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WIDER Working Paper 2021/159

## **An exploration of the association between fuel subsidies and fuel riots**

Neil McCulloch,<sup>1</sup> Davide Natalini,<sup>2</sup> Naomi Hossain,<sup>3</sup> and Patricia Justino<sup>4</sup>

October 2021

**Abstract:** Between 2005 and 2018, 41 countries had at least one riot directly associated with popular demand for fuel. We make use of a new international dataset on fuel riots to explore the effects of fuel prices and price regimes on fuel riots. In line with prior expectations, we find that large domestic fuel price shocks—often linked to international price shocks—are a key driver of riots. In addition, we report a novel result: fuel riots are closely associated with domestic price regimes. Countries that maintain fixed price regimes—notably net energy exporters—tend to have large fuel subsidies. When such subsidies become unsustainable, domestic price adjustments are large, often leading to riots.

**Key words:** fuel subsidies; fuel riots; protests; conflict; price regimes; energy

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# 1 Introduction

In 2019, there were major protests related to energy in Sudan, France, Zimbabwe, Haiti, Lebanon, Ecuador, Iraq, Chile, and Iran—many of which turned into riots. In most years between 2005 and 2018, there have been energy-related riots in at least one or two countries. It is therefore surprising that there is limited academic literature that explores the determinants of fuel riots.<sup>1</sup> A significant literature on energy-related conflict has established a close association between violent conflict and the discovery or abundance of fossil fuels (e.g., Van der Ploeg 2011; Ross 2004; Carbonnier and Wagner 2011). There is also strong evidence that conflict and unrest may be related to increases in oil prices. In a seminal paper, Dube and Vargas (2013) show that increases in the international price of oil are associated with increases in violence in Colombia in municipalities in oil-producing regions. This result is confirmed in a recent review of 350 studies by Blair, Christensen, and Rudkin (2020), who conclude that the probability of conflict is positively associated with increases in oil prices.

However, most of the existing literature focuses on armed conflict and its relation to fossil fuels, and knowledge about less violent forms of political violence (like riots) is more limited.<sup>2</sup> Evidence on the mechanisms that may explain the association between shocks in international oil prices and conflict is also limited. This paper addresses these gaps by drawing on a unique database on fuel riots (Natalini et al. 2020) to examine in detail the association between fuel riots and fuel price shocks. We find, as expected, a positive association between international oil prices and fuel riots. We show that this effect is associated with the domestic price regime and fuel subsidies. We find that countries that are net energy exporters are much more likely to fix domestic fuel prices to protect local populations against price rises. However, countries that fix prices tend to have much larger fuel subsidies and, when these can no longer be sustained, much bigger domestic price adjustments are needed, often leading to riots. These results are robust when tested for different definitions of the dependent variable. We report also that fuel prices subsidies do not affect other broader forms of riots (i.e. riots about other issues), as defined in the [Armed Conflict Location and Event Data \(ACLED\) dataset](#).

These results are an important contribution because the existing literature on riots and civil unrest rarely takes into consideration how fluctuations in international prices of oil may be transmitted to local markets in ways that may drive citizens to riot. This transmission is not a given because several countries adopt subsidy policies to cushion local markets against fluctuations in the international price of oil. As long as these price regimes are sustainable, it is unlikely that changes in the international price of oil will affect local markets and, therefore, the probability of riots occurring. While some countries allow international prices to pass through fully to domestic prices, others fix domestic prices—at least temporarily—in an attempt to protect domestic consumers from such shocks. We find that this can be counter-productive as it is these very countries that are most likely to experience fuel riots. This is because fixing prices below international prices generates fuel subsidies whose size depends on the regulated domestic price and the international price of fuel. When high international fuel prices are sustained for an extended period of time,

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<sup>1</sup> Henceforth we use the phrase 'fuel riots' since the vast majority of such riots are, at least superficially, about the price of fuel. For a detailed definition of fuel riots see (Natalini, Bravo and Newman 2020).

<sup>2</sup> One exception is Natalini (2016) who examines the role of scarcity, prices and political fragility in driving food and fuel riots using a quantitative and agent-based modelling approach.

these governments have to drastically reduce subsidies, therefore generating a large jump in national prices, which can trigger a riot.

The propensity to use fuel subsidies to protect domestic consumers is often linked to the structure of the economy. Fuel exporters are particularly likely to have the kind of consumer price subsidies that are the object of protests (Cheon, Urpelainen and Lackner 2013; Victor 2009). In energy-rich countries where state capacity to distribute resources is weak, consumer fuel subsidies tend to be common and resilient to reform efforts (Inchauste and Victor 2017). Authoritarian regimes are particularly likely to rely on such subsidy regimes as a source of popular legitimacy (Andresen 2008; Rosser 2006). Where other forms of social protection are limited, or natural resource wealth is highly concentrated, or where economic performance is poor, subsidies may be seen as part of the social contract (Lockwood 2015; McCulloch, Moerenhout and Yang 2021). However, when such subsidies become unsustainable, governments often attempt to reduce them by raising fuel prices sharply (Rentschler and Bazilian 2017; Lockwood 2015). When these adjustments result in large increases in the domestic price of oil, social discontent may rise, potentially increasing the likelihood of protests and riots.

Our paper also contributes to the literature on fossil fuel subsidies. This literature is largely concerned with detailing the size of subsidies (Coady, Parry, Sears and Shang 2017), the distributional impact of subsidies (Arze del Granado, Coady and Gillingham 2012), the impact of subsidies on economic and environmental performance (Rentschler, Kornejew and Bazilian 2017; Erickson et al. 2020), and the impact of subsidy reforms on the poor, among other groups (Rentschler 2016; Soile and Mu 2015). There is also a growing literature on the political economy of fossil fuel subsidy reform (Inchauste and Victor 2017; Skovgaard and van Asselt 2018), which provides a nuanced understanding of the complexities of policy reform and why so little progress has been made on it (Ross, Hazlett and Mahdavi 2017). However, this literature rarely mentions an association between price subsidies and fuel riots, other than as an explanation of why reforms stop or stall, or as a reason why reforms are not attempted in the first place.

The paper proceeds as follows. Section 2 describes the data we use in the paper and provides brief descriptive statistics. Section 3 discusses the main results including an analysis of price regimes as potential mediators of the relationship between fuel prices and riots; we also present some robustness tests. Section 4 examines why countries fix prices and create subsidies. Section 5 concludes.

## **2 Data and descriptive statistics**

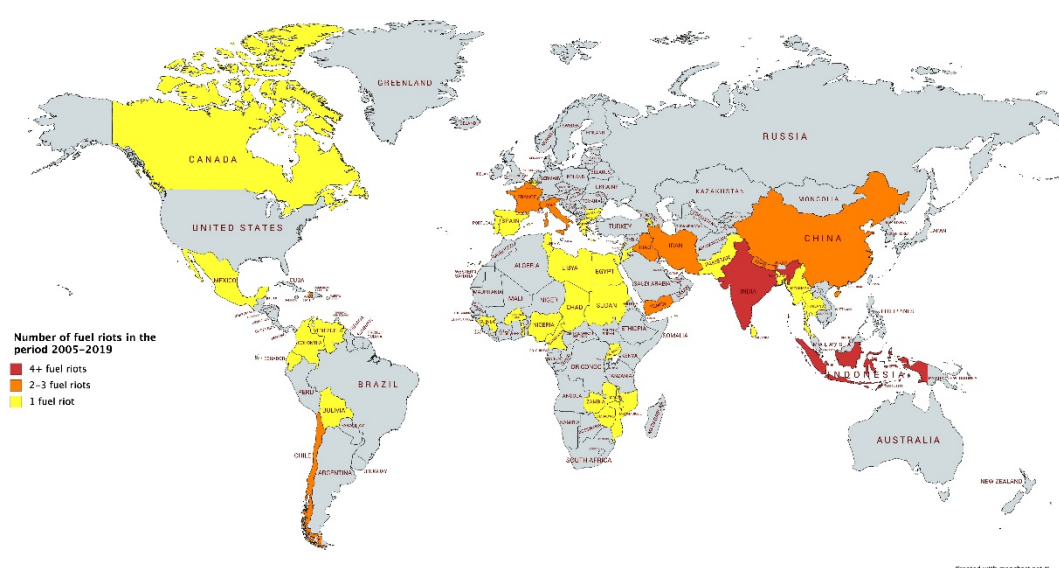
The definition and data we use in this paper to measure the occurrence of fuel riots comes from Natalini et al. (2020). Fuel riots are defined by the authors as ‘incidents of significant unrest – riots, demonstrations, major protests – where grievances over fuel prices, the prospective removal of subsidies, or fuel availability were specifically identified as a factor which motivated people involved in the violent event’ (Natalini et al. 2020: 3).

The original database spanned the period between 2005 and 2016 and was updated to 2018 for this paper using the same methodology. Specifically, we performed a manual Google search with a set of keywords to identify events that matched our definition of fuel riots. Although more sophisticated event collection methodologies exist (e.g. machine learning), these tend to be extremely time-consuming and often result in a large number of duplicates (e.g. via news feed

repositories such as Lexis Nexis), and therefore a manual approach was preferred.<sup>3</sup> Keywords included different combinations and declinations of the words fuel/energy, violence, riot/protest and for every combination we reviewed the first ten pages of Google results.

The search was global in scope and included only English online newspapers (or re-published articles translated into English from the original language). The dataset may therefore suffer from different types of biases (e.g. towards larger, more important events) that are very common when performing global-level research such as this and difficult to avoid (Dowd, Justino, Kishi and Marchais 2020). However, given the parameters we used, we believe the dataset represents a conservative portrayal of fuel riots across the world between 2005 and 2018. The data were recorded on a monthly basis. When undertaking analysis with annual data, we aggregated the data by constructing a binary variable for whether the country had a fuel riot during the year or not.<sup>4</sup> Figure 2.1 shows the geographical distribution of fuel riots over the period.

Figure 2.1 Map of incidence of fuel riots 2005-2018



Source: authors' elaboration with MapChart, CC-BY-SA.

Between 2005 and 2018, we observe 59 country-years in which fuel riots occurred. In one sense, these are relatively rare events since there are 3011 country-years in our data. However, fuel riots happen in quite a few countries: 41 of the 217 countries or jurisdictions in our dataset experienced a fuel riot over the period. Some countries experienced several fuel riots in that period: India had seven; Indonesia had five; and China and Yemen both had three.

To understand the relationship between prices, subsidies and fuel riots, data was obtained on the international price of oil, the level of fuel subsidies, and the domestic price regime implemented in each country. Average international prices for crude oil were sourced from the World Bank's Commodity Price Database.<sup>5</sup> The data on fossil fuel subsidies comes from the IMF's calculation of subsidies for the period 2010-2017. We use estimates for 'total consumer pre-tax subsidies',

<sup>3</sup> See Newman (2020) for a comprehensive discussion on challenges with automatized event data collection with the example of food riots.

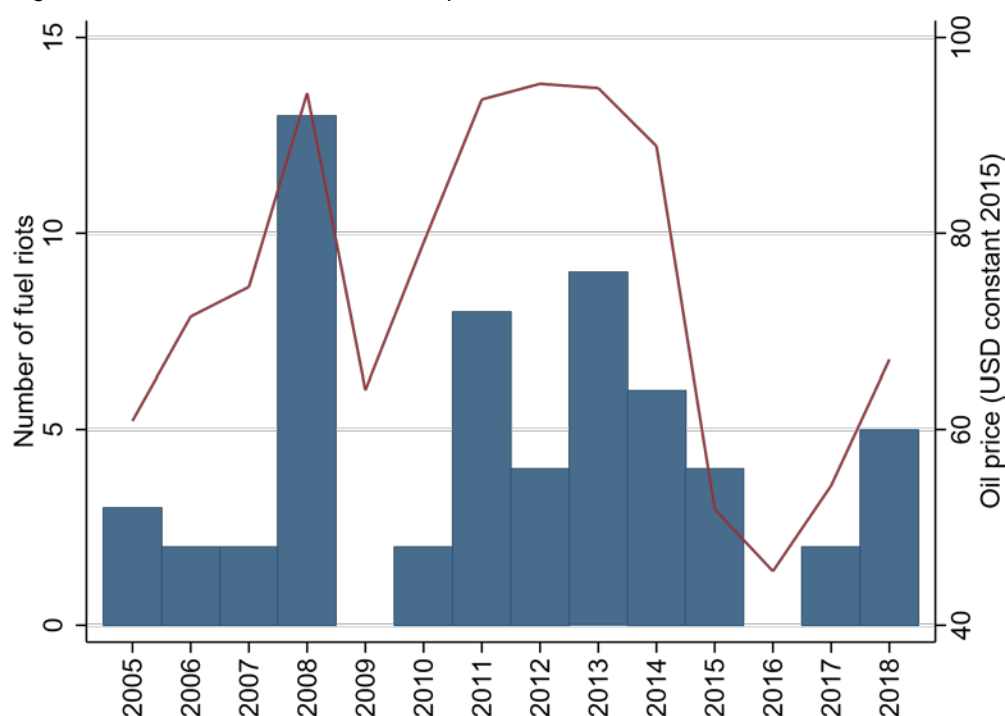
<sup>4</sup> Doing so loses very little information in the annual data because there were only two countries that had more than one fuel riot in the same year - India in 2010 and Indonesia in 2013.

<sup>5</sup> The Pink Sheet—see <https://www.worldbank.org/en/research/commodity-markets> for details.

which include four energy sources (oil, natural gas, coal and electricity) as these capture the difference between retail prices and international price of the resource when this is internationally traded (i.e. fuel), and the difference between the retail price and the user cost (cost of production) for those not usually traded (i.e. electricity) (Coady et al. 2017). Our assessment of the domestic price regime is based on an analysis of monthly price changes in the dataset of international and domestic gasoline prices compiled by Ross et al. (2017) which contains information about local retail gasoline prices for 157 countries from 2003 to 2015.

Globally, fuel riots are clearly related to the price of oil. Figure 2.2 shows the number of fuel riots that took place globally for each year from 2005 to 2018 alongside the international oil price. As expected, fuel riots spike when international oil prices spike, since this generally has a direct impact on the domestic price of fuel.

Figure 2.2 Fuel riots and international oil prices



Source: authors' elaboration.

However, there are several other factors that may influence the likelihood of a fuel riot. Since Gurr (1970), a large literature has shown how relative deprivation and drops in economic standing may give rise to social discontent and grievances.<sup>6</sup> Therefore, it is reasonable to expect the number of fuel riots to be associated with the general development of the country. In addition, our fuel riots variable measures whether there has been a violent riot related to energy during that year, which makes it more likely that we will observe such riots in countries with larger populations simply because there are more people that might feel sufficiently unhappy to participate in a riot. We therefore include in our analysis country-level GDP per capita and population as controls using data compiled from the World Bank's World Development Indicators (WDI) database.

Finally, there are several different aspects of governance which might also influence fuel riots. The Varieties of Democracy (VDEM) (Coppedge et al. 2019) and the Polity IV datasets (Marshall 2019) provide a comprehensive set of variables measuring different aspects of the political and

<sup>6</sup> See the review of this literature in Justino and Martorano (2019).

governance makeup of countries over time. We draw on this to explore the impact of four variables. First, populations may be angered by government incompetence and/or corruption; we therefore include measures of government effectiveness and the extent of corruption. Second, the likelihood of fuel riots may be influenced by the ability to protest. Mass protests may also be more likely when there is space for civic engagement, independent media, and organizations capable of mobilising support are present (Tilly and Tarrow 2015). Conversely, protests may be less likely under authoritarian regimes that suppress civil society freedom; we therefore include measures of regime type and civil society freedom. Finally, riots may not be accidents; rather they may be deliberately orchestrated by groups seizing the opportunity of rising prices to mobilize people against the government. We therefore include a measure that assesses the existence of ‘anti-system’ movements within the country.<sup>7</sup>

### 3 Models

#### 3.1 Domestic price changes and fuel riots

Our first objective is to see if there is a relationship between monthly domestic price changes and fuel riots. Given the range of other factors that could potentially influence the occurrence of fuel riots, we estimate a fixed effects panel regression of the propensity for a fuel riot against the growth in domestic and international fuel prices. We control for the possibility of common time effects (for example, induced by changes in international oil prices) using month dummies for the entire period. By including country fixed effects, we eliminate the possibility that any observed association is due to fixed country characteristics that might affect the likelihood of a fuel riot. As noted above, there is also a possibility that time-varying country characteristics may influence the likelihood of a fuel riot. We therefore include the log of per capita GDP and the log of population as controls. The model that we estimate is:

$$Riot_{im} = \beta_0 + \beta_1 \Delta p_{im}^{dom} + \beta_2 \Delta p_{im}^{int} + \beta_3 \ln GDPpc_{iy} + \beta_4 \ln Pop_{iy} + \gamma_m + \lambda_i + \epsilon_{im} \quad (1)$$

where  $Riot_{im}$  indicates that country  $i$  had a riot in month  $m$ ;  $\Delta p_{im}^{dom}$  is the proportionate change in the domestic fuel price in the preceding month;  $\Delta p_{im}^{int}$  is the proportionate change in the international fuel price in the preceding month;  $\ln GDPpc_{iy}$  is log GDP per capita for country  $i$  in year  $y$ ;  $\ln Pop_{iy}$  is log of the population;  $\gamma_m$  is a month dummy;  $\lambda_i$  is the country fixed effect; and  $\epsilon_{im}$  represents a random error term.

Table 3.1 shows that there is a statistically significant positive relationship between domestic price growth from month to month and fuel riots. The estimated coefficient suggests that an increase in the growth rate of local prices of, say 10 percentage points, would increase the (initially low) probability of a fuel riot by around 13 per cent. However, the relationship with international fuel prices is much weaker and not statistically significant, even if domestic price changes are omitted, suggesting that riots are driven more by the way in which domestic prices are determined than by international price fluctuations.

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<sup>7</sup> See Annexe Table A.1 for a summary of all variables and descriptive statistics.

Table 3.1 Fuel riots and price changes

	(1)	(2)	(3)
	Fuel riot	Fuel riot	Fuel riot
Growth of domestic gasoline price	0.0459*** (7.11)	0.0444*** (6.98)	
Growth of world gasoline price	0.00855 (0.47)		0.0124 (0.68)
Log GDP per capita	-0.00196 (-0.38)	-0.00310 (-0.61)	-0.00285 (-0.55)
Log population	-0.00129 (-0.16)	-0.00114 (-0.14)	-0.00134 (-0.17)
Observations	18307	18587	18307

Note: *t* statistics in parentheses. Fixed effects regression with month dummies. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.001$ .

Source: authors' calculations.

### 3.2 The role of price regimes

We hypothesized in the introduction to this paper that the effect of fuel prices on fuel riots discussed above may be affected by price regimes. To analyse this mechanism, we proceed in three steps. First, we estimate the effect of changes in international prices on domestic prices to check how international price shocks may be transmitted to local markets. Second, we test whether fixing domestic prices—which effectively results in subsidies on fuel—may cushion domestic prices against international price changes. Finally, we estimate the effect of such subsidies on fuel riots.

Domestic fuel prices are largely driven by international price changes, but this relationship can be dampened somewhat by fixing prices domestically, at least for a while. To assess the extent to which this is true, we need a measure of the extent to which prices are fixed. Unfortunately, we are unaware of any database that indicates the policy regime followed by all countries over time. However, it is possible to infer the policy regime by looking at the extent to which prices change.<sup>8</sup> We therefore use the database of monthly domestic prices described above to construct a measure of price ‘fixedness’ which is simply the percentage of months that domestic fuel prices remained the same. If a country has a fixedness of zero, it has a completely flexible price regime in which prices change every month, while if it has a fixedness of 100 then its price regime is completely rigid with no changes in domestic prices at all between 2005 and 2018.

Of the 157 countries for which we have monthly domestic price data, 73 have regimes in which the price changes every month. By contrast, only two countries had no price changes at all over the period. All other countries kept prices fixed at least for some months. However, most let prices adjust regularly. Over three-quarters of the countries adjusted prices at least every two months, while only around a fifth of countries adjusted domestic prices infrequently. To simplify, we define a country as having a ‘fixed price regime’ if it keeps domestic prices the same more than 80 per

<sup>8</sup> For the moment, we have assumed that the policy regime remains fixed over the period for which we have data.

cent of the time across all months for which we have data. If the country fixes prices less than this, we define it as having a ‘flexible price regime’.

To answer our question about the pass-through of international prices to the local market in each country, we estimate the following model:

$$gp_m^{dom} = \beta_0 gp_m^{int} + \beta_1 gp_{m-1}^{int} + \beta_2 gp_{m-2}^{int} + \epsilon_m \quad (2)$$

where  $gp_m^{dom}$  is the growth of the domestic fuel price in a country between month  $m$  and the preceding month;  $gp_m^{int}$  is the growth in the international fuel price during the same period;  $gp_{m-1}^{int}$  and  $gp_{m-2}^{int}$  are the growth in international prices in the preceding months; and  $\epsilon_m$  represents a random error term.

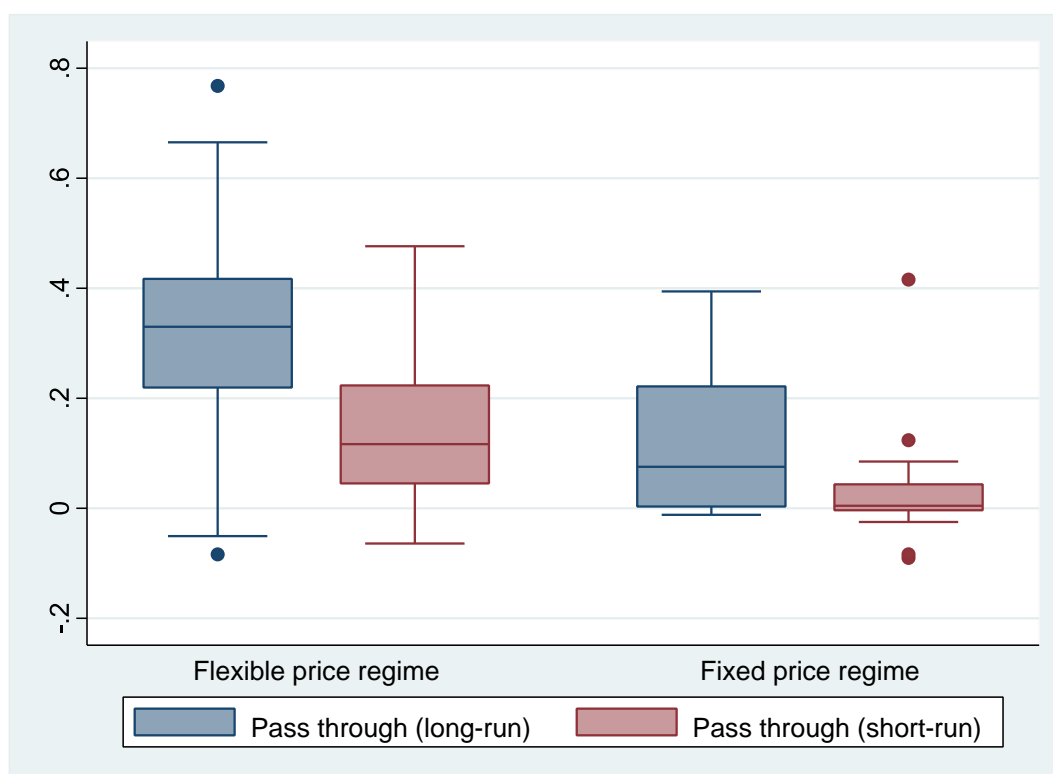
Our model reflects the fact that international prices are unlikely to pass through immediately to domestic prices but may do so with some lag. Thus  $\beta_0$  represents the short-run pass-through of international prices, while the sum  $\beta_0 + \beta_1 + \beta_2$  provides an estimate of the long-run pass-through of prices.<sup>9</sup> Since countries have quite different approaches to regulating domestic prices, it is likely that the value of these coefficients will differ substantially by country. We therefore estimate this model separately for all countries. We find that for the median country, the short-run pass through is around 0.1 - that is around 10 per cent of the change in the international price is passed through to domestic markets in the same month; the long-run pass through is around 0.3.

Our hypothesis is that a policy of fixing local prices should reduce the pass through of international prices. Figure 3.1 shows the range of estimates of short-run and long-run pass-through coefficients for countries with flexible and fixed price regimes. As anticipated both short-run and long-run pass-through coefficients in fixed price regime countries are significantly below those in countries with a flexible price regime. The median short-run pass through for countries with flexible price regimes is 0.12 and the median long-run pass through is 0.33; however, for countries with fixed price regimes the equivalent figures are 0.005 and 0.08. As one might expect, countries which fix prices most of the time pass through international price shocks much less.

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<sup>9</sup> Where long-run means three months in this instance.

Figure 3.1 Pass-through of international prices under flexible and fixed price regimes



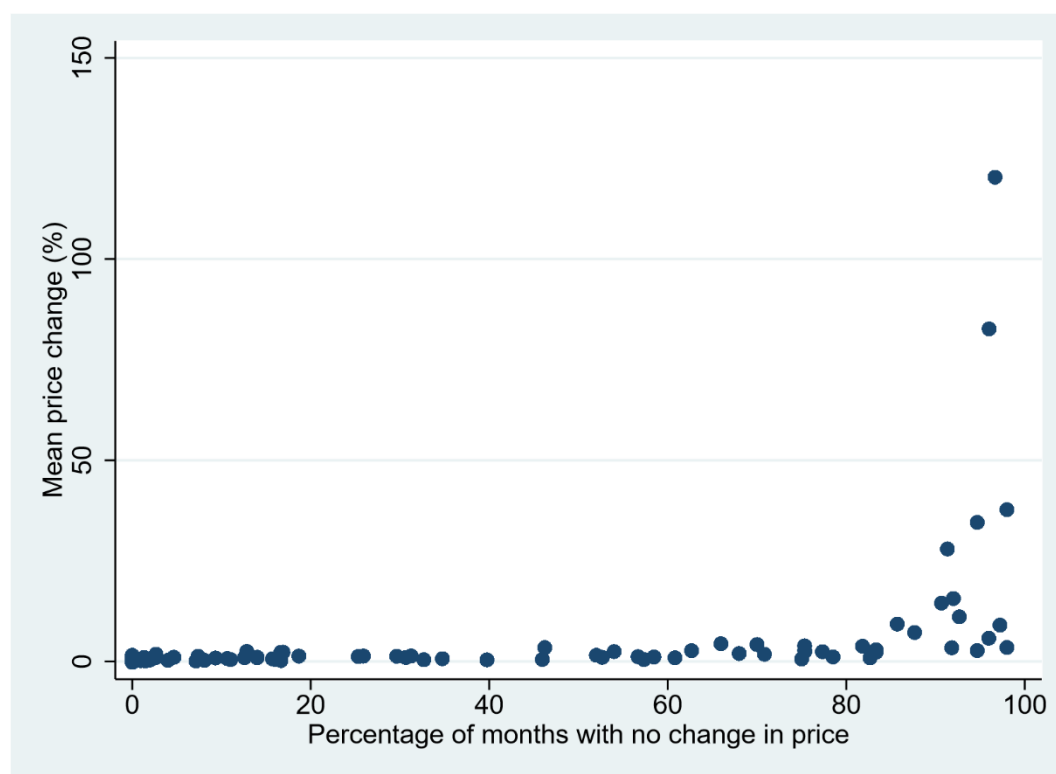
Source: authors' elaboration.

However, while fixing prices does appear to reduce domestic price volatility in the short term, it also has a major impact on the size of domestic price increases when they do occur. Figure 3.2 shows the mean price change for the months in which price changes occurred for all countries plotted against the extent to which they fix prices.<sup>10</sup> Countries that adjusted prices frequently (low fixedness), tended to have relatively small adjustments. However, those that fixed prices and held them for longer, tended to have much larger price increases when prices did change.

Dividing countries again into flexible and fixed price regimes as above, we find that the mean price change for countries with flexible price regimes was 0.7 per cent (the standard deviation of price changes was also 0.7); but for fixed price regimes (i.e. those that kept prices the same for more than 80 per cent of the time), the mean price change was 17.3 per cent, almost 24 times larger. The standard deviation of price changes for this group of countries was 27, almost 40 times larger. Even if we include all of the months in which there is no change in price in the calculation of the mean price change and standard deviation, the mean price change for fixed price regime countries is 68 per cent higher than that of flexible price regimes and the standard deviation more than double. In short, fixed price regimes may protect populations from international price changes over the relatively short term, but when price changes do happen, they are much larger.

<sup>10</sup> Here we are using the continuous measure of price fixedness described above i.e. the percentage of months in which prices stay the same.

Figure 3.2 The impact of fixed prices on average price changes



Source: authors' elaboration.

Why does fixing prices result in large domestic price shocks? The discussion in the introduction to this paper suggests that this is because fixing prices tends to create large subsidies. When such subsidies become fiscally unsustainable, governments choose to raise the domestic price. If this is true, we would expect to find evidence of a strong relationship between fixing prices and subsidies. We use the data on domestic and international gasoline prices in (Ross et al. 2017) as well as their data on gasoline consumption to construct a measure of gasoline subsidies for each country and year. We then regress annual gasoline subsidies on international oil prices and our measure of price fixedness. As before, there are a range of country specific reasons why gasoline subsidies might be high, and gasoline subsidies are also likely to be influenced by the international oil price in any given year. As before we account for these by estimating using a fixed effects panel model, including GDP per capita and population as time-varying controls.

Table 3.2 Subsidies, oil prices, and price fixing

	Log fuel subsidies (Ross)
Log of real oil price	0.199 ** (2.55)
Price fixedness	0.00252 *** (3.46)
Log GDP per capita	-0.362 ** (2.60)
Log population	-0.134 (-0.53)
Observations	838

Note: *t* statistics in parentheses. Panel regression with country level fixed effects. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.001$ .

Source: authors' calculations.

Table 3.2 shows that, as expected, higher oil prices make gasoline subsidies larger—but fixing domestic gasoline prices also increases subsidies significantly. Increasing the level of price fixedness from its mean level of 23 per cent, to 75 per cent (equivalent to shifting from changing prices every three months to changing prices every nine months) more than doubles gasoline subsidies.

So far, we have shown that domestic price shocks are associated with fuel riots; that domestic price changes are larger in regimes that attempt to fix prices for longer; and that fixing gasoline prices increases gasoline subsidies. But gasoline subsidies are only one part of the energy subsidies that countries have. Many countries also subsidize other fuels including diesel, kerosene, coal, natural gas and electricity. Our hypothesis is that it is the fiscal unsustainability of such subsidies that gives rise to the large energy price shocks. Reducing or removing such subsidies may abrogate a social contract which could lead to violent protest (McCulloch et al. 2021). If this is the case, we would expect to see that subsidies have an independent impact on the likelihood of fuel riots.

However, there are also competing explanations for fuel riots which fall into two areas. First, as suggested in Gurr (1970) and a large literature on economic deprivation and unrest that followed it, riots may be a reaction to worsening economic conditions in general, rather than specifically related to energy subsidy reform. Second, people may be angry about different aspects of the governance of the country and use price changes in fuels as a pretext to protest against a wider set of issues (Hossain et al. 2018).

To explore these in an integrated way, we estimate the following model:

$$Riot_{it} = \beta_0 + \beta_1 \cdot L \cdot \ln Subsidies_{it} + \beta_2 \cdot GDPgrowth_{it} + \beta_3 \cdot Governance_{it} + \beta_4 \cdot \ln GDPpc_{it} + \beta_5 \cdot \ln Pop_{it} + \gamma_t + \lambda_i + \epsilon_{it} \quad (3)$$

where  $Riot_{it}$  indicates that country  $i$  had (at least) one riot in year  $t$ ;  $\ln Subsidies_{it}$  is the log of pre-tax subsidies for country  $i$  in year  $t$ ;  $GDPgrowth_{it}$  is the growth in GDP between year  $t - 1$  and year  $t$ ;  $Governance_{it}$  is a vector of governance factors explained below; and  $\ln GDPpc_{it}$  and  $\ln Pop_{it}$  are GDP

per capita and population controls as before,  $\gamma_t$  is a time dummy;  $\lambda_i$  is the country fixed effect; and  $\epsilon_{it}$  represents a random error term.

We use total pre-tax energy subsidies from the comprehensive database provided by the IMF.<sup>11</sup> We lag this variable to minimize endogeneity due to the fact that a subsidy reform early in a year could cause a riot, but also reduce the value of subsidies.

To account for the possibility of poor general economic performance leading to riots (even if they are ostensibly about energy), we include GDP growth as an independent variable. If this is important, we would expect that recessions should be associated with riots (i.e.  $\beta_2$  will be negative).

Table 3.3 shows the results. Our first model includes only lagged subsidies and the GDP per capita and population controls. Subsidies are strongly positively associated with fuel riots. The coefficient suggests that a 10 per cent increase in the size of subsidies will increase the probability of a fuel riot by around one third.

Model 2 explores whether fuel riots are also driven by poor economic performance. The statistically significant negative coefficient would appear to suggest that this is the case, although the effect is small.<sup>12</sup> We treat this result with caution because riots may well influence GDP growth; lagging the GDP growth variable results in no statistically significant result. In either case, the size and significance of the effect of subsidies is unchanged.

While the incompetence and corruption of governments is often mentioned by protesters as a reason for their actions (Hossain et al. 2018), we find no statistically significant relationship between these variables and fuel riots. However, we do obtain a particularly interesting result on the relationship between civil society freedom and fuel riots. Contrary to our expectations, we find that greater civil society freedom results in fewer, rather than more riots. The effect is statistically significant and large—an increase of one point on the five point scale measuring civil society freedom reduces the likelihood of a fuel riot by almost 80 per cent. This suggests that greater openness to dialogue and the ability to complain may actually help to avert fuel riots, rather than promote them. Finally, we also obtain an interesting result regarding anti-system movements.<sup>13</sup> As expected, we find that the presence of these are positively and strongly associated with the increased likelihood of a riot (with a similar size effect as that of civil society freedom).

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<sup>11</sup> By ‘pre-tax subsidies’ the IMF mean the financial value of subsidies before adding optimal taxation to account for the externalities caused by the consumption of energy.

<sup>12</sup> It is also driven in part by the Libyan revolution in 2011 which resulted in extreme values for GDP growth; the effect is not statistically significant if one excludes Libya.

<sup>13</sup> An anti-system opposition movement is any movement—peaceful or armed—that is based in the country (not abroad) and is organized in opposition to the current political system—see Coppedge et al. (2019) for more details.

Table 3.3 Riots and subsidies

	(1)	(2)	(3)
	Fuel riot	Fuel riot	Fuel riot
L.Log subsidies	0.102 *** (4.50)	0.102 *** (4.50)	0.102 *** (4.50)
GDP growth		-0.00215 ** (-2.53)	-0.00219 ** (-2.23)
Government effectiveness			0.0310 (0.86)
Extent of corruption			0.000322 (0.00)
Civil society freedom			-0.0221 * (-1.73)
Anti-system movements			0.0265 ** (2.06)
Log GDP per capita	-0.0786 (-1.22)	-0.0229 (-0.34)	-0.0419 (-0.54)
Log population	-0.182 (-1.31)	-0.193 (-1.39)	-0.129 (-0.82)
Observations	1493	1493	1335

Note: *t* statistics in parentheses. Panel regression with country level fixed effects and year dummies. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.001$ .

Source: authors' calculations.

Taken together, these results strongly suggest that fuel riots are driven by changes in domestic fuel prices, but these are mediated by the price regimes in place in each country and, in particular, by the size and fiscal sustainability of subsidies. Fuel riots are more likely in countries with large energy subsidies. But they may also be influenced by the economic performance of the country, as well as aspects of country governance, notably whether civil society is free to raise complaints and the extent to which opposition groups exist that may wish to exploit price rises to discredit the government.

### 3.3 Robustness tests

To assess the robustness of our result that subsidies are associated with fuel riots we take two approaches.

First, we examine the possibility that our dependent variable may be biased. Our dependent variable is based on media reports of violence associated with fuel related protests, but what constitutes violence is a subjective matter. We therefore draw on a separate database constructed for the Global Chaos Map Project<sup>14</sup> which uses a narrower, but more precise, measure that records

<sup>14</sup> See <https://aru.ac.uk/global-sustainability-institute-gsi/research/global-risk-and-resilience/globalchaos-map-project> for details.

fuel related protests that led to at least one death. Annexe Table A.2 shows the same set of regressions as Table 3.3, but using the new dependent variable. Although the coefficient on subsidies is smaller, it remains positive and statistically significant throughout.

Second, it could be argued that our results are not picking up an association between energy subsidies and fuel riots specifically, but simply the propensity for places with large subsidies to have unrest of any kind. To test this, we draw on the ACLED dataset, which records a variety of different types of conflict across the world and over time and has been used extensively in the analysis of the determinants of conflict (Raleigh et al. 2010). Specifically, we replace our dependent variable with the sub-event type ‘Riots’ from ACLED. If our results were simply capturing riots in general, rather than energy-related riots in particular, then we would expect that subsidies would also be associated with this measure. Annexe Table A.3 shows that this is not the case. Subsidies are not significantly associated with riots in general; the connection only exists with riots that are linked to energy.

Finally, we test the robustness of our results to the estimation method used. Annexe Table A.4 shows our original regression from Table 3.3, alongside estimations of the same regression using a panel logit specification, as well as a Probit with country dummies. In both cases, the results confirm a strong and statistically significant association between subsidies and fuel riots.

#### **4 Why countries fix prices and create subsidies**

Finally, given the adverse impact of fixing domestic prices and thereby creating fuel subsidies, as well as their propensity to prompt riots, we explore why so many governments use this policy instrument. The literature points towards two possible motivations for adopting subsidies by fixing prices. First, people living in countries with oil may feel that they are entitled to a share of the benefits. Knowing this, states choose to subsidize fuel as a way of providing a benefit to the population that is directly linked to the resource (McCulloch et al. 2021). In a sense, this is a basic social contract, but one not based on service delivery, but rather simply sharing out, in an easy and conspicuous way, some of the proceeds of oil wealth. If this is the case, we would expect the adoption of a fixed price regime to be strongly associated with being a net energy exporter.

Second, Victor (2009) argues that some countries subsidize fuel because they lack the capacity to implement more sophisticated forms of social protection. If this is the case, we would expect to see a negative association between government effectiveness and the size of subsidies.

We therefore regress the size of subsidies against whether the country is a net energy exporter and measures of government effectiveness.<sup>15</sup>

Table 4.1 shows that the data support both of the hypotheses above. Net energy exporters are more likely to have large subsidies. Similarly, countries with more effective administration are much less likely to adopt such policies. However, we find that several of our measures of governance quality are also associated with subsidies. If we substitute our measure of government effectiveness with the measures described above for regime type,<sup>16</sup> corruption, and civil society

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<sup>15</sup> We cannot use a fixed effects panel regression because whether a country is a net energy exporter is almost always a fixed characteristic; we therefore estimate an OLS regression controlling for heterogeneity with year and region dummies as well as GDP per capita and population as before.

<sup>16</sup> This takes the values: 0-autocracy; 1-electoral autocracy; 2-electoral democracy; 3-liberal democracy. See Coppedge et al. (2019) for details.

freedom, our results suggest that more democratic and less corrupt regimes, as well as those with greater civil society freedom, also tend to have fewer subsidies. While we are not able to assert causality, our results are consistent with the hypothesis that such policies are often introduced in resource abundant countries with relatively weak governance.

Table 4.1 Structural determinants of subsidies

	(1)	(2)	(3)	(4)	(5)
	<b>Log subsidies</b>	<b>Log subsidies</b>	<b>Log subsidies</b>	<b>Log subsidies</b>	<b>Log subsidies</b>
Net energy exporter	0.612 *** (3.96)	0.632 *** (4.24)	0.604 *** (4.12)	0.552 *** (3.51)	0.466 ** (3.06)
Government effectiveness	-0.348 ** (-2.71)				-0.103 (-0.70)
Regime type		-0.266 ** (-3.28)			
Extent of corruption			0.956 *** (3.49)		0.659 * (1.86)
Civil society freedom				-0.217 *** (-3.60)	-0.162 ** (-2.65)
Log GDP per capita	0.215 ** (2.25)	0.103 * (1.71)	0.175 ** (2.44)	0.0956 (1.62)	0.208 ** (2.39)
Log population	0.302 *** (6.80)	0.316 *** (7.03)	0.301 *** (6.65)	0.302 *** (6.77)	0.314 *** (7.13)
Observations	703	698	698	698	698

Note: *t* statistics in parentheses. OLS regression with year and region dummies. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.001$ .

Source: authors' calculations.

## 5 Conclusions

Fuel riots can have major implications for ordinary people and for entire countries. They are violent—sometimes leading to deaths—and are highly disruptive. Moreover, fuel riots often preempt or prevent further attempts at policy dialogue and reform—at least for a while (Hossain et al. 2021).

Our findings suggest that fuel riots are primarily driven by domestic price increases. To some extent, these reflect changes in the international oil price, but these effects are mediated by how countries attempt to protect their populations by fixing domestic prices for periods of time. However, fixed price policies (both for fuel and electricity) tend to result in large subsidies which can create fiscal strains. Our results show that large subsidies may make fuel riots more likely in countries. This is because when these subsidies are no longer sustainable, the price increases resulting from a reduction of the subsidies are much larger than those that typically occur in countries with more flexible price regimes, potentially triggering riots.

We also find that countries which are net energy exporters are much more likely to have large subsidies. Countries with low levels of government capability and effectiveness are also more likely to have large subsidies, supporting the idea that subsidies are used as an administratively easy way

of providing a social transfer. Ironically, we find that the large subsidies that such policies produce do not protect populations from price shocks and make fuel riots more likely.

Our findings further emphasize the value of removing fuel subsidies and shifting to flexible price regimes. However, this naturally begs the question of why countries have not already done so. The answer is likely to lie in the complex politics of social contracts in countries that are net exporters of energy. Nonetheless, our results should give policymakers further pause for thought about the wisdom of policies that perpetuate large subsidies. Subsidies may provide short-term political gains but, by making riots more likely, they may have large long-term political costs. Going forward, researchers may wish to focus more on building a better understanding of the political, and not just the economic, dimensions of subsidy reform.

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## Appendix

### A Summary statistics and robustness tests

Table A.1 Summary statistics

	<b>Mean</b>	<b>SD</b>	<b>Min</b>	<b>Max</b>	<b>N</b>
Fuel riot	0.02	0.14	0.00	1.00	3,011
GCMP _fuel	0.01	0.09	0.00	1.00	3,011
ACLED riot	0.27	0.44	0.00	1.00	2,452
Log subsidies	0.47	0.86	0.00	4.35	1,534
Log fuel subsidies (Ross)	-0.08	0.79	-5.15	3.08	886
Max monthly growth of domestic gasoline price	0.08	0.17	-0.12	4.00	1,696
Log of real oil price	4.28	0.24	3.82	4.56	3,011
Price fixedness	23.24	37.19	0.00	100.00	1,696
Net energy exporter	0.34	0.47	0.00	1.00	1,419
Government effectiveness	-0.02	1.00	-2.48	2.44	2,822
Regime type	1.65	0.99	0.00	3.00	2,479
Extent of corruption	0.53	0.30	0.01	0.98	2,479
Civil society freedom	0.98	1.40	-3.73	3.38	2,479
Anti-government movements	-0.69	1.12	-2.97	3.01	2,479
Log GDP per capita	8.67	1.50	5.35	12.19	2,780
GDP growth	3.45	5.35	-62.08	123.14	2,575
Log population	15.21	2.36	9.21	21.05	2,962

Source: authors' calculations.

Table A.2 Robustness to alternative dependent variables

	(1)	(2)	(3)
	<b>GCMP fuel</b>	<b>GCMP fuel</b>	<b>GCMP fuel</b>
L.Log subsidies	0.0342 ** (2.40)	0.0342 ** (2.40)	00340 ** (2.22)
GDP growth		-0.000739 (-1.38)	-0.000757 (-1.28)
Government effectiveness			0.00133 (0.06)
Extent of corruption			-0.112 (-1.58)
Civil society freedom			-0.0140 * (-1.74)
Anti-government movements			0.0153 * (1.89)
Log GDP per capita	0.0791 * (1.95)	00982 ** (2.29)	0.101 ** (2.03)
Log population	-0.132 (-1.51)	-0.136 (-1.56)	-0.110 (-1.11)
Observations	1493	1493	1335

Note: *t* statistics in parentheses. Panel regression with country level fixed effects and year dummies. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.001$ .

Source: authors' calculations.