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Natural Resources, Decentralization, and Risk Sharing:
Can Resource Booms Unify Nations?

Fidel Perez-Sebastian
University of Alicante; University of Hull

&

Ohad Raveh
Hebrew University; OxCarre
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Fidel Perez-Sebastian  
U. Alicante; U. Hull  
fidel.perez.sebastian@gmail.com

Ohad Raveh*  
Hebrew University; OxCarre, University of Oxford  
ohad.raveh@mail.huji.ac.il

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Abstract

Previous studies imply that a positive regional fiscal shock, such as a resource boom, strengthens the desire for separation. In this paper we present a new and opposite perspective. We construct a model of endogenous fiscal decentralization that builds on two key notions: a trade-off between risk sharing and heterogeneity, and a positive association between resource booms and risk. The model shows that a resource windfall causes the nation to centralize as a mechanism to share risk. In addition, we provide cross country empirical evidence for the main hypotheses. Specifically, we find that resource booms: (i) decrease the level of fiscal decentralization, primarily through the risk sharing channel, and (ii) have no effect on political decentralization.

Keywords: Natural resources, decentralization, risk sharing

JEL classification: H77, Q33

*Correspondence to: Ohad Raveh, Oxford Centre for the Analysis of Resource Rich Economies, Dept. of Economics, University of Oxford, Oxford, UK.
1 Introduction

The reasons behind why nations centralize or why regions demand higher levels of independence are of first order importance. One contributing factor might be the discovery of natural resources. A windfall of natural riches often provides an enormous source of income that leads to conflict over its distribution, and can even threaten the nation’s unity. This paper tries to unfold this resources-unity nexus by addressing the following question: do resource booms affect the level of fiscal decentralization (FD)? Contrary to conventional wisdom, we argue that resource booms may in fact contribute to the unification of nations, by leading to higher levels of government centralization.

Previous studies on the determinants of FD such as Arzaghi and Henderson (2005), Oates (1972), Panizza (1999) and Treisman (2006) identify several key determinants, ranging from historical and geographical to cultural and institutional. However, very little attention has been devoted to the role that natural resources may have in this.\(^1\) This paper contributes to this strand of the literature by filling this gap and presenting new insights on the association between natural resources and decentralization.

The potential association between natural resources and FD has been observed in several occasions. "It’s Scotland’s Oil" was the widely publicized slogan used in the 1970s by the Scottish National Party to promote Scottish independence; as the slogan implies, the discovery of oil in the North Sea (within the territory of Scotland) created a struggle, between Scotland and the United Kingdom, on the fiscal control over the oil rents. A more extreme case is Sudan, which eventually split into two nations mainly due to the large oil reserves located in the south. Boadway (2006) discusses the influential role of resource booms in Canadian fiscal federalism; indeed, various agreements made between the provincial and federal governments of Canada regarding regional fiscal control over natural wealth provide an indication for that. Similarly, drawing on the related literature on natural resources and conflicts, various studies indirectly document the effects of resource booms on levels of fiscal control in Angola, Colombia, Iraq, Nigeria, and Sierra Leone, among others (see Ross 2004, 2006, and Blattman and Miguel 2010, for surveys).

Albeit not explicitly formalized, previous models of endogenous FD, like Arzaghi

\(^1\) An exception is Freinkman and Plekhanov (2009), who find that resource rich Russian regions tend to have more centralized governments. Unlike these authors, we provide national-level, cross country empirical evidence that addresses potential endogeneity issues and is linked to a formal theory that emphasizes a different mechanism, risk sharing.
and Henderson (2005) and Panizza (1999), imply that a regional fiscal shock is expected to increase the level of FD, and strengthen the desire for separation. Conversely, we offer a theory and empirical evidence that point at the opposite direction; namely, that resource booms can lower the level of FD. The theory treats FD as an endogenous variable, and investigates how it might be affected by a windfall of natural resources, building on two main features: (i) a trade-off between risk sharing and heterogeneity, and (ii) a positive association between resources and risk. The heterogeneity assumption follows Panizza (1999), and is a consequence of spatial decay of public goods’ efficiency. In turn, the positive association between resource wealth and volatility has been widely discussed in previous studies (e.g. van der Ploeg and Poelhekke 2009). Furthermore, as Figure 1 illustrates, this relationship is also a feature of our sample, showing a positive correlation between the share of oil rents in GDP and the standard deviation in the growth of real GDP per capita ($\rho = 0.74$).^2

Risk sharing is the main mechanism put forward by our theory. In the model, we consider two types of risk: revenue volatility, and local inefficiency. The first is based on several studies documenting excessive volatility in oil prices (Blattman et al. 2007, and Davis et al. 2001), and the incentive this provides for governments to share the risk involved (Stroebel and Benthem 2013); the second is motivated by the notion that resource dependence may create adverse effects such as corruption, Dutch Disease, and other development-inhibiting risks that fall under the so-called natural resource curse hypothesis.\(^3\) Importantly, these effects can also provide resource rich regional governments an incentive to mitigate them through sharing. Indeed, recent studies indicate that resource-booming local governments are able to mitigate the adverse effects of resources, and even grow on the account of their neighboring resource poor regions, in fiscally decentralized and federalized economies (Beine et al. 2014, Cai and Treisman 2005, Papyrakis and Raveh 2014, and Raveh 2013).

In the model, the central and regional governments have different incentives regarding FD. In particular, the former always prefers full centralization regardless of the amount of natural riches. The FD trade-off is at work only if the regional government has some bargaining power, either because it fully controls the bargaining process, or because the central government enforces its preferred outcome conditioned

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^2In the empirical part, we describe these variables and discuss the sample in detail.

^3The natural resource curse hypothesis describes an inverse relationship between natural resource abundance and long-term economic growth; see van der Ploeg (2011) for a review of the literature.
on a credible threat of independence by the region. Under these circumstances, in which regional demands are taken seriously, the model shows that risk-increasing resource booms can lead to more centralization due to the incentive to share the risks involved across the nation. More specifically, a resource windfall lowers FD when risk averse agents strictly prefer a higher degree of risk diversification to an increase in expected consumption, which occurs if the revenue volatility and local inefficiency effects offset the increase in average revenues.

In the empirical exercise, we motivate our focus on FD (as opposed to political decentralization), and test the model’s main predictions, including the hypothesized association between resource booms and FD. For that, we employ a large panel of countries, spanning over several decades, and use the Kearney Decentralization Index (Arzaghi and Henderson 2005), and the World Bank’s Vertical Imbalance measure, to approach the endogenous variable. Since the Kearny index is discrete in nature, ordered probit estimation techniques are used, along with linear methods. As a measure of resource abundance, we employ several proxies. The first is GDP share of oil rents, which is suggested by the model. The other measures are chosen so as to address possible endogeneity issues; these include stock measures of giant oil fields, and price-based measures that exploit exogenous variations in the price of crude oil. The main analyses, as well as several robustness checks that test different controls and time periods, indicate that resource booms negatively affect FD (with no apparent U-shaped effects), and have no impact on political decentralization.

In addition, we also test the risk sharing mechanism proposed by the model, and compare it against other potential channels. For this, we use a standard volatility proxy: the standard deviation in the growth of real GDP per capita. While each of the additional potential channels that we test do not affect the impact of resources, the risk proxy does. When added to the regressions, the effect of resources on FD vanishes, that is, their impact – net of risk – becomes insignificant; thus providing some affirmation for the proposed mechanism. Last, based on the assumption that local inefficiency worsens with weaker institutions, we test for the relative dominance of the revenue volatility and local inefficiency effects by adding an interaction term of our proxies for institutional quality and resources. Since this interaction term coefficient ends up being insignificant, we conclude that although both effects may contribute to the overall risk and the incentives to share it, it is the revenue volatility effect that appears to be the
larger contributor.

Besides the literature on the determinants of decentralization, our work is also related to papers on the importance of volatility in resource extraction and management, which include van der Ploeg and Poelhekke (2009, 2010), van den Bremer and van der Ploeg (2013), van der Ploeg (2010) and Stroebel and Benthem (2013). None of them focus on government decentralization. Several authors such as Persson and Tabellini (1996a, 1996b) analyzed fiscal transfers among regions as a way to share risk; unlike them, we allow for different levels of decentralization including the possibility of secession, and look into the consequences of resource booms. The paper is as well related to the literature on secession and the endogenous size of nations, including Alesina and Spolaore (1997), Bolton and Roland (1997), and Buchanan and Faith (1987). As Alesina and Spolaore (2005) argue in their survey, the basic trade-off in this literature is between preference heterogeneity and efficiency in the provision of public goods. Our main trade-off, instead, is between preference heterogeneity and risk sharing, with applicability to the case of natural resource discoveries.

The paper is structured as follows. Section 2 presents the theoretical analysis. Section 3 carries out the empirical work. Section 4 summarizes our main findings and offers concluding remarks.

2 A Model of Natural Resources and Fiscal Decentralization

We build a model similar to Arzaghi and Henderson’s (2005). Our framework, however, proposes an alternative trade-off tightly linked to natural resources, and can account for partial decentralization. The exploitation of natural riches is subject to revenue volatility that harms the economy due to risk aversion. In addition, central and regional governments may face different costs associated with the exploitation of natural resources. Both revenue volatility and local inefficiency are assumed to increase with the stock of natural capital. Under these circumstances, the endogenous level of decentralization can diminish after the resource windfall.
2.1 The Environment

The economy is composed of two regions: region 1 hosts the central government (CG); region 2 has natural resources and a regional authority (RG). FD means that RG is allowed to keep a fraction of the taxes and natural resource rents collected in the area to partially finance public goods. If region 2 obtains a relatively larger fraction then the economy is more fiscally decentralized. As in Arzaghi and Henderson (2005), we assume for simplicity that the constitution forces to charge the same income tax rate ($\tau$) and enjoy the same level of public goods per capita ($g$) in all regions within the union.\footnote{This is a simplifying assumption, made for tractability. Raveh (2013) finds that within a union resource rich regions offer lower tax rates and greater public good provision compared to those offered by the resource poor ones. Applying this to the model would not provide further insights, yet would complicate it considerably.}

Region $j$ is populated by $L_j$ inhabitants, with $L_1 > L_2$.\footnote{Although we consider two regions for simplicity, one can think of a setup with N regions, where CG is an amalgamation of the N-1 resource poor ones. With this framework in mind, we find this relative-size assumption applicable.} Each risk averse individual in a region receives an amount of non-natural-resource income equal to $y_j$. People’s preferences are given by:

$$u = (x^\alpha g^{1-\alpha})^\theta,$$

where $x$ is the per capita level of private good consumption. The parameters $\alpha, \theta \in (0, 1)$, where $\theta$ captures the degree of risk aversion.

A fraction of taxes and resource rents are collected by CG and the rest by RG. The amount collected by RG serves to finance, at the local level, a fraction $\mu$ of the public good, and the rest is supplied by the central authority. Following Panizza (1999), there is spatial decay associated to CG’s provision of the public good to RG. This can be regarded as having a preference for heterogeneity (i.e. putting larger weight on the local public goods), or simply as a cost for delivering public goods to a distant region; in either case, this guarantees that RG will demand some degree of decentralization, even in the absence of natural resources. Thus, the amount of public goods measured in efficiency units in region 2 equals $[(1 - \mu)(1 - \delta) + \mu]g$, or $[1 - \delta(1 - \mu)]g$; where $\delta$ is the spatial decay parameter, and $\delta, \mu \in [0, 1]$. Clearly, in region 1, CG will supply all the public good and collect all taxes.

The above information implies that we can write (1) as

$$u_1 = [y_1^\alpha (1 - \tau)^\alpha g^{1-\alpha}]^\theta,$$
and

\[ u_2 = \left[ y_2^0 (1 - \tau)^\alpha (1 - \delta(1 - \mu))^{1-\alpha} g^{1-\alpha} \right]^\theta \]  \hspace{1cm} (3)

for regions 1 and 2, respectively.

Revenues net of direct and indirect costs from the exploitation of natural resources equal \( Z(1 - b\mu) \). The variable \( Z \) is random, subject to relatively large fluctuations due to changes in the price of minerals (as documented by Davis et al. 2001, for instance). Consistent with the evidence presented previously, we suppose that a fraction \( b\mu \) of potential revenue is lost due to moral hazard, Dutch Disease, and/or corruption problems that affect RG more strongly and, therefore, increase with the level of FD, proxied by \( \mu \).\(^6\)

Also consistent with evidence mentioned above, we assume that resource windfalls increase risk. Specifically, both the revenue volatility and the local inefficiency effects increase with \( Z \). The former because we suppose that the variance of \( Z \) – denoted by \( \sigma_z^2 \) – rises with the stock of natural resources (later in the paper we discuss an example in detail), and the latter because the cost of the inefficiency equals \( Zb\mu \). In addition, we abstract from making any specific assumptions on the distribution of resource rents apart from considering two extreme scenarios: the union, where \( Z \) is distributed equally across the nation, and independence, where \( Z \) is owned by RG.\(^7\)

The reason is that, within the union, the government that controls the resource rents can impact the equilibrium outcome only through its effect on bargaining power.

Finally, the interpretation of \( Z \) deserves some comment. Although referred to as a measure of rents, \( Z \) can be regarded more generally as a measure of the resource sector, and hence in turn as a broad measure of resource dependence, which is as susceptible to the risk involved by a resource windfall, as the actual rents are. For this reason we abstract from considering the option of saving in our framework.

Given the above information, we can write the budget constraint for the union as

\[ \tau L_1 y_1 + \tau L_2 y_2 + Z(1 - b\mu) = (L_1 + L_2) g; \]  \hspace{1cm} (4)

\(^6\)Being the smaller economy, a resource windfall will take a larger share in RG’s GSP than it would in CG’s, hence making RG relatively more susceptible to the adverse effects of resources, compared to CG, given an equivalent windfall. Nonetheless, RG’s greater susceptibility may be triggered also by additional sources; for instance, Bardhan (2002) argues that central bureaucracies attract better talent, especially in developing nations, and Brosio (2006) believes that local governments have less capacity to control costs and are more subject to corruption.

\(^7\)As we discuss later, the third case where CG is stronger, and thus has control of \( Z \), bears no interest, as CG would strictly prefer to centralize, regardless of \( Z \).
and for region 2, if it becomes an independent nation, as
\[ \tau L_2y_2 + Z(1 - b\mu) = L_2g. \] (5)

We consider a political scenario in which CG and RG are elected democratically by
the inhabitants of the whole country and the ones of region 2, respectively.\(^8\) After the
elections, once the state of nature is known, governments decide fiscal policy, that is,
the levels of \( \mu \) if CG and RG belong to the same union, \( g \), and \( \tau \). Conversely, given its
greater importance, a secession decision must be made at the time RG is elected, before
the state of nature is known; we discuss this later in more detail. These simplifying
assumptions will allow to obtain clean results that will later guide the empirical exercise
about the main mechanisms that drive the effect of natural resources on FD.

\subsection{2.2 Independence}

Let us first analyze the case when the two regions are independent states, and denote
the utility obtained in this scenario by \( u^i_j \), where \( i \) stands for independence. Natural
resources would be fully controlled by region 2 where they are located. Both countries
would face very similar problems. For concreteness, let us focus on region 2. Substituting equality (5) into objective function (3) for \( \mu = 1 \) and \( \delta = 0 \), we get that the
value of \( g \) is chosen such that:
\[
\max_g \left\{ u^I_2 = \left[ y_2^\alpha \left( 1 - \frac{L_2g - Z(1 - b)}{L_2y_2} \right)^\alpha \left( \frac{g^{1-\alpha}}{L_2y_2} \right)^{\theta} \right] \right\} 
\] (6)

The level of public goods that solves this maximization problem is
\[ g = (1 - \alpha) \left( \frac{L_2y_2 + Z(1 - b)}{L_2} \right). \] (7)
That is, the level of public good provision is a fraction – given by the weight of \( g \) in
the utility function – of total net income. Taking this expression back to the utility
function, we obtain:
\[
u^I_2 = \left\{ \alpha^\alpha (1 - \alpha)^{1-\alpha} \left( \frac{L_2y_2 + Z(1 - b)}{L_2} \right)^\theta \right\}. \] (8)

\(^8\)This follows Hatfield and Miquel (2012). Nonetheless, this framework is used primarily for con-
venience; main results would not change if other regimes are considered, as long as CG represents
the interest of the resource poor regions. Albeit being interesting, we consider the case where CG
is controlled by some representative of the resource rich region as a rare scenario, which is beyond
the scope of this work. In addition, we abstract from making any further specific assumptions on the
quality of institutions. As will be evident in the empirical part, institutional quality does not seem to
play a key role in this.
Therefore, indirect utility depends on per capita net income from resource and non-resource sources, the weights of the two consumption goods in the utility function, and the rate of risk aversion.

2.3 The level of fiscal decentralization

The chosen level of $\mu$ will be the result of a bargaining process between CG and RG since the two governments have different optimal decentralization levels. We consider three possible scenarios. In the first, CG possesses more bargaining power and can impose its preferred outcome. In the second, RG is the one in control and picks $\mu$. Last, in the third case, CG has more power in the negotiation, but RG can become an independent nation if necessary. Our primary focus is on the latter one; we find it most interesting since the proposed bargaining context resembles reality more closely, as observed for instance in some of the motivational anecdotes discussed initially (specifically, those related to the cases of Canada and the United Kingdom).

2.3.1 Preferred outcomes

Let us start by showing that CG and RG have different optimal decentralization levels. First, we use budget constraint (4) to solve for the tax rate necessary to finance a given level of $g$. We obtain

$$\tau = \frac{Lg - Z(1 - b\mu)}{Y};$$

where $Y = L_1y_1 + L_2y_2$, and $L = L_1 + L_2$.

Under a union, after the state of nature is known, CG’s problem is choosing $\mu$ and $g$ to maximize the median voter’s utility, who is located among the inhabitants of region 1 since $L_1 > L_2$. Denoting the utility of region $j$, when it belongs to the union, by $u^d_j$, and substituting (9) into objective function (2), the problem is

$$\max_{\mu, g} \left\{ u^D_1 = \left[ y_1^\alpha \left( 1 - \frac{Lg - Z(1 - b\mu)}{Y} \right) g^{1-\alpha} \right]^\theta \right\}. \quad (10)$$

The cost of decentralization is the additional economy-wide loss due to the management of part of the natural resources by the local government. However, the inhabitants of region 1 do not gain anything from decentralization. As a consequence, CG’s optimal $\mu$ equals zero. The FOC with respect to the public good, in turn, implies that

$$g = (1 - \alpha) \left( \frac{Y + Z}{L} \right). \quad (11)$$
As above, investment in public goods is a constant fraction of total per capita rents.

Inhabitants of region 2, on the other hand, gain from FD. RG would like to pick the values of $\mu$ and $g$ to maximize (3) subject to (5), taking into account that both $\tau$ and $g$ need to be the same in the two regions. That is,

$$\max_{\mu,g} \left\{ u^D_2 = \left[ y_2^\alpha \left( 1 - \frac{Lg - Z(1 - b\mu)}{Y} \right)^{\alpha} \left[ 1 - \delta(1 - \mu) \right]^{1-\alpha} g^{1-\alpha} \right]^{\theta} \right\}. \quad (12)$$

The solution to this problem is

$$g = (1 - \alpha) \left[ \frac{Y + Z(1 - b\mu)}{L} \right], \quad (13)$$

and

$$\mu = \frac{1 - \alpha}{bZ} \left( Y + Z - Lg \right) - \alpha \frac{1 - \delta}{\delta}. \quad (14)$$

Finally, substituting (13) into (14), we get

$$\mu = \frac{\alpha}{1 - (1 - \alpha)^2} \left[ \frac{1 - \alpha}{b} \left( \frac{Y}{Z} + 1 \right) - \frac{1 - \delta}{\delta} \right]. \quad (15)$$

The optimal $\mu$ decreases with the costs brought to the economy by natural resources ($bZ$), and increases with the degree of spatial decay ($\delta$). The ratio of natural rents to output shows up as a potential determinant of the level of FD, with a negative impact.\footnote{A corollary to the above is that the role of local inefficiency in the model guarantees that an equilibrium with $\mu \in (0, 1)$ exists. Without this inefficiency, neither CG nor RG would experience any cost from FD. Hence, CG would be indifferent about the value of $\mu$, and RG would always prefer either $\mu = 1$ or independence. Under these circumstances, revenue volatility would contribute to the decision of choosing between $\mu = 1$ and independence.}

### 2.3.2 Bargaining outcomes

Clearly, the level of FD $\mu$ will lie between the preferred values of the two governments. As mentioned earlier, the exact degree will depend on the bargaining power of each region. If a threat of independence by region 2 is not credible and CG has a stronger position, the trivial solution will be CG’s preferred outcome – a fully centralized union. The other two scenarios are more interesting; in both, RG has some bargaining power.\footnote{This follows other secession models, which focus on regional demands. See e.g. Bolton and Roland (1997), and Buchanan and Faith (1987).}

Next, we analyze them separately.

The solution to the case that RG can impose its preferred $\mu$ is straightforward. If RG is the one that chooses $\mu$, the degree of FD will be given by expression (15).
We can see that a resource windfall (an increase in $Z$) will decrease the optimal FD. The ultimate reason is the increase in the relative strength of the moral hazard, *Dutch Disease*, and corruption problems that affect the local government. Local inefficiency can then lead to lower levels of FD when a natural stock rises. According to (15), the model predicts that the relevant variable is the ratio of natural resource rents to output ($Z/Y$), a feature that will be obtained again next under our third scenario, and which we will exploit in the empirical part.

Suppose now that CG is the stronger player, but that region 2 can become an independent state if its citizens decide so by majority voting. Independence represents a more important decision than fiscal policy: it is relatively permanent, and may even need a modification of the constitution. For this reason, we assume that this decision is taken before the state of nature is known, at the time when the RG is elected. In this scenario, the outcome will be equivalent to a take-it-or-leave-it offer made by CG to RG so that the latter is indifferent between staying and leaving the union in expected value.

RG’s level of welfare under independence is given by expression (8) above. On the other hand, RG’s indirect utility within the union as a function of $\mu$ is obtained by combining optimality condition (13) and objective function (12):

$$u_D^D(\mu) = \left\{ \left[ y_2 \alpha \frac{Y + Z(1 - b\mu)}{Y} \right]^\alpha \left[ (1 - \delta + \delta\mu) \left(1 - \alpha \right) \frac{Y + Z(1 - b\mu)}{L} \right]^{1-\alpha} \right\}^\theta ;$$

or rewriting it,

$$u_D^D(\mu) = \left\{ \left( \frac{y_2}{\mu/y/L} \right)^\alpha [(1 - \alpha)(1 - \delta + \delta\mu)]^{1-\alpha} \left[ \frac{Y + Z(1 - b\mu)}{L} \right] \right\}^\theta. \quad (16)$$

Function (16) displays an inverted U-shape provided that the ratio of output to resource rents is sufficiently large, and in particular, $Y/Z > (1 - \delta)b/[(1 - \alpha)\delta] - 1$. Under this assumption, the decrease in the spatial decay inefficiency due to additional units of $g$ being supplied by RG dominates for low levels of FD, whereas the higher costs related to a larger $\mu$ dominates when FD is sufficiently high. The function $u_D^D(\mu)$ achieves its maximum for the value of $\mu$ in expression (15).

The indifference condition that determines $\mu$ must hold in expected terms. Therefore, we have that

$$E[u_D^D(\mu)] = E[u_D^L].$$
From expressions (8) and (16), this implies that

\[ E \left[ \left( \frac{L_2 y_2 + Z(1-b)}{L_2} \right)^\theta \right] = \left\{ [1-\delta(1-\mu)]^{1-\alpha} \left( \frac{y_2}{Y/L} \right)^\alpha \right\}^\theta E \left[ \left( \frac{Y + Z(1-b\mu)}{L} \right)^\theta \right]. \]  

(17)

Suppose that there is a resource discovery. The question is how \( \mu \) will change, assuming that \( \mu \) takes on a value to the left of the one given by (15). In this third scenario, effects can go in both directions. On the one hand, independence implies that the new resources are split among less people (\( \Delta Z/L_2 > \Delta Z/L \)), causing a reduction in the tax rate and an increase in the provision of public goods – call it the mean effect. On the other hand, the discovery increases uncertainty, and risk averse agents value that the union represents a larger economy, more able to diversify risks and diminish the incidence of revenue volatility on the tax rate and public goods. The impact of local inefficiency also shows up in condition (17): net revenues from natural resources will be smaller if region 2 becomes independent (\( 1-b < 1-b\mu \)). The mean effect then pushes towards independence, whereas the local inefficiency and revenue volatility effects call for a decline in the level of FD (\( \mu \)) as \( Z \) rises.

To see the importance of volatility, and how it can lead to a reduction in \( \mu \), let us assume that resource rents \( Z \) equals \( pN \); where the variables \( N \) and \( p \) represent the constant flow and the random price of natural resources, respectively. The variable \( p \) is distributed with mean \( \bar{p} \) and variance \( \sigma^2 \). Clearly, the variance of \( Z \) equals \( N^2 \sigma^2 \), which increases with \( N \). Let us also approximate the terms inside the expectation operator in both sides of expression (17) employing a second-order Taylor expansion around the mean.

The new definition of \( Z \) implies that the expectation located in the RHS of (17) can be approximated as:

\[ E \left[ \left( \frac{Y + Z(1-b\mu)}{L} \right)^\theta \right] \approx \left[ \frac{Y + \bar{p}N(1-b\mu)}{L} \right]^\theta \left[ 1 - \frac{\theta(1-\theta)\sigma^2}{\left( \frac{1-b\mu}{N} \bar{p} \right)^2} \right]. \]  

(18)

In the RHS of this last expression, the terms in the first and second squared brackets provide the positive mean effect and the negative volatility effect of an increase in the stock of \( N \), respectively. We see that the negative volatility effect rises with \( N/Y \), that is, with the resource-output ratio. From this result, it is easy to deduce that, in the
case of RG, the relevant ratio that determines the impact of increasing volatility will be $N/L_2 y_2$ (see next expression). Therefore, the fall in expected utility caused by the increase in volatility will be larger for an independent RG than under the union. This is the driving force behind the result presented in the next paragraph.

Performing the approximation of the term inside the other expectation operator and using (18), we can turn (17) into

$$
\left[ \frac{Y + (1 - b\mu)\bar{p}N L_2}{L_2 y_2 + (1 - b)\bar{p}N L} \right]^{2-\theta} = \frac{\left\{ [1 - \delta(1 - \mu)]^{1-\alpha} \left( \frac{Y}{Y/L} \right)^{\alpha} \right\}^{\theta} - \frac{(1 - \theta)\sigma^2}{(1 - b\mu)^2} \frac{\left( \frac{Y}{(1 - b\mu)N + \bar{p}} \right)^2}{\left( \frac{L_2 y_2}{(1 - b)N + \bar{p}} \right)^2}}.
$$

The LHS of (19) always declines with $N$. The RHS, on the other hand, can go up or down depending on whether the variance $\sigma^2$ is sufficiently large compared to the mean $\bar{p}$. For example, if $\bar{p}$ equals zero then it is easy to show that the RHS will go up with $N$, provided that $Y/(1 - b\mu) > L_2 y_2/(1 - b)$. As a consequence, for a sufficiently small $\bar{p}$ and a sufficiently high ratio $Y/y_2$, the negative volatility effect will dominate and CG will be able to impose a smaller level of FD after a natural resource windfall.

To sum up the analysis, the take away message is that under the main scenarios, where regional demands matter, a resource windfall decreases the level of FD due to a preference to share the risk borne by the local inefficiency and volatility effects. Next, we take these predictions to the data.

## 3 Empirics

In this section, we provide empirical evidence for the association between resource booms and decentralization. We first motivate our focus on FD – as opposed to political decentralization – and later investigate whether resource booms decrease the level of FD, as hypothesized in the theoretical analysis. We also try to shed light on the mechanisms pointed out by the model. In particular, we test whether the decrease in the degree of FD is driven by the risk sharing channel. The Appendix describes in detail the countries and variables in each sample, including descriptive statistics.

### 3.1 Decentralization and natural resources

Resource booms might cause changes in various aspects of decentralization, with the fiscal and political dimensions being the two key ones. We start by examining con-
ditional correlations to better understand the patterns at hand. We employ a panel that covers the period 1965-1995 in 5-year intervals, and includes 43 countries.\textsuperscript{11} The underlying model is the following:

\[ D_{it} = \alpha_0 + \alpha_1 X_{it} + \alpha_2 R_{i,t-1} + \varphi_i + \eta_t + \varepsilon_{it}; \]  

(20)

where \( D_{it} \) is the decentralization level for country \( i \) at time \( t \); \( X_{it} \) is a vector of controls; \( R_{i,t-1} \) is the resource proxy; and \( \varphi_i \) and \( \eta_t \) represent country and time fixed effects, respectively.

Previous studies on the determinants of decentralization have found that land area, income level, population size, institutional quality, and urbanization represent significant explanatory variables, each of them with a positive effect.\textsuperscript{12} Given these findings, we include them in the control vector, with the exception of land area which has no time variation (and thus absorbed by the country fixed effects). In addition, we note the essential role of institutional quality in our case. In the model we abstract from making any specific assumptions on institutional quality; thus, including it in each of the specifications serves not only for maintaining consistency with the FD literature, but also for motivating our theoretical framework.

Variables in \( X \) are measured as follows:\textsuperscript{13} institutional quality by the Political Rights Index (Freedom House); income level by the logarithm of real per capita GDP; population by total population; and urbanization by the share of urban population in total population. For the resource proxy, we start with the one suggested by the model in expressions (15) and (18): the GDP share of resource rents; in particular, the share of oil rents. We focus on oil because it represents a relatively large share of total resource rents. Oil has also a more exogenous nature compared to other types of resources, because oil-related operations are often managed by multinational firms that bring their own technology and production factors, making such operations largely independent of the country’s development level. We test additional proxies in later sections.

The level of decentralization is captured by the Kearney Decentralization Index (Arzaghi and Henderson 2005). Although there are other decentralization indices, we

\textsuperscript{11}This is a maximized sample limited by the availability of data for our measure of decentralization.

\textsuperscript{12}See Arzaghi and Henderson (2005), Oates (1972), Panizza (1999), and Treisman (2006).

\textsuperscript{13}Unless specified otherwise, all data come from World Bank Development Indicators. See Appendix for more detailed information.
choose to employ this one due to its heterogeneous sample that includes both developing and developed economies, and the large time period it covers; also, it allows us to use a balanced and complete panel, as opposed to other measures which present incomplete data. The Kearney index is comprehensive and covers nine distinct dimensions which touch on both the fiscal and political aspects of decentralization, namely: government structure, selection of regional executive, selection of local executive, override authority, revenue raising authority, revenue sharing, education authority, infrastructure authority, and police authority; in the Appendix we describe each in more detail. Two of these dimensions are directly related to FD: revenue raising authority, and revenue sharing; the remaining ones are concerned with more politically-oriented aspects. Each dimension is measured by a number between 0 and 4, with 4 representing the highest level of decentralization and 0 the least.

Equation (20) is estimated for each of the nine dimensions and for the overall index, using OLS. Results appear in regressions 1-9 of Table 1 for each of the components and the aggregated index, with the exception of the revenue raising authority dimension; since the latter makes the focus of our subsequent analysis, the equivalent benchmark results for it are presented separately in regressions 1 and 5 of Table 2. As can be seen, oil rents are negatively correlated with the two abovementioned fiscally-related dimensions, and have no significant association with the remaining politically-related ones. Moreover, there is also an apparent negative relationship with the overall index, which seems to be entirely driven by the correlation with the FD channels.

To better distinguish between the FD-related and non-FD-related (political) dimensions, we look into the aggregated measures of each; the first, FD-related, group is an aggregation of the revenue sharing and revenue raising authority components, whereas the second, non-FD-related, group is an aggregation of the remaining ones. Regressions 10 and 11 present the results of the linear estimations of each. Here, the distinction is even clearer: the FD-related group has a significant negative association with oil rents, whereas the second group does not.

In addition, given the discrete nature of the Kearney Index, we test the above using an ordered probit technique. More specifically, since the use of country-specific dummy variables is too demanding in the non-linear model, we exclude them from this specification. Instead, we follow the methodology set by Wooldridge (2005) and

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14 For instance, in the World Bank’s Fiscal Decentralization Indicators (a measure of FD that we adopt later for robustness tests), some countries have observations for only one or two time periods.
add various time-invariant controls to address the fixed-effects issue. These controls are the following: land area, latitude, legal origin, ethnic fractionalization, and the mean values of all time-variant independent variables. Marginal effects are reported in columns 12 and 13, for the FD-related and non-FD-related groups, respectively. Results indicate that the negative effect is sourced solely in the FD-related dimensions, consistent with the outcome observed in the linear cases, thus motivating our focus on FD in the analysis presented in the following subsection.

3.2 Fiscal decentralization

Our next task is to dig deeper into the effects of resource booms on the level of FD. Following the earlier discussion, we concentrate initially on the Revenue Raising Authority dimension. This dimension measures the subnational governments’ formal authority to raise their own revenue through taxation. Hence, from the two fiscally-related dimensions this one is more consistent with the model’s notion of decentralization, motivating our choice of it.\footnote{Nonetheless, results do not change qualitatively if instead we employ the Revenue Sharing dimension, an average of the two fiscally-related dimensions, or the overall index. Results are available from the corresponding author.} Results are presented in Table 2.

We start by estimating Equation (20) using OLS. Keeping exposition to the minimum, we discuss only the main coefficients of interest, though nonetheless we note that results on all other controls are consistent with those reported in previous studies (with some sensitivity in significance to certain specifications). The basic result appears in regression 1. As reported previously, the coefficient on the resource share proxy is negative and significant, confirming the main hypothesis – oil booms decrease the level of FD. In terms of magnitudes, the result indicates that a one standard deviation increase in the GDP share of oil rents is associated with a decrease of one fifth of a standard deviation in the level of FD.\footnote{Although not presented, if we employ as resource proxy the GDP share of rents from diffuse-source resources (agriculture, fishing, hunting, and forestry) at \( t \) – 1, the estimated coefficient is non-significant. This strengthens the preference for focusing on oil-related resources. Results are available upon request.}

Since FD is regarded as being relatively persistent, we add its level at \( t – 1 \) as an additional explanatory variable in regression 2. As expected, its coefficient is positive and significant providing some indication to the hypothesized persistence. Nevertheless, the coefficient on the resource share proxy remains negative, significant and similar in
magnitude, showing that our main result also holds under this dynamic setting.

In regression 3, we investigate the hypothesis of having U-shaped effects. As the anecdotes discussed initially imply, the relationship may not be linear: while FD can drop initially, it may increase if the level of oil rents becomes sufficiently large. To test this hypothesis, we add a squared term of our resource measure to the model. The coefficient on the squared term is indeed positive, but lack any statistical significance. This is consistent with the predictions of the model: given a decision not to secede, resource booms decrease the level of FD continuously, with no apparent U-shaped patterns.

Next, to be further consistent with the model, we test the idea that resource booms create relatively greater centralization in nations with a stronger CG. To test this, we employ the Override Authority component of the Kearney Decentralization Index. This dimension assesses whether the central government has the legal right to override the decisions and policies of lower levels of government; it is a dummy variable that can take a value of either 4 or 0, with 4 representing the existence of such legal right, which in turn implies having a stronger CG relative to RG. We add this measure, together with its interaction term with the resource share proxy, to the model. Results appear in regression 4. The interaction term is indeed negative and significant as expected, providing some evidence for the said hypothesis. Importantly, the coefficient on the resource share proxy remains negative and significant. These results indicate that FD is also an outcome of regional demands, as implied by the model.

As before, due to the discrete nature of the Kearney index we apply an ordered probit approach to a version of equation (20). We follow the same methodology described earlier, in the initial ordered probit estimations, only here we also add the level of FD at the initial period (instead of its first lag) in the dynamic case, consistent with Wooldridge (2005). Results appear in regressions 5-8, which are essentially the probit-version of regressions 1-4. The reported marginal effects indicate that the main result holds: resource booms decrease the level of FD, even under the dynamic setting, present no U-shaped effects, and create greater centralization in nations with a relatively stronger CG.
3.3 Mechanisms

The model points at risk sharing as the driving mechanism behind the negative effect of resource discoveries on FD. However, we can think of other potential channels associated with the ultimate source of the observed outcome, such as the: incidence of corruption, capacity of the region to make decisions, outcome of a violent environment, or the degree of openness. Since institutional quality is already controlled for in all specifications, thus addressing the first conjectured channel, we test each of the other potential mechanisms. Results from this exercise are presented in last five regressions of Table 2.

Starting with openness, Alesina and Spolaore (1997) argue that increased economic integration leads to secession. Therefore, it could be that the underlying mechanism works through this channel. To test this we add a standard measure of trade openness to the model: the GDP share of trade. The result in regression 9 refutes this hypothesis to some extent. As can be seen, the main coefficient of interest remains negative and significant, thus implying the mechanism at work is different.\footnote{Note that the coefficient on openness is negative and weakly significant, which although points at an opposite direction to that proposed by Alesina and Spolaore (1997), is consistent with findings of other studies on FD (e.g. Letelier 2005).}

A second option is that the changes in FD are an outcome of violent political acts. The connection between resource booms and violent conflicts has been discussed extensively in the literature;\footnote{See, for instance, Brunnschweiler and Bulte (2009).} hence, resource booms may affect FD through that channel. This may be especially applicable in economies with weak institutions. We test this hypothesis in regression 10 by controlling for internal armed conflicts. Thus, based on data from the Uppsala Conflict Data Program, we add an indicator for whether an internal armed conflict has taken place in the investigated time period. The negative and significant coefficient on the resource share proxy implies that the changes in FD are not a consequence of this.

Third, we test the hypothesis that the result is driven by a large vertical gap in authority between the central and regional governments. The assumption is that the vertical gap in authority makes more likely that the local authority falls in the type of problems mentioned above. Put differently, it may be the case that regional governments follow the will of the central one because the latter has the legal right to enforce it. To look into that we run a version of regression 4, only with the interaction
term excluded; i.e. we add to the model the Override Authority measure discussed above. Results appear in regression 12. Again, the coefficient on the resource share proxy remains negative and significant, implying this is not the underlying effect.

Next, we test the effect of increasing risk. We attempt to capture the total effect of resources on risk through a proxy that measures the overall volatility in the economy. Following Poelhekke and van der Ploeg (2009), volatility is measured by the standard deviation in the growth of real GDP per capita calculated over the intervals that we consider. When we add this measure in regression 12, the effect of natural resources on FD vanishes, and a negative coefficient on the volatility proxy appears significant. The latter result is consistent with the risk-heterogeneity trade-off put forward by the model. In addition, we see that once the risk component is controlled for, the effect of resources is no longer significant, providing evidence that the underlying mechanism may be one that pertains to the increasing risk involved with resource booms, and thus ultimately to the incentive to share risk.

Last, we try to disentangle the effect of the two risk components: relative inefficiency, and revenue volatility. Data limitations do not allow us to test the dominance of each directly, but we can nevertheless attempt to do so indirectly. The abovementioned literature often indicates that local inefficiencies tend to be worse in economies with relatively weaker institutional quality, whereas the revenue volatility effect is triggered primarily by international shocks. Therefore, although institutional quality is already controlled for, if the local inefficiency effect is dominant, we can expect to see relatively more centralization in economies with weaker institutions. To test that, we add an interaction term of our institutional quality and resource measures (the latter at $t - 1$) in regression 13. The lack of significance of the coefficient on this interaction term, provides some indication that the key effect is the one of the revenue volatility.

### 3.4 Robustness checks

So far, we have used the GDP share of oil rents to capture the degree of resource abundance. We preferred this measure given its relatively wide use in the relevant literature. Nonetheless, this measure is potentially endogenous (see, for example, Van der Ploeg 2011): to the extent that resource extraction is systematically associated with unobserved development factors, our results may suffer from an endogeneity bias. We address this concern by employing two additional resource proxies that are based
on exogenous components of the output-based measure.

The first one relates to the discovery of giant oil fields, and is based on data provided by Horn (2011). A giant oil field is defined to be one for which the estimate of ultimately recoverable oil is at least 500 million bbl of oil or gas equivalent. Horn (2011) reports total ultimately recoverable bbl of oil and gas equivalent estimated at the time of discovery for all giant oil fields discovered from 1868 to 2011; we employ these data but focus on the giant oil fields discovered during our sample’s time interval. Compared to oil rents, the new measure is more exogenous for two reasons. First, giant oil fields present potential for making significant amount of profits, which in turn attracts even more interest by large multinational firms, making extraction-related activities independent of the local economy. Second, this measure provides the stock of potentially extractable oil, as opposed to the flow of rents.

The second alternative looks into the variation in the international real price of oil. Changes in output-based measures may be driven by factors such as resource discoveries, extraction technology, and prices. The first two are potentially endogenous, whereas under reasonable assumptions the latter can be regarded as exogenous because oil prices are determined in the international market. We then build a proxy that exploits this exogenous variation in the international price of crude oil.

The measure is constructed as follows: for each country, we take the GDP share of oil rents in the earliest year available and multiply it by the average international real price of crude oil at time $t$. Thus, we keep the share of oil rents in GDP constant, and weigh it using oil prices that give the required variation. Figure 2 shows that the relative international ranking in the GDP share of oil rents has changed little over time; countries that were largely oil rich at the beginning of the period (1965) appear to hold their relative ranking 30 years later, with a correlation of 0.85. Keeping the share of oil rents in GDP constant, hence, can still capture accurately the countries’ relative position with respect to their resource abundance over time. Hence, to the extent that changes in international mineral prices are exogenously driven and that initial oil output is pre-determined, we argue that the variation we investigate is indeed exogenous since it is entirely triggered by changes in the international price of minerals.

Table 3 provides results using these two new variables. More specifically, regressions 1 to 5 and 6 to 10 show estimated coefficients for the effect of natural resources on the level of FD using giant oil fields and the price-based measure, respectively. In both
cases, results are qualitatively identical to the ones obtained in regressions 1 and 9 to 12 of Table 2. The coefficient on the resource measure is negative and significant, making the main result robust to the new proxies. As before, the exceptions occur when we include the volatility measure. Consistent with the baseline analysis, Regressions 5 and 10 in Table 3 show that the risk sharing proxy is negative and significant, while natural resources are not. This provides additional evidence that resource windfalls affect FD through the risk channel.

Finally, we test the main hypothesis using a different FD measure. We follow Davoodi and Zou (1998), Oates (1985), and Zhang and Zou (1998), and employ the World Bank’s Fiscal Decentralization Indicators, which are based on data from the International Monetary Fund’s Government Finance Statistics. From the several alternatives provided by the World Bank, we pick Vertical Imbalance, which is the one that most closely resembles the model’s notion of FD. This indicator measures the degree to which subnational governments fund their expenditures through their own revenue sources, and is a number between 0 and 100. A higher value means more independent subnational governments in terms of relying on their own revenue sources for their expenditures, implying that the country as a whole is more fiscally decentralized. The sample under the new variable covers the period of 1972-2000 and includes 78 countries. Given that observations are not available for all years and countries, we employ an unbalanced panel and 4-year time intervals to maximize coverage.

All other variables included in the regressions are identical to those used in the initial specifications (Tables 1-3), with the exception of being adjusted in terms of time intervals. Results are reported in Table 4. Regressions 1 to 4 again show a negative and significant impact of the resource share proxy that works primarily through the increased-risk mechanism.

4 Conclusion

Can resource booms unify nations? In light of previous theoretical work and various anecdotes, one might suspect the answer is an unequivocal no. This paper, however, presented a new and opposite perspective on this, through the case of FD. We provided empirical evidence indicating that resource booms tend to decrease the level of FD, without affecting political decentralization, and showed the robustness of this to various measures of decentralization and resource abundance, as well as to different controls,
estimation techniques, and time periods.

In addition, we offered a theory that rationalizes this counter-intuitive empirical finding through a model of endogenous FD. The framework builds on two simple notions: first, a trade-off between risk sharing and heterogeneity; and second, a positive association between resource dependence and risk. With these two ingredients combined, the model showed that both the central and regional governments have an incentive to increase centralization following a resource boom. While CG’s incentive to centralize is standard in the literature, the analysis showed that RG can have such an incentive as well. In equilibrium, RG redistributes a positive amount of its resource rents in exchange for a reduction in the degree of revenue volatility and local inefficiency. Empirical testing of various potential mechanisms implied that income volatility and, therefore, risk sharing is the primary channel that drives the negative impact of natural resources on FD.

The main policy implication of our paper for resource rich economies is that general trends to fiscally decentralize, as well as regional secessionist demands, may not be justified on economic grounds once risk sharing is accounted for. Nonetheless, as usual, we note that the empirical findings are limited to the countries and years covered in our sample. Further research is needed to fully understand the forces behind the decentralization decision of governments and the creation of nations.
Appendix

A Data

Tables 1, 2, and 3 employ a panel that covers the period of 1965-1995 in 5-year intervals; Table 4 employs a panel that covers the period of 1972-2008 with 4-year intervals. Thus, variables correspond to those periods and time intervals in either case. Unless stated otherwise, variables are measured in the initial year of the corresponding time interval.

Variable definitions


(i) Government Structure: Describes whether a country has a federal constitution; measured as either 0 or 4, with 4 representing federal constitution.

(ii) Selection of Regional Executive: Measures whether a country’s regional executives are elected; measured as either 0 or 4, where 4 means they are elected (note that ‘regional’ refers to states or provinces).

(iii) Selection of Local Executive: Measures whether a country’s local executives are elected; measured as either 0 or 4, where 4 means they are elected (note that ‘local’ refers to municipalities or their functional equivalents).

(iv) Override Authority: Measures whether the central government has the legal right to override the decisions and policies of lower levels of government; measured as either 0 or 4, where 4 means the existence of such legal right.

(v) Revenue Raising Authority: Describes sub-national governments’ formal authority to raise their own revenue through taxation; measured as either 0, 2, or 4, where 4 represents having the highest level of revenue raising autonomy and 0 the least.

(vi) Revenue Sharing: Describes whether a country’s central government regularly and unconditionally transfers a portion of national taxes to lower levels of government; measured as either 0, 2, or 4, where 4 represents having the highest level of revenue sharing and 0 the least.

(vii) Authority for Education: Measures responsibility for local primary education; measured as a number between 0 and 4, where 4 represents having the highest local responsibility and 0 the least.
(viii) Authority for Infrastructure: Measures responsibility over local highway construction; measured as a number between 0 and 4, where 4 represents having the highest local responsibility and 0 the least.

(ix) Authority for Police: Measures responsibility for local policing; measured as a number between 0 and 4, where 4 represents having the highest local responsibility and 0 the least.

**GDP share of oil rents:** GDP share of oil rents, expressed as a number between 0 and 1. Rents are computed as unit rents times production, where a unit rent is defined as unit price minus unit cost. Source: World Bank Development Indicators.

**Price-based oil measure:** GDP share of oil rents in initial year multiplied by the average international price of oil in time t (in thousands of real US$). Rents are computed as unit rents times production, where a unit rent is defined as unit price minus unit cost. Source: World Bank Development Indicators.

**Institutional quality:** Political Rights Index, expressed as a number between one and seven, one presenting best institutional quality and seven least. Source: Freedom House.

**Real per capita GDP:** Real GDP per capita, in constant 2000 US$ prices. Source: World Bank Development Indicators.

**Population:** Total population. Source: World Bank Development Indicators.

**Urbanization:** Share of urban population out of total population, expressed as a number between 0 and 100. Source: World Bank Development Indicators.

**Internal armed conflicts:** An indicator for whether an internal armed conflict has taken place in the investigated time interval. An internal armed conflict is defined as a contested incompatibility that concerns government and/or territory where the use of armed force between two parties, of which at least one is the government of a state, results in at least 25 battle-related deaths. More specifically, an internal armed conflict occurs between the government of a state and one or more internal opposition group(s) without intervention from other states. Source: Uppsala Conflict Data Program.

**Giant oil fields:** The logarithm of total recoverable bbl of oil and gas equivalent (estimated at the time of discovery) of all giant oil fields discovered in the investigated time period. A giant oil field is defined to be one for which the estimate of ultimately recoverable oil is at least 500 million bbl of oil or gas equivalent. Source: Horn (2011).

**Vertical imbalance:** The extent to which sub-national governments rely on their
own revenue sources for their expenditures, expressed as a number between 0 and 100. Source: World Bank Fiscal Decentralization Indicators.

*Land area:* Land area in square KM. Source: World Bank Development Indicators.

*Latitude:* The absolute value of the latitude of the capital city, divided by 90 (to take values between 0 and 1). Source: La Porta et al. (1999).

*Legal Origin:* Identifies the legal origin of the company law or commercial code for each country. There are four possible origins: 1) English common law; 2) French commercial code; 3) Socialist/Communist Laws; 4) German commercial code. Source: La Porta et al. (1999).

*Ethnic Fractionalization:* Reflects probability that two randomly selected people from a given country will not belong to the same ethno linguistic group. The higher the number the more fractionalized the society. Source: Alesina et al. (2003).

*Volatility:* The standard deviation of yearly GDP per capita growth in the 5 preceding years (to the year inspected). Source: World Bank Development Indicators.

**Countries included in sample**

*Tables 1, 2, and 3:* Algeria, Argentina, Australia, Bangladesh, Brazil, Cameroon, Canada, Chile, China, Colombia, Ecuador, Egypt, France, Germany, Ghana, Great Britain, Greece, Hungary, India, Indonesia, Italy, Japan, Kenya, Korea Republic, Malaysia, Mexico, Mozambique, Nepal, Netherlands, Pakistan, Peru, Philippines, Poland, Romania, Russian Federation, South Africa, Spain, Sri Lanka, Syria, Thailand, Turkey, United States, Uganda, Venezuela. Thailand, Turkey, United States, Uganda, Venezuela.

*Table 4:* Albania, Austria, Australia, Austria, Azerbaijan, Bahrain, Belarus, Belgium, Bolivia, Brazil, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Croatia, Czech Republic, Denmark, Dominican Republic, Ecuador, Estonia, Fiji, Finland, France, Gambia, Germany, Greece, Guatemala, Honduras, Hungary, Iceland, India, Indonesia, Iran, Ireland, Israel, Italy, Kenya, Korea Republic, Latvia, Lithuania, Luxemburg, Malawi, Malaysia, Mauritius, Mexico, Moldova, Mongolia, Netherlands, New Zealand, Nicaragua, Norway, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Russian Federation, Senegal, Slovak Republic, Slovenia, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Thailand, Tunisia, United Kingdom, United States, Uruguay, Venezuela, Zambia, Zimbabwe.
References


Testing the various dimensions - Linear estimations

<table>
<thead>
<tr>
<th>Dependent variable: Kearney Decentralization Index (panel, period: 1965-1995, 5-year intervals)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>GDP share of oil rents in t-2</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Country FE</td>
</tr>
<tr>
<td>Time FE</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
</tr>
<tr>
<td>Observations</td>
</tr>
<tr>
<td>Number of economies included</td>
</tr>
</tbody>
</table>

Standard errors are robust, clustered by country, and appear in parentheses for independent variables. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance. All regressions include controls for institutional quality, real GDP per capita, population, urbanization, and an intercept. Regressions 12-13 report marginal effects, and include land area, latitude, legal origin, ethnic fractionalization, and the mean values of all time-variant independent variables. In regressions 10 and 12 (11 and 13) the LHS variable is the sum of Revenue Sharing, and Revenue Raising Authority (Government Structure, Selection of Regional Executive, Selection of Local Executive, Override Authority, Authority for Education, Authority for Infrastructure, and Authority for Police) dimensions. For description and source of variables as well as list of economies included in each regression see Appendix. For descriptive statistics see Table A1.
## Table 2: Cross-country regressions, using the Revenue-raising Authority component of the Kearney Decentralization Index (panel, period: 1965–1995, 5-year intervals)

<table>
<thead>
<tr>
<th>Dependent variable: Revenue-raising Authority</th>
<th>Linear estimations</th>
<th>Ordered probit</th>
<th>Linear estimations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main specification</strong></td>
<td>Dynamic Setting</td>
<td>Resource measure</td>
<td>CG and OI</td>
</tr>
<tr>
<td>GDP share of oil rents in t-2</td>
<td>-2.83***</td>
<td>-2.15**</td>
<td>-6.81**</td>
</tr>
<tr>
<td></td>
<td>(1.14)</td>
<td>(0.88)</td>
<td>(2.18)</td>
</tr>
<tr>
<td>The square of GDP share of oil rents in t-2</td>
<td>6.15</td>
<td>2.91</td>
<td>(4.05)</td>
</tr>
<tr>
<td>Regional revenue-raising authority in t-1</td>
<td>0.37***</td>
<td>0.02***</td>
<td>(0.07)</td>
</tr>
<tr>
<td>Openness</td>
<td>-0.83*</td>
<td>-0.83*</td>
<td>-0.257</td>
</tr>
<tr>
<td></td>
<td>(0.46)</td>
<td>(0.46)</td>
<td>(0.47)</td>
</tr>
<tr>
<td>Internal armed conflicts</td>
<td>0.06</td>
<td>0.05</td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td>(0.10)</td>
<td>(0.10)</td>
<td>(0.16)</td>
</tr>
<tr>
<td>Override Authority</td>
<td>0.31</td>
<td>0.03</td>
<td>(0.08)</td>
</tr>
<tr>
<td></td>
<td>(0.37)</td>
<td>(0.06)</td>
<td>(0.07)</td>
</tr>
<tr>
<td>Volatility</td>
<td>-0.12***</td>
<td>-0.22***</td>
<td>(0.06)</td>
</tr>
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<td></td>
<td>(0.05)</td>
<td>(0.04)</td>
<td>(0.06)</td>
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<tr>
<td>Override Authority * GDP share of oil rents in t-1</td>
<td>-0.40***</td>
<td>-0.28**</td>
<td>(0.24)</td>
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<tr>
<td>Institutional quality * GDP share of oil rents in t-1</td>
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<tr>
<td>Time FE</td>
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<td>Yes</td>
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</tr>
<tr>
<td>Adjusted R-squared</td>
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<td>0.3570</td>
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<tr>
<td>Observations</td>
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</tr>
<tr>
<td>Number of economies included</td>
<td>44</td>
<td>44</td>
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Standard errors are robust, clustered by country, and appear in parentheses for independent variables. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance. All regressions include controls for institutional quality, real GDP per capita, population, urbanization, and an intercept. Regressions 2 and 6 include the level of fiscal decentralization at t-1. Regressions 5-8 report marginal effects, and include land area, latitude, legal origin, ethnic fractionalization, and the mean values of all time-variant independent variables, with the exception of the level of fiscal decentralization at t-1 in regression 6 in which the level of fiscal decentralization at the initial period is included instead. Regression 9 includes internal armed conflicts. Regression 10 includes override authority. Regression 11 includes volatility, which is the standard deviation of yearly GDP per capita growth in the 5 preceding years. Regressions 4-6 report marginal effects. For description and source of variables as well as list of economies included in each regression see Appendix. For descriptive statistics see Table A1.
Table 3: Cross-country regressions, using the Revenue Raising Authority component of the Kearney Decentralization Index (panel, period: 1965-1995, 5-year intervals)

<table>
<thead>
<tr>
<th>Dependent variable: Revenue Raising Authority</th>
<th>GIANT OIL FIELDS</th>
<th>PRICE-BASED OIL MEASURE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Main specification</td>
<td>Openness</td>
<td>Armed conflicts</td>
</tr>
<tr>
<td>Giant oil fields in t-1</td>
<td>-0.03**</td>
<td>-0.03**</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.02)</td>
</tr>
<tr>
<td>Price-based oil measure in t-1</td>
<td>Openness</td>
<td>Armed conflicts</td>
</tr>
<tr>
<td></td>
<td>-0.76*</td>
<td>-0.69</td>
</tr>
<tr>
<td></td>
<td>(0.45)</td>
<td>(0.46)</td>
</tr>
<tr>
<td></td>
<td>Internal armed conflicts</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>(0.17)</td>
<td>(0.17)</td>
</tr>
<tr>
<td></td>
<td>Override Authority</td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.08)</td>
</tr>
<tr>
<td></td>
<td>Volatility</td>
<td>-0.15**</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.05)</td>
</tr>
</tbody>
</table>

Dependent variable: Revenue Raising Authority

Main specification: Openness, Armed conflicts, CG authority, Risk

| Country FE | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes |
| Time FE    | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Adjusted R-squared | 0.2669 | 0.2718 | 0.2731 | 0.2802 | 0.3073 | 0.2650 | 0.2801 | 0.281 | 0.2878 | 0.3102 |
| Observations | 204 | 204 | 204 | 204 | 204 | 204 | 204 | 204 | 204 | 204 |
| Number of economies included | 44 | 44 | 44 | 44 | 44 | 44 | 44 | 44 | 44 | 44 |

Standard errors are robust, clustered by country, and appear in parentheses for independent variables. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance. All regressions include controls for institutional quality, real GDP per capita, population, urbanization, and an intercept. Regressions 3 and 9 include internal armed conflicts. Regressions 4 and 8 include override authority. Regressions 5 and 10 include volatility, which is the standard deviation of yearly GDP per capita growth in the 5 preceding years. For description and source of variables as well as list of economies included in each regression see Appendix. For descriptive statistics see Table A1.
Table 4: Cross-country regressions, using the World Bank Fiscal Decentralization Indicators, *Vertical Imbalance* (panel, period: 1972-2000, 4-year intervals)

<table>
<thead>
<tr>
<th>Dependent variable: Vertical Imbalance</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP share of oil rents in t-1</td>
<td><strong>-38.38</strong></td>
<td><strong>-39.79</strong></td>
<td><strong>-39.61</strong></td>
<td><strong>-30.23</strong></td>
</tr>
<tr>
<td></td>
<td>(16.78)</td>
<td>(18.81)</td>
<td>(18.74)</td>
<td>(18.39)</td>
</tr>
<tr>
<td>Openness</td>
<td>3.09</td>
<td>3.13</td>
<td>2.33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(9.46)</td>
<td>(9.37)</td>
<td>(8.91)</td>
<td></td>
</tr>
<tr>
<td>Internal armed conflicts</td>
<td>0.63</td>
<td>0.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(8.59)</td>
<td>(8.71)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volatility</td>
<td>-0.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.63)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Country FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Time FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.6918</td>
<td>0.6904</td>
<td>0.6889</td>
<td>0.6918</td>
</tr>
<tr>
<td>Observations</td>
<td>279</td>
<td>279</td>
<td>279</td>
<td>279</td>
</tr>
<tr>
<td>Number of economies included</td>
<td>77</td>
<td>77</td>
<td>77</td>
<td>77</td>
</tr>
</tbody>
</table>

Standard errors are robust, clustered by country, and appear in parentheses for independent variables. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance. All regressions include controls for institutional quality, real GDP per capita, population, urbanization, and an intercept. Regression 3 includes internal armed conflicts. Regression 4 includes volatility, which is the standard deviation of yearly GDP per capita growth in the 5 preceding years. For description and source of variables as well as list of economies included in each regression see Appendix. For descriptive statistics see Table A2.
Table A1: Descriptive Statistics, Tables 1-3

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government Structure</td>
<td>1.19</td>
<td>1.83</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Selection of Regional Executive</td>
<td>1.19</td>
<td>1.83</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Selection of Local Executive</td>
<td>1.51</td>
<td>1.41</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Override Authority</td>
<td>1.33</td>
<td>1.89</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Revenue Raising Authority</td>
<td>1.51</td>
<td>1.41</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Revenue Sharing</td>
<td>1.54</td>
<td>1.36</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Authority for Education</td>
<td>0.87</td>
<td>1.02</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Authority for Infrastructure</td>
<td>0.91</td>
<td>0.98</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Authority for Police</td>
<td>0.60</td>
<td>0.81</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Overall index</td>
<td>1.18</td>
<td>1.07</td>
<td>0</td>
<td>3.56</td>
</tr>
<tr>
<td>GDP share of oil rents</td>
<td>0.04</td>
<td>0.10</td>
<td>0</td>
<td>0.91</td>
</tr>
<tr>
<td>Price-based oil measure</td>
<td>0.13</td>
<td>0.32</td>
<td>0</td>
<td>3.05</td>
</tr>
<tr>
<td>Institutional quality</td>
<td>3.69</td>
<td>2.20</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Real per capita GDP</td>
<td>5152.20</td>
<td>7164.78</td>
<td>84.71</td>
<td>36789.22</td>
</tr>
<tr>
<td>Population</td>
<td>7.60E+07</td>
<td>1.72E+08</td>
<td>4439206</td>
<td>1.26E+09</td>
</tr>
<tr>
<td>Urbanization</td>
<td>49.71</td>
<td>23.39</td>
<td>3.5</td>
<td>90.1</td>
</tr>
<tr>
<td>Internal armed conflicts</td>
<td>0.31</td>
<td>0.46</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Giant oil fields</td>
<td>2.03</td>
<td>3.43</td>
<td>0</td>
<td>12.03</td>
</tr>
<tr>
<td>Land area</td>
<td>1849242</td>
<td>3295603</td>
<td>33760</td>
<td>1.64E+07</td>
</tr>
<tr>
<td>Latitude</td>
<td>0.31</td>
<td>0.19</td>
<td>0</td>
<td>0.67</td>
</tr>
<tr>
<td>Legal Origin</td>
<td>1.96</td>
<td>0.84</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Ethnic Fractionalization</td>
<td>0.32</td>
<td>0.29</td>
<td>0</td>
<td>0.87</td>
</tr>
<tr>
<td>Volatility</td>
<td>1.71</td>
<td>1.35</td>
<td>0.02</td>
<td>6.95</td>
</tr>
</tbody>
</table>

For description and source of variables see Appendix.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical Imbalance</td>
<td>65.57</td>
<td>22.26</td>
<td>6.96</td>
<td>99.81</td>
</tr>
<tr>
<td>Institutional quality</td>
<td>3.56</td>
<td>1.91</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Real per capita GDP</td>
<td>6336.94</td>
<td>8410.59</td>
<td>86.76</td>
<td>46457.89</td>
</tr>
<tr>
<td>Population</td>
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<td>1.33E+08</td>
<td>209000</td>
<td>1.26E+09</td>
</tr>
<tr>
<td>Urbanization</td>
<td>51.73</td>
<td>22.51</td>
<td>5.94</td>
<td>97.1</td>
</tr>
<tr>
<td>GDP share of oil rents</td>
<td>0.03</td>
<td>0.08</td>
<td>0</td>
<td>0.77</td>
</tr>
<tr>
<td>Internal armed conflicts</td>
<td>0.2</td>
<td>0.4</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Volatility</td>
<td>3.47</td>
<td>2.69</td>
<td>0.22</td>
<td>13.26</td>
</tr>
</tbody>
</table>

For description and source of variables see Appendix.
Figure 1: Resource Dependence and Risk

Figure presents the correlation between the GDP share of oil rents and the standard deviation in the growth of real GDP per capita (Volatility) over 5-year intervals in 1965-2000 (ρ=0.74).
Figure 2: Spearman Correlation, GSP Share of Oil Rents: 1965 vs. 1995

Figure presents the correlation between the relative ranking of the GSP share of oil rents in 1965 and 1995 ($\rho=0.85$).