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# Expenditure decentralization and natural resources

Laura E. Armey[a,*], Robert M. McNab[b]

[a] Defense Resources Management Institute, Graduate School of Business and Public Policy, Naval Postgraduate School, Monterey, CA, 93933, United States
[b] Department of Economics, Strome College of Business, Old Dominion University, Norfolk, VA, 23529, United States

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ABSTRACT

This paper explores the relationship between natural resource revenues and expenditure decentralization. While the literature suggests that an abundance of natural resources may have deleterious effects on fiscal decentralization and other variables, existing empirical evidence regarding expenditure decentralization is scant and suspect. We find that expenditure decentralization is highly persistent. We take this persistence into account and use four different estimation strategies to examine whether natural resource revenues influence expenditure decentralization. Increases in natural resource rents as a percentage of Gross Domestic Product (GDP) statistically significantly and negatively affect expenditure decentralization. A 1% year-on-year increase in natural resource rents reduces estimated expenditure decentralization by approximately 0.1% to 0.3%. This result is robust to an alternative measure of resource dependence. Our findings strongly suggest that increases in resource endowments lead to a centralization of government expenditures.



## 1. Introduction

Often religious, ethnic, and resulting nationalist sentiments form the narrative of the rationale for separatist movements during civil wars. Many of these separatist conflicts, however, occur in natural resource rich regions, suggesting that greed, not grievance, motivates calls for greater autonomy and, in extreme cases, separation. Even resurgent nationalism in Scotland, beginning in the 1970 s, appears to be driven by the discovery of oil in 1966 even though claims to the rich oil reserves of the North Sea are doubtful. Natural resource wealth creates political conflict and may lead to demands for greater subnational autonomy, secession, and, in some cases, armed separatist movements (Ross, 2004, 2015; Le Billon, 2001). Whether subnational governments should, by geographical coincidence, enjoy the rents from natural resource endowments has generated significant debate in the literature and practice. The presence of natural resource endowments may alter the relationship between central and subnational governments; a relationship that we explore in this paper.

This paper examines whether natural resource rents influence expenditure decentralization. As natural resource rents increase, central governments may choose to capture these rents and equalize expenditures across subnational regions. From this perspective, central governments would attempt to use these rents to ameliorate separatist tensions, increasing decentralization as a strategy to avoid conflict. On the other hand, central governments may attempt to capture these rents for more nefarious reasons, to including rent-seeking behavior and outright theft. While the literature has largely focused on rents and the distribution of revenues (Acemoglu & Robinson, 2006; Auty, 2001, 2004; Ross, 2004; Perez-Sebastian & Raveh, 2016a,b), we instead focus on whether natural resource rents influence expenditure decentralization.

As expenditure decentralization is highly persistent, we discuss how spurious regressions may result if one fails to account for this persistency. We compare static and dynamic models of the determinants of expenditure decentralization as a strategy to examine the robustness of our empirical results. We find that increases in natural resource rents as a percentage of Gross Domestic Product (GDP) significantly and negatively affect expenditure decentralization. A 1% year-on-year increase in natural resource rents results in a 0.1% to 0.3% year-on-year decrease in expenditure decentralization. As a robustness check, we also find that natural resource exports negatively and significantly affect expenditure decentralization. This result contributes to the literature by illustrating the

* Corresponding author.
*E-mail addresses:* larmey@nps.edu (L.E. Armey), rmcnab@odu.edu (R.M. McNab).

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need to account for the persistency of expenditure decentralization and estimating the negative impact of natural resource rents on expenditure decentralization.

The remainder of the paper is structured as follows. In the next section, we briefly review the literature and develop the testable hypotheses of interest. We then discuss the data. The fourth section discusses the econometric strategy. The fifth section discusses the econometric tests and presents the results of our analysis. The last section concludes and offers recommendations for future research.

## 2. A brief review of the literature

The resource curse literature credits natural resource abundance with all manner of struggles in developing countries. Countries who depend on natural-resource trade suffer from slower economic growth (Sachs & Warner, 1997, 1999). Natural resource abundant countries may experience lower rates of economic growth due to Dutch disease; rent-seeking behavior, overconfidence, and lack of investment in human capital (Collier, Hoeffler, & Rohner, 2009; Gylfason, 2001). The literature suggests, in addition to Dutch disease, there may be pervasive institutional factors. Relative resource rich countries may increase public expenditures and subsidies to appease elite interests (Auty, 2004; Karl, 1997). These policies may, when resource prices fall, lead to increased public sector borrowing and external debt. Others have found evidence to suggest the lack of growth in resource rich countries is due to the lack of transparency, an absence of democratic governance, and the prevalence of corruption (Acosta, 2013; Kolstad & Wiig, 2009; Leite & Weidmann, 1999; Williams, 2011).

A relative abundance of natural resource rents may lead to a fractional or predatory government that distorts the economy in the pursuit of rents (Auty, 2001). The presence of large resource endowments may decrease democratization (Aslaksen, 2010; Epstein, Bates, Goldstone, Kristensen, & O'Halloran, 2006; Ross, 2004). Large resource endowments may deteriorate contract enforcement and financial development in countries with inadequate political institutions (Bhattacharyya & Roland, 2014). Elites, fearing loss of incumbency advantage, may block political and technological innovations and thus inhibit economic development. The likelihood of blocking is higher in countries with significant resource rents (Acemoglu & Robinson, 2006). Moreover, resource rich societies are also more prone to experience civil wars (Collier et al., 2009; Fearon & Laitin, 2003; Koubi, Spilker, Böhmelt, & Bernauer, 2014; Morelli & Rohner, 2015).[1]

We note that these claims are disputed in the literature and that a large resource endowment may have a positive influence on economic growth (Alexeev & Conrad, 2009; Brunnschweiler & Bulte, 2008). Evidence for the United States, for example, suggests that an increase in natural resource revenues lowers non-resource taxes, increases expenditure, and induces public savings (James, 2015). The resource curse may be an artifact of the relatively slow growth of the natural resource sector to other sectors of the economy (James, 2015). Appropriately structured resource revenue sharing structures across different levels of government may promote economic development, reduce regional inequality, and alleviate conflict. Yet, in many cases, these revenue sharing structures exacerbate political tensions, impede economic development, and, in the worst cases, incentivize violent conflict (Bauer, Gankhuyag, Manley, Halling, & Venugopal, 2016).

Practitioners and policymakers alike have sought policy interventions to improve governance in resource rich countries. Fiscal decentralization, or the delegation or devolution of revenues and expenditures to subnational governments, is of specific interest particularly to address the issue of regional incentives to form independent states (Sambanis & Milanovic, 2014).[2] More generally, decentralization should be considered a national strategy pursued to make the public sector more efficient, effective, and accountable to the needs and preferences of citizens (Oates, 2005; Sepulveda & Martinez-Vazquez, 2011). Reforms promoting fiscal decentralization have gained in popularity due to a wide range of positive outcomes attributed to decentralization (Weingast, 2014). Decentralization may improve allocative efficiency and alter the composition of public expenditures (Arze del Granado, Martinez-Vazquez, & McNab, 2016; Galasso & Ravallion, 2005). Decentralization may also improve economic efficiency, democratic governance, and economic growth (Arzaghi & Henderson, 2005; Martinez-Vazquez & McNab, 2003). Fiscal decentralization may also reduce the likelihood of civil wars (Ezcurra, 2015; Sambanis & Milanovic, 2014), although this may be conditional on a society's income level and ethnic composition (Bakke & Wibbels, 2011; Tranchant, 2008). This effect appears to be more pronounced in countries with relatively large resource endowments (Farzanegan, Lessmann, & Markwardt, 2013).

Fiscal decentralization, however, appears to be dependent on several factors, many of which are lacking in resource rich and developing countries. The degree of fiscal decentralization appears to be driven, in part, by economic, demographic, and environmental conditions (Arzaghi & Henderson, 2005; Oates, 1972, 2005; Panizza, 1999). Decentralization requires coordination among different levels of government; coordination that may be lacking in developing countries with weak institutional arrangements (de Mello, 2000). In the Middle East and North Africa, external conflicts are a major roadblock to fiscal decentralization (Tosun & Yilmaz, 2010). While higher income per capita appears to induce fiscal decentralization, this effect is reversed in developing countries (Bodman & Hodge, 2010) and with respect to health decentralization (Letelier, 2005). Developing countries continue to have relatively low levels of fiscal decentralization, suggesting that these countries struggle to implement proposed reforms (Gadenne & Singhal, 2013).

Fiscal decentralization may be inhibited by rent-seeking behavior in rentier regions (Desai, Freinkman, & Goldberg, 2005). The existing evidence on the impacts of resource dependence on decentralization rely on primarily country-specific evidence. Natural resource endowments and transfer dependency also appear to limit decentralization for the case of China (Stefan, 2013; Wu & Wang, 2013) and Russia (Freinkman & Plekhanov, 2009). Countries with higher levels of expenditure decentralization appear to be more susceptible to the natural resource curse (Perez-Sebastian & Raveh, 2016a,b). It is thus reasonable to hypothesize that increased natural resource endowments negatively affect a country's fiscal decentralization, a hypothesis that we examine in the next section.

## 3. Data

A common problem in the cross-country study of expenditure decentralization is how to measure decentralization. Ideally, we would develop a set of measures of expenditure decentralization that capture the decisions of central and subnational governments. This dataset would quantify the degree of autonomy afforded subnational governments, to include administrative, fiscal, and

[1] Ross (2004) aptly summarizes the drivers of civil wars in resource rich countries: "By harming a country's economic performance; by making its government weaker, more corrupt, and less accountable; by giving people who live in resource-rich regions an incentive to form an independent state; and by helping finance rebel movements."

[2] We focus our efforts on fiscal decentralization. There is a large extant literature on political and administrative decentralization which is beyond the scope of the paper.

**Table 1**
Variables.

| Variable | Definition | Units | Source |
|---|---|---|---|
| Expenditure Decentralization | Ratio of total subnational expenditures to total national expenditures | Fraction [0,1] | Authors' calculation and GFS |
| Ethnic Fractionalization | The index is equal to one is sum of the shares of ethnolinguistic groups in a specific country | Fraction [0,1] | Alesina et al. (2004) |
| Gross Domestic Product Per Capita | Gross Domestic Product divided by total population | Local currency units | WDI |
| Gross Capital Formation as Percent of GDP | Consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories | Fraction [0,1] | WDI |
| Natural Resource Rents as Percent of GDP | The ratio of total nature resources rents to GDP. Total natural resources rents include the sum of oil, natural gas, coal, mineral, and forest rents. | Fraction [0,1] | WDI |
| OECD Dummy | Dummy variable that is 1 for OECD members, 0 otherwise | (0,1) | Author's Calculation |
| Openness to Trade | The sum of exports to GDP and imports to GDP | Fraction [0,1] | Authors' calculation and WDI |
| Regional Autonomy Index | The Regional Authority Index is a measure of the authority of regional governments in 81 countries on an annual basis across ten dimensions: institutional depth, policy scope, fiscal autonomy, borrowing autonomy, representation, law making, executive control, fiscal control, borrowing control, constitutional reform. | | Hooghe et al. (2016) |
| Population | Total population | Millions | WDI |
| Polity2 | The POLITY score is computed by subtracting the Autocracy score from the Democratic Score and ranges from +10 (strongly democratic) to −10 (strong autocratic). The resulting score is then normalized to a 0 (strongly autocratic) to 1 (strong democratic) scale. | Fraction [0,1] | Marshall et al. (2017) |
| Urban Population | Percentage of the population living in urban areas | Fraction [0,1] | WDI |

political autonomy. The dataset would also capture relations between and among different levels of government (Martinez-Vazquez & McNab, 2003). While some advances have been made regarding revenue decentralization for a number of OECD countries (Baskaran & Feld, 2013; Stegarescu, 2005, 2009), similar quality (and quantity) data are not readily available with regards to expenditure decentralization though this would be a welcome (though arduous) area for future research.

To examine the question of whether natural resource rents influence expenditure decentralization across a sample of developed and developing countries, we (as with many other studies) are left with the standard though imperfect measure of expenditure decentralization based on expenditure ratio data. To construct this measure, we use expenditures at the national and subnational government level from the International Monetary Fund's *Government Finance Statistics Annual Yearbook* (GFS). To test the proposition that natural resource rents influence expenditure decentralization, we define the dependent variable, *Decent*, as the share of subnational expenditures in total public expenditures.

We use GFS data at the consolidated central government, regional and state government, and local government levels. For those countries that do not report consolidated central government data, we substitute data for the budgetary central government. Of the 180-plus potential countries in the GFS data set, we select countries that reported expenditures for at least the central government and at least one level of subnational government. We do not adjust data for price or currency fluctuations. We exclude those countries with less than four years of data.

We employ data using the 2001 GFS methodology as the IMF has noted that the 1986 and 2001 methodology data are not comparable.[3] While some authors have attempted to construct a compatible series using both datasets, the resulting datasets are subject to the authors' assumptions regarding the comparability of variables across methodologies (Arze del Granado et al., 2016; Martinez-Vazquez & McNab, 2003). We choose instead to limit our analysis to the 2001 GFS methodology which limits our analysis to 1990 onwards.

For our independent variable of interest, *rents,* we use the ratio of total natural resource rents to GDP from the World Bank's *World Development Indicators* (WDI). Total natural resource rents include the sum of oil, natural gas, coal, mineral, and forest rents. We expect *a priori* that, all other things being equal, countries with more abundant natural resources are less decentralized. To check the robustness of our results, we employ a second independent variable of interest, *rents_exp*, which is the ratio of ores, metals, and fuel exports as a share of total merchandise exports. We obtain this variable from the WDI. We expect *a priori* that the ratio of natural resource exports to total merchandise exports negatively influences decentralization.

We define a matrix **X** of control variables which previous research suggests are significant determinants of expenditure decentralization including population, urban population as a percentage of total population, GDP per capita, and openness to international trade (Arzaghi & Henderson, 2005; Canavire-Bacarreza, Martinez-Vazquez, & Yedgenov, 2016). We include a dummy variable to capture OECD membership status to capture differences between developing and developed countries. We obtain these variables from the World Bank's *WDI*, the POLITY IV database, the Regional Autonomy Index, and Freedom House's *Freedom in the World* yearbook (Table 1). The period of analysis is from 1990 to 2012, although many countries in the sample report for fewer years (Table 2). The resulting unbalanced panel dataset has 67 distinct developed and developing countries with 996 observations.

We present descriptive statistics in Table 3. These descriptive statistics show a wide variety of levels of decentralization and resource dependence across countries. While urbanization and democratization as well are relatively high on average, the sample shows considerable variability across countries and time in these variables as well.

[3] We refer the reader to the 2015 IMF Handbook for a discussion of the 1986 and 2001 GFS methodologies. We also note that even though some 1986 methodology based data are available according to the 2001 GFS methodology, these data are cash based *versus* the accrual basis of the 2001 GFS methodology.

**Table 2**
Sample Countries.

| Country | Years | Country | Years |
|---|---|---|---|
| Afghanistan | 2006–2012 | Kyrgyzstan | 1997–2001<br>2006–2012 |
| Albania | 1995–1998 | Latvia | 1995–2012 |
| Argentina | 1990–2004 | Malaysia | 1990–2001 |
| Armenia | 2003–2012 | Mexico | 1990–2000 |
| Australia | 1990–2012 | Moldova | 1995–2012 |
| Austria | 1990–2012 | Mongolia | 1992–2012 |
| Azerbaijan | 2008–2012 | Morocco | 2002–2012 |
| Belgium | 2000–2012 | Netherlands | 1990–2012 |
| Bulgaria | 1990–2012 | New Zealand | 2002–2012 |
| Belarus | 1992–2012 | Norway | 1990–2012 |
| Bolivia | 1990–2007 | Panama | 1990–1994 |
| Canada | 1990–2012 | Paraguay | 2005–2012 |
| Chile | 1992–2012 | Peru | 1990–2012 |
| China | 2005–2011 | Poland | 1994–2012 |
| Colombia | 1998–2000<br>2008–2012 | Portugal | 1990–2012 |
| Costa Rica | 2002–2012 | Romania | 1990–2012 |
| Croatia | 1995–2005 | Russia | 1994–1995<br>1998–2012 |
| Czech Republic | 1993–2012 | Serbia | 2007–2012 |
| Denmark | 1990–2012 | Slovak Republic | 2000–2012 |
| Dominican Republic | 1990–1996 | Slovenia | 1995–2012 |
| Estonia | 1995–2012 | South Korea | 2007-2012 |
| Finland | 1990–2012 | South Africa | 1990-2012 |
| France | 1990–2012 | Spain | 1990–2012 |
| Georgia | 1998–2012 | Sweden | 1990–2012 |
| Germany | 1990–2012 | Thailand | 1990–2012 |
| Greece | 1995–2012 | Tunisia | 2008–2012 |
| Honduras | 2003–2012 | Turkey | 2008–2012 |
| Hungary | 1991–2012 | Uganda | 1998–2012 |
| Iceland | 1998–2012 | Ukraine | 1998–2012 |
| India | 1990–2011 | United Kingdom | 1990–2012 |
| Ireland | 1990–2012 | United States | 1990–2012 |
| Israel | 1990–2012 | Uruguay | 1990–1997 |
| Italy | 1995–2012 | Zimbabwe | 2001–2005 |
| Kazakhstan | 1995–2012 | | |

## 4. Econometric approach

To test the proposition that an abundance of natural resources leads to lower levels of expenditure decentralization, we employ panel data and specify the initial general estimation form:

$$Decent_{i,t} = \alpha + \beta_1 Rents_{i,t} + \beta_2 OECD + \mathbf{X'_{i,t}}\boldsymbol{\Theta} + \mu_i + \lambda_t + \upsilon_{i,t} \quad (1)$$

where $\mu_i$ and $\lambda_t$ denote the unobservable individual country and time effects, respectively. The subscripts *i* and *t* denote country and time period, respectively.

We begin by examining whether the variables of interest exhibit a unit root process as the presence of a unit root, unless *N* and *T* grow quite large, is likely to induce inconsistent and biased estimates (Baltagi, 2008). We conduct Fisher type unit root tests for the dependent and independent variables (Maddala & Wu, 1999). We reject the null hypothesis that all the panels exhibit a unit root at the one percent level of significance for all the variables of interest with the exception of natural resource exports as a percentage of total merchandise exports and the variables associated with governance: the POLITY IV index, the Regional Autonomy Index, and the *Freedom* variable associated with the Freedom House's indices (Table 4). We are able to reject the null hypothesis at the one percent level of significance for these variables in first differences.

We, however, have an additional concern regarding the persistence of the expenditure decentralization variable. If the expenditure decentralization variable is highly persistent and the sample size is relatively small, unit root tests have relatively low power (Campbell & Perron, 1991). Even if the true process is highly persistent yet stationary ($\rho \rightarrow 1$), the best predictor of decentralization in the current period may be decentralization in the past period. If expenditure decentralization is highly persistent, the estimated standard errors may be biased; potentially leading to spurious conclusions. We investigate the persistency by specifying a general estimation form as

$$Decent_{i,t} = \alpha + \beta_1 Decent_{i,t-1} + \mu_i + \lambda_t + \upsilon_{i,t} \quad (2)$$

We employ three estimators to examine the autoregressive order 1, AR(1), properties of expenditure decentralization: (1) the pooled OLS estimator; (2) the one-way fixed effects estimator; and (3) the system Generalized Method of Moments (GMM) estimator. We would expect, *a priori*, for the pooled OLS and fixed effects estimators to provide the upper and lower bounds for the system GMM estimator, respectively (Bond, 2002).

The results suggest that expenditure decentralization is indeed highly persistent (Table 5). Depending on the estimator and underlying assumptions, the estimated coefficient for lagged decentralization approaches unity. This raises concerns that the persistence of the dependent variable will render the estimators inconsistent or, at a minimum, bias the standard errors and render inferences unreliable. We thus choose to estimate in first differences.

We employ four estimators to investigate whether natural resource rents influence expenditure decentralization: a pooled OLS estimator, a fixed-effects estimator, a system GMM estimator, and a Bias-Corrected Least Squares Dummy Variable (LSDVC) estimator. By estimating in first differences, we examine whether a change in natural resource rents causes a change in expenditure decentralization. This is a somewhat higher hurdle in terms of

**Table 3**
Descriptive Statistics.

| | Count | Mean | Std. Dev | Min | Max |
|---|---|---|---|---|---|
| Age Dependency Ratio | 1073 | 0.531 | 0.117 | 0.345 | 1.087 |
| Log of Land Area | 1073 | 12.602 | 1.676 | 9.917 | 16.654 |
| Expenditure Decentralization | 1073 | 0.254 | 0.136 | 0.003 | 0.652 |
| Ethnic Fractionalization | 765 | 0.330 | 0.257 | 0.010 | 0.932 |
| Log of GDP per capita | 1072 | 10.685 | 2.220 | 1.308 | 17.842 |
| Gross Capital Formation (% of GDP) | 1067 | 23.925 | 5.904 | 0.299 | 58.151 |
| Natural Resource Rents (% of GDP) | 1073 | 0.048 | 0.084 | 0.000 | 0.656 |
| Natural Resource Exports (% of Total Merchandise Exports) | 1028 | 0.187 | 0.207 | 0.002 | 0.974 |
| OECD Dummy | 1073 | 0.489 | 0.500 | 0.000 | 1.000 |
| Openness to Trade (% of GDP) | 1072 | 0.795 | 0.371 | 0.138 | 2.204 |
| Regional Authority Index | 749 | 12.650 | 10.211 | 0.000 | 36.990 |
| Log of Total Population | 960 | 2.717 | 1.416 | −1.289 | 7.124 |
| Polity2 | 1016 | 0.884 | 0.215 | 0.150 | 1.000 |
| Urban Population | 1073 | 0.670 | 0.167 | 0.119 | 0.977 |

**Table 4**
Fisher Type Unit-Root Tests.

| | Constant | Constant and Trend | Constant and 1 lag, ADF | Constant and 1 lag, PP |
|---|---|---|---|---|
| Age Dependency Ratio | 803.62** | 138.06 | 288.15** | 201.71** |
| Expenditure Decentralization | 275.16** | 391.63** | 199.24** | 292.46** |
| Log of GDP per capita | 665.91** | 322.44** | 89.14 | 378.17** |
| Gross Capital Formation (% of GDP) | 299.66** | 303.23** | 291.05** | 380.41** |
| Natural Resource Rents (% of GDP) | 411.40** | 358.82** | 202.73** | 487.47** |
| Natural Resource Exports (% of Total Merchandise Exports) | 166.81** | 140.28 | 124.93 | 167.01* |
| Openness to Trade (% of GDP) | 230.81** | 343.03** | 168.89* | 457.48** |
| Regional Authority Index | 60.37 | 30.68 | 41.02 | 32.63 |
| Log of Total Population | 1545.51** | 641.89 | 1383.68** | 576.67** |
| Polity2 | 51.15 | 36.07 | 95.48 | 39.26 |
| Urban Population | 773.44** | 515.52** | 244.02** | 412.80** |
| *First difference of:* | | | | |
| *Natural Resource Exports* | 853.65** | 821.62** | 388.62** | 881.48** |
| *Regional Authority Index* | 407.84** | 339.43** | 173.40** | 341.09** |
| *Polity2* | 362.82** | 264.17** | 144.55+ | 269.72** |

Notes: The null hypothesis of the Augmented Dickey Fuller (ADF) and Philipp-Perron (PP) test is that all panels exhibit a unit root. Based upon the p-values of the individual panel unit root tests, Fisher's test assumes that all series are non-stationary under the null hypothesis against the alternative that at least one series in the panel is stationary. Full results available upon request. **,*,+ denote significance at the 1%,5%, and 10% level respectively.

**Table 5**
AR(1) Properties of Expenditure Decentralization.

| | (1) OLS | (2) Fixed Effects | (4) System GMM | (5) System GMM | (6) System GMM | (7) System GMM |
|---|---|---|---|---|---|---|
| Expenditure | 0.987** | 0.794** | 0.978** | 0.978** | 0.912** | 0.916** |
| $Decentralization_{t-1}$ | (0.005) | (0.031) | (0.016) | (0.033) | (0.092) | (0.080) |
| Constant | 0.006** | 0.053** | 0.005 | 0.005 | 0.021 | 0.020 |
| | (0.002) | (0.009) | (0.004) | (0.008) | (0.022) | (0.018) |
| Observations | 996 | 996 | 996 | 996 | 996 | 996 |
| Adjusted $R^2$ | 0.974 | 0.683 | – | – | – | – |
| *M1* | −0.877 | 99.560** | −3.595** | −3.622** | −3.737** | −3.817** |
| *M2* | 0.665 | – | 1.287 | 1.290 | 1.297 | 1.297 |
| *Lag Limits* | – | – | All | 3 | 3 | 3 |
| *Number of Instruments* | – | – | 297 | 107 | 27 | 27 |
| *Collapsed* | – | – | No | No | Yes | Yes |
| *One step or Two* | – | – | One | One | One | Two |
| *Hansen Test* | – | – | 50.049 | 48.420 | 0.073 | 0.073 |
| *Diff. in Hansen test* | – | – | −0.000 | −1.147 | 0.028 | 0.028 |

Standard errors in parentheses. AR(1) test for Within estimator is Wooldridge F-Test.
+$p < 0.10$.
*$p < 0.05$.
**$p < 0.01$.

causality yet we believe that earlier studies that failed to account for the persistence of the expenditure decentralization variable are, at a minimum, suspect. As none of the variables exhibit a unit-root in first differences, the general functional form for the static model is:

$$\Delta Decent_{i,t} = \alpha + \beta_1 \Delta Rents_{i,t} + \beta_2 OECD + \Delta \mathbf{X'_{i,t}} \boldsymbol{\Theta} + \mu_i + \lambda_t + \upsilon_{i,t} \quad (3)$$

We also argue that a dynamic model may be important to illustrate the underlying macroeconomic processes in question. Changes in decentralization in the current period may be a function, in part, of changes in decentralization in the preceding period. This approach allows us to compare the static and dynamic results. We employ the following dynamic model to estimate the impact of natural resource rents on expenditure decentralization:

$$\Delta Decent_{i,t} = \alpha + \beta_1 \Delta Decent_{i,t-1} + \beta_2 \Delta Rents_{i,t-1} + \Delta \mathbf{X'_{i,t-1}} \boldsymbol{\Theta} + \mu_i + \lambda_t + \upsilon_{i,t} \quad (4)$$

There are, in addition, several important tradeoffs in the types of models used and how they are specified; we explain more about the choices below.

### 4.1. Generalized method of moments estimator

Two problems arise in the dynamic model. One is that the lagged dependent variable is systematically correlated with the error term, the other, and this is common throughout the models, is that several of the regressors, such as GDP per capita, may be endogenous. We employ a system GMM estimator in both the static and dynamic models in order to use lagged differences and lagged levels as instruments for the lagged dependent variable and other endogenous variables (Arellano & Bover, 1995; Blundell & Bond, 1998). We have choosen to use only internal instrumental variables. Importantly, GMM estimators offer standard errors that are robust to heteroskedasticity and serial correlation.

Researchers have several options available to them when using GMM estimators that incur important trade-offs (Bond, 2002; Wooldridge, 2001). We report the results of several specifications to ensure robustness to specification choices (Roodman, 2009a). We use the two-step process that is generally more efficient and naturally resilient to heteroskedasticity. The two-step process, however, tends to downward bias standard errors enough to make inference impossible when instrument counts are large (Arellano & Bond, 1991). To counter this issue, we employ the two-step process with Windmeijer corrected standard errors which ameliorates such problems (Windmeijer, 2005).

We further explore the sensitivity of our results to changes in the set of instruments. Instrument proliferation can overfit endogenous

variables and weaken Hansen tests. We collapse the instrument matrix and limit the number of lags to control for instrument proliferation (Roodman, 2009b). We assume that population, urban population, and the time variables are exogenous variables. The other variables, including decentralization, natural resource rents, GDP per capita, openness to international trade, and freedom are assumed to be endogenous. In order to preserve the size of our dataset, we employ forward orthogonal deviations using information on future differences to instrument for past differences (Arellano & Bover, 1995).

### 4.2. Bias-corrected least squares dummy variable estimator

This estimator has the potential to be more efficient and consistent than the more common GMM estimators. It is well known that the least squares dummy variable (LSDV) estimator is inconsistent for dynamic panel data with relatively large $N$ and finite $T$ (Nickell, 1981). With highly persistent data, first differenced GMM estimators may suffer from small sample bias due to weak instruments, especially with small $N$ (Blundell & Bond, 1998). It is possible to approximate the small sample bias of the LSDV estimator when $N$ is relatively small (Bun & Kiviet, 2003; Kiviet, 1995). If $N$ is relatively small, we would expect, *a priori*, for the LSDVC estimator to perform as well as the system GMM estimator with respect to mean absolute bias and root mean squared error (Buddelmeyer, Jensen, Oguzoglu, & Webster, 2008). Under the assumptions of strict exogeneity and small $N$, the Bias-Corrected Least Squares Dummy Variable (LSDVC) estimator obtains a bias approximation and corrects the estimates so the estimates are consistent and efficient relative to the Instrumental Variables (IV) and GMM estimators (Bruno, 2005a,b).

As with the system GMM estimator, researchers have several important choices with regards to the LSDVC estimator. Given that the number of countries in our sample is 67, we believe that $N$ is sufficiently small to warrant the use of the LSDVC estimator. We choose to initialize the LSDVC estimators with the Anderson-Hsiao IV estimates.[4] We also choose the most accurate approximation of the bias, $O\left(1/NT^2\right)$.[5] As the estimated asymptotic standard errors may have poor approximation in small samples, we tested the statistical significance of the LSDVC coefficients with bootstrapped standard errors (Bruno, 2005b).

## 5. Results

We find empirical evidence that natural resource rents negatively and significantly affect expenditure decentralization. This result is robust in the static estimators but fragile to the choice of estimator in the dynamic estimations. The results suggest that, for the sample countries and time periods, that increases in natural resource endowments and associated rents lead to decreases in the decentralization of government expenditures.

We first examine the static bivariate relationship between natural resource rents as a percentage of GDP and expenditure decentralization (Table 6). We note, with one exception (Model 12), that the estimated coefficient for natural resource rents is negative and statistically significant at the 10% level. An increase in rents of 1% results in an approximate 0.1% decline in expenditure decentralization. We argue that these results are strongly suggestive of a relationship between natural resources and expenditure decentralization.

Turning to the full static estimations, we find evidence that natural resource rents negatively and significantly affect expenditure decentralization (Table 7). As with the bivariate estimations, a 1% increase in natural resource rents is associated with a 0.1% decrease in expenditure decentralization. This result is robust to different specifications of the system GMM estimator, to include changes in lag length, one-step or two-step estimates, and corrections to the standard errors.[6] The static results are indicative of a relationship between natural resource rents and expenditure decentralization.

These reported estimates, however, are based on static estimators. It is possible that previous changes in expenditure decentralization affect current changes in expenditure decentralization. Table 8 provides evidence to support our argument. The estimated coefficient for the lagged first difference of expenditure decentralization is positive and statistically significant across specifications of the LSDVC estimator though it is statistically insignificant in the system-GMM models.

In the dynamic LSDVC models, using different sets of control variables, we find that natural resources rents consistently significantly and negatively impact decentralization. However, the estimated coefficient for natural resources appears to be fragile to the set of control variables (which in turn influences the available sample) in the system GMM estimator, possibly due to the previously discussed finite sample bias. In the dynamic specifications, we find that a 1% change in natural resource rents results in an approximate 0.1% to 0.2% change in expenditure decentralization. We do note that the estimated coefficient for natural resource rents appears to be fragile to the choice of governance indicator.

Next, we examine whether our results are fragile to the choice of measure of natural resource endowments. We utilize the WDI's measures of ores, metals, and fuel exports as a percentage of total merchandise exports to test the robustness of our previous conclusions. Given the potential finite sample bias of the system GMM estimator, here we rely solely on the LSDVC estimator. We first examine whether there is evidence of a bivariate relationship using dynamic models. We find evidence to suggest that a 1% change in the natural resource exports as a percentage of total merchandise exports results in an approximate 0.1% to 0.2% decrease in expenditure decentralization (Table 9). Turning to the full specifications, we find a similar result (Table 10), leading us to conclude that our results are robust to changes in the measure of natural resource endowments.

Finally, unlike much of the previous literature on the determinants of decentralization, we employ analysis in first differences and examine dynamic models. In so doing, we find some evidence that changes in the common control variables influence decentralization. Only gross capital formation is consistently significant and positive. It is significant and positive at the 5% level in one of the two static system-GMM models that include it (Table 7). Turning to dynamic models (Table 8), in the three LSDVC models, gross capital formation is significant at least the 5% level, and in the system GMM models it is significant at the 1% level in one model, the 10% level in another, and insignificant in a third. Population is insignificant across specifications, and urban population is significant at the 5% level in one system GMM specification. Similarly, GDP per capita is statistically significant and positive in one static system GMM model (5% level), one dynamic System GMM model (10% level). GDP per capita is statistically significant and positive in four out of the five models (two at the 5% level and two at the 1% level) with

[4] We also examined whether initializing with the Arellano-Bond or Blundell-Bond estimates would alter our estimates. There was not a significant change. These estimates are available upon request.

[5] We examined whether less accurate approximations of the bias, to include O(1/T) and O(1/NT) altered the significance of the estimated coefficient for natural resources. While, as one might expect, the estimated coefficient changed slightly in response to the bias approximation, the sign and significance of the estimated coefficients for natural resources did not change. These estimates are available upon request.

[6] Additional estimates are available upon request.

**Table 6**
Expenditure Decentralization on Natural Resource Rents in First Differences.

| | (8) OLS | (9) Fixed Effects | (10) System GMM | (11) System GMM | (12) System GMM | (13) System GMM |
|---|---|---|---|---|---|---|
| Natural Resource Rents as % of GDP | −0.107* (0.044) | −0.116+ (0.063) | −0.112+ (0.065) | −0.129+ (0.069) | −0.090 (0.078) | −0.140+ (0.069) |
| Observations | 996 | 996 | 996 | 996 | 996 | 996 |
| Adjusted $R^2$ | 0.019 | 0.025 | – | – | – | – |
| *M1* | −0.737 | 0.000 | −3.704** | −3.692** | −3.587** | −3.583** |
| *M2* | 0.718 | – | 1.265 | 1.233 | 1.225 | 1.107 |
| *Lag Limits* | – | – | All | 3 | 3 | 3 |
| *Number of Instruments* | – | – | 317 | 127 | 48 | 49 |
| *Collapsed* | – | – | No | No | Yes | Yes |
| *One step or Two* | – | – | Two | Two | Two | Two |
| *Orthogonal* | – | – | No | No | No | Yes |
| *Hansen Test* | – | – | 46.492 | 44.942 | 18.594 | 29.465 |
| *Diff. in Hansen test* | – | – | −1.893 | 4.140 | 0.000 | 1.963 |

**Table 7**
Expenditure Decentralization on Natural Resource Rents in First Differences.

| | (14) OLS | (15) Fixed Effects | (16) System GMM | (17) System GMM | (18) System GMM | (19) System GMM | (20) System GMM |
|---|---|---|---|---|---|---|---|
| Natural Resource Rents | −0.119* (0.050) | −0.122+ (0.070) | −0.161+ (0.090) | −0.164* (0.077) | −0.108+ (0.055) | −0.090+ (0.053) | −0.119* (0.048) |
| Log of Total Population | 0.142 (0.101) | −0.012 (0.464) | 0.106 (0.128) | 0.123 (0.117) | 0.110 (0.088) | 0.088 (0.088) | 0.296 (0.514) |
| Urban Population | −0.214 (0.298) | −0.318 (0.519) | −0.256 (0.234) | −0.235 (0.251) | −0.451* (0.218) | −0.399 (0.308) | 0.178 (1.155) |
| Log of GDP per capita | 0.007 (0.005) | 0.010 (0.006) | 0.007 (0.005) | 0.0074 (0.005) | 0.007 (0.007) | 0.006 (0.007) | 0.033* (0.012) |
| OECD Dummy | 0.007 (0.005) | – | 0.00005 (0.0015) | 0.001 (0.002) | −0.0002 (0.0015) | −0.00002 (0.0016) | 0.003 (0.007) |
| Openness to Trade | – | – | – | 0.004 (0.014) | 0.002 (0.013) | −0.009 (0.017) | −0.029 (0.020) |
| POLITY | – | – | – | – | −0.007 (0.012) | −0.010 (0.009) | −0.004 (0.012) |
| Gross Capital Formation | – | – | – | – | – | 0.103* (0.044) | 0.050 (0.035) |
| Ethnic Polarization | – | – | – | – | – | – | 0.0004 (0.005) |
| Constant | 0.002 (0.004) | 0.002 (0.003) | 0.0002 (15.36) | 0.004 (19.38) | 0.001 (0.006) | −0.002 (0.007) | −0.010 (0.012) |
| Observations | 890 | 890 | 890 | 890 | 863 | 863 | 654 |
| *M1* | 0.294 | 0.001 | −3.384** | −3.394** | −4.218** | −4.188** | −3.544** |
| *M2* | 0.559 | – | 0.594 | 0.590 | −0.738 | −0.808 | 0.100 |
| *Number of Instruments* | – | – | 55.000 | 59.000 | 63.000 | 67.000 | 69.000 |
| *Hansen Test* | – | – | 34.010 | 35.431 | 29.872 | 26.707 | 9.330 |
| *Difference in Hansen* | – | – | 5.411+ | 6.378+ | −0.543 | −5.204 | −1.504 |

*Notes*: All system GMM estimators have collapsed instruments, orthogonal instruments, and use the two-step estimator for the standard errors.

trade in resources instead of resource rents. Openness to trade is negative and significant in only one model. While the POLITY measure of governance is not statistically significant, we find evidence to suggest that a measure of regional autonomy is significant in the LSDVC estimations. This result suggests that regional autonomy, not the overall level of democratization, may play a greater role in the determination of expenditure decentralization.

One possibility for the fragility of the control variables is that the previously determined statistical significance is appropriate in levels and not appropriate in first differences.[7] Another possibility is that our results with system GMM estimator suffer from small sample bias and that the LSDVC estimator is most appropriate. GDP per capita, for example, is statistically significant in all but one of the LSDVC estimations, echoing previous findings that the level of development influences expenditure decentralization. Given that we have found that changes in natural resource rents influence changes in expenditure decentralization across different estimators, we have a high level of confidence in this result. We argue that these results offer strong support for the proposition that natural resource endowments reduce expenditure decentralization in the sample countries.

[7] We also explored whether corruption and inequality influenced expenditure decentralization. Inequality not reduced the sample by approximately half and did not yield significant results. We also examined whether the ICRG's measure of corruption would alter our results. While the sample size fell by approximately 200 observations, the statistical significance of natural resource rents increased and GDP per capita was also significant using the LSDVC estimator. These estimates are available upon request.

**Table 8**
Expenditure Decentralization and Natural Resources in First Differences Dynamic Estimation.

| | (21) System GMM | (22) LSDVC | (23) System GMM | (24) LSDVC | (25) System GMM | (26) LSDVC | (27) System GMM | (28) LSDVC |
|---|---|---|---|---|---|---|---|---|
| Expenditure | −0.038 | 0.178** | −0.017 | 0.273** | −0.026 | 0.316** | 0.045 | 0.396** |
| Decentralization$_{t-1}$ | (0.045) | (0.0530) | (0.050) | (0.055) | (0.055) | (0.104) | (0.045) | (0.065) |
| Natural Resource | −0.121+ | −0.0968** | −0.176 | −0.096** | −0.177+ | −0.235** | −0.070 | −0.018 |
| Rents | (0.072) | (0.0340) | (0.110) | (0.029) | (0.097) | (0.0575) | (0.058) | (0.024) |
| Log of Population | | | 0.720 | 0.132 | 0.262 | −0.250 | 0.060 | 0.210 |
| | | | (0.620) | (0.352) | (0.280) | (0.381) | (0.133) | (0.358) |
| Urban Population | | | −1.385 | −0.429 | −0.230 | 0.122 | −0.246 | −0.543 |
| | | | (1.453) | (0.627) | (0.690) | (1.129) | (0.317) | (0.689) |
| Log GDP Per Capita | | | 0.014 | 0.005 | 0.002 | 0.006 | 0.004+ | 0.005 |
| | | | (0.022) | (0.007) | (0.004) | (0.005) | (0.002) | (0.004) |
| Openness to Trade | | | 0.039 | 0.004 | −0.026* | −0.009 | 0.001 | −0.001 |
| | | | (0.108) | (0.015) | (0.010) | (0.016) | (0.011) | (0.010) |
| Gross Capital | | | −0.004 | 0.001** | 0.002** | 0.001** | 0.001+ | 0.001* |
| Formation | | | (0.003) | (0.0002) | (0.001) | (0.0002) | (0.000) | (0.0004) |
| Regional | | | | | 0.003 | 0.003** | | |
| Autonomy Index | | | | | (0.002) | (0.001) | | |
| POLITY | | | | | | | 0.004 | 0.021 |
| | | | | | | | (0.013) | (0.018) |
| Observations | 921 | 921 | 822 | 822 | 819 | 647 | 795 | 795 |

*Notes*: All system GMM estimators have three lags, collapsed instruments, orthogonal instruments, and use the two-step estimator for the standard errors. Standard errors in parentheses.
+ $p < 0.10$.
* $p < 0.05$.
** $p < 0.01$.

**Table 9**
Expenditure Decentralization and Natural Resources Exports First Differences.

| | OLS | IV | System GMM | LSDVC |
|---|---|---|---|---|
| Expenditure | −0.031 | 0.792 | −0.007 | 0.199** |
| Decentralization$_{t-1}$ | (0.044) | (0.532) | (0.046) | (0.040) |
| Natural | −0.079** | −0.105** | −0.082** | −0.100** |
| Resource | (0.023) | (0.036) | (0.026) | (0.027) |
| Exports | | | | |
| Constant | −0.002** | −0.0001 | −0.007 | |
| | (0.0001) | (0.002) | (0.004) | |
| Observations | 888 | 888 | 888 | 888 |
| Adjusted $R^2$ | 0.022 | −0.653 | | |

*Notes*: See Table 8.

**Table 10**
Expenditure Decentralization and Natural Resources Exports in First Differences Bias-Corrected Least Squares Dummy Variable Estimator.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Expenditure | 0.199** | 0.283** | 0.280** | 0.270** | 0.346** | 0.392** |
| Decentralization$_{t-1}$ | (0.0399) | (0.0571) | (0.0560) | (0.0563) | (0.0783) | (0.109) |
| Natural | −0.0996** | −0.102** | −0.101** | −0.0950** | −0.0864* | −0.0709** |
| Resource | (0.0266) | (0.0276) | (0.0272) | (0.0279) | (0.0419) | (0.0219) |
| Exports | | | | | | |
| Log of | | 0.1000 | 0.0873 | 0.125 | −0.152 | 0.164 |
| Population | | (0.372) | (0.370) | (0.360) | (0.596) | (0.430) |
| Urban | | −0.630 | −0.652 | −0.707 | 0.0598 | −0.719 |
| Population | | (0.545) | (0.532) | (0.772) | (0.926) | (1.134) |
| Log GDP Per | | 0.0123* | 0.0127* | 0.0101 | 0.0155** | 0.0123** |
| Capita | | (0.00606) | (0.00587) | (0.00721) | (0.00558) | (0.00450) |
| Openness to | | | −0.00172 | −0.00128 | −0.0161+ | −0.00327 |
| Trade | | | (0.0113) | (0.0156) | (0.00957) | (0.0196) |
| Gross Capital | | | | 0.000730** | 0.000999** | 0.000661* |
| Formation | | | | (0.00025) | (0.000231) | (0.000303) |
| Regional | | | | | 0.00299** | |
| Autonomy | | | | | (0.000784) | |
| Index | | | | | | |
| POLITY | | | | | | 0.0146 |
| | | | | | | (0.0193) |
| Observations | 888 | 798 | 798 | 795 | 637 | 771 |

Standard errors in parentheses.
+ $p < 0.10$.
* $p < 0.05$.
** $p < 0.01$.

## 6. Conclusions

This paper set out to suggest a test of whether natural resource rents is a determinant of expenditure decentralization. Much of the literature suggests that an increase in rents is negatively associated with revenue decentralization, however, there is a paucity of cross-country evidence of the influence of natural resource rents on expenditure decentralization. If revenues do stick where they land, then one might reasonably expenditure that expenditure assignments and levels would change a result.

We set ourselves the difficult task of determining whether changes in resource dependence induce changes in expenditure decentralization, a somewhat higher hurdle than previous studies that examine whether levels of resource dependence are associated with levels of fiscal decentralization. Using multiple estimators and specifications, our empirical analysis supports the contention that increases in resource rents reduce expenditure decentralization for the sample countries. These results echo early findings in the literature with regards to China, Peru, and Russia (Freinkman & Plekhanov, 2009; Loayza, Rigolini, & Calvo-Gonzalez, 2014; Stefan, 2013; Wu & Wang, 2013).[8] Our results are robust to an alternative measure of resource dependence: resource exports.

This paper additionally presents a rigorous empirical examination of the dynamics of expenditure decentralization. We illustrate the persistence of expenditure decentralization and compare the results of static and dynamic models. While many cross-country determinants are well established in the literature (Arzaghi & Henderson, 2005; Canavire-Bacarreza et al., 2016), first differences some of these control variables do not appear to impact first differences in expenditure decentralization. Gross capital formation does appear to enhance expenditure decentralization consistently and positively. This echoes the fragility of many determinants of economic growth when investment is included in the growth equation (Levine & Renelt, 1992). To the extent that capital formation is a driver of economic development, our finding fits the general story that development enhances demand for decentralization which, in turn, leads to more responsive public goods provision.[9]

We also note that there are other potential drivers of expenditure decentralization. Our results suggest that if the natural resource rents increase by 1% from the previous period then, after accounting for the persistency of expenditure decentralization, expenditure decentralization decreases by approximately 0.1% from the previous period for the sample countries. Some may find this effect relatively small, however, it is robust and implies that other determinants may be in play. Other potential factors, including macroeconomic and demographic variables, may have a statistically larger impact on expenditure decentralization (Sacchi & Salotti, 2016). Our empirical approach, however, suggests that future studies need to account for the dynamic nature of decentralization. We also believe it would be appropriate to apply this approach to question of whether natural resource revenues are 'sticky' (Perez-Sebastian & Raveh, 2016a,b).

With respect to future research, we note that natural resource rents is an aggregate measure, combining rents from oil, natural gas, minerals, forests, and other resources. The type of natural resource may affect expenditure decentralization; a hypothesis that should be of interest to policymakers and practitioners alike (Alexeev & Conrad, 2009; Bauer et al., 2016). We also note that expenditure decentralization (or recentralization) is likely to affect the composition of public expenditures (Arze del Granado et al., 2016). Examining how governments change the composition of public expenditures in response to changes in natural resource rents should be of great interest to those designing and implementing decentralization reforms. Furthermore, we believe it would be fruitful to build upon the question of whether sectoral heterogeneity influences the finding (or lack of a finding) of a resource curse (James, 2015). Examining whether sectoral heterogeneity influences expenditure decentralization may provide insight into why decentralization moves forward in some countries and appears to stall in others.

Improved allocative efficiency, accountability in public goods distribution, enhanced economic growth, avoidance of civil war: these are elusive goals for resource rich countries. While increased decentralization may ameliorate, to some extent, these outcomes, it appears that natural resource abundance decreases expenditure decentralization. It appears that expenditure decentralization is more difficult in natural resource abundant countries and this presents an additional challenge to implementing decentralization reforms in these countries.

[8] An interesting line of research would be to examine whether decentralization affects different types of expenditure (operational and capital). While natural resource revenues appear to negative impact operational expenditure in Peru, these revenues appear to increase capital expenditure (Loayza et al., 2014)

[9] This is not a recent argument as a high rate of capital formation is required if output growth is to accelerate (Solow, 1962).

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