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Oil discoveries and democracy

Tania Masi\textsuperscript{1} and Roberto Ricciuti\textsuperscript{1,2}

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Abstract: We evaluate the effect of natural resources on political regimes. We use the synthetic control method to compare evolution of the democracy level of countries affected by giant oil discoveries with the weighted democracy level of countries that do not incur the same event and have similar pre-event characteristics. Focusing on 12 countries affected by the peak of oil discovery from the 1970s, we find that the exogenous variation in oil endowment does not have the same effect on all countries. In most of cases, the event has a negative effect in the long run, but countries with a high level of democracy in the pre-event period are not affected by the peak of oil discoveries. These results support heterogeneity and non-linearities claimed in the more recent theoretical literature.

Keywords: natural resources, oil discoveries, democracy, synthetic control method

JEL classification: C21, C23, O57, P48

Tables and Figures: at the end of the paper.
1 Introduction

[. . .] the problem is often not the lack of natural resources. Many societies with unfavorable conditions do not lack for resources. Well-ordered societies can get on with very little; their wealth lies else-where: in their political and cultural traditions, in their human capital and knowledge, and in their capacity for political and economic organization. Rather, the problem is commonly the nature of the public political culture and the religious and philosophical traditions that underlie its institutions. The great social evils in poorer societies are likely to be oppressive government and corrupt elites and the subjection of women abetted by unreasonable religion [. . .]. (Rawls 2001: 64)

Natural resources such as minerals, oil, and gas are a source of rent for a state. However, there is strong evidence that large endowments of natural resources may reduce economic growth and are associated with non-democratic regimes. This problem is often called ‘resources curse’.¹ The link to explain this perverse relationship is the public sector: rents from natural resources are used by politicians as a tool to remain in power. For example, a job in the public sector may be offered in exchange for a vote, or simply in acceptance of the status quo in a non-democratic regime. So-called white elephants projects (expensive, used below capacity, and therefore unsustainable over time) are another example of waste of public monies accrued from extractive resources.² Overall, there is an excessive expansion of the public sector that leads to inefficiency. Moreover, a growing extractive sector with high profits tends to attract capital, reducing its availability for investments in other industries. First, this lowers funds for other profitable but less politically linked companies; second, it diminishes diversification and exposes the country to idiosyncratic shocks in the resource-abundant sector. In turn, both may hamper economic growth in the medium term.

The evidence on the resource curse is not unanimous. This paper aims to take heterogeneity across countries seriously: we perform a data-driven analysis that, instead of calculating average effects of natural resource across countries, compares for each country the actual political regime with the counterfactual situation of this country in the absence of a natural resource shock (in our analysis, a giant oil discovery). More precisely, we apply the synthetic control method (SCM), developed by Abadie and Gardeazabal (2003) and extended in Abadie et al. (2010), that can deal with endogeneity from omitted variable bias by accounting for the presence of time-varying unobservable confounders. Moreover, it comes with the advantages of transparency (as the weights identify the countries that are used to estimating the counterfactual outcome of the country that discovers an oil field) and flexibility (as the set of potential controls can be appropriately restricted to make the underlying country comparisons more sensible).

The choice of the natural resource measure is critical in a study like this, as exogeneity is a prerequisite for a meaningful claim of causality. Oil production, the typical measure of natural resource abundance, is imperfect because production is non-monotonic over the lifecycle of any oilfield. Therefore, this is a poor indicator of oil wealth. Following Tsui (2011), we exploit the exogenous variation in oil endowment to provide evidence that does not suffer from an endogeneity problem. In particular, we evaluate the effect of the peak of oil discoveries, defined

¹ For a comprehensive review, see van der Ploeg (2011).
² Anecdotal evidence of the success and failure in the political economy of natural resources is collected in Collier and Venables (2011). Matsen et al. (2016) define petro populism as the economically excessive use of natural resource revenues to buy political support.
as the point in time after which the rate of oilfield discoveries begins to decline. We argue that this event is more plausibly exogenous than the first oil discovery as it depends more on geological factors than on exploration. Our findings are in line with the literature according to which the effect of natural resources on democracy depends on the quality of institutions (Mehlum et al. 2006; Robinson et al. 2006).

The paper is organized as follows: Section 2 reviews the literature on natural resources and political regimes; Section 3 presents the methodology, whereas in Section 4 data and some tests on exogeneity are introduced. Section 5 shows the results, whose robustness checks are presented in Section 6. Section 7 concludes.

2 Natural resources and political regimes

This section presents a selective review of the political resource curse problem. In contrast with the first wave of models (Krugman 1987; Sachs and Warner 1999), and those based on rent-seeking (Lane and Tornell 1996; Torvik 2002) that implied an unconditional negative relationship between resource abundance and growth, a fairly standard result is that countries with good institutions are able to use resource rents to increase their economic performance. This is because well-developed institutions have enough checks and balances to prevent the predatory behaviour of politicians and the unproductive use of government expenditure.\(^3\)

According to Robinson et al. (2006), politicians tend to over-extract natural resources because they discount the future too much. This raises the value of being in power and provides politicians with more resources to influence elections results and increase resource misallocation in the economy. Countries with institutions that promote accountability and competence tend to benefit from resource booms as these institutions reduce the perverse political incentives that such booms create. Similarly, as Mehlum et al. (2006) show, the quality of institutions determines whether or not countries avoid the resource curse. Taken together, these results contrast Sachs and Warner’s (1999) claim that institutions are irrelevant for the resource curse.

Natural resources make it more difficult for citizens to solve the collective action problem when facing a kleptocrat because they provide rulers with substantial resources to buy off opponents. According to Acemoglu et al. (2004), a kleptocrat expropriates the wealth of citizens and uses the proceeds for his own consumption. The success of a kleptocrat rests on the ability to use a divide-and-rule strategy. Members of society need to cooperate in order to depose the kleptocrat, but this cooperation may be neutralized by imposing punitive taxation on the citizens who propose such a move and redistributing the proceeds to those who may agree to it. In equilibrium, all citizens are exploited and the kleptocrat remains unchallenged.

Empirical evidence on the political resource curse has been mainly addressed with the use of panel data, and the quality of institutions has often been proxied by corruption. The link goes from resource availability to corruption and rent-seeking via protection, exclusive licences to exploit, and export resources given by the political elite to oligarchs in order to capture wealth and political power. Resource dependence is indeed strongly associated with a worse corruption perceptions index, which in turn is associated with lower growth (Mauro 1995), and natural

\(^3\) Marchi Adani and Ricciuti (2014) provide evidence on the role of governance quality for African countries. In a more impressionistic way, Robinson et al. claim: ‘For every Venezuela and Nigeria, there is a Norway or a Botswana. A satisfactory model should explain why resources seem to induce prosperity in some countries but not others’ (2006: 451).
resource wealth stimulates corruption among bureaucrats and politicians (Ades and Di Tella 1999). According to Bhattacharyya and Hodler (2010), natural resources induce corruption in countries that have been in a non-democratic regime for more than 60 per cent of the years since 1956. Along the same lines, Collier and Hoeflfer (2009) claim that high natural resource rents and open democratic systems slow growth unless there are sufficient checks and balances.

A new line of empirical research involves quasi-experimental studies. Vicente (2010) compares changes in perceived corruption in Sao Tome, which announced a significant oil discovery in 1997–99, with those in Cape Verde, which did not find oil. Both countries share similar histories, culture, and political institutions. He also finds that corruption increased by almost 10 per cent after the announcement of the oil discovery and slightly decreased later. In a regression-discontinuity study not explicitly related with natural resources, Brollo et al. (2013) find that windfall government revenues on Brazilian municipalities increase corruption and the chances of the incumbent holding on to office but decrease the quality of politicians.

Our analysis follows some insights from Tsui (2011) as far as the choice of oil discoveries as the main variable related with the resource curse is concerned, although his empirical strategy is based on a parametric instrumental variables approach. He argues that oil production—the typical measure of natural resource abundance—is noisy. Owing to geological constraints, the production rate is non-monotonic over the lifecycle of an oilfield; therefore, production is not a good indicator of the remaining reserves and oil wealth (the capital value of future oil rent, and hence a stock variable). Moreover, production understates the oil wealth of swing producers who produce below their capacity. Oil exploration involves high risks: it is unlikely for the first exploratory borehole in a new area to succeed. Cotet and Tsui (2013) report that, with the current technology, the success rate of exploration drilling is still below 50 per cent, and historically this has been much smaller. It is therefore plausible to treat oil discoveries as positive oil shocks, whose timing and size are more exogenous than oil production. Moreover, the size of deposit, the oil quality, and other cost-determining characteristics are exogenous. Tsui (2011) finds that larger oil discoveries cause slower transitions to democracy; however, there is no such effect in democratic countries. This effect is positively correlated with oil quality and negatively correlated with exploration and extraction costs.

We depart from this approach in a fundamental way. The approach adopted by Cotet and Tsui (2013) produces average effects of oil discoveries on the level of democracy, whereas ours gives the effect in each treated country. Their approach, therefore, is more general at the cost of hiding differences across countries. Our methodology returns the country-specific effect at the price of concentrating on a few cases. We think that the two approaches complement each other.

Our methodology has been applied, in addition to panel difference-in-differences, in the study by Smith (2015) that uses resource discovery in countries that were not previously resource-rich as a plausible exogenous source of variation. He finds a positive effect on gross domestic product (GDP) per capita levels in non-OECD (Organization for Economic Co-operation and Development) countries, and mixed evidence of the long-run positive effect of resources on productivity, capital formation, and education.

3 The synthetic control approach

The SCM, applied in the present study, provides quantitative inference in small-sample comparative studies by estimating the counterfactual situation of one or a few aggregate entities in the absence of an event or intervention (Abadie and Gardeazabal 2003; Abadie et al. 2010). The missing counterfactual outcome is given by the weighted outcome of all potential
comparison units that best reproduces the characteristics of the case of interest (Abadie et al. 2015). In our case, we compare the democracy level of countries that reach the peak of oil discoveries with the weighted democracy level of countries that do not incur the same event and have similar pre-event characteristics.

To frame the SCM in the context of the present study, assume that there is a balanced panel of \(I+1\) countries indexed by \(i\) and observed over \(T\) years. Among these, country \(i=1\) reaches the peak of oil discoveries at time \(T_0<T\) (treated unit); the remaining \(I\) countries are not affected by giant oil discoveries (donor pool). The effect of the event is given by:

\[
\hat{\alpha}_{1t} = Y_{1t} - Y^N_{1t},
\]

where \(t \geq T_0\), \(Y_{1t}\) is the observed outcome of country \(i=1\) for a post-event period \(t\), and \(Y^N_{1t}\) is the unobservable potential outcome of country \(i=1\), which is the democracy level that would have been observed in the absence of the event. The SCM estimates \(Y^N_{1t}\) by defining a weighted average of the donor pool (synthetic control). The estimator of \(\alpha_i\) at time \(t\) is given by the difference between the outcome of the treated unit and the outcome of the synthetic control at that period:

\[
\hat{\alpha}_{1t} = Y_{1t} - \sum_{i=2}^{i=I+1} w_i^* Y_{it}.
\]

The weights \(w_i^*\) are chosen such that the characteristics (predictors) of the treated unit are best reproduced by the characteristics of the synthetic control. More formally, let \(X_{1k}\) be the pre-event value of the \(k\)th democracy predictor for the treated unit, and let \(X_{ik}\) be a \((1 \times I)\) vector of the pre-event values of the same variable \(k\)th for the units in the donor pool. Then, the vector \(W^*\) containing the weights assigned to each control unit is chosen in order to minimize the following summation:

\[
\sum_{k=1}^{k} (X_{1k} - X_{ik} W^*)^2,
\]

subject to \(w_i \geq 0\) and \(\sum_{i=2}^{i=I+1} w_i = 1\). Here, \(v_k\) is a weight that reflects the predictive power of variable \(k\). In the following analysis, we choose the positive semi-definite and diagonal matrix \(V\) using the data-driven procedure implemented by Abadie and Gardeazabal (2003) and Abadie et al. (2010): \(V\) minimizes the mean squared prediction error (MSPE) of the outcome variable in the pre-event period. MSPE measures the expected squared distance between the outcome of the treated unit and the outcome of the synthetic control in the pre-event period. Thus, the lower the MSPE, the better the synthetic control resembles the characteristic of the treated unit. To achieve lower MSPE, we implement the nested optimization procedure that searches among all \(V\) matrices and set of \(W^*\) weights for the best fitting convex combination of the units in the donor pool.

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4 This restriction prevents extrapolation outside the support of the data. See Abadie et al. (2015) for a discussion about its relevance.

5 \(MSPE = \frac{1}{T_0} \sum_{k=T_0}^{t=T_1} (Y_{1t} - \sum_{i=2}^{i=I+1} w_i Y_{it})^2.\)
Moreover, to ensure we have found the global minimum in the parameter space, we run the nested optimization using three different starting points of $V^c$.

This data-driven procedure reduces discretion in the choice of the comparison units and comes with the advantage of transparency as it makes explicit the relative contribution of each unit in the donor pool to the counterfactual outcome. In addition, the SCM allows the unobserved variables affecting the outcome to vary with time. In fact, when the number of pre-event periods is large, only those units that are similar in both observed and unobserved characteristics should produce similar paths of the outcome under scrutiny. Therefore, if the trajectories of the democracy level of the treated unit and the synthetic control are alike over extended years prior to the peak of oil discoveries, a gap in the outcome variable in the following years should be interpreted as produced by the peak itself.

These conclusions cannot be validated by the traditional modes of statistical inference because of the small-sample nature of the data (Rubin 1990). However, Abadie et al. (2010) provide an alternative model of inference defined as ‘placebo studies’ and based on the premise that the impact of the event under analysis would be undermined if an estimated effect of similar or greater magnitude were obtained in cases where the intervention did not take place. In particular, placebo studies apply the SCM to every country in the pool of potential controls. This is meant to assess whether the estimated effect for the treated country is large relative to the effect for a country chosen at random. In this study, we conduct ‘in-space placebo tests’ that compare the estimated treatment effect for each country that reaches the peak of oil discoveries with all the (fake) treatment effects of the control countries, obtained from experiments where each control country is assumed to be affected by the same event in the same year of the treated country. If the estimated effect in the treated country is larger than most of the effects obtained by the (fake) experiments, we can safely conclude that the baseline results are not just driven by random chance. This means that if the path of the post-event level of democracy of our case studies falls well outside the distribution of placebo effects, we will attribute that effect to the peak of oil discoveries.

4 Democracy, predictors, and event periods

We analyse the level of democracy using the Polity IV dataset (Marshall et al. 2014), which provides a 21-point scale ranging from $-10$ (hereditary monarchy) to $+10$ (consolidated democracy). To scale down the variance and reduce the effect of outliers, we transform the Polity score to lie between 0 and 1, with 1 corresponding to the higher level of democracy.

The set of predictors encompasses those factors that the literature identifies as determinants of democracy. We take into account the relationship between political regimes and economic factors including the log of GDP per capita ($Gdp$).\(^6\) We also include a set of additional variables related to economic development that may predict a country’s democracy level (see Acemoglu and Robinson 2006; Barro 1999; Lipset 1959): the index of human capital ($human\ cap$); the sum

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\(^6\) The three starting points are the regression-based $V$, the equal $V$ weights, and a third procedure that uses the Stata maximum likelihood search. The nested optimization procedure is implemented by the Stata routine synth statistical software (see Hainmueller 2016).

\(^7\) Several studies corroborate the results of the seminal work of Lipset (1959) according to which economic development consolidates democracy. We use real gross domestic product on the expenditure side that allows comparing living standards across countries and over time (Feenstra et al. 2015).
of imports and exports over GDP (openness); and the value added by the mining, manufacturing, and primary sectors as percentage of the GDP. In addition, we consider the hostility level of interstate disputes (hostility), and the total amount of natural resources rents as percentage of GDP (total rents), to control for the possible effects of both conflicts and natural resource rents. Finally, we include the average level of democracy calculated in the 10 years preceding the event under scrutiny.

Following Tsui (2011), we identify the year of the event exploiting the oil production and depletion dataset collected by Campbell (2006). This dataset contains information on the peak year of oil discoveries for the top 65 oil countries. We consider that year as the period in which the event under scrutiny takes place.

The predictors are averaged over a 10-year pre-event period, and the path of the outcome variable is analysed until 2014. Owing to data availability, we restrict our analysis to countries affected by the peak in the 1970s or later. We also exclude the developed countries that do not show any variation in the Polity score in the time span we consider. Table 1 shows the countries analysed and the year in which they reached the peak of oil discoveries, whereas Appendix Table A1 lists the events excluded. For each treated unit, the donor pool encompasses all the countries not affected by the event for which data are available. Table 2 provides the definitions, sources, and descriptive statistics of variables.

To control whether the characteristics that predict the democracy level are also able to predict the peak of oil discoveries, we run cross-sectional linear regressions. The dependent variable is equal to 1 if the country has reached the peak of oil discoveries since 1970, and 0 otherwise. The predictors are measured at 1970. Table 3 shows the results. All the predictors are insignificant except for human capital and openness, whose coefficients are both negative and significant at 1 and 10 per cent, respectively. However, when we consider a multivariate regression, only the initial level of human capital is a significant predictor of the peak of oil discoveries. The reason for this unusual result may derive from our sample that does not include developed countries that have reached the oil peak. These countries should present a high level of human capital. In any case, this result does not invalidate our analysis since the SCM allows us to discard those countries that have pre-event characteristics dissimilar from the treated unit.

5 Results

As highlighted in the previous sections, the credibility of the SCM hinges on its ability to match the pre-event outcome of the treated country with that of the synthetic control. Table 4 reports the predictor balance and the root mean square predicted error (RMSPE) for each of our case

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8 The value added by the mining sector is obtained subtracting manufacturing from the variable ‘mining, manufacturing, utilities’ taken from the UNCTADStat database (UNCTAD 2015). The noise of utilities in the measurement of the mining sector is small (Caruso et al. 2014).

9 Data on total rents, mining, manufacturing, and primary are available from 1970. Thus, the time span over which they are averaged is different from the 10-year pre-event period for those countries that reached the peak in the 1970s: Brazil, Cameroon, Chad, India, Malaysia, Mexico, Tunisia, and Viet Nam.

10 Angola, United Arab Emirates, Uzbekistan, and Yemen are excluded because of the lack of pre-event data.

11 These countries are Denmark, Italy, Netherlands, Norway, and United Kingdom.

12 Smith (2015) uses linear regressions to show that oil discoveries do not depend on the initial characteristics that may affect future growth.
studies. The low values of the RMSPE confirm the strengths of the synthetic control estimator. However, the RMSPE is higher than 0.10 for Malaysia, Pakistan, and Thailand. As we consider that magnitude too high to have a good fit between the path of the outcome variable of the treated unit and its synthetic control, we discard these countries in the following discussion.

Figures 1–12 provide a graphical illustration of the results: panels (a) display the trajectories of the democracy level of each country and their synthetic counterparts, whereas panels (b) show the gap between the two. Table 5 presents, for each case study, the average effect of oil discoveries calculated by averaging the distance between the outcome of the treated country and the synthetic control every five years after the peak of oil discoveries. Appendix Table A2 lists the potential controls and the weight assigned to each country in the synthetic control.

The main finding of the analysis is that oil discoveries do not affect all countries in the same way. Most of the case studies present a negative outcome gap in the long run. Figure 2 shows that the level of democracy of Cameroon is slightly lower than the synthetic control after the peak of oil discoveries. This negative outcome gap increases consistently five years after the peak of oil discoveries. Ten years after this event, the peak of oil discoveries has a negative average effect of 0.16. In 2014, the level of democracy of Cameroon is 0.5 points lower than the level that the country would have reached in the absence of the peak. The path of democracy of Chad presents a jump after the peak (Figure 3). However, this result is because the period of anarchy started in 1979, two years after the peak (Collins and Burns 2013), and classified with 0 by the Polity score (0.5 according to our transformed index). After this period, the country always presents a level of democracy lower than the synthetic control. The democracy scores of the Republic of Congo (Figure 5) and Sudan (Figure 10) exceed those of their synthetic controls for a short period (five and four years, respectively). Nevertheless, in the long run, the level of democracy of both of them is lower than what would have been observed in the absence of the peak of oil discoveries. Viet Nam’s democracy score is constant during the post-event period. However, the SCM allows estimating that, given the pre-event characteristics of the country, its level of democracy in 2014 would have been 0.63 points higher than the observed level. Kazakhstan has a negative outcome gap in the pre-event period that increases two years after the event, although the magnitude of the effect is not high (−0.15).

For all of those countries, the placebo tests presented in Figure 13 confirm a significant negative effect of oil discoveries on democracy in the decades following the event. On the contrary, oil discoveries affect the level of democracy of Brazil only in the short run (Figure 1). Indeed, after a drop of the democracy level with respect to the synthetic control, Brazil caught up with its counterpart ten years after the peak of oil discoveries. Figure 13a proves the robustness of these results.

Mexico and Tunisia do not show clear paths. In Mexico, the peak of oil discoveries seems to arrest the increase of democracy that started at the eve of that event. However, as in the case of Tunisia, the country presents significant negative levels of the outcome gap. Instead, we cannot reject the null hypothesis of no effect in two cases: Colombia (Figure 13d) and India (Figure 13g). Indeed, even if for both countries the average effect is negative, their post-event levels of democracy do not fall well outside the distribution of placebo effects. For that reason, we can safely affirm that oil discoveries have no effect on the democracy level of India and Colombia. Interestingly, these are the only two countries with a high level of democracy in the pre-event period (>0.9).

Finally, a striking case is represented by Gabon (Figure 6), the only country in which the peak of oil discoveries seems to have a positive effect on democracy. However, these results are misleading because, after the event under scrutiny, another shock affected the political
institutions of the country. In fact, in the 1990s, violent demonstrations and strikes led to political reforms including the transformation of the political system to a multiparty democracy (Collins and Burns 2013). These events are not captured by the synthetic control, which resembles the characteristics of the treated unit only in the absence of further permanent shocks in the outcome.

6 Robustness checks

In this section, we run a robustness check to test the sensitivity of our main results to changes in the measurement of democracy level. We implement the SCM using the Polyarchy dataset compiled by Vanhanen (2014). This dataset provides an index of democracy given by the combination of its two most important dimensions: the degree of competition (competition) and the degree of participation (participation). The former is measured by the smaller parties’ share of all votes casted in parliamentary or presidential elections, whereas the latter is measured by the percentage of the population who actually voted in those elections. The combined index of democracy (democracy) is obtained by multiplying the two indicators and dividing the product by 100 (Vanhanen 2000). We estimate the synthetic control using these three variables as outcomes. Table 6 presents, for each indicator, the average effect of oil discoveries calculated every five years after the peak of oil discoveries.\textsuperscript{13}

The trends of the outcome gaps show that the results of the previous analysis are robust. In particular, the path of democracy gap replicates almost exactly the one given by Polity.\textsuperscript{14} This is not true for Kazakhstan, whose average effect is positive until ten years after the peak of oil discoveries. However, this discrepancy could be explained by the fact that the synthetic control does not replicate the country in the pre-event period. In fact, the RMSPE is equal to 2.107 for democracy. Colombia seems to have a significant, negative outcome gap, but only 14 years after the event. In addition, in this case, the RMSPE is high. This difference vanishes considering participation for which the RMSPE is lower.\textsuperscript{15} Another exception is Mexico for which the effect of oil discoveries is negative and significant, considering both democracy and competition. The negative gap starts to decrease five years after the peak. Overall, we can claim that the peak of oil discoveries has at least delayed democratization in Mexico.

7 Conclusions

In this paper, we have undertaken a case-study analysis to evaluate the effect of giant oil discoveries on the political regimes of the affected countries. We used the SCM to estimate the democracy level that would have been observed in the absence of the event. This approach allows us to overcome the weaknesses of previous analyses as it can deal with the endogeneity problem and the omitted variable bias.

Overall, this paper confirms the idea that natural resources may be a curse or a blessing for a country, depending on the quality of its institutions (Mehlum et al. 2006; Robinson et al. 2006). In particular, the relationship between natural resources and democracy shows some non-

\textsuperscript{13} Graphs and placebo tests are omitted to save space, but are available upon request from the authors.

\textsuperscript{14} We cannot assert the same considering participation. However, we failed to obtain low value of the root mean square predicted error (RMSPE) in most of the cases, as proven by the difference between the treated units and the synthetic controls at $t_0$.

\textsuperscript{15} RMSPE is 1.001 for democracy; 5.287 for competition, and 0.395 for participation.
linearities depending on the initial level of democracy itself. Indeed, only the democracy levels of India and Colombia, which have a democracy score above 0.9, do not change significantly after the peak of discoveries. All other countries, with the exception of Gabon that undertook a period of political reforms after the peak of oil discoveries, are negatively affected by the variation in oil endowment. A plausible explanation of these results is that, as the rate of discoveries starts to decline, the incumbents enforce higher entry barriers to grab the residual resources. This is prevented in democracies with higher levels of executive constraints.

References


Table 1: Case studies

<table>
<thead>
<tr>
<th>Country</th>
<th>Peak of oil discoveries</th>
<th>Start year synth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>1975</td>
<td>1965</td>
</tr>
<tr>
<td>Cameroon</td>
<td>1977</td>
<td>1967</td>
</tr>
<tr>
<td>Chad</td>
<td>1977</td>
<td>1967</td>
</tr>
<tr>
<td>Colombia</td>
<td>1992</td>
<td>1982</td>
</tr>
<tr>
<td>Republic of Congo</td>
<td>1984</td>
<td>1974</td>
</tr>
<tr>
<td>Gabon</td>
<td>1985</td>
<td>1975</td>
</tr>
<tr>
<td>India</td>
<td>1974</td>
<td>1964</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>2000</td>
<td>1991</td>
</tr>
<tr>
<td>Malaysia</td>
<td>1973</td>
<td>1963</td>
</tr>
<tr>
<td>Mexico</td>
<td>1977</td>
<td>1967</td>
</tr>
<tr>
<td>Pakistan</td>
<td>1983</td>
<td>1973</td>
</tr>
<tr>
<td>Sudan</td>
<td>1980</td>
<td>1970</td>
</tr>
<tr>
<td>Thailand</td>
<td>1981</td>
<td>1971</td>
</tr>
<tr>
<td>Tunisia</td>
<td>1971</td>
<td>1961</td>
</tr>
<tr>
<td>Viet Nam</td>
<td>1975</td>
<td>1965</td>
</tr>
</tbody>
</table>

Source: Authors’ compilation based on Campbell (2006).

Table 2: Variable definitions, sources, and descriptive statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Source</th>
<th>Mean</th>
<th>SD</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Democracy</td>
<td>Transformed revised combined Polity IV score (Polity2) ranging from 0 (hereditary monarchy) to 1 (consolidated democracy)</td>
<td>Polity IV Project, Center for Systemic Peace (Marshall et al. 2014)</td>
<td>0.560</td>
<td>0.359</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Gdp</td>
<td>Log GDP per capita (at chained purchasing power parity in million, 2005 USD prices)</td>
<td>Penn World Table 8.1 (Feenstra et al. 2015)</td>
<td>8.055</td>
<td>1.160</td>
<td>5.219</td>
<td>11.325</td>
</tr>
<tr>
<td>Human capital</td>
<td>Index of human capital per person, based on years of schooling (Barro and Lee 2013) and returns to education (Psacharopoulos 1994)</td>
<td>Penn World Table 8.1 (Feenstra et al. 2015)</td>
<td>2.007</td>
<td>0.627</td>
<td>1.018</td>
<td>3.535</td>
</tr>
<tr>
<td>Total rents</td>
<td>Total natural resources rents (percentage of GDP)</td>
<td>World Development Indicators (World Bank 2015)</td>
<td>6.637</td>
<td>10.277</td>
<td>0</td>
<td>83.432</td>
</tr>
<tr>
<td>Mining</td>
<td>Value added by sectors of economic activity, annual, 1970–2013: mining and utilities (percentage of GDP)</td>
<td>UNCTADStat (UNCTAD 2015)</td>
<td>6.607</td>
<td>8.547</td>
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<tr>
<td>Primary</td>
<td>Value added by kind of economic activity, annual, 1970–2013: agriculture, hunting, forestry, fishing (percentage of GDP)</td>
<td>UNCTADStat (UNCTAD 2015)</td>
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<td>15.869</td>
<td>0.034</td>
<td>80.510</td>
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<tr>
<td>Openness</td>
<td>Sum of import and exports over GDP (at constant national 2005 prices)</td>
<td>Penn World Table 8.1 (Feenstra et al. 2015)</td>
<td>0.691</td>
<td>0.482</td>
<td>0.039</td>
<td>4.605</td>
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<tr>
<td>Hostility</td>
<td>Hostility level of interstate dispute ranging from 0 (no dispute) to 5 (war)</td>
<td>Palmer et al. (2015)</td>
<td>0.853</td>
<td>1.591</td>
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Note: SD, standard deviation; min., minimum; max., maximum; GDP, gross domestic product.
Source: Authors’ compilation based on data from sources listed in table.
Table 3: Peak of oil discovery and democracy predictors in 1970

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<th></th>
<th>(1)</th>
<th>(2)</th>
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Note: The dependent variable is an indicator equal to 1 if the country has reached the peak of oil discoveries since 1970, and 0 otherwise. Covariates are measured in 1970. Robust standard errors are in parentheses. ***P<0.01, **P<0.05, *P<0.10.

Source: Authors’ compilation based on variables defined in Table 2.
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<th>Case study</th>
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Cameroon 1977

| Gdp                      | 7.177065    | Synthetic Cameroon |
| Human capital            | 1.311305    | 1.384907    |
| Total rents              | 4.055883    | 6.277098    |
| Mining                   | 1.17727     | 1.180156    |
| Manufacturing            | 14.70772    | 11.03428    |
| Primary                  | 28.28982    | 44.37049    |
| Openness                 | 0.2701598   | 0.2741007   |
| Hostility                | 0.4         | 0.406       |
| Average pre-discovery democracy | 0.125 | 0.12755     |
| RMSPE                    | 0.0075677   |             |

Chad 1977

| Gdp                      | 7.265192    | Synthetic Chad |
| Total rents              | 4.75743     | 4.746761      |
| Mining                   | 0.9221356   | 0.921185      |
| Manufacturing            | 12.31258    | 12.28897     |
| Primary                  | 41.9175     | 41.82736     |
| Openness                 | 0.498415    | 0.4972167    |
| Hostility                | 0.2         | 0.1984       |
| Average pre-discovery democracy | 0.07  | 0.07283     |
| RMSPE                    | 0.0336496   |             |

Colombia 1992

| Gdp                      | 8.731305    | Synthetic Colombia |
| Human capital            | 2.016568    | 2.145918    |
| Total rents              | 6.595242    | 1.345631    |
| Mining                   | 6.283752    | 4.958925    |
| Manufacturing            | 18.12654    | 21.17535    |
| Primary                  | 12.55478    | 7.596763    |
| Openness                 | 0.2025784   | 0.2305646   |
| Hostility                | 1.2         | 1.2468      |
| Average pre-discovery democracy | 0.905 | 0.904515   |
| RMSPE                    | 0.0011125   |             |

Republic of Congo 1984

| Gdp                      | 7.536801    | Synthetic Republic of Congo |
| Human capital            | 1.667621    | 1.458849    |
| Total rents              | 39.64646    | 21.13613    |
| Mining                   | 28.3415     | 19.28067    |
| Manufacturing            | 9.006013    | 9.808753    |
| Primary                  | 13.46419    | 16.33363    |
| Openness                 | 1.111467    | 1.124935    |
| Hostility                | 0.5         | 0.4995      |
| Average pre-discovery democracy | 0.125 | 0.12557    |
| RMSPE                    | 0.0149957   |             |

Gabon 1985

<p>| Gdp                      | 9.252937    | Synthetic Gabon |
| Human capital            | 1.59167     | 1.627161      |
| Total rents              | 47.64735    | 12.65417     |
| Mining                   | 41.641      | 6.981598     |</p>
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Source: Authors’ compilation based on variables defined in Table 2.
## Table 5: Average effect of the peak of oil discoveries on Polity IV indicator

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Note: Dashes (—) indicate no estimation is available.

Source: Authors’ compilation based on study data.
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<td>Participation</td>
<td>-0.421</td>
<td>-0.496</td>
<td>17.558</td>
<td>-21.666</td>
<td>-1.117</td>
<td>13.766</td>
<td>-0.909</td>
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<td></td>
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<tr>
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<td>0.206</td>
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<td>3.946</td>
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<td>2.446</td>
<td>37.020</td>
<td>26.051</td>
<td>23.792</td>
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<td>-16.832</td>
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<td><strong>India 1974</strong></td>
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<tr>
<td>Competition</td>
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<td>-10.113</td>
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<td>Participation</td>
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<td>-3.049</td>
<td>-3.049</td>
<td>-3.049</td>
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<tr>
<td>Competition</td>
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<td>-16.475</td>
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<td>5.809</td>
<td>10.322</td>
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<td>0.000</td>
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<td>0.000</td>
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<td>-0.800</td>
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<td>Participation</td>
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<td>-0.236</td>
<td>2.552</td>
<td>3.341</td>
<td>10.366</td>
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<tr>
<td><strong>Tunisia 1971</strong></td>
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<tr>
<td>Democracy</td>
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<td>Participation</td>
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<td>-31.423</td>
<td>-42.859</td>
<td>-20.544</td>
<td>-23.541</td>
<td>-44.198</td>
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</tbody>
</table>

Note: Dashes (—) indicate no estimation is available.

Source: Authors’ compilation based on Vanhanen (2014).
Figure 1: Path of democracy: (a) Brazil 1975 versus synthetic control (b) outcome gap

(a)

(b)

Source: Authors’ illustration based on study data.
Figure 2: Path of democracy: (a) Cameroon 1977 versus synthetic control; (b) outcome gap

(a)

(b)

Source: Authors’ illustration based on study data.
Figure 3: Path of democracy: (a) Chad 1977 versus synthetic control; (b) outcome gap

(a)

(b)

Source: Authors' illustration based on study data.
Figure 4: Path of democracy: (a) Colombia 1992 versus synthetic control; (b) outcome gap

Source: Authors’ illustration based on study data.
Figure 5: Path of democracy: (a) Republic of Congo 1984 versus synthetic control; (b) outcome gap

(a)

![Graph showing the path of democracy for the Republic of Congo and synthetic control from 1970 to 2010.]

- **Y-axis:** Democracy
- **X-axis:** Year

- **Legend:**
  - Republic of Congo (solid line)
  - Synthetic Republic of Congo (dashed line)

(b)

![Graph showing the outcome gap for the Republic of Congo from 1970 to 2010.]

- **Y-axis:** Gap

Source: Authors' illustration based on study data.
Figure 6: Path of democracy: (a) Gabon 1985 versus synthetic control; (b) outcome gap

(a) 

(b)

Source: Authors’ illustration based on study data.
Figure 7: Path of democracy: (a) India 1974 versus synthetic control; (b) outcome gap

(a)

(b)

Source: Authors’ illustration based on study data.
Figure 8: Path of democracy: (a) Kazakhstan 2000 versus synthetic control; (b) outcome gap

(a)

(b)

Source: Authors' illustration based on study data.
Figure 9: Path of democracy: (a) Mexico 1977 versus synthetic control; (b) outcome gap

(a)

(b)

Source: Authors' illustration based on study data.
Figure 10: Path of democracy: (a) Sudan 1980 versus synthetic control; (b) outcome gap

(a)

(b)

Source: Authors’ illustration based on study data.
Figure 11: Path of democracy: (a) Tunisia 1971 versus synthetic control; (b) outcome gap

(a)

(b)

Source: Authors’ illustration based on study data.
Figure 12: Path of democracy: (a) Viet Nam 1975 versus synthetic control; (b) outcome gap

(a)

(b)

Source: Authors’ illustration based on study data.
Figure 13: (a)–(l) Placebo tests

(a) Brazil

(b) Cameroon
(c) Chad

(d) Colombia
(e) Republic of Congo

(f) Gabon
(k) Tunisia

(l) Viet Nam

Source: Authors’ illustrations based on study data.
## Appendix

### Table A1: Discoveries excluded from the case studies

<table>
<thead>
<tr>
<th>Country</th>
<th>Peak of oil discoveries</th>
<th>Country</th>
<th>Peak of oil discoveries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albania</td>
<td>1928</td>
<td>Italy</td>
<td>1981</td>
</tr>
<tr>
<td>Algeria</td>
<td>1956</td>
<td>Kuwait</td>
<td>1938</td>
</tr>
<tr>
<td>Angola</td>
<td>1971</td>
<td>Libya</td>
<td>1961</td>
</tr>
<tr>
<td>Argentina</td>
<td>1960</td>
<td>Nigeria</td>
<td>1967</td>
</tr>
<tr>
<td>Australia</td>
<td>1967</td>
<td>Oman</td>
<td>1962</td>
</tr>
<tr>
<td>Austria</td>
<td>1947</td>
<td>Peru</td>
<td>1861</td>
</tr>
<tr>
<td>Azerbaijan</td>
<td>1871</td>
<td>Qatar</td>
<td>1940</td>
</tr>
<tr>
<td>Bahrain</td>
<td>1932</td>
<td>Romania</td>
<td>1857</td>
</tr>
<tr>
<td>Bolivia</td>
<td>1966</td>
<td>Russia</td>
<td>1960</td>
</tr>
<tr>
<td>Canada</td>
<td>1958</td>
<td>Saudi Arabia</td>
<td>1948</td>
</tr>
<tr>
<td>Chile</td>
<td>1960</td>
<td>Syria</td>
<td>1966</td>
</tr>
<tr>
<td>China</td>
<td>1959</td>
<td>Trinidad</td>
<td>1959</td>
</tr>
<tr>
<td>Croatia</td>
<td>1950</td>
<td>Turkey</td>
<td>1969</td>
</tr>
<tr>
<td>Ecuador</td>
<td>1969</td>
<td>Turkmenistan</td>
<td>1964</td>
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<tr>
<td>Egypt</td>
<td>1965</td>
<td>Ukraine</td>
<td>1962</td>
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<tr>
<td>France</td>
<td>1958</td>
<td>United Arab Emirates</td>
<td>1980</td>
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<tr>
<td>Germany</td>
<td>1952</td>
<td>United States</td>
<td>1930</td>
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<tr>
<td>Hungary</td>
<td>1964</td>
<td>Uzbekistan</td>
<td>1992</td>
</tr>
<tr>
<td>Indonesia</td>
<td>1945</td>
<td>Venezuela</td>
<td>1941</td>
</tr>
<tr>
<td>Iran</td>
<td>1961</td>
<td>Yemen</td>
<td>1978</td>
</tr>
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</table>

Source: Campbell (2006).

### Table A2: Country weights in the synthetic control and potential controls

#### Brazil

<table>
<thead>
<tr>
<th>Synthetic control</th>
<th>Potential controls</th>
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</thead>
<tbody>
<tr>
<td>Central African Republic (0.01), Democratic Republic of the Congo (0.153), Morocco (0.004), Portugal (0.833)</td>
<td>Belgium, Bulgaria, Burundi, Sri Lanka, Costa Rica, Cyprus, Benin, Dominican Republic, El Salvador, Finland, Gambia, Ghana, Greece, Guatemala, Honduras, Ireland, Israel, Jamaica, Japan, Jordan, Kenya, Republic of Korea, Lao People’s Democratic Republic, Liberia, Luxembourg, Malawi, Mali, Mauritania, Mongolia, Nepal, New Zealand, Niger, Paraguay, Philippines, Poland, Rwanda, Senegal, Sierra Leone, Singapore, South Africa, Spain, Sweden, Switzerland, Togo, Tanzania, Uruguay, Zambia</td>
</tr>
</tbody>
</table>

#### Cameroon

<table>
<thead>
<tr>
<th>Synthetic control</th>
<th>Potential controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benin (0.075), Nepal (0.368), Niger (0.049), Paraguay (0.301), Tanzania (0.156), Uruguay (0.051)</td>
<td>Belgium, Botswana, Bulgaria, Burundi, Central African Republic, Sri Lanka, Democratic Republic of the Congo, Costa Rica, Cyprus, Dominican Republic, El Salvador, Finland, Gambia, Ghana, Greece, Guatemala, Honduras, Ireland, Israel, Jamaica, Japan, Jordan, Kenya, Republic of Korea, Lao People’s Democratic Republic, Lesotho, Liberia, Luxembourg, Malawi, Mali, Mauritania, Mongolia, Morocco, New Zealand, Philippines, Poland, Portugal, Rwanda, Senegal, Sierra Leone, Singapore, South Africa, Spain, Sweden, Switzerland, Togo, Zambia</td>
</tr>
</tbody>
</table>

#### Chad

<table>
<thead>
<tr>
<th>Synthetic control</th>
<th>Potential controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bhutan (0.286), Ethiopia (0.007), Honduras (0.027), Malawi (0.169), Nepal (0.052), Paraguay (0.434), Portugal (0.023)</td>
<td>Belgium, Botswana, Bulgaria, Burundi, Central African Republic, Sri Lanka, Democratic Republic of the Congo, Costa Rica, Cyprus, Benin, Dominican Republic, El Salvador, Finland, Gambia, Ghana, Greece, Guatemala, Guinea, Ireland, Israel, Jamaica, Japan, Jordan, Kenya, Republic of Korea, Lao People’s Democratic Republic, Lesotho, Liberia, Luxembourg, Madagascar, Mali, Mauritania, Mongolia, Morocco, New Zealand, Niger, Philippines, Poland, Rwanda, Senegal, Sierra Leone, Singapore, South Africa, Spain, Sweden, Switzerland, Togo, Tanzania, Burkina Faso, Uruguay, Zambia</td>
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</tbody>
</table>

#### Colombia

<table>
<thead>
<tr>
<th>Synthetic control</th>
<th>Potential controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nepal (0.007), Spain (0.884), Tanzania (0.048), Zambia (0.061)</td>
<td>Belgium, Botswana, Bulgaria, Burundi, Central African Republic, Sri Lanka, Democratic Republic of the Congo, Costa Rica, Cyprus, Benin, Dominican Republic, El Salvador, Finland, Gambia, Ghana, Greece, Guatemala, Guinea, Ireland, Israel, Jamaica, Japan, Jordan, Kenya, Republic of Korea, Lao People’s Democratic Republic, Lesotho, Liberia, Luxembourg, Madagascar, Mali, Mauritania, Mongolia, Morocco, New Zealand, Niger, Philippines, Poland, Rwanda, Senegal, Sierra Leone, Singapore, South Africa, Spain, Sweden, Switzerland, Togo, Tanzania, Burkina Faso, Uruguay, Zambia</td>
</tr>
</tbody>
</table>

37
<table>
<thead>
<tr>
<th>Country</th>
<th>Synthetic control</th>
<th>Potential controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gabon</td>
<td>Mauritania (0.336), Singapore (0.001), Swaziland (0.664)</td>
<td>Bangladesh, Belgium, Botswana, Burundi, Central African Republic, Sri Lanka, Dominican Republic of the Congo, Costa Rica, Cyprus, Benin, Dominican Republic, El Salvador, Fiji, Finland, Gambia, Ghana, Greece, Guatemala, Honduras, Ireland, Israel, Jamaica, Japan, Kenya, Republic of Korea, Lao People’s Democratic Republic, Lesotho, Luxembourg, Malawi, Mali, Mauritania, Mongolia, Morocco, Mozambique, New Zealand, Niger, Panama, Paraguay, Philippines, Poland, Portugal, Rwanda, Senegal, Sierra Leone, Singapore, South Africa, Swaziland, Sweden, Switzerland, Togo, Uganda, Uruguay, Zimbabwe</td>
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<tr>
<td>India</td>
<td>Costa Rica (0.429), Japan (0.517), Lao People’s Democratic Republic (0.001), Nepal (0.051), Zambia (0.002)</td>
<td>Bangladesh, Belgium, Botswana, Burundi, Central African Republic, Sri Lanka, Democratic Republic of the Congo, Costa Rica, Cyprus, Benin, Dominican Republic, El Salvador, Fiji, Finland, Gambia, Ghana, Greece, Guatemala, Honduras, Ireland, Israel, Jamaica, Japan, Kenya, Republic of Korea, Lao People’s Democratic Republic, Lesotho, Luxembourg, Malawi, Mali, Mauritania, Mongolia, Morocco, New Zealand, Niger, Panama, Paraguay, Philippines, Poland, Portugal, Rwanda, Senegal, Sierra Leone, South Africa, Spain, Swaziland, Sweden, Switzerland, Togo, Tanzania, Uruguay, Zambia</td>
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<td>Kazakhstan</td>
<td>Lao People’s Democratic Republic (0.349), Liberia (0.095), Singapore (0.556)</td>
<td>Bangladesh, Armenia, Belgium, Botswana, Bulgaria, Burundi, Cambodia, Central African Republic, Sri Lanka, Democratic Republic of the Congo, Costa Rica, Cyprus, Czech Republic, Benin, Dominican Republic, El Salvador, Estonia, Fiji, Finland, Gambia, Ghana, Greece, Guatemala, Honduras, Ireland, Israel, Jamaica, Japan, Kenya, Republic of Korea, Kyrgyzstan, Lesotho, Latvia, Lithuania, Luxembourg, Malawi, Mali, Mauritania, Mauritius, Mongolia, Moldova, Morocco, Mozambique, Namibia, Nepal, New Zealand, Niger, Panama, Paraguay, Philippines, Poland, Portugal, Rwanda, Senegal, Sierra Leone, Slovenia, South Africa, Spain, Swaziland, Sweden, Switzerland, Togo, Tanzania, Ukraine, Uruguay, Zambia, Zimbabwe</td>
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<td>Mexico</td>
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<td>Sudan</td>
<td>Greece (0.014), Jordan (0.126), Mali (0.385), Tanzania (0.267), Uruguay (0.208)</td>
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<td>Country</td>
<td>Synthetic control</td>
<td>Potential controls</td>
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<td>Vietnam</td>
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Source: Authors’ compilation.