan – and hence omitted them from the analysis.[6] Data for the other countries were collected from both primary and secondary documents, the most common being national accounts (81 countries), the European Commission (24 countries), and IMF or World Bank documents (26 countries). For 17 countries we employed local researchers.

As expected, we ran into availability concerns that limited our ability to collect a complete time-series for all 157 countries. For 73 countries, we have monthly data going back to at least 1995 (for 35 of these we have data beginning in January 1990). For all but a few of

[4]For countries that experienced currency changes or revaluations – Romania (July 2005), Turkey (January 2005), Ghana (August 2007), Madagascar (January 1999) – all prices have been back-converted to the more recent currency price. For example, the Turkish lira was revalued in January 2005 by dividing by 1,000,000 to usher in the "Second Turkish lira." All pre-2005 prices are thus divided by 1,000,000 to be in Second Turkish Lira per liter.

[5]For converting to US dollars we use monthly exchange rates from the IMF International Financial Statistics; for converting from nominal to real 1990 US dollars we use inflation rates from the US Federal Reserve Economic Database (FRED).

[6]Citizens in Turkmenistan receive a monthly allotment of free gasoline, making pricing policies less relevant.

the remaining countries we have data beginning on or around January 2000. As such, our focal period is 2000-2012. A full list of countries, along with the number of country-month observations for each case, is listed in Appendix Table 1.

For countries with data reported more frequently than monthly intervals (daily, weekly, or bi-weekly), we used the price from the first day or week of the month as the monthly price. Whenever possible we collected data on regular-graded gasoline (typically between 87 and 90 octane) as opposed to super or premium grade (typically 95+ octane) to capture the type of gasoline most likely to be purchased by the average consumer.[7]

Model for Derived Variables

In addition to the directly observed data, our dataset includes several derived measures that relate to government pricing policy: *benchmark price gap*, *change frequency*, *pass-through rate*, and the *price shift*.

The first two of these result from simple manipulations of the observed data. The *benchmark price gap* is simply the difference between a country's retail gasoline price and a benchmark price that represents the supply cost. For our benchmark we use the free-on-board (FOB) spot price for conventional refined gasoline at the New York Harbor. This price gap is largely a summary of net taxes and subsidies, though it includes other local costs such as distribution costs, which can vary by country. We assume distribution and other local costs are relatively stable over time in each country, and may affect cross-country comparisons but do not effect within-country comparisons over time, at least over short periods of time.[8] Negative values of the *benchmark price gap* imply net gasoline subsidies. Large positive values imply net taxes, while small positive values are ambiguous, caused by either net taxes or transport and distribution costs. However, where costs can be assumed to be relatively fixed (e.g. within-country), changes in benchmark gap are reasonably good estimates of changes in net taxes and subsidies. For a discussion of the price gap approach and its limitations for estimating subsidies, see Koplow (2009).

Second, a country's tendency towards fixing prices over time is captured by *change frequency*. It is the number of times we observe month-to-month changes in a country's gasoline prices in a given period (e.g. 6, 12, or 24 months), when prices as measured in local currency. A country with a fully fixed price will have a value of zero and a country with a market price will have a value of one. Although straightforward to measure, *change frequency* is only a rough approximation of the degree to which a country has market-based prices.

Our next two measures are derived using a simple modeling approach. Note that the benchmark gap, while informative, can change over time due to either changes in government

[7]For the time being, our collection of data is limited to motor gasoline only and does not include diesel or compressed natural gas.

[8]Internal IMF documents suggest that supply costs in 2014 ranged from 68 cents to $1.02 per liter.

pricing policies, or changes in the benchmark. We thus sought to develop a model that would predict what price would be expected at time t had a country maintained constant policies (vis-à-vis the benchmark), and a remaining "adjusted gap" that expresses the difference between the expected price (given benchmark prices) and the observed price. First, our model determines if a country is currently using fixed prices, by determining whether the price in the present month is identical to the price in the prior month. Then, if the price is not currently found to be fixed, the following model is estimated:

$$\begin{aligned} Price_t = \alpha + \beta_1 BenchA_t + \beta_2 BenchB_t + \\ + \beta_3 BenchA_{t-1} + \beta_4 BenchA_{t-2} + \beta_5 BenchA_{t-3} + \gamma^\top refining + \epsilon_t \end{aligned} \tag{1}$$

where $BenchA$ and $BenchB$ are different benchmark prices for crude, and $refining$ is a vector of refining costs. For $BenchA$, we use the free-on-board (FOB) spot price of conventional gasoline at the New York Harbor, refined primarily from Brent crude oil, making this benchmark more appropriate for European and African markets. For $BenchB$, we use the international spot price of the West Texas Intermediate (WTI) blend of crude oil (WTI). We lag $BenchA$ by up to three months to capture any medium-term effects of changing benchmark prices on local prices, as would be expected if countries use a lagged adjustment or moving-average type smoothing procedure.[9] For refining costs, we use those from refineries in Europe, the US Gulf, and Singapore.[10] This model is estimated over a 24 month window. The coefficients are thus updated continuously, with the model re-estimated for each new month t. After training the model on the last 24 months, it is then applied to the next month, $t+1$, using the benchmark and refining data at time $t+1$ to predict $Price_{t+1}$.

This model is equipped to "learn" any pricing policy a country might adopt that sets prices as a linear combination of the current and recent benchmarking prices, with allowances made for refining costs. For example, if a country purely passes on market prices plus a relatively constant distribution cost, α will absorb the constant cost and $\beta_1 + \beta_2$ will be near 1. If a country uses the current month and prior two months of data in order to smooth prices, this will be captured in β_1 to β_5.

From this model we obtain several additional measures. First, comparing $Price_{t+1}$ to the fitted values, $\widehat{Price}_{t+1}$, we have a price gap that has been adjusted for changes in the benchmark. We call this the *price shift*, since it reflects an unexpected shift in price from what we would have expected given the current and recent benchmark prices.

Second, we construct the (dynamic) *pass-through rate*. If a country has a fixed price at time t (the price is identical to the previous month's price to the last reported digit), then the pass-through rate is zero by definition. Otherwise, the pass-through rate is $\sum_j \beta_j$, reflecting how the current and recent benchmark prices influence the retail price collectively according to the model. A *pass-through rate* of 1 indicates that countries pass-through all of the international price to customers. A value of zero reflects a completely shielded pricing policy, and a value in between

[9] Note that we only lag one benchmark price given the high correlation between $BenchA$ and $BenchB$ over time ($\rho = 0.98$).

[10] The variation in refining margins over time is shown in Appendix Figure 14.

reflects partial but incomplete shielding. We note that this differs from traditional pass-through measures, which usually pick only two years t_1 and t_2, comparing the change in retail prices to the change in benchmark prices, both measured from t_1 to t_2. Here, the pass-through rate is more akin to an instantaneous slope estimate, and is dynamically produced as the model runs forward in time. Together, the *change frequency* and *pass-through rate* describe how much and how frequently prices are adjusting to global market forces.

Finally, while we do not utilize it here, we note that the sum of coefficients stored in the vector γ provide an estimated price-elasticity to refining costs. If a 1-unit change in refining costs is reflected in a 1-unit change in retail costs, then γ will sum to 1. In general we find values of γ closer to 0.10, implying that not all changes in refining costs are passed on to the price, at least not in the same month.

4 Patterns of change in gasoline prices and policies

Here we report on a number of patterns that define the global landscape of gasoline pricing and how it changed between January 2000 and December 2012.

How did gasoline prices change?

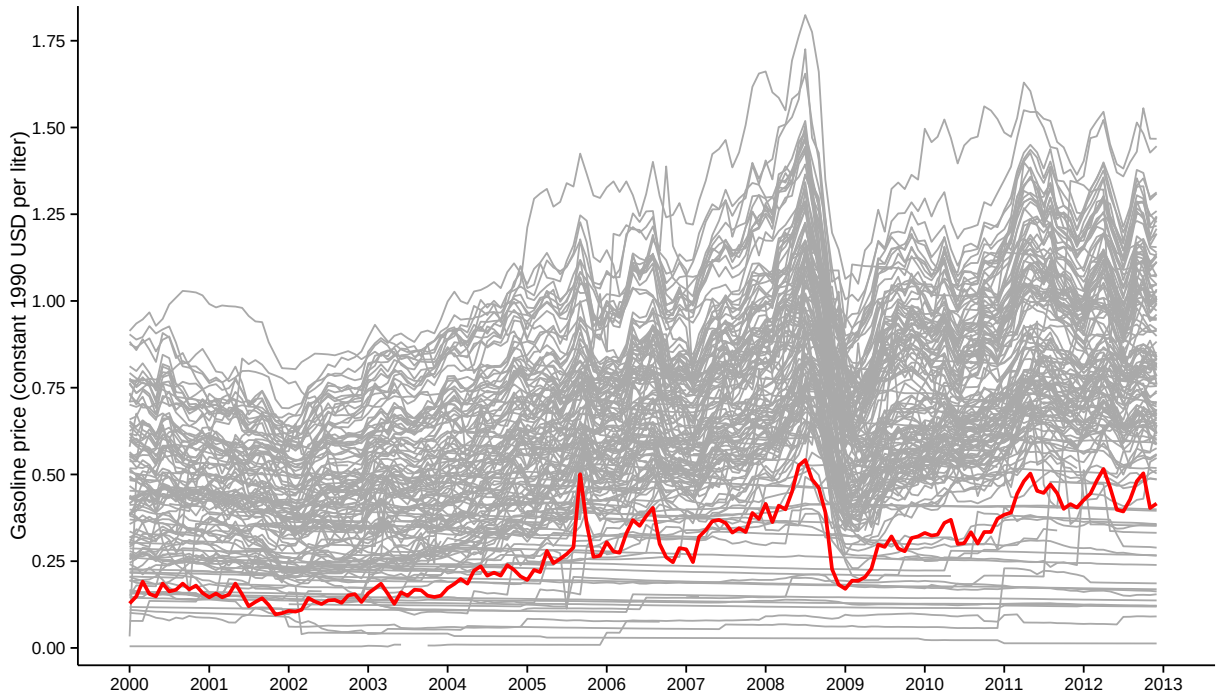
Figure 1 shows the country-level prices for 156 countries along with the benchmark price.[11] States fall into two groups: those above the benchmark (who tax gasoline) and those below it (who subsidize it). Countries above the benchmark saw their prices rise considerably, tracking changes in the benchmark. Countries below the benchmark had prices that were fixed or changed infrequently. Many of these fixed-price states had prices slightly higher than the benchmark in the early 2000s, but as the benchmark price increased over time their prices increasingly fell below it. The result was a divergence in global prices over time – in recent years reaching two orders of magnitude.

If we break prices down by region (Figure 2), we also see considerable variation. Unsurprisingly, gasoline prices are highest in Europe and North America and lowest in the oil-rich Middle East (including North Africa). Real prices in the Middle East crept up slightly over the period, while prices in Europe and North America roughly doubled in real terms.

What is surprising is the pair of regions with the second and third highest prices, respectively, as of December 2012: Africa and the former Soviet Union. African states have some of the highest prices in the world and have maintained this position since at least 2000. States that were part of the Soviet Union, on the other hand, began the period with the lowest real prices but began steadily increasing them after 2003.

[11] Prices have been omitted for Somalia, whose exchange rates were unavailable.

Figure 1: Gasoline prices by country vs. benchmark price (in bold) over time



How did gasoline price policies change?

A more interesting question for political scientists is how pricing policies changed over time. Here we examine how the *benchmark gap*, *change frequency*, and *pass-through rate* vary over time to begin answering this question.

Benchmark Gap

Our analysis begins with Figure 3, which shows the (unweighted) mean gas price for all 156 states alongside the benchmark. Most of the change in the mean price simply reflects changes in the global benchmark; to determine how tax and subsidy policies changed we must look at the gap between the two lines, which is the *benchmark gap*.

What does the *benchmark gap* tell us about policy trends? The answer depends on how we measure it. In absolute terms the gap rose about eighteen percent, from 28 cents in January 2000 to 33 cents in December 2012.[12] In percentage terms, however, the the mean gasoline tax declined from 246 percent of the benchmark to 90 percent of the benchmark. The percentage measure is important because many countries levy ad valorem taxes on gasoline that – like sales or value-added taxes – should be proportional to the value of the sale.

[12]These and other figures are presented in constant 1990 dollars.

Figure 2: Gasoline prices by region over time.

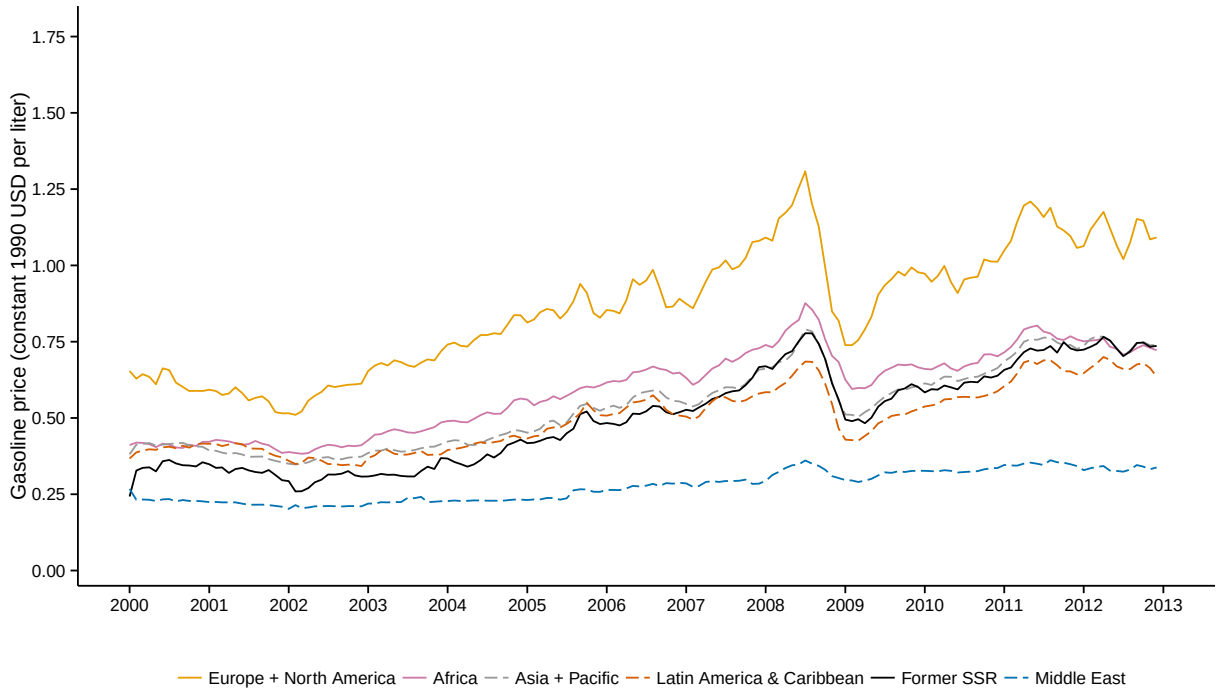


Figure 3: Global gasoline prices vs. benchmark price over time

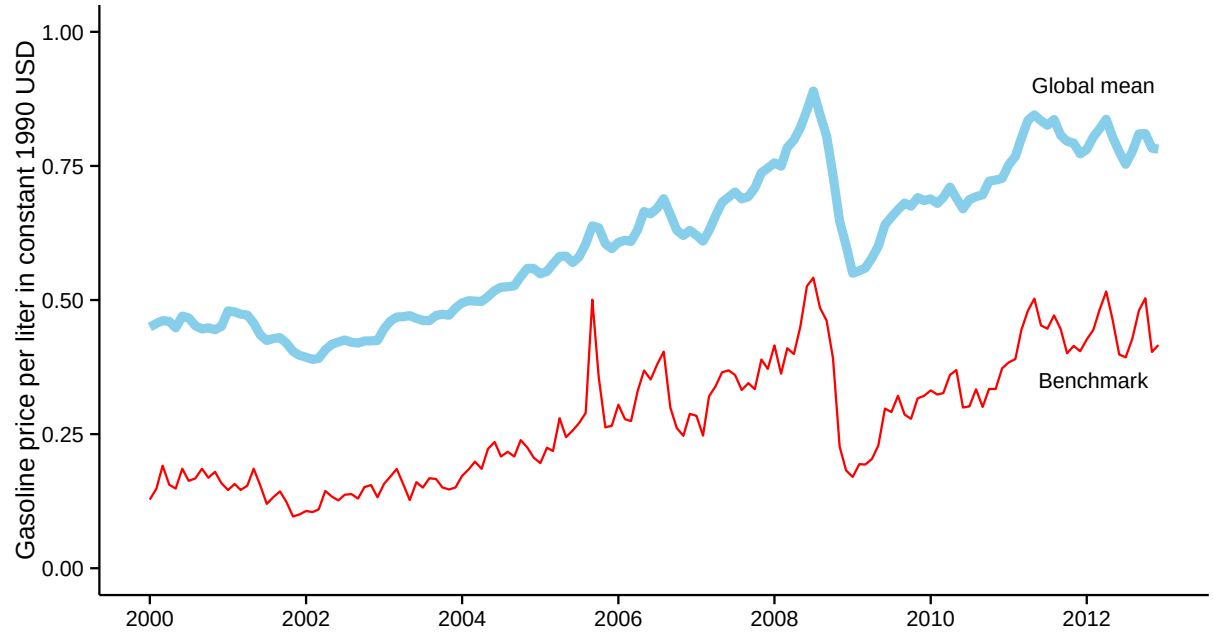


Figure 4: *Benchmark gap* (top panel) and price as percentage of benchmark (bottom panel) by country in January 2002 vs. December 2012.

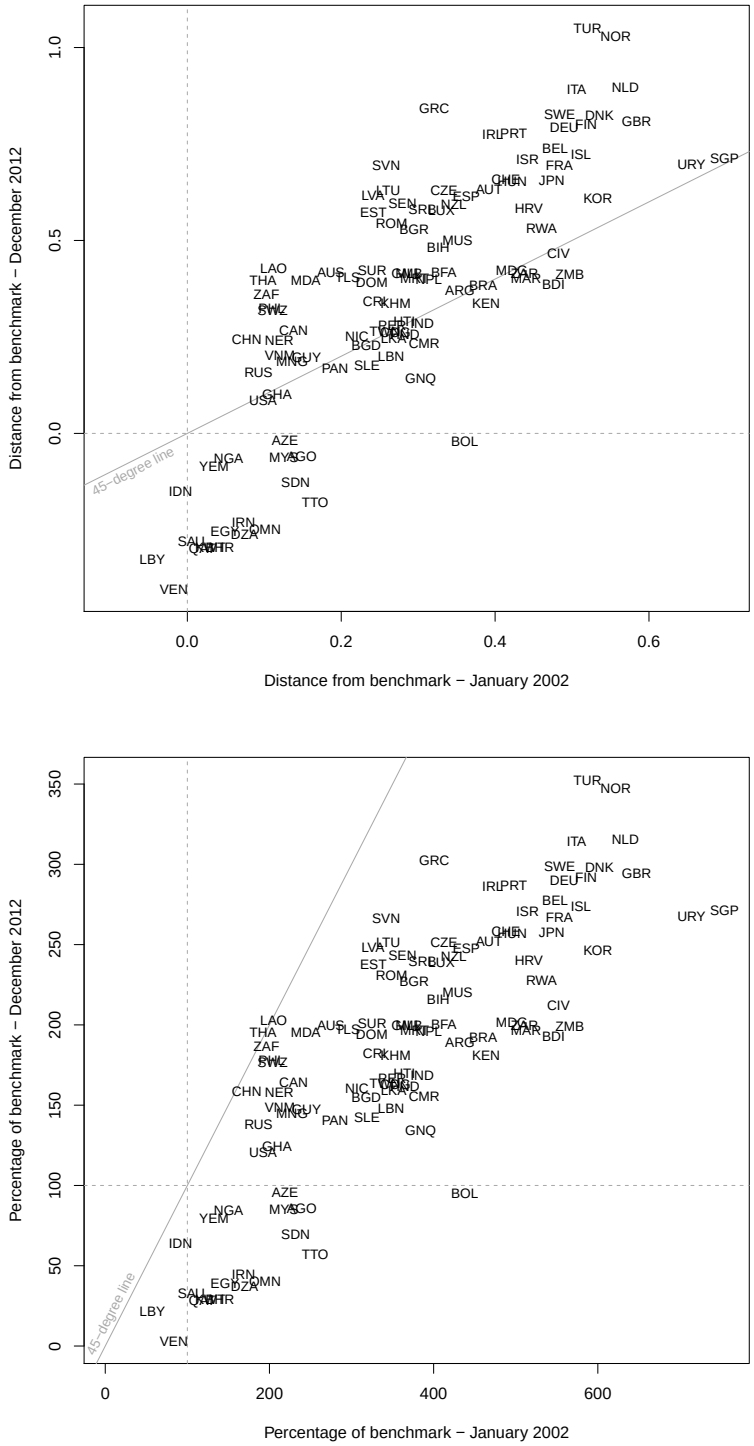


Figure 4 shows changes in the *benchmark gap* at the country level.[13] The top panel displays trends in the absolute size of *benchmark gap* from January 2002 (x-axis) to December 2012 (y-axis). Countries located in the upper right quadrant had prices above the benchmark at both the beginning and end of the period; countries in the lower right quadrant were above the benchmark in 2002 but below it in 2012, meaning they moved from having net taxes to net subsidies. Countries in the lower left quadrant were below the benchmark and hence subsidizing gasoline in both periods. Strikingly, no countries are in the upper left quadrant, which would hold countries that were below the benchmark in 2002 but moved above it by 2012 – in other words, no countries went from net subsidies to net taxes.

Countries on the 45-degree line had about the same taxes or subsidies in both periods, indicating no net change over time; this group includes the US (USA), Brazil (BRA), South Korea (KOR) and Singapore (SGP). About two-thirds (70 out of 107) of all countries with data for both time points lie above the 45 degree line, and hence increased their net taxes in absolute terms; countries with the largest increases include Turkey (TUR), Norway (NOR), Greece (GRC), and Slovenia (SVN). Those that dropped the farthest include oil exporters Venezuela (VEN), Bolivia (BOL), and Libya (LBY).

When calibrated as a percentage of the benchmark the pattern is different (Figure 4, lower panel). The distribution among quadrants is unchanged, but now nearly every country in our sample has decreased prices as a percentage of the benchmark. China (CHN), Laos (LAO), and Thailand (THA) straddle the line. It is not surprising that countries whose taxes were already high, like Norway and Singapore, did not raise them proportionately, since the jump in global prices would result in exceptionally high retail prices. Yet it is striking that taxes as a percent of the benchmark fell so much for countries that began the period with relatively low taxes, like the US, Canada (CAN) and Ghana (GHA).

Visualizing the *benchmark gap* by income group[14] in Figure 5, we find that high-income OECD countries not only have the highest taxes but are the only group of countries to have increased taxes, even in absolute terms, since January 2000. The countries with the second-highest taxes are those categorized as low-income. Taxes in low-income states have remained at about the same level as in January 2000 with some adjustments based on the two big fluctuations in crude oil prices in summer 2005 and summer-fall 2008.

Interestingly, net taxes in middle-income countries were the same as in high-income non-OECD states during the early 2000s. These started to diverge in 2005 as the *benchmark gap* dropped considerably in the latter, while slightly increasing in the middle-income states to converge nearly with the *benchmark gap* in the low-income states. These findings are somewhat at odds with previous work which suggested that the poorest countries tend to have the lowest prices in order to appease citizens and buy political acquiescence (del Granado, Coady and Gillingham, 2012; Hochman and Zilberman, 2013).

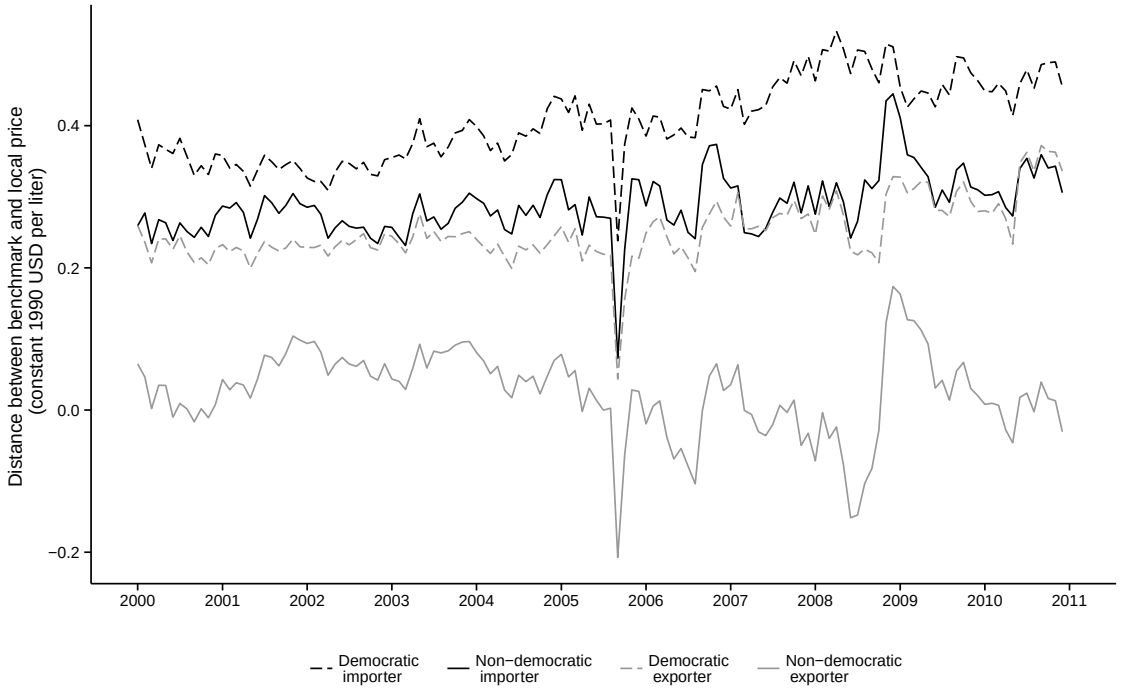
[13] Since we lack data for many countries in January 2000, we choose a starting point with the most data: January 2002. Still, our sample size drops here from 156 to 107 countries, a shortcoming we will rectify in future versions of this paper.

[14] We use a modified categorization of the World Bank *World Development Indicators*, combining "upper middle income" and "lower middle income" into one middle income category.

Figure 5: *Benchmark gap* over time by income group.

Figure 6: *Benchmark gap* over time by status as oil importer/exporter.

Figure 7: *Benchmark gap* over time by regime type and status as oil importer/exporter.



When splitting the sample into countries that either import or export petroleum[15] we again find evidence of divergence in price policies for different sets of countries (Figure 6). Net oil-importing states increased net taxes in absolute terms, notably between mid-2002 and late-2008. Net taxes/subsidies in oil-exporting states were relatively flat until the crude oil price spike and subsequent collapse of the summer and fall of 2008, after which prices declined steadily relative to the benchmark.

Like Victor (2009) and Cheon, Urpelainen and Lackner (2013) we see that both status as an autocracy and status as an oil exporter are independently associated with lower gasoline prices. Figure 7 shows that while democratic importers have the highest taxes (represented again by the *benchmark gap*), democratic exporters have slightly lower taxes than non-democratic importers. Non-democratic exporters round out the group with the lowest taxes (highest subsidies) over time.[16]

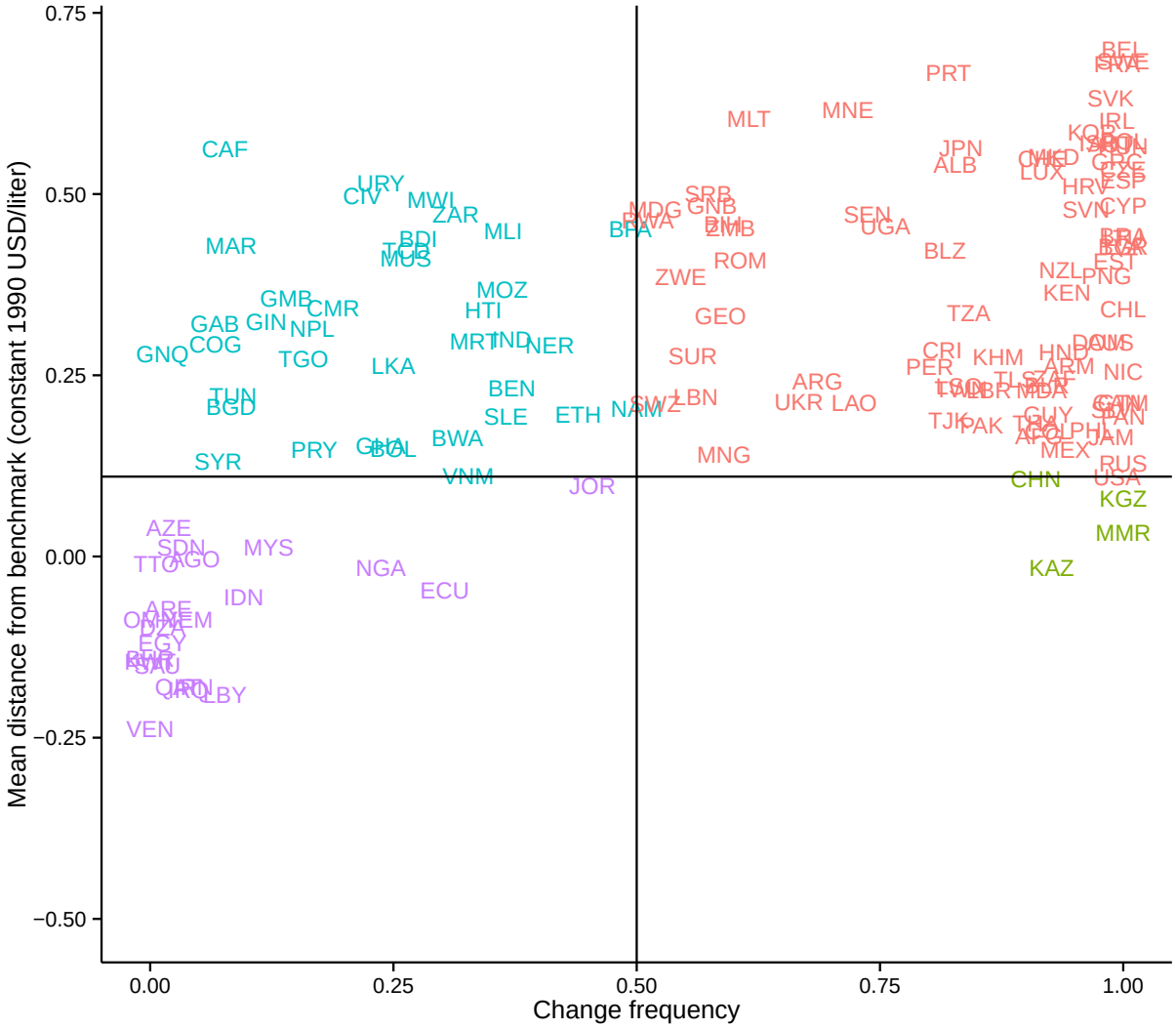
Change Frequency

We earlier pointed out that countries with large subsidies often have relatively fixed prices and that countries with fixed prices tend to be subsidizers, but a close look at our *change frequency* measure reveals a more interesting pattern. In Figure 8 we map all countries along the *benchmark gap* and

[15]This is defined by a threshold of at least $100 income per capita from net exports of oil and gas.

[16]Note that oil exports and regime type are perceived as endogenous (see Ross (2012) and Haber and Menaldo (2011) for competing views).

Figure 8: *Benchmark gap* vs. *change frequency*, country averages across 2000-2012.



change frequency dimensions and observe states falling in one of four possible quadrants.[17]

In the upper right quadrant we find countries whose prices are relatively high and change relatively frequently; most have a *change frequency* close to one, even though their tax levels vary widely. The lower right quadrant is almost empty – Kazakhstan, Kyrgyzstan, and Myanmar are the only occupants – suggesting that countries with frequently-changing prices in general are not net subsidizers. Countries use fixed prices, not flexible ones, to deliver subsidies to their citizens.

Countries in the two left quadrants have relatively fixed prices and are distributed in a surprising way. The lower left quadrant holds countries with prices that are both fixed and subsidized. Several states (notably Oman and Venezuela) did not change their prices a single time from 2000 to 2012. We find it noteworthy, however, that the upper left quadrant is *not* empty: many countries keep their prices relatively fixed yet manage to avoid subsidies. We think of states in the bottom left as "subsidizers" and states in the top left as "stabilizers"; the latter manage to keep prices stable and shield their citizens from global price fluctuations, but nonetheless make frequent-enough adjustments to avoid subsidies.

The World Bank and IMF often suggest that to remove subsidies countries should eschew fixed prices. Our analysis suggests this is only partly true: states that make frequent changes generally avoid subsidies, but countries with fixed prices can also avoid subsidies. Flexible pricing is not necessary for averting subsidies, but it might still be sufficient.

Subsetting by geographic region in Figure 9 highlights both the intra-regional and inter-regional variations in price policies. The upper-left quadrant of "stabilizers" is largely populated by African states, plus four South Asian states (India, Bangladesh, Nepal and Sri Lanka), two Latin American countries (Uruguay and Haiti, with Bolivia and Paraguay on the boundary), and two Middle Eastern states (Morocco and Tunisia, with Syria on the boundary). All European and North American states dwell in the upper right quadrant, as do almost all of the former Soviet states (with the notable exception of oil-dependent Azerbaijan). Most Latin American states are also in the upper right; those in the lower left are oil-rich Venezuela and Trinidad (and former OPEC member Ecuador). Almost all Middle Eastern states are in the left quadrants, except Lebanon and Israel (Jordan straddles the center borders). The African and Asian states are distributed more widely among the three populated quadrants.

One defining pattern in these regions is status as oil exporter. Two-thirds of the oil or gas exporters are clustered in the lower right quadrant, which includes all Middle Eastern oil exporters, plus exporters from the former Soviet Union (Azerbaijan), Southeast Asia (Indonesia and Malaysia), Latin America (Trinidad and Venezuela), and Africa (Nigeria, Sudan and Angola).

In fact, all net subsidizers in our data set are current or recent oil or gas exporters. Yet not all oil or gas exporters are subsidizers, as shown in Figure 10. In the upper left we find four African oil producers (Equatorial Guinea, Gabon, Congo Republic and Chad) whose pricing looks much like Africa's non-oil states. In the upper right we see both the oil exporters of North America and Europe (Canada, Denmark, and Norway), Russia, and four Latin American oil exporters (Mexico, Suriname, Belize, and Colombia). There is important variation among the oil exporters. Having

[17]The horizontal line in this figure represents the US price, which is slightly above the benchmark (marked at 0.00 on the Y axis).

Figure 9: *Benchmark gap* vs. *change frequency*, facetted by geographic region.

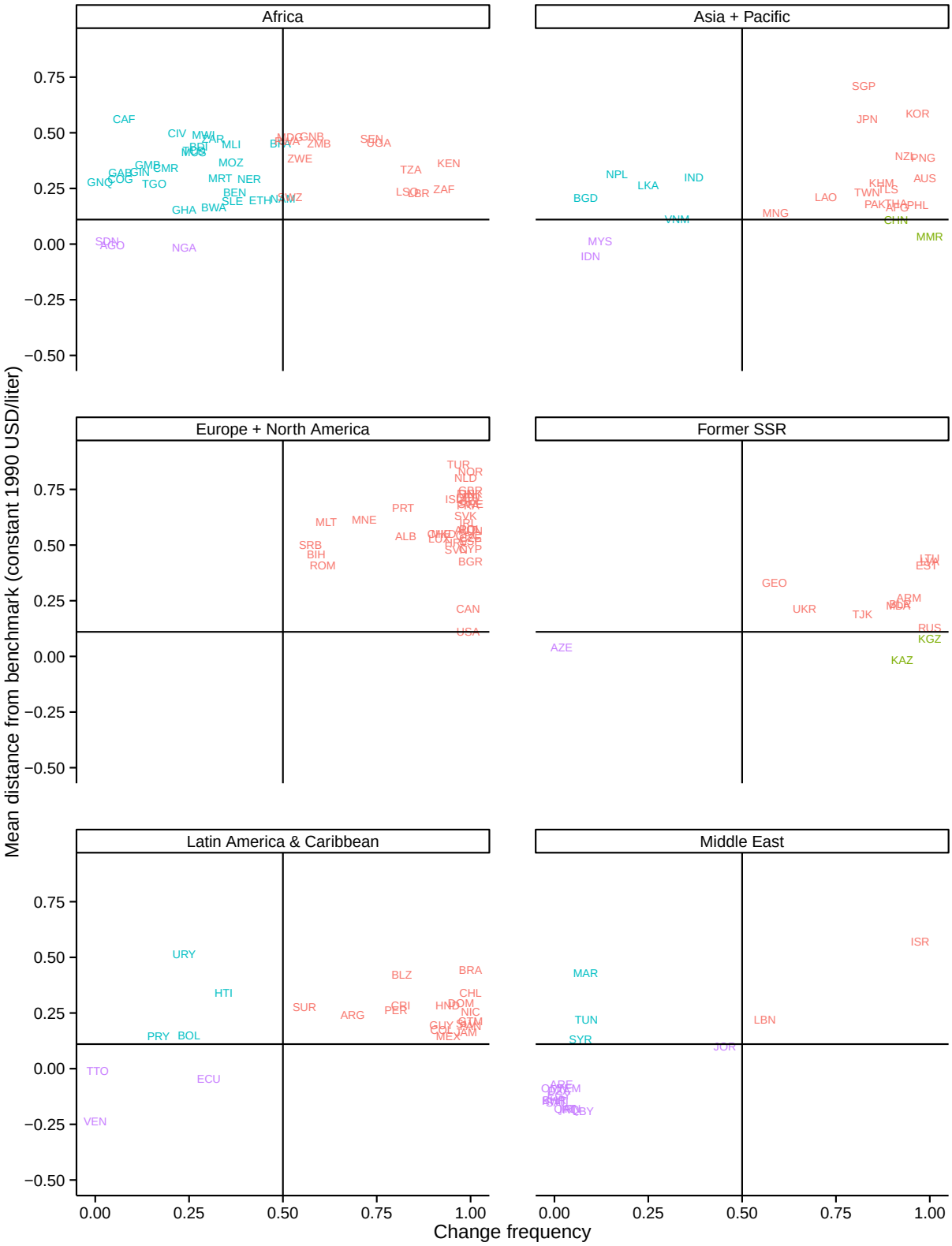
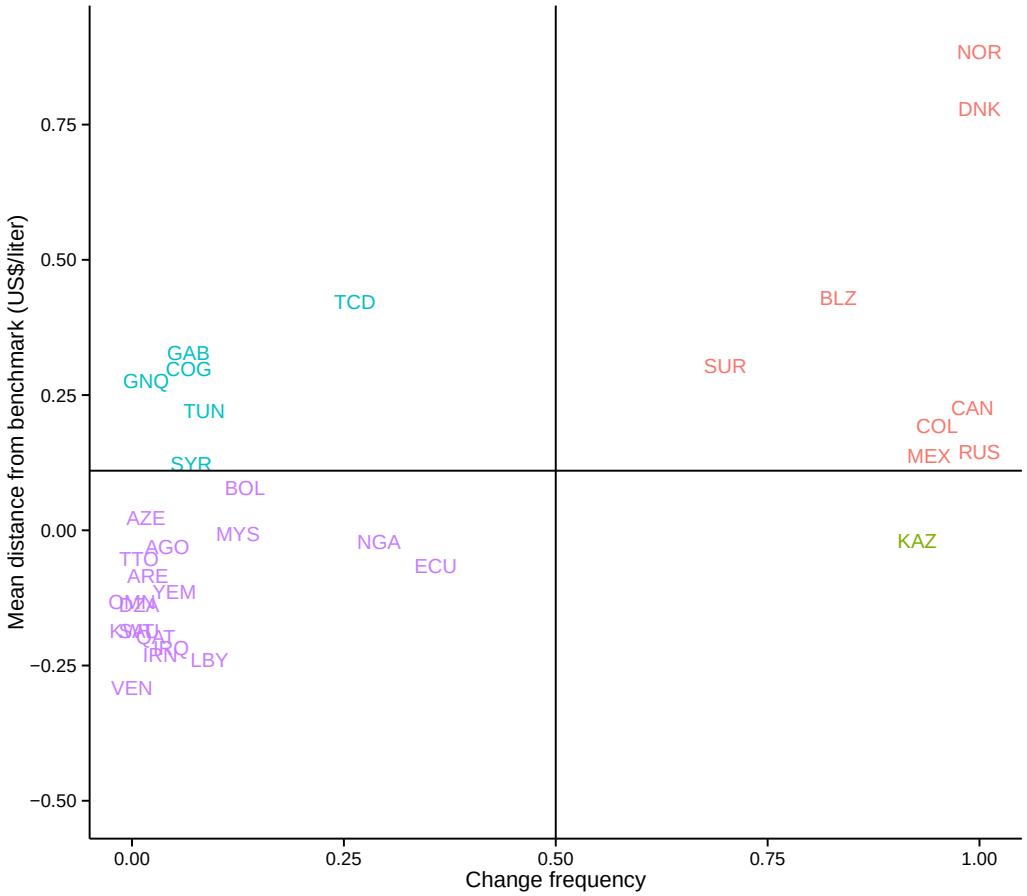


Figure 10: *Benchmark gap* vs. *change frequency* for major oil exporting countries.



oil is necessary but not sufficient to explain why a countries subsidizes gasoline sales.

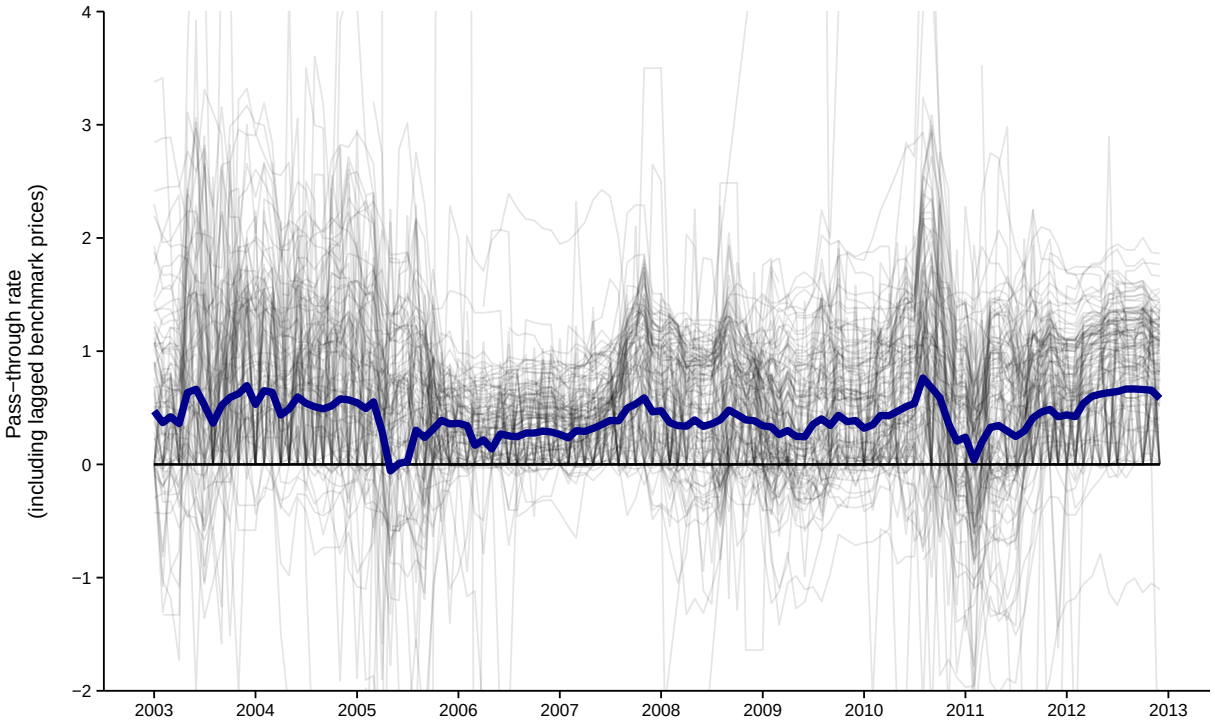
Pass-through Rate

Policy analysts sometimes encourage countries to embrace market-based pricing so that international price shocks are passed on (with or without some smoothing) to local consumers, who can adjust their consumption accordingly. Our *pass-through rate* variable is a time-varying measure of the degree to which this occurs, showing how much countries adjust their prices to global market fluctuations after accounting for local refining costs.

Figure 11 displays the *pass-through rates* for all countries in our data set, plus the global mean. There is considerable variation both across countries and over time. There was a slight increase in the global mean from early 2003 (the first point at which we can reliably measure it for almost all countries) to late 2012. At first glance it looks like World Bank and IMF efforts to encourage market-friendly price adjustments made little progress.

This is misleading: leaving aside the oil exporters, there was surprisingly widespread movement

Figure 11: *Pass-through rate* by country over time, with global mean plotted in bold.



toward higher *pass-through rates* in most regions of the world. Figure 12 shows that states in Asia, Europe & North America, and Latin America noticeably increased their *pass-through rates* from 2003 and 2012. The African states showed a more modest increase, which is consistent with their clustering in the upper-left quadrant of Figure 8. The Middle East maintained *pass-through rates* close to zero.

The rise in *pass-through rates* for a subset of the sample is also apparent in Figure 13. Here we repeat the analysis from Figure 4 comparing country-level scores at the beginning and end of the period, but looking at *pass-through rates* instead of the *benchmark gap*. As before, the 45 degree line divides countries whose scores increased (above) from those whose scores decreased (below). While a group of oil exporters maintained *pass-through rates* close to zero (14 out of 114 stayed exactly at zero), there is much variation across all other countries – just under half of the sample (52 out of 114) showed higher *pass-through rates* in 2012 than in 2003. Although the global mean changed little, there was surprisingly broad variation with some countries opting towards market-based price adjustments, while a nearly equal set of states moving towards regulated price adjustments.

Figure 12: *Pass-through rate* by country over time grouped by region, with regional mean plotted in bold.

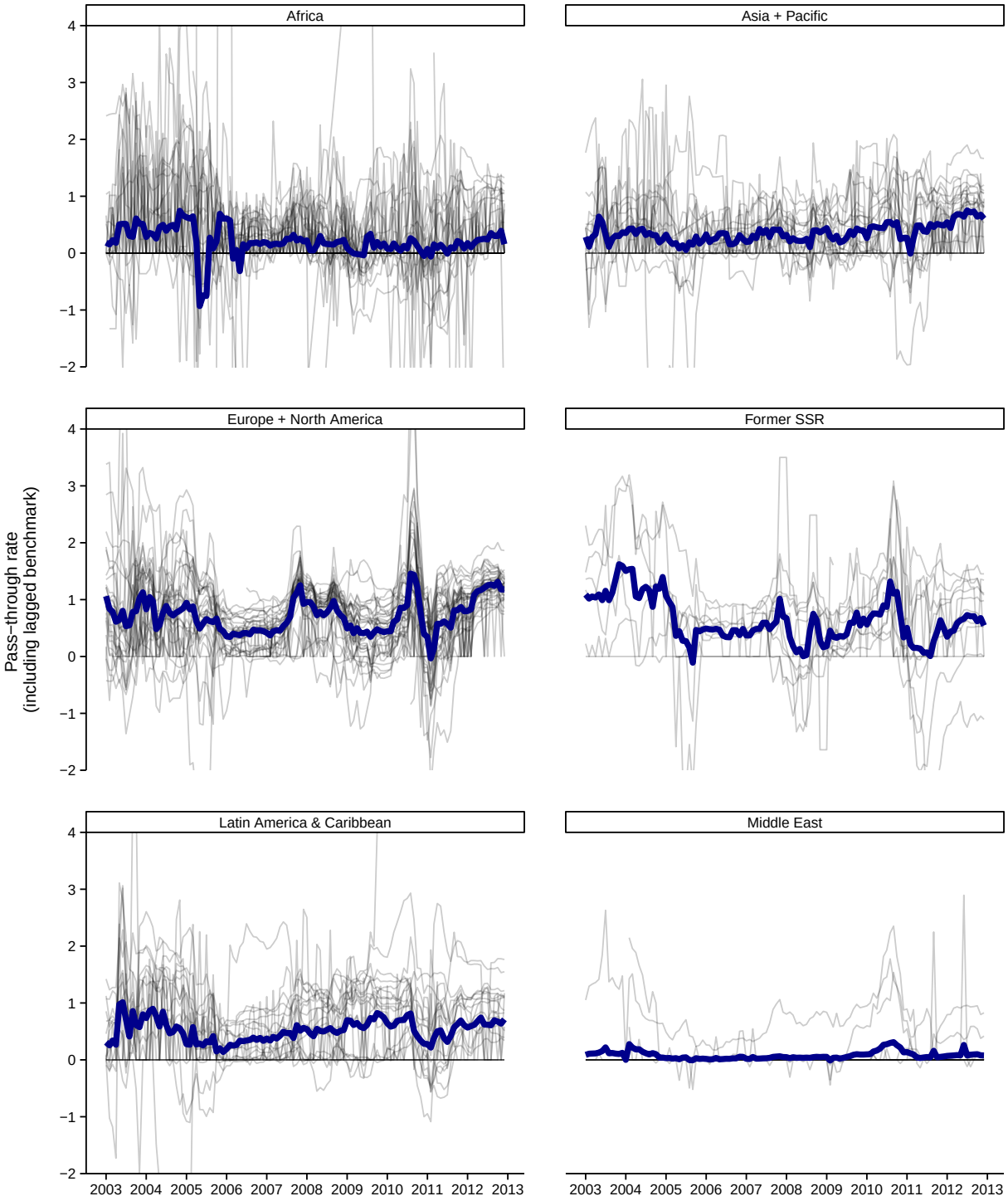
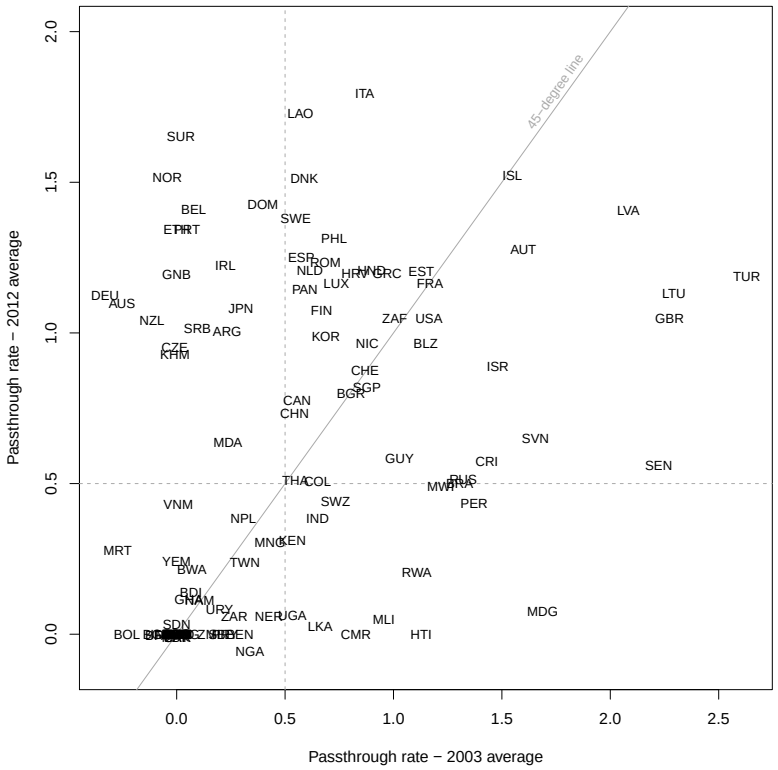


Figure 13: *Pass-through rate* by country, annual averages in 2003 vs. 2012.



5 Conclusion and Next Steps

Fuel pricing policy is important for a variety of reasons, yet many fundamental questions about fuel pricing cannot be answered without data on a large set of countries with sufficient temporal resolution. Here we introduce a dataset of retail gasoline prices at the monthly level for 157 countries.

Using these data, we make several descriptive observations. First, we find that the global mean gasoline tax either increased slightly or declined between 2000 and 2012, depending on how it is measured. In absolute terms it increased slightly, but as a percentage of the benchmark price – in other words, as an *ad valorem* tax – it declined in virtually all countries. To the extent that higher gasoline taxes are a tool for reducing consumption and carbon emissions – or even internalizing negative externalities – this is a disappointment.

Second, global price patterns vary widely by regime type, region, oil exporter status, and income levels: oil exporters have lower prices than oil importers; middle income states have lower prices than both high-income OECD states and low-income states. Autocracies tend to have lower prices than democracies, though oil-exporting democracies have lower prices than oil-importing autocracies. Regionally, the largest price increases were found in the former Soviet states and Europe; the lowest prices were consistently in the Middle East.

Third, the relationship between taxes and price flexibility is nuanced, as shown by our *benchmark gap* versus *change frequency* plot. Contrary to conventional wisdom, many states have maintained prices that are both relatively fixed and relatively high. All states with flexible pricing lie above the benchmark price, but so do many states with fixed prices.

Fourth, like many others we observe that oil-exporting countries often maintain large subsidies. We also observed patterns about these states that may be more novel:

1. oil exports appear to be necessary but not sufficient to explain why some states maintain subsidies: the *only* countries that maintained significant per-unit subsidies over this period were current or recent oil or gas exporters[18];
2. there is considerable variation in both tax policies and market adjustment policies among the oil exporters, particularly in Africa and Latin America;
3. as a group, the oil exporters had much higher subsidies in 2012 than in 2000. Many had no subsidies – at least using our simplified measure – in 2000, but saw them emerge over the period because they maintained fixed local prices at a time when global prices rose sharply;
4. of the four countries with unambiguous subsidies in 2000 (Angola, Indonesia, Saudi Arabia, and Venezuela), only one of them – Angola – reduced them. All other oil exporters increased existing subsidies or began new ones.

Finally, there was surprisingly broad variation in pass-through rates, with nearly half of all states moving towards market-based pricing over time while the other half opting towards regulated pricing or continuing largely fixed-price policies. Even though the global mean *pass-through rate* changed little, it rose in almost all states that did not export oil, particularly in Asia, Latin America, and Europe & North America. Countries in these regions are increasingly passing global price changes on to local consumers.

We note that the *price shift* – the gap between the observed retail price and what we predict the price to be given the current benchmarks and the recently learned "policy" in each country – could potentially provide a means to investigating changes over time and across countries in price policies. However, we find that in our own case studies of six countries (Brazil, Ghana, Namibia, Niger, Rwanda, and Turkey), *price shifts* do not match actual price policy changes as closely as we had expected, except in relatively fixed-price states. This is in part because many price policy changes are too small in magnitude to be picked up by our models, but also in part because price policies are sometimes implemented months after a price policy change is announced.

All of these patterns merit further investigation, and we hope to explore them in future research.

[18]Bahrain, Egypt, and Indonesia all maintained subsidies after transitioning from net exporters to net importers.

Appendix

Figure 14: Refining margins over time for three major refining hubs: Northwest Europe (Rotterdam), Singapore, and U.S. Gulf Coast. Refining margins refer to wholesale price of gasoline per barrel sold by the refiner minus the cost per barrel of crude oil used as input.

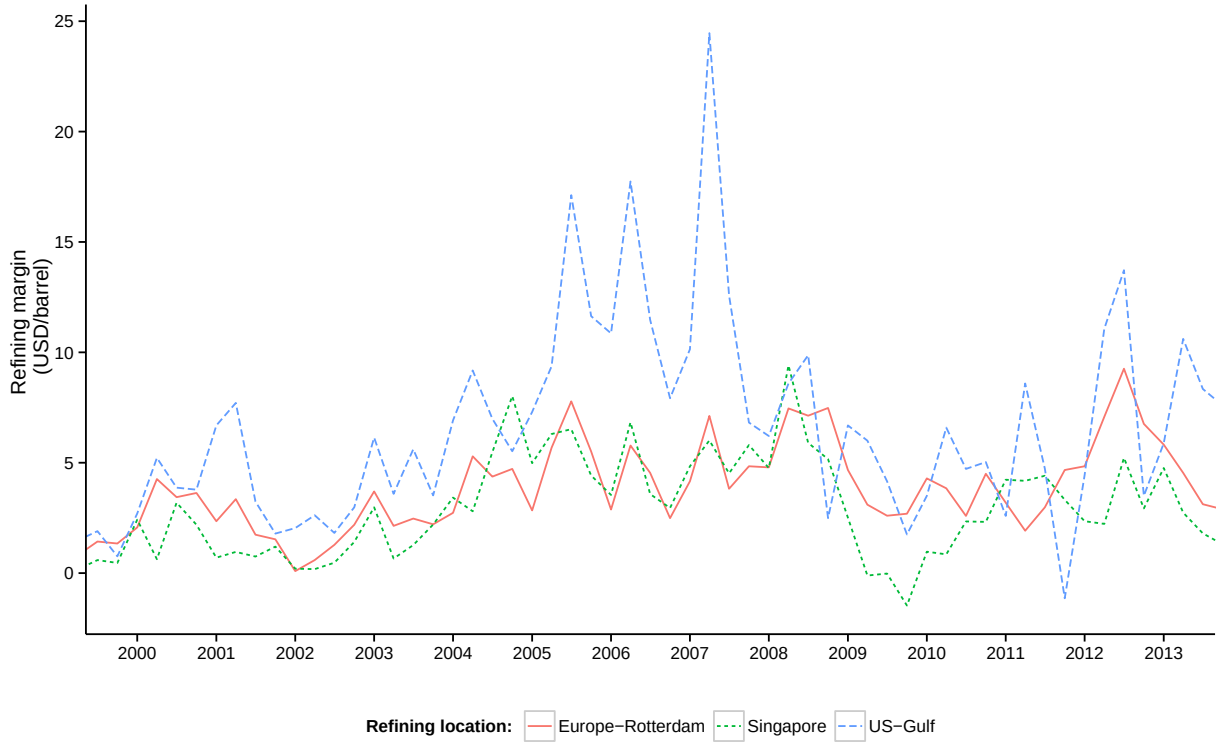


Table 1: Country list

Country name	Earliest year	Latest year	No. monthly obs.
Afghanistan	2004	2013	110
Albania	2008	2013	66
Algeria	1996	2013	209
Angola	2000	2012	156
Argentina	1994	2013	240
Armenia	2004	2013	109
Australia	1990	2013	200
Austria	1995	2013	217
Azerbaijan	1994	2013	240
Bahrain	1990	2013	288
Bangladesh	1990	2013	285
Belarus	2006	2013	88
Belgium	1994	2013	229
Belize	2000	2013	166
Benin	2000	2010	129
Bolivia	1990	2013	288
Bosnia and Herzegovina	2002	2013	144
Botswana	1998	2012	176
Brazil	1990	2013	287
Bulgaria	1995	2012	216
Burkina Faso	1998	2013	191
Burundi	1994	2013	219
Cambodia	1994	2013	228
Cameroon	1991	2013	250
Canada	1990	2013	288
Central African Republic	1995	2013	211
Chad	2003	2013	132
Chile	1990	2008	224
China	1990	2012	276
Colombia	1999	2012	166
Congo, Dem. Rep.	1996	2012	171
Congo, Rep.	2001	2013	150
Costa Rica	1994	2013	239
Cote d'Ivoire	2001	2013	126
Croatia	2000	2013	168
Cyprus	2004	2013	105
Czech Republic	2000	2013	157
Denmark	1994	2013	229
Dominican Republic	2001	2012	134
Ecuador	1990	2010	245
Egypt, Arab Rep.	1990	2013	284

Country name	Earliest year	Latest year	No. monthly obs.
El Salvador	2004	2013	120
Equatorial Guinea	1994	2013	240
Estonia	2000	2013	157
Ethiopia	2000	2012	141
Finland	1995	2013	217
France	1994	2013	229
Gabon	2000	2012	140
Gambia, The	2002	2013	144
Georgia	2008	2013	66
Germany	1994	2013	229
Ghana	1990	2012	276
Greece	1994	2013	229
Guatemala	2005	2013	99
Guinea	2005	2013	108
Guinea-Bissau	1999	2013	116
Guyana	1991	2013	267
Haiti	1998	2013	183
Honduras	2000	2013	168
Hungary	1992	2013	249
Iceland	1997	2012	190
India	1994	2013	237
Indonesia	1990	2012	276
Iran, Islamic Rep.	1990	2013	288
Iraq	2000	2007	84
Ireland	1991	2013	249
Israel	1990	2013	282
Italy	1994	2013	229
Jamaica	2004	2012	104
Japan	1990	2013	281
Jordan	2008	2013	70
Kazakhstan	1998	2011	117
Kenya	1997	2013	195
Korea, Rep.	1990	2013	288
Kuwait	1998	2013	192
Kyrgyz Republic	2003	2013	132
Laos	2000	2013	160
Latvia	2000	2013	157
Lebanon	2002	2013	144
Lesotho	2004	2013	120
Liberia	2008	2013	63
Libya	1996	2013	216
Lithuania	2000	2013	157
Luxembourg	1994	2013	229

Country name	Earliest year	Latest year	No. monthly obs.
Macedonia, FYR	2006	2013	93
Madagascar	1994	2012	219
Malawi	1995	2013	211
Malaysia	1991	2013	276
Mali	2001	2012	138
Malta	2004	2013	104
Mauritania	1997	2013	195
Mauritius	1992	2013	264
Mexico	2002	2013	132
Moldova	1999	2012	168
Mongolia	1995	2013	217
Montenegro	2006	2013	90
Morocco	1996	2013	216
Mozambique	2003	2013	131
Myanmar	1990	2013	288
Namibia	1990	2011	257
Nepal	1996	2013	212
Netherlands	1994	2013	229
New Zealand	1990	2013	283
Nicaragua	1990	2013	277
Niger	2001	2013	149
Nigeria	1990	2012	276
Norway	1990	2013	288
Oman	1990	2013	288
Pakistan	2006	2013	89
Panama	1998	2013	189
Papua New Guinea	2006	2013	96
Paraguay	1990	2011	257
Peru	1993	2012	240
Philippines	1990	2013	288
Poland	2004	2013	105
Portugal	1994	2013	229
Qatar	2002	2012	132
Romania	1998	2013	192
Russian Federation	1997	2012	192
Rwanda	2000	2013	168
Saudi Arabia	2000	2013	168
Senegal	1990	2013	282
Serbia	1998	2013	192
Sierra Leone	1993	2013	192
Singapore	2000	2013	168
Slovak Republic	2004	2013	104

Country name	Earliest year	Latest year	No. monthly obs.
Slovenia	2000	2013	157
Somalia	1995	2013	210
South Africa	1990	2013	288
Spain	1994	2013	229
Sri Lanka	1990	2013	286
Sudan	1997	2013	202
Suriname	1990	2013	288
Swaziland	2000	2013	168
Sweden	1995	2013	217
Switzerland	1993	2012	240
Syrian Arab Republic	2002	2010	108
Taiwan	1990	2013	288
Tajikistan	2002	2013	143
Tanzania	2002	2012	126
Thailand	1996	2013	216
Timor Leste	2001	2013	145
Togo	1998	2010	154
Trinidad and Tobago	1990	2012	276
Tunisia	1990	2013	184
Turkey	1994	2012	228
Uganda	2000	2012	147
Ukraine	2003	2013	130
United Arab Emirates	2002	2013	143
United Kingdom	1994	2013	229
United States	1990	2013	280
Uruguay	1990	2013	288
Venezuela	1990	2013	288
Vietnam	1995	2013	226
Yemen, Rep.	1998	2012	180
Zambia	2001	2013	156
Zimbabwe	2009	2013	58

References

Bacon, Robert. 2001. "Petroleum taxes: trends in fuel taxes (and subsidies) and the implications.".

Bernauer, Thomas. 2013. "Climate change politics." *Annual Review of Political Science* 16:421–448.

Chen, Dorothée, Andrea Liverani and Judith Krauss. 2014. "Assessing Public Opinion in the Political Economy of Reform: The Case of Energy Subsidy Reform in Morocco." *Problem-Driven Political Economy Analysis: The World Bank's Experience* p. 67.

Cheon, Andrew, Johannes Urpelainen and Maureen Lackner. 2013. "Why do governments subsidize gasoline consumption? An empirical analysis of global gasoline prices, 2002–2009." *Energy Policy* 56:382–390.

Cheon, Andrew, Maureen Lackner and Johannes Urpelainen. 2015. "Instruments of Political Control National Oil Companies, Oil Prices, and Petroleum Subsidies." *Comparative Political Studies* 48(3):370–402.

Clements, Benedict, David Coady, Stefania Fabrizio, Sanjeev Gupta, Trevor Alleyne and Carlo Sdralevich. 2013. "Energy Subsidy Reform: Lessons and Implications (Washington: International Monetary Fund).".

Coady, David, Ian Parry, Louis Sears and Baoping Shang. 2015. "How Large Are Global Energy Subsidies?".

Davis, Lucas W. 2014. "The Economic Cost of Global Fuel Subsidies." *American Economic Review: Papers and Proceedings* 104(5):581–85.

del Granado, Francisco Javier Arze, David Coady and Robert Gillingham. 2012. "The unequal benefits of fuel subsidies: A review of evidence for developing countries." *World Development* 40(11):2234–2248.

Fattou, Bassam and Laura El-Katiri. 2013. "Energy subsidies in the Middle East and North Africa." *Energy Strategies Reviews* 2:108–115.

Gupta, Sanjeev and Walter Mahler. 1995. "Taxation of petroleum products: theory and empirical evidence." *Energy Economics* 17(2):101–116.

Haber, Stephen and Victor Menaldo. 2011. "Do natural resources fuel authoritarianism? A reappraisal of the resource curse." *American political science Review* 105(01):1–26.

Hochman, Gal and David Zilberman. 2013. "Fuel prices across countries: dissecting the political and economic factors.".

Hughes, Llewelyn and Phillip Y Lipscy. 2013. "The politics of energy." *Annual Review of Political Science* 16:449–469.

Javeline, Debra. 2014. "The most important topic political scientists are not studying: adapting to climate change." *Perspectives on Politics* 12(02):420–434.

Keohane, Robert O. 2015. "The Global Politics of Climate Change: Challenge for Political Science." *PS: Political Science & Politics* 48(01):19–26.

Koplow, Doug. 2009. "Measuring energy subsidies using the price-gap approach: What does it leave out?" *IISD Trade, Investment and Climate Change Series* .

Kyle, Jordan. 2015. "How Corruption Drives Support for Fossil Fuel Subsidies: Evidence from Indonesia.".

Parry, Ian WH, Mr Dirk Heine, Eliza Lis and Shanjun Li. 2014. *Getting Energy Prices Right: From Principle to Practice*. International Monetary Fund.

Ross, Michael. 2012. *The oil curse: how petroleum wealth shapes the development of nations*. Princeton University Press.

Victor, David G. 2009. "The politics of fossil-fuel subsidies." *Available at SSRN 1520984* .

Wagner, Armin. 2013. "International Fuel Prices 2012/2013." *Retrieved July* 7:2014.