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How does financial sector development improve tax revenue mobilization for developing countries?

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**Abstract**

*This study examines the effect of financial development on tax revenue mobilization in developing countries. Our empirical analysis uses the aggregate financial index that comprises the banking system's depth (size and activity), access, and efficiency of financial institutions and financial markets. Using panel data from developing countries over the period 1995-2017, our findings suggest that more developed financial sectors positively and significantly influence the government's ability to raise tax revenue. More interestingly, we find that this favorable effect is sensitive to developing countries characteristics, namely the level of economic development, the degree of financial openness and the stance of fiscal policies. When we more precisely look at the effects of disaggregated financial development components on tax revenues mobilization, we find that the estimated coefficients on the sub-components of financial development are statistically significant, except for the financial market's efficiency. The results denote that tax revenue in developing countries depends on financial institutions and financial markets.*

**Keywords:** Financial development, non-resource tax revenue, domestic tax revenue, developing countries.

**JEL classification :** C23, E62, G21, H20, O11

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# 1 Introduction

Tax revenue has been documented as particularly important factor in economic growth, poverty reduction, and economic development (Burgess and Stern 1993; Engen and Skinner 1996; Hill 2008; Gordon and Li 2009; Besley and Persson 2013; Ramírez, Díaz, and Bedoya 2017). Developing countries remain the region with the lowest tax revenues as a percentage of GDP in the world (Goodbye 2017). However, public expenditure needs are much higher in these countries. Domestic resource mobilization could help these countries address these development challenges. There exists a large and increasing literature on the determinants of tax revenue mobilization. Several papers have studied the structural factors of the economy (see (Tanzi et al. 1981; Tanzi 1992; Ghura 1998; Mahdavi 2008; Bird, Martinez-Vazquez, and Torgler 2008; Baunsgaard and Keen 2010; Crivelli and Gupta 2014) and the quality of institutions (see (Gupta 2007; Bird, Martinez-Vazquez, and Torgler 2008; Dioda 2012) as the main determinants of revenue mobilization in developing countries. However, few studies have shed light on the link between financial development and tax revenue in developing countries: examples include (Bohn 1990; Tavares and Valkanov 2001; Gordon and Li 2009; Ardagna 2009; Gilbert and Ilievski 2016) investigate the effects of the financial system on either banking or non-banking activities. Financial development<sup>1</sup> constitutes a potential source of tax revenue mobilization for developing countries (Bohn 1990; Gordon and Li 2009). The literature on financial development is still developing, with new definitions, determinants, and measurement procedures being suggested. The factors that facilitate, restrict or reverse financial development are documented in (Huang 2010; 2011); (Girma and Shortland 2008); (Herger, Hodler, and Lobsiger 2008); (Yang 2011); (Roe and Siegel 2011). These include institutional quality, macro-economic policies, geographic and cultural characteristics. The measurement of financial development remains an important issue for empirical studies. Different authors use various sources and analytical methodologies to estimates the value of financial development from developing countries (World Bank (Washington 2020; Svirydzenka 2016; Levine 2005).

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<sup>1</sup> Following the World Bank (Washington 2020), financial development is: “*conceptually, a process of reducing the costs of acquiring information, enforcing contracts, and making transactions.*”

Taking stock of these studies, the goal of this paper is to analyze the effect of financial development on the tax revenue mobilization. This paper contributes to the literature on the tax revenue mobilization in several ways. First, the study most similar to ours is a paper by Gngangnon (2022). Gngangnon investigates the effect of financial development on non-resource tax revenue performance in developing countries through the international trade channel. He measures the overall financial sector development by relying on a composite indicator of financial development obtained by combining several existing financial development indicators, using the principal components analysis (PCA). A key difference from our work is that Gngangnon combines four indicators of financial development, which are the liquid liabilities (% GDP); the private credit by deposit money banks and other financial institutions (% GDP); the bank deposits (% GDP); and the financial system deposit (% GDP), while we draw upon Svirydzhenka (2016)<sup>2</sup>'s new measure of financial development, which takes into account the complex multidimensional nature of financial development (in addition to Gngangnon's four measures, the measure considers 147 other indicators). Another difference from our work is that Gngangnon only investigates the relationship between financial development on non-resource tax revenue performance in developing countries. The tax structures of developing countries are different (Modica, Laudage, and Harding 2018). Consequently, in our work, we also look at the effect of financial development on tax revenue composition by disaggregating tax data between indirect taxes and direct taxes. Our results are, therefore, informative of the effect of financial development on tax structures. The analysis of how financial development facilitates tax revenue mobilization is an essential issue in developing countries. The relation between financial development and tax revenue mobilization is essential for policymakers. Policymakers want to know policies affect tax revenue as well as how they affect growth. Understanding this relationship will allow policymakers to assess whether financial development will improve tax revenue mobilization.

The remainder of the paper is organized as follows. Section 2 reviews the previous literature and section 3 describes the data and identification strategies. Section 4 discusses our empirical results. Section 5 analyzes their robustness, Section 6 analyzes the effect financial development on the

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<sup>2</sup> The World Economic Forum publishes a Financial Development Index annually. The index database provides nine (09) indices for over 180 countries with annual frequency from 1980.

composition of tax revenue, and section 7 explores heterogeneities in the effect of financial development on tax revenue related with economic, and structural factors. Section 8 concludes.

## **2 Financial development and tax revenue mobilization: literature review**

This section discusses whether financial development is essential for fiscal policy. Conceptually, I review ways in which the services provided by the financial system may affect tax revenue collection. Those countries with financial systems that are better at performing will mobilize more tax revenues than those with less developed financial systems. So far, little evidence exists of the effects of financial development on tax revenue in developing countries. Financial development plays a significant role in the mobilization of tax revenue. Broadly speaking, financial development can have a direct and indirect effect on tax revenue.

### **Financial development on tax revenue mobilization: direct channel**

The direct effect stems from the state's ability to tax the financial sector. For instance, Demirgüç-Kunt and Huizinga (2001) show that the financial sector represents significant value-added, employment, and potential tax revenues. In theory, the financial system provides five critical services for economic growth (see (Levine 2005)). We argue that these services offered by financial systems could improve the tax administration's performance in collecting tax revenues. To begin with, better access to financial services may facilitate the tax recovery and compliance by taxpayers, i.e., the financial system aids in the tracking and recovery of taxes. In the same vein, (Gilbert and Ilievski 2016) postulate that Tax-to-GDP ratios increase when bank deposits increase, meaning that taxes on GDP increase for a given value of bank deposits. Bank deposits act here as a source of information for governments. Similarly, governments could tax bank deposits to increase tax revenues. Another strand of research that has been pursued is the role of the lack of state capacity in developing countries (Besley and Persson 2009; 2010; 2013).<sup>3</sup> Governments in developing countries are trying to collect more taxes from businesses but are failing, and their tax revenues are limited by their incapacity to collect them (see, (Gordon and Li 2009; Besley and Persson 2009; 2010; 2013;

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<sup>3</sup> These studies pointed out that developing countries are limited by two complementary aspects of state capacity: (i) fiscal capacity and (ii) legal capacity.

Guo and Hung 2020). After accounting for state capacity variables, firms in countries with a more developed financial sector report a larger share of their sales to the tax authority (see, Guo and Hung 2020). Guo and Hung (2020) assume that if the state capacity is enforced, analytically show that with a less developed financial sector which exhibits higher agency/monitoring costs, the government of a developing country will decrease its optimal tax-auditing probability on operating establishments, which in turn leads to more tax evasion. The above theoretical studies of the positive relationship between finance and tax revenue also accord with previous empirical studies, which show a positive relationship. For example, (Bohn 1990) emphasizes a positive relationship between financial development and tax revenue. (Taha, Colombage, and Maslyuk 2010) find a significant relationship between direct tax revenues and financial activities. In a similar vein, the development of the bonds and stocks market plays a crucial role in revenue generation. Empirical work by (Taha et al. 2013) concluding that the development of the financial system positively influences direct tax revenue in Malaysia.

### **Financial development on tax revenue mobilization: indirect channels**

To the extent that financial development impacts the state of the economy, it will also have an indirect effect on domestic tax mobilization, although alternative macroeconomic channels could be important. These factors include international trade, the underground economy, tax evasion activities, and corruption. According to (Beck 2002), (Svaleryd and Vlachos 2002), (Kim, Lin, and Suen 2010) and (Sare 2019) find that financial development facilitates international trade. (Dabla-Norris, Gradstein, and Inchauste 2008; Beck, Lin, and Ma 2014; Guo and Hung 2020) find that financial development reduces a company's degree of tax evasion. In turn, Capasso and Jappelli (2013) show that financial development can reduce tax evasion and the size of the underground economy. We argue that economic growth is the main indirect channel through which financial development could affect domestic tax revenue mobilization. Financial systems impact investment decisions on productivity enhancement activities through two mechanisms: (i) by assessing potential investors and investing in the most successful ones, (ii): they may also provide research, assessment, and supervisory support more efficiently and cost-effectively than individual investors or individuals, they are equally able to mobilize and provide the appropriate financing to investors rather than to individuals (see (King and Levine 1993)). In sum, the assessment and screening of

investors reduce the cost of investment in improving productivity and stimulates economic growth. As a result, economic growth would increase considerably, and the country's government could collect higher tax revenues. There is a large literature ((Levine 1996; Rajan and Zingales 1996; Levine and Zervos 1998; Beck, Levine, and Loayza 2000; Ang and McKibbin 2007; Greenwood, Sanchez, and Wang 2013) provided empirical evidence of a positive impact of the financial development on the economic growth. Likewise, a developed financial system may facilitate exchanges of goods and services, contributing to boosting the competitiveness of companies on the international market. Consequently, this will result in increasing exports and imports, and the country concerned could be able to generate higher tax revenues. Specifically, the positive effect of international trade on tax revenues is expressed through revenues generated from taxes on international trade and domestic tax revenues. Moreover, financial development may contribute to reducing a company's degree of tax evasion. For example, larger companies and societies owned by foreign investors and other societies whose financial statements are reviewed by external auditors are less likely to escape taxes. Individuals and companies escaping taxes or irregularly operating tend to hide their income. Indeed, access to external credits is very costly for companies having greater tax avoidance practices. Financial development encourages more transparency of companies that depend increasingly on external financing. Thus, developing countries being the most affected by tax evasion, with a certain high level of financial development, may reduce the tax revenue lost due to tax evasion. Finally, financial development is a potential disincentive to the spread of the informal economy.<sup>4</sup> According to Capasso and Jappelli (2013), when companies or individuals work informally, their ability to report income and assets is lower and the cost of credit higher. Thus, as financial markets become more developed, more efficient intermediaries penetrate the market, and the cost of credit decreases, increasing the cost of the opportunity cost of continuing underground exploitation.<sup>5</sup> In Brief, financial development leads to the formalization of firms or individuals, i.e.,

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<sup>4</sup> Many factors explain the emergence and size of informal activities, such as high taxation, high social charges, heavy legislation, and labor costs, as factors that may push firms into informality. Among these factors, credit availability and its price have received little attention.

<sup>5</sup> The starting point of this analysis is that the ability to reveal and report income reduces the frictions of information and the cost of credit ((Ellul et al. 2016)

it pushes firms to reveal information about their income and assets to financial intermediaries and tax officials.

### **3 Data, and methodology**

#### **Variables and data description**

To access the effect of financial development on tax revenue mobilization, this study uses data from 46 developing countries over the period 1995-2017. Our dependent variable is the non-resource tax revenue data stem from the International Centre for Tax and Development (ICTD), and the main explanatory variable is the financial development index according to the Global finindex. This sample period is determined by the availability of non-resource tax revenue and financial development (FD) Index data. Drawing from the literature on the determinants of tax revenue (Tanzi et al. 1981; Tanzi 1992; Ghura 1998; Khattry and Rao 2002; Gupta 2007; Bird, Martinez-Vazquez, and Torgler 2008; Baunsgaard and Keen 2010) we retain several key factors, including structural factors, that influence countries' tax revenue, namely: Gdp growth, trade openness, natural resources rents, share of agriculture, polity2. Table A1 in the appendix report the sources, definitions of variables used in this paper.

#### **Tax revenue**

Following Brun, Chambas, and Mansour (2015) our principal domestic tax revenue measure is the non-resource tax revenue (as a % of GDP) from the International Centre for Tax and Development (ICTD), which are calculated as total tax revenue (excluding grants and social contributions) minus revenues from resource taxes (% of GDP)—using of non-resource tax revenue as a dependent variable result in much greater homogeneity than total government revenue.

#### **Financial development**

The financial development index measures the level of financial development measured by five banking sector performance indicators and size. Financial development summarizes depth (market size and liquidity), access (the ability of individuals and companies to access financial services), and efficiency (the power of institutions to provide financial assistance at low cost and with sustainable incomes and the level of activity in capital markets).



**Gdp-growth.**

The Growth rate of gross domestic product controls the economic cycle and monetary conditions. This variable is assumed to have a positive effect on tax revenue. The growth rate of gross domestic product (Gdp\_growth) controls the economic cycle and monetary conditions. This variable is assumed to have a positive effect on non-resource tax revenue.

**Trade openness.**

The degree of trade openness measured by the share of exports and imports should also impact tax revenue, but its expected sign is controversial. The more open a country is to the outside world, the more a positive effect of trade openness on tax revenue can be expected. Trade openness might have a positive sign because the increase in trade volume increases economic growth and increases tax revenue. For example, (Thomas and Trevino 2013) observe a positive effect of trade openness on non-resource tax revenue. On the other hand, trade openness leads to at least tariff liberalization, which could be associated with lower tax revenue. The empirical literature on the impact of trade openness has provided evidence that trade openness is negatively related to total tax revenue and tax revenue from international trade Khattry and Rao (2002).

**Natural resource rents in the percentage of GDP.**

The natural resource measure is the ratio of resource rents to GDP. These rents, which include rents from energy, minerals, and forestry. The effect of natural resources on tax revenue is ambiguous. Indeed, on the one hand, a resource-rich country can generate a sizeable taxable surplus Gupta (2007), while on the other hand, natural resources might reduce the governments' incentives for collecting taxes (Lim 1988; Martinez-Vazquez 2001).

**Share of agriculture in the GDP.**

The share of agriculture in the GDP (Agriculture/GDP) measures the value-added in the agricultural sector as a proportion of total value-added. We expect agriculture to harm tax revenue considering the difficulty of taxing the farm sector (Khattry and Rao 2002; Baunsgaard and Keen 2010; Brun, Chambas, and Mansour 2015).

## Polity2.

The polity2 score corresponds to the difference between the democracy and the autocracy scores. It measures the competitiveness of political participation, the openness and competitiveness of executive recruitment, and constraint on the executive. This variable represents the quality of governance which measures the degree of democracy in a country. This variable is also expected to have a positive impact on tax revenue (Gupta 2007).

Table 1 contains the list of variables used in this paper and a brief description of the data. <sup>6</sup>

**Table 1: Descriptive statistics for main variables**

Variable name	Obs	Mean	Std.Dev.	Min	Max
Tax revenue over GDP	1010	24.1954	10.0382	5.89	60.68
Non-Resource Tax Revenue over GDP	939	15.6737	6.3472	1.916	56.92
Direct taxes	878	5.6406	3.3630	0.6767	24.0737
Indirect taxes	948	10.7724	5.1950	0.9757	47.8479
Taxes on income	908	5.4747	3.3302	0.6766	24.0737
Total taxes on goods and services	940	7.5420	3.6209	0.4706	18.8459
Value-added tax (VAT)	746	5.303	2.2381	0.02	14.46
Financial Development Index	1058	0.2540	0.1434	0.0308	0.7299
GDP Growth	1057	4.4335	4.1270	-14.7586	34.4662
Trade Openness over GDP	1036	75.4580	33.8562	0.1674	220.407
Natural resource rents over GDP	1053	6.3340	8.3695	0.0227	55.8521
Inflation	1057	19.6206	168.061	-18.8992	4,800.53
Agriculture over GDP	1052	14.0530	10.1237	1.8283	57.2386
Polity2	1058	3.8449	5.5469	-10	10

## Stylized facts

In Figures 1&2, we outline, for the first time, the relation between domestic tax revenue (respectively non-resources tax revenue) and various indices of financial development. The financial development global index is positively related to non-resource tax revenue. Also, Financial Institutions and Financial Markets seem to increase non-resource tax revenue. Financial institutions' depth, financial institutions' access, financial institutions' efficiency, and financial markets' depth positively affect non-resource tax revenue. In contrast, non-resource tax revenue is negatively related to financial market access and financial market efficiency.

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<sup>6</sup> Table C in the appendix presents the matrix of correlation of the variables studied.

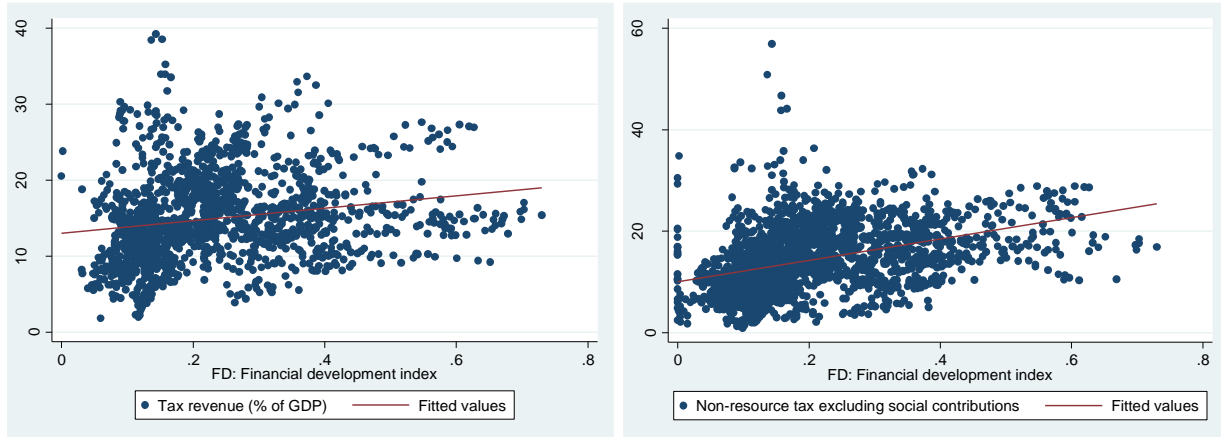


Figure 1: Domestic tax revenue (& non-resource tax excluding social contributions) and financial development index, financial institutions index and financial markets index. Author's calculations using Financial Structure and Economic Development Database (FSED), 2019 and ICTD GRD, 2019

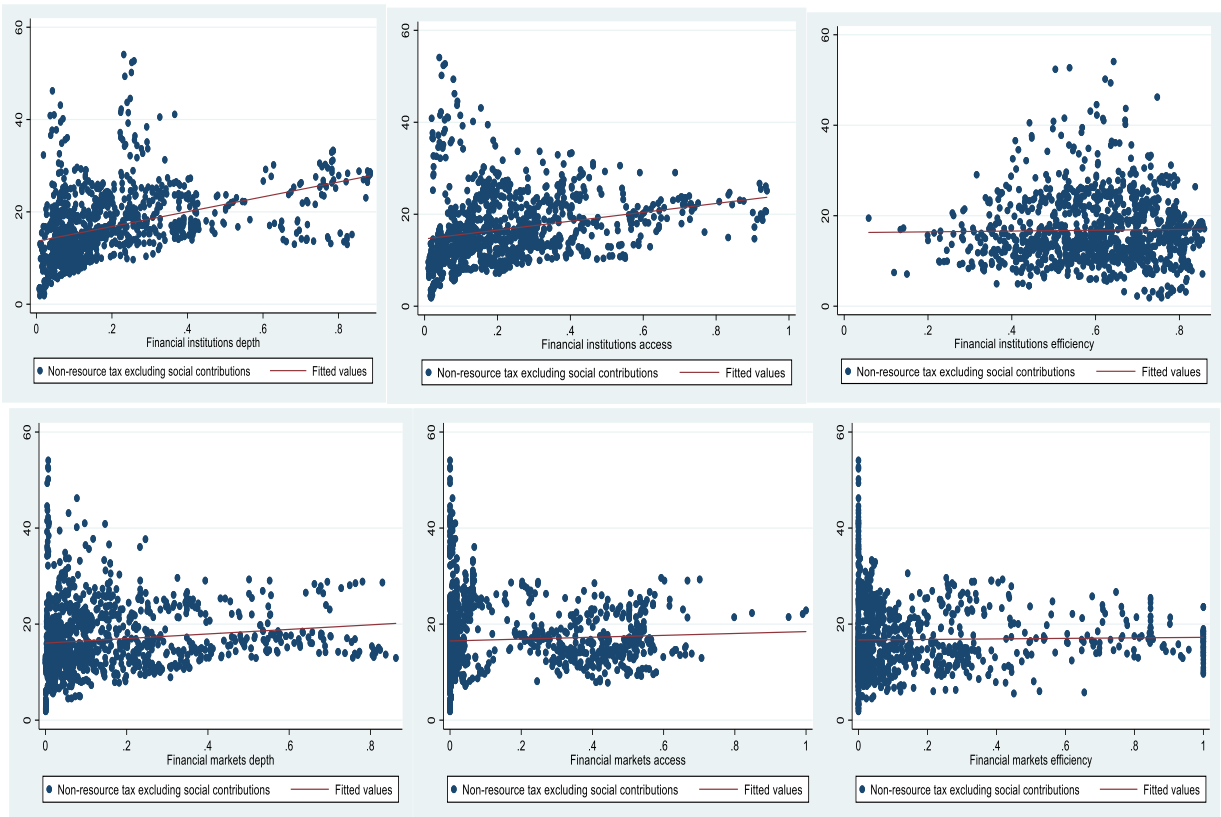


Figure 2: Non-resource tax revenue and financial institutions index sub-components and financial markets index sub-components. Author's calculations using Financial Structure and Economic Development Database (FSED), 2019 and ICTD GRD, 2019

The evolution of financial development highlights that the financial development index increases over the years in developing countries from 0.19 to 0.30 between 1995 to 2017. The financial development index is higher in the Middle East North Africa countries than in other regions worldwide.

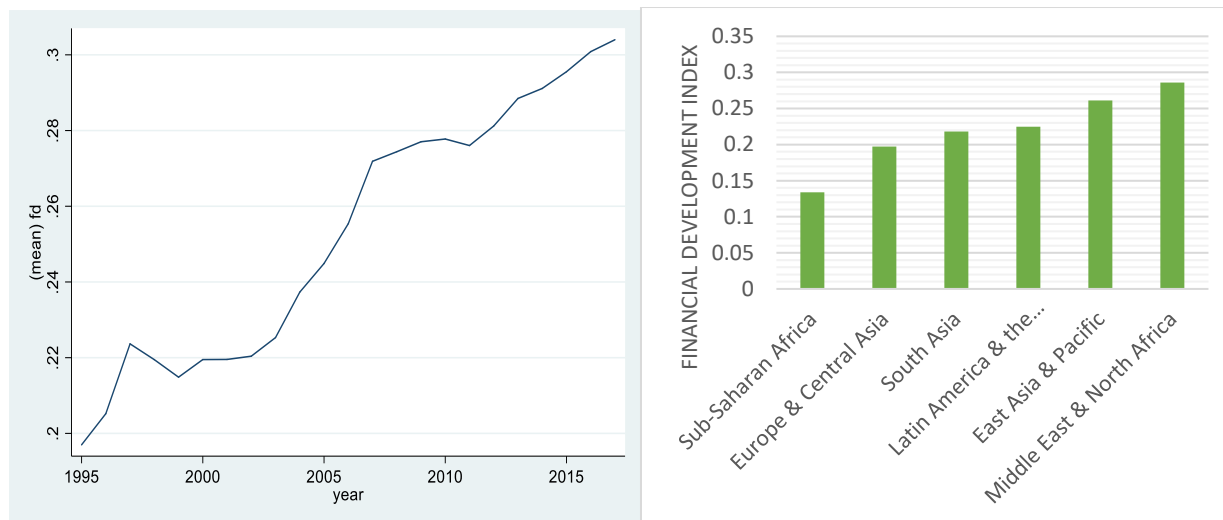


Figure 3: Evolution of financial development index over time and financial development by region from 1995 to 2017

Sources: Author's calculations using Financial Structure and Economic Development Database (FSED, 2019)

### Identification strategy

Following numerous studies on the determinants of the performance of public revenues, especially in developing countries (see (Baunsgaard and Keen 2010; Crivelli and Gupta 2014; Gnanon and Brun 2018)), we use the dynamic panel model:

$$Y_{i,t} = \theta_1 Y_{i,t-1} + \beta_1 FD_{i,t} + X_{i,t} \beta_2 + \alpha_i + \mu_t + \varepsilon_{i,t} \quad (1)$$

Where  $Y_{i,t}$  represents the mobilization of non-resource tax revenue from country  $i$  in period  $t$ .  $\theta_1$  is the coefficient of lagged non-resource tax revenue mobilization (tax revenue/ GDP).  $FD$  represents the level of financial development. We are mainly interested in  $\beta_1$ , which is the coefficient of  $FD$ .  $X$  is the vector of control variables; these include GDP growth, trade openness, natural resource rents,

the share of agriculture, polity2.  $\alpha_i$  and  $\mu_t$  are the country and time fixed effects, and  $\varepsilon_{i,t}$  an error term.

Linear dynamic panel models, such as Eq. (1), contain unobserved panel effects that can be fixed or random (see (Arellano and Bond 1991)). By construction, the unobserved panel-level effects are correlated with the lag(s) of the dependent variable, making most standard estimation approaches inconsistent (see (Arellano and Bond 1991)). Given the need to solve unobserved country heterogeneity, causality bias, and dynamic endogeneity bias, estimating this equation 1 by a fixed-effects model would lead our results to suffer from Nickell's bias (Nickell 1980) severe given the short duration of our data. The dynamic panel GMM estimators developed by Arellano and Bond (1991) and improved by (Arellano and Bover 1995) and then by Blundell and Bond (1998) develop a method for estimating the generalized method of moments (GMM), which gives consistent parameter estimates for models of this type. We evaluate our dynamic panel model using the generalized moment method (GMM) estimator. Two specific econometric methods were used: Arellano and Bond (1991) generalized first difference moment method (GMM in difference) and Blundell and Bond (1998) generalized system moment method (GMM System). The GMM dynamic panel estimator is suitable for estimating our dynamic equation in which a one-year delay of the dependent variable is included as an explanatory variable. These two methods make it possible to control the heterogeneity of countries and address the problem of endogeneity of variables, which may (necessarily) arise when studying the relationship between financial development and tax mobilization (tax revenue mobilization). Indeed, the OLS estimate is biased (upwards) because of the correlation between the error term (which contains specific effects) and the delayed endogenous variable. In addition, the Within estimate is also lowered (downward) because the transformation results in a negative correlation between the error term and the delayed endogenous variable on small samples (Nickell 1980). Thus, to correct Nickell's (1980) estimation bias, an instrumental variable method will be applied. The GMM estimator uses model-internal instruments (delayed values of variables suspected of endogeneity) to counter weak instruments and difficulties in processing several endogenous variables. The GMM first-difference estimator consists of associating the first difference of the equation to be estimated to eliminate country-specific effects with each period and then to instrument our explanatory variables of the first-difference equation by their level values

lagged by one period. The GMM estimator in the Blundell and Bond system combines the first difference equations with the level equations in which their first differences instrument the variables.

## 4 Empirical results

The regressions have used at only a period of the lagged tax revenue variable.<sup>7</sup> Table 2 presents the results for Specification 1, using the dynamic panel two-step system GMM estimations<sup>8</sup>. The statistical tests do not invalidate the econometric method: the null hypotheses of the Sargen/Hasen and AR (2) tests are accepted. Moreover, the positive coefficient of the lagged dependent variable highlights an inertia effect that legitimates the dynamic panel specification. Column [6] is the baseline model, including the lagged tax revenue variable, the financial development variable, real Gdp growth, trade openness, natural resource rents, agriculture value, and polity2. The lagged tax revenue variable's estimated coefficient is positive and statistically significant at a 1% level. This is a common finding in the literature indicating that non-resource tax revenue in one year is heavily influenced by non-resource tax revenue in the previous year, as (Gnangnon and Brun 2018) highlighted. We find that the coefficient of financial development is positive and statistically significant at the 1% level. Financial development has a significant and positive effect on non-resource tax revenue. 1% increase in financial development is associated with a 0.290 percentage point increase in non-resource tax revenue. These results can be explained by the fact the well-functioning financial sector of the developing countries enables the tax collection by the administration and the payment of taxes by taxpayers. Banks and financial institutions in facilitating financing provide different types of payment systems essential for monetary transactions; therefore, if a country has well-developed transparent and efficient financial institutions, businesses and

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<sup>7</sup> To determine the ideal number of lags in this study, we have estimated a linear model that use one of the standard information criteria, for example, the adjusted R-squared and the results (reported in Table A4) show that the ideal number of lags of the dependent variable is 1. From 2 lags onwards we no longer have this inertia effect, i.e., That is, the persistence effect of tax revenues since the lagged variable is no longer statistically significant.

<sup>8</sup> In this paper, our preferred estimator is the system-GMM. It has been highlighted that the lagged values of variables in level as it is done with the difference-GMM estimator are sometimes imperfect instruments for variables in first differences.

taxpayers will use them to carry out their transactions. In turn, tax collecting authorities (tax collectors) can obtain valuable information from these financial institutions, such as the income and assets of taxpayers. As for the control variables, Trade openness exerts a positive and significant impact on non-resource tax revenue. We observe that the level of natural resource rents is positively associated with non-resource tax revenue. These results are consistent with previous works (Gupta 2007; Tanzi 1992; Ghura 1998). We also note that non-resource tax revenue is negatively and significantly driven by high value-added agriculture (as % of GDP). The other control variables are not significant, including quality of governance (polity2) and real GDP growth.

**Table 2. Baseline: The effect of Financial Development on non-resource tax revenue**

Dependent variable: Log. non-resource over GDP	[1]	[2]	[3]	[4]	[5]	[6]
Lag (log. non-resource over GDP)	0.719*** (0.104)	0.701*** (0.100)	0.743*** (0.060)	0.712*** (0.065)	0.732*** (0.060)	0.731*** (0.059)
Financial Development Index	0.455*** (0.166)	0.420*** (0.134)	0.294*** (0.107)	0.310*** (0.095)	0.290*** (0.093)	0.290*** (0.095)
GDP growth		0.005*** (0.002)	0.005** (0.002)	0.002 (0.003)	0.001 (0.003)	0.001 (0.003)
Log. Trade Openness over GDP			0.052*** (0.026)	0.074* (0.041)	0.075* (0.044)	0.073* (0.038)
Log. Natural resource rents over GDP				0.011* (0.006)	0.013** (0.006)	0.013** (0.006)
Agriculture over GDP					-0.002* (0.001)	-0.003** (0.041)
Polity2						0.001 (0.002)
Constant	0.652*** (0.249)	0.681*** (0.243)	0.383** (0.165)	0.382** (0.150)	0.361* (0.203)	0.373* (0.201)
Observations	998	998	980	977	976	976
Countries	46	46	46	46	46	46
Instruments	13	19	22	22	23	24
Hansen	0.542	0.828	0.655	0.692	0.511	0.511
AR1	0.001	0.000	0.000	0.000	0.000	0.000
AR2	0.674	0.504	0.698	0.946	0.962	0.985

Note: Robust Standard Errors are in parenthesis. The variables "GDP growth", "Financial Development Index" and "Log. Trade Openness over GDP" has been considered as endogenous across all model specifications. The variables "Log. Natural Rents", "Agriculture over GDP", "Polity2" have been considered as exogenous. Standard errors in parentheses \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## 5 Robustness checks

In this section, we explore the robustness of our baseline results in several ways.

### An alternative measure of tax revenue

We begin by taking a closer look at our dependent variable. We use the tax revenue ratio (as a % of GDP) from the International Centre for Tax and Development (ICTD), Government Revenue Dataset (GRD), and The IMF's tax revenue dataset as an alternative measure of tax revenue. As we can observe, the coefficient associated with financial development is positive and enormously

significant, suggesting that the increase in tax revenue does not change with the tax revenue measure. Finally, the estimated coefficient in domestic tax revenue in absolute value is 0.307 percentage point, a magnitude somewhat higher compared with our benchmark findings.

**Table 3. Robustness: The effect of Financial Development on non-resource tax revenue (Alternative measure of tax revenue)**

<b>Dependent variable: Log. Domestic Tax revenue over GDP</b>	<b>[1]</b>	<b>[2]</b>
<b>Alternatives</b>	<b>Baseline</b>	<b>Alternative 1</b>
	<b>[1]</b>	<b>[2]</b>
Lag (Log. Tax revenue)	0.731*** (0.059)	0.716*** (0.104)
Financial Development Index	0.290*** (0.095)	0.307** (0.152)
Constant	0.373* (0.201)	0.611* (0.356)
Observations/	976	945
Countries	46	46
Instruments	24	25
Hansen	0.629	0.613
AR1	0.000	0.004
AR2	0.985	0.881
<b>Controls</b>	Yes	Yes

*Note: Robust Standard Errors are in parenthesis. The variables "GDP growth", "Financial Development Index" and "Log. Trade Openness over GDP" has been considered as endogenous across all model specifications. The variables "Log. Natural Rents", "Log. Agriculture over GDP", "Polity2" have been considered as exogenous. Standard errors in parentheses \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$*

### Testing for additional controls

We alternatively introduce additional covariates that may affect non-resource tax revenue mobilization. We add these additional covariates into the main specification to address the issue of omitted variables. (Column [1] is the baseline model. Column [2]-[8] include additional covariates). We control for the population density, financial (capital) openness index, migrants' remittances (% of GDP), inflation, Foreign direct investment (% of GDP), aid (% of GDP), and the government debt (% of GDP). According to columns [2]-[9] in Table 4, the additional variables confirm the robustness of our baseline model. Whenever significant, their effect is consistent with what one may expect. Overall, accounting for other control variables proves the intensely substantial and positive effect of financial development on non-resource tax revenues mobilization.



**Table 4 Robustness: Effects of Financial Sector Development on Non-resource tax revenue (additional controls)**

Dependent variable: Log. Non-resource tax revenue over GDP	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Lag (log. Non-resource tax revenue)	0.731*** (0.059)	0.767*** (0.061)	0.744*** (0.061)	0.732*** (0.053)	0.730*** (0.064)	0.707*** (0.065)	0.768*** (0.048)	0.763*** (0.059)	0.789*** (0.096)
Financial Development Index	0.290*** (0.095)	0.271*** (0.103)	0.269*** (0.104)	0.263*** (0.092)	0.255*** (0.099)	0.336*** (0.102)	0.749*** (0.260)	0.294*** (0.107)	0.350*** (0.129)
GDP growth	0.001 (0.003)	0.005* (0.003)	0.004* (0.003)	0.003 (0.002)	0.006 (0.004)	0.004 (0.004)	0.006 (0.015)	0.005*** (0.002)	0.004 (0.004)
Log. Trade Openness over GDP	0.073* (0.044)	0.047* (0.028)	0.055* (0.031)	0.068 (0.044)	0.055 (0.049)	0.059*** (0.007)	0.038** (0.018)	0.064 (0.041)	0.043 (0.043)
Agriculture to GDP	-0.003** (0.001)	-0.001 (0.001)	-0.002* (0.001)	-0.004*** (0.001)	-0.004** (0.002)	-0.003* (0.002)	-0.004*** (0.001)	-0.004*** (0.001)	-0.002 (0.006)
Log. Natural resource rents over GDP	0.013** (0.006)	0.001 (0.005)	-0.004 (0.006)	0.000 (0.005)	-0.001 (0.006)	-0.003 (0.005)	-0.001 (0.006)	-0.004 (0.007)	-0.003 (0.002)
Polity2	0.001 (0.002)	0.001 (0.001)	0.002* (0.001)	0.000 (0.001)	0.001 (0.002)	-0.001 (0.002)	0.002 (0.005)	0.001 (0.002)	0.001 (0.002)
Log. Population Density		-0.020* (0.011)	-0.023** (0.010)	-0.031*** (0.010)	-0.035*** (0.012)	-0.005 (0.011)	0.031 (0.031)	-0.020 (0.013)	-0.021* (0.013)
Financial Openness Index			-0.018*** (0.014)	-0.020*** (0.006)	-0.019*** (0.005)	-0.039*** (0.015)	-0.051 (0.054)	-0.025*** (0.008)	-0.019 (0.013)
Log. Remittances				0.014* (0.008)	0.014 (0.010)	-0.146*** (0.053)	-0.043* (0.023)	0.008 (0.008)	0.006 (0.009)
Log. Inflation					-0.014*** (0.010)	-0.011* (0.007)	0.039* (0.021)	-0.016** (0.006)	-0.001 (0.040)
Log. Foreign direct investment over GDP						0.009* (0.005)	0.011* (0.005)	0.007 (0.006)	0.013* (0.007)
Log. Aid over GDP							0.767* (0.461)	0.874* (0.504)	0.784 (0.723)
Log. Government debt								0.011 (0.022)	0.037 (0.031)
Corruption									-0.003 (0.007)
Constant	0.373* (0.201)	0.443** (0.188)	0.488** (0.196)	0.529** (0.248)	0.638** (0.341)	0.602** (0.292)	0.470** (0.197)	0.376 (0.249)	0.252 (0.409)
Observations/	976	976	976	937	907	880	854	781	724
Countries	46	46	46	46	46	46	46	43	39
Instruments	24	30	29	28	25	26	34	34	27
Hansen	0.629	0.362	0.431	0.908	0.794	0.784	0.651	0.820	0.612
AR1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR2	0.985	0.716	0.751	0.626	0.600	0.118	0.106	0.119	0.213

Note: Robust Standard Errors are in parenthesis. The variables "GDP growth ", "Financial Development Index "and "Log. Trade Openness over GDP" has been considered as endogenous across all model specifications. The variables "Log. Natural Rents ", " Log. Agriculture over GDP ", " Polity2 " have been considered as exogenous. Standard errors in parentheses \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

## The sub-components of financial development

So far, we have focused on the aggregate financial development (FD) index. We now investigate the effects of disaggregated financial development components on non-resource tax revenue mobilization. Using these indices would provide an excellent understanding of the true relationships between the different dimensions of financial development and tax revenues. First, Financial institutions (FI) include banks, insurance companies, mutual funds, pension funds, and other non-bank financial institutions. Second, financial markets (FM) include mainly stock and bond markets. Thirdly and to finish, within financial institutions (FI) and financial markets (FM), different

dimensions of the financial system were measured: depth, access, and efficiency. The estimated coefficients on the sub-components of financial development are statistically significant, except for the efficiency of the financial markets. Note that the financing of the developing economies relies more on banking intermediation than on the stock market. For example, there is evidence that financial sectors are essentially bank-based (Gaies, Goutte, and Guesmi 2019; Andrianaivo and Yartey 2010; Senbet and Otchere 2006; Creane et al. 2006).

Finally, we pose the following question. Is it possible that one dimension of institutions—banking and nonbanking—as well as markets complements the other? The answer to this question may suggest that the three dimensions of institutions—banking and nonbanking—as well as markets may indeed reinforce each other's effectiveness, and if possible, such complementarity needs to be exploited. We find that the coefficient of the interaction term of financial institutions depth and financial institutions efficiency, the coefficient of the interaction term of financial institutions access and financial institutions efficiency, and the coefficient of the interaction term of financial markets depth and financial markets access, the coefficient of the interaction term of financial markets depth and financial markets efficiency, and the coefficient of the interaction term of financial markets access and financial markets efficiency to be positive, which therefore points to a complementary relationship between financial institutions depth and financial institutions efficiency, financial institutions access and financial institutions efficiency, and financial markets depth and financial markets access, financial markets depth and financial markets efficiency, and financial markets access and financial markets efficiency.

**Table 5. Robustness: The effect sub-components of financial development on non-resource tax revenue**

<b>Dependent variable: Log. Non resource tax revenue over GDP</b>	<b>[1]</b>	<b>[2]</b>	<b>[3]</b>	<b>[4]</b>	<b>[5]</b>	<b>[6]</b>	<b>[7]</b>	<b>[8]</b>	<b>[9]</b>	<b>[10]</b>	<b>[11]</b>	<b>[12]</b>	<b>[13]</b>	<b>[14]</b>
Lag (log. Non-resource tax revenue over GDP)	0.753*** (0.056)	0.739*** (0.069)	0.670*** (0.071)	0.743*** (0.057)	0.779*** (0.057)	0.759*** (0.065)	0.727*** (0.075)	0.990*** (0.056)	0.731*** (0.066)	0.743*** (0.148)	0.847*** (0.079)	0.857*** (0.117)	0.651*** (0.084)	0.732*** (0.061)
Financial institutions	0.237*** (0.070)													
Financial markets		0.144** (0.071)												
Financial institutions depth			0.309*** (0.102)						0.220 (0.287)	-0.443 (0.309)				
Financial markets depth				0.132*** (0.045)								-0.051 (0.102)	-0.185 (0.133)	
Financial institutions access					0.371*** (0.0115)				0.133 (0.185)		-0.760* (0.398)			
Financial markets access						0.182*** (0.068)						-0.446** (0.182)		-0.173* (0.099)
Financial institutions efficiency							0.212** (0.103)			-0.169* (0.091)	-0.222* (0.114)			
Financial markets efficiency								0.057 (0.062)					-0.121* (0.072)	-0.157* (0.094)
Financial institutions depth* Financial institutions access									-0.208 (0.826)					
Financial institutions depth* Financial institutions efficiency										0.928* (0.755)				
Financial institutions access * Financial institutions efficiency											1.288** (0.642)			
Financial markets depth * Financial markets access												0.992* (0.517)		
Financial markets depth * Financial markets efficiency													0.633* (0.347)	
Financial markets access * Financial markets efficiency														0.836** (0.349)
Observations/ Countries	976/46	976/46	976/46	976/46	976/46	976/46	976/46	976/46	976/46	976/46	976/46	976/46	976/46	976/46
Instruments	30	19	19	25	30	30	24	19	23	19	21	14	20	25
Hansen	0.831	0.206	0.704	0.826	0.529	0.788	0.417	0.455	0.424	0.341	0.922	0.998	0.910	0.840
AR1	0.008	0.010	0.012	0.008	0.008	0.006	0.008	0.006	0.000	0.003	0.000	0.001	0.000	0.000
AR2	0.948	0.868	0.716	0.823	0.947	0.943	0.987	0.828	0.868	0.486	0.497	0.581	0.845	0.875
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust Standard Errors are in parenthesis. The variables "GDP growth", "Financial Development Index" and "Log. Trade Openness over GDP" has been considered as endogenous across all model specifications.

The variables "Log. Natural Rents", "Log. Agriculture over GDP", "Polity2" have been considered as exogenous.

<sup>2</sup>Standard errors in parentheses \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

## Alternative Financial development measures: Traditional measures of financial development

We now look at each type of measure. First, our empirical analysis uses six financial development measures: liquid liabilities, central bank assets, deposits money bank assets, private credit by money banks, financial system deposits and private credit by money banks and other financial institutions. Second, following Gnanon (2022); Samargandi, Fidrmuc, and Ghosh (2015) and Huang (2010), we use a composite indicator of financial development to measure the overall financial sector development, obtained by combining several existing financial development indicators using the principal components analysis (PCA). Using these variables, we look both at the level and the magnitude effect. In particular, when the liquid liabilities, the central bank assets, the deposits money bank assets; the private credit by money banks, or the private credit by money banks and other financial institutions measure financial development, the empirical evidence supports the hypothesis that financial development significantly increases non-resource tax revenue. Interestingly, the financial development indicator coefficient is also positive and significant. However, we observe some relative variations in the coefficients according to the type of measure, corroborating our intuition.

**Table 6. Robustness: The effect of traditional measures of financial development on non-resource tax revenue**

Dependent variable: Log. Non-resource tax revenue over GDP	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Lag (log. Non-resource tax revenue over GDP)	0.726*** (0.070)	0.866*** (0.048)	0.686*** (0.076)	0.689*** (0.067)	0.686*** (0.061)	0.701*** (0.062)	0.691*** (0.083)
Log. Liquid liabilities to GDP (%)	0.113** (0.044)						
Log. Central bank assets to GDP (%)		0.004* (0.003)					
Log. Deposit money bank assets to GDP (%)			0.086*** (0.030)				
Log. Private credit by money banks to GDP				0.084*** (0.027)			
Log. Private credit by money banks and other financial institutions to GDP					0.093*** (0.104)		
Log. Financial system deposits to GDP						0.093*** (0.028)	
Indicator "Financial development"							0.014** (0.007)
Constant	0.434** (0.170)	0.130 (0.179)	0.467** (0.229)	0.469** (0.230)	0.377* (0.209)	0.396* (0.216)	0.614*** (0.235)
Observations/ Countries	973/46	950/46	974/46	974/46	973/46	974/46	973/46
Instruments	16	38	19	22	25	18	22
Hansen	0.448	0.394	0.763	0.817	0.967	0.893	0.509
AR1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR2	0.622	0.322	0.506	0.671	0.741	0.609	0.986
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust Standard Errors are in parenthesis. The variables "Log. GDP growth", "Financial Development measures" and "Log. Trade Openness over GDP" have been considered as endogenous across all model specifications. The variables "Log. Natural Rents", "Agriculture over GDP", "Polity2" have been considered as exogenous. \*Standard errors in parentheses \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

## 6 Financial development and the composition of tax revenue

We look at the effect of financial development on tax revenue composition by disaggregating tax data between indirect taxes and direct taxes. The tax structures of developing countries are different (Modica, Laudage, and Harding 2018). For example, some countries have high direct taxes that account for high proportion of the total tax revenue, while others have low tax rates and tax structures that rely heavily on indirect taxes. This may result in insufficient capacity for tax revenue mobilization. The financial sector can play a critical role in the functioning of the tax structure. Thus, consistent with our hypothesis, the results support a positive effect of financial sector development on all subcomponents of total tax revenue (Column [2]-[6]). More specifically, the coefficient associated with financial sector development is more sizeable for direct taxes (Column [2]) compared to the one for indirect taxes (Column [3]). This might suggest that the development of the financial sector allows the government to access each firm's or taxpayer's bank records and can use this information in enforcing the tax law and, thereby, more direct taxes to collect. This is confirmed by the positive and statistically positive coefficient of financial sector development on taxes on income (Column [5]).

**Table 7. Robustness: The effect of financial development on the composition of tax revenue**

Regressions	[1]	[2]	[3]	[4]	[5]	[6]
Dependent variable:	Log. non-resource tax over GDP	Log. Direct taxes	Log. Indirect taxes	Log. Taxes on Income	Log. Taxes on goods and services	Log. Value-added tax
Dependent variable (lagged)	0.731*** (0.059)	0.741*** (0.156)	0.825*** (0.079)	0.705*** (0.147)	0.879*** (0.052)	0.782*** (0.070)
Financial Development Index	0.290*** (0.095)	0.500* (0.294)	0.393** (0.186)	0.471* (0.280)	0.179** (0.079)	0.178* (0.100)
GDP growth	0.001 (0.003)	0.028*** (0.008)	0.003** (0.002)	0.019*** (0.006)	0.001 (0.003)	0.005* (0.003)
Log. Trade Openness over GDP	0.073* (0.044)	0.121 (0.109)	0.112* (0.062)	0.111* (0.066)	0.042 (0.049)	0.079* (0.044)
Log. Natural resource rents over GDP	0.013** (0.006)	0.005 (0.008)	-0.003 (0.008)	0.018 (0.015)	-0.005 (0.005)	0.002 (0.006)
Agriculture over GDP	-0.003** (0.001)	-0.001 (0.003)	0.002 (0.002)	-0.003 (0.004)	0.001 (0.001)	-0.000 (0.001)
Polity2	0.001 (0.002)	0.002 (0.002)	0.001 (0.002)	0.002 (0.003)	0.001* (0.001)	-0.000 (0.001)
Constant	0.373* (0.201)	-0.296 (0.631)	-0.202 (0.342)	-0.130 (0.402)	0.019 (0.164)	0.003 (0.187)
Observations	976	781	874	757	866	695
Countries	46.000	42.000	45.000	42.000	45.000	41.000
Instruments	24.000	22.000	38.000	25.000	18.000	23.000
Hansen	0.629	0.323	0.367	0.458	0.933	0.705
AR1	0.000	0.000	0.002	0.001	0.002	0.009
AR2	0.985	0.419	0.146	0.359	0.839	0.804

Note: Robust Standard Errors are in parenthesis. The variables "GDP growth", "Financial Development Index" and "Log. Trade Openness over GDP" has been considered as endogenous across all model specifications. The variables "Log. Natural Rents", "Agriculture over GDP", "Polity2" have been considered as exogenous. Standard errors in parentheses \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## 7 Heterogeneity

One concern over the findings mentioned above is that these parameters may be heterogeneous across countries. In principle, the system GMM estimates impose homogeneity on all slope coefficients. A natural way to confront this problem is to investigate more homogeneous subsamples. This section turns to three subsamples: lower-income countries, higher-income countries, lower-openness degree, higher-openness degree, lower-public debt levels countries, and higher-public debt levels countries. This section analyzes the sensitivity of the effect of financial development on non-resource tax revenue mobilization concerning the overall state of the economy, financial openness level, and debt level.

### **The state of the economy**

We focus on the level of economic development. Indeed, we search for a potential impact of the level of economic development on the effect of financial development by distinguishing between "low" and "high" GDP growth levels, using the median of GDP growth to separate the two groups. For low-income countries, the net impact of financial development on non-resource tax revenue mobilization in the short term is positive and significant (column [2]) and is 0.112 percentage points (= 0.312 – 0.200). The magnitude of this impact appears to be far higher than the net impact of this variable on non-resource tax revenue in high-income countries (column [3]), which is positive and significant and amounts to 0.108 percentage point. Moreover, results presented in columns [2]– [3] in Table 8 show that fiscal potential is more significant in "low-income" countries in most cases. Although financial development significantly improves tax revenue mobilization in both "high" and "low" levels of economic growth, the estimated coefficient of a financial product is more robust in "low-income."

### **The financial openness level**

We examine the potential influence of financial openness. According to (Balima, Combes, and Minea 2016), more open countries may attract more foreign investors and be more vulnerable to risk. Therefore, non-resource tax revenue mobilization could serve as a social protection tool and

provide a "spare tire" for governments, particularly against adverse shocks affecting access to financial markets. Thus, we expect the estimated effect to be more critical in relatively more financial openness countries. We test this hypothesis by dividing the sample into "high" and "low" openness degrees, using the median level of the Chinn-Ito index to separate the two groups. For high-openness countries, the net impact of financial development on non-resource tax revenue mobilization in the short term is positive and significant (column [4]) and is 0.227 percentage point. The magnitude of this impact appears to be far higher than the net impact of this variable on non-resource tax revenue in low-openness countries (column [5]), which is positive and significant and amounts to 0.014 percentage points ( $= 0.227 - 0.213$ ).

Results depicted on lines [4]– [5] in Table 8 confirm our hypothesis, as estimated coefficients of financial development are larger in "high" openness contexts.

### **The debt level**

We condition the effect of financial development on the debt levels by splitting our sample into "low" and "high" public debt levels, using the median of total government debt in % of GDP to separate the two groups. Indeed, significant debt levels make it more difficult to raise taxes since large debt may reflect less fiscal space (Ostry et al. 2010). Thus, we expect the estimated effect to be more critical in relatively less indebted countries. For low-debt countries, the net impact of financial development on non-resource tax revenues mobilization in the short term is positive and significant (column [6]) and is 0.409 percentage point. The magnitude of this impact appears to be far higher than the net impact of this variable on non-resource tax revenue in high debt countries (column [7]), which is positive and significant and amounts to 0.351 percentage point ( $= 2.927 - 2.576$ ).

Results reported in columns [6]– [7] of Table 8 show that financial development significantly improves non-resource tax revenue mobilization exclusively in "low" debt countries, consistent with theoretical insights.

**Table 8. Heterogeneity in the effect of financial development on non-resource tax revenue**

<b>Dependent variable: Log. Non-resource tax revenue over GDP</b>	<b>[1]</b>	<b>[2]</b>	<b>[3]</b>	<b>[4]</b>	<b>[5]</b>	<b>[6]</b>	<b>[7]</b>
[1] Lag (log. Non-resource tax revenue over GDP)	0.731*** (0.059)	0.811*** (0.067)	0.893*** (0.045)	0.846*** (0.072)	0.879*** (0.071)	0.763*** (0.103)	0.881*** (0.089)
[2] Financial Development Index	0.290*** (0.095)	0.312** (0.152)	0.108* (0.064)	0.227* (0.127)	0.227* (0.127)	0.409* (0.243)	2.957** (1.152)
[3] Financial development*Low Income		-0.200*** (0.073)					
[4] Financial development*High Income			-0.050 (0.056)				
[5] Financial development*Low Openness				-0.213*** (0.065)			
[6] Financial development*High Openness					-0.238 (0.149)		
[7] Financial development*Low Debt ratio						-0.270 (0.284)	
[8] Financial development*High Debt ratio							-2.576** (1.089)
[9] Low Income		0.019 (0.029)					
[10] High Income			0.011 (0.034)				
[11] Low Openness				0.052** (0.021)			
[12] High Openness					0.074 (0.067)		
[13] Low Debt ratio						0.095 (0.108)	
[14] High Debt ratio							0.599** (0.258)
Observations/ Countries	976/46	458/44	518/45	534/36	442/26	554/40	422/36
Instruments	24	33	43	35	24	25	22
Hansen	0.629	0.217	0.479	0.317	0.365	0.567	0.872
AR1	0.000	0.010	0.036	0.009	0.062	0.001	0.000
AR2	0.985	0.429	0.691	0.454	0.565	0.576	0.987
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust Standard Errors are in parenthesis. The variables "Log. GDP growth ", "Financial Development Index "and "Log. Trade Openness over GDP" has been considered as endogenous across all model specifications. The variables "Log. Natural Rents ", " Log. Agriculture over GDP ", " Polity2 " have been considered as exogenous. <sup>2</sup>Standard errors in parentheses \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01



## 8 Conclusion

The main objective of this study was to analyze the relationship between financial development and tax revenue mobilization from theoretical and empirical perspectives in developing countries over the period 1995 to 2017. Our work contributes to the literature on this topic in several ways.

Using an appropriate method, namely the GMM-system estimator, on a sample of 46 developing countries, we have shown that financial development contributes positively and significantly to non-resource tax revenue mobilization. Looking at the effects on the tax structure, the results show that financial sector development has a more sizeable effect on direct taxes than the rest of the total tax subcomponents. This result is supported by an extensive set of robustness tests, including alternative tax revenue measures, additional covariates, and traditional measures of financial development for estimating the coefficient of our financial development variable.

Given these results, this analysis provides straightforward and valuable policy recommendations. On the practical side, the highest effect of financial development in terms of tax revenue mobilization arises when combined with sound fiscal or monetary policy frameworks, and in relatively more open and financially developed contexts. We believe that efforts should help developing countries, particularly low-income countries, build their financial systems to make valuable information easily accessible from these financial institutions. The low development of the financial sector has long been identified as one of the most binding constraints on economic growth, especially in developing countries. In this regard, spurring the development of a country's financial sector not only helps improve economic growth, but also contributes positively to domestic tax revenue mobilization, which may improve the social welfare of the country at the same time.

### **Declaration of Competing Interest**

We have no conflict of interests to report regarding the manuscript “**How does financial sector development improve tax revenue mobilization for developing countries?**” submitted for publication to Comparative Economic Studies.

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## Appendix

### Tables A1-A4.

#### Table A1

##### Definition and sources of variables.

Variables	Descriptions	Sources
<b>Tax revenue</b>	Tax revenue divided by GDP	World Development Indicators (WDI)
<b>Non-Resource Tax Revenue</b>	It is Calculated as total tax revenue (excluding grants and social contributions) minus resource tax revenue (% GDP).	International Centre for Tax and Development (ICTD).
<b>Non-Resource direct tax</b>	Direct taxes including social contributions, excluding resource revenue	International Centre for Tax and Development (ICTD).
<b>Total non-resource indirect taxes.</b>	Total Indirect Taxes, excluding resource revenues. Includes taxes on goods and services, taxes on international trade and other taxes.	International Centre for Tax and Development (ICTD).
<b>Financial Development Index</b>	Index for overall financial development	Financial Structure and Economic Development Database (FSED)
<b>GDP growth</b>	The annual percentage growth rate of GDP at market prices is based on constant local currency.	World Development Indicators (WDI)
<b>Agriculture</b>	Share of agriculture in aggregate value-added.	World Development Indicators (WDI)
<b>Trade Openness</b>	Sum of exports and imports of goods and services, % of GDP.	World Development Indicators (WDI)
<b>Population density</b>	The midyear population is divided by land area in square kilometers.	World Development Indicators (WDI)
<b>Government debt</b>	It includes domestic and foreign liabilities such as currency and money deposits, securities other than shares, and loans.	World Development Indicators (WDI)
<b>Inflation</b>	The annual percentage change of consumer price index.	World Development Indicators (WDI)
<b>External debt</b>	Total external debt stocks, % of GDP (External public and private sector debt)	World Development Indicators (WDI)
<b>FDI net inflows</b>	It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments	World Development Indicators (WDI)
<b>Aid</b>	Net official development assistance and official aid received (constant 2016 US\$)	World Development Indicators (WDI)
<b>Natural resource rents</b>	Total natural resources rents (percentage of GDP)	World Development Indicators (WDI)
<b>Remittances</b>	Remittances in percentage of GDP	World Development Indicators (WDI)
<b>Control of corruption</b>	Control of corruption captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.	International Country Risk Guide (ICRG)
<b>Polity2</b>	Polity2 index	Polity4 Project
<b>Capital openness index</b>	It captures the degree of financial openness	(Chinn and Ito 2008)
<b>Liquid liabilities</b>	Ratio of liquid liabilities to GDP	IMF's International Financial Statistics
<b>Central bank assets</b>	Claims on the domestic real nonfinancial sector by the Central Bank as a share of GDP	IMF's International Financial Statistics
<b>Deposit money bank assets</b>	Claims on the domestic real nonfinancial sector by deposit money banks as a share of GDP	IMF's International Financial Statistics
<b>Private credit by money banks</b>	Private credit by deposit money banks to GDP	IMF's International Financial Statistics
<b>Private credit by money and other financial institutions</b>	Private credit by deposit money banks and other financial institutions to GDP	IMF's International Financial Statistics
<b>Financial institutions</b>	The <sup>2</sup> Financial institutions index	Financial Structure and Economic Development Database (FSED)
<b>Financial markets</b>	The Financial markets index	Financial Structure and Economic Development Database (FSED)
<b>Financial institutions depth</b>	The Financial institution's depth index	Financial Structure and Economic Development Database (FSED)
<b>Financial institutions access</b>	The Financial institution's access index	Financial Structure and Economic Development Database (FSED)
<b>Financial institutions efficiency</b>	The Financial institution's efficiency index	Financial Structure and Economic Development Database (FSED)
<b>Financial markets depth</b>	The Financial markets depth index	Financial Structure and Economic Development Database (FSED)
<b>Financial markets access</b>	The Financial markets access index	Financial Structure and Economic Development Database (FSED)
<b>Financial markets efficiency</b>	The Financial markets efficiency index	Financial Structure and Economic Development Database (FSED)

**Table A2. List of countries used in the analysis**

Full Sample					
Angola	Burkina Faso	Indonesia	Morocco	South Africa	
Albania	China	Jamaica	Myanmar	Thailand	
Argentina	Colombia	Jordan	Namibia	Togo	
Azerbaijan	Costa Rica	Lesotho	Nepal	Tunisia	
Bangladesh	Cote d'Ivoire	Madagascar	Paraguay	Ukraine	
Belarus	Dominican Republic	Malaysia	Peru	Zambia	
Bhutan	Gabon	Mali	Philippines		
Botswana	Ghana	Mexico	Russian Federation		
Brazil	Guatemala	Moldova	South Africa		
Bulgaria	India	Mongolia	Sri Lanka		

**Table A3. Pairwise correlation between variables used in the analysis.**

Variable	Tax revenue	Non-Resource Tax Revenue	Financial Development	GDP growth	Trade Openness	Natural rents	Inflation	Agriculture	Polity2
Tax revenue	1.000								
Non-Resource Tax Revenue	0.6009*	1.000							
Financial Development Index	0.1307*	0.3649*	1.000						
GDP growth	-0.0539*	-0.1609*	-0.0509*	1.000					
Trade openness	0.4038*	0.2713*	-0.1188*	-0.0260	1.0000				
Natural rents	0.1928*	-0.2464*	-0.2074*	0.1916	0.1242*	1.0000			
Inflation	0.0749*	0.0824*	-0.0520*	0.0684*	0.0774*	0.2160*	1.0000		
Agriculture	-0.4537*	-0.3968*	-0.4435*	0.1910*	-0.2204*	0.0024	-0.0202	1.0000	
Polity2	-0.0946*	-0.1102*	0.1318*	-0.1746*	-0.0969*	-0.2866*	-0.0733*	-0.1870*	1.0000

**Table A4. The effect of Financial Development on non-resource tax revenue with lags.**

Dependent variable: Log. non-resource over GDP	[1]	[2]	[3]
log. non-resource over GDP (t-1)	0.756*** (0.038)	0.834*** (0.065)	0.834*** (0.068)
log. non-resource over GDP (t-2)		-0.091* (0.049)	-0.087 (0.067)
log. non-resource over GDP (t-3)			-0.023 (0.044)
Financial Development Index	0.040** (0.019)	0.050** (0.020)	0.056** (0.023)
GDP growth	0.004*** (0.001)	0.004*** (0.001)	0.004*** (0.001)
Log. Trade Openness over GDP	0.058*** (0.016)	0.056*** (0.014)	0.056*** (0.014)
Log. Natural resource rents over GDP	0.007 (0.005)	0.006 (0.005)	0.004 (0.006)
Agriculture over GDP	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)
Polity2	0.002 (0.002)	0.001 (0.002)	0.002 (0.002)
Constant	0.436*** (0.110)	0.503*** (0.109)	0.564*** (0.127)
Observations	976	931	887
Countries	46	46	46
Adjusted_R-squared	0.731	0.725	0.714
Fixed effects	Yes	Yes	Yes

Note: Robust Standard Errors are in parenthesis.

Standard errors in parentheses: \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

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