# Impact of the volatility of resource revenue on non-resource revenue volatility

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**Abstract**

**Purpose** – This paper investigates the effect of the volatility of resource revenue on the volatility of non-resource revenue.

**Design/methodology/approach** – The empirical analysis has utilized an unbalanced panel data set comprising 54 countries over the period 1980–2015. The two-step system generalized methods of moments (GMM) is the main economic approach used to carry out the empirical analysis.

**Findings** – Results show that resource revenue volatility generates lower non-resource revenue volatility only when the share of resource revenue in total public revenue is lower than 18%. Otherwise, higher resource revenue volatility would result in a rise in non-resource revenue volatility.

**Research limitations/implications** – In light of the adverse effect of volatility of non-resource revenue on public spending, and hence on economic growth and development prospects, countries whose total public revenue is highly dependent on resource revenue should adopt appropriate policies to ensure the rise in non-resource revenue, as well as the stability of the latter.

**Practical implications** – Economic diversification in resource-rich countries (particularly in developing countries among them) could contribute to reducing the dependence of economies on natural resources, and hence the dependence of public revenue on resource revenue. Therefore, policies in favour of economic diversification would contribute to stabilizing non-resource revenue, which is essential for financing development needs.

**Originality/value** – To the best of our knowledge, this topic has not been addressed in the literature.

**Keywords** Resource revenue volatility, Non-resource revenue volatility, Dependence on resource revenue

**Paper type** Research paper

## 1. Introduction

In the macro-public finance literature, many studies have been devoted to the determinants of public revenue. However, it is only in recent years that the relationship between two major components of public revenue, namely, resource revenue and non-resource revenue, has attracted the attention of scholars, researchers and policymakers. Among the few existing studies that have looked at the effect of resource revenue on non-resource revenue are Bornhorst *et al.* (2009), Ossowski and Gonzáles (2012), Thomas and Treviño (2013), Crivelli and Gupta (2014), Brun *et al.* (2015), Omgba (2016) and Knebelmann (2017). Resource revenue is a natural resource-based revenue [1] and includes natural resource-based tax revenue and

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non-tax revenue. Non-resource revenue represents the difference between total public revenue and resource revenue. These studies tend to report the existence of a substitution effect, that is, an eviction effect between resource revenue and non-resource tax revenue (see Knebelmann, 2017 for a discussion on the consequences of this eviction effect). However, Knebelmann (2017) has shown that such an effect does not exist as far as the relationship between oil revenue and non-oil tax revenues is concerned.

The current analysis aims to complement the still nascent strand of the macro-public finance literature on the relationship between resource revenue and non-resource revenue, by examining the extent to which the volatility of resource revenue affects the volatility of non-resource revenue. To the best of our knowledge, this is the first study on the issue. Lim (1983), Bleaney *et al.* (1995), Ebeke (2010), Ebeke and Ehrhart (2011), Gnangnon and Brun (2019) and Gnangnon (2020) are among the few studies on the macroeconomic determinants of public revenue instability, in particular, tax revenue instability. Lim (1983) has shown tax revenue instability translates into higher instability of public expenditure in less-developed countries (LDCs). Using a sample comprising developed countries and LDCs, Bleaney *et al.* (1995) have obtained that tax revenue instability is particularly high in LDCs, and highest in open economies with low per capita income, high output variance and inflationary problems. Ebeke (2010) has uncovered that remittances significantly increase both the level and the stability of government tax revenue ratio in developing countries that have adopted the value-added tax (VAT). Ebeke and Ehrhart (2011) have reported, for sub-Saharan African countries, empirical evidence that tax revenue instability translates into the instability of both public investment and government consumption and reduces the level of public investment. Additionally, countries that rely on domestic indirect taxation-based systems experience a robust stabilizing effect. Gnangnon and Brun (2019) have emphasized the importance of tax reform for reducing tax revenue instability in developing countries. Gnangnon (2020) has obtained empirically that government budget support flows contribute to dampening the instability of non-resource tax revenue, particularly in sub-Saharan African countries.

The current analysis builds on these studies to examine the extent to which the volatility in resource revenue affects the volatility in non-resource revenue. As for the theoretical channels through which the volatility in resource revenue could influence the volatility in non-resource revenue, we first postulate that an increasing volatility in resource revenue would make policymakers in resource-rich countries incline to reduce the dependence of their total public revenue on resource revenue. This could notably take place through the exploration by these policymakers of alternative sources of public revenue, that is, by diversifying the public revenue sources away from resource revenue towards non-resource revenue. Policymakers would therefore make effort to ensure a greater stability (or less volatility) of non-resource revenue. Such a public revenue diversification could take place through the utilization of resource revenue to invest in non-resource sectors of the economy in order to diversify the economy. By increasing the value added in non-resource and non-agricultural sectors (including the manufacturing sector), the diversification of the economy could generate higher and more stable tax revenue. The need for policymakers to further rely on non-resource revenue as their primary source of public revenue in a context of higher volatility of resource revenue is particularly dictated by the fact that non-resource revenue is a sustainable source of public revenue, and that sooner or later, natural resources would exhaust. In this context, higher volatility in resource revenue could result in lower volatility in non-resource revenue.

On the other hand, policymakers in resource-rich countries may wish to use the funds (resource revenue) obtained from the exploitation of natural resources (including by multinationals) for investment in building state institutions and political organizations that could carry them through the hard times (Smith, 2004, p. 232). Additionally, these resources could be useful in developing and strengthening the capacity of relevant tax administrations (both involved in the taxation of natural resources and, more generally, to design and frame the appropriate tax policy) through targeted technical trainings, increases in the budget and staff of these administrations and so forth (e.g. Smith, 2004; Thies, 2010; Knebelmann, 2017). This would allow governments to collect higher non-resource revenue in the medium to long term, and hence reduce the public revenue's dependence on resource revenue. In light of the foregoing, we expect on the one hand that a rise in the volatility of resource revenue could compromise this objective of policymakers, and hence induce a higher volatility in non-resource revenue. This is notably because policymakers would not be able to collect the requisite level of resource revenue so as to implement policies in favour of raising higher non-resource tax revenue, while concomitantly ensuring the stability of the latter. In this scenario, higher volatility in resource revenue would translate into a higher volatility in non-resource revenue. In a nutshell, higher volatility of resource revenue could either enhance or reduce non-resource revenue volatility. Nevertheless, we may expect that the negative (i.e. reducing) effect to dominate the positive effect of higher volatility in resource revenue on non-resource revenue volatility.

The empirical analysis covers 54 countries over the period 1980–2015, and primarily uses the two-step system GMM to estimate the model that helps address the question at hand. Results show that resource revenue volatility is associated with lower non-resource revenue volatility if the share of resource revenue in total public revenue is lower than 18%. Otherwise, resource revenue volatility induces a higher volatility of non-resource revenue.

The rest of the analysis comprises four sections. Section 2 lays down the model specification that would help address the issue at hand. Section 3 discusses the econometric method used to perform the empirical analysis. Section 4 interprets the empirical results. Section 5 deepens the analysis by investigating whether the effect of resource revenue volatility on non-resource revenue volatility depends on countries' degree of dependence of the overall public revenue on resource revenue. Section 6 concludes.

## 2. Model specification

To estimate the effect of resource revenue volatility on non-resource revenue volatility, we rely on the existing few studies highlighted above concerning the macroeconomic determinants of public revenue instability (Lim, 1983; Bleaney *et al.*, 1995; Ebeke and Ehrhart, 2010; Gnangnon and Brun, 2019; Gnangnon, 2020), and we postulate the following model:

$$\begin{aligned}\text{Log}(\text{NRESREVVOL})_{it} = {} & \alpha_0 + \alpha_1\text{Log}(\text{NRESREVVOL})_{it-1} + \alpha_2\text{Log}(\text{RESREVVOL})_{it} \\ & + \alpha_3\text{Log}(\text{SHRESREV})_{it} + \alpha_4\text{Log}(\text{GDPC})_{it} \\ & + \alpha_5\text{Log}(\text{GRVOL})_{it} + \alpha_6\text{Log}(\text{OPEN})_{it} \\ & + \alpha_7\text{Log}(\text{TERMSVOL})_{it} + \alpha_8\text{Log}(\text{INFLVOL})_{it} + \mu_i + \omega_{it}\end{aligned} \tag{1}$$

where $i$ represents the country's index; $t$ denotes non-overlapping sub-periods of 5-year average data over the period 1980–2015 (7 non-overlapping sub-periods of 5-year average have been used). The panel data set contains 54 resource-rich countries, including both developed and developing countries, based on data availability. The $\alpha_0$ to $\alpha_8$ are parameters to be estimated, $\mu_i$ are countries' fixed effects and $\omega_{it}$ is a well-behaving error term.

The dependent variable "NRESREVVOL" represents the volatility of non-resource revenue. It has been computed as the standard deviation of the annual growth rate of non-resource revenue (% GDP) over non-overlapping sub-periods of 5-year average data.

The variable "RESREVVOL" stands for the volatility of resource revenue and represents our key variable of interest. It is measured by the standard deviation of the annual growth rate of resource revenue (% GDP) over non-overlapping sub-periods of 5-year average data. The introduction of the one-period lag of the dependent variable in model (1) aims to capture the persistence over time of the volatility of non-resource revenue.

The variable "SHRESREV" is the share (%) of the resource revenue in total public revenue. It has been included in the model to account for countries' dependence of total public revenue on resource revenue.

The variable "GDPC" stands for the real per capita income and acts as countries' development level. It has been introduced in the model to account for the fact that countries may exhibit different degrees of non-resource revenue volatility, depending on their development level.

The variables "GRVOL", "TERMSVOL" and "INFLVOL" are, respectively, the economic growth volatility, terms of trade volatility and inflation volatility. The volatility of growth rate has been calculated as the standard deviation of the annual economic growth rate (growth rate of real GDP) over non-overlapping sub-periods of 5-year data. Terms of trade volatility have been computed as the standard deviation of the annual growth of terms of trade over non-overlapping sub-periods of 5-year data. Finally, inflation volatility has been calculated as the standard deviation of the annual inflation rate over non-overlapping sub-periods of 5-year data. We expect that higher economic growth volatility, inflation volatility and terms of trade volatility would induce a rise in non-resource revenue volatility.

The variable "OPEN" represents countries' level of trade openness. Even though greater trade openness could bring significant benefits to the concerned country (notably in terms of higher export revenues, technology transfer) (e.g. Ahmed and Suardi, 2009; di Giovanni and Levchenko, 2009; Kim *et al.*, 2016; Koren and Tenreyro, 2007; Raddatz, 2007), they could also expose the country to external shocks, and hence induce a higher volatility in non-resource revenue.

All variables in model (1) have been considered in logs (natural logarithm) in order both to limit the skewness of many of these variables and to obtain coefficients in terms of elasticity. The description and source of all variables have been presented in Table A1. Table A2 presents the standard descriptive statistics on variables, and Table A3 reports the list of the 54 countries used in the analysis.

To get an idea on the relationship between the volatility of resource revenue and the volatility of non-resource revenue, we provide in Figure 1, the correlation pattern between these two variables. The left-hand-side graph of the figure (where variables are without the natural logarithm) shows a positive correlation pattern between "NRESREVVOL" and "RESREVVOL", but the skewness of data and the presence of outliers. This positive pattern is confirmed on the right-hand-side graph of the figure, where the natural logarithm has been applied to the variables. It could be particularly noted from the right-hand-side graph of the figure that the transformation of the two variables using the natural logarithm has reduced outlier problems that are present on the left-hand-side graph. Nevertheless, there still appear some outliers on the right-hand-side graph. The identified outlier-countries are Egypt, Kazakhstan and Malaysia. The empirical analysis would take into account the existence of these outliers in the data set.

## 3. Econometric approach

We first estimate model (1) (in its static version, i.e. without the one-period lag of the dependent variable as a regressor) using traditional panel econometric estimators, including the within fixed effects (henceforth denoted "FE") and the random effects ("RE") where standard errors have been clustered at the country level to account for the possible serial correlation and

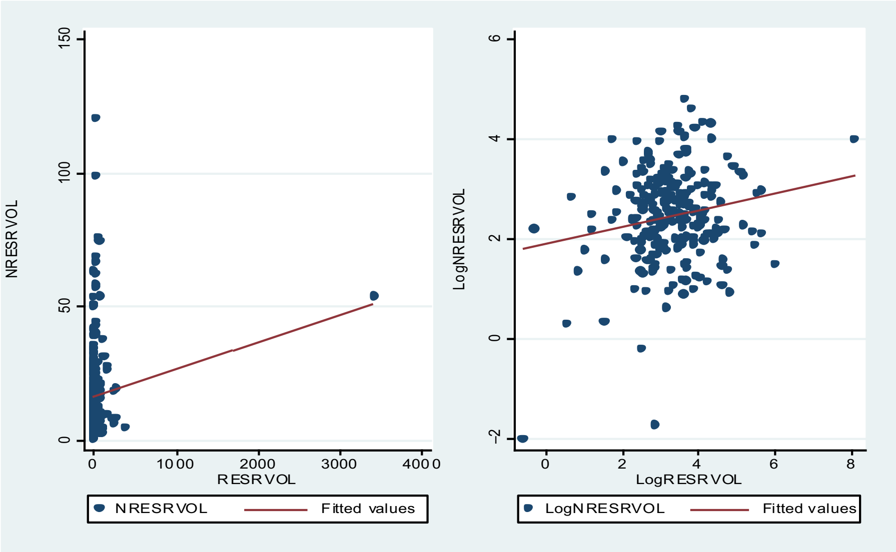


**Figure 1.** Correlation pattern between RESRVOL and NRESRVOL

**Source(s):** Author

heteroscedasticity in the error term. To account for the effect of the outliers highlighted above, we create a dummy variable (denoted "DUMOUTL"), which takes the value 1 for the outlier-countries, and 0 otherwise. This variable is then interacted with the "RESREVVOL" variable, and both the dummy and the interaction variable are introduced in the static version of model (1). The results – based on the FE and RE estimators – of the estimations of the specifications of the static version of model (1) without /and with the outlier dummy (and its interaction with the "RESREVVOL" variable) are reported in Table 1. However, these estimates may be biased because the variable capturing the volatility of the resource revenue could be considered as endogenous. Such an endogeneity could arise from the simultaneity bias, that is, the bidirectional causality between the non-resource revenue volatility and the resource revenue volatility variables. In fact, one could argue that while resource revenue volatility would influence non-resource revenue volatility through the channels described above, it can also be possible that resource-rich countries that experience a rise in their non-resource revenue volatility may be willing to develop strategies to reduce the volatility of their resource revenue, as these revenues might become their main source of their public revenue. Likewise, the trade openness could also be considered as endogenous because even if higher trade openness could expose countries to external shocks that could lead to higher non-resource revenue volatility, countries that experience a higher volatility in non-resource revenue might wish to reduce their degree of trade openness so as to limit their exposure to external shocks.

To address the endogeneity concerns related to these two variables, as well as the potential endogeneity bias [2] (Nickell bias – Nickell, 1981) that stems from the presence of the one-period lag of the dependent variable as a regressor in the dynamic model (1), we estimate model (1) (as it stands) using the two-step system GMM estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998). This estimator is appropriate for addressing various endogeneity concerns (e.g. simultaneity bias, the endogeneity problem stemming from the correlation between the lagged dependent variable and the country-specific effects and the omitted variable biases) in dynamic specifications, such as ours. The use of the two-step system GMM involves the combination of the estimation of an equation in differences

**Table 1.** Impact of the volatility of resource revenue on the volatility of non-resource revenue. *Estimator*: Within fixed effects and random effects

| Variables | Within fixed effects Log(NRESREVVOL) (1) | Within fixed effects Log(NRESREVVOL) (2) | Random effects Log(NRESREVVOL) (3) | Random effects Log(NRESREVVOL) (4) |
|---|---|---|---|---|
| Log(RESREVVOL) | 0.279** | 0.270** | 0.174* | 0.167 |
| | (0.106) | (0.114) | (0.0979) | (0.111) |
| DUMOUTL*Log(RESREVVOL) | | −0.707** | | −1.034*** |
| | | (0.274) | | (0.261) |
| Log(SHRESREV) | 0.225 | 0.276 | 0.352*** | 0.373*** |
| | (0.202) | (0.195) | (0.0962) | (0.0912) |
| Log(GDPC) | 0.404 | 0.354 | 0.0634 | 0.0639 |
| | (0.246) | (0.225) | (0.0602) | (0.0533) |
| Log(GRVOL) | −0.268*** | −0.231*** | −0.107* | −0.0357 |
| | (0.0616) | (0.0676) | (0.0569) | (0.0635) |
| Log(OPEN) | 0.681 | 0.498 | 0.472*** | 0.402*** |
| | (0.425) | (0.380) | (0.144) | (0.131) |
| Log(TERMSVOL) | 0.145 | 0.144 | 0.178* | 0.166* |
| | (0.137) | (0.138) | (0.0963) | (0.0909) |
| Log(INFLVOL) | 0.225*** | 0.206*** | 0.198*** | 0.184*** |
| | (0.0412) | (0.0438) | (0.0364) | (0.0300) |
| Constant | −6.064** | −4.988** | −2.636*** | −2.382*** |
| | (2.405) | (2.239) | (0.851) | (0.898) |
| Observations – countries | 206–54 | 206–54 | 206–54 | 206–54 |
| Within $R$-squared | 0.2251 | 0.2774 | 0.1764 | 0.2278 |
| Between $R$-squared | 0.1719 | 0.2841 | 0.4272 | 0.6215 |
| Overall $R$-squared | 0.2174 | 0.3132 | 0.3470 | 0.4412 |

**Note(s)**: *$p$-value < 0.1; **$p$-value < 0.05; ***$p$-value < 0.01. Robust standard errors are in parenthesis. For the random effects estimator ("RE"), standard errors have been clustered at the country level with an equation in levels where lagged first differences of endogenous variables are treated as instruments for the levels equation and where lagged levels of endogenous variables are used as instruments in the first-difference equation.

The consistency of the the two-step system GMM estimator is assessed through several diagnostic tests: the Arellano-Bond test of first-order serial correlation in the error term [denoted AR(1)]; the Arellano-Bond test of no second-order autocorrelation in the error term [denoted AR(2)]; and the Sargan test of overidentifying restrictions, which helps check the validity of the instruments used in the estimations. Incidentally, a number of instruments in the regressions higher than the number of countries could reduce the power of the aforementioned tests (e.g. Roodman, 2009). As a result, we also report the number of instruments used in the regressions. Summing up, as far as the estimation of model (1) by means of the two-step system GMM is concerned, we consider this dynamic model without/and with the outlier dummy (and its interaction with the "RESREVVOL" variable). In these regressions, the variable "RESREVVOL" and "OPEN" are considered as endogenous. The regressions have used two lags of the dependent variable as instruments and two lags of the endogenous variables as instruments. The results of these estimations are presented in Table 2.

**Table 2.**
Impact of the volatility of resource revenue on the volatility of non-resource revenue.
*Estimator*: Two-step system GMM

| Variables | Log(NRESREVVOL) (1) | Log(NRESREVVOL) (2) |
|---|---|---|
| Log(NRESREVVOL)$_{t-1}$ | 0.154*** | 0.136*** |
| | (0.0347) | (0.0287) |
| Log(RESREVVOL) | 0.127*** | −0.0716** |
| | (0.0480) | (0.0353) |
| DUMOUTL | | −3.706*** |
| | | (0.100) |
| [DUMOUTL]*[Log(RESREVVOL)] | | 0.863*** |
| | | (0.0493) |
| Log(SHRESREV) | 0.500*** | 0.260*** |
| | (0.0640) | (0.0564) |
| Log(GDPC) | 0.387*** | 0.263*** |
| | (0.0470) | (0.0349) |
| Log(GRVOL) | −0.279*** | −0.214*** |
| | (0.0276) | (0.0313) |
| Log(OPEN) | 0.692*** | 0.601*** |
| | (0.109) | (0.130) |
| Log(TERMSVOL) | 0.0633 | 0.175*** |
| | (0.0544) | (0.0552) |
| Log(INFLVOL) | 0.222*** | 0.182*** |
| | (0.0404) | (0.0443) |
| Constant | −6.611*** | −3.935*** |
| | (1.032) | (0.944) |
| Observations – countries | 163–47 | 163–47 |
| Number of instruments | 36 | 38 |
| AR1 ($p$-value) | 0.0278 | 0.0137 |
| AR2 ($p$-value) | 0.2970 | 0.2086 |
| AR3 ($p$-value) | 0.4030 | 0.8416 |
| Sargan ($p$-value) | 0.6711 | 0.8844 |

**Note(s)**: *$p$-value < 0.1; **$p$-value < 0.05; ***$p$-value < 0.01. Robust standard errors are in parenthesis. In the two-step system GMM estimations, the variables "RESREVVOL" and "OPEN" have been considered as endogenous

## 4. Interpretation of empirical results

Results in column [1] of Table 1 show that the volatility of resource revenue exerts a positive and significant (at the 5% level) effect on the volatility of non-resource revenue. Similarly, results in column [2] of the same Table (where we control for outliers) confirm the positive and significant (at the 5% level) impact of the resource revenue volatility on the volatility of non-resource revenue. Interestingly, the coefficients associated with the variable "RESREVVOL" in columns [1] and [2] exhibit almost the same magnitude. Focusing on the results provided in column [2], we can conclude that a 1 percentage increase in the volatility of resource revenue leads to a 0.27 percentage increase in the volatility of non-resource revenue. Turning to results in columns [3] (which are based on the random effects estimator, without controlling for outliers), we obtain that while resource revenue volatility influences positively non-resource revenue volatility, the coefficient associated with the variable "RESREVVOL" is statistically significant only at the 10% level. Results in column [4] (based on the random effects estimator and that take into account outlier problems) suggest that the effect of resource revenue volatility on non-resource revenue volatility is not statistically significant at the 10% level. Incidentally, the effect of the non-resource revenue volatility is lower in outlier-countries than in the other countries of the sample (non-outlier countries) (see the coefficient associated with the interaction between the outlier dummy and the "RESREVVOL" variable in column [4]).

Control variables in columns [1] and [2] show similar estimates. Likewise, results of control variables reported in columns [3] and [4] are also similar. In columns [1] and [2], we find that growth volatility exerts a negative and significant impact on non-resource revenue volatility, while inflation volatility induces higher non-resource revenue volatility. The other control variables do not show statistically significant coefficients at the 10% level.

Even though the coefficient of the resource revenue volatility variable exhibits similar magnitude, sign and statistically significance in columns [1] and [2], we will draw the conclusion of the analysis, based on the specification of model (1) that takes into account the outliers.

Turning now to the estimates displayed in Table 2, we obtain that non-resource revenue volatility exhibits a state-dependence path, whereby the one-period lag of this variable is positively and significantly associated with the current values of non-resource revenue volatility. Additionally, the results of the diagnostic tests related to the two-system GMM approach, provided at the bottom of Table 2, indicate that this estimator is well appropriate to conduct the empirical analysis. In fact, the *p*-values associated with the AR(1) test are lower than 0.05 (i.e. statistically significant at the 5% level), whereas the *p*-values associated with the AR(2) and AR(3) tests are higher than 10% level. Furthermore, the results of the Sargan test show *p*-values higher than 10%. Finally, the number of instruments used in the regressions is, as expected, lower than the number of countries.

Concerning estimates presented in Table 2, we obtain from column [1] that resource-revenue volatility exerts a positive and significant impact (at the 1% level) on non-resource revenue volatility. However, in column [2] (after controlling for the effect of outlier-countries), we find that for non-outlier countries, resource revenue volatility exerts a negative and significant impact on non-resource revenue volatility, while for outlier countries, higher volatility in resource revenue is associated with higher volatility in non-resource revenue. We obtain from column [1] of Table 2 that over the full sample, a 1 percentage increase in resource revenue volatility induces a 0.127 percentage increase in non-resource revenue volatility. However, results in column [2] of the same table show a different story. Specifically, we obtain for non-outlier countries that a higher volatility of resource revenue induces a lower volatility of non-resource tax revenue (the coefficient of the variable "Log(RESREVVOL)" is negative and significant at the 5% level). Here, a 1 percentage increase in the volatility of resource revenue induces a 0.072 percentage decline in non-resource revenue volatility. This means that when countries experience higher volatility in resource revenue, they make effort to reduce the volatility of their non-resource revenue so as ensure a certain stream of non-resource revenue. However, the effect of resource revenue volatility on non-resource revenue volatility for non-outlier countries is surely not the same across countries, depending on the extent of the dependence of their public revenue on resource revenue. This is what we will further check later in the analysis. We also note from column [2] of Table 2 that the interaction term related to the variable ("[DUMOUTL]*[Log(RESREVVOL)]") is positive and significant at the 1% level. This signifies that resource revenue volatility exerts a higher positive effect on non-resource revenue volatility in outlier countries than in non-outlier countries. For outlier countries, a 1 percentage increase in resource revenue volatility induces a 0.794 ( = 0.863 – 0.0716) percentage increase in non-resource revenue volatility.

Concerning control variables, results in column [2] indicate that a rise in the share of resource revenue in total public revenue exerts a positive and significant impact on non-resource revenue volatility. Additionally, the higher the development level, the higher is the volatility in non-resource revenue. Greater trade openness, higher terms of trade volatility and higher inflation volatility are positively and significantly associated with the volatility of non-resource revenue. Higher economic growth volatility generates lower non-resource revenue volatility.

## 5. Further analysis: does the effect of resource revenue volatility on non-resource revenue volatility depend on countries' dependence of overall public revenue on resource revenue?

In this section, we examine whether the effect of resource revenue volatility on the non-resource revenue volatility is conditioned upon countries' dependence of total public revenue on resource revenue. The latter is measured by the share of resource revenue in total public revenue. To address empirically this question, we estimate a variant of model (1) in which we include the interaction between the variables "SHRESREV" and "RESREVVOL", while controlling for the effect of outlier countries on non-resource revenue volatility. The results of the estimation of this variant of model (1) by means of the two-step system GMM approach are reported in Table 3.

Results in Table 3 confirm the state-dependence nature of the volatility in non-resource revenue (i.e. its persistence over time). Additionally, the results associated with the diagnostic tests that help check the consistency of the two-step system GMM estimator (see the bottom of this table) indicate that the system GMM approach is appropriate to estimate the variant of model (1) that helps examine whether the effect of resource revenue volatility on non-resource revenue volatility depends on countries' share of resource revenue in total public revenue. The key coefficients of interest to perform this analysis are the coefficient of the variable "RESREVVOL" and the interaction term associated with the variable "[Log(RESREVVOL)]*[Log(SHRESREV)]". The coefficient of the variable "RESREVVOL" is negative and statistically significant at the 1% level, while the interaction term is positive and statistically significant at the 1% level. The combination of these two results suggests that there is a threshold of "SHRESREV" above which the total impact of resource revenue volatility on non-resource revenue volatility changes sign. This threshold is given by 23.76% [ = exponential (0.849/0.268)]. Hence, on average, when countries' share of resource revenue in total public revenue is lower than 23.8%, they experience a negative impact of resource revenue volatility on non-resource revenue volatility, that is, for these countries, higher volatility in resource revenue leads to lower volatility in non-resource revenue. When this share exceeds the threshold of 23.8%, countries experience a positive impact of resource revenue volatility on non-resource revenue volatility. As these results show an average impact across countries in the full sample, we provide in Figure 2, a better picture on how the

| Variables | Log(NRESREVVOL) (1) |
| --- | --- |
| Log(NRESREVVOL) | 0.0690*** |
| | (0.0238) |
| Log(RESREVVOL) | −0.849*** |
| | (0.118) |
| Log(SHRESREV) | −0.562*** |
| | (0.0770) |
| [Log(RESREVVOL)]*[Log(SHRESREV)] | 0.268*** |
| | (0.0338) |
| [DUMOUTL]*[Log(RESREVVOL)] | 0.975*** |
| | (0.0493) |
| DUMOUTL | −3.998*** |
| | (0.110) |
| Log(GDPC) | 0.282*** |
| | (0.0220) |
| Log(GRVOL) | −0.220*** |
| | (0.0194) |
| Log(OPEN) | 0.589*** |
| | (0.0888) |
| Log(TERMSVOL) | 0.267*** |
| | (0.0486) |
| Log(INFLVOL) | 0.157*** |
| | (0.0326) |
| Constant | −1.677*** |
| | (0.589) |
| Observations – Countries | 163–47 |
| Number of instruments | 43 |
| AR1 (*p*-value) | 0.0291 |
| AR2 (*p*-value) | 0.3059 |
| AR3 (*p*-value) | 0.5223 |
| Sargan (*p*-value) | 0.2567 |

**Note(s)**: **p*-value < 0.1; ***p*-value < 0.05; ****p*-value < 0.01. Robust standard errors are in parenthesis. In the two-step system GMM estimations, the variables "RESREVVOL" and "OPEN" have been considered as endogenous

**Table 3.** Does the impact of the volatility of resource revenue on the volatility of non-resource revenue depend on the share of resource revenue in total public revenue? *Estimator*: Two-step system GMM

impact of resource revenue volatility on non-resource revenue volatility depends on the share of resource revenue in total public revenue. In particular, Figure 2 presents, at the 9% confidence intervals, the development of the marginal impact of "RESREVVOL" on non-resource revenue for various countries' shares of resource revenue in total public revenue. For the interpretation of the graph, the marginal impacts that are statistically significant at the 95% confidence intervals include those encompassing only the upper and lower bounds of the confidence interval that are either above or below the zero line. Hence, this figure shows that the marginal impact of resource revenue volatility on non-resource revenue volatility rises as countries experience a higher dependence of their total public revenue on resource revenue, that is, as the share of resource revenue in total public revenue increases. In particular, this marginal impact is almost always positive and statistically significant. It is negative (and statistically significant) when the share of resource revenue in total public revenue is lower than 18% [ = exponential (2.890064)]. Thus, countries whose share of resource revenue in total public revenue is lower than (or equal to) 18%, experience a negative and significant impact of resource revenue volatility on the non-resource revenue volatility. However, countries whose share of resource revenue in total public revenue exceeds 18% experience a positive impact of resource revenue volatility on the non-resource revenue

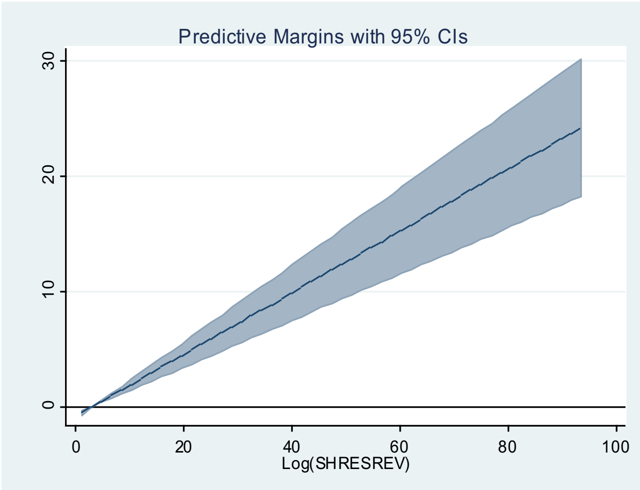


**Figure 2.** Marginal impact of "RESREVVOL" on "NRESREVVOL", for varying levels of "SHRESREV"

**Source(s):** Author

volatility. Additionally, for this set of countries, the higher the share of resource revenue in total public revenue, the greater is the magnitude of the impact of resource revenue volatility on the volatility of non-resource revenue.

Control variables exhibit similar estimates as those reported in column [2] of Table 2.

## 6. Conclusion

This article examines the extent to which the volatility of resource revenue influences the volatility of non-resource revenue. Using a set of 54 countries (over the period 1980–2015) for which data on resource revenue exist, the analysis shows that resource revenue volatility induces higher non-resource revenue volatility when the share of resource revenue in total public revenue is higher than 18%. It is well known that non-resource revenue volatility would translate into the volatility of public expenditure, which could be detrimental for economic growth and development prospects. Thus, countries whose total public revenue is highly dependent on resource revenue should adopt appropriate policies to ensure the rise in non-resource revenue, as well as the stability of the latter. Overall, economic diversification in resource-rich countries (particularly in developing countries among them) could contribute to reducing the dependence of economies on natural resources, and hence the dependence of public revenue on resource revenue. Therefore, policies in favour of economic diversification would contribute to stabilizing non-resource revenue, which is essential for financing development needs.

### Notes

1. Natural resources include a significant component of economic rent, primarily from oil and mining activities.
2. This bias is introduced by the estimation of the dynamic model (1) using standard econometric estimators such as the fixed effects estimator or the random effects estimator.

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**Table A1.**
Definition and source of variables

| Variables | Definition | Sources |
|---|---|---|
| RESREVVOL | This is the measure of the volatility of resource revenue (also referred to as the instability of resource revenue). It has been calculated as the standard deviation of annual growth rate of resource revenue (% GDP) over non-overlapping sub-periods of 5-year data | Author's calculation based on data from the ICTD: ICTD Public Revenue Dataset. See online: https://www.wider.unu.edu/project/government-revenue-dataset |
| NONRESREVVOL | This is the measure of the volatility of non-resource revenue (also referred to as the instability of non-resource revenue). It has been calculated as the standard deviation of annual growth rate of non-resource revenue (% GDP) over non-overlapping sub-periods of 5-year data | Author's calculation based on data from the ICTD: ICTD Public Revenue Dataset |
| SHRESREV | This is the share (%) of resource revenue in total public revenue | Author's calculation based on data from the ICTD: ICTD Public Revenue Dataset |
| TERMVOL | This is the measure of terms of trade instability. Terms of trade represent the ratio of the export price index to import price index. Terms of trade volatility have been calculated as the standard deviation of annual terms of trade growth over 5-year non-overlapping sub-periods | Authors' calculation based on terms of trade data from the World Development Indicators (WDI) of the World Bank |
| INFLVOL | Inflation volatility, calculated as the standard deviation of inflation rate over 5-year non-overlapping sub-periods | Authors' calculation based on inflation data extracted from the WDI |
| GRVOL | This is the measure of the volatility of economic growth rate. It has been calculated as the standard deviation of annual economic growth rate (growth rate of real GDP) over non-overlapping sub-periods of 5-years | Authors' calculation based on economic growth rate data extracted from the WDI |
| OPEN | This is the measure of trade openness (de facto trade openness). It is calculated as the sum of exports and imports, in % GDP | WDI |
| GDPC | GDP per capita (constant 2010 US$) | WDI |

| Entire sample | |
|---|---|
| Algeria | Malaysia |
| Angola | Mali |
| Azerbaijan | Mauritania |
| Bahrain | Mexico |
| Bolivia | Micronesia, Fed. Sts. |
| Botswana | Mongolia |
| Burkina Faso | Namibia |
| Cameroon | Nigeria |
| Chad | Norway |
| Chile | Papua New Guinea |
| Colombia | Qatar |
| Congo, Rep. | Russian Federation |
| Ecuador | Saudi Arabia |
| Egypt, Arab Rep. | Senegal |
| Equatorial Guinea | Sierra Leone |
| Gabon | Sudan |
| Ghana | Suriname |
| Guinea | Togo |
| Indonesia | Trinidad and Tobago |
| Iran, Islamic Rep. | Tunisia |
| Jamaica | Turkmenistan |
| Kazakhstan | United Arab Emirates |
| Kiribati | Venezuela, RB |
| Kuwait | Vietnam |
| Lao PDR | Yemen, Rep. |
| Liberia | Zambia |
| Libya | Zimbabwe |

**Table A2.**
List of countries contained in the entire sample

| Variable | Observations | Mean | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| NRESREVVOL | 163 | 16.039 | 14.802 | 0.132 | 98.266 |
| RESREVVOL | 163 | 38.884 | 44.133 | 0.568 | 408.972 |
| SHRESREV | 163 | 42.222 | 25.045 | 1.261 | 93.704 |
| GDPC | 163 | 9768.420 | 16247.030 | 371.583 | 89835.230 |
| TERMSVOL | 163 | 22.356 | 16.336 | 1.376 | 113.815 |
| INFLVOL | 163 | 20.547 | 150.901 | 0.296 | 1838.105 |
| GRVOL | 163 | 4.179 | 6.135 | 0.244 | 55.638 |
| OPEN | 163 | 89.192 | 46.774 | 33.426 | 440.741 |

**Table A3.**
Descriptive statistics on variables used in the model

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