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# Oil price shocks, protest, and the shadow economy: Is there a mitigation effect?

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**Abstract**

In this study, we look at how oil price shocks affect the incidence of protests in a country and how the size of a country's shadow economy influences this relationship. Using panel data from 144 countries, from the period of 1991–2015, we find evidence that negative oil price shocks significantly increase protests in countries with small shadow economies. The effect dissipates as the size of the shadow economy increases and eventually vanishes in countries with a shadow economy representing more than 35% of gross domestic product. Our analysis departs from existing literature by emphasizing the moderating role of a shadow economy on the effects of negative oil shocks on the incidence of protests in oil-dependent economies. The results are robust to various specifications and their broader implications are discussed.

**KEYWORDS**

conflict, oil price shocks, protest, resource curse, shadow economy

**JEL CLASSIFICATION**

D74; O13; O17; Q34

## 1 | INTRODUCTION

The effect of natural resource wealth and income fluctuations on political stability has been widely explored in the literature (see Bazzi & Blattman, 2014 for a survey). Resource-rich countries are subject to severe commodity price swings that significantly affect their macroeconomic fundamentals,

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including political unrest. Widespread political instabilities are associated with a higher risk of investment and capital flight, displacement of population, and destruction of infrastructure and social capital. These may have significant negative effects on economic growth. For instance, in the case of the Arab Spring protests in Tunisia, Matta et al., (2019) estimated the income lost to range between 5.5 and 6.4 percent of GDP over the period of 2011–2013. Earlier cross-country studies also show sizable negative effects of political instability and conflict on economic growth. Collier (1999) estimates that countries tend to grow, on average, 2.2 percentage points slower during a period of civil war compared to peacetime. Similar negative effects on economic growth, food production, and foreign debt burden are shown by Stewart et al., (2001).

In this paper, we focus on whether fluctuations in international oil prices induce political instability in oil-dependent countries and whether the size of the shadow economy can mitigate these effects. We argue that oil price fluctuations have a lower impact on political unrest in countries incubating sizable shadow economies. Our argument is built on two important strands of economic literature. One concerns the effect of resource rents on political instability and risk of conflict, and the other considers the role of the shadow economy in buffering against social unrest. Our key result shows that declines in oil rents following negative price shocks increase the incidence of protests in oil-dependent economies, but that this effect is significantly mitigated by the size of the shadow economy.

First, a significant unexpected decline in oil rents in an oil-dependent economy can impose a variety of challenges for political power (Bjorvatn & Farzanegan, 2015). The government, which controls resource rents, often uses public sector employment as a redistributive tool and to pacify opposition through patronages. A sudden drop in rents weakens the government's ability to continue making cash transfers and to provide public employment.[1] Negative oil rents shocks increase pressure on the state to cut subsidies, implement the privatization of public assets, reduce the size of the public sector, and increase tax burden. For example, the oil-rich countries of the Gulf Cooperation Council (GCC) have started to introduce value-added taxes and other fees as a result of negative oil shocks (Edwards, 2020).[2] These developments, especially in oil-rich economies, may increase the risk of social unrest. For example, the 2019 countrywide protests and riots in Iran were the result of increased gasoline prices by the state following a significant drop in oil income under sanctions. A reduction in subsidies and cash payments can also have adverse effects on inequality and poverty indicators (Farzanegan & Habibpour, 2017). A reduction in cash payments can negatively affect the size of the middle class and shift them to lower-income deciles, thus reducing the opportunity cost to join the anti-state protests.[3]

Second, although we expect a sudden decline of oil rents in oil-dependent countries to trigger protests and dissatisfaction with the political system, this effect can be moderated by the existence of a shadow economy. A shadow economy can act as a countercyclical device to buffer against social unrest by providing an alternative source of income for disgruntled citizens during an economic downturn (e.gBajada & Schneider, 2009; Boeri & Garibaldi, 2002; Dell'Anno & Solomon, 2007; Eilat & Zinnes, 2002).[4]Furthermore, shadow economies may offer leeway from the distortionary activities of the state in the formal economy, such as administrative corruption, leading to enhanced economic activities in the formal sector (Choi & Thum, 2005). The shadow economy acts as an insurance policy against economic volatility by creating jobs and providing profit opportunities for businesses. In this setting, the existence of a shadow economy may increase the opportunity cost of protesting during periods of sluggish growth following a decline of oil rents in oil-dependent economies. More generally, the existence of a shadow economy reduces the effect of oil price fluctuations on political stability.

As such, our contribution is to demonstrate that the joint effect of declining oil rents and the presence of a shadow economy matters in the incidence of protests in countries. To the best of our knowledge, the mitigating role of the shadow economy on the nexus of declining oil rents and political stability is overlooked in the literature. There is little evidence for the mitigating role of the shadow

economy on social unrest amid oil-induced economic shocks.[5] In the context of oil-producing countries, investigating such role is particularly appealing not only because of the vulnerability of those economies to external shocks, but also because of the considerable share of informal economies in their official GDP. According to the latest data from Medina and Schneider (2018), the average share of the shadow economy to GDP in oil-producing countries ranges from 11 percent to 62 percent, with an average of around 31 percent, which points to the significant role of the informal sector in those economies.

In measuring political instability, we focus on less violent events of unrest such as protests, measured by the number of anti-government demonstrations, general strikes, and riots (Banks & Wilson, 2018). These forms of instability can happen more often in response to macroeconomic shocks and may be the starting point for larger and more intense conflicts and violence, such as revolutions, regime changes, or civil wars (e.g., Syria civil war since 2011).[6] Incidences of protests remain less studied compared to more violent events. The recent findings of Bazzi and Blattman (2014) show oil price shocks to be associated with shorter, less intense civil conflicts instead of new civil war outbreaks. Our macroeconomic shock is given by changes in oil rents, which have a greater impact on economies with higher oil dependence. To measure oil rents shocks, we rely on the variation in international oil prices weighted by the country's time-invariant oil exports share to GDP. This circumvents endogeneity problems associated with the conventional measurements of resource abundance in terms of values of oil production or as a share of resource rents in GDP.

Using panel data on 144 countries, covering the period from 1991 to 2015, we first show that negative oil price shocks increase the incidence of protests. We then proceed to suggest a mechanism to mitigate the protest-induced effects of negative oil shocks. We show that the shadow economy significantly reduces the incidence of protests and that negative oil price shocks cease to have any significant impact on protests in countries with sizable shadow economies (representing more than 35% of GDP). This can be attributed to the safety net provided by the shadow economy as an alternative market to avoid the distortionary interventions of the government in the formal economy.

The rest of the paper is organized as follows: Section 2 reviews the two strands of literature which our study connects: the theoretical discussions of both the oil rents-protest nexus and the shadow economy-protest relationship. Section 3 describes the data and the empirical strategy. Sections 4 and 5 present our baseline results and robustness checks. Finally, Section 6 summarizes and concludes the paper.

## 2 | CONCEPTUAL FRAMEWORK: THE NEXUS BETWEEN OIL RENTS, PROTESTS, AND THE SHADOW ECONOMY

Our study seeks to establish a link between two strands of literature: The first explains the relationship between resource rents and conflict, and the second discusses the relationship between the shadow economy and social unrest. In this section, we briefly review the theoretical arguments of each strand separately. We subsequently combine the theoretical arguments and discuss how a shadow economy can affect the relationship between oil rents and conflict.

### 2.1 | Oil rents and conflict

Earlier studies are divided on the effects of oil rents on political stability. A large part of the literature examines how an increase in resource rents may increase conflict or the risk of political instability.

The starting point in the literature is the curse of resources. Countries with higher levels of resource rents dependency, on average and in the long term, grow slower than resource-poor economies (for a survey, see Frankel, 2010). In particular, the curse is more relevant and significant when the resource is crude oil (Boschini et al., 2007).[7] The negative effects of oil rents on economic growth may be connected to a higher risk of conflict and incidence of protests. Economic growth may shape the opportunity costs of population planning and conflict participation (de Soysa, 2002). Hence, a dampening effect of income growth on a country's risk of conflict is expected, as found by Brückner and Gradstein (2015).

In addition to the indirect effect of resource rents on conflict through the channel of economic growth, the literature also argues that resource rents directly increase the incidence of conflict. For example, Collier and Hoeffler (2012) present possible explanations for the increased effects of rents on conflict. First, rents may increase the value of the state, intensifying conflict over the control of the state (i.e., state as a prize hypothesis). In addition, they refer to the decreased capacity of a state with a resource-rich economy to control corruption, which may increase the risk of conflict. Second, resource rents finance rebel groups and reduce the opportunity costs for rebellion (Collier & Hoeffler, 2004; Le Billon, 2001). One reason is the unequal distribution of rents, leading to economic and political incentives for resource-rich regions to separate from the rest of country. This subsequently increases the risk of conflict (e.gLe Billon, 2001; Ross, 2004).[8]Rents also affect the fiscal relationship between the state and the people, reducing the government accountability of resource-rich states. By lowering the share of tax revenues in the government budget, resource rents increase the political gap between the state and society (Acemoglu & Robinson, 2000). This in turn may negatively affect the quality of political institutions and increase the incidence of protests as other channels of resolving conflicts are unavailable.

Although it may be true that rents dependency in the long-term directly and /or indirectly increase the risk of civil conflict, we also show examples where rents have bought peace, particularly in the short term. In a study of 29 sub-Saharan countries from 1985 to 2007, Arezki and Gylfason (2013) show that higher resource rents result in fewer internal conflicts and less democratic countries face a lower probability of conflicts after an increase in resource rents. This finding, they argue, is because of the ability of the politically powerful to buy peace through the redistribution of rents to the public. This redistribution happens through higher government spending (e.g., subsidies, public employment). Similarly, Andersen and Aslaksen (2013) show that oil rents extend autocratic regimes. They also find political stability to be less sensitive to rents in democratic countries (see also Fjelde (2009) and Omgba (2009) for similar results). More generally, Basedau and Lay (2009) argue that the constructive effects of resource rents on internal stability have largely been neglected in the study of peace and war. They show that political regimes apply resource rents to purchase peace through patronages (political corruption), by implementing large-scale distributive policies (e.g., subsidies) and by suppressing opposition.

Based on the latter studies, we argue that a sudden decline in oil rents should increase political instability and civil conflict in oil-dependent countries. In contrast to these studies, which focus on occurrences of civil wars and regime breakdowns, we estimate the effect of oil rents shocks on less violent incidences of social unrest (i.e., protests). This remains largely unexplored along with the recent findings of Bazzi and Blattman (2014) which shows oil price shocks to be associated with shorter, less intense civil conflicts. To the best of our knowledge, there is only the study (by Smith (2004)) which examines the impact of oil price shocks on anti-state protests and finds that oil wealth is associated with fewer protests. One concern with this study is that it is based on a cross-country empirical specification, which makes it difficult to make causal inferences.

Another concern regards its measure of the time-varying value of oil exports to GDP being partly based on oil production, which makes it endogenous to social unrest.

## 2.2 | Shadow economy and conflict

A line of literature discusses the positive effects of a shadow economy on political instability and incidence of protests. A shadow economy can decrease the risk of protests when the formal part of the economy does not absorb the flow of the working-age population due to regulatory burdens and higher labor costs. Increased unemployment in the formal economy is associated with higher labor force participation in the shadow economy (Dobre et al., 2010). Existence of a shadow economy, with far less regulatory framework and significantly lower labor costs, may provide the unemployed population with income that stimulates general demand in the economy. The role of the shadow economy exists in different countries for various reasons and can reduce the economic pains of high unemployment in the formal economy, reducing the incidence of protests and major conflicts (Lucifora & Moriconi, 2012). The earned income in the shadow economy is also spent in the formal economy and may offset some negative effects on effective household demand (Alexandru et al., 2011). In a sample of 19 Asian countries during the period 1990–2015, Huynh and Nguyen (2020) show that a shadow economy decreases income inequality by increasing the share of income held by the lowest quintile and decreasing the share of income held by the highest quintile. La Porta and Shleifer (2014) study the characteristics of formal and informal entrepreneurs. They show that informal firms are often small, inefficient, and run by entrepreneurs with low education attainment. In other words, the informal economy provides opportunities for a segment of society who may face significant challenges in obtaining employment in the formal and competitive economy. Their findings are mostly in line with Lewis' (1954) dual view of informality, implying that official and shadow economies are largely segregated and produce goods with different labor, capital, and entrepreneurial inputs and that they also serve different customers. This implies that in the absence of a shadow economy, or its repression by the state, we may expect to observe an increasing gap between the rich (with higher skills) and the poor (with lower educational opportunities), which may result in a higher risk of conflict.

The constructive effect of a shadow economy on decreasing conflict and instability is also observed in the arguments by structuralists when discussing the formal and informal economy nexus. Structuralists believe that by providing cheaper goods and services and offering flexible working conditions, a shadow economy increases the level of competition in the formal economy. In the context of developing countries, a shadow economy helps to maintain economic activities when rent seeking and corruption increase the cost of doing business in the formal sector (Eilat & Zinnes, 2002). A shadow economy may also increase financial resources and help to accumulate entrepreneurial experience for the disadvantaged (Dell'Anno, 2016). The positive effect of the shadow economy on the formal economy may manifest itself in higher opportunity costs of conflict.

However, there is also a line of literature which discusses the risks of a shadow economy on political stability. A sizable shadow economy increases budget deficits by reducing tax revenues, especially in natural resource-poor economies. This negative impact on public finances may reduce the capacity of the state to produce public goods and services, such as security and order, thereby increasing the risk of conflict (Farzanegan & Badreldin, 2017). It can also reduce the capacity of the state to maintain redistribution policies and subsidy payments, with negative consequences for poverty and inequality (Chong, & Gradstein, 2007; Enste, 2003). On the interaction between the formal and shadow economy, we also encounter "dual" views, in contrast with the structuralists. According to the "dual" view hypothesis, shadow economy activities are unfairly competitive to the activities in the formal

economy and thus negatively affect market allocation and economic growth. This is also empirically supported (Eilat & Zinnes, 2002). There are a series of allocative inefficiencies at the firm level in the shadow economy. Operating outside of public authorities may endanger the protection of property rights, leading to lower investment activity. Firms in the shadow economy are also forced to operate suboptimally with limited ownership structures. Such firms are exposed to a higher risk of extortion and public corruption, given their unregistered nature and lack of legal support by public institutions (Dell'Anno, 2016). Moreover, Biswas et al., (2012) show that a shadow economy negatively affects the quality of the business environment, which combined with the "dual" view may predict greater dissatisfaction with the political system.

## 2.3 | Shadow economy as a potential moderator for oil conflicts

So far, we have discussed the different channels through which changes in oil rents and the shadow economy may independently affect political instability. These different arguments show that both fueling and dampening effects of oil rents and shadow economies on social unrest are possible. We aim to show that the size of a shadow economy can be an important moderator on the effect of (negative) changes in oil rents on the incidence of protests, especially in oil-dependent economies.

Decreasing oil rents in oil-based economies force the government to increase taxation and to reduce subsidies and public jobs. Negative oil rents shocks may reduce government spending on education and health, as well as its capacity to establish order and safety and to attract foreign investment. These developments may trigger public dissatisfaction with the performance of the state and increase the incidence of protests and anti-government demonstrations. A shadow economy may decrease the negative effect of falling oil rents on the incidence of protests if it acts as a safety net that provides jobs for the unemployed and as a channel to earn income for segments of the population with lower education, skills, or limited capital.

The existence and size of a shadow economy also limits the capacity of the state to increase tax burdens following a decline in oil rents. Ishak and Farzanegan (2020) examine this issue in a sample of 124 countries from 1991–2015. Their panel data analysis shows that declining oil rents after negative price shocks cease to have any significant positive effects on tax revenues in countries with sizable shadow economies. Considering their findings, one can expect that protests and demonstrations against higher tax burdens following negative oil shocks in oil-based countries are less likely with the presence of a sizable shadow economy. This may also indicate a lower chance of instability, as the shadow economy not only provides a safety net but also limits the ability of the state to levy significant taxes. Nevertheless, a significant drop in oil rents may force the state to search for taxation opportunities by repressing the shadow economy and increasing the costs of operating underground through higher penalties. This may backfire and mobilize the low-income households of the shadow economy, leading to more social unrest.

## 2.4 | Main hypotheses

To summarize, the theoretical literature implies that both (negative) oil rents shocks and the shadow economy affect the risk of conflict and incidence of protests. Most arguments show that a drop in oil rents in oil-dependent economies increases the incidence and risk of political instability. Higher levels of oil dependency will have greater negative effects on internal stability. However, higher resource rents, especially in the short term, may also increase the capacity of the political elite to pay off

political opposition, maintaining stability and order. Similarly, theoretical predictions of the effects of shadow economies on instability are not conclusive.

Theory is also not conclusive regarding a shadow economy's effect on the relationship between declining oil rents and the incidence of conflict. There are arguments for the constructive and destructive roles of a shadow economy when an oil-based economy faces significant negative oil shocks. Shadow economies can either moderate or increase internal conflicts following decline in oil rents in these economies. On the one hand, if the shadow economy is able to absorb the large number of the unemployed and provide a safety net for the poorer households when the oil economy is in decline, then we may expect to observe a dampening effect. If the shadow economy helps to reduce income inequality and poverty, one may expect to see higher opportunity costs for individuals to enter conflict. On the other hand, if the shadow economy amplifies the budget deficit of a state which is already experiencing dropping oil income, then state capacity is further undermined and stability and order are more tenuous.

In light of these multifaceted arguments, the aim of our paper is to empirically (1) investigate the link between negative oil rents shocks and the incidence of protests and (2) investigate how the size of the shadow economy influences this nexus. Our hypotheses to be tested are formulated as follows:

**Hypothesis 1** *Negative oil rents shocks are associated with higher incidence of protests in oil-dependent countries, ceteris paribus.*

**Hypothesis 2** *The final effect of negative oil rents shocks on the incidence of protests depends on the size of the shadow economy. Higher levels of the shadow economy (as a share of GDP) moderate the effect of negative oil shocks on the incidence of protests in oil-dependent countries, ceteris paribus.*

## 3 | DATA AND EMPIRICAL METHODOLOGY

### 3.1 | Data

Our panel dataset combines information on oil price shocks, shadow economies, and protests for 144 countries during the period from 1991 to 2015. Our indicator for oil rent fluctuations is measured by the variation in international oil prices weighted by the degree of oil dependency. Hence, the country-specific measure of annual oil price shocks for country $i$ at time $t$ is constructed by multiplying the time-invariant whole-period average of country $i$'s share of oil exports to GDP $\delta_i$ with the annual ln-change in international oil prices $\Delta lnOilPrce_t$ and takes the following form:

$$OilPriceShock_{it} = \delta_i \Delta \ln OilPrice_t \tag{1}$$

This specification captures that oil price shocks should have a greater impact on countries with a greater dependence on oil.[9] The oil exports data are from the United Nations Comtrade database (2016) reported according to the SITC1 system. The calculated country's share of oil to GDP $\delta_i$ was revised so that extreme values are replaced by the second highest value to avoid some of the problems associated with reported export values that may be inaccurate for specific countries (Feenstra et al., 2005).[10] Data on real international oil prices are taken from United Nations Conference on Trade and Development Commodity Statistics (UNCTAD, 2016).

To measure the shadow economy of a country, we rely on data taken from Medina and Schneider (2018), who define the shadow economy as "all the economic activities hidden from official authorities to avoid paying taxes and all social security contributions, to avoid governmental bureaucracy or the burden of regulatory framework, and for institutional reasons including corruption law, the quality of political institutions, and weak rule of law." The estimates of the size of the shadow economy, measured as a percentage of GDP, are based on the Multiple Indicators Multiple Causes (MIMIC) model. This empirical approach first treats the shadow economy as an unobserved (latent) variable, identifying multiple causes and indicators for estimating its size. Second, it uses structural equations modeling to estimate the causal relationships between the unobserved variable and the observed indicators. A key advantage of this dataset is that it uses a light intensity approach instead of GDP as an indicator variable and, hence, captures a wider range of economic activities that are not reported by official GDP figures (Farzanegan & Hayo, 2019). A second advantage of this dataset is the inclusion of a longer time span and a wider set of countries.

We rely on data from the Cross-National Time-Series Data Archive (CNTS) (Banks & Wilson, 2018) to construct our indicator for protests. The CNTS dataset measures different types of political instabilities ranging from the less intense incidences of protests to major events such as civil wars and coups. Given the purpose of this paper, we only select three indicators for less violent events of instabilities: anti-government demonstrations, general strikes, and riots. Our measure for protests is a count variable (expressed in logs) calculated by summing the numbers of all demonstrations, strikes, and riots that took place in a country in a given year; hence, it captures the magnitude or the intensity of the instability. Table 1 provides the summary statistics for our variables of interest.

## 3.2 | Empirical methodology

Our conceptual framework hypothesizes that the effect of negative oil price shocks on protests depends on the size of the shadow economy, ceteris paribus. Specifically, a decline in oil rents will increase protests, but the effect is lower the larger the size of the shadow economy. To test these two hypotheses, we estimate the following model:

$$\begin{aligned}\Delta \ln Protest_{it} = {} & \alpha_i + \theta_t + \gamma_i t + \beta_1 3 - year\ OilPriceShock_{it} + \beta_2 \ln SE_{it-3} \\ & + \beta_3 OilPriceShock_{it} \times \ln SE_{it-3} + \varepsilon_{it}\end{aligned} \tag{2}$$

The dependent variable $Protest_{it}$ is the sum of protest events in a given country $i$ and year $t$, $\alpha_i$ is country fixed effects, $\theta_t$ is year fixed effects, and $\varepsilon_{it}$ is the error term.[11] The $\gamma_i t$ is a country-specific linear time trend to account for potential omitted variables and pre-existing trends. $OilPriceShock_{it}$ is the explanatory variable of interest, proxying changes in oil rents. This is measured as the weighted-change in (log) oil prices averaged over the previous 3 years. Employing the 3-year average has the

**TABLE 1** Summary statistics

| Variable | *N* | Mean | SD | Min | Max |
|---|---|---|---|---|---|
| Oil price shock | 3114 | 0.004 | 0.02 | −0.16 | 0.18 |
| Protest (log) | 3114 | 0.46 | 0.78 | 0 | 4.98 |
| Shadow Economy (% of GDP) (log) | 3114 | 3.33 | 0.49 | 1.82 | 4.28 |

advantage of accounting for the time-dependence of oil shocks, in addition to reducing the role of transitory shocks and measurement error in the explanatory variable.It also allows for the lag response of the outcome variable.[12]

To investigate the mitigating role of the shadow economy, we add the (log) size of the shadow economy (% of GDP), $lnSE_{it-3}$, both by itself and interacted with oil price shocks. This allows us to examine the impact of oil price shocks on protests conditional upon the initial size of the shadow economy. To be consistent with the starting date of the price shock and to address reverse causality, the initial size of the shadow economy is measured at year $t-3$. Hence, if the change in oil prices is measured as the average over the years $t$, $t-1$, $t-2$, and $t-3$ the size of shadow economy enters at year $t-3$. Table B2 in Appendix B shows that the lagged levels of a shadow economy are uncorrelated with contemporaneous oil price changes, which suggests that a lagged level of the shadow economy can be treated as a predetermined variable whose lagged levels are uncorrelated with the current error term. This mitigates the endogeneity concerns and additionally rules out reverse causality, since it is unlikely for protest at time $t$ to affect the shadow economy at time $t-3$.[13] Furthermore, it should be noted that even if there could be remaining concerns regarding the full exogeneity of the shadow economy, the interaction term between oil price shocks (i.e., the exogenous variable) and the shadow economy will remain consistent (Bun & Harrison, 2019).[14]

In this specification, $\beta_1$ captures the linear effect of oil price shocks on protest intensity in countries with greater dependence on oil, and $\beta_3$ measures the effect of oil price shocks on protests conditional upon the initial size of the shadow economy. We expect the sign of the linear effect to be negative (i.e., $\beta_1 < 0$), and the sign of the conditional effect be positive (i.e., $\beta_3 > 0$). Hence, oil price shocks are expected to have a smaller effect on protest proliferation in countries with a relatively larger shadow economy. The time variation stems from movements in international oil prices, allowing the effects to change based on the degree of oil dependency. This helps to circumvent problems associated with using conventional measures of resource wealth, such as export or production levels (typically normalized by GDP or population), which could be spuriously correlated with our outcome of interest. The included country and year fixed effects control for all time-invariant country characteristics and global trends. We cluster the standard errors at the country level.[15]

The usage of (non-) differenced specifications is motivated by the time series properties of international oil prices, protests, and shadow economies. In Table A1 in Appendix A, we provide formal unit root tests for these variables. The tests cannot reject the null hypothesis of the presence of a unit root in the time series of oil price and protests in levels, but they reject it for their first differences. For the shadow economy, formal tests reject the null hypothesis of the presence of unit roots in levels and its first difference.

# 4 | EMPIRICAL RESULTS

## 4.1 | A first look at the data

Our main argument is that the effect of a decline in oil rents due to negative price shocks on protests depends on the size of the shadow economy. To get an initial snapshot of this relationship, Figure 1 graphs the life table survival estimates for country groups classified based on the degree of their dependency on oil revenues and the size of their shadow economies. The graph of the protest survival function in Figure 1(A) indicates that the average survival rate for experiencing protests is

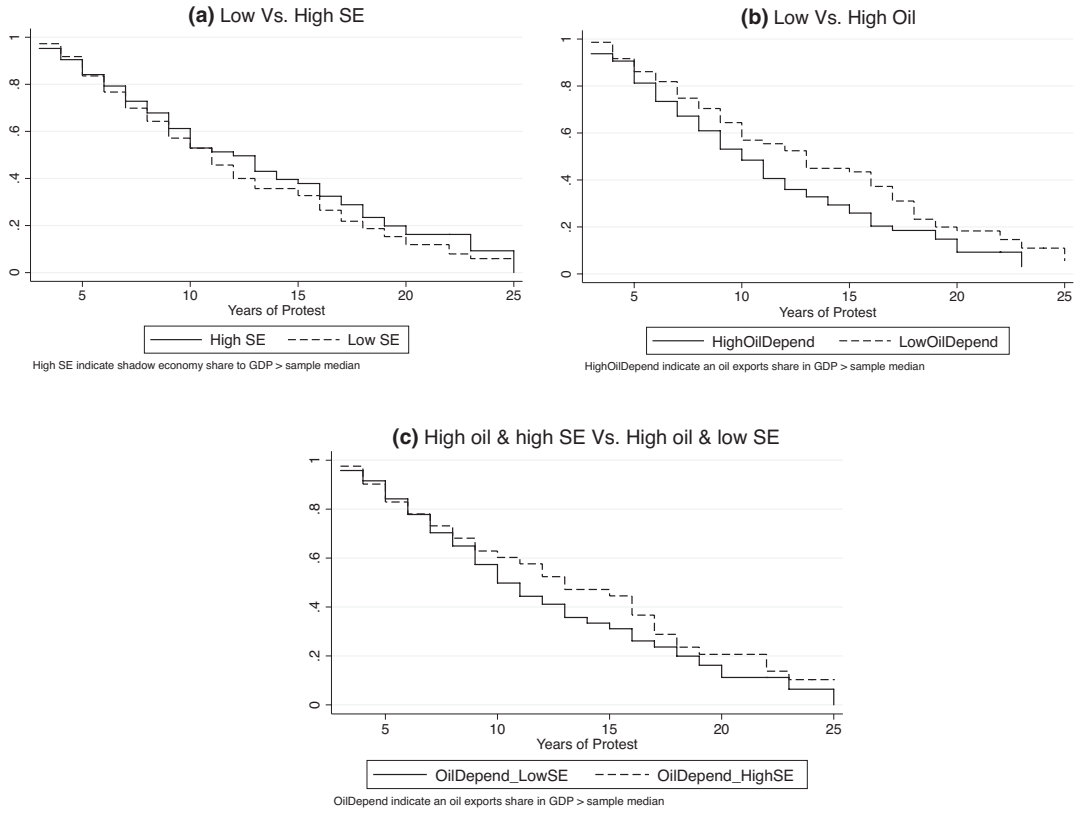



**FIGURE 1** Protest survival functions. Note: (a) displays the protest survival function for high-shadow economy (SE) countries (i.e., share of the shadow economy to GDP >sample median) vs. low SE countries. (b) plots the estimates for high oil-dependent countries (i.e., share of oil exports to GDP >sample median) vs. low oil-dependent countries. (c) plots the protest survival function for high oil-dependent countries with high SE against high oil-dependent countries with low SE

slightly higher for countries where the share of the shadow economy to GDP is greater than the sample median ("high-shadow economy countries") compared to the rest ("low-shadow economy countries"). Put differently, high-shadow economy countries may have a slightly lower likelihood of witnessing protests than low-shadow economy countries. However, the log-rank test for equality of survivor functions fails to reject the null hypothesis that both groups are equal, meaning there is no statistically significant difference for the likelihood of witnessing protests between small and large shadow economy countries. Figure 1(B) plots the protest survival function for countries whose share of oil exports to GDP is greater than the sample median ("high oil-dependent countries") against countries with lower dependency on oil ("low oil-dependent countries"). This indicates that the average survival rate for experiencing protests is lower for high oil-dependent countries and that there is a higher likelihood of witnessing protests in high oil-dependent countries compared to low oil-dependent countries. The log-rank test for equality of survivor functions rejects the null hypothesis that both groups are equal.

Finally, Figure 1(C) plots the protest survival function for high oil-dependent countries with large shadow economies against high oil-dependent countries with small shadow economies. This indicates that the average survival rate for experiencing protest is higher for high oil-dependent countries with large shadow economies relative to those with small shadow economies. The log-rank test for equality of survivor functions rejects the null hypothesis that both groups are equal.

**TABLE 2** Oil price shocks, protest, and shadow economy

| Model | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| | Δ ln Protest | Δ ln Protest High SE | Δ ln Protest Low SE | Δ ln Protest | Δ ln Riots | Δ ln Strikes | Δ ln Anti-Gov Demos |
| | OLS | OLS | OLS | OLS | OLS | OLS | OLS |
| 3-year oil price shock, *t* | −0.589 | 0.472 | −1.584** | −12.406*** | −9.202** | −1.883 | −6.415* |
| | (0.437) | (0.742) | (0.696) | (3.973) | (3.763) | (1.341) | (3.739) |
| Shadow economy (log), *t−3* | | | | 0.122 | 0.103 | −0.008 | 0.005 |
| | | | | (0.158) | (0.109) | (0.057) | (0.135) |
| 3-year oil price shock*Shadow economy (log) | | | | 3.391*** | 2.394** | 0.579 | 1.799* |
| | | | | (1.097) | (1.034) | (0.363) | (1.073) |
| Chow test *p*-value | | 0.01 | 0.01 | | | | |
| Number of observations | 3,114 | 1,557 | 1,557 | 3,114 | 3,114 | 3,114 | 3,114 |
| Number of countries | 144 | 94 | 102 | 144 | 144 | 144 | 144 |
| $R^2$ | 0.055 | 0.053 | 0.120 | 0.056 | 0.066 | 0.037 | 0.053 |
| Country FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country-specific time trend | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

*Note:* Oil price shock is the average 3-year ln-change in the oil price multiplied by whole-period average oil exports share to GDP (1991–2015). The dependent variable in Columns (1)-(4) is the ln-change of sum of protest events that took place in a given country at a given year; Column (5) is ln-change in the number of riots; Column (6) is ln-change in the number of strikes; and Column (7) is the ln-change in the number of anti-government protests. The method of estimation is ordinary least squares with Huber-robust standard errors (reported in parentheses) clustered at the country level. Country fixed effects, year fixed effects, and country-specific time trends are not reported. Significantly different from zero at *10% significance, **5% significance level, ***1% significance level.

### 4.2 | Baseline results

Table 2 presents our main results for estimating Equation (2). In Column (1), we look at the average effect of the 3-year average oil price shocks on protests without controlling for the initial size of the shadow economy. The negative coefficient implies that oil price shocks, on average, have a negative impact on protests, but it is not statistically significant. In Columns (2) and (3), we divide our sample into high-shadow economy and low-shadow economy countries, based on whether the 3-year lagged shadow economy is above or below the median. We see that oil price shocks have no statistically significant effect on protests in the high-shadow economy group, but have a negative and statistically significant effect on protests in low-shadow economy countries. In addition, the reported Chow test rejects the hypothesis that the estimated coefficient in high-shadow economy countries is the same as the coefficient in low-shadow economy countries. Hence, it is not surprising to see the average effect of oil price shocks in the full sample to be nil, since the opposing effects found in the low-shadow economy and high-shadow economy groups offset (with both samples having an equal number of observations).

Column 4 adds the 3-year lagged level of (log) shadow economy (as a % of GDP), both by itself and interacted with oil price shocks, as additional control variables. We see that the coefficient of the oil price shocks is still negative and statistically significant, while the interaction term between the oil price shocks and the lagged shadow economy is positive and significant at a 1% significance level. This is in line with our hypotheses that negative oil price shocks significantly increases protests in small shadow economy countries, but the effect dissipates as the initial size of the shadow economy increases. In very high levels of shadow economies, the effect becomes very small and statistically insignificant.[16]

To put the coefficients in Column (4) into perspective, we see that in a low-shadow economy country (where the shadow economy is around 7% of GDP), the effect of a 1 percentage point decline in weighted-international oil price implies an increase in protests by 6 percentage points. In a mid-shadow economy country (where the shadow economy is around 32% of GDP), the effect of a 1 percentage point decline in weighted-international oil price implies an increase in protests by 0.64 percentage points. Negative oil price shocks cease to have a significant impact on protests in high-shadow economy countries (where the shadow economy is more than 35% of GDP). Consider Iran, Equatorial Guinea, and Nigeria as examples of oil-dependent countries, with an average shadow economy of 17.6%, 31%, and 56.4% of GDP, respectively. The coefficient estimates imply that in response to a 1 percentage point decline in weighted-international oil prices, protests will increase in Iran by 2.7 percentage points but will only increase by 0.8 percentage points in Equatorial Guinea. The same decline will have no significant impact on protest in Nigeria.

Finally, in Columns (5)-(7), we disaggregate our protest measure into its three indicators: riots, strikes, and anti-government demonstrations. We find that the number of both riots and anti-government demonstrations increases significantly following negative oil price shocks, but the effect becomes less severe the larger the initial size of the shadow economy. In contrast, negative oil price shocks have no statistically significant impact on strikes. The estimated coefficients also suggest that oil price shocks have a stronger impact on riots, both quantitatively and qualitatively, relative to anti-government demonstrations and strikes.

## 5 | ROBUSTNESS CHECKS

Table 3 presents various important robustness checks to our main results (Column (4) in Table 2). One concern is that the international price of oil could be endogenous to major oil producers and

**TABLE 3** Oil price shocks, protest, and shadow economy—Robustness checks

| Model | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | Δ ln Protest | Δ ln Protest | Δ ln Protest | Δ ln Protest | Δ ln Protest | Δ ln Protest | Δ ln Protest | Δ ln Protest |
| | OLS | OLS | OLS | OLS | OLS | OLS | OLS | OLS |
| | Drop major oil exporters | Drop major oil producers | Drop OPEC | Democratic countries | Autocratic countries | drop extreme SE values | Drop high SE countries | Alternative SE measure (1984–2006) |
| 3-year oil price shock, *t* | −12.142** | −11.299** | −24.447*** | −27.419** | −12.240** | −13.732*** | −13.426*** | −23.151** |
| | (5.627) | (4.654) | (6.831) | (12.492) | (5.018) | (5.173) | (4.295) | (10.611) |
| Shadow economy (log), *t−3* | 0.129 | 0.069 | 0.073 | 0.241 | 0.092 | 0.028 | 0.093 | 0.104 |
| | (0.162) | (0.169) | (0.167) | (0.188) | (0.433) | (0.163) | (0.159) | (0.094) |
| 3-year oil price shock*Shadow economy | 3.500** | 3.078** | 7.059*** | 7.328** | 3.441** | 3.772** | 3.694*** | 6.898** |
| | (1.618) | (1.289) | (1.916) | (3.062) | (1.428) | (1.477) | (1.203) | (3.163) |
| Chow test *p*-value | | | | 0.53 | 0.53 | | | |
| Number of observations | 2,979 | 2,874 | 2,871 | 2,090 | 830 | 2,828 | 2,982 | 2,116 |
| Number of countries | 137 | 133 | 132 | 111 | 56 | 138 | 138 | 108 |
| $R^2$ | 0.054 | 0.055 | 0.053 | 0.074 | 0.158 | 0.066 | 0.056 | 0.041 |
| Country FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country-specific time trend | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

*Note:* Oil price shock is the average 3-year ln-change in the oil price multiplied by whole-period average oil exports share to GDP (1991–2015). The dependent variable is the ln-change of sum of protest events that took place in a given country at a given year. In Column (1), we exclude the quintile of countries with highest whole-period average oil exports as a share of GDP; in Column (2), we exclude quintile of countries whose share of world oil production exceeds 3%, averaged over the sample period; in Column (6), we exclude the quintile of country-year observations with highest share of shadow economy to GDP; and in Column (7), we exclude the quintile of countries with the highest share of shadow economy to GDP, averaged over the whole-period sample. Democratic (autocratic) countries are defined as those whose Polity2 score strictly > (<) zero. The method of estimation is ordinary least squares with Huber-robust standard errors (reported in parentheses) clustered at the country level. Country fixed effects, year fixed effects, and country-specific time trends are not reported. Significantly different from zero at *10% significance, **5% significance level, ***1% significance level.

exporters, introducing bias to the estimates. Specifically, reverse causality may arise if an intensification of protests disturbs oil production and thus world supply, causing international prices to increase. To account for this, in Column (1), we exclude the quintile of countries with the highest whole-period average oil exports as a share of GDP, while in Column (2) we exclude the top quintile of countries whose share of world oil production exceeds 3%, averaged over the sample period.[17] Additionally, we exclude members of Organization of the Petroleum Exporting Countries (OPEC) in Column (3). In all instances, the coefficients of interest maintain their signs and statistical significance. Next, in Columns (4) and (5), we divide the sample into democratic and autocratic regimes to investigate the heterogeneity of oil price shocks on protests. We base our classification for political regimes on the Polity IV regime database (Marshall & Jaggers, 2016) and follow the convention of classifying countries as democracies (autocracies) if their Polity2 score is strictly positive (negative) (e.gCaselli & Tesei, 2016; Persson & Tabellini, 2006).[18] Our coefficients of interest remain robust in both samples. Moreover, the Chow test fails to reject the null hypothesis that impact of oil price shocks on protest in autocracies is equal to that of the full sample. Thus, there is no statistically significant difference between autocracies and democracies on the effect of protests following oil price shocks.

In Column (6), we omit the quintile of country-year observations with the highest share of shadow economy to GDP (i.e., more than 55% of GDP) to check whether the results are influenced by extreme observations. Similarly, in Column (7), we drop the quintile of countries with the highest share of shadow economy to GDP, averaged over the whole-period sample. In both cases, our main results remain robust in sign and significance. Finally, in Column (8), we check whether our estimates are sensitive to a specific measure of the shadow economy. We employ an alternative measure for the size of a shadow economy taken from Alm and Embaye (2013), with estimates based on the currency demand method for the period 1984–2006. In our sample, the correlation between Medina and Schneider's (2018) estimates of the shadow economy with Alm and Embaye (2013) is around 0.78. The coefficients of interest remain qualitatively similar despite the smaller sample size.

Table 4 conducts further robustness checks. In Column (1), we use a different weight for oil price shocks by employing the mid-period value of oil exports share to GDP. We calculated the average of the closest 5 years to the year 2003. In Column (2), the 3-year lagged shadow economy is entered in levels rather than in logs. In Column (3), we restrict our sample to high oil-dependent countries, defined as oil exporters whose whole-period average exports share to GDP is above the median. In Columns (4) and (5), we differentiate between developed and developing countries based on the World's Bank income classification. In Column (6), we account for the additional effects of other natural resources, such as coal, natural gas, and minerals, to alleviate the concern that dependence on these natural resources rents may be correlated with oil prices and influence the results. These natural resources are measured by their corresponding rents as a share of GDP (WDI, 2018). This is particularly important to check since oil exporters could also be exporters of other commodities and highly dependent on both.

In all specifications, the signs and statistical significance of our variables of interest remain robust, with no statistically significant differences in effects between developed and developing countries. However, we find a relatively higher effect in high oil-dependent countries compared to low oil-dependent countries and the difference is statistically significant (Chow test p-value 0.08). The dependence on other natural resource rents and their interactions with the shadow economy are statistically insignificant and small in magnitude (not reported). This means that, on average, a greater dependency on oil and thus greater exposure to price changes dominates the effects of dependency on other minerals. In other words, the relationship of interest still holds even conditional on the presence of other minerals.[19]

**TABLE 4** Oil price shocks, protest, and shadow economy—Robustness checks

| Model | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | Δ Log Protest | Δ Log Protest | Δ Log Protest | Δ Log Protest | Δ Log Protest | Δ Log Protest | Δ Log Protest | Δ Log Protest |
| | OLS | OLS | OLS | OLS | OLS | OLS | OLS | OLS |
| | Weight average mid-period | SE in levels | High oil exporters only | Developed countries | Developing countries | Adding additional natural resources | Post−2003 period | Falsification test |
| 3-year oil price shock, *t* | −11.814*** | −3.776*** | −12.494*** | −13.207 | −27.984*** | −12.611*** | −19.541*** | 1.597 |
| | (3.827) | (1.222) | (4.031) | (10.685) | (9.353) | (4.365) | (6.744) | (4.587) |
| Shadow economy (log), *t−3* | 0.118 | 0.006 | 0.173 | 0.180 | 0.089 | 0.094 | 0.003 | 0.048 |
| | (0.158) | (0.005) | (0.235) | (0.197) | (0.242) | (0.163) | (0.349) | (0.114) |
| 3-year oil price shock*Shadow economy | 3.266*** | 0.090*** | 3.373*** | 4.102 | 7.476*** | 3.423*** | 5.118*** | −0.360 |
| | (1.073) | (0.030) | (1.095) | (3.445) | (2.494) | (1.208) | (1.830) | (1.382) |
| Additional natural resources (with interactions) | | | | | | Yes | | |
| | | | | | | | | |
| Chow test *p*-value | | | 0.08 | 0.13 | 0.13 | | 0.19 | |
| Number of observations | 3,114 | 3,114 | 1,538 | 0.083 | 0.056 | 3,064 | 1,850 | 3,114 |
| Number of countries | 144 | 144 | 72 | 1,055 | 2,059 | 143 | 144 | 144 |
| $R^2$ | 0.056 | 0.056 | 0.066 | 49 | 95 | 0.059 | 0.095 | 0.042 |
| Country FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country-specific time trend | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

*Note:* Oil price shock is the average 3-year ln-change in the oil price multiplied by whole-period average oil exports share to GDP (1991–2015). The dependent variable is the ln-change of sum of protest events that took place in a given country at a given year. The additional natural resources are mineral rents, natural gas rents, and coal rents, all as a percentage of GDP. The method of estimation is ordinary least squares with Huber-robust standard errors (reported in parentheses) clustered at the country level. Country fixed effects, year fixed effects, and country-specific time trends are not reported. Significantly different from zero at *10% significance, **5% significance level, ***1% significance level.

In Column (7), we restrict our sample to the post-2003 period, which constitutes half of the sample period and captures the oil boom period. The estimated coefficients maintain similar significance levels as the entire sample. The Chow test fails to reject the null hypothesis that the estimated coefficients in this subsample are the same as for the full sample. Finally, in Column (8), we conduct a placebo test to make sure that our results are not mechanical or driven by pre-existing trends. We do this by regressing past protest data (1966–1990) on current period oil price shocks. We find that the coefficients of interest have switched signs and lost their significance.

Other robustness checks are reported in Table B3 in Appendix B. We check the robustness of our baseline results to the inclusion of fixed effects and drop in influential observations. Column (1) removes country-specific time trends, and Column (2) removes both country fixed effects and country-specific time trends. In all models, our main variables of interest remain robust in sign and significance. In Columns (3) and (4), we omit influential observations using Cook's distance and Welsch distance formulas, respectively. The coefficients of interest show the predicted signs and are statistically significant in all instances.

## 6 | CONCLUSION AND GENERAL DISCUSSION

Fluctuations in oil prices and rents can have significant implications for political instability in countries. We investigated the incidence of protests to oil rents shocks relationship in 144 countries from 1991 to 2015. Our panel estimations show that there is a significant positive effect of negative oil rents shocks on protests (i.e., anti-government demonstrations, riots, and strikes). Our main contribution, however, is to present the shadow economy as an important moderator in the negative oil shocks-conflict problem.

Our results indicate that negative oil price shocks significantly increase protests in small shadow economy countries, but the effect dissipates as the initial size of the shadow economy increases, eventually vanishing at the highest levels. A larger shadow economy can thus contribute to political stability by providing a complementary source of income for countries that depend on oil revenues and experience negative price shocks. Our results are also in line with findings of Choi and Thum (2005) who show that the presence of a shadow economy mitigates government-induced distortions that may arise after negative price shocks, and as a result, leads to more economic activities in the formal sector. Our results on the constructive role of the shadow economy in mitigating the effects of declining oil rents on conflicts may be seen in contrast with the studies of Loayza (1996) and Johnson et al., (1997). These studies argue that the formal and informal sectors compete for resources and the existence of the shadow economy is viewed as destructive for economic growth.

This finding has several implications. First, such a mitigating role should allow for reconsiderations of permanent calls to eliminate the unofficial economy, by depicting it as a source of evil, a stance that simply conflates causes with symptoms. Governments must recognize that the existence of a shadow economy serves as an implicitly or explicitly integral part of social risk management strategies. Second, even with the justified objective of eliminating inefficiencies in allocating goods and factors in the economy, deregulation and structural adjustment strategies must be designed carefully. Specifically, strategies must be implemented in such a way that a reduction or abolishment of the shadow economy will be complemented by an increase in or establishment of other risk management pillars (social security payments, unemployment insurance, etc.). Third, diversification of production will reduce state dependency on oil revenues and therefore economic vulnerability to shocks. Thus, industrial diversification strategies can serve as an important complement to strategies aimed at reducing the role of the shadow economy. Ultimately, the existence of the shadow economy is a response to

unsound economic policies and inefficient economic structures that fail to shield the economy against shocks, aspects that should be addressed in advance.

Future research should investigate drivers of shadow economy activities in oil-dependent countries and investigating the effect of other commodity price shocks. Shadow economies may exist to correct market inefficiencies by providing business opportunities for small-scale firms and low-skilled and poorly educated workers. These segments of the population are systemically excluded from official economies due to heavy market regulations, inability to access credit, and poor educational and training services in oil-producing countries (Dreher & Schneider, 2010; van der Ploeg, 2011; and Gylfason, 2001).

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## END NOTES

[1] As mentioned in Bjorvatn and Farzanegan (2013), governments that control resource rents use public sector employment as a redistributive instrument, mainly for "patronage" purposes to secure re-election or to stay in power (also see Alesina, Baqir, & Easterly, 1998; Auty, 2001; Robinson, Torvik, & Verdier, 2006).

[2] See https://www.brookings.edu/events/the-impact-of-low-oil-prices-and-taxation-on-the-gcc-countries/

[3] Farzanegan et al (2021) study the relationship between oil rents and the middle class in Iran. They show that the middle class expands in response to positive shocks in oil income.

[4] Farzanegan (2009) also finds that smuggling of commercial goods (as a part of the shadow economy) has a significant and dampening effect on import prices in the case of Iran.

[5] The literature on the shadow economy either focuses on estimating its size and discerning its causes (e.g., Schneider and Enste, 2000; Medina and Schneider, 2018) or studies its impact on the official economy and vice-versa on either a limited subset of countries or using cross-country variation (e.g. Dell'Anno and Solomon, 2007). Other cross-country studies examine its relationship with other macroeconomic variables, such as inequality, inflation, and corruption (e.g., Dreher and Schneider, 2010). See Goel and Nelson (2016) for recent review of literature.

[6] Another example is related to Iran. Anti-government protests against the monarchy which started in 1977–78 led to the Islamic Revolution in 1979, followed by eight years of war with Iraq (1980–88). The economic costs of the revolution and war are estimated to be, on average, $3000 per person, per year from 1979 to 1988 (Farzanegan, 2020).

[7] The focus of our paper is exclusively on oil rents, which ensures homogeneity in the effects of resource rents on political instability and conflict. This approach is also utilized in other studies, such as Arezki and Brückner (2011). Earlier studies in the resource curse have highlighted the importance of not pooling commodities when we are examining the effects of rents on governance or economic growth indicators. For example, Isham et al., (2005) suggest that while the point resource exporters (e.g., oil) perform relatively poorly in different institutional dimensions, the exporters of diffuse resources such as agricultural products or livestock do not record such a significant negative effect and show more robust economic growth. In his book on the oil curse, Ross (2012) and many others show that properties of oil resources differentiate it from other resources in the context of political economy analysis. van der Ploeg (2011) also provides a survey on this topic.

[8] Farzanegan, Lessmann & Markwardt (2018) show that the increased risk of conflict in resource-rich economies can be reduced by promoting political decentralization.

[9] See Bazzi and Blattman (2014), and Brückner, Ciccone and Tesei (2012) for a similar methodology.

[10] Only 15 observation were modified for The Bahamas (1975–1983), Congo Republic (2015), Oman (1970–1971), Equatorial Guinea (2000–2004), and Qatar (1971–1972).

[11] Since our econometric specification employs the log of protests, we add "one" to the number of each protest indicator to avoid the sample selection bias that would arise from dropping country-year observations with no reported protest events in at least one year.

[12] This is the same approach followed by Brückner and Ciccone (2010), Brückner, Ciccone and Tesei (2012) and Caselli and Tesei (2016). Ciccone (2011) shows (in the context of rainfall-induced income shocks) that in the presence of a non-stationary time series, the effect of shocks on conflicts can be uncovered using a specification in differences. Furthermore, given the persistence of oil prices, using contemporaneous year-to-year change without taking into account the effect of shocks in previous years could lead to displacement effects and could incorrectly estimate the effect of a given shock on protests which could be due to previous shocks that had a lag effect.

[13] We also considered using the second and fourth lags, when choosing the initial level of the shadow economy and results remain robust (available upon request). However, deeper lags severely reduce our sample size, and the second lag does not match the starting date of the shock.

[14] We use the shadow economy in logs to smooth out outliers and obtain a smoother distribution of values, but results remain robust if the shadow economy is entered in levels (see Table 4).

[15] It is worth noting that our empirical specification does not intend to capture variation in absolute levels of protests across countries and does not imply that protests should be attributed primarily to oil price shocks. To eliminate these time-variant cross-country differences in the propensity and drivers of protest occurrence, we need to take the first difference of protests in the presence of country fixed effects, year fixed effects, and country-specific time trends to account for secular changes in protest breakouts that vary across countries and over time. In this way, we exploit the *annual fluctuations (i.e., growth)* of protests to assess the impact of oil price shocks and the mitigating role of the shadow economy.

[16] We checked whether the effect of negative oil price shocks differs from positive price shocks by including a dummy in Column (4) that takes the value of 1, if the 3-year average oil price shock is strictly negative. Our coefficients of interest remain unchanged in sign and significance, but the interaction effects were statistically insignificant. Hence, the estimated effect of negative shocks is not statistically significantly different from positive shocks. This follows that our interpretation is also applicable in case of positive oil price shocks.

[17] The latter group was identified using Ross and Mahdavi (2015) dataset on oil production covering the period 1932–2014, and refers to the top 10 percent of oil producers or countries producing (over the whole-period average) more than 3 percent of world oil production.

[18] Following Brückner and Ciccone (2010), we adjust Polity2 so that periods of interregnum, coded as 0, and transitionary periods are treated as missing. Such adjustment ensures that instability is not affected by the particular political situation in a given year. The results also remain robust to the inclusion of those periods.

[19] Note that here we only investigate the interaction between dependency on other natural resources and oil price fluctuations, and not the impact of other commodity price fluctuations. The latter is left for future research to differentiate between the impact of other point resources (coal, gold) and non-point resources (agriculture and food products).

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## APPENDIX 1

## List of countries included

Albania, Algeria, Angola, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahamas, Bahrain, Bangladesh, Belarus, Belgium, Belize, Benin, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Brunei, Bulgaria, Burundi, Cameroon, Canada, Chad, Chile, China, Colombia, Congo Dem. Rep., Congo Rep., Costa Rica, Cote d'Ivoire, Croatia, Cyprus, Czech Republic, Denmark, Dominican

Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Estonia, Ethiopia, Fiji, Finland, France, Gabon, Georgia, Germany, Ghana, Greece, Guatemala, Guinea, Guinea-Bissau, Guyana, Honduras, Hungary, Iceland, India, Indonesia, Iran, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Korea Rep., Kuwait, Kyrgyzstan, Laos, Latvia, Lebanon, Lesotho, Liberia, Libya, Lithuania, Luxembourg, Madagascar, Malawi, Malaysia, Mali, Malta, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russia, Rwanda, Saudi Arabia, Senegal, Singapore, Slovakia, Slovenia, Solomon Islands, South Africa, Spain, Sri Lanka, Suriname, Swaziland, Sweden, Switzerland, Tajikistan, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Venezuela, Vietnam, Yemen, Zambia, Zimbabwe.

List of main variables

| Variable | Definition | Source |
|---|---|---|
| Oil Price shock | Oil price shock is the average 3-year ln-change in the oil price multiplied by whole-period average oil exports share to GDP (1991–2015) | The oil export data are from the United Nations' Comtrade data (2016). Data on international oil prices are taken from United Nations Conference on Trade and Development Commodity Statistics (UNCTAD, 2016) |
| Protest | The sum of all events of demonstrations, strikes, and riots that took place in a country in a given year | Cross-National Time-Series Data Archive (CNTS) (Banks, 2018) |
| Shadow economy | Economic activities hidden from official authorities to avoid paying taxes and social security contributions, to avoid governmental bureaucracy or the burden of regulatory framework, and conducted for institutional reasons, including corruption law, the quality of political institutions, and weak rule of law | Medina and Schneider (2018) |

## APPENDIX 2

In Table B1, we conduct formal unit root tests for the log of oil prices, protests and the shadow economy. The tests cannot reject the null hypothesis of the presence of a unit root in the time series of oil prices and protests but they reject it for their first differences. Although the tests for the log of protests contradict the series in levels, they both reject the hypothesis of the presence of unit roots in their first differences. For the shadow economy, formal tests reject the null hypothesis of the presence of unit roots in levels and the first difference.

Table B2 formally checks whether lagged levels of shadow levels can be used as a predetermined variable by regressing the lagged levels of shadow economy at time $t-2$, $t-3$, and $t-4$ on contemporaneous oil price shocks. The results show that the coefficient of oil price shocks is small and statistically insignificant in all models. Hence, this lends us credence that lagged levels of the shadow economy are uncorrelated with the error term at time $t$ and can be safely treated as a predetermined variable.

Table B3 checks the robustness of Equation (2) to the inclusion of fixed effects and removal of influential observations. Column (1) drops the country-specific time trends, and Column (2) drops both country fixed effects and country-specific time trends. In all models, our main variables of interest remain robust in sign and significance. In Columns (3) and (4), we omit influential observations using Cook's distance and Welsch distance formulas, respectively. The coefficients of interest show the predicted signs and are statistically significant in all instances.

**TABLE B1** Unit root tests

| Variable | Log Oil Prices (Time-Series Tests) | | Log Protest (Panel Data Tests) | | Log Shadow economy (Panel Data Tests) | |
|---|---|---|---|---|---|---|
| | Level | Diff. | Level | Diff. | Level | Diff. |
| Dickey-Fuller | n.s. | ** | n.s. | *** | *** | *** |
| Dickey-Fuller-GLS | n.s. | ** | - | - | - | - |
| Philipps-Perron | n.s. | *** | *** | *** | *** | *** |

*Note:* All unit root tests contain trend. For panel data, we apply the fisher type tests. Abbreviation: n.s., not significant at the 10% level. Significantly different from zero at *10% significance, **5% significance level, ***1% significance level.

**TABLE B2** Correlation oil price shocks and lagged levels of shadow economy

| Model | (1) | (2) | (3) |
|---|---|---|---|
| | Shadow economy (log), t−2 | Shadow economy (log), t−3 | Shadow economy (log), t−4 |
| | OLS | OLS | OLS |
| 3-year oil price shock, *t* | −0.097 | −0.060 | −0.056 |
| | (0.145) | (0.139) | (0.128) |
| Number of observations | 3,114 | 3,114 | 2,980 |
| Number of countries | 144 | 144 | 143 |
| $R^2$ | 0.738 | 0.725 | 0.713 |
| Country FE | Yes | Yes | No |
| Year FE | Yes | Yes | Yes |
| Country-specific time trend | Yes | No | No |

*Note:* Oil price shock is the average 3-year ln-change in the oil price multiplied by whole-period average oil exports share to GDP (1991–2015). The method of estimation is ordinary least squares with Huber-robust standard errors (reported in parentheses) clustered at the country level. Country fixed effects, year fixed effects, and country-specific time trends are not reported. Significantly different from zero at *10% significance, **5% significance level, ***1% significance level.

**TABLE B3** Oil price shocks, protest, and shadow economy—Robustness checks

| Model | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Δ Log Protest | Δ Log Protest | Δ Log Protest | Δ Log Protest |
| | OLS | OLS | OLS | OLS |
| | Drop country-specific time trend | Drop country-specific time trend & country FE | Drop influential observations (Cook's distance) | Drop influential observations (Welsch distance) |
| 3-year oil price shock, *t* | −10.980*** | −8.783*** | −4.455* | −7.041** |
| | (3.906) | (3.076) | (2.697) | (2.929) |
| Shadow economy (log), *t−3* | 0.001 | −0.032*** | 0.086 | 0.123 |
| | (0.093) | (0.010) | (0.110) | (0.110) |
| 3-year oil price shock*Shadow economy | 2.959*** | 2.382*** | 1.229* | 2.015** |
| | (1.058) | (0.836) | (0.739) | (0.832) |
| Number of observations | 3,114 | 3,114 | 2,842 | 2,869 |
| Number of countries | 144 | 144 | 144 | 144 |
| $R^2$ | 0.042 | 0.041 | 0.103 | 0.100 |
| Country FE | Yes | No | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |
| Country-specific time trend | No | No | Yes | Yes |

*Note:* Oil price shock is the average 3-year ln-change in the oil price multiplied by whole-period average oil exports share to GDP (1991–2015). The dependent variable is the ln-change of sum of protest events that took place in a given country at a given year. The method of estimation is ordinary least squares with Huber-robust standard errors (reported in parentheses) clustered at the country level. Country fixed effects, year fixed effects, and country-specific time trends are not reported. Significantly different from zero at *10% significance, **5% significance level, ***1% significance level.