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The Impact of Resource Revenue on Non-Resource Tax Revenue in Oil-Exporting Countries: Evidence from Nonlinear Analysis

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ABSTRACT

The main objective of this study was to examine the asymmetric effect of resource tax revenues on non-resource ones in oil-rich countries, as most previous research on the subject has assumed a symmetric resource-non-resource tax revenue nexus. We employed linear ARDL model to analyze the short- and long-term effects and found a negative relationship between resource and non-resource tax revenues. Based on nonlinear ARDL model estimates, empirical results provide strong evidence for the asymmetric effect of resource tax revenues. In the long-run, positive shocks have negative impacts on non-resource tax revenues. Conversely, negative shocks were found to not lead to increased non-resource tax revenues. In addition, findings show that the short-term effects are stronger when resource tax revenues increase.

Keywords: Resource Tax Revenues, Non-Resource Tax Revenues, Oil-Exporting Countries, NARDL Model
JEL Classifications: E62, H20, Q43, C23

1. INTRODUCTION

According to the resource curse hypothesis, resource-rich economies should experience slower long-term economic growth than resource-poor ones (Sachs and Warner, 2001). The negative effect of higher rents on economic growth have been linked to a variety of transmission mechanisms (Alexeev and Conrad, 2005). One of them is the "fiscal resource curse", which states that resource tax revenues negatively affect non-resource ones (Collier and Hoeffler 2005; Collier, 2006). The hypothesis refers to a country's inability to raise revenues other than resource taxes.

However, the diversification of revenue sources remains a dauting challenge for resource-rich countries. The importance of domestic tax mobilization stems from the fact that the unpredictable nature of resource tax revenues induces countries to count on non-resource ones (Knebelmann, 2017). Furthermore, the Prebisch-Singer hypothesis posits that, in contrast to manufactured goods, the terms of trade for primary commodities deteriorate over time. More so, revenues collected are less than potential total revenues, which is exacerbated by inefficiencies in the resource taxation system. Finally, a lower domestic tax regime reduces the incentive for the public to scrutinize the government, which may cause governance issues (Collier and Hoeffler 2005; Collier, 2006). In this regard, policymakers should identify any opportunities and specific conditions to increase domestic tax revenue.

According to a large number of empirical studies, increases in resource tax revenues are countered by decreases in non-resource revenues (Abdelwahed, 2020). Some studies—such as Bornhorst et al. (2009), Ossowski and Gonzales (2012), Thomas and Treviño (2013), Crivelli and Gupta (2014), and Knebelmann (2017)—have highlighted the existence of a substitution effect—i.e. an eviction effect—between resource tax revenues and non-resource tax revenues. However, there are also arguments asserting that resource tax revenues could increase non-resource tax revenues, thereby avoiding any crowding-out effects. First, governments invest resource tax revenues directly into their fiscal administration to increase non-resource ones (Besley and McLaren, 1993; Besley and Persson, 2009, 2013). Second, when resource tax revenues increase, governments may decide to reduce their fiscal reliance on natural resources and seek to strengthen the non-resource taxation system. Third, the direct and indirect connections that exist between the resource sector and the rest of the economy support the development of the non-resource sector and broaden its tax base (Knebelmann, 2017).

The possibility that resource tax revenues could have an asymmetric impact on its non-resource counterpart has been the object of little attention although this is more likely to hold in the real world. To date, most of the literature has focused on increases in resource tax revenues and has typically found a negative relationship between resource tax revenues and non-resource ones, ignoring the possibility of asymmetric relationships (Bornhorst et al., 2009; Crivelli and Gupta, 2014; Ossowski and Gonzales, 2012; Thomas and Treviño, 2013). Additionally, recent research has suggested that macroeconomic variables exhibit nonlinear and asymmetric relationships, and the findings indicate that ignoring such asymmetry can produce misleading outcomes (Abubakar et al., 2023). Therefore, the conventional wisdom that increases (decreases) in resource tax revenues weaken (improve) non-resource ones can be challenged. Particularly, declining resource tax revenues may not lead to higher non-resource tax revenues. This may be conditional on the state's capacity for taxation and on its willingness to reform the tax system (Ishak and Farzanegan, 2020). Furthermore, the degree to which non-resource tax revenues respond to increases in resource revenues may differ from that to which they respond to decreases.

In this study, we attempted to address this gap in the literature by providing empirical evidence of the asymmetric aspect of the "fiscal resource curse hypothesis". In doing so, we added a critical dimension to the resource curse literature; our main contribution pertains to identifying the asymmetric effects changes in resource tax revenues have on non-resource revenues. To the best of our knowledge, such resource revenue shocks had not previously been examined in relation to their asymmetric effects.

Our study extends prior ones in several aspects. First, few studies have hitherto distinguished between resource revenue shocks (i.e., positive and negative changes), thereby implicitly assuming that resource tax revenues affect non-resource tax ones symmetrically. Second, our study is timely and crucial for oil-exporting countries, which, since the 2014 oil price crash, have faced serious fiscal challenges and concerns in regard to their capacity to strike a fiscal balance through the mobilization of new tax revenues. Despite the efforts made by several countries to implement tax reforms, not all of them have been successful in increasing their tax mobilization capacity. In this context, our findings advance our understanding of the relationship between resource tax revenues and non-resource ones. Third, we drew our data from the Government Revenue Dataset (GRD) newly published by the International Conference on Taxation and Development (ICTD). The main advantage of this database is that it distinguishes between the revenues drawn from resource- and non-resource-related sectors. Finally, we focused on non-resource tax revenues to shed light on the fiscal efforts enacted in resource-rich economies. Finally, we employed a panel nonlinear ARDL model. For the purposes of our study, we used the nonlinear autoregressive distributed lag (NARDL) model developed by Shinet al. (2014). Such model was suited to our analysis as it enables the decomposition of resource revenue changes into positive and negative ones, which provided us with insights into how resource tax revenues asymmetrically affect the non-resource ones of oil-rich economies.

2. LITERATURE REVIEW

The effects of an abundance of natural resource on the economy have been an active area of research for many years.

Active research has long been conducted on how an abundance of natural resources affects a country's economy. Most extant studies have focused on long-term growth effects and the empirical evidence on this topic is controversial. While some studies have considered natural resources as a blessing (Alexeev and Conrad, 2005; Brunnschweiler and Bulte, 2008; Lederman and Maloney, 2006; Sala-I-Martin et al., 2004), others have deemed them a curse (Gylfason et al., 1999; Leite and Weidmann, 1999; Sachs and Warner, 2001; Sala-I-Martin and Subramanian, 2003), and others still have pointed out that the results depend on a number of variables (Collier and Goderis, 2012; Mehlum et al., 2006).

Various theoretical explanations have been proposed for these mixed findings. Such arguments can be divided into economic and political (Badeeb et al., 2017), The "Dutch disease" phenomenon (Sachs and Warner, 2001), the volatility view (Davis and Tilton, 2005; Deaton, 1999; van der Ploeg and Poelhekke, 2009; Venables, 2016), lower education levels (Gylfason, 2001; Gylfason and Zoega, 2006), and the "fiscal resource curse" hypothesis (Chachu and Nketiah-Amponsah, 2022) are the main economic explanations, whereas the principal political ones are related to rent seeking behaviors (Gylfason, 2001; Hodler, 2006; Iimi, 2007), and weak institutions (Tornell and Lane, 1999).

It is important to note that the "fiscal resource curse" hypothesis has hitherto not received much attention in the literature. According to this hypothesis, one effect of resource abundance is the potential crowding-out of non-resource revenues. The recent development literature claims that resource-rich countries struggle to raise taxes from a broad base, especially outside of the resource sector (Masi et al., 2018; Jensen, 2011). In theory, governments would use any additional revenue to increase public spending or lower non-resource taxes (James, 2015).

There are several mechanisms through which an abundance of natural resources could adversely impact domestic tax revenue mobilization. First, the management of fiscal and macroeconomic policy may be hindered by the volatility of resource tax revenues (Arezki and Nabli, 2012). Second, the "Dutch Disease" lessens the opportunities for tax revenue mobilization. Natural resources are often associated with exchange rate appreciations, which impede economic diversification, and narrowing tax bases (van der Ploeg and Poelhekke, 2009). Third, rent-seeking behaviors weaken institutions in general—and, by extension, those in charge of raising domestic tax revenues—and precipitate bad tax policy choices (Mehlum et al., 2006). Fourth, resource windfalls crowd out income-generating activities like entrepreneurship and investments, resulting in a tax base reduction (Papyrakis and Gerlagh, 2006; Torvik, 2002). Fifth, an abundance of natural resources may lead to conflict, which lowers investor and business confidence as well as the security of capital, resulting in a narrower tax base (Collier and Hoeffler, 2005). Finally, as the resource sector has fewer stakeholders, revenue mobilization is straightforward (Lei and Michaels, 2014).

Alternatively, resource tax revenues can boost non-resource ones via a number of channels. The direct and indirect links between the resource sector and the rest of the economy lead to growth in non-resource sector activities and widen the non-resource tax base (Knebelmann, 2017). Furthermore, in order to increase tax revenues, governments will direct revenue into the tax administration (Besley and McLaren, 1993; Besley and Persson, 2009). Moreover, commodity price volatility may serve as a source of motivation for governments to strengthen their domestic revenue systems (Abdelwahed, 2020).

The empirical evidence has hitherto not yielded any agreement on the relationship between resource and non-resource tax revenues, although empirical studies have found that increases in resource tax revenues are offset by decreases in non-resource ones (Abdelwahed, 2020). Bornhorst et al. (2009) used fixed-effects and generalized method of moments estimators to examine the relationship between hydrocarbon tax revenues and non-hydrocarbon ones for 30 oil-producing countries from 1992 to 2005. Their findings show that a 10% increase in hydrocarbon tax revenues displaces non-hydrocarbon ones by about 2%. Similar findings have been reported for Latin America and Sub-Saharan Africa by Ossowski and Gonzales (2012) and Thomas and Treviño (2013), respectively. More recently, Crivelli and Gupta (2014) obtained similar findings from a panel of 35 resource-rich countries. Specifically, they found that a 1% increase in resource tax revenues leads to a 0.3% decrease in tax efforts, which mainly occurs through a reduction in revenues from taxes on goods and services. Mawejje (2019) confirmed the existence of a negative relationship between resource tax revenues and non-resource ones for a panel of 31 Sub Saharan African countries. The displacement effect has also been confirmed by Chachu and Nketiah-Amponsah (2022). When hydrocarbon tax revenues increase by 1%, non-hydrocarbon ones are displaced by 0.2% to 0.3%.

In contrast, Ghura (1998), Keen and Mansour (2010) and Thies (2010) found positive correlations between resource tax revenues and non-resource ones. Moreover, Knebelmann (2017) and Abdelwahed (2020) did not find any evidence to confirm the hypothesis that a decline in non-resource tax revenues replaces oil ones.

The lack of consensus around the relationship between resource tax revenues and non-resource ones could be attributed to methodological issues, as most previous empirical studies have ignored any potential nonlinearity. Previous studies have solely focused on the effects of positive resource windfalls, assuming that resource tax revenue booms and busts have symmetrical impacts. At the same time, it is well established that fluctuations in commodity prices have an asymmetric impact on economic growth (Ben Slimane et al., 2021) and fiscal policy (Arezki and Ismail, 2013). In brief, there is a lack of research on the asymmetry found in the relationship between resource tax revenues and non-resource ones. More importantly, it is still unclear whether such asymmetry exists in the case of oil-exporting nations. There was therefore the need for an extensive investigation into the impact of resource tax revenues on non-resource ones using a nonlinear framework.

3. EMPIRICAL STRATEGY

In our study, we used annual data pertaining to 36 oil-exporting countries[1] over the 2000-2020 period. In our analysis, we made use of all the data in their natural logarithm form.

To consider the fiscal effort, we specifically focused on non-resource tax revenues. We sourced our data for resource and non-resource tax revenues from the Government Revenue Dataset (GRD) published by the International Center for Taxation and Development (ICTD) in October 2022. The GRD includes the most up-to-date and harmonized government revenue data, including both tax and non-tax revenues. Full details about data construction are provided by McNabb (2017).

In our analysis, we used additional control variables—including real GDP per capita, inflation, trade openness, corruption and agriculture value added—to overcome the issue of omitted variables bias. The source for these data was the World Bank's World Development Indicators database, except for those on corruption, which were drawn from the perception-based index found in the International Country Risk Guide (ICRG) dataset.

The descriptive statistics are presented in Table 1. The percentage of GDP devoted to resource taxes was found to vary from 0 to approximately 39%, with a country average of 7.9% and a standard deviation of about 7%. Non-resource taxes were found to range from 1.2% to about 31.5%, with a mean and standard deviation of about 7.9% and 7.3%, respectively.

The empirical model used to analyze the resource tax revenue-non-resource tax revenue nexus follows the empirical work of Bornhorst et al. (2009). We modelled non-resource taxes in relation to a percentage of GDP, $\left(\frac{NRT}{Y}\right)$, as a function of resource taxes as a percentage of GDP, $\left(\frac{RT}{Y}\right)$, and a series of control variables. The base model specification is given as:

$$\left(\frac{NRT}{Y}\right)_{it} = \alpha_i + \gamma_t + \beta_1 \left(\frac{RT}{Y}\right)_{it} + X_{it}^{'}\beta_2 + \varepsilon_{it} \quad (1)$$

1 List of countries: Algeria, Angola, Argentina, Azerbaijan, Bahrain, Brazil, Brunei, Cameroun, Canada, Chad, Colombia, Congo, Ecuador, Egypt, Equatorial Guinea, Gabon, Indonesia, Iran, Kazakhstan, Kuwait, Malaysia, Mexico, Nigeria, Norway, Qatar, Russia, Saudi Arabia, Sudan, Syria, Thailand, Trinidad & Tobago, UAE, USA, Venezuela, Vietnam, Yemen.

Table 1: Summary Statistics for Key Variables

Variables	Mean	Std. Dev.	Min	Max
Resource taxes (as percent of GDP)	11.4	6.9	0.0	39.2
Non-resource taxes (as percent of GDP)	7.9	7.3	1.2	31.5
GDP per capita	9.7	4.1	5.9	27.1
Trade openness (as percent of GDP)	70.7	40.4	12.1	220.4
Inflation	71.5	41.8	0.0	348.9
Corruption	531.2	1.12	0.0	6.0
Agriculture Value Added (as percent of GDP)	10.4	10.8	0.09	55.7

Source: Author's calculation

We allowed for country-fixed effects α_i and year-fixed effects γ_t. β_1 was the coefficient of interest, X'_{it} was the vector of control variables, and β_2 was the vector of associated parameters. We included the following control variables in the analysis to better predict tax revenue performance: real GDP per capita, trade openness, agriculture value added, inflation, and corruption.

Non-resource revenues have a greater probability to be attracted in high-income countries (Chachu and Nketiah-Amponsah, 2022). As most countries with abundant resources have not fully liberalized their trade sector, it can be a significant source of income, with its expansion being anticipated to boost non-resource tax revenues (Belinga et al., 2017). Furthermore, countries with high shares of agriculture commonly have a sizable informal sector, which reduces tax effort. Moreover, corruption could hamper tax effort.

Using the panel ARDL approach, we defined the symmetric cointegration relationship as follows:

$$\Delta\left(\frac{NRT}{Y}\right)_{i,t} = \sum_{j=1}^{p}\varnothing_{ij}\Delta\left(\frac{NRT}{Y}\right)_{i,t-j} + \sum_{j=0}^{q}\partial_{ij}\Delta\left(\frac{RT}{Y}\right)_{i,t-j} + \sum_{j=0}^{q}\theta_{ij}\Delta X_{i,t-j} + \alpha_i + \gamma_t + \varepsilon_{i,t} \quad (2)$$

The Error Correction representation was as follows:

$$\Delta\left(\frac{NRT}{Y}\right)_{i,t} = \varphi_i\sum_{j=1}^{p}\left(\left(\frac{NRT}{Y}\right)_{i,t-j} - \tau_i\left(\frac{RT}{Y}\right)_{i,t-j} - \vartheta_i X_{i,t-j}\right) + \sum_{j=1}^{p}\varnothing_{ij}\Delta\left(\frac{NRT}{Y}\right)_{i,t-j} + \sum_{j=0}^{q}\partial_{ij}\Delta\left(\frac{RT}{Y}\right)_{i,t-j} + \sum_{j=0}^{q}\theta_{ij}\Delta X_{i,t-j} + \mu_i + \gamma_t + \varepsilon_{i,t} \quad (3)$$

The φ_i parameter represents the error correction term. The asymmetric form of equation (1) is indicated beneath and the decomposition of resource tax revenues into positive and negative shocks follows Shin et al. (2014).

$$\Delta\left(\frac{NRT}{Y}\right)_{i,t} = \sum_{j=1}^{n}\lambda_{ij}\Delta\left(\frac{NRT}{Y}\right)_{i,t-j} + \sum_{j=0}^{m}(\delta_{ij}^{+}\Delta\left(\frac{RT}{Y}\right)_{it-j}^{+} + \delta_{ij}^{-}\Delta\left(\frac{RT}{Y}\right)_{it-j}^{-} + \sum_{j=0}^{m}\beta_{ij}\Delta X_{i,t-j} + \mu_i + \gamma_t + \varepsilon_{i,t} \quad (4)$$

Where λ_{ij} is the autoregressive parameter and δ_{ij}^{+} and δ_{ij}^{-} are the asymmetric distributed-lag parameters.

In equation (4), we decomposed non-resource tax revenues into (RT_t^{+}, RT_t^{-}), signifying positive and negative changes in resource taxes.

$$\left(\frac{RT}{Y}\right)^{+} = \sum_{j=1}^{t}\Delta\left(\frac{RT}{Y}\right)_{j}^{+} = \sum_{j=1}^{t}\max(\Delta\left(\frac{RT}{Y}\right)_{j}^{+},0) \quad (5)$$

$$\left(\frac{RT}{Y}\right)^{-} = \sum_{j=1}^{t}\Delta\left(\frac{RT}{Y}\right)_{j}^{-} = \sum_{j=1}^{t}\min(\Delta\left(\frac{RT}{Y}\right)_{j}^{-},0) \quad (6)$$

The error correction form of the NARDL panel can be specified as:

$$\Delta\left(\frac{NRT}{Y}\right)_{i,t} = \omega_i\sum_{j=1}^{n-1}\left(\begin{array}{l}\left(\frac{NRT}{Y}\right)_{i,t-j} - \rho_j^{+}\left(\frac{RT}{Y}\right)_{it-j}^{+} \\ +\rho_j^{-}\left(\frac{RT}{Y}\right)_{it-j}^{-} - \sigma_i X_{i,t-j}\end{array}\right) + \sum_{j=1}^{n-1}\gamma_{ij}\Delta\left(\frac{NRT}{Y}\right)_{i,t-j} + \sum_{j=0}^{m-1}(\alpha_{ij}^{+}\Delta\left(\frac{RT}{Y}\right)_{it-j}^{+} + \alpha_{ij}^{-}\left(\frac{\Delta RT}{Y}\right)_{it-j}^{-}) + \sum_{j=0}^{m-1}\vartheta_{ij}\Delta X_{i,t-j} + \mu_i + \gamma_t + \varepsilon_{i,t} \quad (7)$$

Where $\rho^{+} = -\frac{\delta^{+}}{\omega}, \rho^{-} = -\frac{\delta^{-}}{\omega}\ and\ \sigma = -\frac{\beta}{\omega}$.

The short-term adjustments to the positive and negative resource tax revenues changes are captured by and α_{ij}^{+} and α_{ij}^{-}, respectively.

Mean Group (MG), Pooled Mean Group (PMG), and Dynamic Fixed Effect (DFE) were the main estimators used in our study. The MG estimator allowed for the heterogeneity of all coefficients, intercepts, and slopes. Second, the PMG one imposed homogeneity in the long-term coefficients. Third, the DFE estimator allowed for different intercepts across countries.

4. EMPIRICAL RESULTS AND DISCUSSION

4.1. Preliminary Data Analysis

The first step, before performing the main estimations, involved performing panel unit root tests to check whether the variables were non-stationary. To overcome the problem of cross-sectional dependence, we performed second generation panel unit root tests, including the Levin et al. (2002) test and the PCADF test developed by Pesaran (2007). All these tests assume cross-sectional dependence and hypothesize non-stationarity. The results, presented in Table 1, show that resource taxes, non-resource taxes, and GDP per capita were found to be I (1). However, trade openness, inflation, corruption, and agriculture value added were found to be I (0).

We also performed the cross-sectional (CD) test developed by Pesaran (2021) to check for the existence of cross-sectional dependency. Such dependency is frequently caused by the presence of common shocks (e.g. the global financial crisis, oil shocks). The findings, as reported in Table 2, show that the null hypothesis of cross-section independence was found to be rejected at the 1% level of significance for all variables.

Based on the results of preliminary non-stationarity tests, we found that a cointegration test would be required to determine the possibility of a long-term relationship. We performed a second generation cointegration test, as developed by Westerlund (2007). The results, as presented in Table 4, were found to show a high probability of no rejection of the null hypothesis, giving evidence of no-cointegration. According to Asteriou et al. (2021), the panel ARDL method can account for long- and short-term relationships, even when the variables are non-stationary and there is no cointegration.

4.2. Empirical Results

We estimated the linear model to examine the effects of changes in resource tax revenues on non-resource ones. Table 5 reports estimates for all the three methods we used in our study (MG, PMG, and DFE).

We performed a Hausman test to assess the efficiency and consistency of the aforementioned estimators. The null hypothesis tested the efficiency of the PMG estimator over the MG and DFE ones. The Hausman test result was found to not reject the null hypothesis, indicating that PMG was the best estimator.

According to the long-term estimates, the error correction coefficient had a significant negative sign, which implied that this model converged to a long-term equilibrium relationship. All specifications were found to show a negative offset in non-resource tax revenues for a 1% increase in resource tax revenues. According to the PMG estimator, an 1% increase in resource tax revenues will reduce non-resource ones by about 0.18%. However, the magnitude of this offset was found to decrease in regard to the DFE estimator. As shown in Column 3, a 1% increase in resource tax revenues was found to crowd out non-resource ones by about 0.34%. The effects estimated in all specifications were however found to be consistent with those of Bornhorst et al. (2009) and Crivelli and Gupta (2014).

The domestic revenue displacement found in resource-rich countries can be explained in various ways. First, oil-exporting countries have dual fiscal systems that feature substantial distortions between their resource and non-resource tax regimes. As a result, the revenue performance of the two may differ significantly. In general, policymakers are more involved in developing the resource sector because an appropriate fiscal regime has been already established, and thus pay less attention to the non-resource one (Venables, 2016). The second argument concerns the tax capacity effect. According to Besley and Persson (2009), in countries lacking human resources, any expansion of the resource sector draws talent away from the non-resource one. As a result, the latter's human resource base is severely constrained and diminished. The third explanation is linked to the emergence of new resource policies during boom periods (Chaudhry, 1997).

We then looked at the other determinants of tax performance and found the coefficients to have the expected sign. The impact of agriculture value added was found to be negative and significant. This may in part be due to the agricultural sector's highly informal and subsistence nature. Non-resource tax revenues were found to be positively correlated with GDP per capita. Trade openness was also found to have a statistically significant positive effect on non-resource tax revenues. Corruption was found to be negatively—albeit statistically non-significantly—related to non-resource tax revenue efforts.

We now refer to our findings pertaining to the short-term estimation. The coefficient of contemporaneous change in resource taxes was found to be significantly negative. Increases in resource tax revenues were thus found to have a negative impact on non-resource ones, implying that the long-term effects of resource tax increases are the result of a combination of negative short-term effects.

Previous findings indicate that a cointegration relationship cannot be established. This result could be explained by the symmetric effect assumption (Farzanegan and Markwardt, 2009). As such, modeling the relationship between resource and non-resource tax revenues in a nonlinear framework could be appropriate. Furthermore, the ARDL model explicitly assumes that the relationship between resource and non-resource tax revenues

Table 2: Results of panel unit root tests

Variables	LLC test		PCADF test	
	Level	First difference	Level	First difference
Resource taxes (as percent of GDP)	−0.330 (0.370)	−6.831*** (0.000)	−1.203 (0.1143)	−7.827*** (0.000)
Nonresource taxes (as percent of GDP)	0.739 (0.770)	−1.637* (0.050)	−0.760 (0.223)	−5.856*** (0.000)
Log (GDP per capita)	−0.418 (0.337)	−7.361*** (0.000)	−0.017 (0.493)	−6.836*** (0.000)
Openness (as percent of GDP)	−3.061*** (0.001)		−6.759*** (0.000)	
Corruption	−4.219*** (0.000)		−5.280** (0.007)	
Agriculture (as percent of GDP)	−2.515** (0.005)		−4.219*** (0.000)	

***, **, *The statistically significant at 1%, 5%, and 10% confidence level, respectively. p- values are in parentheses. The test has the null hypothesis of presence of a unit root. Optimal lags are introduced to allow for serial correlation in the errors is linear and symmetric. This assumption, however, contradicts that of our study, which is that an asymmetric relationship exists between such variables.

To achieve our study's objective, we used the non-linear ARDL (NARDL) model, which is an asymmetric extension of the ARDL one. The NARDL model assesses the asymmetric effect by decomposing resource tax revenues into partial sums of positive and negative shocks. Table 6 presents the results of the estimated NARDL model.

Akin to the ARDL model, the presence of a long-term nonlinear cointegration relationship must be considered. The results of the panel cointegration test developed by Westerlund (2007) suggest that a cointegration relationship exists in the long-run using the NARDL model (Table 3). Moreover, the results of the Hausman test were found to not reject the null hypothesis, suggesting PMG as the most effective estimator.

We performed Wald tests of short- and long-term symmetry to determine whether resource tax revenues are indeed asymmetric (Shin et al., 2014). Through this test, we checked the null hypothesis of symmetry against its asymmetry alternative. The results were found to demonstrate that, both in the short- (W_{SR}) and the long-run (W_{LR}), resource tax revenues are statistically significant at the 5% level. This confirmed that resource tax revenues have an asymmetric effect. The results are aligned with those of Ben Slimane et al. (2021), who provided evidence that the growth effect of commodity prices can be adequately modeled using an asymmetric framework.

From the estimated long-term model, positive and negative shocks were found to carry significant coefficients. Positive shocks were found to have negative and significant impacts on non-resource tax revenues. This demonstrates that a 1% increase in resource tax revenues is mitigated negatively by non-resource ones. These estimated effects are largely consistent with those found by Bornhorst et al. (2009), Ossowski and Gonzales (2012), Thomas and Treviño (2013), Crivelli and Gupta (2014), and Knebelmann (2017).

Interestingly, negative shocks were found to have positive and significant effects. This finding implies that a decrease in resource tax revenues cannot cause an increase in non-resource tax revenues. This result provide evidence in support of the asymmetric effect of resource tax revenues. Positive shocks were found to have a significant effect, mirroring the findings of the ARDL model and indicating that increases in resource tax revenues are associated with decreases in non-resource ones. However, the finding whereby negative shocks have a positive effect of on non-resource tax revenues is contrary to conventional wisdom, whereby decreases in resource tax revenues entail increases in non-resource ones. This supports our hypothesis that decreases in resource tax

Table 3: Results of cross-sectional dependence test

Variables	Statistics	P
Resource taxes	23.94***	0.000
Nonresource taxes	16.67***	0.000
GDP per capita	28.54***	0.000
Trade openness	30.33***	0.000
Corruption	10.37***	0.000
Agriculture	8.86***	0.000

***The statistically significant at 1% confidence level. The null hypothesis indicates cross-sectional independence. The CD statistic follows N (0, 1) distributions

Table 4: Results of Westerlund (2007) Panel Cointegration Test

Variables	Linear model	Non-Linear model
	Statistic	Statistic
(Gt)	-0.074 (0.991)	-3.697*** (0.000)
(Ga)	0.106 (0.881)	-4.702*** (0.001)
(Pt)	0.017 (0.994)	-2.941*** (0.000)
(Pa)	0.007 (0.996)	-4.436*** (0.000)

***, **,* indicate the statistically significant at 1%, 5%, and 10% confidence level, respectively. P-values are in parentheses. H0: no cointegration; Gt and Ga test the cointegration for each country individually, Pt and Pa test the cointegration of the panel as whole.

Table 5: Panel autoregressive distributed lag estimation results

Variables	MG	PMG	DFE
Long-run estimates			
Resource taxes	−0.257 (0.426)	−0.186** (0.015)	−0. 344*** (0.000)
GDP per capita	0.021 (0.440)	0.010** (0.037)	0.015** (0.040)
Trade	−0.001 (0.658)	0.053*** (0.000)	0.006*** (0.000)
Corruption	0.026 (0.254)	−0.003*** (0.008)	−0.005 (0.809)
Agriculture	−0.005 (0.547)	−0.001*** (0.002)	−0.002* (0.054)
Short-run estimates			
Error correction term	−0.401*** (0.000)	−0.194*** (0.000)	−0.201*** (0.000)
Δ Nonresource taxes	−0.061 (0.428)	−0.021*** (0.001)	−0.032** (0.022)
Δ Resource taxes	−0.014 (0.313)	−0.020** (0.034)	−0.042* (0.068)
Δ GDP per capita	0.034 (0.229)	0.056** (0.038)	0.082* (0.060)
Δ Trade	−0.002 (0.095)	−0.035*** (0.004)	−0.001* (0.078)
Δ Corruption	−0.050 (0.317)	−0.004 (0.172)	−0.001 (0.952)
Δ Agriculture	−0.003 (0.109)	−0.001*** (0.009)	−0.046* (0.083)
Constant	0.044*** (0.000)	0.016*** (0.001)	0.023*** (0.000)
Time trend	0.055 (0.312)	0.048 (0.468)	0.007 (0.640)
Hausman test	1.09 (0.508)		

*, **, and ***Significance at 10%, 5% and 1%, respectively. PMG, MG, and DFE, all controlling for the country and time effects. Hausman test is indicating that PMG is consistent and efficient estimation than MG and DFE estimation. PMG: Pooled mean group, MG: Mean group, DFE: Dynamic fixed effect

Table 6: Panel nonlinear autoregressive distributed lag estimation results

Variables	MG	PMG	DFE
Long-run estimates			
Resource taxes increases	0.056 (0.194)	−0.044* (0.056)	−0.016* (0.069)
Resource taxes decreases	0.021 (0.349)	0.026** (0.030)	0.017** (0.048)
GDP per capita	0.092 (0.545)	0.060*** (0.002)	0.021** (0.018)
Trade	0.004 (0.317)	0.013** (0.025)	0.011* (0.001)
Corruption	0.020 (0.223)	0.029*** (0.000)	0.051*** (0.007)
Agriculture	−0.003	−0.005	−0.004**
Long-run symmetry			
Test W_{LR}	5.986		
P	0.019		
Short-run estimates			
Error correction term	−0.434*** (0.000)	−0.220*** (0.000)	−0.174*** (0.000)
Δ Nonresource taxes	0.068 (0.384)	0.053* (0.065)	0.019* (0.087)
Δ Resource taxes increases	−0.015 (0.240)	−0.002*** (0.010)	−0.001** (0.011)
Δ Resource taxes decreases	0.027 (0.279)	−0.082** (0.023)	−0.079** (0.028)
Δ GDP per capita	0.016 (0.887)	0.079* (0.062)	0.038*** (0.009)
Δ Trade	−0.006 (0.207)	−0.001*** (0.000)	−0.006*** (0.000)
Δ Inflation	0.002 (0.516)	0.004* (0.054)	0.002* (0.063)
Δ Corruption	0.002 (0.945)	0.014*** (0.002)	0.075** (0.031)
Δ Agriculture	0.004** (0.006)	−0.005*** (0.006)	−0.003** (0.045)
Short-run symmetry			
Test W_{SR}	4.176		
P	0.034		
Constant	0.047*** (0.000)	0.018*** (0.005)	0.020*** (0.000)
Trend	0.023 (0.196)	0.067 (0.384)	0.021 (0.421)
Hausman test	1.167 (0.763)		

*, **, and ***Significance at 10%, 5% and 1%, respectively. (PMG, M, and DF), all controlling for the country and time effects. Hausman test is indicating that PMG is consistent and efficient estimation than MG and DFE estimation. PMG: Pooled mean group, MG: Mean group, DFE: Dynamic fixed effect

revenues will not be followed by increases in non-resource ones. The latter could be conditional on the state's capacity for taxation and on its willingness to reform the tax system. These results are in agreement with those of Farzanegan and Markwardt (2009), who documented that negative oil price shocks have a positive but statistically insignificant impacts on non-resource tax revenues.

Our short-term estimates showed both coefficients to be significantly negative—albeit with different magnitudes—thus seemingly endorsing the short-term asymmetry assumption we were testing. The negative relationship in the estimation was found to be significant only in the PMG and DFE methods. We found the impact of positive shocks to be much stronger than that of negative ones. This result provides evidence for short-term asymmetry and indicates that decreases in resource tax revenues have limited improvement effects. We believe this result to be intuitive because the mobilization of domestic revenues necessitates the implementation of tax reforms over time.

Our empirical results highlight the importance of asymmetric resource tax revenue effects. We found strong evidence that increases and decreases in such revenues have significantly different effects.

5. CONCLUSION

The purpose of our study was to determine whether changes in resource tax revenues have an asymmetric effect on non-resource ones. Before estimating the NARDL model to the asymmetric effects, we used the ARDL model to examine the linear effects.

We drew our data—covering 36 oil-exporting countries for the 2000-2020 period—from a new dataset developed by the International Centre for Taxation and Development (ICTD). The novel aspect of our study lies in its re-examination of the "fiscal resource curse hypothesis, within the framework of oil-exporting countries. In doing so, it extended the extant research by considering the asymmetric effects of resource tax revenue fluctuations.

The linear ARDL model revealed the absence of a cointegration relationship, whereas the NARDL model indicated that resource tax revenue variations have long-term asymmetric effects. This supports the claim that the relationship between resource and non-resource tax revenues appeared asymmetric. In relation to our ARDL model estimates, we found a significant negative relationship between resource and non-resource tax revenues in both the short and long-run. This suggests that resource tax revenues have detrimental effects on non-resource ones. Hence, our findings support our "fiscal resource curse hypothesis".

Based on our NARDL model estimates, our empirical results provide strong evidence for the asymmetric effect of resource tax revenues. In the long-run, positive shocks have negative impacts on non-resource tax revenues, implying a displacement effect. Conversely, negative shocks were found to not lead to increased non-resource tax revenues, implying a reduction in tax performance due to limited state capacity for taxation and to state unwillingness to reform the tax system. Although both positive and negative shocks have negative significant effects, our findings show that the short-term effects are stronger when resource tax revenues increase.

The findings of our study have significant implications for the design of policies for revenue mobilization in countries with abundant resources. Those countries should invest part of their resource tax revenues into other forms of productive assets. Such a strategy should yield returns because it contributes to diversifying the economy and to expanding the non-resource tax base.

Moreover, tax performance improvements in oil-exporting countries are attributed to improved state capacity for taxation and willingness to implement tax reforms. Specifically, governments should pursue tax reforms, particularly during periods of decline in resource tax revenues.

Furthermore, shifts in government revenue toward more non-resource taxes can potentially have negative effects on the economy. Hence, the challenge for oil-exporting countries is to find the optimal tax revenue mix. Finally, when performing policy oriented economic analyses, policymakers should consider the asymmetric effects of resource tax revenue variations, as oil-exporting countries rely heavily on oil revenues and, as a result, are more vulnerable to oil price shocks.

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