Title
Global progress and backsliding on gasoline taxes and subsidies

Journal
Nature Energy, 2(1)

ISSN
2058-7546

Authors
Ross, Michael L
Hazlett, Chad
Mahdavi, Paasha

Publication Date
2017

DOI
10.1038/nenergy.2016.201

Peer reviewed

nature energy

ANALYSIS

PUBLISHED: 9 JANUARY 2017 | VOLUME: 2 | ARTICLE NUMBER: 16201

Global progress and backsliding on gasoline taxes and subsidies

Michael L. Ross[1]*, Chad Hazlett[2] and Paasha Mahdavi[3]

To reduce greenhouse gas emissions in the coming decades, many governments will have to reform their energy policies. These policies are difficult to measure with any precision. As a result, it is unclear whether progress has been made towards important energy policy reforms, such as reducing fossil fuel subsidies. We use new data to measure net taxes and subsidies for gasoline in almost all countries at the monthly level and find evidence of both progress and backsliding. From 2003 to 2015, gasoline taxes rose in 83 states but fell in 46 states. During the same period, the global mean gasoline tax fell by 13.3% due to faster consumption growth in countries with lower taxes. Our results suggest that global progress towards fossil fuel price reform has been mixed, and that many governments are failing to exploit one of the most cost-effective policy tools for limiting greenhouse gas emissions.

Since the early 2000s, the Intergovernmental Panel on Climate Change, the International Energy Agency, the International Monetary Fund (IMF), and the World Bank have urged governments to remove subsidies for fossil fuels and instead tax them at rates that account for their social and environmental costs[1–3]. The IMF estimates that global fossil fuel subsidies—including social and environmental costs—reached US$5.3 trillion in 2015, equivalent to 6.5% of global GDP (gross domestic product)[4]. The removal of fossil fuel subsidies is widely regarded as one of the most cost-effective ways for governments to meet their commitments under the Paris climate agreement to curtail greenhouse gas (GHG) emissions[5,6]. At the same time, reduced subsidies and higher taxes can generate local benefits by reducing road congestion, traffic fatalities, and local air pollution from nitrogen oxide, ozone, and fine particulates[7].

It is unclear, however, whether governments have been adopting these recommendations. Self-reporting by governments is often incomplete and unreliable. Many taxes and subsidies are indirect, or hidden in the budgets of state-owned enterprises; moreover, the real value of taxes and subsidies changes over time due to inflation and currency fluctuations. Some countries announce reforms but either fail to enact them or nullify their impact with countervailing policies, as in the case of Brazil[8]. Others try to remove gasoline subsidies quietly to avoid dissent: according to news reports, since 2006 attempts to raise gasoline prices have been followed by protests in at least 19 countries, including Bolivia, Brazil, Burkina Faso, Cameroon, Chile, Cote D'Ivoire, Ghana, India, Indonesia, Iran, Jordan, Kyrgyzstan, Mozambique, Myanmar, Nicaragua, Niger, Nigeria, Uganda and Yemen.

The taxes and subsidies that governments place on energy reflect their efforts to reduce GHG emissions from fossil fuels[9]. Yet without a consistent way to measure these taxes and subsidies, we cannot know much about these efforts and whether they are changing over time; nor can we know whether the world as a whole is making progress towards fossil fuel price reform. Better measures of energy policies can help observers track the climate change mitigation efforts of governments—including their adherence to the pledges they made in conjunction with the Paris climate agreement—particularly if the measures are comprehensive, based on observable data, replicable, and can be applied to all countries[9]. Consistent measures of fossil fuel price policies will also help scholars study the conditions that foster or impede politically difficult energy reforms[10–12].

We use monthly data on retail gasoline prices in 157 countries from 2003 to 2015 to calculate the implicit net tax or subsidy that governments place on a litre of gasoline. These countries contain 97.1% of the world population and represent 98.2% of all GHG emissions. Our analysis shows that from the first half of 2003 to the first half of 2015, net gasoline taxes rose in 83 countries, with significant gains in China, Brazil and Indonesia. Net taxes fell or subsidies rose in 46 states, including many oil-exporting countries in the Middle East, North Africa and Latin America. At a global level, the unweighted mean gasoline tax across all countries in our sample rose from 42.8 US cents to 50.9 US cents, equivalent to a 1.44% compound annual growth rate (CAGR). Since countries vary widely in their gasoline consumption, however, this figure does not reveal the global per-litre average tax. Moreover, from 2003 to 2012, the final year for which consumption data are available, consumption grew more quickly in low-tax countries than high-tax countries. Using a consumption-weighted measure to reflect the true per-unit level of taxation, we find that the implicit global mean tax fell from 27.9 US cents to 24.2 US cents, a CAGR decline of 1.18%. Even though a majority of countries reformed their gasoline taxes, progress towards higher taxes at a global level was thwarted by a shift in consumption towards countries that had subsidies or lower taxes.

Measuring gasoline taxes and subsidies

All governments either tax or subsidize the consumption of fossil fuels, but many of these taxes and subsidies are difficult to observe or infer. Coal taxes and subsidies, for example, are exceptionally hard to determine since in many countries coal is sold directly to government-owned utilities through long-term contracts rather than through retail markets; any subsidies may be hidden in the

[1]Department of Political Science, University of California Los Angeles, Los Angeles, California 90095, USA. [2]Departments of Statistics and Political Science, University of California Los Angeles, Los Angeles, California 90095, USA. [3]McCourt School of Public Policy, Georgetown University, Washington DC 20057, USA. *e-mail: mlross@polisci.ucla.edu

price of electricity[11]. It is also hard to determine the supply cost for coal, since there is no single international reference price. Without either the supply cost or the retail price, taxes and subsidies are very difficult to measure.

Our study focuses on gasoline taxes and subsidies, which can be more readily measured: gasoline is sold directly to consumers in all countries, which gives it an observable retail price; country-to-country differences in gasoline quality are relatively small; and there is effectively a single world reference price. Until now, data on gasoline prices have been limited to a single price every two years for most countries, which is too infrequent to observe many policy changes[13].

We collected data on local gasoline retail prices for 157 countries from January 2003 to June 2015 using both primary and secondary sources. We included all sovereign states whose populations were greater than one million in 2012, except for four countries for which we could not locate reliable data: Cuba, Eritrea, North Korea and Turkmenistan. For 46 countries our coverage is temporally incomplete for the full time series, with data missing for 1,067 (4.5%) of the 23,550 country-months. A full list of countries, along with the number of country-month observations for each case, is found in Supplementary Table 1.

Primary documents were obtained from national governments and found on websites maintained by ministries of finance, commerce, trade, communications, transportation, natural resources, petroleum, energy, and mining; central statistical agencies; central banks; energy regulatory bodies; state-owned oil companies, including oil refining companies; and official government decrees and public announcements. In 17 countries we employed local researchers to obtain primary data that were not otherwise accessible.

Secondary sources included the European Commission, the International Road Transport Union, the Food and Agriculture Organization, the Famine Early Warning System, CITAC Africa, the Organization of Arab Petroleum Exporting Countries, and documents from the IMF and World Bank. Whenever possible we cross-validate price data across multiple sources to alleviate concerns about measurement bias.

To measure implicit taxes and subsidies we use the price gap method, which compares the observed retail price in each country with a global benchmark price[14]. This method yields a single figure that represents the net per-unit value of all taxes and subsidies, both implicit and explicit, and that can be readily compared across countries and over time. Below we refer to these implicitly measured net taxes or subsidies as 'net taxes' or 'net subsidies.'

The price gap method allows us to measure what the IMF calls 'pre-tax subsidies', which represent the difference between the retail price and the international supply cost; we do not attempt to estimate 'post-tax subsidies', which are defined as the difference between the retail price and the sum of the international supply cost, a basic consumption tax, and a Pigouvian tax that offsets the costs of local pollution, congestion, and carbon emissions[4]. Hence, the price gap should be interpreted as a lower-bound estimate of total fossil fuel subsidies.

Country-level trends

Figure 1 shows country-level gasoline prices for 155 countries in constant 2015 US dollars (USD). Prices have been omitted for Somalia and Myanmar, whose exchange rates were unavailable for most of this period. It also displays the benchmark price, which is the spot price for conventional refined gasoline at the New York Harbor, adjusted to account for distribution costs. Net taxes and subsidies are given by the difference between the retail price and the benchmark price. States fall into two groups: those above the benchmark (whose prices indicate net taxes) and those below it (whose prices indicate net subsidies).

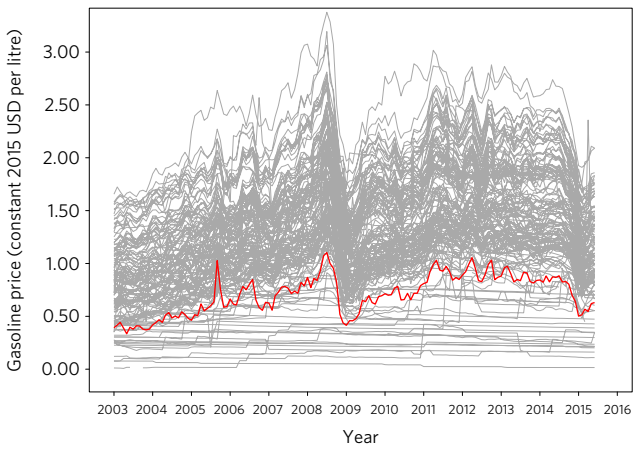

Figure 1 | Gasoline prices by country and benchmark price trends over time. Individual country price trends are shown in grey, and the global benchmark price is plotted in red. Countries fall into two groups: those with prices above the benchmark (who tax gasoline) and those below it (who subsidize it). The overall shape of many trend lines is driven by changes in benchmark price. In general, countries that tax gasoline also allow the price to fluctuate in tandem with global prices, while those that subsidize gasoline keep their prices fixed for long periods. All prices are in constant 2015 USD per litre.

Thirty-three countries were subsidizers for at least one 12-month period from 2003 to 2015, and 9 countries were subsidizers for the entire period. We classify 22 countries as 'persistent subsidizers', meaning their median price for the 2003–2015 period was below the median benchmark price (that is, the net tax was negative). They include Algeria, Angola, Azerbaijan, Bahrain, Ecuador, Egypt, Indonesia, Iran, Iraq, Kuwait, Libya, Malaysia, Myanmar, Nigeria, Oman, Qatar, Saudi Arabia, Sudan, Trinidad, United Arab Emirates, Venezuela and Yemen. In general these subsidizers kept their gasoline prices fixed, adjusting them an average of once every 17 months. All of them were economically dependent on oil or natural gas exports, implying that their low, fixed gasoline prices reflected political pressure to distribute resource revenues[15].

Figure 2 displays changes in net taxes and subsidies at the country level from the first half of 2003 to the first half of 2015. We find that net taxes rose in 83 states (above the 45-degree line) and declined in 46 others (below the 45-degree line). The largest increases in net taxes were in Argentina, China, Malawi and Yemen; the biggest drops were in Chad, Saudi Arabia, Trinidad and Venezuela. Among the 20 largest petroleum-based CO_2 emitters, the largest tax increases were in China and Singapore, while the largest decreases were in Saudi Arabia and South Korea (Table 1).

The global mean tax on gasoline

When all countries are given equal weight, the mean net gasoline tax averaged across countries rose from 42.8 US cents in the first half of 2003 to 50.9 US cents in the first half of 2015, using constant 2015 USD (Fig. 3). This constitutes an 18.9% increase and is equivalent to a 1.44% CAGR. Yet these figures do not reveal the global mean net tax on gasoline, since countries vary in their consumption, and consumption grew more quickly in countries with subsidies or low taxes than countries with high taxes (Supplementary Fig. 1 and Supplementary Note 1). When we use a consumption-weighted measure to correct for these differences, our data show that from the first half of 2003 to the first half of 2015, the global mean net tax fell from 27.9 US cents to 24.2 US cents, a drop of 13.3% and a CAGR decline of 1.18%.

This decline was not an artefact of changes in the price of crude oil. As a proportion of the benchmark price, the unweighted mean

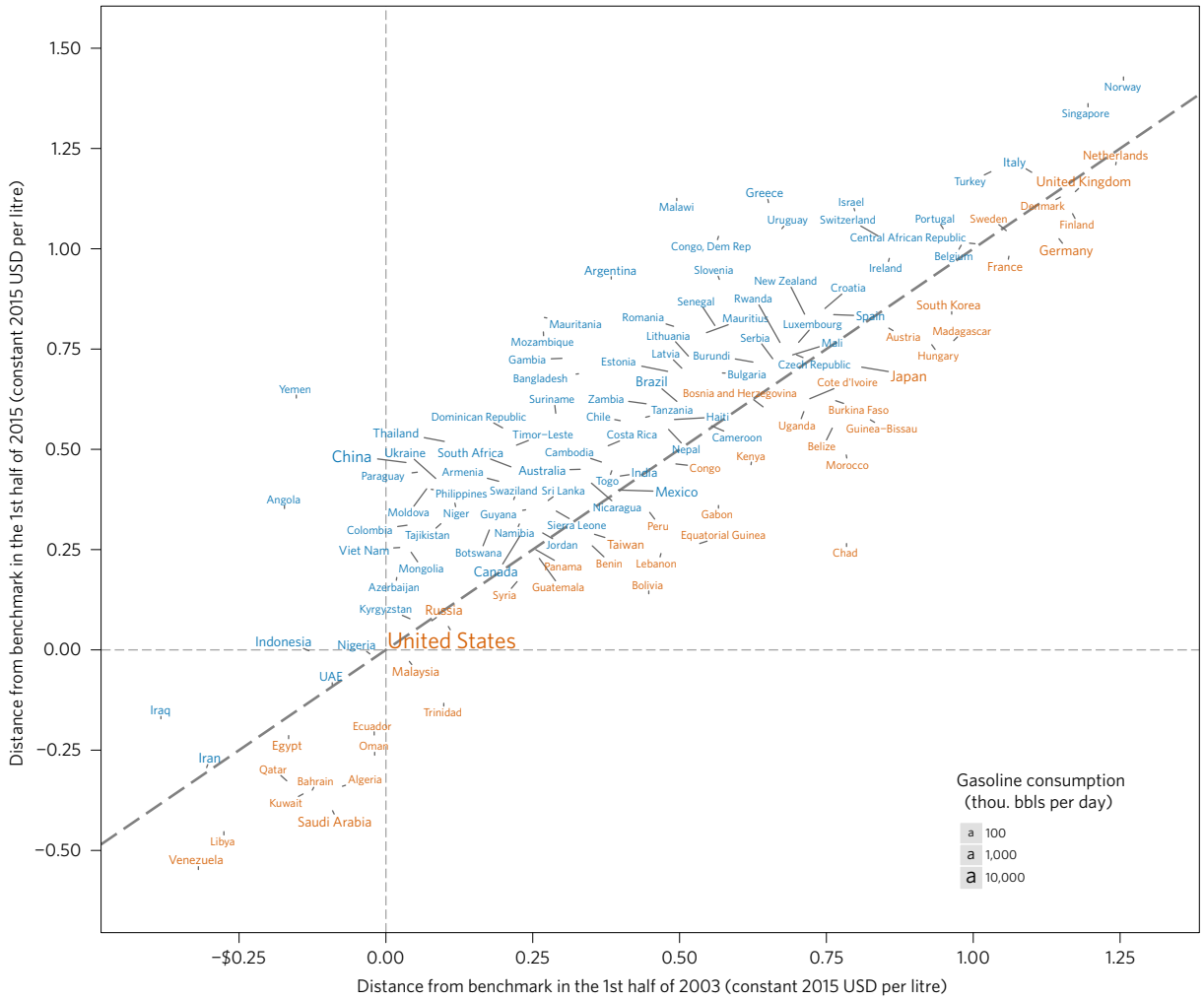

Figure 2 | Net taxes and subsidies by country in 2003 versus 2015. Eighty-three countries increased their net taxes or reduced their net subsidies between the first six months of 2015 and the first six months of 2003; they are shown in blue and lie above the 45° dashed line. By contrast, 46 countries reduced net taxes or increased net subsidies over the same period, and are shown in dark orange below the 45° line. While most countries had net taxes in both periods (placing them in the upper-right quadrant), 14 countries had subsidies in both periods (placing them in the lower-left quadrant). Just two countries changed from net taxers to net subsidizers (lower-right quadrant) while two others changed from net subsidizers to net taxers (upper-left quadrant). Text size is proportional to average gasoline consumption.

price fell from 210% to 192%, and the consumption-weighted price fell from 172% to 144% (Supplementary Fig. 2). Nor is it an artefact of our starting point: if we begin our analysis in 2001 or 2005 and end in 2011 or 2015, the unweighted mean net tax still shows a modest increase (with a positive CAGR ranging from 0.59% to 1.59%), while the consumption-weighted mean net tax still shows a decline (with a negative CAGR ranging from 0.76% to 2.88%) (Supplementary Table 2). These patterns are also robust to the use of alternative benchmark prices (Supplementary Figs 3 and 4 and Supplementary Note 2).

Regional and G20 trends

When prices are disaggregated by region (Fig. 4), we find the highest net taxes in Europe and North America and the lowest in the oil-rich Middle East and North Africa. Net taxes in the Middle East rose slightly over the period, while those in Europe and North America rose sharply in real terms before dropping after July 2014, when global oil prices collapsed.

What is surprising is the pair of regions with the second highest and second lowest net tax levels, respectively, as of June 2015: Africa and the former Soviet Union. African states have some of the highest net gasoline taxes in the world and have maintained this position since at least 2003. States that were part of the Soviet Union, on the other hand, began the period with the lowest real net taxes but began steadily increasing them after 2003 before dropping sharply after the 2014 oil price crash.

In September 2009, the G20 heads of state agreed to phase out 'inefficient fossil fuel subsidies'[16]. Even though the agreement called attention to the problem of fossil fuel subsidies, its real-world effect is not apparent: we find no evidence that it was followed by a rise in the unweighted mean net gasoline tax across these 20 countries (Fig. 5).

Changes in price fixity

Our data allow us to measure changes in price fixity, meaning the degree to which governments keep gasoline prices fixed or allow them to fluctuate with market forces. The World Bank and IMF generally encourage countries to reform their policies by moving from fixed to floating prices, in order to reduce market distortions and avoid subsidies when supply costs rise[17]. Price fixity helps explain much of the change in subsidies over time: rising global oil prices caused many fixed-price states to become subsidizers between 2003 and 2009, while the drop in global oil prices after mid-2012 caused both the number of subsidizers and the magnitude of their subsidies to fall[18].

Table 1 | Changes in net taxes in the 20 largest petroleum-based CO_2 emitters.

Rank	Country	Net tax 2003	Net tax 2015	Change (US$)	Emissions
1	United States	0.11	0.06	−0.05	2,240
2	China	0.03	0.47	0.43	1,306
3	Japan	0.81	0.70	−0.11	568
4	Russia	0.08	0.07	−0.01	436
5	India	0.40	0.43	0.03	435
6	Brazil	0.50	0.62	0.12	390
7	Saudi Arabia	−0.09	−0.40	−0.31	389
8	Germany	1.15	1.03	−0.12	313
9	Canada	0.23	0.28	0.06	291
10	Mexico	0.40	0.40	0.00	263
11	Iran	−0.31	−0.29	0.01	256
12	South Korea	0.96	0.84	−0.13	253
13	France	1.06	0.98	−0.08	232
14	Indonesia	−0.13	0.00	0.13	229
15	United Kingdom	1.17	1.14	−0.03	202
16	Singapore	1.20	1.36	0.17	190
17	Spain	0.76	0.84	0.07	187
18	Italy	1.10	1.19	0.09	185
19	Australia	0.33	0.45	0.12	138
20	Netherlands	1.24	1.21	−0.03	135

Countries are ranked by total emissions. From the first half of 2003 to the first half of 2015, net taxes rose in 11 of these countries and fell in 9. China had by far the largest increase in net taxes, followed by Singapore, Indonesia, Australia and Brazil. The largest decline was in Saudi Arabia, followed by South Korea, Germany and Japan. All prices are in constant 2015 USD per litre; CO_2 emissions from petroleum are in million metric tonnes in 2012.

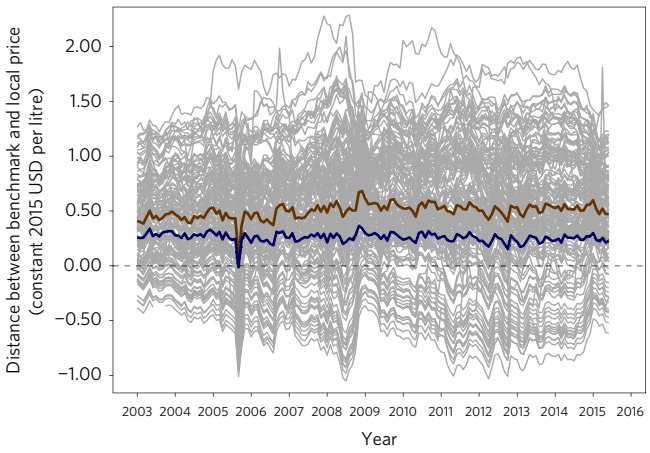

Figure 3 | Net taxes and subsidies over time. When all countries are weighted equally, average net taxes from 2003 to 2015 slightly rose at a 1.44% compound annual growth rate (shown in brown). If countries are weighted by their gasoline consumption in each period, thus taking consumption levels and trends into account, the average net taxes instead declined at a 1.18% compound annual growth rate (dark blue line). Individual country tax and subsidy trends are shown in grey.

Yet we also find that fixity reform is rare. From 2003 to 2015 the fraction of states with fixed prices dropped only slightly, from 38.5% to 33.5% (Fig. 6). Only one subsidizer switched from fixed to floating prices: Nigeria, which switched back to fixed prices after 28 months.

Conclusion

Our high-frequency data can provide policymakers with a comprehensive, replicable, and observable measure of progress towards fossil fuel price reform in virtually all countries. It should also help scholars who wish to study topics such as the determinants of gasoline taxes and subsidies, the conditions under which reform tends to be successful, the factors that affect the elasticity of gasoline prices, and how gasoline taxes can affect political, economic, social and environmental outcomes.

For supporters of fossil fuel tax reform, our study reports a mix of good and bad news: while almost two-thirds of the countries in our sample increased their net gasoline taxes from 2003 to 2015, global progress was thwarted by a shift in consumption towards states that maintain gasoline subsidies or low taxes. Fixity reforms were virtually non-existent for those countries with persistent subsidies, where such reforms are most needed. Higher gasoline taxes may be one of the most cost-effective policy tools for reducing carbon emissions, but from 2003 to 2015 many governments were reluctant to adopt them, leading to a global decline in net taxes on the average litre of consumed gasoline.

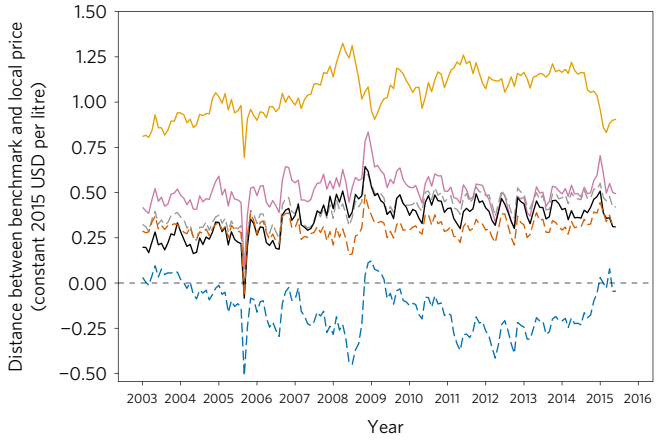

Figure 4 | Net taxes and subsidies by region over time. Europe and North America (gold) had the world's highest average taxes. The Middle East and North Africa (blue) had the lowest, and is the only region with average net subsidies in most time periods. In between were Africa (magenta), Asia-Pacific (grey), former Soviet Union (black), and Latin America and the Caribbean (orange). Regional averages are computed monthly by weighting all countries equally.

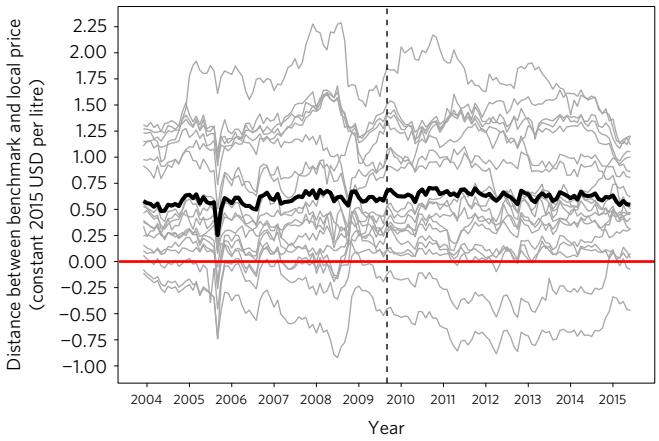

Figure 5 | Net taxes and subsidies in the G20. This figure shows net taxes and subsidies for each country in the G20 plotted in grey lines, along with an average across all G20 countries marked in black. The dashed vertical line marks the September 2009 agreement by the G20 heads of state to phase out 'inefficient fossil fuel subsidies.' There was no apparent change in average trend following the agreement.

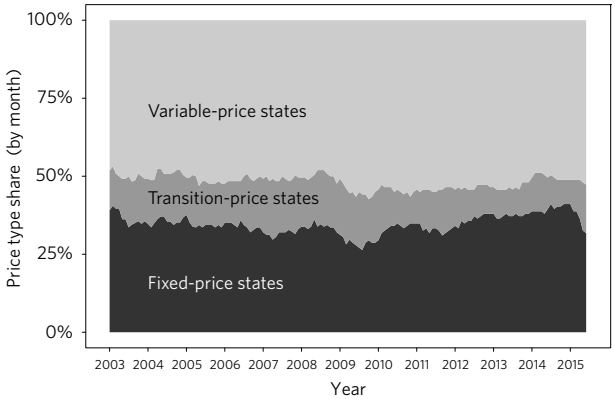

Figure 6 | Price fixity over time. We place countries in one of three categories indicating how many times their gasoline prices changed over the previous twelve months: three or fewer (black), four to eight (dark grey), or nine to twelve (light grey). From 2003 to 2015 there was a small drop in the proportion of countries with fixed prices and a small rise in those with fluctuating prices. Shares shown are monthly averages.

Methods

Selection of dates and grades. 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. When data on multiple gasoline grades were available we use regular-graded gasoline (typically between 87 and 90 octane) to reflect the type most likely to be purchased by the average consumer. In countries where the availability of grades changes over time we selected the grade with the longest coverage. When data were available for different parts of a country we selected the region that includes the capital city.

Converting local currencies. To convert local currencies to US dollars we use monthly exchange rates from the IMF International Financial Statistics. For converting from nominal to real 2015 US dollars we use monthly inflation rates from the US Federal Reserve Economic Database (FRED) Consumer Price Index for All Urban Consumers: All Items Less Food and Energy (CPILFESL) series. In countries that experienced currency changes or revaluations—for example, Romania (July 2005), Turkey (January 2005), Ghana (August 2007)—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 litre.

Benchmark prices. To estimate implicit net taxes and subsidies we compute the gap between the local price and the international benchmark price, less a small adjustment to account for distribution costs. To simplify our analysis we assume local distribution costs are fixed for all countries and years at 10 US cents per litre in constant 2015 US dollars; this estimate is drawn from ref. 19, which uses a similar figure for the cost of bringing refined gasoline to retailers. Though distribution and other local costs may vary by location, we expect those unobserved differences to change slowly, and thus may affect cross-country comparisons but not within-country comparisons over time.

For our benchmark we use the spot price for conventional refined gasoline at the New York Harbor as reported by the US Energy Information Administration. For oil-importing countries, the benchmark price represents the marginal cost of supplying gasoline to consumers. For oil-producing countries, who in many cases can supply gasoline to their citizens at a lower cost, the difference between the retail price and the benchmark represents the opportunity cost to the government: if it sets a retail price below the international benchmark, it is forgoing revenue it would otherwise accrue by selling its gasoline at a market price. In both cases we treat the difference between the retail price and the benchmark as the net implicit tax or subsidy.

Start and end dates. Six-month averages for 2003 ('first half 2003') and 2015 ('first half 2015') are computed using prices for January through June, where available. In countries where one or several of these months are missing, we instead use the average price for the non-missing months. Alternative start and end points used in Supplementary Table 2 use the same six-month average approach to smooth out month-to-month fluctuations.

Calculating price fixity. To measure price fixity we count the number of month-to-month changes in gas prices, in local currency, over a rolling twelve-month interval. Countries that changed their prices three or fewer times over the prior twelve months were coded as having fixed prices, countries with four to eight changes were coded as transitional, and countries with nine to twelve changes were coded as having floating prices.

Consumption weighting. We weight implicit net taxes and subsidies by consumption using data on annual motor gasoline consumption from the US Energy Information Agency International Energy Statistics. A weight w_{it} is given by a country's consumption share, calculated as the total consumption by each country i divided by total global consumption in month t (assuming constant consumption share across all 12 months in a given year). A global consumption-weighted mean implicit net tax is then given by $\text{tax}_t = (\sum_{i=1}^{N} w_{it}\text{price}_{it})$ — benchmark$_t$ at each month t. The most recent Energy Information Administration data on motor gasoline consumption are from 2012; we extrapolate consumption shares up to 2015 by assuming that shares (but not consumption) remain fixed across the 2012–2015 period.

Data availability. The data that support the plots within this paper and other findings of this study are publicly available on the Harvard Dataverse at https://dataverse.harvard.edu/dataverse/mlross.

Received 24 June 2016; accepted 28 November 2016; published 9 January 2017

References

1. Gupta, S. & Mahler, W. Taxation of petroleum products: theory and empirical evidence. *Energy Econ.* **17**, 101–116 (1995).
2. Bacon, R. Petroleum taxes: trends in fuel taxes (and subsidies) and the implications. *Viewpoint* (*World Bank*) **240**, 1–4 (2001).
3. IPCC *Climate Change 2001: The Scientific Basis* (eds Houghton, J. T. *et al.*) (Cambridge Univ. Press, 2001).
4. Coady, D., Parry, I., Sears, L. & Shang, B. How large are global energy subsidies? *IMF Working Paper* **105**, 1–41 (2015).
5. Rentschler, J. & Bazilian, M. Reforming fossil fuel subsidies: drivers, barriers and the state of progress. *Clim. Policy* **16**, 1–24 (2016).
6. Davis, L. W. The economic cost of global fuel subsidies. *Am. Econ. Rev.* **104**, 581–585 (2014).
7. Parry, I. W., Heine, M. D., Lis, E. & Li, S. *Getting Energy Prices Right: From Principle to Practice* (International Monetary Fund, 2014).
8. de Oliveira, A. & Laan, T. *Lessons Learned from Brazil's Experience with Fossil-Fuel Subsidies and their Reform* (International Institute for Sustainable Development, 2010).
9. Aldy, J. E. & Pizer, W. A. Alternative metrics for comparing domestic climate change mitigation efforts and the emerging international climate policy architecture. *Rev. Environ. Econ. Policy* **10**, 3–24 (2016).
10. Vagliasindi, M. *Implementing Energy Subsidy Reforms: Evidence from Developing Countries* (The World Bank, 2013).
11. Victor, D. G. *The Politics of Fossil-Fuel Subsidies* (IISD Global Subsidies Initiative Series, 2009).
12. Cheon, A., Urpelainen, J. & Lackner, M. Why do governments subsidize gasoline consumption? An empirical analysis of global gasoline prices, 2002–2009. *Energy Policy* **56**, 382–390 (2013).
13. Wagner, A. *International Fuel Prices 2012/2013* (accessed 1 July 2014); https://energypedia.info/index.php/International_Fuel_Prices
14. Koplow, D. *Measuring Energy Subsidies Using the Price-Gap Approach: What Does it Leave Out?* (IISD Trade, Investment and Climate Change Series, 2009).
15. Fattou, B. & El-Katiri, L. Energy subsidies in the Middle East and North Africa. *Energy Strateg. Rev.* **2**, 108–115 (2013).
16. G20 *Leaders' Statement* The Pittsburgh Summit, September 24–25, 2009 (accessed 14 May 2016); https://www.treasury.gov/resource-center/international/g7-g20/Documents/pittsburgh_summit_leaders_statement_250909.pdf
17. Clements, B. *et al. Energy Subsidy Reform: Lessons and Implications* (International Monetary Fund, 2013).
18. Kojima, M. Petroleum product pricing and complementary policies: experience of 65 developing countries since 2009. *World Bank Policy Research Working Paper* **6396**, 1–116 (2013).
19. Coady, D. *et al. Petroleum Product Subsidies: Costly, Inequitable, and Rising* (International Monetary Fund, 2010).

Acknowledgements

We thank K. Bawn, M. Bazilian, D. Coady, A. Cooley, J. Kyle, Y.-M. Liou, I. Parry, D. Posner, B. Shang and D. Treisman for their suggestions on the analysis, IMF and World Bank staff for sharing their country data, and E. Chenoweth and A. Glynn for their early guidance on the research design. Our data collection efforts were supported by

the UCLA Burkle Center and the Natural Resources Governance Institute. Earlier versions of this paper were presented to seminars at the World Bank, the Council on Foreign Relations, the 2015 meeting of the American Political Science Association, the 2015 meeting of the International Political Economy Society, Georgetown University, UCLA Law School, Yale University and Columbia University.

Author contributions

M.L.R. secured project funding and designed the study; M.L.R. and P.M. supervised the data collection; P.M. and C.H. analysed the data; P.M. created the figures; and M.L.R., P.M. and C.H. drafted and edited the manuscript.

Additional information

Supplementary information is available for this paper.

Reprints and permissions information is available at www.nature.com/reprints.

Correspondence and requests for materials should be addressed to M.L.R.

How to cite this article: Ross, M. L., Hazlett, C. & Mahdavi, P. Global progress and backsliding on gasoline taxes and subsidies. *Nat. Energy* **2**, 16201 (2017).

Competing interests

The authors declare no competing financial interests.