Export product diversification, poverty and tax revenue in developing countries

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ABSTRACT
The current paper has examined the effect of both export product diversification and poverty on non-resource tax revenue in developing countries. The analysis has used an unbalanced panel dataset of 111 countries over the period 1980–2014. Based on the Blundell and Bond two-step system Generalized Methods of Moments technique, the empirical analysis has shown interesting findings. Export product concentration and poverty influence negatively non-resource tax revenue over the full sample, but this effect varies across countries in the sample. Furthermore, the effect of export product diversification on non-resource tax revenue performance depends on the level of poverty. It appears that export product diversification influences positively non-resource tax revenue performance in countries that experience lower poverty rates. From a policy perspective, these findings show that policies in favour of diversifying export product baskets and reducing poverty would contribute to enhancing non-resource tax revenue performance in developing countries.

KEYWORDS
Export product diversification; poverty; non-resource tax revenue

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1. Introduction
Developing countries need huge amounts of financial resources to finance their development objectives. Public revenue mobilization remains the first and foremost means to ensure a stream of financial resources for governments, including in developing countries. A voluminous literature has been devoted to the determinants of public revenue (including tax revenue), notably in developing countries. However, to the best of our knowledge, the relationship between export product diversification and public revenue, on the one hand, and poverty and public revenue, on the other hand, has received scant attention in this literature. To our knowledge, only Gnangnon (2018) and Gnangnon and Brun (2017) have explored the effect of export product diversification on public revenue performance in development. This issue is all the more relevant that the literature has now well established that to ensure a sustainable economic growth and development...
path, developing countries would need to upgrade their export product baskets, including by diversifying export products away from primary commodities towards higher value-added products (e.g. Hausmann, Hwang, and Rodrik 2007; Herzer and Nowak-Lehmann 2006; Naudé, Bosker, and Matthee 2010; Prebisch 1950; Redding 1999; Singer 1950). In fact, export product diversification can contribute to enhancing economic growth, reducing aggregate output volatility, firms’ output volatility (e.g. Kramarz, Martin, and Mejean 2020; Vannoorenberghe, Wang, and Yu 2016), dampening export revenue volatility (e.g. Athukorala 2000; Prebisch 1950; Singer 1950; Stanley and Bunnag 2001), and reducing poverty (e.g. Pugliese et al. 2017; Santos-Paulino 2017; Weinberger and Lumpkin 2007).

Poverty reduction (at least in monetary terms) is also at the heart of the policymakers’ agenda both at the national and international levels. For example, in September 2015, the United Nations Members adopted seventeen Sustainable Development Goals (SDGs) (which have replaced the Millennium Development Goals). The first of the SDGs concerns poverty reduction, and specifically aims at ending poverty in all its forms everywhere (see page 14 of the United Nations document A/RES/70/1).

While the macroeconomic effects of export product diversification have received a large attention from scholars and researchers (see studies cited above), the macroeconomic effects of poverty have been less explored. For example, the extent of the related literature has focused on the effect of poverty on human capital (e.g. Bain et al. 2013; Hanson et al. 2013; Haushofer and Fehr 2014; Lichand et al. 2020), labour productivity (e.g. Hill and Sandfort 1995), economic growth (e.g. López 2006; Ravallion 2012, 2016), economic development (e.g. Nakabashi 2018), export product diversification (e.g. Gnangnon 2020b) and trade openness (e.g. Gnangnon, 2020a). To the best of our knowledge, there is no published work on the effect of poverty on public revenue, including tax revenue. The present analysis aims to fill this gap in the literature by investigating the effect of poverty and export product diversification on tax revenue performance in developing countries. It additionally examines how export product diversification interacts with poverty in influencing tax revenue performance in developing countries.

The analysis is conducted using an unbalanced panel dataset of 111 countries, over the period 1980–2014, and the Blundell and Bond two-step system Generalized Methods of Moments technique. Results have shown that over the full sample, export product concentration and poverty lead to lower non-resource tax revenue performance. However, this effect varies across countries in the sample. Additionally, export product diversification influences positively non-resource tax revenue performance in countries that experience lower poverty rates.

The remainder of the paper is structured around four Sections. Section 2 discusses theoretically how both export product diversification and poverty can affect tax revenue, and in particular how both factors interact in influencing developing countries’ tax revenue performance. Section 4 presents the empirical analysis. Section 5 undertakes additional robustness check analysis, and Section 6 concludes.

2. Export product diversification, poverty, and tax revenue

Gnangnon and Brun (2017) have shown that export product upgrading (including both export product diversification and export product quality) influences positively non-resource tax revenue performance. The effect of export product upgrading on public revenue can work through several avenues (see also Gnangnon 2020). First, export
product upgrading generates higher income for traders, including trading firms, and employees in these firms. For example, export product diversification can influence export performance at the aggregate level (e.g. Camanho da Costa Neto and Romeu 2011; del Rosal 2019; Funke and Ruhwedel 2001, 2002) and increase their income. According to Camanho da Costa Neto and Romeu (2011), product diversification has helped to enhance export resilience in Latin American countries during the global financial crisis, including by dampening the trade collapse effect of the 2018 global financial crisis. However, this was not the case for geographical diversification. Funke and Ruhwedel (2001, 2002) have reported for 10 East Asian countries and 15 Organization for Economic Co-operation and Development (OECD) countries that export product variety enhances export performance. del Rosal (2019) has obtained for Spain that export product concentration induces greater export performance by destination country of Spain exports. At the firm-level, export product diversification also influences positively export performance (e.g. Balabanis 2001; Nijikam 2017; Solano et al. 2019; Xuefeng and Yaşar 2016). A few studies have shown that export product diversification may induce higher employment, that is, a higher demand for labour. Naudé and Rossouw (2011) have used data for Brazil, China, India and South Africa over the period 1962–2000, and obtained that export product diversification has led to higher employment in South Africa. However, for the other countries, it is rather export concentration that influences positively employment. They have concluded that export product diversification induces higher employment only at the early stages of development. Songwe and Winkler (2012) have shown for 30 African countries over the period 1995–2008 that export product diversification has not resulted in higher labour demand. However, these findings might not apply to all developing countries. UNCTAD (2018) has used a large sample of both advanced and developing countries to conclude that export product diversification promotes employment in developing countries and advanced countries alike, although this positive effect is lesser in African countries than in other countries.

The rise in trading firms’ income (due to greater export product diversification) can lead firms to increase their demand for skilled and unskilled workers. For governments, these would result in higher corporate income tax revenue, as well as higher personal income tax revenue, and hence higher direct tax revenue. At the same time, the aforementioned positive effects of export product upgrading on the income of trading firms and their employees could also translate into higher domestic consumption. The latter would generate higher indirect tax revenue, including value-added tax (VAT) revenue and excise tax revenue. If the rise in income results in higher imports, the government could collect higher international trade tax revenue. Taking all these together, we expect the positive effect of export product diversification on corporate (trading firms’) income and on the income of employees would result in higher total tax revenue through higher direct tax revenue, indirect tax revenue, as well as international trade tax revenue.

In addition to its effect on tax revenue through employees and firms’ income, export product diversification can also affect tax revenue through its effect on output volatility. On the one hand, by stabilizing firms’ output volatility or firms’ export revenue volatility (e.g. Kramarz, Martin, and Mejean 2020; Vannoorenbergh, Wang, and Yu 2016), export product diversification can help increase tax revenue through the channels described above. On the other hand, export product diversification can contribute to reducing aggregate output volatility, which in turn often leads to lower economic growth and welfare. At the same time, economic growth contributes significantly to determining the breadth of the tax base, and hence tax revenue performance (e.g. Besley and Persson 2014;
Tosun and Abizadeh (2005). Against this backdrop, we expect that greater export product concentration would be associated with lower tax revenue performance in countries that experience higher economic growth volatility. Likewise, in light of the positive effect of export product diversification on economic growth, one could also expect that the effect of export product diversification on tax revenue performance may work through the economic growth channel. Specifically, export product diversification can improve tax revenue performance in countries that experience a rise in the economic growth rate.

We also expect that an increase in the poverty level would lead to lower tax revenue performance. Higher poverty levels reflect the lack of resources to meet the minimum basic necessities of life. As a result, higher poverty rates lead to lower consumption (e.g. Blocker et al. 2013; Chakravarti 2006; Ravallion 2012), lower investment – for example – in human capital (e.g. Bain et al. 2013; Hanson et al. 2013; Haushofer and Fehr 2014; Lichand et al. 2020), lower productivity (e.g. Breunig and Majeed 2020; Hill and Sandfort 1995), lower economic growth (e.g. López 2006; Ravallion 2012, 2016), and lower economic development (e.g. Nakabashi 2018). The decline in consumption due to the rise in poverty rates would result in lower indirect tax revenue, including through lower VAT and excises tax revenue, and eventually import tariff revenue (if the poverty-related fall in consumption translates into lower imports). Similarly, the fall in personal income – that either pushes some individuals into poverty or traps others in poverty – would induce lower personal income tax revenue, unless the government raises the personal income tax rates on rich people so as to compensate for the tax revenue losses due to the poverty rises. However, increasing taxes on rich people might be politically untenable for the government, notably if rich people represents an important electorate for politician in power. Summing-up, we expect that a rise in poverty would likely result in lower tax revenue performance.

The adverse effect of poverty on tax revenue could be severe in the cases of negative external shocks on the economy. These shocks generate greater macroeconomic volatility, including economic growth volatility, and can result in a substantial rise in poverty rates. For example, macroeconomic volatility, including greater economic volatility reduces welfare in developing countries, with a higher negative effect on poor countries (e.g. Dabla-Norris and Bal Gündüz 2014; Hnatkovska and Loayza 2005). Terms of trade shocks can raise poverty rates (e.g. Guillaumont and Puech 2005; Nkurunziza, Tsowou, and Cazzaniga 2017). Global food prices shocks have resulted in higher poverty rates in low-income countries (e.g. Ivanic and Martin 2008), and increases in international prices of agricultural commodities have exerted substantial adverse effects on welfare, and significantly raised poverty (e.g. Moncarz, Barone, and Descalzi 2018). According to Rewilak (2018), currency crises are the most harmful types of crises to the poor. Given the likely negative effect of poverty rates on non-resource tax revenue performance, we argue that the effect of poverty on non-resource tax revenue performance could work through the economic growth volatility channel. Specially, we expect the magnitude of the negative effect of poverty on non-resource tax revenue performance to increase as the level of economic growth volatility rises.

Overall, on the one hand, we expect that greater export product diversification (or export product concentration) would lead to higher (lower) tax revenue performance (Assumption 1). On the other hand, higher poverty rates would be associated with lower tax revenue performance (Assumption 2). Thus, export product diversification can result in higher tax revenue performance in countries that experience lower poverty rates (Assumption 3). At the same time, one can also argue that the effect of export
product diversification on tax revenue performance might, in reality, depend on the poverty rates. In fact, it is possible that higher poverty rates lessen the eventual positive effect of export product diversification on tax revenue performance. This will be particularly the case if export product diversification does not benefit to poor people. In such a scenario, there might be export product diversification that would induce lower tax revenue performance only above a certain level of poverty (Assumption 4).

3. Model specification

To examine empirically the effect of export product diversification and poverty on tax revenue performance, and the extent to which both factors interact in influencing tax revenue, we build on the extensive literature on the determinants of tax revenue performance. This literature has pointed out a number of structural factors that matter for the dynamics of public revenue performance. Thus, in addition to our two regressors of interest, namely the indicator of export product concentration, denoted ‘ECI’ and the poverty indicator denoted ‘POV’, we have included in the model specification a number of structural factors. The latter include the overall level of development, proxied by the real per capita income denoted ‘GDPC’; the degree of trade openness, denoted ‘OPEN’; the sectoral composition of domestic output, measured by the share of value added in agriculture in total output, denoted ‘SHAGRI’; demographic characteristics, such as the size of the total population, denoted ‘POP’. Additionally, many studies have underlined that inflation can also influence tax revenue performance in developing countries. Therefore, we also include a variable capturing the inflation rate in the model. The inflation rate variable has been transformed for reasons explained below. The transformed inflation rate variable is denoted ‘INFL’. Finally, we also include the terms of trade variable in the analysis (see, for example, Gnangnon and Brun 2019) to capture the potential effect of terms of trade movements on tax revenue performance in developing countries.

We expect that the level of development (proxied by the country’s real GDP per capita) may be positively relating to public revenue, as it could reflect the fact that the demand for public services would increase with per capita income as well as with a greater economic and institutional sophistication (e.g. Crivelli and Gupta 2014). We have applied the natural logarithm to the real per capita income so as to reduce its skewness. On another note, we expect that in light of the difficulties to tax the agriculture sector, a higher share of value added in agriculture in total output would be negatively associated with tax revenue. While some authors (e.g. Bahl 2003) argue that agriculture is not difficult to tax, others such as Tanzi (1992) have contended that a relatively important share of agricultural sector in a country’s economy would be associated with a lower need for governmental activities and services, as many public sector activities are city-based. Furthermore, Bird, Martinez-Vazquez, and Torgler (2008) argue that for political reasons, some countries exempt a large share of agricultural activities from taxes. From the empirical perspective, virtually all studies have confirmed this theoretical expectation.

The foreign trade sector of the economy measured by the degree of international trade openness of the economy is also an important tax handle. Stotsky and Wolde-Mariam (1997) have pointed out that certain features of international trade make it more amenable to taxation than domestic activities. In the same vein, Bornhorst, Gupta, and Thornton (2009), and Drummond et al. (2012) have noted that countries could easily levy taxes at the border. Trade openness can also influence tax revenue through its positive productivity effect (e.g. Alesina, Spolaore, and Wacziarg 2005; Grossman and

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Helpman 2015; Melitz 2003), and hence through its enhancing economic growth effect. Nevertheless, Ebrill, Stotsky, and Gropp (1999) and Agbeyegbe, Stotsky, and Wolde-Mariam (2006) have demonstrated that the impact of trade openness on public revenue depends on several factors, including the structure of trade liberalization and the effect of this structure on the components of tax revenue.

The literature has underlined the importance of the institutional and governance quality for tax revenue performance (e.g. Bird, Martinez-Vazquez, and Torgler 2008; Bird, Martinez-Vazquez, and Torgler 2014; Ghura 1998). Here, we use the level of democracy in a given country as a proxy for the institutional and governance quality. Some works have underlined the close links between the democracy level of a country and its institutional and governance quality (e.g. Charron and Lapuente 2010; Desbordes and Verardi 2017; Guerin and Manzocchi 2009; Sung 2004). Greater democratization has been argued, and found, to be positively associated with tax revenue performance (e.g. Acemoglu and Robinson 2006; Boix 2001; Gould and Baker 2002; Yogo and Ngo Njib 2018). One theoretical reason for this is that as countries democratized, they tend to have better-designed tax systems that induce more voluntary tax compliance, and make less use of repressive measures as governing instruments (e.g. Wintrobe 1990; 1998). The impact of institutional and governance quality on public revenue could be a direct one as well as an indirect one on the efficiency of tax administrations to collect tax revenue. We expect a good institutional and governance quality to be positively related to tax revenue performance.

Terms of trade improvements could generate higher income for trading firms, and hence induce higher tax revenue (e.g. Agbeyegbe, Stotsky, and Wolde-Mariam 2006).

We also argue that higher inflation can result in lower tax revenue performance (Tanzi 1977), in particular when the tax system is not protected from inflation. In light of the high skewness of the inflation rate variable, and given that it contains negative values, we have transformed it as follows: $\text{INFL} = \text{sign} (\text{INFLATION}) \times \log (1 + |\text{INFLATION}|)$ (2), where $|\text{INFLATION}|$ refers to the absolute value of the annual inflation rate (%), denoted ‘INFLATION’ (see Gnangnon and Brun 2019; Yeyati, Panizza, and Stein 2007).

Finally, countries’ demographic characteristics, proxied by the size of total population, has been introduced in model (1) to capture the fact that tax systems in countries with a rapidly growing population may find it difficult to capture new taxpayers (e.g. Bahl 2003, 13). In that respect, one may expect Accordingly, we expect that the rise in the population size could be negatively associated with tax revenue performance.

Against this background, we postulate the following baseline specification:

\[
\text{NRTAX}_{it} = \alpha_1 \text{NRTAX}_{i,t-1} + \alpha_2 \text{ECI}_{it} + \alpha_3 \text{POV}_{it} + \alpha_4 \log (\text{GDPC})_{it} + \alpha_5 \text{OPEN}_{it} \\
+ \alpha_6 \text{INFL}_{it} + \alpha_7 \text{TERMS}_{it} + \alpha_8 \text{SHAGRI}_{it} + \alpha_9 \text{INST}_{it} + \alpha_{10} \log (\text{POP})_{it} \\
+ \mu_i + \gamma_t + \omega_{it}
\]  

(1)

$i$ and $t$ represent respectively a country, and the time-period. Model (1) has been estimated using an unbalanced panel dataset of 111 countries, over the period 1980–2014. Following the practice in the empirical literature, we have used non-overlapping sub-periods of 5-year (1980–1984; 1985–1989; 1990–1994; 1995–1999; 2000–2004; 2005–2009 and 2010–2014), with a view to mitigating the effect of business cycles on variables. $\alpha_1$ to $\alpha_{10}$ are coefficients to be estimated, $\mu_i$ are countries’ time-invariant specific effects; $\gamma_t$ are time dummies and stand for global shocks that affect simultaneously all countries’ tax revenue performance. $\omega_{it}$ is a well-behaving error term.
The dependent variable ‘NRTAX’ is the indicator of tax revenue performance, measured here by the ratio (in percentage) of total non-resource tax revenue to the gross domestic product (GDP). It represents the difference between the total tax revenue excluding grants and social contributions (in % GDP) and the resource tax revenue (in % GDP), the latter being the tax revenue collected on natural resources. We have used the non-resource tax revenue as a share in GDP rather than the total tax revenue share of GDP because excluding resources tax revenue from total tax revenue allows to ensure homogeneity in the tax revenue variable across countries in the full sample (e.g. Brun, Chambas, and Mansour 2015).

The first regressor of interest, ‘ECI’ is the Theil index of overall export product concentration computed by the International Monetary Fund (IMF), using the definitions and methods employed by Cadot, Carrere, and Strauss-Kahn (2011) (see Appendix 1). Higher values of this index reflect greater export product concentration, while declining values of this index indicate a higher degree of export product diversification, that is, the fact that exports are more homogeneously distributed among a series of products. The overall export product concentration is the outcome (i.e. the sum) of the export product concentration at the intensive margins, and the export product concentration at the extensive margins. Export product diversification at the intensive margins signifies a growth in the exports of already existing products, while export product diversification at the extensive margins refers to the growth in the number of active export lines, via new products and new markets. The two components of overall export product concentration are denoted ‘ECIINT’ for export product concentration at the intensive margins, and ‘ECIEXT’ for export product concentration at extensive margins. Higher values of ‘ECIINT’ and ‘ECIEXT’ reflect respectively an increase in the level of export product concentration at the intensive margins and the export product concentration at the extensive margins.

The second key regressor of interest ‘POV’ is the measure of the poverty rate. Two indicators of poverty (often used in the empirical literature) have been utilized here as well. These include the poverty headcount ratio at $1.90 a day, denoted ‘POVHC’, and the poverty gap at $1.90 a day, denoted ‘POVGAP’. The headcount poverty ratio is the main measure of poverty, while the poverty gap rate has been used for robustness check analysis. The poverty headcount at $1.90 a day represents the percentage of the population living with less than $1.90 a day, at 2011 international prices. The poverty gap accounts for the distance of the poor from the poverty line. The poverty gap at $1.90 a day (at 2011 international prices) reflects the depth and incidence of poverty, and represents the mean shortfall in income or consumption from the poverty line $1.90 a day (counting the nonpoor as having zero shortfall), expressed as a percentage of the poverty line.

All variables (including control variables used in the model (1)) are described in Appendix 1. Standard descriptive statistics on all variables are presented in Appendix 2. The list of the 111 countries of the sample is provided in Appendix 3.

4. Empirical analysis

This section presents some data analysis (Section 4.1), discusses the econometric method to conduct the empirical analysis (Section 4.2), and interprets estimations’ outcomes (Section 4.4).
4.1. Preliminary data analysis

Using the panel dataset covering the 111 countries and non-overlapping of 5-year average, we present in Figures 1 and 2 the development of export product concentration and the tax revenue variable over time, and respectively over the full sample, and two sub-samples of Least developed countries\textsuperscript{11} (LDCs) and countries in the full sample that are no LDCs (denoted ‘NonLDCs’). We also display in Figures 3 and 4 the developments of the two indicators of poverty and the tax revenue variable, respectively over the full sample, and two sub-samples of LDCs and NonLDCs. Using the same dataset, we have presented in Figures 5 and 6 a simple correlation pattern (in the form of cross-plot) between the indicators of overall export product concentration and non-resource tax revenue share of GDP on the one hand, and between each indicator of poverty and

![Figure 1](image1.png)

**Figure 1.** Export product concentration and non-resource tax revenue_Over the full sample. Source: Author.

![Figure 2](image2.png)

**Figure 2.** Export product concentration and Non-resource tax revenue_Over the sub-samples of LDCs and NonLDCs. Source: Author.
non-resource tax revenue share of GDP, on the other hand (and respectively over the full sample, and two sub-samples of LDCs and NonLDCs).

We note from Figure 1 that non-resource tax revenue share of GDP has steadily risen, from 12.6% in 1980–1984 to 15.6% in 2010–2014. At the same time, the indicator of overall export product concentration has declined from 1980–1984 to 1990–1994 (which reflects a tendency for export product diversification). It has then steadily increased over the rest of the period, thereby indicating a tendency for a greater level of export product concentration. Figure 2 shows, without surprise, that NonLDCs experienced a higher non-resource tax revenue share of GDP than LDCs. The latter experienced a rising trend for non-resource tax revenue from 8.35% in 1990–1994 to 11.94% 2010–2014, after a decline from 9.74% from 1980 to 1984 to 8.34% in 1990–1994. For NonLDCs, non-resource revenue share of GDP also exhibited an upward trend, but only slightly increased over the full period, including from 14.84% in 1980–1984 to 17.30% in 2011–2014. At the same time, over the full period, export product concentration was
far higher in LDCs than in NonLDCs. This suggests that NonLDCs diversified their export product basket at a higher level than LDCs did. However, the patterns of developments of export product concentration are not the same in LDCs and NonLDCs. In NonLDCs, export product concentration declined from 3.6 in 1980–1984 to 2.8 in 1990–1994 (which reflects a tendency for diversification), but then rebounded to reach the value of 3.25 in 2010–2014 (this reflects a tendency for concentration). In contrast, in LDCs, there seems to be a slight tendency for export product diversification, with values
of the index of export product concentration moving from 4.45 in 1980–1984 to 17.30 in 2010–2014. Figure 3 indicates, for the full sample, that after some fluctuations of poverty indicators from 1980–1984 to 1990–1994, poverty rates have steadily declined over the rest of the period. We note from Figure 4 that poverty indicators exhibited a declining trend for both LDCs and Non-LDCs over the full period, although poverty was always higher in LDCs than in Non-LDCs, regardless of the indicator of poverty considered (i.e. poverty headcount rate or poverty gap).

Figures 5 and 6 indicate, respectively, for the full sample, and the two sub-samples that there is a negative correlation pattern between overall export product concentration as well as poverty indicators with non-resource tax revenue share.

4.2. Empirical approach

Following previous studies (e.g. Agbeyegbe, Stotsky, and WoldeMariam 2006; Baunsgaard and Keen 2010; Crivelli 2016; Crivelli and Gupta 2014; Gnangnon and Brun 2018, 2019; Prichard 2016), the primary estimator used in the empirical analysis is the Blundell and Bond (1998)’s two-step system Generalized Methods of Moments (GMM) estimator. This estimator is particularly suited for dynamic panel datasets like ours, with small time dimension, and a large cross-section dimension (e.g. Roodman 2006). The two-step system GMM estimator performs better than the first-differenced GMM estimator proposed by Arellano and Bond (1991), in particular, when variables are persistent (as in such a case, the first-differenced GMM estimator generates weak instruments) and when the panel dataset is unbalanced (as in this case, gaps are magnified) (e.g. Roodman 2009). More importantly, this estimator helps handle several endogeneity concerns. These include, for example, the omitted variable bias, the endogeneity arising from the correlation between the one-period lag of the dependent variable and the error term, and the endogeneity related to the bi-directional causality between some regressors and the dependent variable. In the present analysis, the possible endogenous regressors include export product concentration and poverty indicators, as well as the institutional and governance quality, and trade openness variables. The utilization of the two-step system GMM estimator involves estimating a system of equations comprising an equation in differences, and an equation in levels, where lagged first differences being used as instruments for the levels equation, and lagged levels being used as instruments for the first-difference equation.

The consistency of the two-step system GMM estimator is assessed by the Arellano–Bond test of first-order serial correlation in the error term (AR(1)), the Arellano–Bond test of no second-order autocorrelation in the error term (denoted AR(2)), and the Sargan–Hansen test of over-identifying restrictions (OID), the latter being useful in evaluating the validity of the instruments used in the regressions. We have also presented the outcome of the Arellano–Bond test of no second-order autocorrelation in the error term (denoted AR(3)). The consistency of this estimator also rests on ensuring that there is no proliferation of instruments (e.g. Bowsher 2002; Roodman 2009), as otherwise, the tests mentioned above may lose power. To meet the requirements of the two-step system GMM estimator, the regressions have used three lags of the dependent variable as instruments, and two lags of endogenous variables as instruments, along with the Windmeijer (2005) corrected standard errors.

Tables 1–4 report the outcomes arising from the estimation of different specifications of the model (1) using the two-step system GMM approach.
Table 1. Effect of export product concentration and poverty on non-resource tax revenue. **Estimator**: two-step system GMM.

| Variables    | NRTAX (1)       | NRTAX (2)       | NRTAX (3)       | NRTAX (4)       |
|--------------|-----------------|-----------------|-----------------|-----------------|
| NRTAXt-1     | 0.565***        | 0.593***        | 0.590***        | 0.649***        |
|              | (0.0398)        | (0.0355)        | (0.0354)        | (0.0398)        |
| ECI          | −0.876***       | −0.815***       | −0.778***       | −0.0569***      |
|              | (0.189)         | (0.159)         | (0.139)         | (0.0105)        |
| POVHC        | −0.0760***      | −0.102***       | −0.0778***      | −0.0569***      |
|              | (0.0135)        | (0.0222)        | (0.0139)        | (0.0105)        |
| POVGAP       | −0.0760***      | −0.102***       | −0.0778***      | −0.0569***      |
|              | (0.0135)        | (0.0222)        | (0.0139)        | (0.0105)        |
| ECIINT       | −0.953***       | −0.953***       | −0.953***       | −0.953***       |
|              | (0.182)         | (0.182)         | (0.182)         | (0.182)         |
| ECIEXT       | 0.886***        | 0.886***        | 0.886***        | 0.886***        |
|              | (0.333)         | (0.333)         | (0.333)         | (0.333)         |
| Log(GDPC)    | −1.289***       | −0.603**        | −1.222***       | −0.161          |
|              | (0.285)         | (0.241)         | (0.321)         | (0.295)         |
| OPEN         | 0.000599        | 0.00790*        | 0.00303         | 0.00527         |
|              | (0.000506)      | (0.00455)       | (0.00484)       | (0.00513)       |
| INFL         | −0.281***       | −0.208**        | −0.294***       | −0.202**        |
|              | (0.0861)        | (0.0870)        | (0.0899)        | (0.0835)        |
| TERMS        | 0.000599***     | 0.00677***      | 0.00500**       | 0.00193         |
|              | (0.00199)       | (0.00199)       | (0.00200)       | (0.00176)       |
| SHAGRI       | −0.0344         | −0.0202         | −0.0282         | −0.0240         |
|              | (0.0212)        | (0.0193)        | (0.0242)        | (0.0214)        |
| Log (POP)    | −0.449***       | −0.374**        | −0.238          | 0.120           |
|              | (0.165)         | (0.155)         | (0.152)         | (0.163)         |
| INST         | 0.0471          | 0.0596**        | 0.0482*         | 0.0883***       |
|              | (0.0317)        | (0.0283)        | (0.0271)        | (0.0254)        |
| Observations – Countries 463 – 111 | 463 – 111 | 463 – 111 | 463 – 111 | 463 – 111 |
| Number of Instruments | 63 | 63 | 63 | 63 |
| AR1 (P-Value) | 0.0278         | 0.0282         | 0.0221         | 0.0146         |
| AR2 (P-Value) | 0.2524         | 0.2077         | 0.2640         | 0.2307         |
| AR3 (P-Value) | 0.2304         | 0.2677         | 0.2446         | 0.2976         |
| OID (P-Value) | 0.2894         | 0.1953         | 0.3845         | 0.1242         |

Notes: *p-value < .1; **p-value < .05; ***p-value < .01. Robust Standard Errors are in parenthesis. In the two-step system GMM estimations, the variables ‘ECI’, ‘ECIINT’, ‘ECIEXT’, ‘POVHC’, ‘POVGAP’, ‘INST’, ‘OPEN’ have been considered as endogenous. Time dummies have been included in the regressions, but were not significant.

Specifically, Table 1 reports the outcomes of the estimation of the dynamic model (1) that includes the overall export product concentration variable ‘ECI’ (see columns [1] and [2], respectively with each of the poverty indicator as a measure of ‘POV’). In columns [3] and [4] of Table 1, the variable ‘ECI’ has been replaced with each of its components, namely export product concentration at the intensive margins and export product concentration at the extensive margins (note that in these specifications of the model (1), the variable ‘POV’ is measured exclusively by the poverty headcount ratio – but results do not change qualitatively and quantitatively when we use alternatively the poverty gap rate).

In Table 2, we first show the results from the estimation of specifications of model (1) that help explore the effect of export product concentration and poverty on non-resource tax revenue share of GDP in LDCs versus NonLDCs. The first two specifications of the model (1) are model (1) in which we introduce the interaction variables capturing respectively the interaction between a dummy variable denoted ‘LDC’ and each of
Table 2. Effect of export product concentration and poverty on non-resource tax revenue for varying values of real per capita income. Estimator: two-step system GMM.

| Variables | NRTAX (1) | NRTAX (2) | NRTAX (3) | NRTAX (4) | NRTAX (5) | NRTAX (6) | NRTAX (7) | NRTAX (8) |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| NRTAX, t−1 | 0.615*** (0.0426) | 0.627*** (0.0386) | 0.637*** (0.0379) | 0.620*** (0.0408) | 0.614*** (0.0395) | 0.623*** (0.0320) | 0.625*** (0.0383) | 0.644*** (0.0394) |
| ECI | −1.199*** (0.253) | −1.155*** (0.228) | 8.846*** (1.532) | 7.879*** (1.431) |
| POVHC | −0.130*** (0.0233) | −0.0825*** (0.0135) | −0.0588*** (0.0123) | −0.311*** (0.0773) | −0.105*** (0.0145) | −0.0579*** (0.0102) |
| POVGAP | −0.276*** (0.0607) | −0.494*** (0.149) |
| ECI × LDC | 1.395*** (0.263) | 1.476*** (0.271) |
| POVHC × LDC | 0.0882*** (0.0238) |
| POVGAP × LDC | 0.226*** (0.0601) |
| ECIINT | −1.181*** (0.255) | 4.154** (1.744) |
| ECIINT × LDC | 0.869*** (0.308) |
| ECIEXT | −0.136 (0.780) | 9.440*** (1.787) |
| ECIEXT × LDC | 1.283* (0.735) |
| ECI × Log(GDPC) | −1.206*** (0.200) | −1.076*** (0.188) |
| POVGAP × Log(GDPC) | 0.0351*** (0.0117) |
| ECIINT × Log(GDPC) | 0.0631*** (0.0231) |
| ECIEXT × Log(GDPC) | −0.606*** (0.223) |
| LDC | −6.529*** (1.285) | −6.480*** (1.336) | −1.074 (1.156) | 1.450* (0.838) |
| Log(GDPC) | −1.198*** (0.403) | −0.648 (0.385) | −0.918 (0.446) | 0.565 (0.358) | 2.401*** (0.691) | 2.771*** (0.701) | 0.235 (0.655) | 0.294 (0.343) |
| OPEN | 0.00277 (0.00539) | 0.00367 (0.00486) | 0.00819 (0.00541) | 0.00292 (0.00635) | −0.00657 (0.00501) | −0.00313 (0.00485) | −0.00239 (0.00537) | −0.00155 (0.00533) |
| INFL | −0.103 (0.0780) | −0.105 (0.0765) | −0.102 (0.0852) | −0.0689 (0.0784) | −0.177*** (0.0890) | −0.126 (0.0857) | −0.236*** (0.0894) | −0.152** (0.0815) |
| TERMS | 0.00305 (0.00194) | 0.00379** (0.00178) | 0.00166 (0.00184) | −0.000731 (0.00152) | 0.00776*** (0.00232) | 0.00951*** (0.00197) | 0.00390* (0.00210) | 0.000789 (0.00160) |
| SHAGRI | −0.0407 (0.0241) | −0.0266 (0.0224) | −0.0369 (0.0259) | −0.0325 (0.0223) | −0.0391** (0.0236) | −0.0499** (0.0220) | −0.0188 (0.0234) | −0.0315 (0.0203) |
| INST | 0.0236 (0.0273) | 0.0323 (0.0240) | 0.0223 (0.0280) | 0.0589** (0.0283) | 0.0526* (0.0228) | 0.0541* (0.0294) | 0.0235 (0.0285) | 0.0715*** (0.0284) |
| Log(POP) | −0.201 (0.184) | −0.0633 (0.162) | −0.198 (0.173) | 0.0479 (0.176) | −0.00249 (0.179) | −0.000711 (0.158) | −0.139 (0.169) | 0.241 (0.160) |
| Observations – Countries | 463 − 111 | 463 − 111 | 463 − 111 | 463 − 111 | 463 − 111 | 463 − 111 | 463 − 111 | 463 − 111 |
| Number of instruments | 65 | 65 | 65 | 64 | 65 | 64 | 65 | 64 |
| AR1 (P-Value) | 0.0253 | 0.0263 | 0.0242 | 0.0185 | 0.0263 | 0.0325 | 0.0213 | 0.0134 |
| AR2 (P-Value) | 0.2426 | 0.2143 | 0.2613 | 0.2848 | 0.1154 | 0.1075 | 0.1620 | 0.3275 |
| AR3 (P-Value) | 0.2267 | 0.2514 | 0.2531 | 0.2807 | 0.3474 | 0.4215 | 0.2450 | 0.2917 |
| OID (P-Value) | 0.1638 | 0.1134 | 0.2261 | 0.1731 | 0.3518 | 0.2439 | 0.2340 | 0.2452 |

Notes: *p-value < .1; **p-value < .05; ***p-value < .01. Robust Standard Errors are in parenthesis. In the two-step system GMM estimations, the variables ‘ECI’, ‘ECHINT’, ‘ECIEEXT’, ‘POVGAP’, ‘INST’, ‘OPEN’ have been considered as endogenous. Time dummies have been included in the regressions, but were not significant.
Table 3. Interaction effect between export product concentration and poverty on non-resource tax revenue.

| Variables | NRTAX (1) | NRTAX (2) | NRTAX (3) | NRTAX (4) | NRTAX (5) | NRTAX (6) |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| NRTAX\_t-1 | 0.604*** (0.0259) | 0.592*** (0.0263) | 0.594*** (0.0282) | 0.627*** (0.0258) | 0.659*** (0.0318) | 0.626*** (0.0299) |
| ECI × POVHC | 0.0262*** (0.00497) | 0.0523*** (0.00830) | 0.00760 (0.00504) | 0.0153* (0.00848) | 0.0504*** (0.00807) | 0.0781*** (0.0122) |
| ECIINT × POVGAP | 0.0262 | 0.0523*** | 0.00760 (0.00504) | 0.0153* (0.00848) | 0.0504*** (0.00807) | 0.0781*** (0.0122) |
| ECIEXT × POVHC | 0.0262 | 0.0523*** | 0.00760 (0.00504) | 0.0153* (0.00848) | 0.0504*** (0.00807) | 0.0781*** (0.0122) |
| ECIINT × POVGAP | 0.00760 (0.00504) | 0.0153* (0.00848) | 0.0504*** (0.00807) | 0.0781*** (0.0122) |
| ECIEXT × POVGAP | 0.0504*** (0.00807) | 0.0781*** (0.0122) |
| ECI | −1.447*** (0.192) | −1.416*** (0.175) | −1.280*** (0.186) | −1.165*** (0.167) | −1.494*** (0.526) | −1.030*** (0.459) |
| ECIINT | −1.465*** (0.223) | −0.963*** (0.182) | −1.448*** (0.282) | −0.585*** (0.210) | −0.429 (0.263) | −0.672 (0.174) |
| ECIEXT | −0.278*** (0.0622) | −0.294*** (0.0676) | −0.347*** (0.0848) | −0.316*** (0.0910) | −0.216*** (0.0795) | −0.193*** (0.0779) |
| POVHC | −0.176*** (0.0233) | −0.0970*** (0.0225) | −0.0804*** (0.00777) | 0.000678 | 0.00491 | 0.00467 | 0.00432 | 0.00297 | 0.00553 |
| POVGAP | −0.312*** (0.0378) | −0.118*** (0.0336) | −0.141*** (0.0144) | 0.000678 | 0.00491 | 0.00467 | 0.00432 | 0.00297 | 0.00553 |
| Log(GDPC) | −1.465*** (0.223) | −0.963*** (0.182) | −1.448*** (0.282) | −0.585*** (0.210) | −0.429 (0.263) | −0.672 (0.174) |
| OPEN | 0.000678 | 0.00491 | 0.00467 | 0.00432 | 0.00297 | 0.00553 |
| INFL | −0.278*** (0.0622) | −0.294*** (0.0676) | −0.347*** (0.0848) | −0.316*** (0.0910) | −0.216*** (0.0795) | −0.193*** (0.0779) |
| TERMS | 0.00634*** (0.00142) | 0.00817*** (0.00145) | 0.00801*** (0.00155) | 0.00987*** (0.00174) | 0.00440*** (0.00128) | 0.00485*** (0.00141) |
| SHAGRI | −0.0474*** (0.0169) | −0.0547*** (0.0139) | −0.0366** (0.0162) | −0.0281* (0.0158) | −0.0321* (0.0186) | −0.0313* (0.0176) |
| INST | 0.0182 | 0.00384 | 0.0646** (0.0248) | 0.0944*** (0.0202) | 0.0718*** (0.0198) | 0.0587*** (0.0208) |
| Log(POP) | −0.310*** (0.0210) | −0.400*** (0.0199) | −0.225** (0.0248) | −0.186** (0.0202) | 0.164 (0.0202) | 0.0379 (0.0202) |
| Turning Point of ‘POVHC’ or ‘POVGAP’ | 55.22 (1 = 1.447/0.0262) | 27.07 (1 = 1.416/0.0253) | 29.6 (1 = 1.494/0.0254) | 13.2 (1 = 1.30/0.0254) | 0.0781 (1 = 1.30/0.0254) |
| Observations – Countries | 463 – 111 | 463 – 111 | 463 – 111 | 463 – 111 | 463 – 111 | 463 – 111 |
| Number of Instruments | 73 | 73 | 73 | 73 | 73 | 73 |

Note: *p-value < .1; **p-value < .05; ***p-value < .01. Robust standard errors are in parenthesis. In the two-step system GMM estimations, the variables ‘ECI’, ‘ECIINT’, ‘ECIEXT’, ‘POVHC’, ‘POVGAP’, ‘INST’, ‘OPEN’ have been considered as endogenous. Time dummies have been included in the regressions, but were not significant.
Table 4. Channels through which export product concentration and poverty influence non-resource tax revenue performance. **Estimator:** two-step system GMM.

| Variables                  | NRTAX  | NRTAX  | NRTAX  | NRTAX  | NRTAX  |
|----------------------------|--------|--------|--------|--------|--------|
|                            | (1)    | (2)    | (3)    | (4)    | (5)    |
| NRTAX\(_t-1\)              | 0.633*** (0.0348) | 0.629*** (0.0268) | 0.616*** (0.0173) | 0.671*** (0.0274) | 0.689*** (0.0229) |
| ECI × GRVOL                 | −0.157*** (0.0262) | | | | |
| ECI × GROWTH                | 0.0346 (0.0346) | −0.286*** (0.0273) | | | |
| ECI × GROWTH\(^2\)         | 0.0329*** (0.00298) | | | | |
| POVHC × GRVOL               | −0.0968*** (0.0122) | −0.0564*** (0.00904) | −0.0515*** (0.00672) | −0.0355*** (0.0119) | −0.00969*** (0.00119) |
| POVGAP × GRVOL              | | | | | −0.0238*** (0.00234) |
| ECI                         | 0.251 (0.206) | −1.151*** (0.210) | −0.190** (0.0875) | −0.525*** (0.184) | −0.497*** (0.153) |
| POVHC                       | −0.0968*** (0.0122) | −0.0564*** (0.00904) | −0.0515*** (0.00672) | −0.0355*** (0.0119) | −0.00969*** (0.00119) |
| POVGAP                      | | | | 0.00159 (0.0167) | |
| GRVOL                       | 0.669*** (0.111) | | | | |
| GROWTH                      | | | 1.717*** (0.120) | | |
| GROWTH\(^2\)               | | | −0.178*** (0.0147) | | |
| Log(GDPC)                   | −1.833*** (0.287) | −1.112*** (0.198) | −1.108*** (0.152) | −1.861*** (0.274) | −1.223*** (0.200) |
| OPEN                        | 0.00326 (0.00505) | 0.00533 (0.00342) | 0.00576*** (0.00178) | 0.00856* (0.00492) | 0.0110*** (0.00436) |
| INFL                        | −0.217*** (0.0829) | −0.199*** (0.0634) | −0.0925** (0.0462) | −0.176** (0.0797) | −0.105 (0.0819) |
| TERMS                       | 0.00292* (0.00176) | 0.00778*** (0.00173) | 0.00626*** (0.00925) | 0.00767*** (0.00173) | 0.00798*** (0.00156) |
| SHAGRI                      | −0.0434** (0.0188) | −0.0220** (0.0110) | −0.0248*** (0.00530) | −0.0535*** (0.0155) | −0.0474*** (0.0148) |
| INST                        | 0.0569** (0.0252) | 0.0467*** (0.0225) | 0.0744*** (0.00998) | 0.0509** (0.0203) | 0.0643*** (0.0173) |
| Log(POP)                    | −0.307** (0.126) | −0.120 (0.0846) | −0.151** (0.0685) | −0.0800* (0.124) | −0.0132 (0.101) |
| Observations – Countries    | 462 – 110 | 463 – 111 | 463 – 111 | 462 – 110 | 462 – 110 |
| Number of instruments       | 74 | 83 | 100 | 74 | 74 |
| AR1 (P-Value)               | 0.0246 | 0.0265 | 0.0671 | 0.0194 | 0.0210 |
| AR2 (P-Value)               | 0.2877 | 0.1959 | 0.8631 | 0.2259 | 0.1787 |
| AR3 (P-Value)               | 0.2342 | 0.2450 | 0.1815 | 0.2548 | 0.2702 |
| Old (P-Value)               | 0.3513 | 0.2628 | 0.5431 | 0.4199 | 0.6028 |

Notes: *p-value < .1; **p-value < .05; ***p-value < .01. Robust Standard Errors are in parenthesis. In the two-step system GMM estimations, the variables 'ECI', 'GRVOL', 'GROWTH', 'POVHC', 'POVGAP', 'INST', and 'OPEN' have been considered as endogenous. Time dummies have been included in the regressions, but were not significant.

A non-resource tax revenue share of GDP in LDCs versus NonLDCs. The outcomes of the estimation of these models are presented in columns [3] and [4] of Table 2. As estimates provided in columns [1] to [4] of Table 2 represent average effects across sub-samples (of LDCs and NonLDCs) and can indeed vary across countries in the full sample, we find it useful to deepen the analysis by investigating how the effects of export product concentration (both overall export product concentration, and each of its two
components) and poverty affect non-resource tax revenue share of GDP for varying levels of the real per capita income in the full sample. The outcomes of these investigations are reported in columns [5]–[8] of Table 2. To obtain these results, we estimate several specifications of the model (1) in which we introduce the interaction variable that captures, on the one hand, the interaction between the indicator of export product concentration and the real per capita income and, on the other hand, the interaction between the poverty indicator and the real per capita income. Note that for the regressions that involve the assessment of how each component of overall export product concentration influences non-resource tax revenue share of GDP as the real per capita income changes, only the poverty headcount ratio has been used as a measure of the variable ‘POV’ (results do not change quantitatively or qualitatively when ‘POV’ is measured by the poverty gap rate – these results could be obtained upon request).

Table 3 contains the estimates arising from different specifications of the model (1) that allow testing the question at the heart of this analysis, that is, how export product concentration and poverty interacts in influencing non-resource tax revenue share of GDP. These model specifications contain the interaction between each indicator of export product concentration (i.e. the overall export product concentration, and alternatively each of its components) and each poverty indicator.

Finally, the outcomes in Table 4 allow exploring the channels through which export product diversification and poverty affect non-resource tax revenue performance. As discussed in Section 2, economic growth volatility and economic growth are two indirect channels through which export product concentration can affect non-resource tax revenue. We have also postulated that the effect of poverty on non-resource tax revenue performance can pass through the economic growth volatility channel. The empirical analysis carried out here has used the poverty headcount ratio (our preferred measure of poverty) as the measure of the variable ‘POV’. Note that similar results are obtained when we use the poverty gap rate as the measure of poverty (and can be obtained upon request). To examine empirically whether the effect of export product concentration (or diversification) on non-resource tax revenue performance works through the economic growth volatility channel, we estimate a variant of the model (1) that includes the variable capturing the economic growth volatility as well as its interaction with the overall export product concentration variable. The results of the estimation of this variant of the model (1) by means of the two-step system GMM approach are provided in column [1] of Table 4. The variable measuring the economic growth volatility (denoted ‘GRVOL’) has been computed as the standard deviation of the annual economic growth rate (growth rate of real GDP) over each of the aforementioned seven non-overlapping sub-periods of 5-year. We also investigate the extent to which the effect of export product concentration (or diversification) on non-resource tax revenue performance depends on the economic growth rate by estimating another variant of the model (1) that includes the measure of economic growth rate (i.e. the annual growth rate (%) of real GDP, denoted ‘GROWTH’) and the interaction between the latter and the indicator of overall export product concentration. Results of the estimation of this model specification are presented in column [2] of Table 4. Columns [3] and [4] contain the estimates that allow examining whether the effect of poverty on non-resource tax revenue performance depends on the economic growth rate volatility. Model specifications used to obtain these estimates are model (1) that includes the economic growth volatility variable and the interaction between this variable and each poverty indicator.
4.3. Discussion of empirical outcomes

For the sake of simplicity, we refer in this section to ‘non-resource tax revenue share of GDP’ as ‘non-resource tax revenue’.

We note from all columns of Tables 1–4 that the one-period lag of the dependent variable is always positive and significant at the 1% level. This highlights the persistence of the non-resource tax revenue over time, and thus, the need for considering a dynamic specification of the model (1) in the analysis. Additionally, the OID test and the autoregressive AR(1), AR(2), and AR(3) tests have yielded expected outcomes. Specially, the \( p \)-values of the AR(1) are lower than .05, while the AR(2) and AR(3) tests yield \( p \)-values higher than .10. The \( p \)-values of the OID test are also always higher than .10. Overall, these outcomes indicate that the two-step system GMM estimator is appropriate to conduct the empirical analysis.

Turning now to results in Table 1, we note from columns [1] and [2] that both the overall export product concentration, and the two poverty indicators exert a negative and significant effect (at the 1% level) on non-resource tax revenue share in GDP. The estimates associated with the variable ‘ECI’ are lower than those reported in columns [3] and [4] of Table 1. Findings in columns [1] and [2] of Table 1 confirm our theoretical expectations (see Assumptions 1 and 2) that greater export product concentration and a rise in poverty rates induce lower non-resource tax revenue performance in developing countries. Focusing on the results in column [1] of Table 1, we find that a 1-point increase in the index of overall export product concentration induces a 0.88-point decline in non-resource tax revenue. In other words, an increase in the index of overall export product concentration by a one standard deviation is associated with a 0.98 point \( (= 1.117 \times 0.876) \) fall in non-resource tax revenue. Likewise, a 1-point increase in the poverty headcount ratio generates a 0.08-point fall in non-resource tax revenue. Put it differently, an increase in the poverty headcount ratio by a one standard deviation results in a fall in non-resource tax revenue by a 1.3-point \( (= 12.866 \times 0.102) \).

Estimates related to control variables in columns [1] and [2] suggest that at the 5% level, lower inflation, improvements in terms of trade, and lower population size are positively and significantly associated with non-resource tax revenue performance. An improvement in the institutional and governance quality exerts a positive effect on non-resource tax revenue performance (see results in column [2] of Table 1). The coefficient of the variable capturing the share of value added in agriculture in total output is yet negative, as expected, but not significant at the conventional levels. Similarly, trade openness does not affect non-resource tax revenue. However, real per capita income appears to be negatively and significantly associated with non-resource tax revenue performance. This surprising outcome aligns with the findings by Gnangnon and Brun (2017). The latter has obtained a negative impact of the real per capita income on non-resource tax revenue, using a panel dataset containing both developed and developing countries. This indicates that less developed countries performed better in terms of the non-resource tax revenue share of GDP than relatively more advanced economies among developing countries. One possible explanation for this outcome can be that an improvement in the real per capita income might not be sufficient to explain the
differences between countries’ non-resource tax revenue performance in the sample. For example, a higher real per capita income could contribute to enhancing non-resource tax revenue performance when the institutional quality and governance concomitantly improves. We do not go further into this analysis, as it is not the topic at the heart of the present study.

Results in columns [3] and [4] of Table 1 show that the poverty indicator (here poverty headcount ratio) still holds a negative and significant coefficient. However, the negative effect of overall export product concentration on non-resource tax revenue performance found in column [1] of Table 1 reflects a negative and significant (at the 1% level) effect of export product concentration at the intensive margins on non-resource tax revenue, and a positive and significant effect of export product concentration at the extensive margins on non-resource tax revenue. These suggest that export product diversification at the intensive margins enhances non-resource tax revenue performance, whereas export product concentration at the extensive margins influences it positively. However, these findings certainly hide differentiated effects across countries in the full sample. This is what we will examine in Table 3. Before moving to the results in this table, we note here that a 1-point increase in the index of export product concentration at the intensive margins is associated with a 0.95-point decline in non-resource tax revenue. Expressed differently, a rise in the index of export product concentration at the intensive margins by a 1 standard deviation (i.e. 0.979) leads to a fall in non-resource tax revenue by 0.93 point \((= 0.979 \times 0.953)\). For export product concentration at the intensive margins, a 1-point increase in this index leads to a 0.89-point rise in non-resource tax revenue. Alternatively, an increase in the index of export product concentration at the extensive margins by a 1 standard deviation (i.e. 0.549) results in a rise in non-resource tax revenue by 0.49 point \((= 0.886 \times 0.549)\).

Turning now to Table 2, we obtain from column [1] that the net effects of export product concentration on non-resource tax revenue in LDCs and NonLDCs amount respectively to 0.20 \((= −1.199 + 1.395)\) and −1.199. These results suggest that export product concentration exerts a positive effect on non-resource tax revenue in LDCs, while in NonLDCs, it is rather export product diversification that positively affects (raises) non-resource tax revenue. These findings are in line with those of Gnangnon and Brun (2017). Additionally, we find that a rise in poverty headcount rate results in a fall of non-resource tax revenue in both LDCs and NonLDCs. The net effects of poverty headcount rate on non-resource tax revenue in LDCs and NonLDCs amount respectively to −0.042 \((= −0.130 + 0.0882)\) and −0.130. These results show that higher poverty headcount rates exert a higher negative effect on non-resource tax revenue in NonLDCs than in LDCs. These findings obtained from estimates in column [1] are confirmed by those arising from results in column [2]. Specifically, estimates in column [2] show that the net effects of the poverty gap on non-resource tax revenue in LDCs and NonLDCs amount respectively to −0.05 \((= −0.276 + 0.226)\) and −0.276.

Results in column [3] of Table 2 show that the net effect of export product concentration at the intensive margins on non-resource tax revenue in LDCs and NonLDCs are respectively given by −0.31 \((= −1.181 + 0.869)\) and −1.181. As a result, export product diversification at the intensive margins raises non-resource tax revenue in both LDCs and NonLDCs, and the magnitude of this positive effect is higher in NonLDCs than in LDCs. However, we note from estimates in column [4] that export product concentration at the extensive margins influences positively non-resource tax revenue in LDCs, but only at the 10% level. As noted above, outcomes in columns [1] to [4] of
Table 2 provide average effects for sub-samples, and may hide differentiated effects of export product concentration and poverty on non-resource tax revenue across countries in the full sample. To address this shortcoming, we turn to results in columns [5] to [8] of Table 2. Taking up estimates in columns [5] and [6] of the Table, we find that the coefficient of ‘ECI’ is positive and significant at the 1% level, while the interaction term of the variable [‘ECI × Log(GDPC)’] is negative and significant at the 1% level. The combination of these two outcomes indicates that there is a turning point of the real per capita income above which the total effect of overall export product concentration changes sign, that is, becomes negative; otherwise, it is positive. Focusing on the results in column [1] of Table 2, we find that the value of this turning point of the real per capita income is US$ 1533 [ = exponential(8.846/1.206)]. Hence, for countries whose real per capita income is lower than US$ 1533 (i.e. this category primarily includes low-income countries), overall export product concentration exerts a positive and significant effect on non-resource tax revenue. Additionally, among these countries, the lower the real per capita income, the higher is the magnitude of the positive effect of overall export product concentration on non-resource tax revenue. This finding aligns with that of Gnangnon and Brun (2017) who have also obtained that overall export product concentration influences positively non-resource tax revenue in low-income countries. This outcome can be explained by the fact that in low-income countries, trading firms contribute significantly to improving tax revenue performance through their export earnings that rely heavily on primary commodities. In such a context, one could expect that export product concentration (including on primary commodities) would be associated with higher non-resource tax revenue. Countries whose real per capita income exceeds US$ 1533 experience a positive effect of overall export product diversification on non-resource tax revenue, and the higher the real per capita income, the greater is the magnitude of the positive effect of export product diversification on non-resource tax revenue.

Meanwhile, results in column [4] of Table 2 indicate that the coefficient of ‘POVHC’ is negative and significant at the 1% level, and the interaction term of the variable [‘POVHC × Log(GDPC)’] is positive and significant at the 1% level. Taken together, these two outcomes suggest that the total effect of poverty headcount ratio on non-resource tax revenue changes once the real per capita income exceeds US$ 7047.3 [ = exponential(0.311/0.0351)]. Thus, a rise in poverty headcount ratio influences negatively non-resource tax revenue in countries whose real per capita income is lower than US$ 7047.3. For this set of countries, the magnitude of this negative effect rises as the real per capita income declines, that is, low-income countries experience a higher negative effect of poverty headcount ratio on non-resource tax revenue than relatively advanced countries in the full sample. However, in countries with a real per capita income higher than the US$ 7047.3, the poverty headcount ratio exerts a positive effect on non-resource tax revenue. For this group of countries, the magnitude of the positive effect of poverty headcount ratio on non-resource tax revenue increases as the real per capita income rises. These findings can be explained by the fact that in contrast with countries with a real per capita income lower than US$ 7047.3, those whose real per capita income exceeds US$ 7047.3 are more capable of compensating the negative effect of higher poverty rates on non-resource tax revenue. They can do so by increasing tax rates on richer people (if such a measure can be politically acceptable), or reducing tax relief and tax exemptions granted to the segment of rich people in the population. Results in column [5] of Table 2 concerning the total effect of the poverty gap on non-resource tax revenue display similar patterns to those concerning the non-resource tax revenue
effect of poverty headcount ratio. In fact, we also find a negative and significant (at the 1% level) coefficient of ‘POVGAP’, and a positive and significant (also at the 1% level) interaction term of the variable ['POVGAP × Log(GDPC)']. Therefore, the reasoning above also applies here as well, with the difference being that the turning point of the real per capita income above which the total effect of poverty gap on non-resource tax revenue changes sign is US$ 2512 [ = exponential (0.494/0.0631)].

Overall, the key messages from columns [5] and [6] of Table 2 are that export product diversification contributes to enhancing non-resource tax revenue performance in relatively advanced developing countries, while in low-income countries, it is rather export product concentration that influences positively non-resource tax revenue. Additionally, poverty tends to affect negatively non-resource tax revenue in less developed countries, while in relatively ‘advanced’ developing countries, it is positively associated with non-resource tax revenue.

The outcomes in columns [7] and [8] of Table 2 suggest that the effect of each component of the overall export product concentration on non-resource tax revenue depends on countries’ real per capita income. In fact, we note from the two columns that the coefficients of ‘ECIINT’ and ‘ECIEXT’ are both positive and significant respectively at the 5% level, and the 1% level, whereas the interaction terms related to the relevant interaction variables are negative and significant at the 1% level. Based on these outcomes, we conclude that both export product diversification at the intensive margins, and at the extensive margins exert a positive and significant effect on non-resource tax revenue only when the real per capita income exceeds a certain level. The value of this turning point of the real per capita income amounts to US$ 948.4 [ = exponential (4.154/0.606)] (for the outcomes based on export product concentration at the intensive margins) and US$ 1408.7 [ = exponential (9.440/1.302)] (for the outcomes based on export product concentration at the extensive margins). Hence, it is still for relatively low-income countries that export product concentration either at the intensive margins or at the extensive margins, induces a higher non-resource tax revenue performance. These findings line up with the previous one, whereby overall export product concentration is positively associated with non-resource tax revenue in relatively low-income countries. In contrast, countries whose real per capita income exceeds US$ 948.4 and US$ 1408.7 experience, respectively a positive non-resource revenue effect of both export product diversification at the intensive margins, and export product diversification at the extensive margins. For these countries, the magnitude of this positive effect rises with the real per capita income.

Considering now estimates in Table 3, we note that across columns [1] and [2], the coefficients of the interaction variables ['ECI × POVHC'] and ['ECI × POVGAP'] are positive and significant at the 1% level. These suggest that export product diversification is positively associated with non-resource tax revenue in countries that experience lower poverty rates (this finding validates assumption 3, but not assumption 4). Alternatively, a fall in poverty rates influences positively non-resource tax revenue in countries that diversify their export products basket. As reported at the bottom of Table 3, the turning points of poverty headcount ratio and poverty gap rate above which export product diversification exerts a negative effect on non-resource tax revenue performance, are respectively 55.2 and 27.1. To recall, the maximum values of the variables ‘POVHC’ and ‘POVGAP’ in the full sample are respectively 94.4 and 64.5 (see Appendix 2). Therefore, we can conclude that as long as poverty headcount rates are lower than 55.22 or poverty gap rates are lower than 27.07, export product diversification induces a greater non-resource tax revenue performance, and the magnitude of this positive effect rises
as poverty rates become lower. Conversely, when poverty headcount and poverty gap rates exceed the respective turning points 55.2 and 27.1, export product diversification becomes negatively associated with non-resource tax revenue performance, and the higher the poverty rate, the greater is the magnitude of the negative effect of export product diversification on non-resource tax revenue.

In a nutshell, the take-home message of columns [1] and [2] of Table 3 is that export product diversification and poverty genuinely interact in influencing non-resource tax revenue performance in developing countries. Export product diversification leads to higher non-resource tax revenue when poverty rates are relatively low, as for higher poverty rates, it induces lower non-resource tax revenue performance.

Results in columns [3] and [4] of Table 3 show that the interaction terms are not significant at the 5% level. These outcomes reveal that the effect of export product concentration at the intensive margins on non-resource tax revenue performance does not depend on the level of poverty. Thus, the findings drawn from the estimates in columns [1] and [2] of Table 3 concerning how the overall export product diversification and poverty interact in influencing non-resource tax revenue performance, are not driven by export product diversification at the intensive margins, but instead by export product diversification at the extensive margins, as shown by results in columns [5] and [6] of the same table. We observe in these two latter columns that the coefficients of both ['ECIEXT * POVHC'] and ['ECIEXT * POVGAP'] are significant at the 1% level. These signify that export product diversification at the extensive margins exerts a positive effect on non-resource tax revenue performance in countries that experience lower poverty rates. Given that the coefficients of 'ECIEXT' are negative and significant (at the 1% level) in columns [5] and [6] of Table 3, we conclude that export product diversification at the extensive margins influences positively non-resource tax revenue performance only when the poverty rate is below the values 29.6 and 13.2, respectively for poverty headcount and poverty gap indicators (see the bottom columns [5] and [6] of Table 3).

Finally, we examine the outcomes in Table 4. In column [1] of this Table, the coefficient of the interaction variable ['ECI * GRVOL'] is negative and significant at the 1% level, while the variable ‘ECI’ exhibits a positive but not significant coefficient at the conventional levels. Thus, the overall export product concentration induces lower non-resource tax revenue performance in countries that experience a higher economic growth volatility, and the greater the level of economic volatility, the higher is the magnitude of the negative effect of export product concentration on non-resource tax revenue performance. This also means that greater overall export product diversification contributes to enhancing non-resource tax revenue performance in the context of higher economic growth volatility.

We also obtain from column [2] of Table 4 that the interaction term of ['ECI × GROWTH'] is not significant at the conventional levels, whereas the coefficient of ‘ECI’ is negative and significant at the 1% level. Therefore, we may be tempted to deduce that the effect of export product diversification on non-resource tax revenue performance does not pass through the economic growth channel: regardless of the level of economic growth, export product diversification always leads to a higher non-resource tax revenue performance. However, this conclusion may be misleading because there may eventually be a non-linear relationship concerning the joint effect of export product diversification and economic growth on tax revenue performance in developing countries. In other words, the effect of export product diversification on tax revenue performance through the economic growth channel may be non-linear. We
attempt to check this hypothesis by considering the same model specification as the one whose results are reported in column [2] of Table 4, and by adding to this model specification the squared terms of the economic growth variable along with the interaction between this squared term variable and the overall export product concentration variable. The outcomes of the estimation of this new model specification by the two-step system GMM estimator are reported in column [3] of Table 4. We find that the interaction term associated with the interaction variable ‘ECI × GROWTH’ is negative and significant at the 1% level. At the same time, the interaction term concerning the interaction variable ‘ECI × GROWTH²’ is positive and significant at the 1% level. In light of the difficulties of interpreting these coefficients, we present in Figure 7, at the 95% confidence intervals, the marginal impact of export product concentration on tax revenue performance for varying rates of economic growth. The figure indicates that the values of this marginal impact can be positive or negative, and the marginal impact declines as economic growth rates rises. In other words, export product diversification influences positively tax revenue performance when the economic growth rate exceeds 0.15 percentage (to recall, values of economic growth rates range between −11.5 and 21.6 − see Appendix 2). Additionally, the magnitude of the positive effect of export product diversification on tax revenue performance increases as countries enjoy a higher economic growth rate. In contrast, for economic growth rates lower than 0.15 percentage, it is rather export product concentration that positively influences tax revenue performance.

Estimates in column [4] of Table 4 show negative and significant coefficients (at the 1% level) of both ‘POVHC × GRVOL’ and ‘POVHC’ variables. Similarly, as per results in column [5] of Table 4, the interaction term of the variable ‘POVGAP × GRVOL’ is negative and significant at the 1% level, while the coefficient of the variable ‘POVGAP’ is not significant at the conventional levels. Taken together, these results indicate that the effect of poverty (poverty headcount or poverty gap) on non-resource tax revenue genuinely depends on the degree of economic growth volatility. In fact, regardless of the

Figure 7. Marginal Impact of ‘ECI’ on ‘NRTAX’, for varying rates of economic growth. Source: Author.
degree of economic growth volatility, poverty always influences negatively non-resource tax revenue performance. But, the magnitude of this adverse effect rises with the level of economic growth volatility.

Results concerning control variables in Tables 2–4 are largely consistent with those in Table 1, particularly in columns [1] and [2] of Table 1.

5. Additional robustness check analysis

This section deepens the analysis carried out, thus far, on how export product concentration and poverty interact in influencing non-resource tax revenue. It does so by replacing the indicator of export product concentration with that of economic complexity in the model (1). The concept of ‘economic complexity’ measures the sophistication of a country’s productive structure, which reflects the diversity of this country (i.e. the number of products it exports) and the ubiquity of its products (i.e. the number of countries that also export these products) (e.g. Hausmann and Hidalgo 2009). Thus, complex products have a heavy technological content, cannot be easily reproduced by other countries (they have a low ubiquity), but are produced by few countries endowed with a wide range of diverse and exclusive capabilities. The empirical analysis is performed here using the economic complexity index developed by the Observatory of Economic Complexity of the Massachusetts Institute of Technology (see Appendix 1). For a given country, higher values of this index indicate that this country produces increasingly complex exported products, while lower values show that the products exported by the country are rather simpler. The robustness check analysis is, therefore, performed by using the two-step system GMM approach to estimate several variants of the model (1) where the variable ‘ECI’ has been replaced with the index of economic complexity, denoted ‘ECONCOMP’.

The first variant of the model (1) is nothing else than model (1) as it stands, and where ‘ECI’ has been replaced with ‘ECONCOMP’. It helps investigate the effect of economic complexity on non-resource tax revenue over the full sample. Results of the estimation of this model specification are reported in column [1] of Table 5. The second model specification is model (1) (with ‘ECONCOMP’) in which we introduce the interaction between the economic complexity index and the real per capita income. This specification of the model (1) allows exploring how the effect of economic complexity on non-resource tax revenue varies across countries in the full sample. The outcomes arising from the estimation of this model are displayed in column [2] of Table 5. Columns [3] and [4] contain estimates that help examine how economic complexity and each of the two poverty indicators interact in influencing non-resource tax revenue. These results are obtained by estimating two different other variants of the model (1) (including where ‘ECI’ is replaced with ‘ECONCOMP’) that contain the interaction between the economic complexity index and the index of poverty headcount rate (see results in column [3]), and the interaction between the economic complexity index and the index of poverty gap (see results in column [4]).

Estimates reported in all columns of Table 5 confirm the persistence nature of the non-resource tax revenue share (the coefficient of the one-period lag of the dependent variable is always positive and significant at the 1% level). Moreover, the results of the diagnostic tests to check the consistency of the two-step system GMM are fully satisfactory (see results at the bottom of Table 5). Column 1 of Table 1 shows a positive and significant effect (at the 5% level) of economic complexity on non-resource tax revenue. This indicates that greater economic complexity influences positively non-resource tax
Table 5. Robustness check: Effect of economic complexity and poverty on non-resource tax revenue. *Estimator*: two-step system GMM.

| Variables        | NRTAX \(_t-1\) (1) | NRTAX \(_t-1\) (2) | NRTAX \(_t-1\) (3) | NRTAX \(_t-1\) (4) |
|------------------|----------------------|----------------------|----------------------|----------------------|
| NRTAX \(_t-1\)   | 0.603***             | 0.579***             | 0.577***             | 0.590***             |
|                  | (0.0285)             | (0.0211)             | (0.0177)             | (0.0207)             |
| ECONCOMP         | 0.479***             | -10.58***            | 2.048***             | 2.009***             |
|                  | (0.215)              | (1.483)              | (0.191)              | (0.233)              |
| POVHC            | -0.0706***           | -0.106***            | -0.123***            |                     |
|                  | (0.0119)             | (0.00766)            | (0.00798)            |                     |
| POVGAP           | -0.0706***           | -0.106***            | -0.123***            |                     |
|                  | (0.0119)             | (0.00766)            | (0.00798)            |                     |
| ECONCOMP × Log(GDPC) | 1.371***         |                     | -0.0516***           |                     |
|                  | (0.189)              |                     | (0.00446)            |                     |
| ECONCOMP × POVHC |                     | -0.105***            | -0.0516***           |                     |
|                  |                     | (0.00446)            | (0.00446)            |                     |
| Log(GDPC)        | -0.668**             | -0.964***            | -1.472***            | -1.414***            |
|                  | (0.309)              | (0.284)              | (0.238)              | (0.160)              |
| OPEN             | 0.00355              | -0.00771**           | -0.00981***          | -0.00538*            |
|                  | (0.00463)            | (0.00387)            | (0.00313)            | (0.00312)            |
| INFL             | -0.0938              | -0.105***            | -0.237***            | -0.220***            |
|                  | (0.0748)             | (0.0405)             | (0.0563)             | (0.0597)             |
| TERMS            | 0.00582***           | 0.00541***           | 0.0107***            | 0.0117***            |
|                  | (0.00152)            | (0.00142)            | (0.00117)            | (0.00152)            |
| SHAGRI           | -0.0898***           | -0.0876***           | -0.105***            | -0.127***            |
|                  | (0.0146)             | (0.0157)             | (0.0123)             | (0.0155)             |
| Log(POP)         | -0.237**             | -0.248***            | -0.127               | -0.0947              |
|                  | (0.127)              | (0.0834)             | (0.0876)             | (0.0768)             |
| INST             | 0.0361**             | -0.00202             | 0.00521              | 0.0132               |
|                  | (0.0181)             | (0.0168)             | (0.0155)             | (0.0163)             |

Notes: *p-value < .1; **p-value < .05; ***p-value < .01. Robust Standard Errors are in parenthesis. In the two-step system GMM estimations, the variables ‘ECONCOMP, ‘POVHC’, ‘POVGAP’, ‘INST’, and ‘OPEN’ have been considered as endogenous. Time dummies have been included in the regressions.

Revenue: a 1-point increase in the index of economic complexity generates a 0.48-point rise in the share of non-resource tax revenue to GDP. This finding aligns with the one obtained in Table 1, whereby export product diversification raises non-resource tax revenue. In the meantime, we also note that the poverty headcount ratio exerts a negative and significant (at the 1% level) on non-resource tax revenue. Estimates in column [2] show that the coefficient of ‘ECONCOMP’ is negative and significant at the 1% level, and the interaction term of the variable ‘ECONCOMP × Log(GDPC)’ is negative and significant at the 1% level. Therefore, we conclude that economic complexity exerts a positive effect on non-resource tax revenue, as countries enjoy an increase in their real per capita income, notably when the latter is higher than US$ 2246.2 \([=\text{exponential}(10.58/1.371)]\). Hence, countries with a real per capita income higher than US$ 2246.2, experience a positive effect of economic complexity on non-resource tax revenue, and the magnitude of this positive effect increases as the real per capita income improves. Conversely, in countries with a real per capita income lower than US$ 2246.2, economic
complexity leads to lower non-resource tax revenue, and the magnitude of this negative effect increases as the real per capita income falls further. This may signify that for this set of countries, economic complexity has not reached a sufficient level so as to induce a rise in non-resource tax revenue. Results in columns [3] and [4] show positive and significant (at the 1% level) coefficients of ‘ECONCOMP’, but negative and significant coefficients of the interaction between the economic complexity index and each of the poverty indicator. These outcomes suggest that poverty induces higher non-resource tax revenue in countries that experience lower poverty rates, be the latter poverty headcount rates or poverty gap. Specifically, greater economic complexity results in higher non-resource tax revenue in countries with poverty headcount rates lower than 39.7 ( = 2.048/0.0516) or a poverty gap lower than 19.1 ( = 2.009/0.105).

Overall, estimates in Table 5 confirm the findings obtained in Table 1: greater economic complexity (that involves also greater export product diversification) is positively associated with non-resource tax revenue, with the magnitude of this effect rising as the real per capita income increases. Furthermore, economic complexity improves non-resource tax revenue performance in countries with lower poverty rates.

6. Conclusion

This paper has investigated the effect of export product diversification and poverty on non-resource tax revenue in developing countries. The empirical analysis has established interesting findings. First, export product diversification leads to higher non-resource tax revenue performance in advanced developing economies, while for relatively less developed countries, it is export product concentration that induces greater non-resource tax revenue performance. Second, higher poverty rates lead to lower non-resource tax revenue performance in less developed countries but induces higher non-resource tax revenue performance in relatively ‘advanced’ developing countries. Third, the effect of export product diversification and poverty on non-resource tax revenue performance works through the economic growth, and economic growth volatility channels. On the one hand, export product diversification results in greater tax revenue performance in countries with a higher economic growth rate, and the greater the economic growth rate, the higher the magnitude of the positive effect of export product diversification on tax revenue performance. On the other hand, greater export product diversification helps to reduce the adverse effect of economic growth volatility on non-resource tax revenue. Higher poverty rates consistently reduce non-resource tax revenue performance in countries that experience a higher degree of economic growth volatility. Fourth, the effect of export product diversification on non-resource tax revenue performance depends on the level of poverty. In fact, export product diversification is associated with higher non-resource tax revenue performance in countries that experience lower poverty rates.

Developing countries are in need for high amounts of financial resources to address development challenges. One sustainable means for financing their development needs is the mobilization of domestic revenue. The findings of the present study show that enhancing export product diversification and reducing poverty would contribute to the improvement of non-resource tax revenue performance in developing countries. These positive non-resource tax revenue performance effects of export product diversification and lower poverty rates would particularly be stronger in countries where governments
endeavour to enhance tax and customs administrations efficiency, design appropriate tax policy, and improve voluntary tax compliance.

Promoting export product diversification requires the elaboration by developing countries of medium-to long term national export promotion strategies. While such strategies may include tax measures to attract foreign direct investment for example (and therefore, are not directly tax measures to improve revenue mobilization), they do result in higher tax revenue, as hypothesized and demonstrated empirically. Besides, there is a virtuous relationship between tax revenue and poverty: implementing policies to enhance tax and customs administrations efficiency, designing appropriate tax policy, and improving voluntary tax compliance would help directly improve tax revenue mobilization, and tax revenue performance. Greater fiscal space allowed by higher tax revenue performance would help increase the financing of public services in favour of poor segments of the population and hence reduce poverty. In the meantime, economic and social policies targeting poor segments of the population could improve these people’s incomes and consumption, expand the tax base, and generate higher tax revenue.

Future research could use other econometric approaches, such as panel threshold regression approaches to examine non-linear effects between export product diversification, poverty and tax revenue.

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Notes

1. A recent literature review on the matter has been provided by Prichard (2016). Recent studies include for example, Abdelwahed (2020); Baunsgaard and Keen (2010); Bird, Martinez-Vazquez, and Torgler (2008); Brun, Chambas, and Mansour (2015); Cagé and Gadenne (2018); Crivelli (2016); Crivelli and Gupta (2014, 2018); Gnangnon (2018, 2019); Gnangnon and Brun (2017, 2018, 2019); Langer and Korzhenevych (2019); Morrissey et al. (2016); and Oz-Yalaman (2019).
2. See, for example, Aditya and Acharyya (2013); Can and Gözgör (2017); Hausmann, Hwang, and Rodrik (2007); Herzer and Nowak-Lehmann (2006); Mania and Rieber (2019); Naudé, Bosker, and Matthee (2010); and Redding (1999).
3. See, for example, di Giovanni, Levchenko, and Méjean (2014); Haddad et al. (2013); Malik and Temple (2009); and Camanho da Costa Neto and Romeu (2011).
4. The 17 SDGs were adopted by the General Assembly of the United Nations, and contained in the document ‘Transforming our world: the 2030 Agenda for Sustainable Development’, whose reference number is A/RES/70/1. The SDGs replaced the Millennium Development Goals (MDGs) (adopted in September 2000 by United Nations Members), the first of these goals being to halve extreme poverty by the target date of 2015.
5. It is worth noting that the MDGs were adopted at the Millennium Summit of the United Nations held at the United Nations headquarters in New York, on 8 September 2000. The first MDG aimed at to halving extreme poverty by the target date of 2015.
6. Tax revenue performance is measured by the tax revenue share in gross domestic product.
7. See for example, di Giovanni, Levchenko, and Méjean (2014); Haddad et al. (2013); Lee and Zhang (2019); Malik and Temple (2009); and Camanho da Costa Neto and Romeu (2011).
8. See, for example, Acemoglu et al. (2003); Alimi (2016); Antonakakis and Badinger (2016); Badinger (2010); Berument, Dincer, and Mustafaoglu (2012); Campi and Dueñas (2020); Fata (2002); Hnatkovska and Loayza (2005); and Ramey and Ramey (1995).

9. Studies include, for example, Agbeyegbe, Stotsky, and WoldeMariam (2006); Bahl (2003); Baunsgaard and Keen (2010); Bird, Martinez-Vazquez, and Torgler (2008); Brun, Chambas, and Mansour (2015); Cagé and Gadenne (2018); Crivelli (2016); Crivelli and Gupta (2014, 2018); Ebrill, Stotsky, and Gropp (1999); Ghura (1998); Gnangnon (2018, 2019a); Gnangnon and Brun (2017, 2018, 2019); Khattry and Rao (2002); Langer and Korzhenevych (2019); Morrissey et al. (2016).

10. This positive productivity effect of trade openness can take place through increased competition in domestic markets, knowledge diffusion, market size expansion and the resulting opportunities for economies of scale.

11. The group of Least developed countries is designated by the United Nations, and refers to poorest and most vulnerable countries to external and environmental shocks in the world. Further information on this group could be obtained online at: http://unohrls.org/about-ldcs/

12. This value of economic growth rate is extracted from the software Stata that we used to depict Figure 7.

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