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Article

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Suggested Citation: Ho, Thuy Tien; Tran, Xuan Hang; Nguyen, Quang Khai (2023) : Tax revenue-economic growth relationship and the role of trade openness in developing countries, Cogent Business & Management, ISSN 2331-1975, Taylor & Francis, Abingdon, Vol. 10, Iss. 2, pp. 1-14, https://doi.org/10.1080/23311975.2023.2213959

This Version is available at:
https://hdl.handle.net/10419/294449

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Cogent Business & Management

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/oabm20

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To cite this article: Thuy Tien Ho, Xuan Hang Tran & Quang Khai Nguyen (2023) Tax revenue-economic growth relationship and the role of trade openness in developing countries, Cogent Business & Management, 10:2, 2213959, DOI: 10.1080/23311975.2023.2213959

To link to this article: https://doi.org/10.1080/23311975.2023.2213959

Published online: 14 May 2023.

Ho et al., *Cogent Business & Management* (2023), 10: 2213959
https://doi.org/10.1080/23311975.2023.2213959

cogent business & management

MANAGEMENT | LETTER

Tax revenue-economic growth relationship and the role of trade openness in developing countries

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Received: 17 July 2022
Accepted: 10 May 2023

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Abstract: This study investigates the impact of tax revenue on economic growth in the context of increasing trade openness in developing countries by using the data of 29 developing countries with accelerating economic growth during the period 2000–2020. This study further applies the Fixed Effect Model (FEM) and the Generalized Least Squares (GLS) estimation methods for panel data to test the proposed hypotheses. The research results show that tax revenue positively affects economic growth in general. Furthermore, we find that trade openness increases the positive relationship between tax revenue and economic growth but excessive trade openness reduces such a relationship. Our findings provide important implications for developing countries in the context of increasing tax revenue and trade openness.

Subjects: Political Economy; Economics; Business, Management and Accounting

Keywords: Economic growth; trade openness; tax revenue; developing countries

JEL classification: H20; F43; O10

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PUBLIC INTEREST STATEMENT

Economic growth is an issue that most countries are particularly concerned about. Policymakers in most countries are always trying to find solutions that can boost economic growth. Therefore, studies aimed at providing solutions to the problem of economic growth are always of interest to researchers. In particular, increasing tax revenue and trade openness is considered an effective solution. However, whether these solutions are applicable in developing countries is a matter of further study.

1. Introduction

Taxation is one of the main economic tools used by governments to regulate the macroeconomy and mobilize revenue for the budget towards the goal of economic growth, poverty alleviation, and social justice (Arvin et al., 2021; Gurdal et al., 2021; Maganya, 2020). Since the early twentieth century, governments across countries have undertaken extensive tax reforms to pursue growth goals, especially in low—middle-income countries, where the tax revenue and GDP is only 14–15%, compared to 30% in developed countries (World Bank, 2021). Thus, policymakers in developing countries are concerned about funding public spending activities aimed at economic development. However, increasing tax revenue leads to many objections since it directly affects several aspects of the economy. Therefore, such countries are always cautious while adjusting tax policies to increase revenue.

Although there have been numerous efforts to promote the economy, with many encouraging achievements, low—middle-income countries seem to not have kept pace with the development of other countries. In 2000, the per capita income of low—middle-income countries was USD 740 per person per year and had become approximately USD 2,500 per person per year by 2020 (World Bank, 2021), compared to developed countries, which had an average per capita income of USD 14,000 per person per year in 2020. Therefore, accelerating economic growth and development and completing economic and financial policies with a focus on tax policy is an important task for countries, especially developing countries (Grdinić, 2017).

The effects of trade liberalization on developing economies have been extensively analyzed (A. G. Khan et al., 2021; Combes & Saadi-Sedik, 2006; Gnangnon & Brun, 2019; Montalbano, 2011; Pernia & Quising, 2003). This increased research interest can be attributed to the two-way impact of trade liberalization on the economy. Trade liberalization often entails cutting tariffs and loosening trade barriers. This has resulted in tax revenue from foreign trade in developing countries to decrease from 2.5% of GDP to 1.8% of GDP in 2019 (World Bank, 2020). The reduction in tax revenues has raised concerns that greater trade liberalization will deprive developing countries of an important source of revenue (i.e., revenue from foreign trade taxes), thereby reducing their ability to finance the goods and services that the public needs for development (Brautigam et al., 2008). Khattry (2003) also argues that the liberalization of trade regimes ultimately leads to lower tax revenues and increased budget deficits. However, it is undeniable that trade liberalization not only brings opportunities for socio-economic change but also creates jobs and increases incomes for workers in many countries. Developing trade and services through trade liberalization has always played an important role in the socio-economic development strategies of countries, especially low—middle-income countries. Therefore, the question is whether low—middle-income countries should liberalize trade. If trade liberalization is carried out, how will it affect the national tax revenue? Gnangnon and Brun (2019) demonstrated that, in developing countries, greater trade liberalization not only changes the tax system but also has a positive impact on tax revenue, ultimately aiding in the development of the economy; however, Khattry and Rao (2002) and Cagé and Gadenne (2012) found results to the contrary. Such mixed results motivated this study to deeply investigate the role of trade openness in the relationship between tax revenue and economic growth in developing countries.

In addition, as the national tax structure changes from the process of trade liberalization, it is inevitable that economic growth will be affected, as taxes are the core tool in the hands of the government to make expenditures and help achieve growth goals. The nature of taxes can help predict growth patterns (Li & Lin, 2023; Myles, 2000; Romer & Romer, 2010). A good tax system is one of the most effective means of mobilizing a country's internal resources and the precondition for creating a favorable environment that promotes economic growth and development (Xing, 2012). Therefore, this study aims to examine the impact of taxes on economic growth in developing countries, with a focus on the role of trade liberalization in supporting economic growth and developing tax revenue.

This study contributes to the literature in several ways. First, by using cross-country data in developing countries, we provide empirical evidence that taxes play an important role in economic growth in the context of whether or not developing countries should increase or reduce taxes. Second, to our knowledge, this is the first study investigating the role of trade openness in the relationship between tax revenue and economic growth. Our results provide important implications for developing countries in the context of increasing tax management effectiveness and trade openness.

2. Literature review and hypotheses development

Public choice theory suggests that the government always wants to increase tax revenue to finance spending activities. At the same time, the government makes decisions on how to use resources with tax funding to manage economic activities. Therefore, government spending can contribute significantly to economic growth. Therefore, the more revenue the government has, the stronger the economic growth. Some related studies support this argument, such as Tosun and Abizadeh (2005), who investigated the relationship between tax policy and economic growth in 21 member countries of the Organization for Economic Cooperation and Development (OECD) during the period 1980–1999 using a random-effects model (REM). The results show the positive and significant relationship between tax revenue and economic growth for personal and corporate taxes. Similarly, M. K. Ocran (2011) investigated the impact of fiscal policy on economic growth in South Africa using a vector automatic regression (VAR) model. The findings showed that tax revenue is positively related to economic growth. However, tax revenue implemented alone takes a remarkably long time to impact economic growth.

Furthermore, Canavire-Bacarreza et al. (2013) examined the impact of taxation on economic growth in Latin America using vector autoregressive (VAR) modeling for each country, but their results were inconsistent. They analyzed panel data across three groups of countries: Latin American countries, developing countries, and developed countries. The results showed that personal income tax and corporate income have a positive correlation with growth in Latin American countries, but there is no evidence of such a relationship in developing and developed countries. O. A. Babatunde et al. (2017) conducted a study to examine the relationship between taxation and economic growth in Africa from 2004 to 2013. Descriptive statistics and unit root test were performed as the pre-estimation test, showing that the GDP and taxation variables are normal and stable. However, the findings of this study indicate that tax revenue is positively related to GDP and promotes economic growth in Africa. Based on economic theory and empirical evidence from previous studies, we propose the following hypothesis:

H1: *Tax revenue has a positive effect on economic growth.*

Currently, developing countries face significant challenges in raising budget revenues to achieve development goals when opening their economies to international trade (Mahdavi, 2008). The high dependence of these countries on state budget revenues, most of which comes from tax revenues, is further affected by the reduction of foreign trade taxes when implementing medium- and long-term trade liberalization (Weisbrot & Baker, 2003). The inevitable process of trade liberalization through multilateral or bilateral trade agreements may further erode foreign trade tax revenues. Several studies (Cagé & Gadenne, 2018; Gnangnon & Brun, 2019; Khattry & Rao, 2002; Khattry, 2003) have demonstrated that trade openness (or trade policy liberalization) has a negative impact on budget revenues, including tax revenues in developing countries. Therefore, policymakers in developing countries are undertaking tax reforms to help reduce the dependence of the tax structure on foreign trade revenue in the medium and long term to domestic consumption tax (Brun & Chambas, 2015; Gnangnon & Brun, 2019). The tax reform that included a proportional tariff reduction is combined with an increase in consumption tax, known as income-neutral tax reform. This will lead to more efficient allocation of resources in the manufacturing sector and ultimately, welfare benefits based on increased production efficiency that help drive economic growth.

Previous studies, such as Michael et al. (1993), and Hatzipanayotou et al. (1994), studied the economy with a small degree of trade liberalization, and the results showed that the shift of dependence from foreign trade tax to domestic consumption tax increases economic welfare. Naito and Abe (2008) used a two-factor endogenous growth model to theoretically investigate the impact of tariff reform on economic growth, tax revenue, and social welfare. Their findings indicate that, for countries with small economies, trade liberalization helps tax reform boost growth by increasing consumption taxes on inelastic goods, which can lead to higher economic growth, higher total tax revenue, and welfare benefits. The combination of the tax structure of a developing country with the tax structure of developed countries is closed based on trade liberalization. This means that, for developing countries with small open economies, tax reform can also positively affect economic growth through trade openness. Gnangnon and Brun (2019) provided empirical evidence that tax reform related to the harmonization of tax structures in the direction of developed countries leads to more openness to trade in developing countries.

Based on these arguments, we expect that trade openness enhances the role of tax revenue in increasing economic growth. Therefore, we propose the following hypothesis:

H2: *Trade openness is positively associated with the relationship between tax revenue and economic growth.*

As discussed above, increased trade openness in developing countries makes them rebuild their tax structure. However, changing the tax structure does not always work. The crowding-out effect hypothesis implies that excessive domestic tax increases can reduce consumer demand and limit private investment. Therefore, excessive trade openness may reduce the role of tax revenue in increasing economic growth. Emran and Stiglitz (2005) extended the static trade model to find that consumption tax would be reduced if the informal sector existed. At that time, liberalization can reduce foreign trade tax but not compensating with a consumption tax led to a decrease in economic growth. Similarly, Keen and Ligthart (2005) argue that, when implementing trade liberalization, income-neutral tariff policies will reduce welfare. This is because a reduction in import taxes combined with an increase in consumption taxes shifts from imperfectly competitive domestic firms to foreign firms, and the negative impact on domestic profits will reduce economic growth.

Because developing countries often rely heavily on convenient tax treatments such as tariffs and treat these international trade taxes as an important source of government revenue, reducing tax rates in the process of trade liberalization to join the World Trade Organization (WTO) and entering into a regional trade agreement such as ASEAN Free Trade Area (AFTA) or North American Free Trade Agreement (NAFTA) or reach bilateral trade agreements with other developed countries, it can have a significant impact on their economies and government revenues. Substantial budget loss could occur, at least in the short term, before imports respond to tariff changes. As stated earlier, most developing countries have decided to mitigate the damage in this situation by increasing domestic tax, as this is the most feasible option on the basis of both policy and governance. However, this may increase the crowding-out effect. We therefore expect that the effect of trade openness on the relationship between tax revenue and economic growth is non-linear and that excessive trade openness may reduce the positive effect of tax revenue on economic growth. Therefore, we propose the following hypothesis:

H3: *Excessive trade openness is negatively associated with the relationship between tax revenue and economic growth.*

3. Data and models

The study uses data from 29 developing countries according to World Bank (2020) classification criteria (Appendix A). Data of all variables in the study were collected from World Development Indicators (WDI) with 609 observations for the period from 2000 to 2020.

First, to test hypothesis H1, this study proposed a basic model to introduce the impact of tax revenue on economic growth, as follows:

$$lnGDP_{i,t} = \alpha_0 + \alpha_1 TR_{i,t} + \alpha_2 X_{it} + \mu_{it} \quad (1)$$

Where $lnGDP_{i,t}$ is the dependent variable that represents the economic growth of country i over year t. It was measured by the logarithm of the GDP of each country per year. $TR_{i,t}$is tax revenue, measured as total tax revenue over gross domestic product. X_{it} is a vector of control variables, including: (1) $OPEN_{it}$, which is the trade openness of country i in time t, representing trade liberalization; (2) $GOV_{i,t}$, which is the government spending of country i in time t; (3) $INV_{i,t}$, which is foreign direct investment capital of country i in time t; (4) $INF_{i,t}$, which is the inflation of country i in time t; and (5) POP_{it}, which is the population growth rate of country i over time t, representing the population growth rate. These variables are expected to affect economic growth as found in previous studies (Alfaro et al., 2004; Am Marcel, 2019; Canavire-Bacarreza et al., 2013; Ristanović, 2010). i and t is the index of country and time, α_i is the coefficient need to estimate and, μ_{it} is the error term of the model.

To test the impact of trade openness on the relationship between tax revenue and economic growth in developing countries (i.e., hypothesis H2 and H3), we apply the following model:

To test the impact of trade openness on the relationship between tax revenue and economic growth in developing countries (i.e hypothesis H2 and H3), we apply the model as follows:

$$lnGDP_{i,t} = \alpha_0 + \alpha_1 TR_{i,t} + \alpha_2 TR * OPEN_{it} + \alpha_3 X_{it} + \mu_{it} \quad (2)$$

$$lnGDP_{i,t} = \alpha_0 + \alpha_1 TR_{i,t} + + \alpha_2 TR * OPEN_{it} + \alpha_3 TR * OPEN\_2_{it} + \alpha_4 X_{it} + \mu_{it} \quad (3)$$

Models 2 and 3 are used to test hypotheses H2 and H3, respectively. *OPEN_2* is the square of OPEN variable. All other variables are the same as the variables used in equation (1). We also summarize all variables in Table 1.

To estimate these models, we use the fixed-effect estimation method for the balanced panel data after performing the Hausman test (Boubakri et al., 2013; Dang & Nguyen, 2021b, 2022; Nguyen & Dang, 2022a, 2022b, 2022c; Nguyen, 2021). However, Moulton (1986, 1990) suggested that, when using panel data for cross-country analysis, it is possible to encounter group effects leading to the problem of error in statistical conclusions. Therefore, we also use the general least squares (GLS) estimation method to deal with the autocorrelation of observations within countries and variance across countries. Finally, we apply the System GMM method as a robustness test to treat potential endogeneity problems (Almustafa et al., 2023; Dang & Nguyen, 2021a; Dang et al., 2022; Nguyen & Dang, 2022a, 2022b; Nguyen, 2020).

4. Research results and discussion

4.1. Descriptive statistic and correlation matrix

Table 2 presents the descriptive statistic of all variables used in this study. The proportion of tax revenue of the group of developing countries has an average 14.17% total tax revenue compared to GDP. This proportion is lower than the average share of developing countries, mainly focusing on consumption tax, especially the low proportion of foreign trade tax, indicating that these countries are implementing trade liberalization. In terms of the level of trade liberalization, the average value is 79.11% of GDP. As for the level of import and export goods, low and low—middle income countries

Table 1. Variable definition

Variables	Definitions and measures	Source
LnGDP	Real per capita income (logarithmic). GDP at constant price and constant PPP per population aged 15–64.	WDI
TR	Total tax revenue-to-gross domestic product GDP	WDI
OPEN	The ratio of exports and imports to gross domestic product GDP	WDI
GOV	(% GDP) Government final consumer spending includes all expenditures on the purchase of goods and services and expenditures on defense and security, but does not include government military expenditures.	WDI
INV	(% GDP) Foreign direct investment is the net inflow of capital to obtain long-term management benefits. It is the sum of equity capital, reinvested income, other long-term capital, and short-term capital shown in the balance of payments; shows the net inflows (new investment inflows less than inflows) into the reporting economy from foreign investors, divided by GDP.	WDI
INF	Measured by the consumer price index, it reflects the annual percentage change in the cost that the average consumer takes to obtain a good or service, which can be fixed or variable over specified time period, e. g., years.	WDI
POP	Annual population growth rate. Population is based on the actual definition of population, counting all residents, regardless of legal status or nationality (%).	WDI

increased the number of goods in circulation when conducting trade liberalization, combined with a reduction of tax rates according to the roadmaps when entering the world economy.

Table 3 presents the correlation matrix of the variables. This table shows that the correlation coefficient between TR and LnGDP is positive and significant, as per our expectation. The highest correlation coefficient is 0.753, which is between the GOV and TR variables; therefore, the relatively low levels of correlation between the independent variables of the study indicate that multi-collinearity should not be of concern.

4.2. Main results

Table 4 reports the estimation results for Equations 1 and 2. Regressions 1 and 3 in this table show the estimation results for Equation 1 by applying the FEM and GLS estimation method, respectively. The coefficients on TR are positive and statistically significant with LnGDP in both regressions 1 and 3, indicating that the increase in tax revenue promotes economic growth in developing countries. This result support hypothesis H1 and the public choice theory that the government always wants to increase tax revenue to finance spending activities. At the same time, the government makes decisions on how to use resources with tax funding to achieve economic development goals. This

Table 2. Descriptive statistic

Variables	Obs	Mean	Std. Dev	Min	Max
LnGDP	609	1760.083	1220.325	179.426	4638.635
TR	609	14.175	5.424	2.479	39.987
OPEN	609	79.113	34.075	25.993	211.499
GOV	609	13.052	6.545	−1.092	43.483
INV	609	6.089	13.780	−37.172	80.665
INF	609	6.065	5.983	−18.108	48.699
POP	609	1.549	1.081	−1.718	4.668

Note: This table presents descriptive statistic of main variables. See Table 1 for variable definitions.

Table 3. Correlation matrix

	LnGDP	TR	OPEN	GOV	INV	INF	POP	VIF
LnGDP	1.000							
TR	0.204*	1.000						3.43
OPEN	0.047	0.530*	1.000					3.97
GOV	−0.044	0.572*	0.360*	1.000				1.87
INV	0.225*	0.075*	0.112*	−0.279*	1.000			1.25
INF	−0.123*	0.021	0.073*	−0.024	−0.082	1.000		1.03
POP	−0.386*	−0.456*	−0.287*	−0.132*	−0.156*	−0.060	1.000	1.32

Note: This table presents correlation matrix of main variables. See Table 1 for variable definitions. * significant at 10% level or better.

result is consistent with previous empirical studies such as Tosun and Abizadeh (2005), M. Ocran (2009), and O. A. Babatunde et al. (2017), who found that tax revenue increases economic growth in some countries. Our results once again confirm the role of taxes on economic growth in emerging countries in the context that these countries are confused in choosing to increase tax collection or reduce tax rates to attract investment. Clearly, it is not feasible to reduce taxes to promote growth.

To test hypothesis H2, we used the variable trade openness that interacts with the tax revenue variable. Regressions 2 and 4 in Table 4 report the estimation results for Equation 2 by applying the FEM and GLS estimation method, respectively. The results show that the coefficients on TR are still positive and statistically significant with LnGDP in both regressions 2 and 4. This result still supports hypothesis H1. Furthermore, the coefficients on TR*OPEN are positive and statistically significant with LnGDP in all regressions, indicating that trade openness plays an important role in increasing the positive relationship between tax revenue and economic growth, i.e., trade openness will create a favorable environment to promote tax collection activities. In developing countries with large trade openness, implementing the roadmap to remove tariff barriers will reduce tax revenue but will increase the number of goods and stimulate consumption for domestic use and export promotion. This result supports hypothesis H2 and is consistent with our expectations. Our results also support a number of previous studies on the important role of trade openness to economic growth such as Álvarez et al. (2018) and Abreo et al. (2022). Our results suggest that governments in emerging countries can combine increased tax revenue and increased trade openness to achieve their growth goals more easily.

Regarding control variables, the results in Table 4 show that the coefficients on OPEN are negative and statistically significant with LnGDP in most regressions (except regression 3),

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Table 4. Results of fixed effect estimation and generalized least square

Variables	FEM		GLS	
	Coeff (t-stat)	Coeff (t-stat)	Coeff (z-stat)	Coeff (z-stat)
	(1)	(2)	(3)	(4)
TR	0.0691***	0.0619***	0.0101**	0.0095**
	(8.32)	(7.37)	(2.55)	(2.44)
OPEN	−0.0047***	−0.006***	−0.0012	−0.0013*
	(−3.03)	(−3.98)	(−1.54)	(−1.77)
GOV	−0.0162	−0.012	−0.0091***	−0.0091***
	(−1.44)	(−1.15)	(−3.00)	(−3.03)
INV	0.0151***	0.016***	0.0040***	0.0041***
	(3.42)	(3.65)	(2.86)	(2.92)
INF	−0.0211***	−0.019***	−0.0008	−0.0009
	(−5.22)	(−4.79)	(−0.78)	(−0.84)
POP	−0.1186**	−0.077	−0.2140***	−0.2111***
	(−1.97)	(−1.29)	(−5.54)	(−5.50)
TR*OPEN		0.0002***		0.00005***
		(3.93)		(2.83)
Cons	7.0167***	6.8312***	7.5414***	7.4788***
	(35.06)	(33.61)	(68.46)	(67.35)
R-square	0.1847	0.0919		
Wald test (P-value)			0.0000	0.0000
Obs	609	609	609	609

Note: This table presents the estimation results of Equations 1 and 2 by applying FEM and GLS estimation method, respectively. See Table 1 for variable definitions. *, **, *** mean significant at 10%, 5% and 1%, respectively.

indicating that trade openness directly reduces economic growth due to reducing tariff tax revenue but can indirectly increase economic growth due to a country's tax restructure. This finding is consistent with the previous studies, which agree that the effect of trade openness on economic growth is complicated through various channels such as technology transfer, product diversification, economies of scale, and efficiency in allocating and distributing resources in the economy (Law, 2009; Qamruzzaman, 2021). This negative direct effect can be explained in developing countries, where the proportion of trade openness reached an average of 79% of GDP, which is quite high, and opening up to trade often means reducing tariffs. Several studies have had similar results (Batra & Slottje, 1993; Gnangnon & Brun, 2019).

The coefficients on INV are positive and statistically significant in all regressions. This confirms previous studies that FDI inflows have created spillover effects in technology, supported human resource investment, contributed to international trade integration, and contributed to creating a competitive business environment and increased development (Akinlo, 2004; Dritsaki et al., 2004). In addition, the coefficients on GOV, INF, and POP are negative and significant with LnGDP in most regressions. This means that government spending, inflation, and population growth reduce economic growth. These results are consistent with previous studies (M. Khan & Hanif, 2020; Rehman, 2019; S. A. Babatunde, 2018; Sidrauski, 1967)

Table 5 presents the estimation results for Equation 3 to test hypothesis H3. First, the results in this table show that the coefficients on TR are still positive and statistically significant with LnGDP in both regressions 1 and 2. This result continues to support hypothesis H1. Moreover, the sign of coefficients of TR*OPEN is positive and significant, indicating that hypothesis H2 is strongly supported. Overall, the results in Table 5 are consistent with the results in Table 4. Specifically, we find

Table 5. The results of a non-linear relationship among tax revenue, trade openness, and economic growth

Variables	FEM		GLS	
	Coeff	t-stat	Coeff	z-stat
	(1)		(2)	
TR	0.2027***	3.68	0.1540***	6.56
OPEN	−0.0000	−0.00	0.0165***	7.82
GOV	−0.0102	−0.52	−0.0121**	−2.45
INV	0.0169***	2.94	0.0019*	1.78
INF	−0.0174**	−2.13	−0.0173***	−4.41
POP	−0.0323	−0.18	−0.2770***	−10.83
TR*OPEN	0.0000***	2.70	0.0000***	2.52
TR*OPEN_2	−0.0022**	−2.88	−0.0011***	−2.83
Cons	6.1604***	8.16	5.7440***	26.75
R-square	0.1251			
Wald test (P-value)			0.0000	
Obs	609		609	

Note: This table presents the estimation results of Equations 1 and 2 by applying the FEM and GLS estimation methods, respectively. See Table 1 for variable definitions. *, **, *** indicate significant at 10%, 5%, and 1%, respectively.

that the coefficients on TR*OPEN_2 are negative and statistically significant with LnGDP. This result implies that excessive trade openness reduces the positive relationship between tax revenue and economic growth, and thus, it strongly supports hypothesis H3. Our finding also supports the crowding-out hypothesis that excessive domestic tax increases can reduce consumer demand and limit private investment. The excessive trade openness may lead to developing countries increasing domestic taxes and thus, reducing economic growth.

4.3. Robustness test

In this study, we applied the System GMM estimation method as a robustness test to treat potential endogeneity problems. The estimation results for Equations 1, 2, and 3 are presented in Table 6. First, the sign of TR coefficients remains positive and statistically significant in all regressions, implying that hypothesis H1 is strongly supported. Second, the coefficients on TR*OPEN are positive and statistically significant with LnGDP in regressions 2 and 3. We continue to provide strong evidence that trade openness increases the positive relationship between tax revenue and economic growth, and thus, it supports hypothesis H2. However, the coefficient on TR*OPEN_2 is negative and statistically significant with LnGDP in regression 3, indicating that excessive trade openness can reduce the positive relationship between tax revenue and economic growth in developing countries. This result continues to support hypothesis H3.

We applied the Hansen test and AR(2) test to ensure the appropriation of the System GMM method. The p-value of the Hansen test and AR(2) test are higher than 10%, indicating that the statistical tests do not reject the validity of our models and confirm both the validity of the instruments and the absence of second-order serial correlation we use to avoid the endogeneity problem. The number of instruments in each model is lower than the total units in our data, indicating that the Hansen test is reliable.

As another robustness test, we use another proxy of excessive trade openness. Specifically, we use a dummy variable (EXOPEN) which is 1 if OPEN in year t is higher than the median value of the sample, and 0 otherwise. We also use the System GMM method for Equation 3 and the results are presented in Table 7. This table shows that the coefficients on TR*OPEN are positive in all regressions and statistically significant in regressions 2 and 3 while the coefficients on

Table 6. Robustness test-System GMM estimation results

	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Variables	**(1)**		**(2)**		**(3)**	
TR	0.0390*	1.87	0.1427***	5.28	0.5132***	2.90
OPEN	−0.2466**	−2.29	−0.2391**	−2.72	−0.1130	−0.90
GOV	−0.0019	−0.45	0.0134**	2.51	0.0301**	2.12
INV	−0.0244	−1.26	−0.0091	−0.66	−0.0168	−0.75
INF	0.0038	0.63	0.0045	1.05	0.0042	0.73
POP	−0.0444***	−3.41	−0.0352***	−3.64	0.0060	0.55
TR*OPEN			0.0010***	4.71	0.0000*	2.02
TR*OPEN_2					−0.0055**	−2.33
Cons	7.7743***	15.82	56.0510***	10.59	2.7279*	1.80
AR2 (p-value)	0.607		0.483		0.473	
Hansen J (p-value)	0.135		0.451		0.542	
No of instruments	21		25		26	
Obs	609		609		609	

Note: This table presents the System GMM estimation results for Equations 1, 2, and 3. See Table 1 for variable definitions. *, **, *** mean significant at 10%, 5%, and 1%, respectively.

TR*EXOPEN are negative in all regressions and statistically significant in regressions 1 and 2. These results indicate that excessive trade openness reduces the positive relationship between

Table 7. Robustness test-an alternative measure of excessive trade openness

	FEM		GLS		GMM	
	Coeff	t-stat	Coeff	z-stat	Coeff	t-stat
Variables	**(1)**		**(2)**		**(3)**	
TR	0.0749	1.40	0.1608***	14.97	0.2782*	1.83
OPEN	−0.0006**	−2.09	−0.0146***	−6.66	0.0238	1.26
GOV	−0.0157	−0.77	0.0128***	2.57	0.0142*	1.71
INV	0.0152***	2.76	0.0019*	1.80	0.0012	0.20
INF	−0.0218**	−2.57	−0.0174***	−4.51	−0.0187***	−2.05
POP	−0.1020	−0.60	−0.2726***	−10.72	−0.2443	−1.45
TR*OPEN	0.0001	1.08	0.0012***	12.90	0.0019***	2.56
TR*EXOPEN	−0.0026**	−1.99	−0.0016*	−1.92	−0.0012	−0.22
Cons	6.7604***	9.16	5.8189***	32.30	4.44138	1.86
R-square	0.1668					
Wald test (P-value)	0.0000			0.0000		
AR2 (p-value)					0.538	
Hansen J (p-value)					0.026	
No of instruments					28	
Obs	609			609	609	

Note: This table presents System GMM estimation results for Equation 3. See Table 1 for variable definitions. *, **, *** mean significant at 10%, 5% and 1%, respectively.

tax revenue and economic growth. The robustness test results in Table 7 are consistent with our initial results in Table 5. Therefore, it strongly supports hypothesis H3.

Overall, after using the System GMM method and an alternative measure of excessive trade openness as robustness tests, our results are consistent with the initial result as well as our expectations. All hypotheses (hypotheses H1, H2, and H3) are strongly supported. In other words, we provide strong evidence about the relationship between tax revenue, trade openness, and economic growth in developing countries.

5. Conclusion

In this study, we investigated the relationship between tax revenue, trade openness, and economic growth in developing countries by using the data of 29 developing countries during the period 2000–2020. Our results show that tax revenue positively impacts economic growth, and trade openness plays an important role in enhancing such impact generally. Our research results are consistent with economic theories as well as previous studies. However, the too-large trade openness does not add positive value to the economy in developing countries, because it may reduce the positive relationship between tax revenue and economic growth.

Our findings provide important implications for developing countries in the context of trying to find the best ways to increase tax management effectiveness, trade openness, and economic growth. First, developing countries need to maintain higher tax revenues for economic growth. Second, these countries also need to strengthen international economic integration as well as improve trade openness since it will indirectly contribute to economic growth. These two policies need to be implemented simultaneously to best promote the role of tax policy and trade openness. Finally, although an increase in trade openness benefits developing countries, excessive increase in trade openness will have a negative impact on growth. Therefore, these countries should not increase trade openness excessively, but instead maintain it appropriately. Our study has a limitation in that the sample is quite small because of few developing countries. Further studies can extend the scope of countries such as emerging or developed countries.

Funding

This research is funded by University of Finance – Marketing

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Disclosure statement

No potential conflict of interest was reported by the authors.

Citation information

Cite this article as: Tax revenue-economic growth relationship and the role of trade openness in developing countries, Thuy Tien Ho, Xuan Hang Tran & Quang Khai Nguyen, *Cogent Business & Management* (2023), 10: 2213959.

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Appendix A: List of countries

No	Country	No	Country
1	Afghanistan	16	Madagascar
2	Armenia	17	Mali
3	Bangladesh	18	Moldova
4	Bhutan	19	Mongolia
5	Burkina Faso	20	Morocco
6	Cambodia	21	Nepal
7	Congo, Rep.	22	Nicaragua
8	Cote d'Ivoire	23	Philippines
9	Egypt	24	Sri Lanka
10	El Salvador	25	Togo
11	Ghana	26	Tunisia
12	Guatemala	27	Ukraine
13	India	28	Vietnam
14	Indonesia	29	Zambia
15	Lesotho		