Commodity Price Shocks, Conflict and Growth: The Role of Institutional Quality and Political Violence

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Abstract

This analysis empirically investigates the relationships between resource windfalls, political regimes, conflict and economic growth using recent advances in panel estimation methods and a distinctive commodity price shock measurement. The paper clarifies many of the ambiguous outcomes of the existing literature, particularly showing that resource windfalls have significant impact on conflict only in politically unstable autocracies, which itself is heterogeneous in the response conditional on a country's initial political violence level. The findings also demonstrate that resource shocks are positively associated with economic performance in democracies and in politically stable autocracies, while significantly deteriorating growth for politically unstable autocracies.

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1. Introduction

The effect of resource abundance on the growth prospects is a perennially important topic in the growth and development literature. How do resource windfalls affect a country's development level? And how do additional revenues generated by resource abundance reflect on economic growth? These are important questions, as the effects of income shocks generated by resource windfalls cannot be referred to as generic income changes. Because resource booms typically translate into direct windfalls into the hands of political elite, these shocks may have very different political and economic consequences than other sources of income shocks (Sachs and Warner, 2001; Caselli and Tesei, 2011). Considered alternatively, resource windfalls may just represent short run gains to an economy which do not feed into future development.

This analysis empirically investigates the relationships between resource windfalls, political regimes, conflict and growth using recent advances in panel estimation methods and a distinctive commodity price shock measurement. The investigation clarifies the potential mechanism behind the ambiguous outcomes of the existing resource literature, particularly showing that resource windfalls have a significant impact on conflict only in politically unstable autocracies, which itself is heterogeneous in the response, conditional on a country's initial political violence level. Specifically, a positive shock to an autocratic country's flow of resource rents decreases conflict potential if within-country political violence level is high, while for autocracies with relatively low political violence levels the opposite effect occurs. The investigation also contributes to the growth literature by showing that resource shocks are positively associated with growth in democracies and in politically stable autocracies, while deteriorating a country's economic performance for politically unstable autocracies.

In order to motivate the empirical analysis and facilitate the interpretation of the results, the paper opens the discussion with a novel story as developed in Caselli and Tesei (2011), Besley and Persson (2011). Assuming that the governing elite or ruler has complete control of the flow of income from natural resources, the growth prospects of a country will depend on decisions of the government regarding how to diversify this revenue. Countries where the ruler decides to invest into the well-managed development activities are likely to enjoy a stable socio-political environment and experience higher economic growth from resource windfalls. However if the ruler chooses to invest into "self-preservation" activities, this will enhance the likelihood of economic and political instability and lead to diminished growth.

Self-preservation activities can range from the mild (e.g., direct and indirect vote-buying, imprisoning) to the extreme case scenarios (e.g., violent repression, execution), which will also shape the decision of opposition groups of whether or not to challenge the incumbent government conditional on the threat level faced. For instance, in the context of potential conflict scenarios (where both an incumbent government and an opposition group can each make an investment into violence), an increase in resource windfalls, on one hand, may serve as an incentive for rebellions promoting rapacity over these resources, and hence increase violence by raising the gains from appropriation if they are successful ("state prize" theories); on the other hand, it may also serve for the effectiveness of the state to confront the rebellions and decrease the likelihood for insurgents of being successful ("opportunity cost" arguments), where investment into self-preservation activities by an incumbent government is expected to further decrease the incentives of opposition group to resist against the government if the threat level is sufficiently large enough. It is also worth mentioning that these outcomes are expected to be the case *only* for countries with unstable political environment and non-cohesive institutions.

Considering instead how these effects reflect on economic growth provides another source of ambiguity. For instance, investment into self-preservation activities are expected to decrease the possibility of conflict and hence promote growth by delivering peace dividends; however, it also refers to the amount of investment that could be directed into delivering public goods through well-managed development projects, thus leading to reduced growth. Clearly, these determinants – resource windfalls, political institutions and violence, all interact to influence each other; and the relative dominance and sign of these effects in cross country analysis, as well as how these effects are transferred onto growth, can only be ascertained by empirical investigation.

Moreover, the main determinant for the decision-making processes here is the amount of revenue accruing from resource windfalls, which is partly determined by the payoff from staying in the office, as political survival as a ruler implies that the current elite remains in control of future revenues; and partly explained by budget constraints, since at low levels of resource income the incentive to engage in self-preservation activities (or oppose the incumbent government) is relatively low, as the future "pie" to hold on to is small. At higher levels instead the future benefits from holding on to power are sufficiently large; and the larger is the "pie", there is more likelihood that the ruler finds it optimal to spend on self-preservation.

The remainder of the paper is organized as follows. The next section reviews the long-lasting debate in the literature regarding the impact of resource abundance on institutional quality, conflict and growth. The methodology and data employed is described in Section 2. Section 3 presents the estimation results and Section 4 concludes.

1.1. Related Literature

Many researchers have noted the resource-led development failures – economic and political factors that may have played a role in the disappointing performance of resource-intensive economies in the 1970s and 1980s (Gelb, 1988; Auty, 1990), although the adverse effects of resource abundance on growth was first confirmed in the 1990s by Sachs and Warner (1995), igniting a subsequent tranche of research that focuses on the resource curse paradox. The literature has distinguished between no less than three different dimensions of the resource curse effect, where resources are associated with (i) slower economic growth, (ii) undemocratic regime types, and (iii) violent civil conflict.

Among the popular early explanations for the curse effect on growth are rent-seeking analyses (e.g., Torvik, 2002), and stories based on "Dutch-disease" arguments where the non-resource sector is the long-run engine of growth due to increasing returns at the sector level, but becomes crowded out by the resource sector (Sachs and Warner, 1999). Empirical support for this view is provided by various authors, including Ross (1999, 2001a), Leite and Weidmann (2002), Sala-i-Martin and Subramanian (2003), Isham *et al.* (2005), and Bulte *et al.* (2005). Mehlum *et al.* (2006) demonstrate that the impact of resource abundance is conditional on institutional quality, i.e. while countries with good institutions which promote accountability and state competence will tend to benefit from resource abundance, countries without such institutions may suffer from a resource curse (see also Jensen and Wantchekon, 2004; Robinson *et al*., 2006). Along with these transmission channels, another feature that has emerged in the resource curse literature is the link between resources and conflict pioneered by empirical contribution in Collier and Hoeffler (1998).[1]

[1] Although the resource-conflict link is increasingly viewed as a stylized fact in economics and political science (see e.g., Ross 2004a), the explanations of this evidence are mixed. Focussing on the economic roots of conflict, Fearon (2005), Ross (2006), De Soysa and Neumayer (2007), and Lujala (2009) highlight the role of (legal) oil and mineral resource trading. The probability of foreign intervention (Rosser, 2006) and the probability of suffering from economic shocks (Collier and Hoeffler, 2005) are other explanations as to why resources might be linked to conflict. Other explanations of the resource-conflict link arise around political (state-strength)

However the validity of these results has been criticized by Brunnschweiler and Bulte (2008, 2009) drawing attention in the literature. The authors disputed the arguments that abundant resources lead to bad institutions, higher conflict potential or slower growth by emphasizing their concerns regarding the endogeneity of resource exports ratio to GDP where the denominator explicitly measures the magnitude of other activities in the economy, i.e. the ratio is not independent of economic policies and institutions which is to the large extent produced by choices of individual governments.[2]

In the light of endogeneity concerns regarding the resource rent share, measuring resource shocks with changes in international commodity prices is more promising since they are typically unaffected by the behaviour of individual countries (Deaton and Miller, 1995).[3] Alternatively viewed, since world commodity prices are set in international markets, they are less likely to be influenced by the socio-economic and political events in a single country. While empirical studies by Deaton and Miller (1995) and Raddatz (2007) do find that commodity price shocks raise growth, Collier and Goderis (2009) demonstrate that this positive association is only the case in the short-run and an increase in commodity price levels can lead to slower growth in the long-run conditional on poor governance.

A recent literature has also investigated the effect of commodity price shocks on political regime types as a proxy for institutional quality.[4] Using commodity price changes as

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perspectives of (potential) rebels as key decision-makers (e.g., Dunning, 2005; Humpreys, 2005). Ballantine (2003) has emphasized that the mix of greed and grievance can be particularly effective and relevant as an explanation of the onset of war. These are not to argue that there were no "dissident" views: e.g., Homer-Dixon (1999) who suggests resource scarcity, rather than abundance as a driver of violent conflict.

[2] Alternative measures of resource abundance have been also used in the literature, casting some doubts on the consistency and robustness of the curse. For example, Brunnschweiler (2008) finds no curse evidence using World Bank resource data; Alexeev and Conrad (2009) employ several measures of resource abundance, including hydrocarbon deposits per capita, and oil and mining outputs, and find no negative effects on income. Lederman and Maloney (2007) also demonstrate that the resource curse effect disappears when employing system GMM.

[3] During the analysis, the issue of large producers with potential to influence world prices is addressed, with findings that the results are robust and not altered by these economies.

[4] For the relationship between political regimes and income shocks measured other than commodity price changes, see e.g., Acemoglu and Robinson (2001), Acemoglu *et al*. (2008) who empirically investigated the causal relationship between income and democracy; Haber and Menaldo (2011) who concentrated on windfalls from natural resources, finding no effect of oil windfalls on greater autocracy. As for the literature studying the effects of resource windfalls on political institutions (and institutional quality more broadly) other than

instruments for income changes, Burke and Leigh (2010) find insignificant effects of commodity-driven income changes on political regimes. Bruckner *et al*. (2012) instead find a positive effect of oil-price shocks interacted with the share of net oil exports in GDP for movements towards democracy. A good summary of this literature (with associated weaknesses and advantages regarding the approaches employed) is provided in Caselli and Tesei (2011) who present an outstanding strategy to capture the effect of commodity price shocks on political regime types, with findings revealing that while price shocks have no effect on political system in democracies, a positive shock to an autocratic country's flow of resource rents significantly exacerbate the autocratic nature of the political system which itself is heterogeneous in the response across deeply and moderately entrenched autocratic regimes.

There is also an emerging literature regarding the link between conflict and commodity prices, yet the results are ambiguous. While Bruckner and Ciccone (2010) and Savun and Cook (2011) demonstrate that negative shocks to export prices increase the risk of civil conflict, Besley and Persson (2008) demonstrate that higher world market prices of exported, as well as imported, commodities are strong and significant predictors of higher within-country incidence of civil conflict.[5] Differentiating the effect of labour intensive commodities and natural resources on conflict within Colombia, Dube and Vargas (2013) show that a rise in international prices of oil, coal and gold increases violence, while this association is negative when commodities like coffee, sugar, bananas and tobacco are considered (see also Angrist and Kugler, 2008).[6]

Although it seems that the case studies of individual countries offer relatively clear-cut evidence, the relationship between resource windfalls and conflict for cross-country analysis is not clear. Along with these complications, Bazzi and Blattman (2011) suggest "absence of evidence" from resource windfalls on conflict.

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democracy/autocracy, see also the theoretical studies of Baland and Francois (2000), and Torvik (2002), all whom study theoretically the consequences of windfalls for rent seeking, and Leite and Weidman (2002) and Salai-i-Martin and Subramanian (2003) that present corresponding empirical evidence (where rent-seeking is usually measured through proxies of corruption).

[5] See also Besley and Persson (2010), who demonstrate that resource dependence can increase the propensity towards conflict while lowering income and state capacity; and Besley and Persson (2011), who show that natural disasters are negatively correlated with income per capita and induce greater political violence.

[6] The theoretical foundation of these perspectives may be traced back to Dal Bo and Dal Bo (2011).

2.1. Empirical Methodology

The investigation firstly explores the link between resource windfalls and conflict following a similar specification to Bruckner and Ciccone (2010), where the indicator for civil conflict onset linearly responds to the changes in commodity price index. Starting from this benchmark, the analysis further investigates the impact of changes in commodity prices on conflict possibility, conditional on political institutions and a country's political violence level.[7]

The analysis then turns to the exploration of how these relationships between resource windfalls, political regimes and violence are reflected onto economic growth. The baseline investigation for the growth analysis employs similar specification used by Collier and Goderis (2009). Letting the subscripts *i* and *t* represent country and time period respectively, the estimated model can be written as

$$y_{it} - y_{i(t-1)} = \alpha\, y_{i(t-1)} + \theta_1 Compricegrowth_{i(t-1)} + \varphi' X_{i(t-1)} + \beta' Z_{i(t-1)} + \mu_t + \xi_i + \varepsilon_{it} \quad (1)$$

where y is log of real per capita income, $Compricegrowth_{i(t-1)}$ is the change in commodity price index, $X_{i(t-1)}$ is the vector of interaction variables (political regimes and political violence) with price index, $Z_{i(t-1)}$ is a vector of additional control variables, μ_t is a period-specific constant, ξ_i is an unobserved country-specific effect, and ε_{it} is an error term.

The hypothesis for these relationships is that the impact of resource windfalls on both conflict onset and economic growth is a non-linear function of a country's political institutions and political violence levels, where the marginal impact of price shocks is increasing while within-country political violence (stability) level decreases (increases). Alternatively, governments in countries with stable socio-political environments have a greater incentive to spend the resource windfalls beneficially, whereas in politically unstable countries with non-cohesive institutions the resource windfalls may be spent in unproductive directions.

[7] In order to keep the specification straightforward and to concentrate on how the conflict possibility responds non-linearly to the changes in commodity price index conditional on political institutions and within-country political violence level, the investigation does not include the additional two lags of price index into the specification as is done in Bruckner and Ciccone (2010). In addition, it is also worth mentioning that both lags demonstrated no impact on conflict onset when are included; thus a parsimonious specification without additional lags during the analysis was preferred.

The analysis for growth estimation employs the system GMM dynamic panel data estimator developed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998).[8] This approach has the advantage of addressing the issues of joint endogeneity of all explanatory variables in a dynamic formulation, and of potential biases induced by country specific effects.[9] Moreover, to ensure that the estimated effect is not driven by the number of instruments, the analysis employs the "1 lag restriction" technique introduced by Roodman (2009) that uses only certain lags instead of all available lags as instruments. The treatment of each regressor according to their exogeneity levels is based on upper and lower bound conditions (Roodman, 2006).

2.2. Data and Descriptive Statistics

The initial analysis is based on an unbalanced dynamic panel dataset consisting of 135 countries over the 1963-2010 period.[10] The dependent variable, logged per capita real (Laspeyres) GDP growth, is constructed using data from the Penn World Tables (PWT 7.1). Log of initial income per capita is used as regressor.

The measure of resource wealth is the commodity export price index which is constructed using a similar methodology to Deaton and Miller (1995), Dehn (2000) and Collier and Goderis (2009). More specifically, first, data on world commodity price indices and commodity export and import values are collected for as many commodities as data availability allowed. All commodity price indices are extracted from the IMF International Financial Statistics (IFS) dataset, where the list of 54 commodities used to construct the composite index is listed in Appendix Table D3. Export and import data by commodity,

[8] Since the dependent variable for the investigation of the relationship between resource windfalls and conflict onset is dichotomous, the analysis employs largely preferred in the literature the ordinary least squares (OLS) estimator. In addition, the investigation also considered Logit and Probit models, which indicated that the results are robust and not altered by the choice of estimator. The results from employing these additional estimators are available upon request.

[9] Along with coefficient estimates obtained using GMM system estimator, the tables also report three tests of the validity of identifying assumptions they entail: Hansen's (1982) J test of over-identification; and Arellano and Bond's (1991) AR(1) and AR(2) tests in first differences. AR (1) test is of the null hypothesis of no first-order serial correlation, which can be rejected under the identifying assumption that error term is not serially correlated; and AR (2) test is of the null hypothesis of no second-order serial correlation, which should not be rejected. In addition, to deal with heteroskedasticity, the Windmeijer (2005) small-sample correction is applied.

[10] See Appendix Tables D1 and D2 for the list of countries and descriptive statistics.

country and year are collected from the United Nation's Comtrade data set, which reports dollar values of exports and imports according to the SITC1 system, for the period 1963 to 2010. To construct the composite commodity export price index, total net export value (exports minus imports) of all commodities in 1990 for which the country is a net exporter is first calculated for each country. Then the individual 1990 net export values for each commodity are divided by this total in order to achieve 1990 country-commodity specific weights, w_i, which are held fixed over time and applied to the world price indices of the same commodities to form the country-specific geometrically weighted index of commodity export prices. More specifically, for each year and country the geometrically weighted index is constructed as follows:

$$P = \prod_i p_i^{w_i}$$

where w_i is 1990 country-commodity specific weight and p_i is the international commodity price index for the commodity i. The weighting item, w_i, can be interpreted as a value of commodity i in total value of all commodities, n, for constant base year j:

$$w_i = \frac{P_{ji}Q_{ji}}{\sum_n P_{jn}Q_{jn}}$$

Finally, to allow the effect of commodity export prices to be larger for countries with higher commodity exports, the log of geometrically weighted index of commodity export prices for each country i and year t, P_{it}, is weighted by the 1990 share of net commodity exports in a country's GDP, denoted s_i, resulting in the final shape of the composite commodity price index, ${P_{it}}^{s_i}$. This contrasts to Collier and Goderis (2009) (see also Bazzi and Blattman, 2011), where the final construction is instead realized by multiplying the weighted index with export shares which can cause potential endogeneity issues as discussed in Brunnschweiler and Bulte (2008). Considered alternatively, this might alter not only the magnitude of the commodity price index effect, but its direction as well, while here if anything of commodity price index estimates is affected, it will be just the magnitude of the coefficient, not the sign. The separate indices for different type of commodities are constructed in a similar way.[11]

Although the measurement of commodity price shocks using shares of commodities in a given year is far from ideal, it has several advantages. Since the index uses a constant base

[11] See also Appendix C for more detailed information regarding the sources and the data coverage methodology used to construct the price index.

year, it does not cope well with shifts in the structure of trade. In particular, the index does not capture resource discoveries and other quantity shocks after the base year. Nor does it capture temporary volume shocks other than those which happen to occur in the base year itself. However, since the purpose is to capture price shocks rather than quantity movements, but at the same time differentiate between resource abundant and resource scarce countries, it is desirable to hold volumes constant. This also avoids possible endogeneity problems arising in the event of a volume response to price changes. Nevertheless, the index will understate income effects of a given price change. In addition, as discussed above, the geometrical weighting scheme has the comparative advantage in avoiding the potential endogeneity issues that can be faced with when using arithmetically weighted indices.[12]

As a proxy for institutional quality outcome, the analysis employs the variable of *polity2* in the Polity IV database (Marshall and Jaggers, 2010), which is widely used in the empirical political-science literature (e.g., Acemoglu *et al*., 2008) to measure the position of a country on a continuum of autocracy-democracy spectrum. It aggregates information on several building blocks, including political participation (existence of institutions through which citizens can express preferences over policies and leaders), constraints on the executive, and guarantees of civil liberties both in daily life and in political participation, as evaluated by Polity IV coders. *Polity2* varies continuously from -10 (extreme autocracy) to +10 (perfect democracy). The analysis follows the convention in the vast majority of the literature that interprets negative values of *polity2* as pertaining to autocracies and positive ones to democracies (e.g., Persson and Tabellini, 2006, 2009).

Data on civil conflict is obtained from UCDP/PRIO Armed Conflicts 2012 Dataset of the International Peace Research Institute's (PRIO) Centre for the Study of Civil War and the Uppsala Conflict Data Programme (UCDP). The UCDP/PRIO Armed Conflict Database defines civil conflict as a "contested incompatibility which concern government and/or

[12] Caselli and Tesei (2011) suggested a nice strategy of using a country's principal export commodity prices to capture the effect of price shocks. However, the analysis here did not follow this strategy since only a few oil producing countries are specialised to the point of exporting only a single commodity, so for the majority of countries the full ramifications of being a commodity exporter cannot be determined with reference to just a single commodity price series. In addition, given the findings from the literature that different type of commodities are likely to behave very differently within a given country (see e.g., Dube and Vargas, 2013), conditional on everything else being constant, the broad aggregate indices of commodity prices based on export baskets of individual country was preferred.

territory where the use of armed force between two parties, of which at least one is the government of a state, results in at least 25 battle deaths". Civil conflict outbreak is captured by defining civil conflict onset indicator that is unity if there is conflict in year *t* but not in *t-1*, and zero if there is no civil conflict in *t* and *t-1*; if there is a conflict in *t-1*, the year *t* civil conflict onset indicator is not defined.

To measure the political violence in the country and its actual or potential impact on governance, the analysis employs the index of internal conflict risk – *proxy for stability* – obtained from International Country Risk Guide (ICRG) Dataset.[13] The index ranges from 0 to 12, where the highest rating is given to those countries where there is no armed or civil opposition to the government and the government does not indulge in arbitrary violence, direct or indirect, against its own people. The lowest rating is given to a country embroiled in an on-going civil war. The risk rating assigned is the sum of three subcomponents, each with a maximum score of 4 points and a minimum score of 0 points. The subcomponents are civil war/coup threat, terrorism/political violence and civil disorder.

The analysis also includes the additional set of control variables taken from the empirical growth literature: trade openness measured as the sum of exports and imports of goods and services as a share of GDP; inflation computed as the log of 1 plus the annual consumer price inflation rate, where data for both controls is collected from the World Bank Development Indicators (WDI); and international reserves (from IFS series 1..SZF) over GDP (from PWT 7.1).

Table 1 provides summary statistics for growth rates, political contestability and violence/stability levels, and probability of conflict onset over the different subsamples according to countries' income (Panel A) and resource dependence levels (Panel B).[14] Two

[13] Employing the political violence/stability measure restricts the sample to 119 countries and the time span to the period of 1984-2010. Moreover, due to lack of the data for some countries for which data on political violence and civil conflict onset is available, the price shocks and conflict analysis was constrained to the sample of 77 countries.

[14] The cut-off levels for low and high-half income groups are taken as in DeJong and Ripoll (2006), where country classifications are obtained by mapping classification thresholds as defined by the World Bank's income measures into the corresponding Penn World income measures. The resulting definitions are as follows: high-half income countries are those with real per capita GDP above $5,500; and low-half income countries are those with real per capita GDP less than $5,499. All classifications are based on the beginning sample income

features of these statistics are of particular interest for the analysis. The first aspect is the tendency that higher income level countries tend to enjoy relatively rapid growth, better institutional quality and experience relatively less (higher) political violence (stability) and conflict. Average statistics of growth rates (conflict onset) increase (decrease) when moving from the lower to higher income classifications: from 1.698% (0.049) for low-income countries to 1.739% (0.035) for high-income countries. Furthermore, the lower (higher) income level countries are on average more autocratic (democratic) and likely to suffer from unstable political environment: average statistics of *polity2* (political stability) increases from -0.371 (7.976) to 5.662 (10.07) when moving from the lower to higher income classifications. The second facet of these statistics is that relatively low resource dependent countries are likely to lie down on the upper-half (more democratic) of autocracy-democracy spectrum and enjoy relatively higher political stability: average statistics of *polity2* (political stability) decreases from 2.408 (8.784) to -1.284 (8.585) when moving from the lower to higher resource dependent countries.

Figure 1 plots how average cross-country political violence/stability levels change across political regime types. In order to do so, all observations are divided into eight bins depending on the value of *polity2*, where bin sizes are chosen to have as uniform as possible a sample size across bins, while at the same time preserving symmetry the between "autocratic" and "democratic" bins. The resulting intervals of the eight bins are for the average *polity2* values [-10,-8], [-8,-5], [-5,-3], [-3, 0], [0, 3], [3, 5], [5, 8] and [8, 10], respectively.[15] Three features are of note. The first is that for deeply entrenched autocracies (interval of [-10,-8]) the average political stability is above the mean illustrating low variation in political violence. The second facet of these statistics is that average political stability rapidly jumps down below the mean when moving from deeply to less entrenched autocracies reaching its minimum average value and maximum variation range for the [-5,-3] interval which also demonstrates similar behaviour for the [-3, 0] interval. The third aspect is the

rankings. The threshold for the low and high resource dependence levels are defined as countries with net export shares below and above the 75th percentile of the distribution respectively.

[15] It is of note that none of the countries in the data set lay on bounds of average *polity2* level intervals. Moreover, since the number of countries with available political violence data is severely low for bottom distribution of autocracy-democracy spectrum, the convention of the overlapping intervals is preferred during the analysis in order to be able to achieve as large as possible number of observations for small sample sized bins.

intuitive tendency that the average political stability gradually increases when moving from less democratic to highly democratic subsamples.[16]

3. Empirical Results

Aforementioned, the previous literature suggests that income shocks generated by resource windfalls might have a heterogenous impact on growth conditional on a country's governance level. In particular, Collier and Goderis (2009) adopting a panel co-integration methodology show that resource shocks have an unconditional positive association with growth in the short-run, however an increase in commodity price *levels* may lead to slower growth in the long-run conditional on poor governance, which itself is heterogeneous across different type of commodities.[17] A simple illustration of how the impact of resource windfalls on economic growth can vary across countries with different income levels, presented in Figure 2, indeed provides support for this view.[18] The plots illustrate a significant positive impact of resource windfalls on growth only for the high-half income subsample, while this effect is

[16] The average political stability across democratic bins drastically decreases showing wide variation in political violence only for the [5, 8] interval which is mainly driven by the presence of three countries: Colombia, Peru and Sri Lanka. Eliminating these countries from the subsample illustrates a monotonic increase (decrease) in average political stability (violence) levels when moving from less democratic to highly democratic bins.

[17] The replication analysis of these relationships is demonstrated in Appendix Table A1. Although the analysis in this paper does not purport to test the short-run and long-run impacts of resource windfalls on growth, by replicating Collier and Goderis (2009) results using the preferred measurement, the investigation confirms the original findings that the impact of commodity price levels on growth can vary in the long-run and across different commodity types. In particular, the replication results demonstrate that short-term effects of commodity price shocks are always positive and illustrate strong quantitative significance with growth. Decomposing the composite commodity export price index levels into point vs. diffuse and energy vs. non-energy source commodities illustrates that the negative and statistically significant long-run effects might occur only in point source and energy source commodity exporting countries. This effect instead is more likely not to be detrimental for diffuse and non-energy source commodity exporting countries. For the more detailed analysis regarding using co-integration techniques, its requirements, non-linearity results, please see Collier and Goderis (2009).

[18] Scatter plots and fitted relationships between the variables of interest for low and high-half income groups are achieved using partial regressions which are obtained in two stages. First, both the dependent variable and the isolated independent variable are projected onto the additional set of regressors under consideration. Next, the fitted dependent variable is regressed against the fitted independent variable. In each case, the residuals of a growth regression on a set of variables are compared with the residuals of commodity price shocks regression on the same variables. The figures are produced using least squares regressions where growth and commodity price shocks are related linearly.

insignificant on average across the lower income distribution subsample, perhaps reflecting a contradictory effect induced by institutional quality and political instability, which signifies how economic and political factors may have played a role in the disappointing performance across resource-intensive economies.

The role of political institutions (and institutional quality more broadly) in explaining the cross-country differences in income levels and economic performances (see e.g. Acemoglu *et. al.*, 2005),[19] as well as how resource abundance might affect institutional quality has been largely explored in the literature. A particularly interesting study for the analysis in this paper is the recent work by Caselli and Tesei (2011) where the authors document how a country's political institutions respond heterogeneously to the changes from natural resource windfalls. Specifically, the results reveal that resource windfalls have no political consequences when they occur in democracies. However, in autocracies, the changes in the flow of resource rents make the political regimes more autocratic. Moreover, in autocracies the increase in autocracy following an increase in resource revenues is diminishing in the initial level of autocracy, i.e. the less autocratic the form of government was initially.[20] Further analysis by Caselli and Tesei (2011) also reveals the fact that in autocracies the negative impact from resource windfalls is mainly driven by moderately entrenched autocracies, while in deeply entrenched autocracies this effect on politics is virtually nil confirming the importance of within-country political violence/stability levels in shaping a country's political institutions.[21]

[19] See also Sirimaneetham and Temple (2009) who argue that instability can form a binding constraint on economies' growth rates, where for the more stable countries, the measures of institutional quality have more explanatory power on economic performance, i.e. fundamentals for growth such as good institutions are not strongly associated with growth unless stability is also in place.

[20] The main findings from Table 3 (columns 3 and 4) as in Caselli and Tesei (2011) are replicated in Appendix Table B2 (columns 1 and 2). Appendix B provides more detailed information on the replication analysis. For more detailed analysis regarding the relationship between natural resource windfalls and political system, please refer to the original paper.

[21] In addition to the replication exercise, the analysis also estimated the non-linear relationship between price shocks and political system conditional on initial political violence/stability levels (columns 3 and 4 in Appendix Table B2). The results provide supportive evidence for the original findings and are consistent with Figure 1, confirming that price shocks significantly exacerbate political system only in politically unstable autocracies and have no impact on politics when they occur in democracies and in politically stable autocracies. For more detailed information regarding this investigation, please see Appendix B.

The analysis of how the impact of resource windfalls on conflict can be dependent on these interactions between political institutions and political violence are presented in Table 2. Table 3 instead addresses the issue of how these relationships are reflected onto the economic growth. The subsequent Tables 4-8 report a number of sensitivity checks on the results from Table 3. In particular, the analysis explores the robustness of the results to: alternative criteria for inclusion of countries in the sample based on (i) importance of the shares from natural resource rents in the economy; (ii) dropping large commodity producers and (iii) dropping subsets of countries for certain aspects of their political contestability levels and (iv) their political violence experiences; (v) breaking down the resource wealth by commodity type.

3.1. Resource Windfalls and Conflict Onset

The conjecture of this investigation follows the idea that the impact of resource windfalls on conflict outbreak is a non-linear function of a country's political institutions and effective political violence/threat posed by internal forces (incumbent government vs. opposition group). Alternatively, in the presence of stable socio-economic and political environment and cohesive institutions, resource windfalls have no impact on conflict onset. However, for countries with non-cohesive institutions and unstable political background, the impact of resource windfalls on conflict depends on the threat level that incumbent government/opposition group faces with. Specifically, if the initial within-country violence level is high, an increase in resource windfalls is expected to increase the investment into self-preservation activities and hence state capacity, and therefore decrease conflict possibility by reducing incentives of potential opposition groups to confront the incumbent government. However, if the initial threat/violence level is relatively low (or the chance of opposition group to be successful and replace the incumbent government is relatively high), an increase in resource windfalls is expected to increase the incentives of opposition group by raising the gains from appropriation, and therefore increase the conflict possibility. The overall impact from the cross-country analysis will also vary on the relative strength of the two effects within violence groups.

Estimation results of the resource-conflict link analysis are presented in Table 2. The first column derives this relationship linearly where civil conflict onset responds to the changes in commodity price index, controlling for country and time fixed effects. The results are similar to those found in the existing literature where the risk of civil conflict outbreak is higher when the change in price of export commodity index drops. The statistically significant effect

implies that a one standard deviation drop in countries' commodity price indices is associated with an increase in the probability of a civil conflict onset of about 0.67 percentage points.[22]

The subsequent two columns estimate this relationship non-linearly using the following strategy. Firstly, the specification in column 2 adds the initial level of political violence/stability both, by itself and interacted with price index change; while column 3 runs the same exercise by separating the change in price index into two variables according to the initial political contestability level: the first is an interaction between the change in the price index and a dummy for democracy and the second is an interaction with dummy for autocracy.

The results from the non-linear estimation of these relationships provide support for the conjecture, and indicate that positive shocks in commodity prices have even larger negative direct impact on conflict outbreak in politically violent countries. The coefficients on the interaction terms are significant and positive in all cases, implying a positive marginal impact of resource windfalls while within-country political threat level decreases. Stratifying this association for countries with autocratic/democratic regime types reveals that the significant consequences from price shocks is only present in autocratic countries, while resource windfalls have no impact on conflict possibility when they occur in democracies.

As a check on the results, the last column re-estimates the effect of price shocks for the subsamples below and above the average political stability level.[23] In order to do so, the change in commodity price index interaction with continuous political violence/stability variable is replaced by the price shocks interacted with a dummy that takes the value of unity if a country's initial political stability level is above the sample mean, and zero otherwise. Interpretation of the coefficient estimates is as follows: if the findings above are true, then the direct impact of changes in price index (referring to high violence level countries) should be negative, and the coefficient on interaction term (referring to relatively low violence level countries) should be positive. Moreover, in order to have a total positive impact on conflict for the subsample with relatively stable political environment, the coefficient of the latter

[22] These measures are obtained by multiplying the coefficient estimate by average standard deviation of 0.011, and then multiplying by 100 to convert to a percentage-point measurement.

[23] Since the investigation does not reveal any differential impact of resource windfalls for democratic countries, the specification in column 4 does not break up the democracy specific price index into violence level categories.

should be significantly larger in absolute value than the former, representing the *deviation* of price shock effects from the reference subsample with high violence levels.[24]

The results from this exercise are consistent with the findings above where the risk of civil conflict outbreak is significantly higher only for autocracies with a politically violent environment when the change in price of export commodity index drops. The interaction term is positive illustrating that the effect of price shocks for relatively low violence level countries significantly deviates from the effect for the reference group with high political threat levels. The associated quantitative significance of one standard deviation increase in price shocks from splitting the data set into subsamples is estimated as -2.28 percentage points among high threat level countries. The magnitude of interaction term implies that this effect is positive, albeit on average, is not significantly different from zero for relatively stable autocracies.

In a further effort to probe whether this heterogeneity for price shock effects is somehow different across infra-marginal changes in political regimes, Figure 3 plots the estimated coefficients of high and low violence specific changes in commodity price index along with their relative confidence bands (at 95% level) for each bin given the exclusion of potential outliers.[25] For ease of comparison of the price change estimates, the conflict equation is re-estimated using two interactions of price shocks (always controlling for country and time fixed effects): one with a dummy for high violence levels illustrated with red colour; and other with a dummy for relatively low violence levels illustrated with blue colour.

The estimation results of high and low violence specific changes in commodity price index for democratic countries are consistent with the findings from Table 2 confirming that, on average, resource shocks do not have significant consequences on conflict possibility when they occur in countries with cohesive institutions. Considering the impact of these shocks across infra-marginal changes for autocracies instead provides further intriguing results. For deeply entrenched autocracies, the impact of price shocks on conflict is virtually nil. Moving

[24] It can be easily checked that this is equivalent to including the interactions of price shocks with both dummies for high and low violence level subsamples. However, the implementation of the specification in column 4 has the advantage of demonstrating whether the price shock effects for relatively stable countries significantly differ from the reference group with high violence levels, at the same time enabling us to distinguish whether these effects are significantly different from zero.

[25] The potential outlier countries are identified as those associated with the combination of experiencing the highest frequency of high and low political violence within each violence group for each bin.

from deeply to moderately entrenched autocracies reveals a positive impact (significant at 10% level) of price shocks for relatively low threat level countries in the [-8,-5] interval, which in turn demonstrates strong quantitative significance (at 1% level) when the subsample in the [-5,-3] interval is considered. For the least entrenched autocracies (interval of [-3, 0]) with high political threat levels instead, the positive shock to price changes significantly decreases the probability of conflict outbreak.[26] It is also of emphasis that in all cases across the bins, relatively lower initial political threat levels within subsamples provides relatively less opportunity cost for conflict possibility compared with high initial threat level countries, which supports the hypothesis that the marginal impact of price shocks on conflict outbreak is increasing while political violence level decreases. These results also suggest that average insignificant price shock effect on conflict for relatively low violence level autocracies in Table 2 (column 4) is driven by the fact that two opposing effects cancel each other out.

Altogether, these findings demonstrate that (i) there is an absence of evidence between resource windfalls and conflict outbreak for democracies and for stable autocracies (as in e.g., Bazzi and Blattman, 2011); (ii) there is a positive association for unstable autocracies if initial political violence level is relatively low (as in e.g., Collier and Hoeffler, 1998; Besley and Persson, 2008); and a negative association if an unstable autocratic country's political violence level is high (as in e.g., Brunnschweiler and Bulte, 2009; Bruckner and Ciccone, 2010).

3.2 Resource Windfalls and Growth

The analysis now turns to the exploration of the impact of resource shocks on economic growth with the emphasis of the importance of political institutions and within-country political violence levels to explain this relationship. The supposition for the growth analysis is that resource wealth is associated with higher economic performance only for countries with stable socio-economic and political environment, while significantly deteriorating growth for unstable countries with non-cohesive political institutions.

The estimation results for this analysis are presented in Table 3. The first column derives this relationship linearly where growth responds to the changes in commodity price index in the

[26] The associated quantitative significance of one standard deviation increase in price shocks for the subsample in the [-5,-3] ([-3, 0]) interval is estimated as 3.38 (-6.41) percentage points among relatively low (high) threat level countries.

presence of additional control set. The results are consistent with the existing literature where a positive shock from resource windfalls is associated with higher economic growth. The statistically significant effect implies that one standard deviation increase in commodity price index is associated with an increase in economic performance of about 0.33 percentage points.

The approach to capture the non-linear relationship between resource windfalls and growth conditional on political institutions and within-country political violence levels is twofold. Under the first (column 2), the specification, in addition to separating the resource shocks into autocracy/democracy specific price change index according to a country's initial political contestability levels, also includes the initial level of *polity2* (interacted with an autocracy dummy), both by itself and interacted with the autocracy specific price change index, enabling us to estimate how price shock effects on growth vary when moving from deeply to moderately entrenched autocracies, given the amplification of political violence in this direction.[27] The second approach (column 3) instead applies the same strategy as in column 4 in Table 2 in presence of an additional control set to estimate how the relationships between resource windfalls, political regimes and violence are reflected onto economic growth.

The estimation results demonstrate that for democracies resource windfalls are positively associated with growth, while in autocracies this association is generally negative and diminishing in the initial level of autocracy, i.e. an increase in the price change index is more detrimental for growth in relatively unstable autocratic regimes. Stratifying this association into high and low violence levels reveals that resource windfalls are harmful to economic growth only for autocracies with high political violence levels, while this association is positive if within-country political threat level is low. Regarding quantitative significance, the impact on growth of one standard deviation increase in the commodity price index change is estimated to be 1.09 percentage points among democracies, -0.81 percentage points for high

[27] The inclusion of an interaction term between democracy specific price change index and the initial level of *polity2* (interacted with a democracy dummy) again does not reveal significant differential impact of resource windfalls on growth, also illustrating insignificant interaction effect when the democracy specific price change is stratified into political threat categories (results available upon request). Therefore, the specifications during the rest of analysis omit any interactions of democracy specific price change index.

within-country threat level (unstable) autocracies, and 0.33 percentage points among low within-country threat level (stable) autocracies.[28]

Coefficient estimates of additional explanatory variables also enter with the expected signs. Estimated coefficients on initial levels of income and inflation rate are negative, statistically significant, and indicate strong quantitative effects. Trade openness and international reserves ratios are always positive and typically exhibits a strong relationship with growth.

In summary, the findings show that an increase in commodity price *shocks* are positively associated with economic performance in democracies and in politically stable autocracies, while significantly deteriorating growth for politically unstable autocracies. Thus the analysis confirms that, despite the arguments in the literature, resource windfalls can lead to slower growth (even when commodity price *shocks* measurement is considered) conditional on poor governance of resource revenues.

3.2.1. Robustness Checks

Table 4 examines the robustness of the results estimated for the relationship between price shocks and growth for the approaches in columns 2 and 3 of Table 3 to the exclusion of countries whose resource wealth accounts for only a small share of GDP. For these countries it is less likely that price changes would represent large windfalls, and hence would not provide motivation to engage in self-preservation activities or oppose the incumbent government, thus focussing on a sample with larger commodity shares is arguably a better test for the sensitivity of the results. Columns 1 and 2 exclude countries in the first decile of the average share distribution (respectively, 13 and 11 countries); columns 3 and 4 exclude countries in the first quartile (35 and 30 countries); and columns 5 and 6 exclude all countries below the median average share (69 and 59 countries). Despite the significant drop in the sample size, the results from baseline sample remain robust at least at the 10% significance level in all cases and are generally reinforced as the threshold to be included in the sample progressively increases. In particular, the point estimates for the autocracies (democracies) in columns 1, 3 and 5 (columns 2, 4 and 6) become more (less) negative (positive) as the analysis focuses on more resource dependent countries.

[28] The impact of resource windfalls on growth for low threat level autocracies are calculated by summing the autocracy specific price shock estimates (-0.732 + 1.033), multiplying by average standard deviation of 0.011, and then multiplying by 100 to convert to a percentage-point measurement.

Table 5 addresses the reasonable concern that commodity prices can be affected by expectations of economic and political developments in the main world producers, and hence shaping the decision-making process of incumbent government regarding to make an investment into self-preservation activities, especially in places where politics is the only road to richness. The investigation therefore excludes from the sample three subsets of countries: (i) those belonging to OPEC; (ii) big energy producers; (iii) and large commodity producers accounting for significant shares of total world production.[29] In all cases, the results remain robust at least at the 10% significance level with coefficient estimates of the variables of interest lying mostly within one standard deviation of the full sample estimate.

The potential influence on the results of several additional subsets of countries is also considered. The collection of these subsets reflects countries singled out due to their resource dependence and political violence experiences across autocracy/democracy spectrum during the time period spanned by the sample. The results of this exercise are illustrated in Tables 6 and 7. For each subset, Tables 6 and 7 report the list of countries, their 1990 net export shares, political contestability and violence levels, growth rates measured over the sample period, and the coefficient estimates of variables of interest as specified above for the first and the second approach.

Table 6 checks the sensitivity of the results under the first approach to the exclusion of resource abundant countries resting at the top and bottom of the autocracy/democracy spectrum. The results of this exercise are demonstrated for two subsets of countries with high net export shares (above the 75^{th} percentile): (i) countries placed at the bottom quartile of political contestability level; (ii) and countries located at the top quartile of the autocracy/democracy spectrum. The coefficient estimates of the variables of interest change very little given the removal of any one of the subsets under consideration, lying within one standard deviation of the full sample estimates. What does change somewhat is the statistical

[29] The investigation treats Indonesia as an OPEC country, as it belonged to the organisation almost during the whole sample period, but excludes Angola and Ecuador who joined the OPEC in 2007, and Gabon who was a member of the OPEC only for the period of 1975-1994. Alternative treatments of these countries do not alter the results. Big energy (oil, natural gas, gasoline, uranium and coal) producers reflect countries whose principal net export commodity production share accounts for more than 2.5% of total world supply. The list of large commodity producers instead captures all countries whose principal net export commodity production share belongs to the list of top 15 biggest producers (according to the latest estimates) in the world by commodity. Please see Appendix Table B3.

significance of the interaction term with initial autocracy specific political contestability level in the case when the exclusion of the first subset is employed.

The second collection of subsets includes countries singled out due to their political violence experiences among autocratic economies located at the bottom quartile of autocracy/democracy spectrum, whose net exports accounts for above the mean of GDP share. Two subsets are considered: the 11 autocratic countries with high political violence levels specified as those below the mean; and the 10 relatively stable autocracies with political violence levels above the mean. The impact of removing these subsets of countries under the second approach is reported in Table 7. Once again, point estimates are not altered greatly, lying within 1.5 standard deviations of the full sample estimates, although showing some sensitivity for statistical significances across subsets. Overall, the general pattern of results reported in Table 3 remains apparent given the exclusion of both collection of countries from the sample.[30]

Collectively, the results from Tables 4-7 suggest that the non-linear relationship between commodity price shocks and growth does not seem attributable to just a number of exceptional countries exerting a large influence.

Table 8 deals with the issue of commodity typology. An important distinction that has been made in the literature is the role of point and energy source commodities (e.g., Isham *et al*., 2005; De Soysa and Neumayer, 2007), which is believed to induce a higher risk of conflict, foster weaker institutional capacity and provide higher pay-offs from non-productive lobbying and rent-seeking activities, as they are generally more valuable. Therefore columns 1-2 and 3-4 break down the change in commodity price index, respectively, into point and energy sources. Although, the significances for energy source commodity price index change show some sensitivity across specifications, the coefficient estimates of the variables of interest change little lying within one standard deviation of the full sample estimates. Overall, the general pattern of results is consistent with findings reported in Table 3.[31]

[30] An analogous analysis employing the sample restrictions as in Table 6 (Table 7) under the second (first) approach is also considered where the results remain robust at least at the 10% significance level in all cases (available upon request).

[31] An analogous analysis has been carried for diffuse and non-energy source commodity exporting countries. The findings reveal that the price shocks are not detrimental within autocracies typically illustrating insignificant impact on growth (available upon request).

4. Conclusion

The empirical analysis has confirmed that the impact of resource windfalls on economic growth, political system and conflict depends on government performance and can lead to slower growth, bad institutions and higher conflict potential if the additional revenues from resource shocks are not being spent productively.

The investigation has illustrated that institutional quality and within-country political violence/stability levels, to a large extent, are able to explain the ambiguity behind the confronting results in the resource literature. In particular, re-assessing the price shock effects on conflict outbreak, the analysis has shown that the resource windfalls have no significant consequences in democracies and in politically stable autocracies. In contrast, for politically unstable autocracies, the significant impact from resource windfalls is conditional on a country's initial political violence level. Specifically, a positive shock to an autocratic country's flow of resource rents with high political threat levels decreases conflict possibility, while leading to higher potential for violence if within country political threat level is relatively low.

The investigation has also contributed to the growth literature showing that resource *shocks* are positively associated with growth in democracies and in politically stable autocracies, while deteriorating a country's economic performance for politically unstable autocracies.

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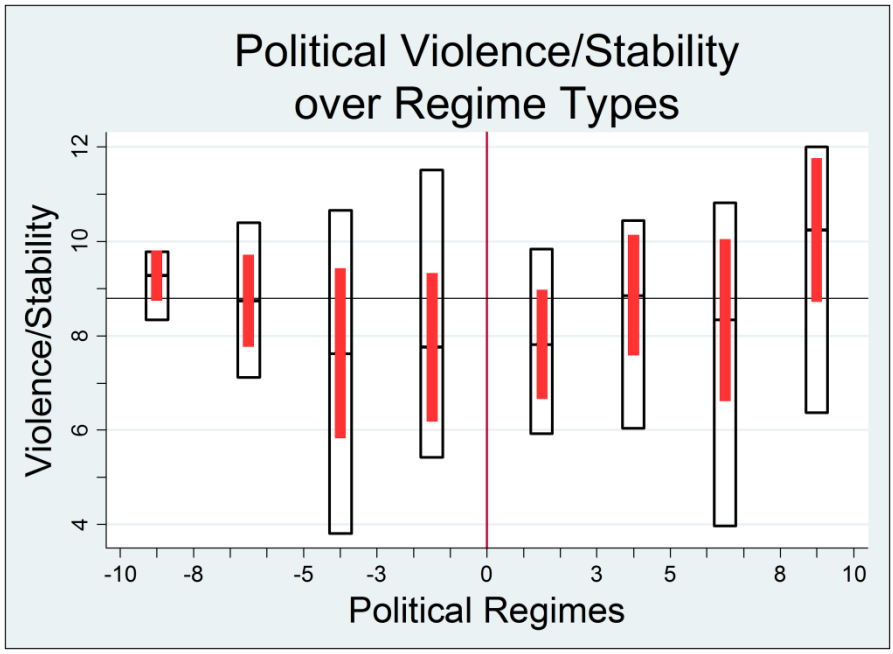
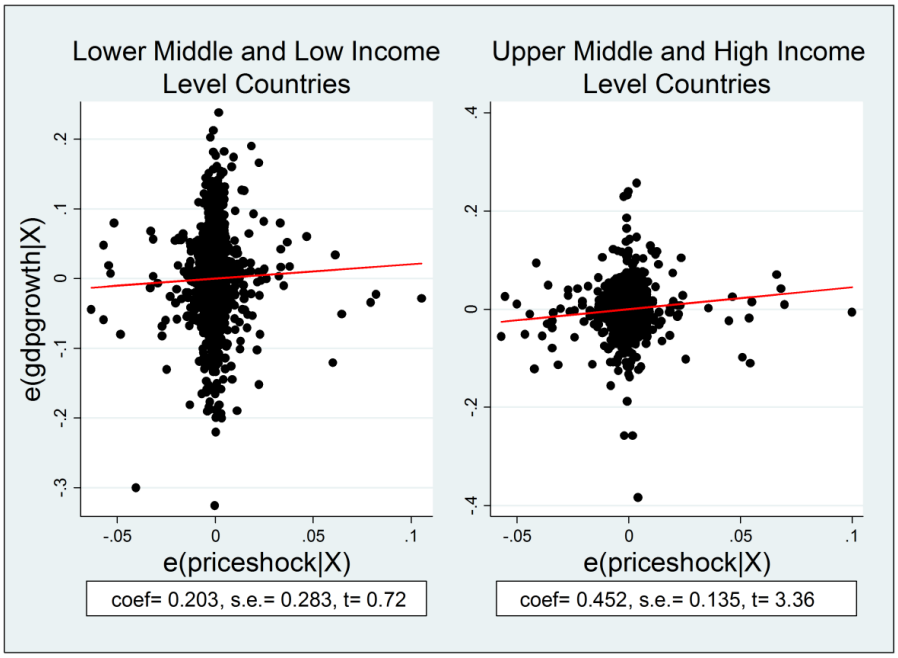
Figure 1: Summary of Political Violence over Political Regime Types



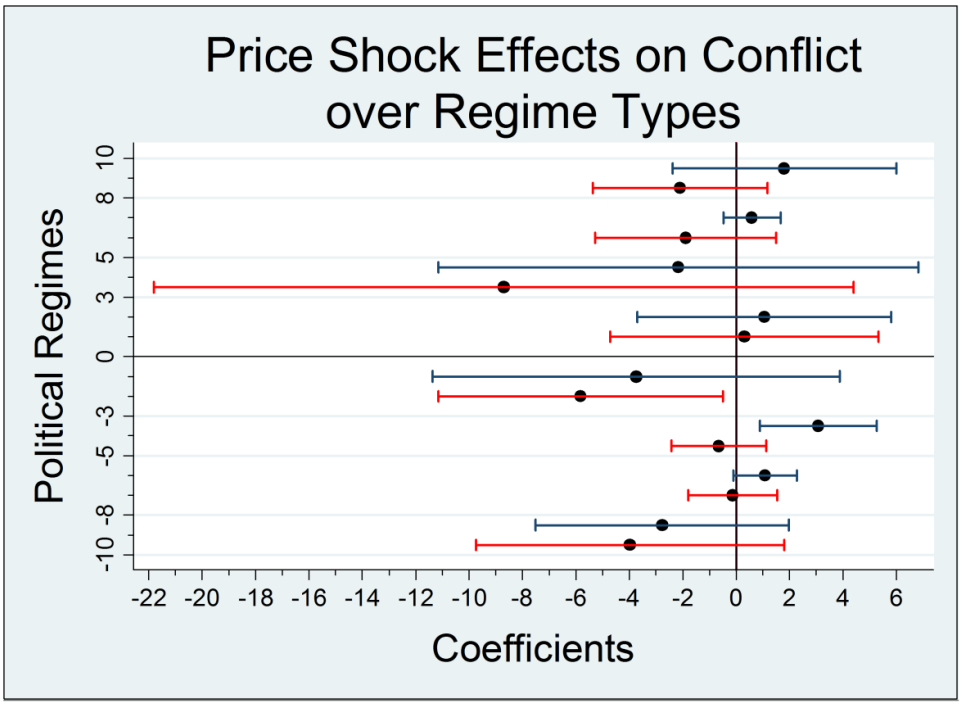
Note: Respective cross-country average statistics of political violence/stability over political regime types are summarized for the period of 1984-2010 and a sample of 119 countries. Red bars represent average mean of political violence ± one standard deviation, while empty bars correspond to its maximum and minimum value in each interval. Mean line of political violence corresponds to the value of 8.7. The number of observations for eight intervals when moving from "autocratic" to "democratic" bins is 6, 8, 14, 12, 12, 9, 25 and 33 respectively.

Figure 2: Partial Regression Plots for Commodity Price Shocks and Growth



Note: The set of regressors includes initial levels of logged income, trade openness, log of inflation rate, international reserves ratio, country and time-specific fixed effects. The figures are produced using OLS regressions.

Figure 3: Estimated Coefficients of Price Shocks on Conflict at Different Bins



Note: The graph plots the estimated impact of high and low violence specific price shocks on conflict conditional on initial *polity2* levels for each bin. Red spikes represent 95% confidence bands for high violence specific price shock estimates, while confidence intervals for low violence sample are illustrated with blue colour. The bins are constructed so to maintain the symmetry around the zero threshold, while maximising the number of observations and minimizing the differences in frequency across them. The number of observations for eight intervals when moving from "autocratic" to "democratic" bins is 110, 357, 134, 103, 88, 124, 327 and 426, respectively. The eliminated countries for the 1st bin are Oman and Syria; 2nd bin China and Cameroon; 3rd bin Gabon and Sudan; 4th bin Gambia and Guinea; 5th bin Mali and Pakistan; 6th bin Malaysia and Lebanon; 7th bin Argentina and Columbia; 8th bin Australia, France, Netherlands, Portugal, United Kingdom, United States and Israel. The method of estimation is the least squares with robust standard errors clustered by country.

Table 1: Descriptive Statistics for Growth, Political Regimes, Political Violence and Conflict Onset

Sample split	Variable	Observations	Mean	Std. Dev.
Panel A: Income levels				
Lower Mid./Low	Growth	89	1.698	6.579
	Polity2	89	-0.371	6.684
	Violence/Stability	74	7.976	2.474
	Conflict Onset	59	0.049	0.216
High/Upper-Mid.	Growth	46	1.739	7.079
	Polity2	46	5.662	7.114
	Violence/Stability	45	10.07	1.972
	Conflict Onset	18	0.035	0.185
Panel B: Resource Dependence levels				
Low	Polity2	101	2.408	7.185
	Violence/Stability	89	8.784	2.551
High	Polity2	34	-1.284	7.248
	Violence/Stability	30	8.585	2.406

Note: Summary statistics for growth rates and *polity2* are based on country averages for the period of 1963-2010 and a sample of 135 countries. Political violence/stability and civil conflict onset statistics are restricted to the period of 1984-2010 and summarized for 119 and 77 countries data set respectively.

Table 2
Commodity Price Shocks and Conflict
Dependent Variable: Civil Conflict Onset

	(1)	(2)	(3)	(4)
Δ *Index*	-0.612*	-4.097*		
	(0.346)	(2.146)		
Δ $Index_{*}$ $Violence_{t-1}$		0.389*		
		(0.209)		
Δ $Index_{d}$			-8.254	-1.300
			(5.692)	(0.971)
Δ $Index_{a}$			-2.791*	-2.072**
			(1.585)	(0.969)
Δ $Index_{d*}$ $Violence_{t-1}$			0.849	
			(0.623)	
Δ $Index_{a*}$ $Violence_{t-1}$			0.256*	
			(0.149)	
Δ $Index_{a*}$ $Violence_{low}$				2.077***
				(0.763)
$Violence_{t-1}$		-0.004	-0.004	
		(0.004)	(0.004)	
Country FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Observations	1709	1612	1597	1597

Note: ***, **, * represent significance of estimates respectively at 1%, 5% and 10% levels. The method of estimation is least squares. Robust standard errors clustered by country are presented in the parentheses.

Table 3
Commodity Price Shocks and Growth
Dependent Variable: Logged per capita real (Laspeyres) GDP growth
Estimation: System GMM estimation with Windmeijer (2005) Small Sample Robust Correction

	(1)	(2)	(3)
GDP per capita (log)	-0.037***	-0.080***	-0.078***
	(0.011)	(0.016)	(0.015)
Trade openness	0.036***	0.035**	0.021**
	(0.012)	(0.016)	(0.011)
Inflation (log)	-0.026***	-0.026**	-0.014**
	(0.009)	(0.009)	(0.006)
Reserves/GDP ratio	0.097*	0.127*	0.088
	(0.056)	(0.066)	(0.056)
Δ *Index*	0.297**		
	(0.145)		
Δ $Index_{d}$		0.645*	0.995***
		(0.367)	(0.351)
Δ $Index_{a}$		-0.567***	-0.732***
		(0.201)	(0.215)
Δ $Index_{a*}Pl_{t-1,a}$		-0.113***	
		(0.038)	
Δ $Index_{a*}$ $Violence_{low}$			1.033***
			(0.262)
$Pl_{t-1,a}$		-0.005***	
		(0.002)	
Country FE	YES	YES	YES
Time FE	YES	YES	YES
Observations	4337	4324	2428
Specification tests			
(a) Hansen Test:	0.926	0.993	0.976
(b) Serial Correlation:			
First-order	0.000	0.000	0.000
Second-order	0.691	0.965	0.260

Note: The estimation results are achieved using the "1 lag restriction" technique following Roodman (2009). ***, **, * represent significance of estimates respectively at 1%, 5% and 10% levels. Standard errors are presented in parentheses.

Table 4
Excluding Low Export Share Countries
Dependent Variable: Logged per capita real (Laspeyres) GDP growth
Estimation: System GMM estimation with Windmeijer (2005) Small Sample Robust Correction

	Above 1st Decile Share		**Above 1st Quartile Share**		**Above Median Share**	
	(1)	(2)	(3)	(4)	(5)	(6)
Δ *Index*$_d$	0.944**	0.984***	0.901**	0.962**	0.912**	0.625**
	(0.402)	(0.355)	(0.401)	(0.383)	(0.395)	(0.236)
Δ *Index*$_a$	-0.777***	-0.739***	-0.803***	-0.762***	-0.812***	-0.622*
	(0.206)	(0.219)	(0.212)	(0.236)	(0.219)	(0.334)
Δ *Index*$_{a*}$*Pl*$_{t-1,a}$	-0.159***		-0.163***		-0.164***	
	(0.031)		(0.033)		(0.034)	
Δ *Index*$_{a*}$ *Violence*$_{low}$		1.029***		1.052***		0.829**
		(0.267)		(0.296)		(0.409)
Pl$_{t-1,a}$	-0.007*		-0.009**		-0.011**	
	(0.004)		(0.004)		(0.005)	
Control Set	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Observations	3885	2214	3268	1810	2122	1190
Specification tests						
(a) Hansen Test:	0.925	0.999	0.143	0.723	0.187	0.942
(b) Serial Correlation:						
First-order	0.000	0.000	0.000	0.000	0.000	0.001
Second-order	0.262	0.270	0.435	0.266	0.100	0.389

Note: In addition to the variables of interest reported above, all specifications employ an additional control set which includes initial levels of logged income, trade openness, log of inflation rate and international reserves ratio. Columns 1-2, 3-4 and 5-6 exclude countries below the first decile, the first quartile and the median of the average commodity export share distribution, respectively. The respective number of countries eliminated in columns 1 (2), 3 (4) and 5 (6) are 13 (11), 35 (30), and 69 (59). The estimation results are achieved using the "1 lag restriction" technique following Roodman (2009). ***, **, * represent significance of estimates respectively at 1%, 5% and 10% levels. Standard errors are presented in parentheses.

Table 5
Excluding Big Producers
Dependent Variable: Logged per capita real (Laspeyres) GDP growth
Estimation: System GMM estimation with Windmeijer (2005) Small Sample Robust Correction

	Exclude OPEC Countries		**Exclude Big Energy Producers**		**Exclude Large Commodity Producers**	
	(1)	(2)	(3)	(4)	(5)	(6)
Δ *Index*$_d$	0.596*	0.907**	0.966**	1.239***	0.974*	1.695***
	(0.339)	(0.424)	(0.403)	(0.463)	(0.535)	(0.449)
Δ *Index*$_a$	-0.682**	-0.711**	-0.449*	-0.674**	-0.458*	-0.654**
	(0.339)	(0.322)	(0.234)	(0.297)	(0.262)	(0.294)
Δ *Index*$_{a*}$*Pl*$_{t-1,a}$	-0.175***		-0.101***		-0.105**	
	(0.068)		(0.038)		(0.049)	
Δ *Index*$_{a*}$ *Violence*$_{low}$		0.938*		0.924**		0.944**
		(0.476)		(0.401)		(0.393)
Pl$_{t-1,a}$	-0.003		-0.003		-0.009	
	(0.002)		(0.002)		(0.006)	
Control Set	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Observations	4088	2267	3829	2118	2155	1140
Specification tests						
(a) Hansen Test:	0.752	0.169	0.313	0.234	0.257	0.982
(b) Serial Correlation:						
First-order	0.000	0.000	0.000	0.000	0.000	0.000
Second-order	0.817	0.537	0.710	0.451	0.339	0.880

Note: In addition to the variables of interest reported above, all specifications employ an additional control set which includes initial levels of logged income, trade openness, log of inflation rate and international reserves ratio. The estimation results are achieved using the "1 lag restriction" technique following Roodman (2009). ***, **, * represent significance of estimates respectively at 1%, 5% and 10% levels. Standard errors are presented in parentheses.

Table 6
Exclusion of Countries with Unusual Characteristics
Dependent Variable: Logged per capita real (Laspeyres) GDP growth
Estimation: System GMM estimation with Windmeijer (2005) Small Sample Robust Correction

Country	1990 Net Export share	Average Polity2	Av. Political Violence	Average Growth Rate	Coeff.	S. E.	p value
Remove Autocratic (<25th percentile) Countries with High Commodity Export Shares							
Algeria	0.11	-5.67	6.68	0.02			
Cameroon	0.12	-6.15	7.12	0.004			
Congo, Rep.	0.35	-5.19	7.89	0.02			
Cote d'Ivoire	0.24	-6.13	8.52	0.01			
Gabon	0.33	-4.67	9.36	0.01		Δ $Index_d$	
Iran	0.07	-5.81	7.59	0.02	0.803	0.402	0.048
Kuwait	0.28	-7.6	8.86	0.01		Δ $Index_a$	
Libya	0.29	-7	8.90	-0.02	-0.545	0.251	0.032
Malawi	0.09	-3.77	7.59	0.01		Δ $Index_a$*$Pl_{t-1,a}$	
Mauritania	0.23	-6.10	N/A	0.03	-0.126	0.088	0.152
Oman	0.36	-9.29	9.78	0.03			
Qatar	0.29	-10	9.58	0.04			
Saudi Arabia	0.27	-10	8.96	0.001			
Swaziland	0.08	-8.83	N/A	0.02			
Syria	0.08	-8.25	9.52	0.01			
Remove Democratic (>75th percentile) Countries with High Commodity Export Shares							
						Δ $Index_d$	
Mauritius	0.09	9.67	N/A	0.03	0.627	0.351	0.076
New Zealand	0.08	10	11.79	0.01		Δ $Index_a$	
Trinidad & Tobago	0.08	8.85	8.71	0.03	-0.649	0.170	0.000
Venezuela	0.16	7.35	9.19	0.004		Δ $Index_a$*$Pl_{t-1,a}$	
					-0.137	0.029	0.000

Note: In addition to the variables of interest reported above, all specifications control for initial levels of logged income, trade openness, log of inflation rate, international reserves ratio, autocracy specific *polity2*, country and time-specific fixed effects. The estimation results are achieved using the "1 lag restriction" technique following Roodman (2009). ***, **, * represent significance of estimates respectively at 1%, 5% and 10% levels. Standard errors are presented in parentheses.

Table 7
Exclusion of Countries with Unusual Characteristics
Dependent Variable: Logged per capita real (Laspeyres) GDP growth
Estimation: System GMM estimation with Windmeijer (2005) Small Sample Robust Correction

Country	1990 Net Export share	Average Polity2	Average Violence	Average Growth Rate	Coeff.	S. E.	p value
Remove Resource Dependent Autocratic Countries with High Political Violence Levels							
Algeria	0.11	-5.67	6.68	0.02			
Angola	0.30	-3.23	5.34	0.04			
Bahrain	0.07	-8.98	8.33	0.001		Δ *Index*$_d$	
Cameroon	0.12	-6.15	7.12	0.004	1.320	0.385	0.001
Congo Rep.	0.35	-5.19	7.89	0.02		Δ *Index*$_a$	
Cote d'Ivoire	0.24	-6.13	8.52	0.01	-0.469	0.298	0.119
Iran	0.07	-5.81	7.59	0.02		Δ *Index*$_{a*}$ *Violence*$_{low}$	
Morocco	0.03	-7.38	8.41	0.03	0.771	0.297	0.011
Togo	0.06	-5.13	7.40	-0.001			
Uganda	0.05	-3.17	5.94	0.01			
Zimbabwe	0.27	-3.89	7.34	0.001			
Remove Resource Dependent Autocratic Countries with Low Political Violence Levels							
Gabon	0.33	-4.67	9.36	0.01			
Kazakhstan	0.04	-4.62	10.65	0.02			
Kuwait	0.28	-7.6	8.86	0.01		Δ *Index*$_d$	
Libya	0.29	-7	8.90	-0.01	1.109	0.357	0.002
Oman	0.36	-9.29	9.78	0.03		Δ *Index*$_a$	
Qatar	0.29	-10	9.58	0.04	-0.476	0.261	0.071
Saudi Arabia	0.27	-10	8.96	0.001		Δ *Index*$_{a*}$ *Violence*$_{low}$	
Syria	0.08	-8.25	9.52	0.01	0.684	0.447	0.129
Tunisia	0.03	-6.29	9.75	0.02			
Vietnam	0.09	-7	9.43	0.05			

Note: In addition to the variables of interest reported above, all specifications control for initial levels of logged income, trade openness, log of inflation rate, international reserves ratio, country and time-specific fixed effects. The estimation results are achieved using the "1 lag restriction" technique following Roodman (2009). ***, **, * represent significance of estimates respectively at 1%, 5% and 10% levels. Standard errors are presented in parentheses.

Table 8
Typologies of commodities
Dependent Variable: Logged per capita real (Laspeyres) GDP growth
Estimation: System GMM estimation with Windmeijer (2005) Small Sample Robust Correction

	Point source Commodity price index		**Energy source Commodity price index**	
	(1)	(2)	(3)	(4)
Δ *Index*$_d$	0.906*	1.323***	1.469*	0.849*
	(0.467)	(0.497)	(0.793)	(0.506)
Δ *Index*$_a$	-0.493**	-0.802***	-0.433	-0.684
	(0.189)	(0.245)	(0.294)	(0.494)
Δ *Index*$_{a*}$*Pl*$_{t-1,a}$	-0.107***		-0.124***	
	(0.030)		(0.037)	
Δ *Index*$_{a*}$ *Violence*$_{low}$		1.127***		0.804
		(0.302)		(0.625)
Pl$_{t-1,a}$	-0.002		-0.007*	
	(0.002)		(0.004)	
Control Set	YES	YES	YES	YES
Country FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Observations	4161	2404	2292	1407
Specification tests				
(a) Hansen Test:	0.999	0.348	0.994	0.985
(b) Serial Correlation:				
First-order	0.000	0.000	0.020	0.011
Second-order	0.932	0.295	0.109	0.426

Note: In addition to the variables of interest reported above, all specifications employ an additional control set which includes initial levels of logged income, trade openness, log of inflation rate and international reserves ratio. The estimation results are achieved using the "1 lag restriction" technique following Roodman (2009). ***, **, * represent significance of estimates respectively at 1%, 5% and 10% levels. Standard errors are presented in parentheses.

Table A1
Long and Short-Run Impact of Commodity Price Index
Dependent Variable: Logged per capita real (Laspeyres) GDP growth

	(1)	(2)	(3)
	Estimates of long-run coefficients		
Trade openness $_{t-1}$	0.027***	0.026***	0.027***
	(0.006)	(0.006)	(0.008)
Inflation (log) $_{t-1}$	-0.025***	-0.024***	-0.023**
	(0.009)	(0.009)	(0.010)
Reserves/GDP ratio $_{t-1}$	0.066**	0.063*	0.049
	(0.033)	(0.034)	(0.041)
Commodity export price index $_{t-1}$	**-0.085*** **		
	(0.027)		
Points export price index $_{t-1}$		**-0.086*** **	
		(0.029)	
Diffuse export price index $_{t-1}$		**0.136**	
		(0.379)	
Energy export price index $_{t-1}$			**-0.187*** **
			(0.057)
Non-energy export price index $_{t-1}$			**0.301** **
			(0.116)
	Estimates of short-run coefficients		
GDP per capita (log)$_{t-1}$	-0.047***	-0.046***	-0.045***
	(0.006)	(0.006)	(0.008)
Δ GDP per capita (log)$_{t-1}$	0.089**	0.103***	0.135**
	(0.034)	(0.037)	(0.053)
Δ Trade openness $_{t-1}$	-0.005	-0.006	-0.013
	(0.015)	(0.015)	(0.017)
Δ Inflation (log) $_{t-1}$	0.004	0.004	0.005
	(0.006)	(0.006)	(0.006)
Δ Reserves/GDP ratio $_{t-1}$	0.171**	0.173**	0.176
	(0.079)	(0.079)	(0.140)
Δ Commodity export price index $_{t}$	0.342**	0.336**	0.356**
	(0.155)	(0.158)	(0.153)
Δ Commodity export price index $_{t-1}$	0.311***	0.314***	0.335***
	(0.104)	(0.103)	(0.114)
Δ Commodity export price index $_{t-2}$	0.424***	0.413***	0.505***
	(0.152)	(0.153)	(0.163)
Country FE	YES	YES	YES
Time FE	YES	YES	YES
Observations	4200	4041	2225
R-squared	0.23	0.23	0.26

Note: ***, **, * represent significance of estimates respectively at 1%, 5% and 10% levels. Robust standard errors clustered by country are presented in the parentheses.

Appendix B: Principal Export Commodity Price Shocks and Political Regimes

For the replication analysis of the relationship between resource windfalls and political system, the investigation employs changes in principal export commodity price measurement constructed following Caselli and Tesei (2011). In particular, the measurement of resource windfalls at country level is computed as follows. First, for each country and for each year that data is available, all commodities are ranked by their value (share) of exports. The commodity that is ranked first in the largest number of years within country is identified as country's principal commodity (see Appendix Table B1). Finally, each country's principal commodity is matched with an annual time series of that commodity's world prices (not indices). The data for export values and commodity prices are from the United Nation's Comtrade and IMF International Financial Statistics (IFS) dataset respectively.

The estimated specification used is identical to the one employed in columns 3 and 4 of Table 3 as in Caselli and Tesei (2011) where the dependent variable, measured as one year change in *polity2*, responses to the lagged change in the price of the principal commodity averaged over the previous three years, i.e. if the change in *polity2* is measured between years *t-1* and *t*, the change in commodity prices is the average over the years *t-4*, *t-3*, *t-2* and *t-1*. The construction of interaction terms is accomplished firstly by separating out the price change variable into two variables according to the initial levels (measured as four year lags or year *t-4* in order to be consistent with starting date for the price shock) of political contestability: the first is an interaction between the change in principal export commodity price and a dummy for autocracy, and the second is an interaction with a dummy for democracy. Then the full specification includes initial levels of *polity2* (separated into two by interacting with autocracy and democracy dummies) both, by themselves and interacted with the (autocracy/democracy specific) principal commodity price change.

The first two columns in Appendix Table B2 present the results from this replication exercise where column 1 estimates the non-linear relationship between resource windfalls and political system using OLS, while column 2 employs the GMM system estimator. The results are consistent with original findings where commodity price shocks have significant negative impact on politics only in autocratic countries, which is decreasing in initial level of autocracy.

In addition to the replication analysis, the subsequent two columns estimate this relationship non-linearly conditional also on initial political violence/stability levels. Firstly, the

specification reported in column 3, in addition to separating the resource shocks into autocracy/democracy specific price changes according to a country's initial political contestability levels, also includes the initial level of political violence/stability, both by itself and interacted with the autocracy/democracy specific principal commodity price change; while column 4 re-estimates the effect of price shocks for the subsamples with high (low) political violence levels by interacting autocracy/democracy specific price shocks with a dummy that takes the value of unity if a country's initial political violence level is below (above) the sample mean and zero otherwise.

The results from the non-linear estimation of these relationships provide support for the original findings, and indicate that positive shocks in commodity prices have a negative direct impact on political system in politically violent autocracies, which is marginally increasing while within-country political violence level decreases. Stratifying this association for the subsamples reveals that the significant consequences from price shocks is only the case for politically unstable autocratic countries, while resource windfalls have no impact on politics when they occur in democracies and in politically stable autocracies.

Table B1: Countries by Principal Commodity

Princ. Comm.	No. Countries	Countries
Aluminium	9	Bahrain, Germany, Guinea, Jamaica, Lebanon, Mozambique, Slovakia, Slovenia, Switzerland
Bananas	2	Honduras, Panama
Beef	4	Burkina Faso, Djibouti, Ireland, Mali
Coal	3	Australia, Czech Republic, Poland
Cocoa	2	Cote d'Ivoire, Ghana
Coconut oil	1	Philippines
Coffee	13	Brazil, Burundi, Colombia, Costa Rica, El Salvador, Ethiopia, Guatemala, Haiti, Madagascar, Nicaragua, Rwanda, Tanzania, Uganda
Copper	5	Botswana, Chile, Papua New Guinea, Peru, Zambia
Cotton	2	Lesotho, Pakistan
Fish	5	Bangladesh, Cape Verde, Denmark, Korea Rep., Namibia
Gasoline	1	Italy
Groundnuts	3	Gambia, Guinea-Bissau, Sudan
Groundnuts oil	1	Senegal
Pig iron	6	Albania, Armenia, Bhutan, Georgia, Japan, Ukraine
Iron ore	3	Liberia, Mauritania, Sierra Leone
Jute	1	Nepal
Natural Gas	3	Belgium, Bolivia, Netherlands
Oil	31	Algeria, Angola, Azerbaijan, Cameroon, China, Congo Rep., Ecuador, Egypt, Gabon, Indonesia, Iran, Kazakhstan, Kuwait, Libya, Malaysia, Mexico, Nigeria, Norway, Oman, Qatar, Russia, Saudi Arabia, Syria, Trinidad and Tobago, Tunisia, UAE, United Kingdom, Venezuela, Vietnam, Yemen
Oranges	2	Israel, Spain, Turkey
Palm kernel oil	1	Benin
Phosphates	3	Jordan, Morocco, Togo
Pulp	1	Portugal
Rice	1	Thailand
Rubber	2	Cambodia, Singapore
Silver	1	South Africa
Soybean	2	Paraguay, United States
Sugar	5	Dominican Rep., Fiji, Guyana, Mauritius, Swaziland
Sunflower oil	1	Moldova
Tea	3	India, Kenya, Sri Lanka
Tobacco	5	Cyprus, Greece, Kyrgyzstan, Malawi, Zimbabwe
Uranium	1	Niger
Wheat	2	Argentina, France
Wood	8	Austria, Canada, Central African Rep., Finland, Latvia, Lithuania, Romania, Sweden
Wool	2	New Zealand, Uruguay

Table B2
Commodity Price Shocks and Political Regimes
Dependent variable: Change in Political System (Δ polity2)

	(1)	(2)	(3)	(4)
$\Delta\ Pr_d$	-0.042	-0.208	-2.030	
	(0.516)	(0.631)	(1.365)	
$\Delta\ Pr_a$	-1.629**	-1.898**	-3.316*	
	(0.765)	(0.761)	(1.872)	
$\Delta\ Pr_{d*}Pl_{t-4,d}$	0.031	0.059		
	(0.057)	(0.076)		
$\Delta\ Pr_{a*}Pl_{t-4,a}$	-0.185*	-0.221**		
	(0.111)	(0.110)		
$\Delta\ Pr_{d} * Violence_{t-4}$			0.190	
			(0.143)	
$\Delta\ Pr_{a} * Violence_{t-4}$			0.356*	
			(0.202)	
$\Delta\ Pr_{d} * Violence_{high}$				-0.896
				(1.116)
$\Delta\ Pr_{d} * Violence_{low}$				0.098
				(0.343)
$\Delta\ Pr_{a} * Violence_{high}$				-1.710*
				(0.939)
$\Delta\ Pr_{a} * Violence_{low}$				0.628
				(0.620)
$Pl_{t-4,d}$	-0.095***	-0.144**		
	(0.015)	(0.067)		
$Pl_{t-4,a}$	-0.074***	-0.044		
	(0.017)	(0.041)		
$Violence_{t-1}$			-0.088	
			(0.064)	
Estimation method	OLS	GMM	GMM	GMM
Country FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Observations	5036	5036	2419	2419
Specification tests				
(a) Hansen Test:		0.993	0.483	0.772
(b) Serial Correlation:				
First-order		0.000	0.000	0.000
Second-order		0.242	0.746	0.730

Note: ***, **, * represent significance of estimates respectively at 1%, 5% and 10% levels. The dependent variable is the *t-1* to *t* change in *polity2*. The method of estimation in columns 1 and 2-4 are least squares and system-GMM, respectively. Robust standard errors presented in the parentheses for the least squares estimation are clustered at country level, while system-GMM estimation applies the Windmeijer (2005) small-sample correction.

Table B3: Big Producers by Principal Commodity

Princ. Comm.	No. Countries	Countries
Aluminium	4	Bahrain, Germany, Lebanon, Mozambique
Beef	1	Ireland
Coal	2	Australia, Poland
Cocoa	2	Cote d'Ivoire, Ghana
Coconut oil	1	Philippines
Coffee	7	Brazil, Colombia, Costa Rica, Ethiopia, Guatemala, Nicaragua, Uganda
Copper	4	Chile, Papua New Guinea, Peru, Zambia
Cotton	1	Pakistan
Fish	2	Bangladesh, Korea Rep.
Groundnuts	2	Gambia, Sudan
Groundnuts oil	1	Senegal
Pig iron	2	Japan, Ukraine
Iron ore	1	Mauritania
Jute	1	Nepal
Natural Gas	1	Netherlands
Oil	12	Algeria, China, Indonesia, Iran, Kuwait, Mexico, Nigeria, Norway, Russia, Saudi Arabia, UAE, Venezuela
Oranges	2	Spain, Turkey
Phosphates	2	Jordan, Morocco
Rice	1	Thailand
Rubber	1	Cambodia
Soybean	2	Paraguay, United States
Tea	3	India, Kenya, Sri Lanka
Tobacco	2	Malawi, Zimbabwe
Uranium	1	Niger
Wheat	1	France
Wood	3	Canada, Finland, Sweden
Wool	1	New Zealand

Note: Large producers reflect countries (63) whose principal net export commodity production share belongs to the list of top 15 biggest producers in the world by commodity. Data for production of commodities by country are obtained from the following sources: aluminium, copper, pig iron and iron ore from the United States Geological Survey; phosphates and uranium from the British Geological Survey; beef, cocoa, coconut oil, cotton, fish, jute, oranges, rice, tea, tobacco, wheat, wood and wool from the Food and Agricultural Organization; rubber from the Association of Natural Rubber Producing Countries; groundnuts, groundnuts oil and soybeans from the US Department of Agriculture; coffee from the International Coffee Organization; oil, natural gas and coal from the US Energy Information Administration.

Appendix C: Data Description, Sources and Coverage

Commodity export and import values for 1990 are collected from the United Nation's Commodity Trade Statistics Database. For countries with missing 1990 net export values, the analysis employs net export values available in the year closest to 1990 where the maximum distance from 1990 ranges in ±10 years interval.[32] Annual world commodity price indices are initially collected for 59 commodities from International Financial Statistics (IFS series 74 and 76), except for the natural gas and gasoline, which are from the United States Energy Information Administration (EIA 2013, 9.4 and 9.10); and pig iron obtained from the United States Geological Survey. However, commodities of olive oil, poultry, swine meat, urea and uranium were left out of the sample due to lack of adequate data in the early sample periods. Therefore the results for countries, in which the weights of these commodities over the export share are relatively important (e.g., Niger), should be interpreted with caution.

IFS price series have gaps for some commodities. Since the identical sample length is an important consideration for constructing the commodity price index measure, the analysis employed a combination of methods to generate missing values. For instance, the IFS price series for bananas and pepper are available only from 1975 and 1983 respectively; therefore missing values for the previous periods were replaced with the data from UNCTAD since the price series from both sources are almost identical. Three price series (coal, plywood and tobacco) have short gaps at the beginning of the sample period. Following Dehn (2000), these gaps were filled by holding the price constant at the value of the first available observation. Palm-kernel oil series have one missing value in the middle which was filled by linear interpolation. Missing values for oranges and barley (1962-1975) are replaced first with the rescaled price data available from FAOSTAT (Food and Agriculture Organisation) for the period 1966-1975, where the gap for 1962-1966 period was then filled by holding the price constant at the 1966 value.

For price series with missing values for which other highly correlated price series are available, the missing values are generated using partial adjustment regression equation:

$$\ln\left(\frac{X_t}{Y_t}\right) = \theta_0 + \theta_1 \ln\left(\frac{X_t}{Y_t}\right) + \theta_2 \ln(Y_{t-1}) + \varepsilon_t$$

[32] Any biases that might be generated by this choice are checked by re-estimating the main findings for the sample where countries with missing 1990 net export shares are removed. In all cases, the results remain robust at conventional significance levels (available upon request).

where X_t is the series with missing early values and Y_t is a highly correlated series with a full set of observations. The regression is run on overlapping observations, and the coefficients are then used to "backcast" the missing observations. This method is used to fill the initial gap of 17 observations in the fish series and 8 observations in pulp series. The close correlates used were IFS fishmeal prices and plywood prices respectively.

Appendix D1: List of Countries

Code	Country	Code	Country	Code	Country
1	Albania $_{c}$	46	Ghana	91	Norway $_{c}$
2	Algeria	47	Greece $_{c}$	92	Oman
3	Angola	48	Guatemala	93	Pakistan
4	Argentina	49	Guinea	94	Panama
5	Armenia $_{c}$	50	Guinea-Bissau	95	Papua New Guinea
6	Australia	51	Guyana $_{c}$	96	Paraguay
7	Austria $_{c}$	52	Haiti	97	Peru
8	Azerbaijan	53	Honduras	98	Philippines $_{c}$
9	Bahrain $_{c}$	54	India $_{c}$	99	Poland $_{c}$
10	Bangladesh	55	Indonesia	100	Portugal
11	Belgium $_{c}$	56	Iran	101	Qatar $_{c}$
12	Benin $_{cg}$	57	Ireland $_{c}$	102	Romania
13	Bhutan $_{cg}$	58	Israel $_{c}$	103	Russia
14	Bolivia	59	Italy $_{c}$	104	Rwanda $_{cg}$
15	Botswana $_{c}$	60	Jamaica $_{c}$	105	Saudi Arabia $_{c}$
16	Brazil $_{c}$	61	Japan $_{c}$	106	Senegal
17	Burkina Faso	62	Jordan	107	Sierra Leone
18	Burundi $_{cg}$	63	Kazakhstan $_{c}$	108	Singapore $_{c}$
19	Cambodia $_{cg}$	64	Kenya	109	Slovak Rep. $_{c}$
20	Cameroon	65	Korea Rep. $_{c}$	110	Slovenia
21	Canada $_{c}$	66	Kuwait	111	South Africa
22	Cape Verde $_{cg}$	67	Kyrgyzstan $_{cg}$	112	Spain
23	Central African Republic $_{cg}$	68	Latvia $_{c}$	113	Sri Lanka
24	Chile	69	Lebanon	114	Sudan $_{c}$
25	China	70	Lesotho $_{cg}$	115	Swaziland $_{cg}$
26	Colombia $_{c}$	71	Liberia	116	Sweden $_{c}$
27	Congo, Rep.	72	Libya	117	Switzerland $_{c}$
28	Costa Rica $_{c}$	73	Lithuania $_{c}$	118	Syria
29	Cote d'Ivoire	74	Madagascar	119	Tanzania
30	Cyprus	75	Malawi $_{c}$	120	Thailand
31	Czech Republic $_{c}$	76	Malaysia	121	Togo
32	Denmark $_{c}$	77	Mali	122	Trinidad and Tobago
33	Djibouti $_{cg}$	78	Mauritania $_{cg}$	123	Tunisia
34	Dominican Republic	79	Mauritius $_{cg}$	124	Turkey
35	Ecuador	80	Mexico	125	Uganda
36	Egypt	81	Moldova	126	Ukraine $_{c}$
37	El Salvador	82	Morocco	127	United Arab Emirates $_{c}$
38	Ethiopia	83	Mozambique	128	United Kingdom
39	Fiji $_{cg}$	84	Namibia $_{c}$	129	United States
40	Finland $_{c}$	85	Nepal $_{cg}$	130	Uruguay
41	France	86	Netherlands	131	Venezuela
42	Gabon	87	New Zealand $_{c}$	132	Vietnam
43	Gambia	88	Nicaragua	133	Yemen
44	Georgia $_{cg}$	89	Niger	134	Zambia $_{c}$
45	Germany $_{c}$	90	Nigeria	135	Zimbabwe

Note: Subscripts *c* and *g* represent countries, respectively, those are excluded from the conflict onset and growth analysis when political violence/stability variable is employed.

Appendix D2: Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
GDP per capita (log)	5735	8.29	1.31	5.08	11.82
GDP per capita growth rate	5735	0.02	0.07	-0.81	0.64
Trade over GDP	5399	0.69	0.45	0.05	5.62
Inflation (log (1+inflation rate))	4800	0.12	0.28	-0.12	4.77
Reserves over GDP	5397	0.05	0.06	0.00	0.52
Polity2	5654	1.51	7.37	-10	10
Δ Polity2	5642	0.09	1.78	-18	16
Δ Principal Commodity Price	5717	0.04	0.25	-1.04	1.58
Composite Commodity Price Index	5735	1.09	0.17	1.00	2.75
Unlogged unweighted index (1980=100)	5735	82.37	43.06	3.89	693.06
Commodity Exports to GDP (net)	5735	0.06	0.09	0.00	0.54
Δ Commodity Price Index	5735	0.001	0.011	-0.184	0.193
Δ Point source Commodity Price Index	5519	0.001	0.010	-0.127	0.193
Δ Diffuse source Commodity Price Index	5735	0.000	0.001	-0.017	0.035
Δ Energy source Commodity Price Index	3023	0.001	0.013	-0.069	0.192
Δ Non-Energy source Commodity Price Index	5735	0.000	0.005	-0.061	0.084
Political Violence/Stability	3036	8.73	2.52	0	12
Civil Conflict Onset	1709	0.05	0.21	0	1

Note: Summary statistics are based on panel country averages for the period of 1963-2010 and a sample of 135 countries, except the last two. Political violence/stability and civil conflict onset statistics are restricted to the period of 1984-2010 and summarized for 119 and 77 countries data set respectively.

Appendix D3: List of Commodities

Non-agricultural				
Aluminium	Gasoline	Lead	Oil	Tin
Coal	Pig Iron	Natural Gas	Phosphatrock	Zinc
Copper	Iron ore	Nickel	Silver	
Agricultural				
Bananas	Cotton	Linseed oil	Pulp	Soybeans
Barley	Fish	Maize	Rice	Sugar
Beef	Fishmeal	Oranges	Rubber	Sunflower oil
Butter	Groundnuts	Palm-kernel oil	Shrimp	Tea
Cocoa	Groundnuts oil	Palm oil	Sisal	Tobacco
Coconut oil	Hides	Pepper	Sorghum	Wheat
Coffee	Jute	Plywood	Soybean meal	Wood
Copra	Lamb	Potash	Soybean oil	Wool

Note: The categorisation of point source commodities is identified as all non-agricultural commodities plus coffee, cocoa, sugar and bananas. Energy source categorisation includes coal, gasoline, natural gas and oil.