Resource Windfalls, Political Regimes, and Political Stability

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Abstract

We present a simple model in which political incumbents choose the degree of political contestability by deciding how much to spend on vote-buying, bullying, or outright repression. Potential challengers decide whether or not to try to unseat the incumbent and replace him. The model predicts that resource-poor countries will tend to be democracies, while resource-rich ones will tend to be autocracies. Furthermore, democracies experience no change in political contestability following resource windfalls, while autocracies become more autocratic, the more so the milder the initial level of autocracy. These predictions are supported by data where resource windfalls are measured by changes in the price of a country's principal commodity, and the level and changes in political contestability are measured using the *polity2* score.

1 Introduction

Looking at the historical experiences of specific countries it seems uncontroversial that an abundance of natural resources can shape political outcomes. Few observers of Venezuela, Nigeria, Saudi Arabia, and many other resource-rich countries would take seriously the proposition that political developments in these countries can be understood without reference – indeed without attributing a central role – to these countries' natural wealth. Yet, the mechanisms through which natural-resource abundance affects politics frustrate attempts to identify simple generalizations, with resource-rich countries displaying great variations in measures of autocracy and democracy, and political stability. For example, Saudi Arabia and Nigeria both feature a strong tendency towards autocracy but the former is extraordinarily stable while the latter has experienced nine successful coups since independence (and many unsuccessful ones). Venezuela seems to go back and forth between democracy and autocracy, with swings that closely follow the price of oil, while of course Norway appears to be safely and stably democratic irrespective of the oil price.

In this paper we use a large panel of countries to document the following regularities. Natural resource windfalls have no effect on the political system when they occur in *democracies*. However, windfalls have significant political consequences in *autocracies*. In particular, when an autocratic country receives a positive shock to its flow of resource rents it responds by becoming even *more autocratic*. Importantly, there is heterogeneity in the response of autocracies. In deeply entrenched autocracies the effect of windfalls on politics is virtually nil. It is only in moderately entrenched autocracies that windfalls exacerbate the autocratic nature of the political system. Hence, our evidence generalizes casual observation: windfalls have little or no impact in democracies (the Norways) or very stable autocracies (Saudi Arabia), but change the political equilibrium in more unstable autocracies (Nigeria, Venezuela).

To reach these conclusions we measure natural-resource windfalls as changes in the price of a country's principal export commodity. We argue that such changes are exogenous to a country's political system. While total resource exports may depend on political developments, the *identity* of a country's main export commodity (e.g. oil v. gold) is unlikely to depend on politics. Similarly, the vast majority of countries individually account for a relatively small share of world output in their principal export commodity, so it is unlikely that political changes there will have an important effect on prices. Our main measure of political institutions is from the Polity IV database. Crucially for our analysis this is a continuous measure that varies from extreme autocracy to perfect democracy, so it allows us to condition the analysis on infra-marginal differences in the degree of autocracy/democracy, as well as to capture the effects of windfalls on infra-marginal changes in autocracy/democracy. As this variable captures the extent to which the political system is open to competition, we sometimes refer to our measure of autocracy/democracy as a measure of "political contestability."

In order to motivate our empirical analysis, and facilitate the interpretation of the results, we open the paper with a simple model of endogenous determination of political contestability. In our model there is a governing elite that has complete control of the flow of income from natural resources, and decides whether and how much of it to invest in what we call "self-preservation activities." These range from the mild (e.g. direct or indirect vote-buying) to the extreme (violent repression of the opposition). At the same time, a political entrepreneur outside the ruling elite decides whether or not to challenge those in power and try to replace them. This simple game generates endogenously two possible political "modes" : free and fair political competition (recognizable as democracy), where the elite essentially allows challenges to occur on a relatively

level-playing field, and the political entrepreneur chooses to compete for power; and a "repression" mode where the elite invests some of the resources deriving from natural resources in self-preservation activities, without however succeeding in completely deterring challenges.

In our basic model, the key determinant of the regime that is selected as an equilibrium is the amount of revenue accruing to the government from natural resources. This enters the ruling elite's decision problem in two ways: it is part of the payoff from staying in office, as political survival implies that the current elite remains in control of future revenues; and it also enters the budget constraint, as it is the principal source of funding for self-preservation activities, such as vote-buying or political repression. At low levels of resource income, the incentive to engage in self-preservation spending is relatively low, as the future "pie" to hold on to is small. Democracy is the outcome. At higher levels the future benefits from holding on to power are sufficiently large that the government shifts to autocracy. Crucially, the larger the pie, the more the incumbent finds it optimal to spend on self-preservation, so the degree of autocracy is increasing in the size of the resource rents.

One prediction of the model is that political contestability is non-linearly related to resource abundance. Resource-poor countries will be democratic, while resource-rich ones will be autocratic, and the level of autocracy will be increasing in the amount of resource rents. We show that this simple cross-country relation is consistent with the data, when resource abundance is measured in terms of commodity exports. However for reasons we discuss later this is not a compelling test. We therefore note that another prediction of the model is that resource-poor countries (democracies) will not experience changes in political contestability following (small) resource shocks, while resource-abundant countries will. Furthermore, in the model, the rate of decline in political contestability following changes in resource rents is decreasing in the initial level of resource rents (and hence in the initial level of autocracy). This is due to an assumption of decreasing returns in self-preservation spending by the incumbent government. Hence, the model also predicts that in autocracies the effect of windfalls is decreasing in the extent to which the autocracy is entrenched. This predicted heterogeneity in response between democracies and autocracies, as well as within autocracies, is the focus of our empirical work.

The threshold levels of resource income that cause the shift from one political regime to the other depend on parameters that may vary across countries. In a very simple extension to our basic model, in particular, the thresholds depend on a parameter that could be interpreted as the return offered by the markets on the human capital of defeated politicians. If former politicians can look forward to decent returns on their talent in the market, the range of values of natural wealth for which the ruling elite accepts free and fair challenges is (potentially much) wider than in places where politics is the only road to riches. In this way, the model can potentially also explain cases, such as Norway, where great natural-resource wealth is associated with democracy.

The paper continues as follows. In the next subsection we briefly review the relevant literature. Section 2 presents the model and Section 3 presents data and results. Section 4 concludes.

1.1 Related Literature

An important literature in political science studies the relationship between resource abundance and democratic/autocratic institutions using predominantly comparative case studies or cross-country variation [e.g. Ross (2001a, 2001b, 2009), Ulfelder (2007), Collier and Hoeffler (2009), Alexeev and Conrad

(2009) and Tsui (2010)]. While there is some heterogeneity in the conclusions this literature tends to reach, the evidence in these studies points to a negative relationship between resource abundance and democracy/democratization, consistent both with our model and the circumstantial cross-sectional evidence we also present below. However, we argue that identification of causal effects can be achieved with greater confidence using within-country variation, and this is the basis for the core of our empirical evidence.

A recent literature narrowly focused on windfalls from oil uses within-country evidence. Haber and Menaldo (2010) and Wacziarg (2009) find no evidence that oil windfalls lead to greater autocracy. One concern with the Haber and Menaldo (2010) study is that its measure of oil revenue, partly based on oil production, is potentially endogenous to democratic change, while a possible concern with Wacziarg's analysis is that it uses the world oil price for all countries, meaning that there is no possibility to control for correlated time effects across countries. Brückner, Ciccone, and Tesei (2011) find a positive coefficient on oil-price shocks interacted with the share of net oil exports in GDP in a regression for movements towards democracy. They do not condition on whether the country is initially a democracy or an autocracy, nor do they examine heterogeneous responses within autocracies.[1]

On the theoretical front, Acemoglu, Robinson, and Verdier (2004) present a model of autocratic rule where, as in our model, natural-resource rents affects both the value of holding power and the resources available to the incumbent to protect himself. In many ways our model is a much simplified version of theirs. However, they focus on a dichotomous outcome (democracy v. autocracy) so their analysis has no predictions on how the effect of windfalls will vary within autocracies. Also, in their framework democracies are absorbing states by construction, whereas we derive this endogenously. Finally, somewhat more subtly, in their framework the main results are derived as a consequence of resource windfalls relaxing the kleptocrat budget constraint, whereas in our model the main mechanism is the variation in the value of staying in power. Haggard and Kaufman (1997) and Geddes (1999) also stress the role of the budget constraint of political incumbents.

Still fairly closely related are studies of how economic changes other than resource windfalls affect democracy/autocracy, and how resource windfalls affect political outcomes other than democracy/autocracy.

Prominent in the first vein is the long tradition, stretching back at least to Lipset (1959) of studies linking changes in incomes to changes in political institutions. Acemoglu and Robinson (2001, 2006) develop models in which temporarily low income lowers the opportunity cost of challengers to the status quo, leading to democratic transitions in autocracies and reversals in democracy. Our model differs in that the effect of income changes depends not only on whether the political system is initially autocratic or democratic, but also on infra-marginal heterogeneity in the degree of initial autocracy. Furthermore, to make the model speak more directly to the effects of commodity booms we model the economic mechanism not as a change in the opportunity cost of challengers but as a change in the reward of holding political power. Furthermore, we model changes in political regime not as a dichotomous transitions towards democracy but as continuous changes in the degree to which the regime represses political contestability. Because of these differences, our predictions also differ markedly, as we predict no response in democracies and infra-marginal changes in autocracies.

Many authors have investigated empirically the causal relationship between income and democracy [e.g.

[1] A possible interpretation of the result in Brückner, Ciccone, and Tesei (2011) is that, since the oil share is highly correlated with autocracy, their oil-share/oil-price interaction operates as a rough proxi for our autocracy/oil-price interaction. The results are therefore consistent, as in both cases they imply a lesser movement towards autocracy in more entrenched autocracies.

Barro (1999), Epstein et al. (2006), Ulfelder and Lustik (2007), Glaeser, Ponzetto, and Shleifer (2007), Acemoglu, Johnson, Robinson, and Yared (2008), Brückner and Ciccone (2009), and Burke and Leigh (2010).] As discussed, we focus not on generic income changes but more specifically on windfalls associated with commodity price shocks. Because natural-resource booms typically translate into direct windfalls into the hands of political elites these shocks may have very different political consequences than other sources of income shocks. In fact, the literature on the natural resource curse casts doubt on the premise that resource windfalls are aggregate-income increasing [e.g. Sachs and Warner (2001)]. Burke and Leigh (2010) do use commodity price changes as instruments for income changes, so their work is more closely related. They find insignificant effects of commodity-driven income changes on political regimes. Their focus, however, is on dichotomous variables measuring the onset of large changes towards autocracy or democracy. Instead, in keeping with the spirit of our model, we study changes in autocracy/democracy as a continuous variable. Also, Burke and Leigh do not condition the effect of commodity price changes on whether the country was initially democratic or autocratic, much less on infra-marginal differences in the initial level of political contestability. Finally, as already mentioned, in Burke and Leigh the effect of windfalls is mediated by their effect on income changes, while we estimate the direct effect of the windfall. For the reasons mentioned above there may be reasons to prefer a reduced-form specification.

As for the literature studying the effects of resource windfalls on political outcomes other than democracy/autocracy, a very incomplete list includes the theoretical studies of Tornell and Lane (1998), Baland and Francois (2000), and Torvik (2002), all of whom study theoretically the consequences of windfalls for rent seeking, and Leite and Weidmann (1999), Tavares (2003), Sala-i-Martin and Subramanian (2003), Dalgaard and Olsson (2008) and Caselli and Michaels (2011) that present corresponding empirical evidence (where rent seeking is usually measured though proxies of corruption). Caselli and Coleman (2006) examine theoretically the consequences of resource abundance for ethnic conflict, and Besley and Persson (2010) for political violence.[2] Cabrales and Hauk (2009) study the impact of resource windfalls on incumbents' probability of re-election, though their main focus is on the consequences for human-capital accumulation.

2 Natural Resources and Political Outcomes

2.1 Model

The setting is a discrete-time infinite-horizon economy which generates, in every period, a constant flow of consumption goods A from the exploitation of natural resources. Interpretations of A include: the flow of royalties and other fees paid to the government by international extracting companies for the right to operate in the country; profits of state-owned corporations engaged in drilling and mining; rents generated by the international distribution of domestic cash crops by state-controlled marketing boards; or other rents linked to cash-crops exports due to discrepancies between official and market exchange rates. We will refer to A as "resource rents."

The economy is populated by a very large number of infinite-lived agents. In every period one agent, which we term the "incumbent," has complete control of these flows, in the sense that he can decide how

[2]The mechanism in Caselli and Coleman (2006) and Besley and Persson (2010) is similar to ours: fiscal windfalls increase the value of holding power leading to grater incentives to engage in exploitation of others, repression and (for the non-incumbent group), fight back. However, initial political institutions are taken as exogenous, while they are endogenous in our model.

to allocate them between different uses. One should think of the incumbent as the individual or group of individuals who has *de facto* control of the government - and is hence in receipt of the resource rents. In a democracy this would be the President and his collaborators (in presidential systems), or the leadership of the governing parties (in parliamentary systems). In autocracies this would be the autocrat, his family, and his close associates. Aside from the benefits associated with control of the resource rent A, an incumbent also receives a flow of "ego rents" Θ. Assuming that there are additional benefits (both psychological and material) from holding political power is realistic and indeed standard in the literature.

In every period another agent (not the incumbent) is randomly selected by nature to be the "potential challenger." The potential challenger is given an opportunity to try to replace the incumbent. In particular, if the potential challenger decides to attempt to unseat the incumbent, the attempt will succeed with probability p. p is endogenous as we discuss shortly. In a democracy the potential challenger could be interpreted as the person with the best chance to win an electoral context against the incumbent president/party. In an autocracy it could be the agent best placed to successfully lead a coup or a popular uprising against the ruling clique. The assumption that in every period there is only one potential challenger is not important for the results but simplifies the analysis. For simplicity of presentation and again without loss of generality we also assume that potential challengers are drawn without replacement (i.e. each agent gets at most one chance to challenge) and that deposed incumbents never get a chance to challenge subsequent incumbents. The potential challenger has an outside option represented by the present value of his activities outside politics, which we denote Π.

As mentioned the incumbent must allocate the resource rent among possible uses. One use of the resource rents is what we call "self-preservation." Self-preservation spending is any spending that reduces the probability that a challenge succeeds (conditional on a challenge occurring). Hence, if B_t is self-preservation spending, the probability of a successful challenge is $p(B_t)$, with $p'(B_t) < 0$. Our interpretation of self-preservation spending is as a catch-all for all activities the government engages in in order to subvert the outcome of the political-selection process in his favor. It includes vote-buying and patronage spending, buying and/or bullying and intimidation of the media, and outright repression and persecution of opponents. The higher is B, the more aggressive and draconian the tactics employed. Hence, we think at variation in B as capturing infra-marginal variation in the efforts exerted by those currently in power to subvert the rules of the game in their favor, with greater values of B being associated with greater autocracy. By the same token, we think of $B = 0$ as the situation where the incumbent accepts to be challenged on a "free and fair" basis. In sum, we interpret countries with $B = 0$ as "democracy" and countries with $B > 0$ as displaying varying levels of autocracy. Since B also affects a potential challenger's chances of taking over we will also refer to B as a measure of *political contestability*.

In order to obtain crisp results, we need to pick a functional form for $p(B)$. We use

$$p(B) = \Omega e^{-\delta B},$$

where $\Omega \in (0, 1)$ and $\delta > 0$ are exogenous parameters. Hence, self-preservation spending is subject to decreasing returns, with $p(0) = \Omega$ - implying that a challenger can never be absolutely certain of success - and $p(B) > 0$ for all B - implying that an autocrat can never be absolutely sure of successfully withstanding a challenge. These features are important but seem sensible.

The portion of A not spent on self-preservation is spent on another activity, which we call "consumption"

and denote by C_t. C_t provides a direct utility flow to the incumbent, so that his total utility flow in period t is $C_t + \Theta$. Obviously one interpretation of C_t is resources appropriated by the incumbent and his clique for personal enrichment - the infamous "Swiss bank accounts." But in general C_t could be interpreted as an aggregate of all the spending that provides satisfaction to the incumbent and hence, possibly, it could include public spending on schools, hospitals, etc., if the incumbent is partially altruistic or derives satisfaction from doing a "good job."

The restrictive assumption is that the components of C_t do not affect p or Π. If the public is less tolerant of corrupt politicians, then we might expect the components of C_t that represent self-enrichment to enter p positively. If the public rewards competent politicians, we should expect the components of C_t that represent public spending to enter p negatively. Perhaps more importantly, public spending in infrastructure, human capital, and other growth-promoting public goods could improve the outside option of potential challengers by improving opportunities in the private economy. Hence, these components of C_t could increase Π. We abstract from these issues in order to get simple results, but see Caselli and Cunningham (2009) for a detailed discussion. We are also implicitly assuming that there is no scope for government borrowing, though as we discuss below this assumption could easily be replaced by an assumption that incumbents face an upward-sloping supply curve for borrowing, without qualitative changes in the results.

The series of events within each period is the following. First the incumbent allocates the period rents A between self-preservation B_t and consumption C_t. Next nature picks a potential challenger, and the potential challenger decides whether or not to try to unseat the incumbent. If yes, then the challenge success with probability $p(B_t)$. If the challenge succeeds, the challenger becomes the new incumbent. If it fails, the incumbent continues as incumbent, as he does if the challenger foregoes the opportunity to try. Time is discounted by all agents at rate β.

2.2 Analysis

We formally analyze the model in the Appendix. Here we offer a heuristic discussion and explain the key results.

We focus on Markov Perfect Equilibria (MPE), of which we show there is only one. Given that the only state variable is the resource rent A, and this is constant over time, it is immediate that players will follow stationary strategies, namely the incumbent will set the same value of B in every period, while the potential challenger will either always challenge or never challenge.

We begin by establishing the conditions for equilibria where the challenger always challenges. In such an equilibrium, the value of being an incumbent at the beginning of any period is

$$V(A, B') = \frac{\Theta + A - B'}{1 - \beta\left[1 - p(B')\right]},$$

where B' is the equilibrium level of self-preservation spending. In every period the incumbent receives ego rents Θ and consumes resource rents net of self-preservation spending $A - B$. This flow utility is appropriately discounted by taking into account time preferences β and the fact that in each period the probability of "political death" is $p(B')$. Note that for simplicity we have normalized the continuation value after losing office to 0.

One condition for an equilibrium with challenges is that the level of self-preservation spending must be

feasibly optimal from the point of view of the current incumbent. The current incumbent's problem is

$$\max_{B} \{\Theta + A - B + \beta [1 - p(B)] V(A, B')\}$$

$$\begin{aligned} \text{s.t..} B &\geq 0 \\ B &\leq A \end{aligned}$$

In choosing B the incumbent trades off the short-term decline in consumption with the improved probability of surviving until next period and enjoying the continuation value of office. The feasibility constraints say that self-preservation spending cannot be negative and cannot exceed the resources available to the incumbent.

Now define $b(A, B')$ as the solution to the above problem. In an equilibrium, $b(A, B')$ must be a fixed point, or

$$b(A, B') = B'.$$

In the appendix we show that this fixed-point problem has a unique solution. In particular, there exists a value of A, A_0, such that the solution is at the corner $B' = 0$ for $A \leq A_0$, while for $A > A_0$ B' is the interior solution to the problem above. We call this interior solution $B^*(A)$. $B^*(A)$ is increasing, concave, and satisfies $B^*(A_0) = 0$. The intuition for this result is simple, and can be illustrated with reference to the incumbent's problem above. The marginal cost of extra preservation spending is constant and equal to 1. The marginal return is $-p'(B)\beta V(A, B')$, i.e. the improvement in survival probabilities times the value of surviving. Since the value of surviving is increasing in A, there can be sufficiently low values of A such that the incumbent renounces all self-preservation efforts. On the other hand, if A is sufficiently large, the incumbent spends (increasing) amounts on self-preservation. The equilibrium amount of self-preservation is the one that equalizes marginal cost and marginal benefit.[3]

The threshold value A_0 is given by

$$A_0 = \frac{1 - \beta(1 - \Omega) - \beta\Omega\delta\Theta}{\beta\Omega\delta},$$

and is therefore decreasing in the "ego rents" from holding office. Intuitively, the larger the ego rents, the less the level of resource rents required to make the incumbent feel that incumbency is valuable enough to invest resources in protecting it. The technology of political replacement also affects A_0. In particular, a higher productivity of self-preservation spending, δ, makes the incumbent more willing to exert efforts in this direction, lowering the threshold for autocratic behavior.

As mentioned above we think of $B = 0$ as akin to the idea of "free and fair" political competition, and hence as democracy. Since democracy is the observed equilibrium outcome in many countries, we assume that there exists a region of the parameter space where it occurs. Formally,

Parametric Assumption (PA) 1:

$$A_0 > 0.$$

A second condition for an equilibrium where the challenger challenges is that challenging is optimal given the level of self-preservation efforts exerted by the incumbent. If the equilibrium incumbent strategy is B,

[3]We show in the appendix that the other constraint, $B \leq A$, is never binding.

the challenger decides to challenge if

$$p(B)\beta V(A,B) > \Pi. \tag{1}$$

The left hand side is the expected utility of challenging. This is equal to the time-discounted value of beginning next period as the incumbent, times the probability that the challenge will succeed. Note that we are implicitly assuming that the challenger experiences no flow utility in the period of the challenge (conditional on a challenge occurring). This could easily be relaxed without any change in results. Also note that for simplicity we normalize the value of a defeated challenger to 0. We discuss the implications of relaxing this assumption below. The right hand side is the (certain) utility from not challenging, i.e. the outside option Π.[4]

Since the value of holding office is increasing in A, condition (**??**) is satisfied for A if it is satisfied for $A = 0$. In turn, the condition is satisfied for $A = 0$ if the following parametric assumption holds.[5]

Parametric Assumption (PA) 2

$$\Pi < \frac{\beta\Omega\Theta}{1-\beta(1-\Omega)}.$$

Note that for $A = 0$ the incumbent chooses democracy. If PA2 did not hold incumbents would face no challenges in democracies. This would be counterfactual so PA2 seems like a plausible assumption. The simple interpretation of PA2 is that the ego rents from office are sufficiently attractive relative to private life to make potential challengers willing to try their luck at politics (when there are no resource rents and the country is a democracy).

A final requirement for an equilibrium where the challenger challenges is that the incumbent does not try to completely deter a challenge in the current period. The deviation that does so is the one that satisfies (**??**) with equality. Call $\tilde{B}_c(A)$ such a deviation. We show that there exists a level of A, $\tilde{A}$, such that $\tilde{B}_c(A) > A$ for all $A < \tilde{A}$. This says that "resource poor" incumbents cannot afford the level of preservation spending that would be required to completely deter challenges. Only when A is sufficiently large can an incumbent achieve complete control of his destiny. The value of $\tilde{A}$ is given by

$$\tilde{A} = \frac{1}{\delta}\log\frac{\beta\Omega\Theta}{\Pi(1-\beta)}.$$

This is increasing in the ego rents. Larger ego rents mean that potential challengers are less easily deterred, i.e. the required investments in self-preservation are larger, and therefore unaffordable for a broader range of values of A. Similarly, $\tilde{A}$ is decreasing in the opportunity cost of challenging and in the productivity of spending.

For values of $A \geq \tilde{A}$ deviating to a strategy of complete deterrence is feasible, and the question is whether the deviation is preferred. It turns out that this depends on whether $\log(\delta\Pi) + 1 \geq 0$ – in which case the deviation is preferred – or $\log(\delta\Pi) + 1 < 0$, in which case the incumbent sticks to the "interior" (non-deterring) amount of preservation spending. The intuition is that both δ and Π reduce the cost of full deterrence, the former by increasing the productivity of preservation spending, and the latter by making the

[4] Note that Π depends on β. In particular, if π is the flow utility in the private sector then $\Pi = \pi/(1-\beta)$.

[5] To see that PA1 and PA2 are mutually consistent notice that PA1 can be rewritten as

$$\frac{\beta\Omega\Theta}{1-\beta(1-\Omega)} < \frac{1}{\delta}$$

challenger more easily convinced thanks to a better outside option.

For reasons to be discussed shortly, we assume that even when a deviation is feasible the incumbent will not deviate from the "interior" strategy. Formally,

Parametric Assumption (PA) 3:

$$\log(\delta\Pi) + 1 < 0.$$

This leads to the following summary of the discussion so far.

Lemma 1. *Under PA2 and PA3 a MPE where the challenger challenges exists for all A. If $A \leq A_0$ then $B = 0$ (democracy). If $A > A_0$ then $B = B^*(A)$ (autocracy).*

We can now turn to the conditions for a MPE where the challenger is deterred. In this equilibrium the incumbent invests an amount $\tilde{B}(A)$ that solves

$$p(\tilde{B})\beta\tilde{V}(A, \tilde{B}) = \Pi,$$

where $\tilde{V}(A, \tilde{B})$ is now the value of incumbency when the challenger does not challenge. $\tilde{B}(A)$ is increasing and concave. By definition of $\tilde{B}(A)$ the challenger is deterred. Not surprisingly it turns out that the policy is feasible if $A \geq \tilde{A}$, but it is preferred by the current incumbent to a one-period deviation to the optimal "interior" level of B if PA 3 holds. Hence, we have the following result.

Lemma 2. *Under PA3 there is no MPE where the challenger is deterred.*

The reason for imposing PA3 are largely dictated by events in the Middle East and North-Africa of early 2011. Even regimes that were the byword for stability and entrenchment have appeared unable to discourage attempts to unseat them, irrespective of the large amounts of resources (from oil or from foreign aid) available to their rulers. PA3 rules out the possibility of complete deterrence.[6]

Note that Lemmas 1 and 2 imply that the MPE is unique. This gives rise to the following conclusion.

Conclusion. *In the unique MPE equilibrium, resource poor countries are democracies, while resource rich countries are autocracies. In autocracies, spending on self-preservation is an increasing and concave function of the resource rents.*

This result says that for values of the resource rent that are sufficiently small the value of staying in office is limited, and does not justify spending on self-preservation. Hence, resource poor countries will tend to be democratic. For higher values of resource rents the incumbent finds it optimal to exert efforts to remain in power, and does so up the point where the extra improvement in the expected value of staying in office is equal to the marginal cost of resources spent on self-preservation. Figure 1 depicts the equilibrium amount of self-preservation spending as a function of A.

To get us closer to our empirics we now consider the following thought experiment. Suppose that at some date the value of A unexpectedly increases by a (small) amount dA, and all agents expect it to remain constant at this value for the indefinite future (this is all consistent with rational expectations if A is believed to be a random walk). Then we obviously have

$$\begin{aligned} dB &= 0 \quad \text{for} \quad A \leq A_0 \\ dB &= B^{*\prime} \quad \text{for} \quad A_0 < A \end{aligned}$$

[6] If we were to replace PA2 with its opposite , and assumed $A_0 \leq \tilde{A}$ then we would have three types of political regimes: democracies ($B = 0$ for $A \leq A_0$); unstable autocracies ($B = B^*$ for $A_0 < A \leq \tilde{A}$); and stable autocracies ($B = \tilde{B}$ for $\tilde{A} < A$). While this set of outcomes may have seemed anecdotally appealing until recently we think this is no longer the case.

Hence, in resource-poor countries marginal increases in resource rents lead to no political change. However, in countries with non-negligible resource rents, further windfalls induce an increase in self-preservation spending. In particular for intermediate values of the rent flow the incumbent becomes keener to stay in office, and hence increases his efforts in this direction. For even larger initial levels of the resource flow, the incumbent finds that the required amount of spending needed to deter challengers goes up, and must correspondingly increase it. Because B^* is a concave functions of A, the response of self-preservation spending is decreasing in the resource flow over this range.

Combining the two sets of results on the level of B and the change of B as functions of the initial level of A, it is also possible to recast the latter set of results as conditioned on the initial level of democracy/autocracy. In particular, as we have noted, for low levels of A countries tend to be democratic. This implies that *in democracies, marginal changes in the flow of resource rents have no effect on the political equilibrium.* For larger values of the resource rent, countries are autocracies. Hence, we find that *in autocracies, marginal changes in the flow of resource rents make the political equilibrium more autocratic.* Furthermore, the degree of tightening of the autocratic screws is variable. Clearly the concavity of B^* with respect to the initial level of A also carries through to the relationship between the change and the initial level of B. Hence, *in autocracies, the increase in autocracy following an increase in resource revenues is diminishing in the initial level of autocracy.* For reasons we discuss below, the core empirical work in the paper is based on the predictions of this paragraph.

To fully appreciate the potential for the model to map into real-world outcomes it is essential to note that the threshold A_0 depends on parameters that are potentially country-varying. For example, a decline in the effectiveness of self-preservation spending δ or in the ego rents Θ shift the autocracy threshold A_0 to the right. In other words, countries with greater cultural, geographical, historical, or external resistance to autocracy – all features that should map into a lower value of δ – or countries where the same factors dictate that the balance between the privileges and the responsibilities of political power weighs the latter more (low Θ), will remain in democratic mode for a wider range of values of A. This way, the model can perhaps be seen as consistent with cases of high A associated with free and fair democracy, such as Norway.

Possibly one limitation of the model above is that we impose a balanced-budget constraint. It should be fairly obvious that the mechanism highlighted in the previous section will continue to work even if the government can tap into foreign financial markets to finance self-preservation spending. All that is needed is that the government faces an upward sloping supply curve of funds. relative to the model presented above, the marginal cost of self-preservation spending would be increasing, rather than a constant. There would still be a threshold analogous to A_0 for autocracy, and for higher values of A there would still be a unique interior optimal amount of self-preservation spending, increasing in A. A sufficient condition for self-preservation spending beyond A_0 to still be concave would be that the supply curve for foreign loans is convex, which is very likely to be the empirically relevant case.

3 Evidence

3.1 General strategy

The main result of the paper is a highly non-linear relationship between resource income A and self-preservation efforts B, as depicted in Figure 1. In principle, there are three possible approaches to try to identify this relationship empirically. We discuss the three approaches and explain why only one, which we discuss last, is likely to generate compelling evidence. In discussing the three approaches we assume we have good measures of A and B. In the next section we discuss the data in detail.

Given a measure of B the first plan that comes to mind (Plan A) is to try to get a measure of A and then use non-linear methods to directly estimate the function in Figure 1 using cross-country data in levels. There are at least two problems with this approach. First, is the well-rehearsed vulnerability of cross-country relationships to omitted variable bias. There may be plenty of hard-to-account-for factors correlated both with the volume of resource rents and the political system. Second, as discussed at the end of the previous section the autocracy threshold A_0 is likely to be country specific. Appropriate identification would therefore require explicitly modelling the dependence of A_0 on hard-to-measure country specific factors. The results would likely be fairly untransparent and inconclusive.

Plan B investigates the relationship between A and B *within countries*, or, equivalently, in differences, conditioning on the initial level of A. Looking at the effects of changes in A on changes in B eliminates time-invariant confounding country-specific factors that bias inference in levels. Country fixed effects can be added to control for country-specific trends in democracy/autocracy and time effects can be added to control for global trends. Hence, plans B largely sidesteps the first of the identification issues affecting Plan A. However, because it conditions on the initial level of A, Plan B still requires an estimate of country-specific autocracy thresholds A_0, so it is still unsatisfactory.

Plan C, like plan B, estimates the relationship in differences, but instead of conditioning on the initial level of A it conditions on the initial level of B. Our theoretical results say that countries to the left of the autocracy threshold are democracies so we can infer that if a country is a democracy it is to the left of its A_0. We therefore expect no effect of changes in A on changes in B in democracies. We also know from the model that countries to the right of A_0 are autocracies, and the further to the left they are the more autocratic they are. Hence, we can infer that autocracies are to the right of A_0, and the more autocratic they are the further to the right they are. We therefore expect that the effect of changes in A on changes in B is positive in autocracies, the less so the more autocratic the initial position. This plan largely sidesteps both the problem of omitted factors in levels and the country-specificity of the autocracy threshold.

3.2 Data

We construct a measure for B from the variable *Polity2* in the Polity IV database [Marshall and Jaggers (2005)]. *Polity2* is widely used in the empirical political-science literature as a measure of the position of a country on a continuum autocracy-democracy spectrum [e.g. Acemoglu, Johnson, Robinson, and Yared (2008), Persson and Tabellini (2006, 2009); Besley and Kudamatsu (2008); Brückner and Ciccone (2009)]. 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). Note, therefore, that *polity2* is an *inverse measure* of B.[7] We follow 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); Besley and Kudamatsu (2008); Brückner and Ciccone (2009), Olken and Jones (2009), Epstein et al. (2006)]. Nevertheless we discuss alternative thresholds in Section **??**.

To map the Polity Score into a proxy for B we make the following assumption:

$$\text{Polity}_{it} = \alpha - f(B_{it}) + \varepsilon_{it}, \tag{2}$$

where B_{it} is our variable of interest, f is a monotonic function with $f(0) = 0$, $\alpha > 0$ is a constant, and ε_{it} is an i.i.d. error with zero mean. These assumptions imply that when the government does not attempt to subvert in its favour the political process ($B = 0$) the polity measure tends to be positive and its variation to depend on factors we do not model. Instead, when the government takes an autocratic stance, the polity variable is decreasing in the aggressiveness of this stance.

As long as $f(B)$ is not (too) convex, Assumption (**??**) implies that the polity score will inherit the same properties of B in the model. In particular, for values of the polity score associated with democracies (polity> 0, or $B = 0$) changes in A have no systematic effect on changes in polity score. In autocracies (negative polity, or positive B) increases in A have *negative but decreasing* effects on changes in the polity score.

To measure natural-resource windfalls at the country level we proceed as follows. First, for each country and for each year that data is available we rank all commodities (in the universe of agricultural and mineral commodities) by value of exports. We then identify each country's principal commodity as the commodity that is ranked first in the largest number of year. The export data by commodity, country, and year are from the United Nation's Comtrade data set, which reports dollar values of exports according to the SITC1 system, for the period 1962 to 2009. Finally, we match each country's principal commodity with an annual time series of that commodity's world price. All commodity prices are extracted from the IMF IFS dataset, with the exception of Gemstones, Pig Iron and Bauxite, whose price series are obtained from the United States Geological Survey.

We identify a change in A in country i as a change in the price of country i's principal commodity. As both the identity of a country's principal commodity and its price in international markets are largely exogenous to the country's political outcomes we think this measure allows for clean identification of the causal effects of resource windfalls (we investigate robustness to dropping the largest producers below).

We study changes over the period 1962-2009. Our baseline sample consists of 131 countries with information on both principal-commodity export shares and polity2 scores. There are 32 distinct principal commodities in this sample. The most frequent are oil, which is the principal commodity in 30 countries and coffee (11 countries). Table 1 gives the list of these principal commodities and their distribution among

[7] The Polity2 variable is a modification of the basic Polity variable, added in order to facilitate the use of the Polity in time-series analysis. It converts "standardized authority scores"(-88, -77, -66) into conventional polity scores. In particular, "foreign interruptions" (-66) are coded as missing variables, cases of "interregnum and anarchy" (-77) are coded as 0, and "transitions" (-88) are prorated through the time span of the transition. We adjust Polity2 by assigning missing values to cases of interregnum and anarchy, to avoid the misleading representation of autocracies progressing toward democracy in periods of anarchy. In section **??** we investigate the robustness of our results to alternative adjustments of "standardized authority scores."

countries.

Summary statistics are presented in Table 2. $\Delta Polity$ is the one-year difference in Polity2, while AvgΔPrice is the average growth rate in the price of the principal commodity over a three-year window (we discuss timing issues below). AvgShare is the average over time of the value of exports of a country's principal commodity as a share in GDP. Countshare Princ indicates the number of years the principal commodity has been the principal export, while Countshare is the total number of years in which commodity shares are available. Some of the notable features in the data are the huge variation in the polity2 score (spanning the entire set of possibilities in all years) and the secular trend towards greater democracy. The table also shows that principal commodities are ranked first in almost all years in which resource shares are available. Finally, the table shows that there is much variation in the measure of resource windfalls.

3.3 Results

Our main empirical results are presented in Table 3. The dependent variable is the one-year change in *Polity2*. Recall that an increase in this variable means that the country becomes less autocratic (more democratic). In column 1 the explanatory variable is the lagged change in the price of the principal commodity, averaged over the previous three years. Hence, 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 $t-1$. We look at lagged changes in prices to defuse lingering concerns about reverse causation, as well as to allow for possible lags in the reaction of political actors to economic events. We take averages of price changes over three periods to reduce the role of extremely transitory shocks as well as measurement error in the explanatory variable. By construction, however, the rolling windows introduce serial correlation in the estimates. To account for this, we cluster the standard errors at the country level in all regressions, allowing for heteroskedasticity and arbitrary correlation in the error term. We further report on robustness to timing assumptions below. Country and time fixed effects are included here, and in all subsequent specifications.

Column 1 reports estimates for the average effect of resource windfalls, which is negative but not statistically significant. Recall that in our theory the average effect is a weighted average of nil effects in democracies and negative effects in autocracies, and thus depends on the relative frequency of autocratic and democratic observations. In our sample the number of democracies substantially exceeds the number of autocracies (2236 versus 1818 observations). It is therefore not surprising that the overall effect is not statistically significant.

In the remaining columns we test our more detailed predictions. Column 2 looks at the effect of price changes in democracies and autocracies separately. This is accomplished by separating out the price-change variables into two variables: the first is an interaction between the price change and a dummy for autocracy (following the literature convention that identifies autocracies as countries with a negative *polity2* score); the second is an interaction between price change and a dummy for democracy (non-negative *polity2*).[8] To be consistent with the starting date for the price shock implied by our lagging choices we measure the initial level of autocracy democracy with a four year lag, or in year $t-4$. As predicted by the model, price changes in the principal commodity have a negative impact on the *polity2* score in autocracies, i.e. make autocracies

[8]It can be easily checked that this is equivalent to including the price change by itself and then an interaction between the price change and, say, a democracy dummy. Our specification makes the interpretation of the coefficients even more straightforward.

more autocratic. Instead, they have no significant impact on the *polity2* score in democracies.[9]

Our model not only has predictions for the average effect of resource windfalls in democracies and autocracies, but also on the relative magnitude of the effect depending on the initial value of (resource rents and hence) the measure of political contestability. In particular, the prediction is that in democracies commodity-price changes will have no impact not only on average but also for any initial level of *polity2*. Instead, in autocracies the magnitude of the effect should be increasing in contestability: small in very aggressive autocracies, and larger as the autocracy takes milder forms. We test this prediction in Column 3, where we add four-year lags of *polity2* both, by themselves and interacted with the (autocracy/democracy specific) price change, the latter being the variable of interest. The conditioning variable has been entered with a lag to allow once again for potentially slow responses by political actors**.** As predicted, in democracies commodity price changes have no impact at any level of initial polity2, while in autocracies the increase in autocracy following a resource windfall is larger the higher the initial value of *polity2*, i.e. the less autocratic the form of government was initially. The estimated coefficients imply that the impact of resource windfalls for a mild autocracy at polity2 level -2 is almost 13 times stronger than for a consolidated autocracy at polity2 level -9.

The results in Columns 1-3 are based on OLS estimation. In Column 4 we show that the results are virtually unchanged using System-GMM estimation. System-GMM provides consistent estimates in dynamic panel data model with fixed effects, by instrumenting the differenced variables that are not strictly exogenous with all their available lags in levels and differences. This removes the bias introduced in OLS estimates by the within group transformation, which by construction produces a correlation between the transformed lagged dependent variable and the transformed error term [Nickell (1981), Bond (2002)]. The system GMM results in Column 4 are very close to the original OLS.

Our main results are illustrated in Figure 2, which plots the estimated effect of a change in the price of the principal commodity on the change in polity2, conditional on the initial level of polity2, together with 90% confidence bands. In the top panel, we have the average (unconditional) effect, which is negative but insignificant. In the middle panel we have average effects in democracies and autocracies separately. The effect is negative in autocracies and nil in democracies. In the bottom panel we plot the response conditional on infra-marginal differences in contestability. The increase in autocracies is more severe the milder the initial level of autocracy.

3.4 Robustness checks

In this section we report a number of robustness checks on our results from the previous subsection. In particular, we discuss robustness to: alternative criteria for inclusion in the sample based on (i) importance of the principal commodity in the economy and (ii) accuracy of the identification of the principal commodity; (iii) focusing on observations away from the lower and upper bounds of *polity2*; (iv) dropping large commodity producers with the potential of influencing the world price; (v) measuring resource-rent shocks based on a basket of commodities rather than only the principal commodity; (vi) breaking down commodities by type (mineral v. non-mineral; point-source v. diffuse); (vii) alternative ways to treat problematic values of *polity2*; (viii) alternative measures of the outcome variable; (ix) alternative timing structures for the relationship

[9] In Column 2 and elsewhere in the table the coefficients on the level of initial contestability is negative in democracies, and insignificant in autocracies. This suggests that there is some convergence among democracies but not among autocracies.

between outcomes and shocks; and (x) alternative thresholds for democracy.

Table 4 checks the robustness of our results to the exclusion of countries whose principal commodity accounts for only a small share of GDP. For these countries it is unlikely that a price change represents a large windfall, so focusing on a smaller sample with significant principal-commodity share is arguably a better test for our model.[10] Columns 1 to 3 exclude countries in the first decile of the average share distribution (14 countries, typically modern democracies with a diversified economy); columns 4 to 6 exclude countries in the first quartile (38 countries); and columns 7 to 9 exclude all countries below the median average share (68 countries). Results from baseline sample are confirmed and generally reinforced as we progressively increase the threshold to be included in the sample. In particular the point estimates for the average effect in autocracy (columns 2, 4 and 6) become more negative as we focus on more commodity dependent countries. Also the lagged level of polity2 interacted with the (autocracy specific) price change remains negative and significant throughout all subsamples, confirming the heterogeneous impact of resource windfalls within autocracies.

In Table 5 we show results are robust to the possible sample selection induced by data availability. As some countries only report few years of export data, their principal commodity may be poorly identified. We address this concern in a number of ways. First, we rank countries by number of years on which it was possible to identify the principal commodity. We then drop the 25% with fewest years (which turn out to be countries with at most nine years of export-share data). The results are in Columns 1 to 3. Columns 4 to 6 restrict the sample to countries for which we observe export data for the principal commodity at least once before 1986, which is the mid-point of the sample period. In columns 7 to 9 we also include those countries that do not have share data before 1986, but whose principal commodity has always been ranked first afterwards. In this case it is plausible to assume that the commodity had been important before 1986, even though there is lack of data to confirm it. Our results are robust to all these checks.

Table 6 investigates the robustness of our result on the heterogeneous impact of resource windfalls within autocracies. One potential concern is that such heterogeneity might be driven by the boundedness of the polity scale. The argument is that observations at the -10 boundary are more constrained in their movements than non-boundary observations. In particular, as they can't go lower than -10, price increases would not result in institutional changes. To address this concern in a number of ways. In column 1 we restrict the sample to non-negative polity2 changes, so that countries at the -10 boundary are unconstrained in their movements. We still find a negative and highly significant heterogeneous effect among autocracies. In column 2 we perform a similar exercise, but replace the polity2 change by a dummy variable that takes the value of 1 if we observe a positive change and 0 otherwise. This weighs all institutional changes equally. The heterogeneous impact of price variation is also maintained under this specification. Column 3 restricts the sample to all countries that never touched the [-10, +10] boundaries. This is the sample of countries that had effective free movements in both positive and negative directions. In this case the differential impact of price variation, while still present, turns marginally insignificant (p-value 0.13). Finally in column 4 we exclude all country-year observations at the [-10, 10] boundaries. Limiting the sample to the unbounded cases provides consistent estimates for censored regressors [Rigobon and Stoker (2007, 2009)]. The results again confirm the heterogeneity among autocracies.

[10] However this benefit should be weighed against the fact that the size of the commodity sector is endogenous. Hence this exercise reintroduces through the back door of sample selection the endogeneity issues we sought to avoid by focusing on price changes. This is why the exercise is a robustness check. Our prefereed approach remains the one in the previous section.

In a further effort to probe the role of observations at the -10 boundary, we estimate the heterogenous effect of price changes non parametrically. We divide all observations into six bins, depending on the value of *polity2*, and re-estimate the relationship between changes in *polity2* and changes in principal-commodity prices separately for each of these bins (always including country and year fixed effects). The six bins are for *polity2* values [-10,-8], [-7,-6], [-5,0], [1,5], [6,7], and [8,10], respectively. These bin sizes were chosen to have as uniform as possible a sample size across bins, while at the same time preserving symmetry between "autocratic" and "democratic" bins. The estimated coefficients and the relative confidence bands (at the 90% level) are plotted against the average value of *polity2* in each bin in Figure 3. The figure shows that even in the second bin from the bottom, the effect of price changes is considerably weaker than in the third bin. This is important because for observations in this bin the upper bound at -10 does not appear ever to be binding. To check this, we have calculated, for each initial value of the *polity2* variable on the right hand side of our main regression, the fraction of (strictly) negative policy changes equal to the distance from the lower bound, on the left hand side. For example, for observations at *polity2*=-7, we computed the fraction of negative changes equal to -3. The results, reported in Appendix Table **1** (together with the analogous numbers for positive changes), show that the lower bound at -10 is *never* binding for changes in any of the five bins other than the bottom bin.[11]

In Table 7 we address the plausible concern that current commodity prices are affected by expectations of future political developments in the main world producers. We therefore exclude from the sample all countries belonging to OPEC (columns 1 and 2) and those accounting for more than 3% of total world production of their principal commodity (columns 3 and 4).[12] Despite the significant drop in sample size, in our key specifications the results on the heterogeneous impact among autocracies remain robust at least at the 10% significance level.

Our source of identification for resource windfalls stems from variations in the international price of the principal commodity. Other authors in this field [Deaton (1999), Ciccone and Brückner (2010), Besley and Persson (2010)] use instead a country-specific composite price index, weighting commodity prices by the each commodity's share in the country's total exports. We have not followed this strategy because of concerns with the possible endogeneity of commodity shares (as well as measurement error). However in Table 8 we check the robustness of our results to this alternative specification, constructing a country-specific index based on commodities in our sample. In column one we weight price changes by each country's time average of the share of that commodity in exports. Because time coverage of the share data varies dramatically over time, these averages are also computed over very different time periods from country to country. In the other columns we follow the far superior practice of using shares in a given year. The downside of this is that sample sizes shrink significantly as in each year there is a sizable subset of countries for which shares are not observed. In these experiments, the qualitative patterns of our baseline results are robust, but statistical significance is not always achieved.

In Table 9 we deal with the issue of commodity typology. An important distinction that has been made

[11] It may seem strange that there are strictly negative changes at initial *polity2* equal to -10, but remember that the initial value is observed with a four year lag. It is thus possible for a country that was at -10 4 years before to have since moved to a level strictly less than -10 and then have a regression between year t-1 and t.

[12] We treat Indonesia and Gabon as OPEC countries, as they belonged to the organization for more than half of the sample period. Instead, we exclude Angola and Ecuador, who joined the OPEC only in 2007. Alternative treatments of these countries do not alter the results. A list of the major producers by prinicpal commodity , as well as data sources for commodity production, is given in Appendix Table 2.

in the literature is between point source and diffuse natural commodities [Sokoloff and Engerman (2000), Isham et al. (2005)]. The former are believed to foster weaker institutional capacity and induce greater resistance to democratic reforms than the latter, as they are generally more valuable and easier to control for the ruling elite. We therefore expect our theory to apply more strictly to point source countries. We take as point source all mineral commodities plus coffee, cocoa, sugar and bananas [agricultural commodities identified as point source in Sokoloff and Engerman (2000), Isham et al. (2005)]. Our data show that point source producers are indeed more autocratic (average polity2 level -0.81) than countries with diffuse principal commodities (average polity2 level 3.13). A mean comparison test rejects the null hypothesis of means equality at the 99% confidence level (t-stat 17.4). Column 1 in Table 9 confirms our baseline results for the sample of point source producers: the impact of resource windfalls is negative and heterogeneous within autocracies, while it has no effect in democracies. Column 2 shows instead that there is no significant effect for diffuse commodity producers, neither in autocracy nor in democracy. In columns 3 and 4 we consider an alternative classification, taking as point source commodities minerals only. Column 3 confirms the results for mineral autocratic countries. Column 4 considers non mineral countries only and displays a negative average relation between price and institutional change, with no evidence of heterogeneity in the effect. Altogether, Table 9 provides support for our theory in point source producers under both alternative classifications, while it is less conclusive for diffuse commodities producers.

As reported in section **??**, the *polity2* variable codes foreign interruptions as missing variables, cases of interregnum and anarchy with a "neutral"score of 0, while transitions are prorated through the time span of the transition. There exists a general agreement in recent literature on the miscoding of interregnum and anarchy, as the 0 score often produces the wrong representation of autocracies progressing toward democracy in periods of anarchy [Brückner and Ciccone (2010), Burke and Leigh (2010), Plumper and Neumayer (2010)]. The adopted solution consists in assigning missing values to interregnum and anarchy periods. We have applied the same methodology in this paper. In Table 10 we set all observations pertaining to transition periods to missing and we still get (in Column 3) a significantly heterogeneous effect among autocracies..

One set of robustness checks that did not prove consistent with our baseline results was the use of alternative proxies for our variable B, which in our model represents the self-preservation activities of incumbents. We tried two alternative measures of political repression: the Political Terror Scale (Wood and Gibney, 2010), and the CIRI index of human rights (Cingranelli and Richards, 2008).[13] PTS uses data from Amnesty International and the US State Department. It gives a classification 1-5 from lowest to highest human insecurity and provides a single score into which multiple dimension of abuse have been collapsed. The CIRI index explicitly codes four different types of abuses: disappearances; political torture; imprisonment of political opponents; killing of political opponents. It then constructs a nine point scale of "physical integrity"based on the sum of these components. Neither of these measures turned out to be significantly related to resource windfalls in our sample. One relevant concern with such measures of repression however is that they only capture outcomes. As has been noted by other authors as well, the PTS (but the same can be said of the CIRI Index) "measures actual violations of physical integrity rights more than it measures general political repression. In fact there will be instances in which one government is so repressive that, as a consequence,

[13]Another plausible candidate is the variable "purges"from the Banks database, which unfortunately is not available free of charge.

there are relatively few acts of political violence" (Wood and Gibney, 2010, p. 370). This is to say, most repressive countries can score low values of human rights violations as the high expected punishment deters any actions that could trigger overtly repressive acts. This represents a main difference with respect to the *polity2* variable, which attempts to capture not only outcomes but also procedural rules. In addition, *polity2* aims to include a broader set of dimensions along which political activity can be distorted, beyond physical repression. These observations are corroborated by the low correlation between the *polity2* scores and the PTS and CIRI scores (0.36 and 0.37, respectively).

Throughout our empirical analysis the main explanatory variable is the lagged change in the price of the principal commodity, averaged over the previous three years. This means that institutional changes between 1979-1980 are explained by average price changes in 1977-1979; institutional changes between 1980-1981 are explained by average price changes in 1978-1980, and so on. The rolling window specification has the clear advantage of smoothing out extreme observations and reducing measurement error, and the resulting serial correlation in the estimates can be dealt with by clustering the standard errors at the country level, allowing for heteroskedasticity and arbitrary correlation in the error term, as we have done. To further check the robustness of our results to the timing structure, Table 11 presents estimates using three years non-overlapping windows. This reduces the sample size by two thirds, which in turn increases standard errors. Yet, we still find some evidence consistent with our baseline specification. In particular, in column 3 the key interaction term between initial political institutions and price changes still takes a negative (and 10% significant) coefficient. We have also tried a different exercise related to the timing structure, maintaining the overlapping nature of our explanatory variable but changing the time horizon. We have thus estimated the effect of five and ten years rolling windows on institutional changes between $t-1$and t. In the case of the five years window, the coefficients have the same signs, but are not statistically significant; in the case of the ten years widow, the effect is negative and significant for the average autocracy but displays no heterogeneity.

While a large majority of authors have interpreted positive values of *polity2* as pertaining to democracy, one can find in the literature examples of authors who have used a more stringent criterion. Thus in Table 12 we present results using alternative thresholds. Our results are statistically robust when using thresholds of 1 and 2. For more demanding definitions of democracy the results are qualitatively robust, but lose statistical significance. A final robustness check we performed was on the sensitivity of our results to possible outliers. We re-run our specifications excluding all the observations in the top 1% of the distribution of price changes (in absolute value) and/or in the top 1% of the distribution of *polity2* changes. We also excluded all influential observations, as identified by the DFBETA method, once again without changes in results. These results are available on request.

4 Conclusions

We have presented a model of endogenous political-regime determination as a function of natural-resource rents. The model predicts that, everything else equal, resource poor countries will be more likely to be democracies that resource rich ones. It further predicts that, among autocracies, resource windfalls will trigger further moves towards harsher forms of autocracy, with the effect being larger for initially mild autocracies. These predictions find empirical support in a broad panel of countries.

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5 Appendix: Formal Analysis of the Model

5.1 Equilibria where the challenger always challenges

5.1.1 Optimal choice of B subject to challenger challenging

The problem solved by a generic incumbent when all other incumbents choose B' and the challenger always challenges is

$$\max_B \beta(1-\Omega e^{-\delta B})V(A,B') + A + \Theta - B,$$

s.t. $0 \leq B \leq A$. Define $B^*(A,B')$ as the solution to

$$e^{-\delta B^*} = \frac{1}{\beta\Omega\delta V(A,B')}.$$

Since $V(A,B') > 0$ $B^*(A,B')$ exists for every A.

The equilibrium value of B must satisfy

$$\begin{aligned} B &= 0 \text{ if } B^*(A,0) < 0 \\ B &= B^*(A,B) \text{ if } 0 \leq B^*(A,B) \leq A \\ B &= A \text{ if } B^*(A,A) > A \end{aligned}$$

Begin by computing $B^*(A,0)$. Since

$$V(A,0) = \frac{A+\Theta}{1-\beta(1-\Omega)}$$

we have

$$e^{-\delta B^*(A,0)} = \frac{1-\beta(1-\Omega)}{\beta\Omega\delta(A+\Theta)}.$$

Hence $B^*(A,0) < 0$ if the expression on the right hand is greater than 1. This can be rearranged to

$$A < \frac{1-\beta(1-\Omega)-\beta\Omega\delta\Theta}{\beta\Omega\delta} \equiv A_0.$$

By PA1 in the text $A_0 > 0$.

Next we compute $B^*(A,B)$.Since

$$V(A,B^*) = \frac{A+\Theta-B^*}{1-\beta(1-\Omega e^{-\delta B^*})}$$

we have

$$e^{-\delta B^*} = \frac{1-\beta(1-\Omega e^{-\delta B^*})}{\beta\Omega\delta(A+\Theta-B^*)}.$$

Rearranging,

$$e^{\delta B^*} = \frac{\beta\Omega\left[\delta(A+\Theta)-1\right]}{1-\beta} - \frac{\beta\Omega\delta}{1-\beta}B^*.$$

The right side is monotonically increasing, ranging from 0 to infinity. The left side is monotonically

decreasing, ranging from positive to negative infinity. Hence B^* always exists. The intercept of the left side on the vertical axis is grater than1 if $A > A_0$. Hence the condition $B^* > 0$ is satisfied for $A > A_0$.

Define $B^*(A)$ the solution to the fixed point problem we have just examined. We have $B^*(A_0) = 0$ (as the intercept of the right side of the expression above is 1). Using the implicit function theorem we also find

$$\begin{aligned} B^{*\prime}(A) &= \frac{1}{\delta(A + \Theta - B^*(A))}, \\ B^{*\prime\prime}(A) &= -\frac{1}{\delta(A + \Theta - B^*(A))^2}, \end{aligned}$$

so $B^*(A)$ is increasing and concave. Plugging in the expression for A_0 in $B^{*\prime}(A)$, and recalling that $B^*(A_0) = 0$ one can check that $B^{*\prime}(A_0) < 1$. This implies that the $B^*(A)$ function never crosses the 45-degree line, so the condition $B^*(A, A) > A$ is never satisfied.

5.1.2 Optimality of decision to challenge

We have established that in this MPE (if it exists) the incumbent plays

$$\begin{aligned} B &= 0 \text{ if } A \leq A_0 \\ B &= B^*(A) \text{ if } A_0 < A. \end{aligned}$$

Subject to the game continuing as one where challengers challenge, the challenger of a generic period challenges if

$$\beta p(B) V(A, B) > \Pi.$$

Since $V(A, B)$ is increasing in A (after taking into account the dependence of B on A, and using the fact that $B^{*\prime}(A) < 1$) the condition is satisfied for all values of A if it is satisfied for $A = 0$. For $A = 0$ the condition is

$$\frac{\beta\Omega\Theta}{1 - \beta(1 - \Omega)} > \Pi,$$

which is PA2.

5.1.3 Absence of profitable deviations for incumbent

The last thing to check is that a generic incumbent cannot or does not wish to implement a one-period deviation that deters the current challenger from challenging. Call the deviation $\tilde{B}_c(A)$. This is given by

$$\Omega e^{-\delta \tilde{B}_c} \beta \frac{A + \Theta - B^*(A)}{1 - \beta\left[1 - \Omega e^{-\delta B^*(A)}\right]} = \Pi.$$

Note that

$$\Omega e^{-\delta B^*(A)} \beta \frac{A + \Theta - B^*(A)}{1 - \beta\left[1 - \Omega e^{-\delta B^*(A)}\right]} = \frac{1}{\delta}.$$

Hence

$$\frac{e^{-\delta B^*(A)}}{e^{-\delta \tilde{B}_c(A)}} = \frac{1}{\Pi\delta}$$

Or

$$\tilde{B}_c = B^* - \frac{1}{\delta}\log(\Pi\delta).$$

The deviation dominates if

$$\begin{aligned}
A+\Theta-\tilde{B}_c+\beta\frac{A+\Theta-B^*}{1-\beta\left[1-\Omega e^{-\delta B^*}\right]} &> \frac{A+\Theta-B^*}{1-\beta\left[1-\Omega e^{-\delta B^*}\right]}\\
A+\Theta-B^*+\frac{1}{\delta}\log(\Pi\delta)+\beta\frac{A+\Theta-B^*}{1-\beta\left[1-\Omega e^{-\delta B^*}\right]} &> \frac{A+\Theta-B^*}{1-\beta\left[1-\Omega e^{-\delta B^*}\right]}\\
A+\Theta-B^*+\frac{(\beta-1)\left[A+\Theta-B^*\right]}{1-\beta\left[1-\Omega e^{-\delta B^*}\right]} &> -\frac{1}{\delta}\log(\Pi\delta)\\
\frac{\left\{1-\beta\left[1-\Omega e^{-\delta B^*}\right]\right\}(A+\Theta-B^*)+(\beta-1)\left[A+\Theta-B^*\right]}{1-\beta\left[1-\Omega e^{-\delta B^*}\right]} &> -\frac{1}{\delta}\log(\Pi\delta)\\
\frac{\beta\Omega e^{-\delta B^*}(A+\Theta-B^*)}{1-\beta\left[1-\Omega e^{-\delta B^*}\right]} &> -\frac{1}{\delta}\log(\Pi\delta)\\
\frac{1}{\delta} &> -\frac{1}{\delta}\log(\Pi\delta)\\
1 &> -\log(\Pi\delta),
\end{aligned}$$

which is the opposite of PA3. Hence PA3 insures the existence of a MPE where the challenger always challenges. (Note that the deviation described above may be unfeasible for certain values of A in which case *a fortiori* the existence of the challenging equilibrium is confirmed.)

5.2 Equilibria where the challenger never challenges

Define $\tilde{V}(A,B)$ the value of incumbency in a MPE where the challenger never challenges and all incumbents play B:

$$\tilde{V}(A,B) = \frac{A+\Theta-B}{1-\beta}$$

The condition that assures that the challenger does not challenge is

$$\beta\Omega e^{-\delta B}\frac{A+\Theta-B}{1-\beta} \leq \Pi.$$

For reasons already seen above there exists a unique solution to the equation

$$\beta\Omega e^{-\delta B}\frac{A+\Theta-B}{1-\beta} = \Pi.$$

We call this solution $\tilde{B}(A)$. Note that $\tilde{B}(A)$ is strictly increasing.

The condition that $\tilde{B}(A) > 0$ for all A is given by

$$\frac{\beta\Omega\Theta}{(1-\beta)\,\Pi} > 1,$$

which is trues in view of PA2..

It is obvious that any $B > \tilde{B}$ cannot be an equilibrium. Any incumbent would deviate to a lower level

of B. Obviously for $\tilde{B}$ to be an equilibrium it must be feasible, or

$$\tilde{B}(A) \leq A.$$

Since $\tilde{B}(0) > 0$, there exists an interval of values for A such that an equilibrium where the challenger does not challenge does not exist.

Now rewrite the definition of $\tilde{B}$ as

$$e^{-\delta B}\left(A + \Theta - B\right) = \frac{\Pi(1-\beta)}{\beta\Omega},$$

then using the implicit function theorem

$$\begin{aligned}
\tilde{B}'(A) &= \frac{1}{\delta\left(A + \Theta - \tilde{B}(A)\right) - 1}, \\
\tilde{B}''(A) &= -\frac{\delta}{\left[\delta\left(A + \Theta - \tilde{B}(A)\right) - 1\right]^2} < 0.
\end{aligned}$$

Because $\tilde{B}(A)$ is concave and $\tilde{B}(0) > 0$, there exists a $\tilde{A} > 0$ such that $\tilde{B}(A) < A$ for $A > \tilde{A}$. $\tilde{A}$ is defined by

$$e^{-\delta\tilde{A}}\Theta = \frac{\Pi(1-\beta)}{\beta\Omega},$$

or

$$\tilde{A} = \frac{1}{\delta}\log\frac{\beta\Omega\Theta}{\Pi(1-\beta)}.$$

The key condition that must be satisfied by an equilibrium with no challenges is that the incumbent does not wish to deviate to a lower B. A generic deviation B is dominated if

$$A + \Theta - B + \beta(1 - \Omega e^{-\delta B})\frac{A + \Theta - \tilde{B}}{1-\beta} < \frac{A + \Theta - \tilde{B}}{1-\beta}.$$

The left side is maximized by $B_c^*(A, \tilde{B})$, which, after rearranging the first order condition is given by

$$B_c^*(A, \tilde{B}) = \frac{1}{\delta}\log\delta\beta\Omega V(A, \tilde{B}).$$

Plugging this back into the left side of the inequality above we have

$$\begin{aligned}
A+\Theta-\frac{1}{\delta}\log\delta\beta\Omega V(A,\tilde{B})+\beta\left(1-\frac{1}{\delta\beta V(A,\tilde{B})}\right)V(A,\tilde{B}) &< \frac{A+\Theta-\tilde{B}}{1-\beta}\\
A+\Theta-\frac{1}{\delta}\log\delta\beta\Omega V(A,\tilde{B})+\beta\frac{A+\Theta-\tilde{B}}{1-\beta}-\frac{1}{\delta} &< \frac{A+\Theta-\tilde{B}}{1-\beta}\\
A+\Theta-\frac{1}{\delta}\log\delta\beta\Omega V(A,\tilde{B})-\frac{1}{\delta} &< A+\Theta-\tilde{B}\\
-\frac{1}{\delta}\log\delta\beta\Omega V(A,\tilde{B})-\frac{1}{\delta} &< -\tilde{B}\\
\frac{1}{\delta}\left[\log\delta\beta\Omega V(A,\tilde{B})+1\right] &> \tilde{B}\\
\exp\left[\log\delta\beta\Omega V(A,\tilde{B})+1\right] &> e^{\delta\tilde{B}}
\end{aligned}$$

Now recall that

$$e^{\delta\tilde{B}(A)}=\frac{\beta\Omega V(A,\tilde{B}(A))}{\Pi}$$

so the condition for $\tilde{B}$ to be an equilibrium is

$$\begin{aligned}
\exp\left[\log\left(\delta\beta\Omega V(A,\tilde{B})\right)+1\right] &> \frac{\beta\Omega V(A,\tilde{B})}{\Pi}\\
\exp\left[\log(\delta)+1+\log\left(\beta\Omega V(A,\tilde{B})\right)\right] &> \exp\left[\log(1/\Pi)+\log\left(\beta\Omega V(A,\tilde{B})\right)\right]\\
\exp\left[\log(\delta)+1\right] &> \exp\left[\log(1/\Pi)\right]\\
\exp\left[\log(\delta)+1\right]\exp\left\{-\left[\log(1/\Pi)\right]\right\} &> 1\\
\exp\left[\log(\delta)+1-\log(1/\Pi)\right] &> 1\\
\exp\left[\log(\delta)+1+\log(\Pi)\right] &> 1\\
\exp\left[\log(\delta\Pi)+1\right] &> 1\\
\log(\delta\Pi)+1 &> 0,
\end{aligned}$$

which once again is the opposite of PA3 so PA3 rules out equilibria where the challenger never challenges.

Figure 1. Theoretical relation between resource revenues and autocracy

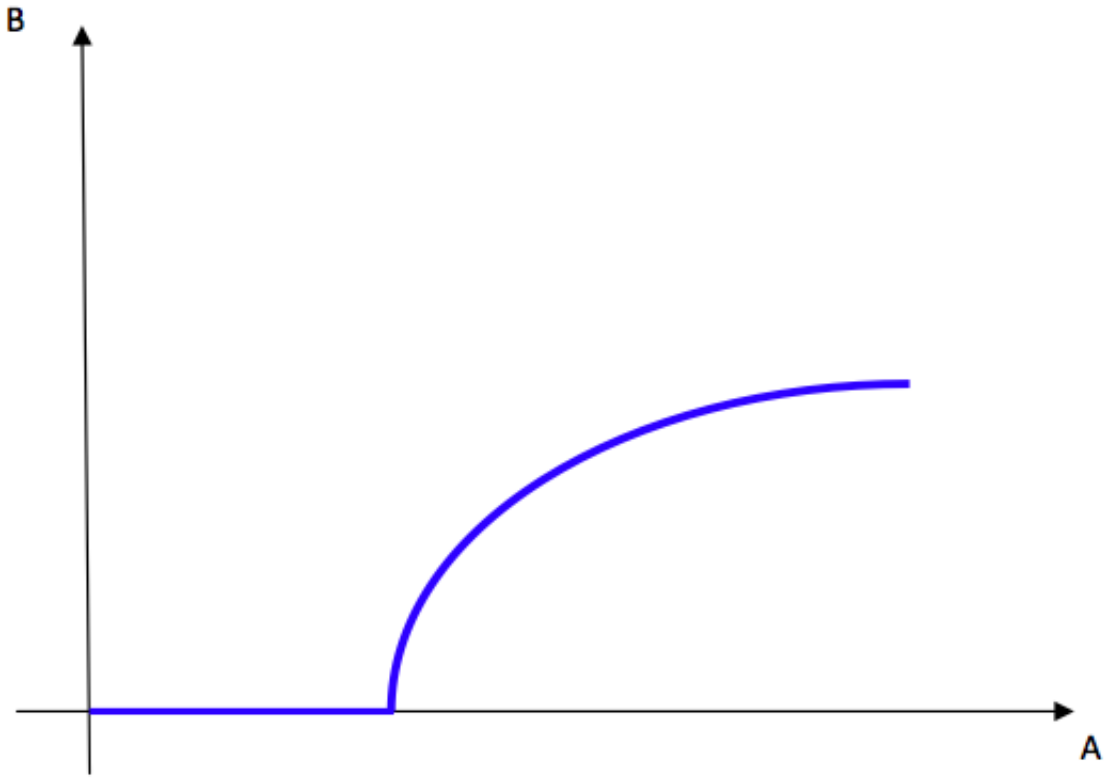
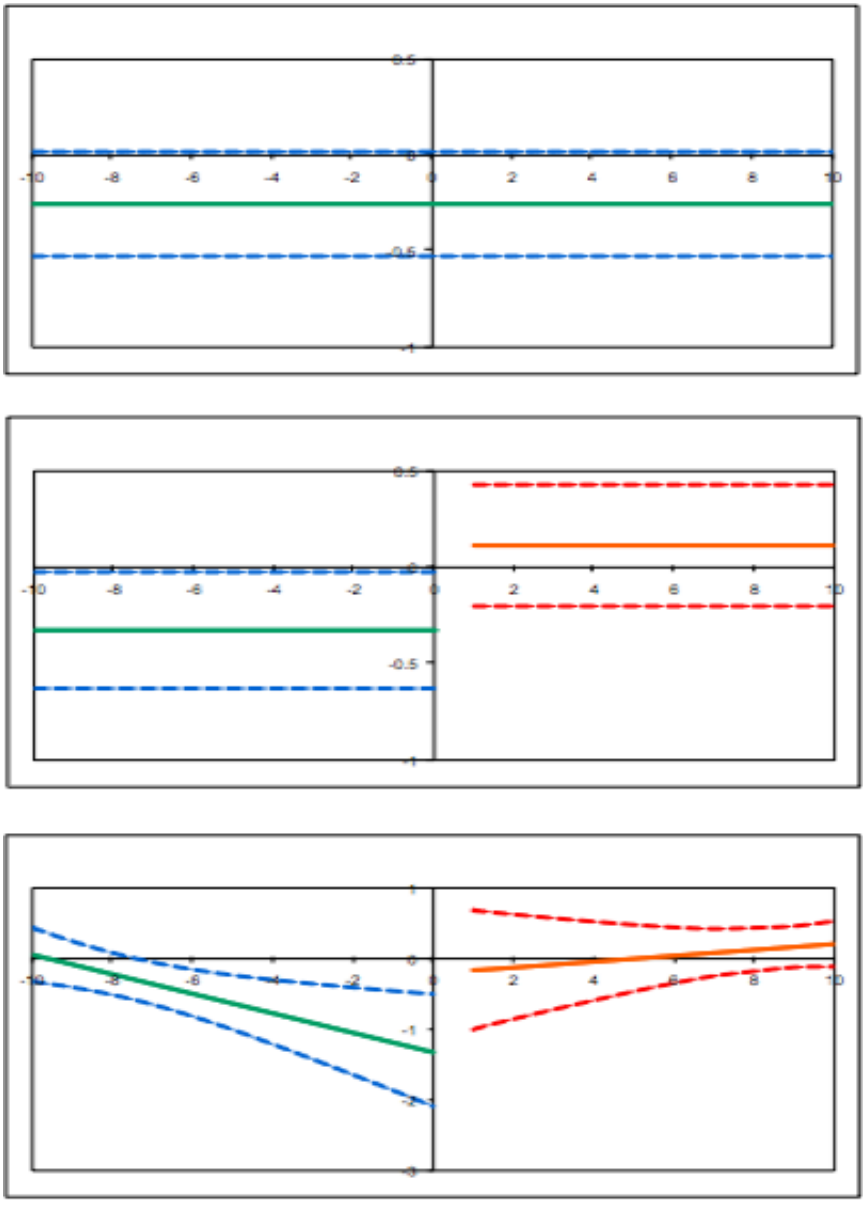
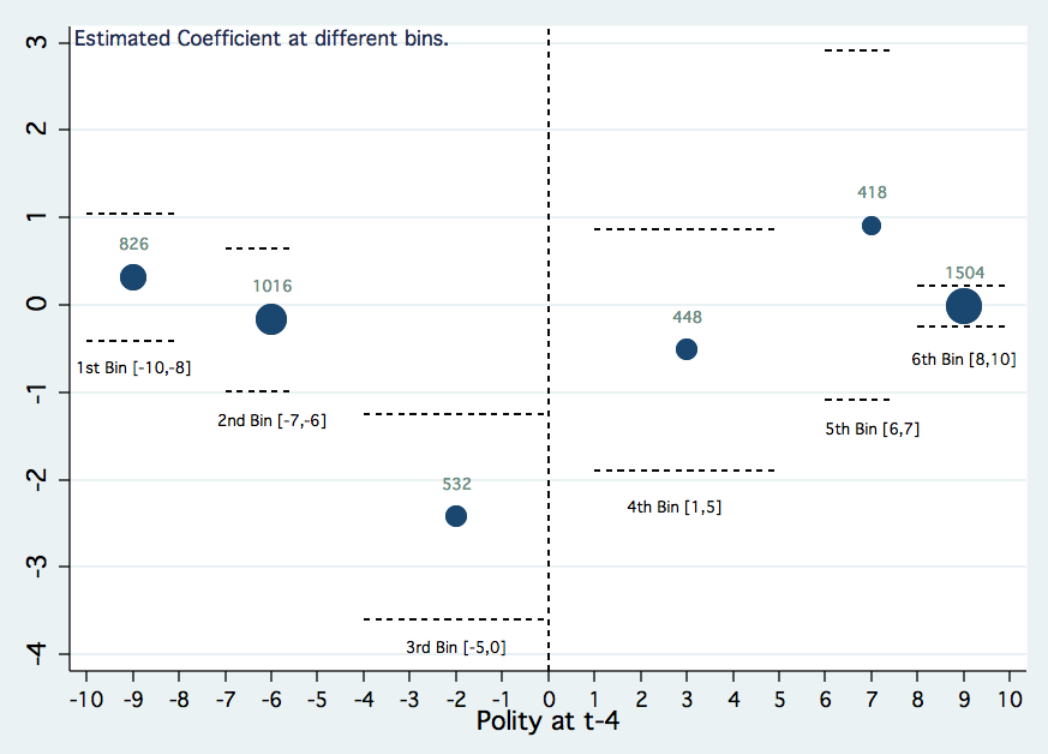


Figure 2. Marginal price effect at different levels of initial *Polity*



All graphs plot estimates from Table 3. The upper graph plots the estimates in column (1) for the average effect of price changes on *Polity*2 changes. The central graph plots the estimates in column (2) where the effect of price changes is conditional on the country being an autocracy or a democracy. The lower graph plots the estimates in column (3), which condition on the exact *Polity*2 level the country is at the start of the price variation.

Figure 3. Estimated coefficients at different bins



The graph divides the *Polity* scale into six bins. The bins are constructed so to maintain the symmetry around the zero threshold, while minimizing the differences in frequency across them. For each bin the estimated coefficient of *Polity*2 change on price change and the relative 90% confidence intervals are plotted.

Table 1. Countries, by Commodity

Princ. Comm.	Countries	Countries
Oil	30	Algeria, Angola, Azerbaijan, Cameroon, China, Norway, Congo, Ecuador, Egypt, Gabon Indonesia, Iran, Kazakhstan, Kuwait, Lybia, Malaysia, Mexico, Nigeria, Oman, Qatar, Russia, Saudi Arabia, Syria, Trinindad, Tunisia, UAE, UK, Venezuela, Vietnam, Yemen
Coffee	11	Brazil Burundi, Colombia, El Salvador, Ethiopia, Guatemala, Haiti, Madagascar Nicaragua, Rwanda, Uganda
Wood	9	Austria, Canada, Estonia, Finland, Latvia, Lithuania, Portugal, Romania, Sweden
Pig Iron	8	Albania, Bhutan, Dominican Republic, Georgia, Japan, Lebanon, Slovakia, Ukraine
Gemstones	7	Armenia, Botswana, Central African Republic, India, Lesotho, Namibia, Sierra Leone
Oranges	6	Cyprus, Israel, Italy, Moldova, Spain, Turkey
Aluminum	6	Bahrain, Germany, Ghana, Mozambique, Slovenia, Switzerland
Cotton	5	Benin, Burkina Faso, Kyrgyzstan, Mali, Sudan
Bananas	4	Costa Rica, Honduras, Panama, Philippines
Beef	4	Djibouti, Ireland, New Zealand, Uruguay
Copper	4	Chile, Mongolia, Peru, Zambia
Fish	4	Bangladesh, South Korea, Malta, Tanzania
Phosphates	4	Jordan, Morocco, Senegal, Togo
Coal	3	Australia, Czech Republic, Poland
Tobacco	3	Greece, Malawi, Zimbabwe
Bauxite	2	Guinea, Jamaica
Natural gas	2	Belgium, Turkmenistan
Rice	2	Pakistan, Thailand
Swine	2	Denmark, Netherlands
Tea	2	Kenya, Sri Lanka
Wheat	2	Argentina, France
Cocoa	1	Cote d'Ivoire
Gold	1	Papua New Guinea
Groundnuts	1	Gambia
Jute	1	Nepal
Maize	1	United States
Rubber	1	Cambodia
Silver	1	South Africa
Soybean	1	Paraguay
Sugar	1	Eritrea
Tin	1	Bolivia
Uranium	1	Niger

Table 2. Summary Statistics.

	Mean	Std. Dev.	Min.	Max.	Obs.
$Avg\Delta Price$	.078	.19	-.36	1.04	5486
$\Delta Polity$	.09	1.72	-18	16	5380
Polity2	.99	7.56	-10	10	5528
Polity2 1962	-.11	7.60	-10	10	4464
Polity2 2009	4.16	6.05	-10	10	6276
AvgShare	.067	.09	.001	.41	6276
Countshare Princ	22.12	11.85	2	48	6276
Countshare	30.86	15.03	2	48	6276

Table 3. Baseline Sample

	(1)	(2)	(3)	(4)
	LS	LS	LS	SYS-GMM
ΔPr	-0.253			
	(0.17)			
ΔPr_a		-0.326*	-0.418**	-0.717***
		(0.18)	(0.19)	(0.22)
ΔPr_d		0.114	0.117	0.051
		(0.19)	(0.18)	(0.26)
$\Delta Pr_a * Pl_{t-4,a}$			-0.137**	-0.139*
			(0.06)	(0.08)
$\Delta Pr_d * Pl_{t-4,d}$			0.041	0.030
			(0.06)	(0.09)
$Pl_{t-4,a}$			-0.064***	-0.073***
			(0.02)	(0.03)
$Pl_{t-4,d}$			-0.118***	-0.079***
			(0.03)	(0.03)
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N. of countries	131	131	131	131
Observations	4875	4744	4744	4744

***,** ,* represent significance at 1%, 5%, and 10%, respectively. The dependent variable is the $t-1$ to t change in the revised Polity score ($Polity2$). The method of estimation in columns (1)-(3) is least squares, in column (4) system-GMM (Blundell-Bond). The values in brackets are Huber robust standard errors clustered at the country level.

Table 4. Export Shares

	(1)	(2)	(3)	(4)	(5)	(6)
	Above 1st Decile Share		Above 1st Quartile Share		Above Median Share	
ΔPr_a	-0.268	-0.374*	-0.278	-0.407*	-0.407	-0.494*
	(0.20)	(0.20)	(0.21)	(0.21)	(0.26)	(0.26)
ΔPr_d	0.289	0.271	0.350	0.328	0.435	0.402
	(0.19)	(0.18)	(0.23)	(0.22)	(0.31)	(0.31)
$\Delta Pr_a * Pl_{t-4,a}$		-0.135**		-0.162***		-0.112**
		(0.06)		(0.05)		(0.05)
$\Delta Pr_d * Pl_{t-4,d}$		0.023		0.058		-0.048
		(0.07)		(0.07)		(0.09)
$Pl_{t-4,a}$		-0.078***		-0.074***		-0.060**
		(0.03)		(0.02)		(0.03)
$Pl_{t-4,d}$		-0.125***		-0.138***		-0.071*
		(0.03)		(0.03)		(0.04)
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N. of countries	117	117	97	93	63	63
Observations	4206	4206	3413	3413	2312	2312

***,** ,* represent significance at 1%, 5%, and 10%, respectively. The dependent variable is the $t-1$ to t change in the revised Polity score ($Polity2$). The values in brackets are Huber robust standard errors clustered at the country level. Columns (1)-(2) exclude countries in the first decile of average share for the principal commodity. Columns (3)-(4) exclude countries in the first quartile of average share for the principal commodity. Columns (5)-(6) exclude countries below the median of average share for the principal commodity.

Table 5. Shares Availability

	(1)	(2)	(3)	(4)	(5)	(6)
	Above 1st Quartile Obs.		Observations before 1986		Always 1st after 1986	
ΔPr_a	-0.360*	-0.500**	-0.393**	-0.515**	-0.321*	-0.428**
	(0.21)	(0.21)	(0.20)	(0.20)	(0.18)	(0.19)
ΔPr_d	0.214	0.203	0.134	0.132	0.116	0.124
	(0.20)	(0.19)	(0.21)	(0.20)	(0.20)	(0.19)
$\Delta Pr_a * Pl_{t-4,a}$		-0.163**		-0.158**		-0.142**
		(0.06)		(0.06)		(0.06)
$\Delta Pr_d * Pl_{t-4,d}$		0.007		0.037		0.036
		(0.08)		(0.08)		(0.08)
$Pl_{t-4,a}$		-0.070**		-0.071***		-0.070***
		(0.03)		(0.03)		(0.03)
$Pl_{t-4,d}$		-0.105***		-0.116***		-0.113***
		(0.03)		(0.03)		(0.03)
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N. of countries	96	96	92	92	105	105
Observations	3795	3795	3724	3724	4072	4072

***,** ,* represent significance at 1%, 5%, and 10%, respectively. The dependent variable is the $t-1$ to t change in the revised Polity score ($Polity2$). The values in brackets are Huber robust standard errors clustered at the country level. Columns (1)-(2) exclude countries in the first quartile of observations on which the principal commodity is identified. Columns (3)-(4) exclude countries that don't have observations for share before 1986, the midpoint year of share observations. Columns (5)-(6) include countries that don't have observations for share before 1986, but whose principal commodity has *always* been ranked first afterwards.

Table 6. Boundary Observations

	(1)	(2)	(3)	(4)
	$\Delta Pl \geq 0$	D=1|$\Delta Pl \geq 0$	Unbounded Countries	Unbounded Obs.
ΔPr_a	-0.448**	-0.052	-0.391*	-0.413*
	(0.17)	(0.03)	(0.23)	(0.21)
ΔPr_d	-0.021	-0.009	0.075	0.106
	(0.12)	(0.03)	(0.29)	(0.26)
$\Delta Pr_a * Pl_{t-4,a}$	-0.158***	-0.028**	-0.134*	-0.139*
	(0.05)	(0.01)	(0.08)	(0.07)
$\Delta Pr_d * Pl_{t-4,d}$	0.032	0.012	0.076	0.032
	(0.04)	(0.01)	0.076	(0.11)
$Pl_{t-4,a}$	-0.013	-0.004	-0.080***	-0.076***
	(0.02)	(0.00)	(0.03)	(0.03)
$Pl_{t-4,d}$	-0.075***	-0.013***	-0.150***	-0.133***
	(0.02)	(0.00)	(0.03)	(0.03)
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N. of countries	131	131	90	107
Observations	4592	4744	3222	3634

***,** ,* represent significance at 1%, 5%, and 10%, respectively. The dependent variable is the $t-1$ to t change in the revised Polity score ($Polity2$). The values in brackets are Huber robust standard errors clustered at the country level. Column (1) considers non-negative $Polity2$ changes only. Column (2) estimates a dummy variable which takes value of 1 if there is a positive $Polity2$ change, and 0 otherwise. Column (3) restricts the sample to countries that never touched the boundaries at -10 and +10 on the Polity scale. Column (4) excludes the observations at -10 and +10.

Table 7. Big Producers

	(1)	(2)	(3)	(4)
	Exclude OPEC countries		Exclude Big Producers	
ΔPr_a	-0.361	-0.433**	-0.428*	-0.536**
	(0.22)	(0.21)	(0.26)	(0.24)
ΔPr_d	0.087	0.092	-0.016	-0.049
	(0.20)	(0.19)	(0.26)	(0.25)
$\Delta Pr_a * Pl_{t-4,a}$		-0.147**		-0.153*
		(0.07)		(0.08)
$\Delta Pr_d * Pl_{t-4,d}$		0.036		0.074
		(0.06)		(0.08)
$Pl_{t-4,a}$		-0.066**		-0.084***
		(0.03)		(0.03)
$Pl_{t-4,d}$		-0.120***		-0.130***
		(0.03)		(0.04)
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N. of countries	120	120	87	87
Observations	4282	4282	3003	3003

***,** ,* represent significance at 1%, 5%, and 10%, respectively. The dependent variable is the $t-1$ to t change in the revised Polity score ($Polity2$). The values in brackets are Huber robust standard errors clustered at the country level. Columns (1)-(2) exclude OPEC countries. Columns (3)-(4) exclude countries producing more than 3% of total world production in their principal commodity. Detail on the sources used to identify big producers are reported in Table 7b.

Table 8. Alternative Definitions Price Index.

	(1)	(2)	(3)	(4)	(5)
	Average	1975	1980	1990	2001
$\Delta Index_a$	-0.461	-0.491*	-0.461	-0.515*	-0.518*
	(0.33)	(0.28)	(0.28)	(0.30)	(0.28)
$\Delta Index_d$	0.176	0.318	0.299	0.104	0.304
	(0.35)	(0.38)	(0.22)	(0.37)	(0.33)
$\Delta Index_a * Pl_{t-4,a}$	-0.097	-0.118	-0.157*	-0.220**	-0.111
	(0.09)	(0.08)	(0.09)	(0.12)	(0.08)
$\Delta Index_d * Pl_{t-4,d}$	0.071	0.117	-0.007	0.011	0.083
	(0.09)	(0.10)	(0.09)	(0.14)	(0.08)
$Pl_{t-4,a}$	-0.067***	-0.074**	-0.064**	-0.025	-0.072***
	(0.02)	(0.03)	(0.03)	(0.03)	(0.02)
$Pl_{t-4,d}$	-0.098***	-0.099***	-0.064	-0.055	-0.096***
	(0.03)	(0.04)	(0.04))	(0.04)	(0.03)
State FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	4957	3600	3527	3327	4629
Countries	131	84	82	78	122

***,** ,* represent significance at 1%, 5%, and 10%, respectively. The dependent variable is the $t-1$ to t change in the revised Polity score ($Polity2$). The values in brackets are Huber robust standard errors clustered at the country level. All columns follow the methodology in Deaton and Miller (1995) to construct the weighted price index of commodities. We use all commodities included in the UN COMTRADE database and whose price series is identified in the IMF IFS database. Columns (1) weights commodities by their average share in country exports, measured over all available years. Column (2) weights commodities by their share in 1975, the base year used in Deaton-Miller (1995). Column (3) weights commodities by their share in 1980, the base year used in Besley-Persson (2008). Column (4) weights commodities by their share in 1990, the base year used in Deaton (1999) and Brückner and Ciccone (2010). Column (5) weights commodities by their share in 2001, the year with the highest number of reporting countries.

Table 9. Typologies of Commodities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Mineral		Non Mineral		Point Source		Diffuse	
ΔPr_a	-0.141	-0.222	-1.062**	-1.069***	-0.273	-0.372*	-1.583*	-1.633*
	(0.29)	(0.29)	(0.41)	(0.40)	(0.21)	(0.21)	(0.82)	(0.82)
ΔPr_d	0.236	0.224	-0.225	-0.239	0.250	0.237	-0.511	-0.436
	(0.28)	(0.27)	(0.36)	(0.33)	(0.22)	(0.22)	(0.46)	(0.44)
$\Delta Pr_a * Pl_{t-4,a}$		-0.119**		-0.037		-0.177***		0.331
		(0.05)		(0.21)		(0.05)		(0.57)
$\Delta Pr_d * Pl_{t-4,d}$		0.064		-0.008		0.021		0.138
		(0.07)		(0.13)		(0.07)		(0.13)
$Pl_{t-4,a}$		-0.079**		-0.053		-0.051**		-0.116
		(0.02)		(0.05)		(0.02)		(0.08)
$Pl_{t-4,d}$		-0.123***		-0.109***		-0.111***		-0.126***
		(0.03)		(0.04)		(0.03)		(0.05)
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N. of countries	70	70	61	61	87	87	44	44
Observations	2494	2494	2250	2250	3127	3127	1617	1617

***,**,* represent significance at 1%, 5%, and 10%, respectively. The dependent variable is the $t-1$ to t change in the revised Polity score ($Polity2$). The values in brackets are Huber robust standard errors clustered at the country level. Mineral commodities are: Aluminum, Bauxite, Coal, Copper, Gemstones, Gold, Natural Gas, Oil, Pig Iron, Phosphates, Silver, Tin, Uranium. Non-mineral commodities are: Bananas, Beef Meat, Cocoa, Coffee, Cotton, Fish, Groundnuts, Jute, Maize, Oranges, Rice, Rubber, Soybean, Sugar, Swine Meat, Tea, Tobacco, Wheat, Wood. The point source/diffuse distinction follows almost the same classification, but assign countries producing Bananas, Cocoa, Coffee and Sugar to the other category.

Table 10. Exclude Transition Periods

	(1)	(2)	(3)
ΔPr	-0.074		
	(0.15)		
ΔPr_a		-0.085	-0.171
		(0.18)	(0.19)
ΔPr_d		0.192	0.195
		(0.18)	(0.17)
$\Delta Pr_a * Pl_{t-4,a}$			-0.123**
			(0.06)
$\Delta Pr_d * Pl_{t-4,d}$			0.020
			(0.07)
$Pl_{t-4,a}$			-0.035
			(0.02)
$Pl_{t-4,d}$			-0.081***
			(0.03)
State FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
N. of countries	131	131	131
Observations	4751	4555	4555

***,**,* represent significance at 1%, 5%, and 10%, respectively. The dependent variable is the $t-1$ to t change in the revised Polity score ($Polity2$). The values in brackets are Huber robust standard errors clustered at the country level. Columns (1) to (4) consider the baseline sample of 131 countries and replace transition years ($Polity$=-77) by missing values.

Table 11. Alternative Timing Structure: 3 years non-overlap

	(1)	(2)	(3)
ΔPr	0.082		
	(0.14)		
ΔPr_a		0.023	-0.042
		(0.13)	(0.15)
ΔPr_d		0.239	0.228
		(0.15)	(0.14)
$\Delta Pr_a * Pl_{t-4,a}$			-0.078*
			(0.05)
$\Delta Pr_d * Pl_{t-4,d}$			-0.026
			(0.05)
$Pl_{t-4,a}$			-0.276***
			(0.07)
$Pl_{t-4,d}$			-0.310***
			(0.09)
State FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	1621	1599	1599

***,**,* represent significance at 1%, 5%, and 10%, respectively. The dependent variable is the $t-3$ to t change in the revised Polity score ($Polity2$). The values in brackets are Huber robust standard errors clustered at the country level. The estimation is for three-years non-overlapping periods: the change in $Polity2$ in period 1963-1966 is explained by the change in price in period 1962-1965; the change in $Polity2$ in period 1966-1969 is explained by the change in price in period 1965-1968; and similarly for following periods.

Table 12. Alternative Thresholds for Democracy

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$Polity \geq 1$		$Polity \geq 2$		$Polity \geq 3$		$Polity \geq 4$		$Polity \geq 5$	
ΔPr_a	-0.353*	-0.484***	-0.360*	-0.458**	-0.362*	-0.408**	-0.308*	-0.296*	-0.363*	-0.289
	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)	(0.19)	(0.18)
ΔPr_d	0.198	0.175	0.176	0.160	0.147	0.149	0.094	0.112	0.071	0.131
	(0.19)	(0.18)	(0.19)	(0.18)	(0.19)	(0.18)	(0.20)	(0.19)	(0.19)	(0.19)
$\Delta Pr_a * Pl_{t-4,a}$		-0.164***		-0.125**		-0.080		-0.012		-0.004
		(0.06)		(0.05)		(0.05)		(0.04)		(0.03)
$\Delta Pr_d * Pl_{t-4,d}$		-0.038		-0.024		-0.007		0.057		0.065
		(0.06)		(0.07)		(0.06)		(0.11)		(0.15)
$Pl_{t-4,a}$		-0.62***		-0.064***		-0.069***		-0.071***		-0.082***
		(0.03)		(0.01)		(0.02)		(0.01)		(0.01)
$Pl_{t-4,d}$		-0.109***		-0.104***		-0.105***		-0.087**		-0.114***
		(0.03)		(0.04)		(0.03)		(0.04)		(0.04)
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4744	4744	4744	4744	4744	4744	4744	4744	4744	4744

***,**,* represent significance at 1%, 5%, and 10%, respectively. The dependent variable is the $t-1$ to t change in the revised Polity score ($Polity2$). The values in brackets are Huber robust standard errors clustered at the country level.

Appendix Table A1

	(1)	(2)	(3)	(4)	(5)	(6)
Pl_{t-4}	$\#\Delta Pl \leq 0$	$\#(Pl = -10 \mid \Delta Pl \leq 0)$	% to Pl=-10	$\#\Delta Pl \geq 0$	$\#(Pl = 10 \mid \Delta Pl \geq 0)$	% to Pl=10
-10	4	1	0.25	9	0	0
-9	5	2	0.4	40	0	0
-8	5	2	0.4	18	0	0
-7	16	0	0	76	0	0
-6	8	0	0	29	0	0
-5	6	0	0	17	0	0
-4	5	0	0	10	0	0
-3	7	0	0	7	0	0
-2	2	0	0	9	0	0
-1	7	0	0	13	0	0
0	4	0	0	3	0	0
1	4	0	0	5	0	0
2	3	0	0	6	0	0
3	4	0	0	6	0	0
4	5	0	0	5	0	0
5	10	0	0	13	0	0
6	12	0	0	20	0	0
7	16	0	0	17	1	0.059
8	19	0	0	17	1	0.059
9	13	0	0	15	9	0.6
10	5	0	0	1	0	0

Column (1) reports the number of negative changes in the *Polity*2 score at each initial level of *Polity*2 at t-4. Column (2) reports the number of negative changes that bring the *Polity*2 score at -10. Column (3) calculates the percentage. Column (4) reports the number of positive changes in the *Polity*2 score at each initial level of *Polity*2 at t-4. Column (5) reports the number of positive changes that bring the *Polity*2 score at 10. Column (6) calculates the percentage.

Appendix Table A2. Big Producers, by Commodity

Commodity	Countries
Oil	Algeria, Angola, China, Indonesia, Iran, Kuwait, Lybia, Mexico Norway, Russia, Saudi Arabia, UAE, Venezuela
Coffee	Brazil, Colombia, Ethiopia, Guatemala
Wood	Canada, Finland, Sweden
Tea	Kenya, Sri Lanka
Bananas	Costa Rica, Philippines
Oranges	Italy, Spain
Copper	Chile, Peru, Zambia
Bauxite	Guinea, Jamaica
Phosphates	Jordan, Morocco
Uranium	Niger
Tobacco	Malawi
Rice	Thailand
Cotton	Mali
Coal	Australia
Cocoa	Cote d'Ivoire
Maize	United States
Beef	France
Gemstones	Botswana
Pig Iron	Ukraine
Tin	Bolivia

Data for commodities produced in a country that constitute more than 3% of total world supply are obtained from the following sources: Copper, Gold, Bauxite, Tin, Phosphates, Uranium, Gemstones (British Geological Survey 2000-2008, available here); Cocoa, Bananas, Oranges, Beef, Jute, Maize, Wood, Rice, Sugar, Tea, Tobacco (Food and Agricultural Organization 1970-2009, available here); Coffee (International Coffee Organization 1980-2009, available here); Cotton (US Department of Agriculture 1970-2009, available here); Coal, Oil (US Energy Information Administration 1980-2009, available here).