Resource Windfalls, Political Regimes, and Political Stability

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ABSTRACT

We study theoretically and empirically whether natural resource windfalls affect political regimes. We 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. Furthermore, there is heterogeneity in the response of autocracies. In deeply entrenched autocracies the effect of windfalls on politics is virtually nil, while in moderately entrenched autocracies windfalls significantly exacerbate the autocratic nature of the political system. To frame the empirical work 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 uncovers a mechanism for the asymmetric impact of resource windfalls on democracies and autocracies, as well as the the differential impact within autocratic regimes.

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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 generalisations, 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 and within-country variation 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 plausibly exogenous to changes in a country's political system. First, the *identity* of a country's main export commodity (e.g. oil v. gold) should be mostly driven by geography and geology. Second, 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.[1] Also, since we include country fixed effects, our results cannot be driven by underlying country-specific trends common to changes in principal-commodity

[1] In the empirical analysis we address the issue of large producers with the potential to influence world prices, and find that our results are not affected by these economies.

prices and changes in political regimes.

Our main measure of political institutions is the variable Polity2 from the Polity IV database. Crucially for our analysis this is a continuous measure that varies from extreme autocracy (Polity2= -10) to perfect democracy (Polity2= +10), 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."

To get a better sense of the sort of episodes driving our empirical analysis consider the recent case of oil-rich Kazakhstan. President Nursultan Nazarbayev has been in office since the country became independent. He has gradually expanded his presidential powers by decree: only he can initiate constitutional amendments, appoint and dismiss the government, dissolve Parliament, call referendums, and appoint administrative heads of regions and cities. This expansion in his powers has coincided with strong rise in the international price of oil. In 2002 the president promulgated a law that set very stringent requirements for the maintenance of legal status of a political party. As a consequence, the number of legal parties dropped from 19 in 2002 to 8 in 2003. In the same year the president imprisoned two leaders of the main opposition party on charges of corruption. As a result of these changes Kazakhstan's Polity2 score dropped from -4 to -6 in 2002. In the three preceding years the average annual increase in the price of oil had been 27%, leading to a doubling of the price over the period. Another oil-related case that will be fresh in the memory of many readers is Iran in 2009. With the price of oil increasing on average by 22% per year during the previous three years, the presidential elections of that year were considered fraudulent by the opposition, who rejected the results and called for mass demonstrations. These demonstrations were violently repressed by the regime. As a result, Iran's Polity2 score fell from -6 to -7.

Such examples are certainly not limited to oil. In El Salvador the presidential elections of February 1977 took place with the price of coffee increasing by an average 41% per year in the previous three years. There was a clumsy and poorly disguised electoral fraud in favour of the ruling conservative party candidate, General Carlos Humberto Romero. The opposition candidate, Colonel Ernesto Claramount, and a crowd of thousands gathered in the Plaza Libertad in San Salvador to protest Romero's election. The rally was attacked by government forces, leaving as many as fifty protesters dead. In November the grip of repression was further strengthened with the approval of the Law for the Defense and Guarantee of Public Order, eliminating almost all legal restrictions on violence against civilians. As a result El

Salvador's Polity2 score fell from -1 to -6.[2]

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.

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. *Ceteris paribus*, 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. However, for reasons we discuss later, this prediction is hard to test in an econometrically compelling way. We therefore note that another prediction of the model is

[2] A very similar case is represented by Guatemala, whose principal commodity is also coffee. As in El Salvador, also in Guatemala the role of the military had been prominent since the early 1960s, with the support of the coffee elite. The response to social protests during the 1970's were similar to those in El Salvador. The Presidential elections of 1978 took place with prices of coffee increasing on average by 60% per year in the previous three years. The elections were fraudulent, and the ensuing revolutionary movement was repressed by the harsh counter-revolutionary activity of the government, backed by the military and the coffee oligarchy. This started a period of violence and institutional chaos that only ended in 1985 with the return to democracy. Guatemala's Polity2 score fell from -3 to -5 in 1978.

that resource-poor countries (which the model predicts to be 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. For example if the "ego rents" from office are lower, 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 political power per se offers greater rewards. A similar effect is produced if the "technology" for self-preservation is less effective, which could be the case in countries with a culture less deferential to those in power, where the citizens are willing to bear greater costs to challenge abuses, or where political leaders cannot rely on pre-existing structures of power (e.g. ethnic allegiances) to lever the resources conferred by incumbency. 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 (2011)].[3] 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

[3] Tsui (2011) is perhaps closest to us among these, as he also looks at the heterogenous responses between democracies and autocracies. His results are consistent with ours. Aside from relying on cross-sectional evidence, however, his contribution only focuses on oil, and does not explore heterogeneity in responses within autocracies.

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 include time effects to control for global trends. 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.[4]

More broadly the paper contributes to a significant empirical literature on the economic determinants of democracy/autocracy. Many authors have investigated the causal relationship between income and democracy [e.g. Barro (1999), Epstein et al. (2006), Ulfelder and Lustik (2007), Glaeser, Ponzetto, and Shleifer (2007), Acemoglu, Johnson, Robinson, and Yared (2008), Brückner and Ciccone (2010), 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 reach the general population [e.g. Sachs and Warner (2001), Caselli and Michaels (2003)]. 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. Furthermore, 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

[4] 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 proxy for our autocracy/oil-price interaction. The results are therefore consistent with ours, as in both cases they imply a lesser movement towards autocracy in more entrenched autocracies.

the reasons mentioned above there may be reasons to prefer a reduced-form specification.

Finally, several authors have looked at the effects of resource windfalls on political-economy outcomes other than democracy/autocracy. For example, Leite and Weidmann (1999), Tavares (2003), Sala-i-Martin and Subramanian (2003), Dalgaard and Olsson (2008) and Caselli and Michaels (2011) present corresponding empirical evidence on resource abundance and corruption. Besley and Persson (2011), Lei and Michaels (2011), Cotet and Tsui (2011), Dube and Vargas (2013), among others, have looked at resource windfalls and civil war/political violence; Deaton and Miller (1995) and Andersen and Aslaksen (2013) at incumbents' survival; Egorov, Guriev, and Sonin (2009) at media repression by autocrats; and Caselli, Morelli, and Rohner (2013) at international war.

Theoretically, our model is illustrative of a class of contributions that have examined the effect of resource windfalls on rulers/elites' decisions on the amount of political contestability they choose to allow [e.g. Acemoglu, Robinson, and Verdier (2004), Caselli (2006), Dunning (2008), Caselli and Cunningham (2009), Tsui (2010), Besley and Persson (2011)]. Resource windfalls may increase repression by relaxing the ruler's budget constraint (particularly emphasized by Acemoglu, Robinson, and Verdier);[5] in response to increased challenges by outsiders (Tsui); or because they increase the value of staying in power for the incumbent (this paper).[6] Many of these studies (particularly those by Caselli and by Tsui) derive non-monotonicities analogous to the one in this paper, and for similar reasons. More generally, the model belongs to a class of work on "conditional" resource curses, i.e. where the effects of resource windfalls can be beneficial or adverse according to the size of the windfall or the values of certain conditioning variables [e.g Tornell and Lane (1998), Baland and Francois (2000), Torvik (2002), Cabrales and Hauk (2010), Besley and Persson (2011), Caselli and Coleman (2013)].

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

[5] Haggard and Kaufman (1997) and Geddes (1999) also stress the role of the budget constraint of political incumbents.

[6] In Dunning (2008) however, windfalls may *reduce* suppression of contestability as they reduce the amount of redistribution that would be implemented under democracy.

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."[7]

The economy is populated by an infinite number of infinitely-lived agents (which can also be intepreted as political dynasties or interest groups). In every period there is one agent that begins the period as the "incumbent." One should think of the incumbent as the individual, or group of individuals, who has *de facto* control of the government. 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.

The sequence of events and actions within each period is the following. First the incumbent allocates the period rents A between self-preservation spending, B_t and consumption, C_t. Next, nature picks at random another agent (not the incumbent) to be the "potential challenger." The potential challenger then decides whether or not to stage a challenge to the incumbent. If yes, the challenge succeeds with probability $p(B_t)$. If the challenge succeeds, the challenger begins the next period as the new incumbent. If the challenge fails, the incumbent begins the next period as incumbent. If the potential challenger does not challenge, the incumbent also continues as incumbent. Time is discounted by all agents at rate β.

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.

Period payoffs for the incumbent are $C_t + \Theta$. 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." An incumbent also receives a flow of "ego rents," Θ. Assuming that

[7] We abstract from other sources of government revenues, as none of our comparative static results would be affected by their explicit inclusion. Nor are we able to make progress on the important question of whether/why resource windfalls have different political effects than other types of government revenues.

there are additional benefits (both psychological and material) from holding political power is realistic and indeed standard in the literature [e.g. Rogoff (1990), Osborne and Slivinski (1996)].

Period payoffs for the individual selected as the potential challenger are normalized to 0 if he challenges, and to Π if he does not challenge. Π represents the present value of income from his activities outside politics. We also normalize to 0 the continuation payoff of a challenger if he chooses to challenge and the challenge fails, as well as the continuation payoff of an incumbent who is successfully challenged.[8]

The probability that a challenge will succeed is decreasing in self-preservation spending, or $p'(B_t) < 0$. 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 favour. Anecdotically, it appears that the "first steps" towards autocracy are relatively mild: "beginner" autocrats engage in some patronage, some vote buying, some corruption of journalists and media outlets. More established ones add some physical or judicial intimidation, and perhaps electoral irregularities. Yet more aggressive autocrats further include disappearances and show trials. Finally, the most entrenched call off elections, prohibit political parties, and repress violently all sorts of opposition. If this description is correct, then the overall budget devoted to these activities seems likely to rise, as further tools are deployed by the autocrat. At the same time the likelihood of a successful challenge declines. This is why we assume that p is decreasing in B.

Hence, B captures infra-marginal variation in the efforts exerted by those currently in power to subvert the rules of the game in their favour, 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

[8] These normalizations could be relaxed as long as both the incumbent and the challenger prefer winning rather than losing in case of a challenge.

absolutely sure of successfully withstanding a challenge. These features are important but seem sensible.

The most restrictive assumption of the model 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, in the tradition of Barro (1973). In addition, 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 (or increasing the cost of recruiting supporters). 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) and Tsui (2010) for a detailed discussion.[9]

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

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

[9] A straightforward extension in the direction of allowing productive public spending would be as follows. Rents are allocated between repression, B, private consumption, C, and productive public spending, G, and the probability of successful challenge is decreasing in both B and G: $p(B) = \Omega e^{-\delta B - \gamma G}$. It is immediate to show that in this case the incumbent never uses both tools at the same time. In particular, if $\delta > \gamma$ the incumbent only uses repression, while if $\delta < \gamma$ he only uses productive public spending. Hence, one interpretation of the model is that we focus on the case $\delta > \gamma$. Another interpretation is that the relative magnitudes of γ and δ vary across countries, perhaps for cultural, geographic, or geostrategic reasons. In countries where $\delta > \gamma$ the analysis in the rest of this section applies. Countries with $\gamma > \delta$ will obviously be democracies, as we defined democracy as a country with $B = 0$. Furthermore, in such countries shocks to natural-resource rents will have no impact on B. Hence, we recover the same empirical prediction as in the baseline model, namely that we should observe no systematic response of political institutions to resource shocks in democracies.

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 $p(B')$.

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

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

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

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.[10]

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 (to be characterized shortly), 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.

[10] The mechanism highlighted in the model will continue to work even if the government can tap into foreign financial markets to finance self-preservation spending. Foreign borrowing may somewhat reduce the opportunity cost of preservation spending by shifting it to the future, creating a bias towards greater autocracy. On the other hand, autocrats (as most countries) are likely to face increasing, and indeed convex, supply curves for foreign funds, so the marginal opportunity cost of self-preservation spending will also be increasing and convex. The combination of an increasing and convex marginal opportunity cost of funds with decreasing returns in the self-preservation activity will generate the same concave relation (beyond A_0) between resource endowments and self-preservation spending as in the model with a balanced-budget.

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.[11]

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 lower 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 1 (PA1):

$$A_0 > 0.$$

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, 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. The right hand side is the (certain) utility from not challenging, i.e. the outside option Π.[12]

Since the value of holding office is increasing in A, condition (1) is satisfied for any A if it is satisfied for $A = 0$. In turn, the condition is satisfied for $A = 0$ if the following parametric

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

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

assumption holds.[13]

Parametric Assumption 2 (PA2)

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

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 (1) with equality.[14] 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 entirely deter challenges. 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 challenger more easily convinced thanks to a better outside option.

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

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

[14] We implicitly assume that the incumbent does not challenge when indifferent.

We assume that even when a deviation is feasible the incumbent will not deviate from the "interior" strategy.[15] Formally,

Parametric Assumption 3 (PA3):

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

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 PA3 holds. Hence, we have the following result.

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

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.

[15] If we were to replace PA3 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 $\tilde{A} < A$), defined as autocracies that choose to completely deter any challenge. The empirical predictions would be quite similar.

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.[16]

2.3. Testable Implications

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

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

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

[16] The uniqueness of the MPE is of course in part a feature of some of our simplifying assumptions. For example, if we allowed a former incumbent to enjoy the flow payoff of private citizens, *and* made the value of being a private citizen depend on the amount of repression experienced, it is conceivable that we would have multiple MPEs. In particular, if future governments repress a lot, the value of being a citizen goes down, so current incumbents want to hold-on more tightly.

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.

3. Evidence

3.1. General strategy

The main result of the model 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 1) 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 opaque and inconclusive.

Plan 2 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, plan 2 largely sidesteps the first of the identification issues affecting Plan 1. However, because it conditions on the initial level of A, Plan 2 still requires an estimate of country-specific autocracy thresholds A_0, so it is still unsatisfactory.

Plan 3, like plan 2, 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 right 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 (2011)]. 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).[17] Note, therefore, that *Polity2 is an inverse measure of B*. 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 (2011), Olken and Jones (2009), Epstein et al. (2006)]. Nevertheless we discuss alternative thresholds in Section 3.4.[18]

To map the Polity2 score into a proxy for B we make the following assumption:

$$\text{Polity2}_{it} = \alpha - f(B_{it}) + \varepsilon_{it}, \tag{2}$$

[17] We adjust Polity2 by assigning missing values to cases of interregnum and anarchy, which are misleadingly coded as 0 in the original data. In section 3.4 we investigate the robustness of our results to further adjustments.

[18] In the online appendix we also present an exercise that attempts to identify the location of the "kink" in the relationship between changes in B and our measure of resource windfalls. The results are very consistent with a location at (or near) polity2=0.

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 Polity2 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 Polity2 variable is decreasing in the aggressiveness of this stance.

As long as $f(B)$ is not (too) convex, Assumption (2) implies that the Polity2 score will inherit the same properties of B in the model. In particular, for values of the Polity2 score associated with democracies (Polity2> 0, or $B = 0$) changes in A have no systematic effect on changes in Polity2 score. In autocracies (negative Polity2, or positive B) increases in A have *negative but decreasing* effects on changes in the Polity2 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 years. 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).[19]

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 countries. In the Online Appendix we

[19] It would be desirable to check the robustness of our results to non-export based methods to identify principal commodities, such as total production or endowments. Unfortunately commodity production and endowment data are not readily available for a large number of countries. We have made an attempt to identify a principal commodity using total output data from the UN Industry Commodity Production Statistics (ICPS) but, despite its name, this data set mainly focuses on manufactured goods and does not include many key commodities, such as coffee (our second most represented principal commodity), cotton, tea, and tobacco.

present some illustrative graphs of the time series relationship between lagged price changes and changes in political regime for selected countries.

Summary statistics are presented in Table 2. $\Delta Polity2$ is the one-year difference in Polity2, while ΔPr is the average growth rate in the price of the principal commodity over a three-year window (we discuss timing issues below). *Country Avg. Share* is the average over time of the value of exports of a country's principal commodity as a share in GDP. *Years Princ. Comm.* indicates the number of years the principal commodity has been the principal export, while *Total Years* 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 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.

A further breakdown of the data, reported in the online appendix, reveals that there is very substantial variation in both the commodity-windfall variable and in the political-change variable in all decades of the sample period. Hence, our results are not driven by individual eras of particularly volatile commodity prices or political upheaval.

In our model regime change is triggered by changes in resource rents that are perceived to be permanent. We proxy these changes with changes (over three years) in the commodity spot price. A natural question is whether changes in the spot price are sufficiently persistent to justify using them as proxies for long-run changes in resource income. In the Appendix, we present a variety of tests of stationarity/nonstationarity of our commodity price series. With very few exceptions and across three different testing strategies, we cannot reject (reject) the hypotheses that our commodity price series have unit roots (are stationary).[20]

[20] An alternative strategy to capture changes in expected rents from commodities may be to focus on changes in futures prices. Unfortunately, historical data on futures prices are relatively hard to come by, perhaps because these markets are less liquid and established than most economists tend to assume. The most comprehensive soource we were able to identify, for example, only features futures prices for 17 of the 32 principal commodities in our sample. Furthermore, it turns out that contracts exist only for delivery at future dates only relatively close to the present. In particular, for no commodity but oil could we find future prices with delivery date further than one year in the future. Even for oil the time series for contracts with delivery date later than one year suggest that these markets are very illiquid, inducing us to focus on the one-year contract in this case as well. Finally, for most commodities the sample period for which data is available is significantly shorter than for the spot prices. As we show in the online appendix, despite the much smaller sample size results using spot prices are entirely in line with those using sport prices. This result is less remarkable than it may seem as the correlation between spot and futures prices is very high.

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.[21] 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. Crucially, 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 exceeds the number of autocracies (2570 versus 2305 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).[22] The democracy dummy is also included separately in the model. 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 more autocratic. Instead, they have no significant impact on the Polity2 score in

[21] This is also the approach followed by Brückner and Ciccone (2010), and discussed in Deaton (1999).

[22] 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.

democracies.

A more specific prediction of our model is that in democracies commodity-price changes will have no impact for any initial level of Polity2, while 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.[23] 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 results in Columns 1-3 are based on OLS estimation. Because this is a dynamic panel model with fixed effects, there arises a natural concern with Nickell bias.[24] To address this concern, in Column 4 we show results using system-GMM estimation [Blundell and Bond, 1998].[25] The system-GMM results are very close to the original OLS. Tests for first- and second-order autocorrelation in the coefficients hint at a proper specification. While we continue to present both OLS and system-GMM results throughout the paper, our discussion emphasizes the OLS coefficients.[26]

[23] Notice that by interacting the price shock with the four-years lag of Polity2 level, ΔPr_a does no longer capture the average effect in autocracy, but rather the effect in the average autocracy.

[24] The Fixed-Effects OLS specification transforms the data in deviations from the group mean, producing a mechanical correlation between the transformed lagged dependent variable and the transformed error term [Nickell (1981), Bond (2002)].

[25] System-GMM provides consistent estimates in dynamic panel data model with fixed effects, by taking first differences and instrumenting the differenced variables with all their available lags in levels and differences. Asymptotic results of system-GMM are potentially misleading when T increases, as the instrument count grows large relative to the sample size, over-fitting the instrumented variables and failing to expunge their endogenous components. To limit the number of instruments generated in system-GMM we follow Beck and Levine (2004) and Calderon, Chong and Loayza (2002), by combining instruments through addition into smaller sets. Collapsing makes the instrument count linear in T, while retaining information as no lags are actually dropped (Roodman 2009a).

[26] As can be seen in the subsequent tables system-GMM and OLS results are typically quite close to each other. This is not surprising given that the large time dimension of our sample (T=48) greatly reduces concerns with Nickell bias in the OLS specification. Indeed, given the structure of our panel OLS may well be preferable. As pointed out in Roodman (2009b), "if T is large, dynamic panel bias becomes insignificant, and a more straightforward fixed-effects estimator works. Meanwhile, the number of instruments in difference and system-GMM tends to explode with T. If N is small, the cluster–robust standard errors and the Arellano-Bond autocorrelation test may be unreliable". This seems indeed what is happening in our sample. Even collapsing the instruments count, their number remains large relative to the number of observations. The estimated covariance matrix of moments becomes singular, weakening the Hansen test of over-identifying restrictions to the point of generating implausible good p-values (in our regressions, the p-value of the Hansen test is always close or equal to 1). This does not compromise the consistency of the system-GMM estimates, but increases its distance from the asymptotic ideal.

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.

The estimated coefficients imply that the impact of resource windfalls for a weak autocracy (say, at Polity2 level -2) is more than twice as large as the one for a more consolidated autocracy at Polity2 level -6. In the weak autocracy, the long-run effect of resource windfalls implies that a 10% increase in the price of the principal commodity reduces the Polity2 score by 1.65 points, or 8% of the domain of Polity2 (which goes from -10 to +10). For the more consolidated autocracy, instead, the effect of a 10% increase in the price of the principal commodity only reduces the Polity2 score by 0.8 points. An alternative way to put this is that a weak autocracy like Ecuador (average Polity2 score in autocracy -2) needs a 24% price shock to move to a more consolidated form of autocracy, like Nigeria's (average Polity2 score in autocracy -6). For Nigeria to experience a similar 4 points reduction in the Polity scale, and become like Saudi Arabia (average Polity2 score in autocracy -10), the price increase in the principal commodity should be of 50%.

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: (i) breaking down the Polity2 score in its components; alternative criteria for inclusion in the sample based on (ii) importance of the principal commodity in the economy and (iii) accuracy of the identification of the principal commodity; (iv) focusing on observations away from the lower and upper bounds of Polity2; (v) dropping large commodity producers with the potential of influencing the world price; (vi) measuring resource-rent shocks based on a basket of commodities rather than only the principal commodity; (vii) breaking down commodities by type (mineral v. non-mineral; point-source v. diffuse); (viii) alternative ways to treat problematic values of Polity2; (ix) alternative timing structures for the relationship between outcomes and shocks; (x) alternative thresholds for democracy; and (xi) alternative measures of the outcome variable.

The Polity2 score is a summary measure of three sets of indicators describing constraints on the executive, openness and competitiveness of the recruitment process into the executive,

and political competition. All three sets of outcomes are plausible proxies for B. A turn towards a more autocratic stance will result in fewer constraints on the actions and recruitment process of the executive power and, by definition, in less political competition. Hence, our first robustness check is to see whether resource windfalls affect all three subcomponents of Polity2. The results are reported in Table 4. The results are in line with those obtained on the overall Polity2 variable: there exists a negative and significant relation, in autocracies only, between commodity windfalls and the change in all three different components of institutional quality. The impact among autocracies is heterogeneous and statistically significant at the 95% confidence level for the three Polity2 sub-scores. Given these results, in the rest of the paper we stick to the overall Polity2 score.

Table 5 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.[27] Columns 1 and 2 exclude countries in the first decile of the average share distribution (14 countries, typically modern democracies with a diversified economy); columns 3 and 4 exclude countries in the first quartile (38 countries); and columns 5 and 6 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 autocracy 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.

A related concern is that the interaction between the level of autocracy and the price of the principal commodity may proxy for the interaction between the share of the principal commodity in the economy and its price. This would be true if countries for which the principal commodity accounts for a large share of GDP tend to be more autocratic- which is indeed roughly what our model predicts. If this was true then the coefficient on the interaction term may simply be saying that large resource-rent shocks leads to increases in autocracy while small ones do not. To address this concern in the last two columns of Table 5 we add a control for the share of the principal commodity in GDP. Admittedly econometrically this procedure is a bit dubious, as the share in GDP of the principal commodity is almost certainly endogenous. Nevertheless, it does serve as a rough-and-ready check on the hypothesis that

[27] 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 preferred approach remains the one in the previous section.

the Polity interaction simply proxies for the share of the principal commodity in GDP. As can be seen, whether estimated by least squares or by system GMM, principal-commodity price increases reduce democracy, at decreasing rates, in autocracies only, *even after controlling for the share of the principal commodity in GDP*. Because of the endogeneity of the principal-commodity share, in all other robustness checks we return to the specification that omits this variable.

In Table 6 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 sixteen years of export-share data). The results are in Columns 1 and 2. Columns 3 and 4 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 5 and 6 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 7 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. We address this concern in a number of ways. In columns 1 and 2 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 significant heterogeneous effect among autocracies. In columns 3 and 4 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. Columns 5 and 6 restrict 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. Also in this case, we find a negative and significant effect among autocracies. Finally in columns 7 and 8 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.

In a further effort to probe the role of observations at the -10 boundary, we estimate the heterogenous effect of price changes nonparametrically. 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 lower 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 changes equal to -3. The results, reported in Table A1 (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.[28]

In Table 8 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).[29] 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), Brückner and Ciccone (2010), Besley and Persson (2011)] 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

[28] 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.

[29] 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 principal commodity, as well as data sources for commodity production, is given in Table A2.

of commodity shares (as well as measurement error). However in Table 9 we check the robustness of our results to this alternative specification, constructing a country-specific index based on commodities in our sample. In columns 1 and 2 we weigh 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 sizeable 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 10 we deal with the issue of commodity typology. An important distinction that has been made 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 countries whose principal commodity is point source. 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). Columns 1 and 2 in Table 10 confirm 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. Columns 3 and 4 show instead an average significant effect for diffuse commodity producers, but no significant heterogeneity. In columns 5 to 8 we consider an alternative classification, taking as point source commodities minerals only. Columns 5 and 6 confirm the results for mineral autocratic countries. Column 7 and 8 consider non mineral countries only and displays a negative average relation between price and institutional change, with no evidence of heterogeneity in the effect. In the last set of columns we tried to check whether the difference in results between point-source/mineral and diffuse/non-mineral is driven by oil. Unfortunately, the "oil" sample becomes too small for significant results, but the similarity of coefficients suggests that oil is not the only mineral driving the heterogeneous effect of resource booms in autocracies. Altogether, Table 10 provides support for our theory in point source producers under both

alternative classifications, while it is less conclusive for diffuse commodities producers.[30]

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 columns 1 and 2 of Table 11 we make the additional change of setting all observations pertaining to transition periods to missing. We still get a significantly heterogeneous effect among autocracies. 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, columns 3 and 4 of Table 11 present 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, 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

[30] In a related finding Andersen and Aslaksen's (2013) report that the probability of leadership change decreases following windfalls in the form of oil and lootable diamonds, while it increases following mineral windfalls.

statistically robust when using thresholds of 1 and 2. For more demanding definitions of democracy the results are qualitatively robust, but lose statistical significance.

In another set of robustness checks we have looked at alternative proxies for our variable B, which in our model represents the self-preservation activities of incumbents. The results are presented in Table 13. We began with proxies from Freedom House, which provides a generalized index of liberty (columns 1 and 2), as well as its constituent components, such as civil liberties (columns 3 and 4), and political rights (columns 5 and 6). The estimates in columns 1 and 2 support our baseline results, in that, following resource windfalls, the institutional quality of intermediate autocracies worsen. Columns 3 to 6 indicate that the result is driven by more restrictive political participation and political rights, rather than by greater limits on civil liberties, consistent with our interpretation. Columns 7 and 8 report results using a combined Freedom House/Polity2 index. Hadenius and Teorell (2005) show that this average index performs better both in terms of validity and reliability than its constituent parts. The results using the average index confirm those from our baseline specification.

The last four columns report results using 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).[31] 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 important limitation of these 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, 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

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

low correlation between the Polity2 scores and the PTS and CIRI scores (0.36 and 0.37, respectively). Additional shortcoming of the PTS and CIRI indices are that they suffer from severe censoring and selection biases, as information on abuses is less forthcoming the more repressive the state is [Goldstein, 1986]; that the focus of the datasets is on Western countries [Foweraker and Krznaric, 2000]; and that the State Department (one of two key sources for these datasets) tends to exaggerating the level of repression in countries ideologically opposed to the US, while favoring those in which the US had strategic interests [Innes de Neufville, 1986]. We conclude that lack of robustness to PTS and CIRI, while important to notice, need not cast an overly negative light on the validity of our benchmark conclusions.

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.[32]

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 than resource rich ones. This is a notoriously difficult prediction to test. Hence, we use the model to develop an additional testable implication that, we argue, better leads itself to causal identification. This prediction is that, among autocracies, resource windfalls will trigger further moves towards harsher forms of autocracy, the more so the less entrenched the autocracy was initially, while there is no impact in countries that start out as democracies. These predictions find empirical support in a broad panel of countries.

Future work could usefully look at other outcomes. We have briefly discussed in the text the possibility of extending the model to deliver predictions on uses of the resource rents other than to distort the political rules of the game in the incumbent's favour, such as spending

[32] Our paper focuses on increases in export prices. Conceivably an increase in the price of imports may indirectly have a negative effect on the rents enjoyed by political incumbents (for example because they have to use more of the state revenues to subsidize consumption of imported commodities) and therefore, in the spirit of our model, lead to improvements in the polity score in autocracies. But clearly this is a much more indirect mechanism, and the adverse quantitative impact of a given import price change on rents is likely to be much smaller in absolute value than the positive effect on rents of an export-price increase - which affects rents directly, as discussed in the paper. Consistent with this discussion, results reported in the online appendix show that import-price increases increase the policy score in autocracies, and more so for weak autocracies, but the estimated coefficients are much smaller in absolute value than those for exports in Table 3, and indeed they do not reach statistical significance.

on education or infrastructure. This could be further extended to generate predictions on the growth response of the economy to resource windfalls. It seems likely that such extensions will produce similar nonmonotonicities in the relation between resource windfalls and outcomes as we found in this paper, and that such predictions could be tested using a similar conditioning strategy.

The nonmonotonicities we uncover, both theoretically and empirically, imply a more nuanced policy response to natural-resource windfalls than has generally been the case heretofore. While our empirical work focuses on "local" changes in resource rents, the model predicts that a large discrete resource windfall has the capacity to tip a democracy into autocracy. Countries close to the democracy-autocracy threshold are therefore more vulnerable to the impact of large resource discoveries, and should be the focus of heightened attention from policy makers in importing countries and extractive industries alike.

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5. Appendix 1: 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

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

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.

6. Appendix 2: Non-Stationarity of Commodity Prices

We study the persistence of commodity price shocks under three alternative tests, reported in Table A3. In column (1) we start by analyzing the modified version of the augmented Dickey Fuller test proposed by Elliott, Rothenberg, and Stock (1996).[33] The optimal lag length is chosen using the modified Akaike information criterion. The null hypothesis is that the price series contains a unit root. We fail to reject this null for 30 of the 32 commodities in our sample (but reject the null hypothesis of a unit root in first-differenced prices in 31 out of 32 commodities at the 99% confidence level). Unit root tests have notoriously low power against competing alternative, so that a failure to reject the null hypothesis of a unit root should not be taken as conclusive evidence for accepting the null. For this reason, in column (2) we complement the previous test with the Kwiatkowski, Phillips, Schmidt, Shin (1992) test for stationarity of a time series.[34] This test differs from the previous one by having a null hypothesis of stationarity. We reject the null for 25 out of 32 commodity prices at the 90% confidence level (but we do not reject the stationarity of the first-differenced price series for all commodities in the sample). Finally, in column (3) we perform the Lo-MacKinlay (1998) test, which more specifically tests for the time series being a random walk. The test computes a overlapping variance-ratio test on a time series, exploiting the fact that the variance of the increments of a random walk is linear in the sampling interval. We fail to reject the null hypothesis that the price series follows a random walk for 29 out of 32 commodities in our sample.[35] All three tests therefore indicate, under alternative null hypotheses, that the commodity price series are, by and large, best characterized as random walk processes. In this sense, the spot price represents the best guess as to the immediate value of the resources moving forward a few years. This is consistent with previous studies finding that shocks to commodity prices are very long-lasting (e.g. Bruckner and Ciccone 2010).

[33] The test is similar to the original augmented Dickey-Fuller test, except that the time series is transformed via a generalized least squares (GLS) regression before performing the test. This is shown to significantly increase the power of the original test.

[34] The kernel bandwidth in the Kwiatkowski et al. test is based on the Newey and West automated bandwidth selection criteria and set equal to 4 or 5, depending on the commodity.

[35] The reported test-statistics refer to increments of 2 periods. We obtain the same results using increments of 4, 8 and 16 periods.

Figure 1. Theoretical Relation between Resource Revenues and Autocracy

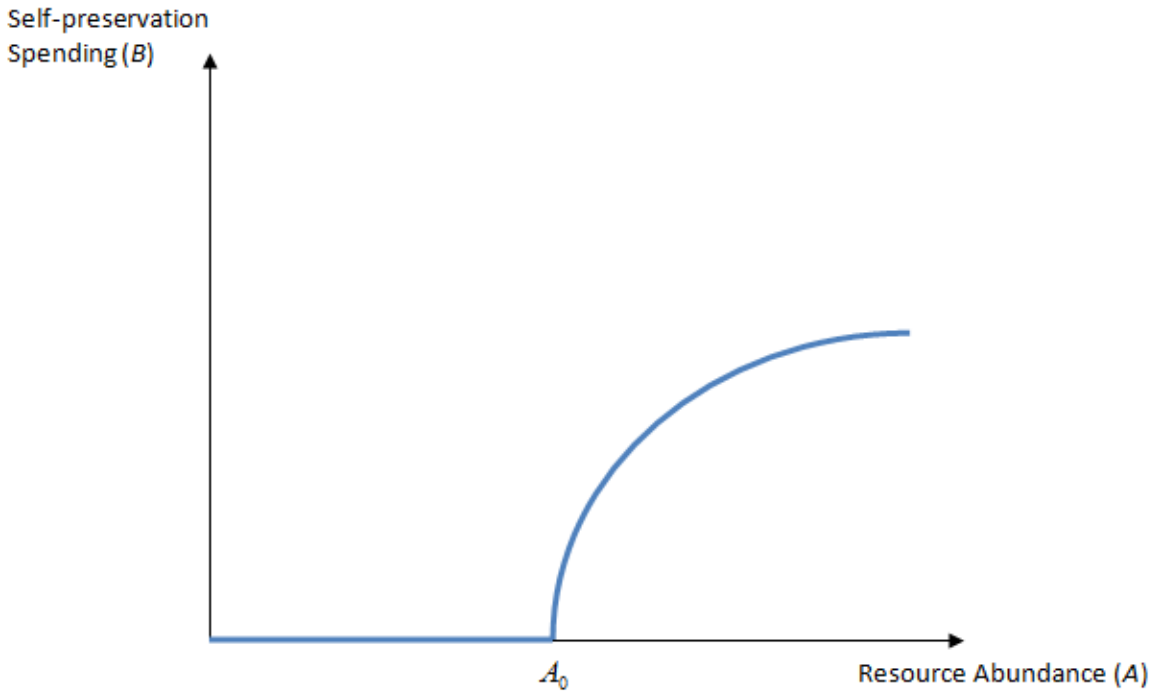
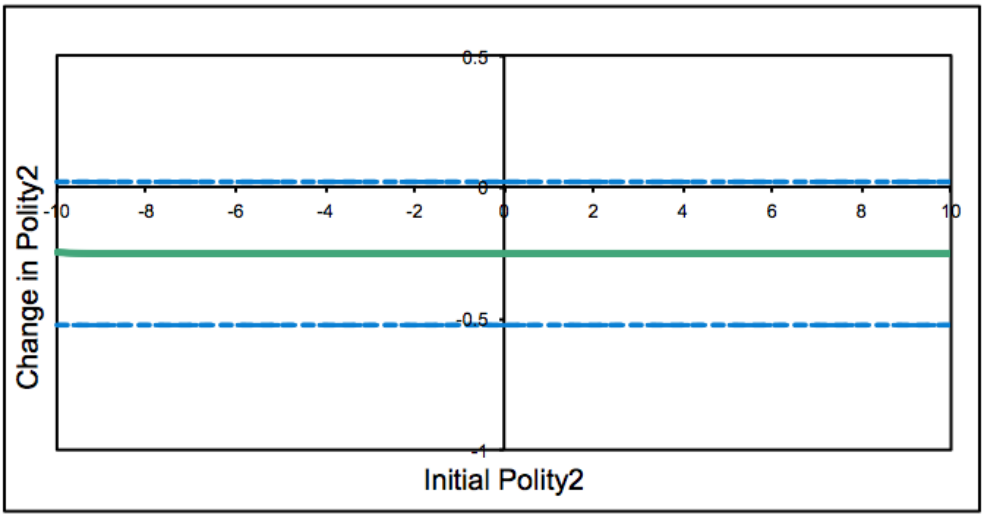
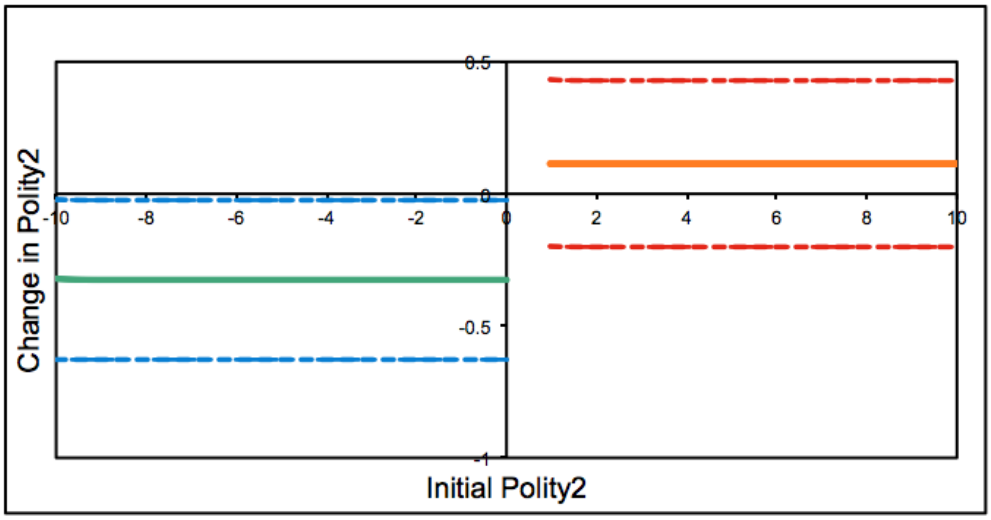


Figure 2. Marginal Price Effect at Different Initial Levels of *Polity*





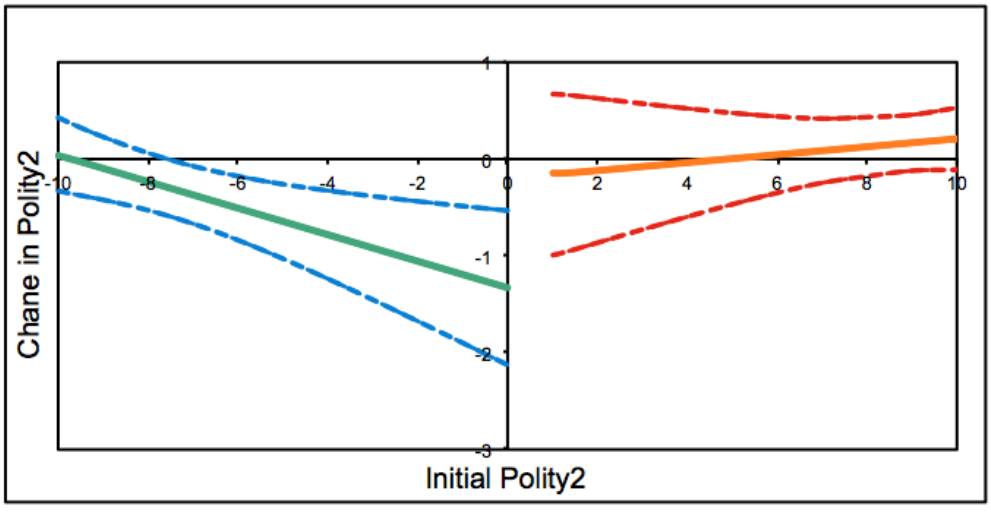


Figure 3. Estimated Coefficient at Different Bins

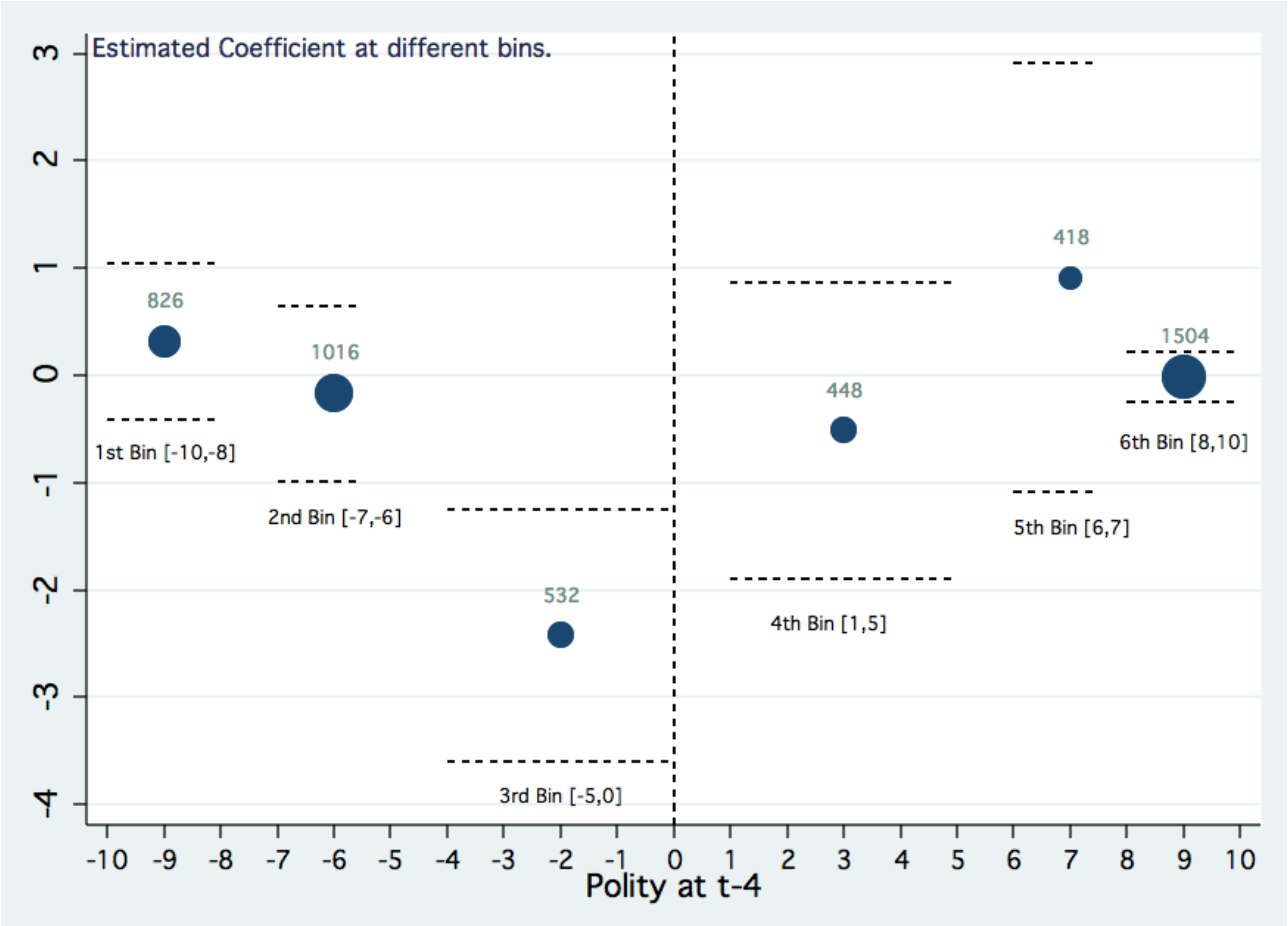


Table 1. Countries by Commodity

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

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
$\Delta Polity2$	0.096	1.724	-18	16	5380
*Polity*2	0.983	7.538	-10	10	5572
*Polity*2 *1962*	-0.118	7.641	-10	10	93
*Polity*2 *2009*	4.145	6.091	-10	10	131
ΔPr	0.078	0.185	-0.366	1.044	5486
Share	0.057	0.094	0	0.757	4019
Country Avg. Share	0.067	0.091	0.001	0.41	6276
Years Princ. Comm.	22.124	11.851	2	48	6276
Total Years	30.863	15.032	2	48	6276

Table 3. Commodity Price Shocks and Institutional Change. Baseline Sample

	(1) LS	(2) LS	(3) LS	(4) SYS-GMM
ΔPr	-0.25			
	(0.17)			
ΔPr_a		-0.33*	-0.42**	-0.43*
		(0.18)	(0.19)	(0.26)
ΔPr_d		0.11	0.12	0.08
		(0.19)	(0.18)	(0.24)
$\Delta Pr_a * Pl_{t-4,a}$			-0.14**	-0.19***
			(0.06)	(0.07)
$\Delta Pr_d * Pl_{t-4,d}$			0.04	-0.07
			(0.06)	(0.08)
$Pl_{t-4,a}$			-0.06***	-0.04
			(0.02)	(0.04)
$Pl_{t-4,d}$			-0.12***	-0.11
			(0.03)	(0.07)
Dem_{t-4}		-1.03***	-1.35***	-0.92***
		(0.11)	(0.14)	(0.31)
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
AR(1)				[0.000]
AR(2)				[0.692]
N. of countries	131	131	131	131
Observations	4875	4744	4744	4744

* Significantly different from zero at the 90% level, ** 95% level, *** 99% level. The dependent variable is the $t-1$ to t change in the revised Polity score ($Polity2$). ΔPr is the average 3-years change in the price of the principal commodity. ΔPr_a is the average 3-years change in the price of the principal commodity, multiplied by a dummy variable equal to 1 if the country is autocratic at t-4. $Pl_{t-4,a}$ is the country's Polity2 score at $t-4$, minus the average score among autocracies at $t-4$. ΔPr_d and $Pl_{t-4,d}$ are the corresponding definitions for democracies. Dem_{t-4} is a dummy variable equal to 1 if the country is democratic at t-4. The method of estimation in columns (1)-(3) is least squares, in column (4) system-GMM (Blundell-Bond). Standard errors in parenthesis are Huber robust and clustered at the country level. The values reported for AR(1) and AR(2) are the p-values for first and second order autocorrelated disturbances in the first differences equations.

Table 4. Components of *Polity2*

	$\Delta Exconst$		$\Delta Exrec$		$\Delta Polcomp$	
	(1)	(2)	(3)	(4)	(5)	(6)
	LS	SYS-GMM	LS	SYS-GMM	LS	SYS-GMM
ΔPr_a	-0.10	-0.10	-0.18**	-0.17*	-0.09	-0.09
	(0.07)	(0.09)	(0.07)	(0.09)	(0.10)	(0.13)
ΔPr_d	0.01	0.00	0.03	0.04	0.07	0.03
	(0.07)	(0.09)	(0.06)	(0.08)	(0.09)	(0.12)
$\Delta Pr_a * Pl_{t-4,a}$	-0.04**	-0.05**	-0.06**	-0.07**	-0.07**	-0.09**
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.04)
$\Delta Pr_d * Pl_{t-4,d}$	0.00	-0.03	0.02	-0.02	0.01	-0.02
	(0.02)	(0.03)	(0.02)	(0.03)	(0.03)	(0.04)
$Pl_{t-4,a}$	-0.02*	-0.01	-0.01	-0.01	-0.04***	-0.02
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)
$Pl_{t-4,d}$	-0.05***	-0.04**	-0.02*	-0.01	-0.06***	-0.05**
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)
Dem_{t-4}	-0.42***	-0.36***	-0.42***	-0.25**	-0.56***	-0.37***
	(0.06)	(0.11)	(0.04)	(0.12)	(0.06)	(0.12)
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
AR(1)		[0.000]		[0.000]		[0.000]
AR(2)		[0.778]		[0.633]		[0.708]
N. of countries	131	131	131	131	131	131
Observations	4744	4744	4744	4744	4744	4744

* Significantly different from zero at the 90% level, ** 95% level, *** 99% level. The dependent variable in columns (1)-(2) is the $t-1$ to t change in the Polity IV subscore of constraints on the executive (Exconst), whose range is [1, 7]. In columns (3)-(4) is the $t-1$ to t change in the Polity IV subscore of contraints on the executive recruitment (Exrec), whose range is [1, 8]. In columns (5)-(6) is the $t-1$ to t change in the Polity IV subscore of political competition (Polcomp), whose range is [1, 10]. ΔPr_a is the average 3-years change in the price of the principal commodity, multiplied by a dummy variable equal to 1 if the country is autocratic at t-4. $Pl_{t-4,a}$ is the country's Polity2 score at $t-4$, minus the average score among autocracies at $t-4$. ΔPr_d and $Pl_{t-4,d}$ are the corresponding definitions for democracies. Dem_{t-4} is a dummy variable equal to 1 if the country is democratic at t-4. The method of estimation in columns (1), (3), (5) is least squares, in columns (2), (4), (6) system-GMM (Blundell-Bond). Standard errors in parenthesis are Huber robust and clustered at the country level. The values reported for AR(1) and AR(2) are the p-values for first and second order autocorrelated disturbances in the first differences equations.

Table 5. Account for Export Share

	Ex. 1st Decile		Ex. 1st Quartile		Ex. Below Median		Control for Share	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	LS	SYS-GMM	LS	SYS-GMM	LS	SYS-GMM	LS	SYS-GMM
ΔPr_a	-0.37*	-0.41	-0.41*	-0.51	-0.49*	-0.76*	-0.40*	-0.63*
	(0.20)	(0.28)	(0.21)	(0.31)	(0.26)	(0.39)	(0.21)	(0.32)
ΔPr_d	0.27	0.24	0.33	0.32	0.40	0.25	0.22	0.12
	(0.18)	(0.26)	(0.22)	(0.29)	(0.31)	(0.35)	(0.19)	(0.24)
$\Delta Pr_a * Pl_{t-4,a}$	-0.13**	-0.19**	-0.16***	-0.20***	-0.11**	-0.16**	-0.17**	-0.26**
	(0.06)	(0.07)	(0.05)	(0.07)	(0.05)	(0.07)	(0.07)	(0.10)
$\Delta Pr_d * Pl_{t-4,d}$	0.02	-0.10	0.06	-0.08	-0.05	-0.19	0.03	-0.05
	(0.07)	(0.08)	(0.07)	(0.09)	(0.09)	(0.12)	(0.06)	(0.07)
$Pl_{t-4,a}$	-0.08***	-0.06	-0.07***	-0.05	-0.06**	-0.04	-0.05*	0.04
	(0.03)	(0.04)	(0.02)	(0.05)	(0.03)	(0.05)	(0.03)	(0.06)
$Pl_{t-4,d}$	-0.13***	-0.13*	-0.14***	-0.14*	-0.07*	-0.10	-0.12***	-0.16**
	(0.03)	(0.07)	(0.03)	(0.08)	(0.04)	(0.07)	(0.03)	(0.07)
Share							0.04	-2.48
							(0.51)	(1.54)
Dem_{t-4}	-1.37***	-0.99***	-1.38***	-0.87***	-1.25***	-0.88***	-1.32***	-0.86**
	(0.15)	(0.30)	(0.17)	(0.32)	(0.19)	(0.31)	(0.19)	(0.38)
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR(1)		[0.000]		[0.000]		[0.000]		[0.000]
AR(2)		[0.184]		[0.050]		[0.447]		[0.633]
N. of countries	117	117	93	93	63	63	131	131
Observations	4206	4206	3413	3413	2312	2312	3579	3579

* Significantly different from zero at the 90% level, ** 95% level, *** 99% level. The dependent variable is the $t-1$ to t change in the revised Polity score (*Polity*2). ΔPr_a is the average 3-years change in the price of the principal commodity, multiplied by a dummy variable equal to 1 if the country is autocratic at t-4. $Pl_{t-4,a}$ is the country's Polity2 score at $t-4$, minus the average score among autocracies at $t-4$. ΔPr_d and $Pl_{t-4,d}$ are the corresponding definitions for democracies. Dem_{t-4} is a dummy variable equal to 1 if the country is democratic at t-4. 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. Columns (7)-(8) control for the export share level. The method of estimation in columns (1), (3), (5), (7) is least squares, in columns (2), (4), (6), (8) system-GMM (Blundell-Bond). Standard errors in parenthesis are Huber robust and clustered at the country level. The values reported for AR(1) and AR(2) are the p-values for first and second order autocorrelated disturbances in the first differences equations.

Table 6. Breaking by Number of Export Share Observations

	Ex. 1^{st} Quartile		Obs. before 1986		Always 1^{st} after 1986	
	(1)	(2)	(3)	(4)	(5)	(6)
	LS	SYS-GMM	LS	SYS-GMM	LS	SYS-GMM
ΔPr_a	-0.50**	-0.53**	-0.51**	-0.43	-0.43**	-0.37
	(0.21)	(0.26)	(0.20)	(0.29)	(0.19)	(0.27)
ΔPr_d	0.20	0.32	0.13	0.23	0.12	0.23
	(0.19)	(0.24)	(0.20)	(0.25)	(0.19)	(0.24)
$\Delta Pr_a * Pl_{t-4,a}$	-0.16**	-0.21***	-0.16**	-0.22***	-0.14**	-0.21***
	(0.06)	(0.07)	(0.06)	(0.07)	(0.06)	(0.07)
$\Delta Pr_d * Pl_{t-4,d}$	0.01	-0.06	0.04	-0.05	0.04	-0.06
	(0.08)	(0.09)	(0.08)	(0.09)	(0.08)	(0.09)
$Pl_{t-4,a}$	-0.07**	-0.05	-0.07***	-0.06	-0.07***	-0.05
	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)
$Pl_{t-4,d}$	-0.11***	-0.14*	-0.12***	-0.13*	-0.11***	-0.13*
	(0.03)	(0.08)	(0.03)	(0.07)	(0.03)	(0.07)
Dem_{t-4}	-1.41***	-1.20***	-1.45***	-1.12***	-1.40***	-1.10***
	(0.15)	(0.28)	(0.15)	(0.31)	(0.15)	(0.30)
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
AR(1)		[0.000]		[0.000]		[0.000]
AR(2)		[0.117]		[0.195]		[0.304]
N. of countries	96	96	92	92	105	105
Observations	3795	3795	3724	3724	4072	4072

* Significantly different from zero at the 90% level, ** 95% level, *** 99% level. The dependent variable is the $t-1$ to t change in the revised Polity score (*Polity*2). ΔPr_a is the average 3-years change in the price of the principal commodity, multiplied by a dummy variable equal to 1 if the country is autocratic at t-4. $Pl_{t-4,a}$ is the country's Polity2 score at $t-4$, minus the average score among autocracies at $t-4$. ΔPr_d and $Pl_{t-4,d}$ are the corresponding definitions for democracies. Dem_{t-4} is a dummy variable equal to 1 if the country is democratic at t-4. Columns (1)-(2) exclude countries in the first quartile of observations on which the principal commodity is identified. Columns (3)-(4) exclude countries without share observations before 1986, the midpoint year of share observations. Columns (5)-(6) include countries without share observations before 1986, but whose principal commodity has *always* been ranked first afterwards. The method of estimation in columns (1), (3), (5) is least squares, in columns (2), (4), (6) system-GMM (Blundell-Bond). Standard errors in parenthesis are Huber robust and clustered at the country level. The values reported for AR(1) and AR(2) are the p-values for first and second order autocorrelated disturbances in the first differences equations.

Table 7. Boundedness of *Polity2* Score

	$\Delta Pl \geq 0$		D=1 | $\Delta Pl \geq 0$		Unbounded Countries		Unbounded Obs.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	LS	SYS-GMM	LS	SYS-GMM	LS	SYS-GMM	LS	SYS-GMM
ΔPr_a	-0.45**	-0.73**	-0.05	-0.06	-0.39*	-0.49	-0.41*	-0.44
	(0.17)	(0.35)	(0.03)	(0.04)	(0.23)	(0.32)	(0.21)	(0.30)
ΔPr_d	-0.02	-0.29	-0.01	0.00	0.08	-0.00	0.11	0.04
	(0.12)	(0.21)	(0.03)	(0.03)	(0.29)	(0.34)	(0.26)	(0.31)
$\Delta Pr_a * Pl_{t-4,a}$	-0.16***	-0.13	-0.03**	-0.04**	-0.13*	-0.20**	-0.14*	-0.18**
	(0.05)	(0.14)	(0.01)	(0.01)	(0.08)	(0.09)	(0.07)	(0.09)
$\Delta Pr_d * Pl_{t-4,d}$	0.03	0.07	0.01	0.00	0.08	-0.02	0.03	-0.07
	(0.04)	(0.07)	(0.01)	(0.01)	(0.13)	(0.14)	(0.11)	(0.12)
$Pl_{t-4,a}$	-0.01	0.06	-0.00	0.00	-0.08***	-0.04	-0.08***	-0.03
	(0.02)	(0.05)	(0.00)	(0.01)	(0.03)	(0.04)	(0.03)	(0.04)
$Pl_{t-4,d}$	-0.07***	-0.09**	-0.01***	-0.01	-0.15***	-0.12	-0.13***	-0.09
	(0.02)	(0.04)	(0.00)	(0.01)	(0.03)	(0.07)	(0.03)	(0.07)
Dem_{t-4}	-0.84***	-0.42**	-0.13***	-0.08***	-1.25***	-1.23***	-1.25***	-1.22***
	(0.12)	(0.18)	(0.02)	(0.03)	(0.14)	(0.23)	(0.13)	(0.20)
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR(1)		[0.000]		[0.000]		[0.000]		[0.000]
AR(2)		[0.010]		[0.001]		[0.241]		[0.821]
N. of countries	131	131	131	131	90	90	107	107
Observations	4592	4592	4744	4744	3222	3222	3634	3634

* Significantly different from zero at the 90% level, ** 95% level, *** 99% level. The dependent variable is the $t-1$ to t change in the revised Polity score (*Polity*2). ΔPr_a is the average 3-years change in the price of the principal commodity, multiplied by a dummy variable equal to 1 if the country is autocratic at t-4. $Pl_{t-4,a}$ is the country's Polity2 score at $t-4$, minus the average score among autocracies at $t-4$. ΔPr_d and $Pl_{t-4,d}$ are the corresponding definitions for democracies. Dem_{t-4} is a dummy variable equal to 1 if the country is democratic at t-4. Columns (1)-(2) consider non-negative *Polity*2 changes only. Columns (3)-(4) estimate a dummy variable equal to 1 if there is a positive *Polity*2 change, and 0 otherwise. Columns (5)-(6) restrict the sample to countries that never touched the boundaries at -10 and +10 on the Polity scale. Columns (7)-(8) exclude the observations at -10 and +10. The method of estimation in columns (1), (3), (5), (7) is least squares, in columns (2), (4), (6), (8) system-GMM (Blundell-Bond). Standard errors in parenthesis are Huber robust and clustered at the country level. The values reported for AR(1) and AR(2) are the p-values for first and second order autocorrelated disturbances in the first differences equations.

Table 8. Excluding Big Producers

	Exclude OPEC countries		Exclude Big Producers	
	(1)	(2)	(3)	(4)
	LS	SYS-GMM	LS	SYS-GMM
ΔPr_a	-0.43**	-0.36	-0.54**	-0.54
	(0.21)	(0.28)	(0.24)	(0.33)
ΔPr_d	0.09	0.01	-0.05	-0.26
	(0.19)	(0.25)	(0.25)	(0.36)
$\Delta Pr_a * Pl_{t-4,a}$	-0.15**	-0.21**	-0.15*	-0.23**
	(0.07)	(0.08)	(0.08)	(0.09)
$\Delta Pr_d * Pl_{t-4,d}$	0.04	-0.00	0.07	0.02
	(0.06)	(0.07)	(0.08)	(0.11)
$Pl_{t-4,a}$	-0.12***	-0.12*	-0.13***	-0.11
	(0.03)	(0.07)	(0.04)	(0.10)
$Pl_{t-4,d}$	-0.12***	-0.12*	-0.13***	-0.11
	(0.03)	(0.07)	(0.04)	(0.10)
Dem_{t-4}	-1.30***	-1.00***	-1.41***	-1.27***
	(0.13)	(0.32)	(0.18)	(0.43)
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
AR(1)		[0.000]		[0.000]
AR(2)		[0.758]		[0.764]
N. of countries	120	120	87	87
Observations	4282	4282	3003	3003

* Significantly different from zero at the 90% level, ** 95% level, *** 99% level. The dependent variable is the $t-1$ to t change in the revised Polity score ($Polity2$). ΔPr_a is the average 3-years change in the price of the principal commodity, multiplied by a dummy variable equal to 1 if the country is autocratic at t-4. $Pl_{t-4,a}$ is the country's Polity2 score at $t-4$, minus the average score among autocracies at $t-4$. ΔPr_d and $Pl_{t-4,d}$ are the corresponding definitions for democracies. Dem_{t-4} is a dummy variable equal to 1 if the country is democratic at t-4. 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 Appendix Table A2. The method of estimation in columns (1), (3) is least squares, in columns (2), (4), system-GMM (Blundell-Bond). Standard errors in parenthesis are Huber robust and clustered at the country level. The values reported for AR(1) and AR(2) are the p-values for first and second order autocorrelated disturbances in the first differences equations.

Table 9. Alternative Commodity Price Index

	Average Weight		Weight 1975		Weight 1980		Weight 1990		Weight 2001	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	LS	SYS-GMM	LS	SYS-GMM	LS	SYS-GMM	LS	SYS-GMM	LS	SYS-GMM
ΔPr_a	-0.46	-0.43	-0.49*	-0.34	-0.46	-0.35	-0.52*	-0.28	-0.52*	-0.59*
	(0.33)	(0.47)	(0.28)	(0.40)	(0.28)	(0.32)	(0.30)	(0.34)	(0.28)	(0.35)
ΔPr_d	0.18	0.58	0.32	1.03*	0.30	0.48	0.10	0.23	0.30	0.76
	(0.35)	(0.56)	(0.38)	(0.56)	(0.22)	(0.34)	(0.37)	(0.46)	(0.33)	(0.54)
$\Delta Pr_a * Pl_{t-4,a}$	-0.10	-0.17	-0.12	-0.19*	-0.16*	-0.25**	-0.22**	-0.20**	-0.11	-0.18*
	(0.09)	(0.11)	(0.08)	(0.10)	(0.09)	(0.10)	(0.09)	(0.09)	(0.08)	(0.10)
$\Delta Pr_d * Pl_{t-4,d}$	0.07	-0.19	0.12	-0.20	-0.01	-0.09	0.01	-0.06	0.08	-0.15
	(0.09)	(0.15)	(0.10)	(0.20)	(0.09)	(0.11)	(0.15)	(0.17)	(0.08)	(0.14)
$Pl_{t-4,a}$	-0.07***	-0.05	-0.07**	-0.07	-0.06**	-0.04	-0.03	-0.00	-0.07***	-0.06
	(0.02)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)	(0.02)	(0.04)
$Pl_{t-4,d}$	-0.10***	-0.11*	-0.10***	-0.13*	-0.06	-0.09	-0.06	-0.05	-0.10***	-0.12*
	(0.03)	(0.06)	(0.04)	(0.07)	(0.04)	(0.08)	(0.04)	(0.08)	(0.03)	(0.06)
Dem_{t-4}	-1.32***	-1.02***	-1.43***	-1.11***	-1.29***	-1.04***	-1.20***	-0.83***	-1.32***	-1.07***
	(0.13)	(0.26)	(0.17)	(0.29)	(0.14)	(0.25)	(0.15)	(0.30)	(0.13)	(0.26)
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR(1)		[0.000]		[0.000]		[0.000]		[0.000]		[0.000]
AR(2)		[0.467]		[0.758]		[0.016]		[0.425]		[0.088]
N. of countries	131	131	84	84	82	82	78	78	122	122
Observations	4957	4957	3600	3600	3527	3527	3327	3327	4629	4629

* Significantly different from zero at the 90% level, ** 95% level, *** 99% level. The dependent variable is the $t-1$ to t change in the revised Polity score ($Polity2$). ΔPr_a is the average 3-years change in the price of the principal commodity, multiplied by a dummy variable equal to 1 if the country is autocratic at t-4. $Pl_{t-4,a}$ is the country's Polity2 score at $t-4$, minus the average score among autocracies at $t-4$. ΔPr_d and $Pl_{t-4,d}$ are the corresponding definitions for democracies. Dem_{t-4} is a dummy variable equal to 1 if the country is democratic at t-4. 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)-(2) weigh commodities by their average share in country exports, measured over all available years. Columns (3)-(4) weigh commodities by their share in 1975, the base year used in Deaton-Miller (1995). Columns (5)-(6) weigh commodities by their share in 1980, the base year used in Besley-Persson (2008). Columns (7)-(8) weigh commodities by their share in 1990, the base year used in Deaton (1999) and Brückner and Ciccone (2010). Columns (9)-(10) weigh commodities by their share in 2001, the year with the highest number of reporting countries. The method of estimation in columns (1), (3), (5), (7), (9) is least squares, in columns (2), (4), (6), (8), (10) system-GMM (Blundell-Bond). Standard errors in parenthesis are Huber robust and clustered at the country level. The values reported for AR(1) and AR(2) are the p-values for first and second order autocorrelated disturbances in the first differences equations.

Table 10. Typologies of Commodities

	First Classification				Second Classification				Third Classification			
	Point Source		Diffuse		Mineral		Non Mineral		Oil		Non Oil	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	LS	SYS-GMM	LS	SYS-GMM	LS	SYS-GMM	LS	SYS-GMM	LS	SYS-GMM	LS	SYS-GMM
ΔPr_a	-0.37*	-0.41	-1.63*	-1.37*	-0.22	-0.23	-1.07***	-0.66	-0.30*	-0.36	-0.95***	-0.78**
	(0.21)	(0.29)	(0.82)	(0.82)	(0.29)	(0.36)	(0.40)	(0.44)	(0.15)	(0.22)	(0.29)	(0.38)
ΔPr_d	0.24	0.22	-0.44	-0.23	0.22	0.20	-0.24	-0.20	0.22	0.31	-0.14	-0.34
	(0.22)	(0.25)	(0.44)	(0.59)	(0.27)	(0.31)	(0.33)	(0.41)	(0.23)	(0.28)	(0.19)	(0.27)
$\Delta Pr_a * Pl_{t-4,a}$	-0.18***	-0.22***	0.33	0.54	-0.12**	-0.12*	-0.04	-0.04	-0.08	-0.07	-0.08	-0.16
	(0.05)	(0.07)	(0.57)	(0.63)	(0.05)	(0.07)	(0.21)	(0.24)	(0.06)	(0.08)	(0.12)	(0.12)
$\Delta Pr_d * Pl_{t-4,d}$	0.02	-0.10	0.14	0.23	0.06	-0.05	-0.01	0.04	-0.04	-0.08	0.04	-0.04
	(0.07)	(0.08)	(0.13)	(0.14)	(0.07)	(0.07)	(0.13)	(0.16)	(0.11)	(0.13)	(0.07)	(0.09)
$Pl_{t-4,a}$	-0.05**	-0.04	-0.12	-0.10	-0.08***	-0.07	-0.05	-0.02	-0.08*	-0.08	-0.07**	-0.03
	(0.02)	(0.04)	(0.08)	(0.10)	(0.02)	(0.05)	(0.05)	(0.07)	(0.04)	(0.06)	(0.03)	(0.04)
$Pl_{t-4,d}$	-0.11***	-0.07	-0.13***	-0.18	-0.12***	-0.15***	-0.11***	-0.11	-0.10	-0.07	-0.13***	-0.16**
	(0.03)	(0.05)	(0.05)	(0.12)	(0.03)	(0.05)	(0.04)	(0.11)	(0.07)	(0.09)	(0.03)	(0.07)
Dem_{t-4}	-1.34***	-0.64*	-1.35***	-1.40***	-1.39***	-1.02***	-1.30***	-1.06***	-1.92***	-1.70**	-1.37***	-1.12***
	(0.17)	(0.34)	(0.22)	(0.47)	(0.20)	(0.34)	(0.17)	(0.39)	(0.56)	(0.69)	(0.13)	(0.30)
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR(1)		[0.000]		[0.000]		[0.000]		[0.000]		[0.000]		[0.000]
AR(2)		[0.973]		[0.534]		[0.676]		[0.689]		[0.187]		[0.826]
N. of countries	87	87	44	44	70	70	61	61	30	30	101	101
Observations	3127	3127	1617	1617	2494	2494	2250	2250	1152	1152	3592	3592

* Significantly different from zero at the 90% level, ** 95% level, *** 99% level. The dependent variable is the $t-1$ to t change in the revised Polity score (*Polity*2). ΔPr_a is the average 3-years change in the price of the principal commodity, multiplied by a dummy variable equal to 1 if the country is autocratic at t-4. $Pl_{t-4,a}$ is the country's Polity2 score at $t-4$, minus the average score among autocracies at $t-4$. ΔPr_d and $Pl_{t-4,d}$ are the corresponding definitions for democracies. Dem_{t-4} is a dummy variable equal to 1 if the country is democratic at t-4. Mineral commodities are: Aluminium, 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. The method of estimation in columns (1), (3), (5), (7), (9), (11) is least squares, in columns (2), (4), (6), (8), (10), (12) system-GMM (Blundell-Bond). Standard errors in parenthesis are Huber robust and clustered at the country level. The values reported for AR(1) and AR(2) are the p-values for first and second order autocorrelated disturbances in the first differences equations.

Table 11. Alternative Time Specifications

	(1)	(2)	(3)	(4)
	Exclude Transition Periods		3 Years Non-Overlap	
	LS	SYS-GMM	LS	SYS-GMM
ΔPr_a	-0.09	-0.22	-0.04	-0.04
	(0.20)	(0.34)	(0.15)	(0.16)
ΔPr_d	0.20	0.39	0.23	0.22
	(0.18)	(0.27)	(0.14)	(0.14)
$\Delta Pr_a * Pl_{t-4,a}$	-0.14**	-0.30**	-0.08*	-0.08*
	(0.06)	(0.12)	(0.05)	(0.05)
$\Delta Pr_d * Pl_{t-4,d}$	0.03	-0.11	-0.03	-0.05
	(0.07)	(0.08)	(0.05)	(0.05)
$Pl_{t-4,a}$	-0.04	-0.05	-0.28***	-0.25**
	(0.02)	(0.06)	(0.07)	(0.10)
$Pl_{t-4,d}$	-0.08***	-0.08	-0.31***	-0.30**
	(0.03)	(0.07)	(0.09)	(0.13)
Dem_{t-4}	-0.96***	-0.81**	-4.91***	-4.34***
	(0.16)	(0.37)	(0.48)	(0.65)
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
AR(1)		[0.000]		[0.000]
AR(2)		[0.557]		[0.151]
N. of countries	131	131	131	131
Observations	4578	4578	1599	1599

* Significantly different from zero at the 90% level, ** 95% level, *** 99% level. In columns (1)-(2) the dependent variable is the $t-1$ to t change in the revised Polity score (*Polity*2), where transition years (*Polity*=-88) have been replaced by missing values. In columns (3)-(4) is the $t-3$ to t change in the revised Polity score (*Polity*2), where the estimation is for three-years non-overlapping periods: the change in *Polity*2 in period 1963-1966 is explained by the change in price in period 1962-1965; and similarly for the following periods. ΔPr_a is the average 3-years change in the price of the principal commodity, multiplied by a dummy variable equal to 1 if the country is autocratic at t-4. $Pl_{t-4,a}$ is the country's Polity2 score at $t-4$, minus the average score among autocracies at $t-4$. ΔPr_d and $Pl_{t-4,d}$ are the corresponding definitions for democracies. Dem_{t-4} is a dummy variable equal to 1 if the country is democratic at t-4. The method of estimation in columns (1), (3) is least squares, in columns (2), (4) system-GMM (Blundell-Bond). Standard errors in parenthesis are Huber robust and clustered at the country level. The values reported for AR(1) and AR(2) are the p-values for first and second order autocorrelated disturbances in the first differences equations.

Table 12. Alternative Thresholds for Democracy

	Polity ≥ 1		*Polity* ≥ 2		*Polity* ≥ 3		*Polity* ≥ 4		*Polity* ≥ 5	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	LS	SYS-GMM	LS	SYS-GMM	LS	SYS-GMM	LS	SYS-GMM	LS	SYS-GMM
ΔPr_a	-0.48***	-0.43*	-0.46**	-0.41	-0.41**	-0.34	-0.30*	-0.29	-0.29	-0.26
	(0.18)	(0.26)	(0.18)	(0.26)	(0.18)	(0.25)	(0.18)	(0.23)	(0.18)	(0.23)
ΔPr_d	0.17	0.13	0.15	0.10	0.14	0.01	0.10	-0.04	0.12	-0.02
	(0.18)	(0.23)	(0.18)	(0.23)	(0.18)	(0.23)	(0.19)	(0.25)	(0.19)	(0.25)
$\Delta Pr_a * Pl_{t-4,a}$	-0.16***	-0.19***	-0.13**	-0.14**	-0.08	-0.09	-0.01	-0.02	-0.01	-0.01
	(0.06)	(0.07)	(0.05)	(0.06)	(0.05)	(0.07)	(0.04)	(0.05)	(0.03)	(0.04)
$\Delta Pr_d * Pl_{t-4,d}$	-0.04	-0.11	-0.03	-0.10	-0.01	-0.06	0.06	-0.10	0.06	-0.04
	(0.06)	(0.08)	(0.07)	(0.09)	(0.06)	(0.06)	(0.11)	(0.12)	(0.15)	(0.15)
$Pl_{t-4,a}$	-0.06***	-0.01	-0.06***	-0.01	-0.07***	-0.01	-0.07***	-0.02	-0.08***	-0.04*
	(0.02)	(0.04)	(0.01)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.01)	(0.02)
$Pl_{t-4,d}$	-0.11***	-0.04	-0.10***	-0.02	-0.10***	0.01	-0.09**	0.10	-0.11***	0.02
	(0.03)	(0.06)	(0.04)	(0.07)	(0.03)	(0.07)	(0.04)	(0.07)	(0.04)	(0.09)
Dem_{t-4}	-1.36***	-0.84***	-1.36***	-0.87***	-1.35***	-0.88***	-1.32***	-0.68**	-1.30***	-0.68**
	(0.14)	(0.30)	(0.14)	(0.31)	(0.14)	(0.32)	(0.14)	(0.30)	(0.14)	(0.30)
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR(1)		[0.000]		[0.000]		[0.000]		[0.000]		[0.000]
AR(2)		[0.715]		[0.700]		[0.715]		[0.720]		[0.695]
N. of countries	131	131	131	131	131	131	131	131	131	131
Observations	4744	4744	4744	4744	4744	4744	4744	4744	4744	4744

* Significantly different from zero at the 90% level, ** 95% level, *** 99% level. The dependent variable is the $t-1$ to t change in the revised Polity score (*Polity*2). ΔPr_a is the average 3-years change in the price of the principal commodity, multiplied by a dummy variable equal to 1 if the country is autocratic at t-4. $Pl_{t-4,a}$ is the country's Polity2 score at $t-4$, minus the average score among autocracies at $t-4$. ΔPr_d and $Pl_{t-4,d}$ are the corresponding definitions for democracies. Dem_{t-4} is a dummy variable equal to 1 if the country is democratic at t-4. In columns (1)-(2) a country is considered democratic if its Polity2 score is ≥ 1, in columns (3)-(4) if it is ≥ 2, and so on. The method of estimation in columns (1), (3), (5), (7), (9) is least squares, in columns (2), (4), (6), (8), (10) system-GMM (Blundell-Bond). Standard errors in parenthesis are Huber robust and clustered at the country level. The values reported for AR(1) and AR(2) are the p-values for first and second order autocorrelated disturbances in the first differences equations.

Table 13. Alternative Measures of Institutional Quality

	Freedom House		Civil Liberties		Political Rights		Freedom House/Polity2		Political Terror Scale		CIRI Index	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	LS	SYS-GMM	LS	SYS-GMM	LS	SYS-GMM	LS	SYS-GMM	LS	SYS-GMM	LS	SYS-GMM
ΔPr_a	0.02	0.02	0.09	0.08	-0.05	-0.05	-0.13	-0.28*	0.04	0.01	0.07	0.23
	(0.06)	(0.06)	(0.07)	(0.07)	(0.07)	(0.07)	(0.10)	(0.15)	(0.07)	(0.11)	(0.26)	(0.39)
ΔPr_d	0.10*	0.03	0.07	0.02	0.12*	0.03	0.13	0.03	0.09	0.14	0.21	0.27
	(0.05)	(0.06)	(0.06)	(0.06)	(0.07)	(0.08)	(0.08)	(0.11)	(0.06)	(0.10)	(0.18)	(0.23)
$\Delta Pr_a * Pl_{t-4,a}$	-0.05**	-0.04*	-0.01	0.00	-0.09***	-0.08**	-0.10***	-0.15***	-0.00	-0.02	0.05	-0.07
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.05)	(0.02)	(0.04)	(0.10)	(0.14)
$\Delta Pr_d * Pl_{t-4,d}$	0.01	0.03	0.03*	0.04*	-0.00	0.01	0.02	0.00	0.01	0.01	-0.06	-0.05
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.04)	(0.02)	(0.04)	(0.09)	(0.11)
$Pl_{t-4,a}$	-0.01*	-0.02*	-0.02***	-0.01	-0.01	-0.02*	-0.03**	-0.05**	0.01	0.01	0.00	-0.03
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.03)
$Pl_{t-4,d}$	-0.02***	-0.01	-0.02***	-0.02	-0.02***	-0.00	-0.05***	-0.05**	-0.00	0.01	-0.03*	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.00)	(0.01)	(0.02)	(0.03)
Dem_{t-4}	-0.26***	-0.25***	-0.18***	-0.14**	-0.35***	-0.35***	-0.59***	-0.52***	-0.06**	-0.02	-0.17**	-0.05
	(0.03)	(0.05)	(0.03)	(0.05)	(0.04)	(0.07)	(0.06)	(0.12)	(0.02)	(0.06)	(0.07)	(0.14)
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR(1)		[0.000]		[0.000]		[0.000]		[0.000]		[0.000]		[0.000]
AR(2)		[0.280]		[0.530]		[0.774]		[0.896]		[0.001]		[0.003]
N. of countries	129	129	129	129	129	129	131	131	130	130	131	131
Observations	4145	4145	4145	4145	4145	4145	3852	3852	3742	3742	3244	3244

* Significantly different from zero at the 90% level, ** 95% level, *** 99% level. Columns (1)-(2) consider the variable Freedom House, representing the combined average rating of political rights and civil liberties from Freedom House. Columns (3)-(4) and (5)-(6) consider, respectively, civil liberties and political rights. Columns (7)-(8) average the Freedom House and Polity2 scores. Columns (9)-(10) consider the Political Terror Scale, while columns (11)-(12) the CIRI index of human rights. ΔPr_a is the average 3-years change in the price of the principal commodity, multiplied by a dummy variable equal to 1 if the country is autocratic at t-4. $Pl_{t-4,a}$ is the country's Polity2 score at $t-4$, minus the average score among autocracies at $t-4$. ΔPr_d and $Pl_{t-4,d}$ are the corresponding definitions for democracies. Dem_{t-4} is a dummy variable equal to 1 if the country is democratic at t-4. The method of estimation in columns (1), (3), (5), (7), (9), (11) is least squares, in columns (2), (4), (6), (8), (10), (12) system-GMM (Blundell-Bond). Standard errors in parenthesis are Huber robust and clustered at the country level. The values reported for AR(1) and AR(2) are the p-values for first and second order autocorrelated disturbances in the first differences equations.

Table A1. Percentage Changes to the Boundary

	(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.

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).

Table A3. Non-Stationarity of Commodity Prices

	(1) DF H_0: series has unit root	(2) KPSS H_0: series is stationary	(3) LM H_0: series is random walk
Oil	-1.555	0.613**	-1.029
Coffee	-2.126	0.282	-1.038
Wood	-2.759	0.786***	-0.151
PigIron	-2.122	0.742***	-1.259
Gemstones	-1.988	0.637**	0.567
Oranges	-1.369	0.652**	-0.745
Aluminium	-3.868***	0.768***	0.301
Cotton	-1.564	0.390*	-0.073
Bananas	-1.429	0.670**	0.531
Beef	-1.586	0.589**	1.246
Copper	-3.045*	0.582	1.774*
Fish	-1.185	0.323	0.338
Phosphates	-2.150	0.604**	-1.266
Coal	-0.875	0.505**	-1.068
Tobacco	-1.255	0.684**	1.427
Bauxite	-1.609	0.518**	-0.197
NaturalGas	-0.441	0.424*	-1.193
Rice	-2.149	0.307	-0.538
Swine	-0.725	0.547**	2.479**
Tea	-2.496	0.595**	-0.470
Wheat	-2.448	0.532**	-1.378
Cocoa	-2.125	0.274	4.284***
Gold	-1.625	0.681**	1.251
Groundnuts	-1.888	0.688**	-1.085
Jute	-1.313	0.349*	0.769
Maiz	-1.974	0.583**	-0.265
Rubber	-2.907	0.595**	-0.197
Silver	-1.568	0.362*	0.054
Soybean	-2.039	0.623**	-0.337
Sugar	-1.369	0.832***	1.518
Tin	-1.620	0.136	1.546
Uranium	-0.458	0.292	1.557

Significantly different from zero at the * 90% level, ** 95% level, *** 99% level. Column (1) reports the test-statistic for the modified Dickey-Fuller (1979) unit roots test proposed by Elliott, Rothenberg, and Stock (1996). The null hypothesis is that the price series contains a unit root. The optimal lag is chosen using the Modified Akaike criterion. Column (2) reports the test-statistic for the Lo-MacKinlay (1988) variance to ratio test, robust to heteroskedasticity. The null hypothesis is that the series follows a random walk process. Column (3) reports the test-statistic for the Kwiatkowski-Phillips-Schmidt-Shin (1992) unit roots test. The null hypothesis is that the price series is trend stationary. The kernel bandwidth is based on the Newey and West (1994) automated bandwidth selection criteria.