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From Tax Revenue Mobilization to Financial Development: Essays on Financing for Development

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L'Université n'entend donner aucune approbation ou improbation aux opinions émises dans cette thèse. Ces opinions doivent être considérées comme propres à leur auteur.

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List of acronyms

AEs	Advanced Economies
ATI	Addis Tax Initiative
BEPS	Base Erosion and Profit Shifting
CIT	Corporate Income Tax
COW	Correlates of Wars
DPS	Dynamic Panel Specification
DRM	Domestic Revenue Mobilization
EC	European Commission
ECA	Europe and Central Asia
EMEs	Emerging Markets Economies
EU	European Union
FAS	Financial Access Survey
FE	Fixed Effect
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GFS	Government Finance Statistics
GFSM	Government Finance Statistics Manual
GMM	Generalized Method of Moments
GTD	Global Terrorism Database
HIC	High-Income Countries
ICTD	International Centre for Tax and Development
IMF	International Monetary Fund
LAC	Latin America and the Caribbean
LIC	Low-Income Countries
LIDCs	Low-Income Developing Countries
LMIC	Lower Middle-Income Countries
MDGs	Millennium Development Goals

MENA	Middle East and North Africa
MEPV	Political Terror Scale
MFIs	Microfinance Institutions
MLE	Maximum Likelihood Estimator
NA	North America
ODA	Official Development Assistance
OECD	Organization for Economic Co-operation and Development
PIT	Personal Income Tax
PSC	Panel Specific Correlation
PTS	Political Terror Scale
PWT	Penn World Table
RE	Random Effects
SA	South Asia
SDGs	Sustainable Development Goals
SFA	Stochastic Frontier Analysis
SSA	Sub-Saharan Africa
TADAT	Tax Administration Diagnostic Tool
TP	Transfer Pricing
TPAF	Tax Policy Assessment Framework
TTA	Tax Technical Assistance
UCDP	Uppsala Conflict Data Program
UMIC	Upper Middle-Income Countries
UNU-WIDER	United Nations University World Institute for Development Economics Research
US	United States (of America)
USAID	United States Agency for International Development
VAT	Value-Added Tax
WBG	World Bank Group
WDI	World Development Indicators
WEO	World Economic Outlook

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Chapter 1. General Introduction and Overview

The exploding financing needs in developing countries: the paramount role of taxation…

Financing structural transformation investments in developing countries necessary to embark on a sustainable development path is at the center stage of the international debate in recent years. Developing countries face huge development challenges. Yet, financial resources are quite limited with tight fiscal space. In addition, the ongoing global health crisis (*i.e.*, Covid-19 pandemic) jeopardizing the hard-won development gains achieved over the past years exacerbates financing needs and the pressure on public finance to mitigate economic and health damages. The World Bank estimates at about $2.5 trillion annually, the financing gap for achieving the Sustainable Development Goals for developing countries. A viable tax system allowing proper taxation would undoubtedly constitute an important source to finance this gap.

"*[…] Until someone comes up with a better idea, taxation is the only practical means of raising the revenue to finance government spending on the goods and services that most of us demand*". (*Tanzi and Zee, 2001*)

Taxation is compulsory levies on individuals as well as on corporations imposed by governments. Historically, the main and primary purpose of taxation is to raise revenue to finance public spending and services provision. The bulk of taxes are basically collected to ensure the welfare of taxpayers as a whole. Therefore, the individual taxpayer's liability is independent of any specific compensation, except for a few taxes (McLure *et al*., 2019). For instance, payroll taxes will benefit the taxpayer since they are levied on labor income to finance social security programs, medical payments, retirement benefits, etc. Likewise, fuel taxes are imposed to finance the construction and maintenance of road infrastructure that would benefit no other than road users.

However, the role of taxation could not be conceptually limited to the only purpose of public expenditure. Indeed, in addition, to its financial purpose, taxation was also assigned a role related to social policy to promote *social welfare*. More precisely, it serves as a regulating factor to lessen inequalities in the distribution of national income and wealth. Last but not the least, the role of taxation in modern economies is that of maintaining economic stability through the

implementation of tax policy, to promote price stability and high employment (McLure *et al*., 2019).

In the literature, taxation is widely accepted as an important pillar of state erection. The IMF (2011) asserts that taxation is a defining feature of state power, making its improvement a key aspect of state-building. In the same vein, Junquera-Varela *et al*. (2017) emphasize the paramount role of taxation as a plank of state-building and that, through different ways. In fact, as governments rely on taxes and on the prosperity of the people, they have a strong incentive to promote economic growth and engage with the public. This dependence leads to accountability and responsiveness on the part of the state. Moreover, implementing taxation opens avenues to introduce good practices within different parts of government (Junquera-Varela *et al*.,2017). Indeed, through the introduction of a unique taxpayer identification number, tax systems build databases that are essential for broader economic and administrative management.

"*Beards, boots, beehives, candles, nuts, hats, horses, chimneys, water – Tsar Peter taxed them all. But he is still styled 'The Great' in modern histories of Russia, perhaps because of the mighty works his taxes produced*." James Harvey Robinson, ed., *Readings in European History*, 2 Vols. (Boston: Ginn and Company., 1904-1906), Vol. II: *From the opening of the Protestant Revolt to the Present Day*, pp. 303-312.

To some extent, taxation has also contributed to the establishment of the politico-institutional power in modern economies (Levi, 1981, 1989; Brewer, 1989; Hoffman and Rosenthal, 1997). According to O'Brien (2005) for instance, the supremacy of British naval over nearly three hundreds of years was rooted in the superior power to raise taxes. In addition, Hoffman and Rosenthal (1997) in their theoretical model to study warfare and taxation in modern Europe consider that a country ruler's decision to join in a fight or to attack another country depends on its capacity to mobilize resources from taxation. Moreover, the "*new fiscal sociology*" literature emphasizes that implementing taxation fosters state building both by providing a focal point for bargaining between the state and citizenry and through the development of high-quality institutions for tax collection (Bräutigam *et al*., 2008).

An increasing interest in enhancing domestic revenue mobilization (DRM) in developing countries over recent years: tax revenue as sustainable source of development financing

Since the adoption of the 2030 Agenda, mobilizing sufficient and durable financial resources has been the priority for the international community. While the major source of development financing in developing countries (DCs) has historically been international development assistance provided by development finance institutions (DFIs), a flourishing literature underscores the highly volatility of official development assistance (ODA) which compromises its efficacy (Bulíř and Hamann, 2003; Hudson and Mosley, 2008; Kharas, 2008; Chauvet and Guillaumont, 2009; Hudson, 2015, Afawubo and Mathey, 2017). Empirical studies at both macro and micro level highlight that volatile ODA hampers economic growth by affecting the level as well as the composition of investment, and the fiscal planning (Kharas, 2008). ODA, in addition to fluctuate over time, is finite and therefore, a chronic and substantial dependence would imply serious uncertainties for recipient countries regarding the sustainability of government expenditures and its implications for future economic growth and development (Junquera-Varela *et al*., 2017).

Alternatively, to the ODA, international financial markets also represent an important source for raising consistent financial resources to meet financing needs. This option however is still marginally tapped by developing economies. As stressed by the IMF (2003), accessing international capital markets requires favorable domestic and external conditions including, among others: good macroeconomic stability and performance, fiscal discipline, good external debt management, political stability. Developing countries do not always achieve these conditions.

Moreover, the recent collapse in commodity prices, mainly for oil, has led to colossal losses in export revenues and serious fiscal constraints in resource-rich countries. A vast strand of the empirical literature brightly evidenced the adverse effects of negative commodity prices shocks on various economic variables (see *e.g.,* Deaton and Miller 1995; Dehn 2000; Brückner and Ciccone 2010; Arezki and Brückner 2012; Fabrizio, 2012; Arezki and Ismail 2013; Knop and Vespignani, 2014; Kinda *et al*., 2016, Mlachila and Ouedraogo, 2018; Eberhardt and Presbitero, 2018; Sekine and Tsuruga, 2018) underscoring the limitations of extractive revenues dependence.

Hence, domestic resource mobilization, more particularly tax revenues,[1] rightly appear to be not only the remaining alternative tool for generating revenues, but also the reliable and sustained sources of government revenues to support sustained and inclusive economic development.

Taxes represent one of the most important sources of government revenue in modern economies (McLure *et al*., 2019). Over recent decades, taxation in developing countries has been receiving important and increasing attention among academics and policymakers. This particular focus on taxation in developing economies results from *inter alia*, the rapid debt accumulation over the past fifty years in emerging economies and developing countries (Kharas, 2020; Kose *et al*., 2020; Koh *et al*., 2020; World Bank, 2020), the decrease and the volatility in the international development aid flows, and most importantly, the wide recognition[2] (*e.g*., the 2010 G-20 Summit, the 2015 Financing for Development Conference: Addis Tax Initiative (ATI), and the 2017 new European Consensus on Development, etc.) that enhancing domestic tax revenue mobilization in developing countries constitutes a key tool to generate revenues for a sustainable and inclusive economic development financing.

The relation between taxation and growth, and to a broader extent, economic development, has been subject to a substantial literature (*e.g*., Levi 1988; Myles, 2000; Bleaney *et al*., 2001; Yakita, 2003; Johansson *et* al., 2008; Bräutigam, 2008; Bräutigam, Fjeldstad, and Moore 2008; Besley and Persson, 2009-2010; IMF, 2011; Gale and Samwick, 2014; Aghion *et al*., 2016; Gaspar *et al*., 2016a, 2016b, Jaimovich and Rebelo, 2016,). Empirical works stressed out that taxes promote economic growth and development. Taxes revenues lead to improved development when they are fully translated into productive and beneficial public spending (Junquera-Varela *et al*., 2017). Some empirical studies also infer the existence of a minimum level of the tax-to-GDP ratio that is associated with a significant acceleration in the process of growth and development. Gaspar *et al*. (2016) for instance, drawing on a contemporary database covering

[1] It is worth noting that domestic revenues sources also include non-tax revenues such as royalties and resource rents from extractive industries and, to some extent, user fees for public services, delivered by local governments (Junquera-Varela *et al.*, 2017).

[2] See Domestic Revenue Mobilization: Mapping Existing Research, Initiatives, and People for a summary on the increasing number of domestic tax revenue mobilization initiatives over the recent past years.

139 countries from 1965 to 2011 and a historical database for 30 advanced economies from 1800 to 1980, find evidence that countries embark to a higher growth path once their tax ratio oversteps the threshold of 12, with a per capita GDP of 7.5 percent larger after 10 years. Besides, Gaspar and Selassie (2017) assert that regarding the exploding debt levels in African countries, raising tax revenues will be the most growth-friendly way to stabilize debt. Moreover, taxation favors growth through an increase in firms' productivity. As emphasized by Gaspar and Jaramillo (2017), a well-designed tax system is conducive to greater firm productivity.

However, many developing countries are still struggling to collect sufficient tax revenues to finance their structural transformation projects. Kaldor (1963) has set a very ambitious tax revenue ratio of 25-30 percent of GDP that nations should collect to become developed countries. However, according to Coady (2018) about a third of emerging market economies and half of the low-income countries have low tax ratios –below 15 percent– which in turn result in low levels of social expenditures, scanty to carry out the most basic state functions.

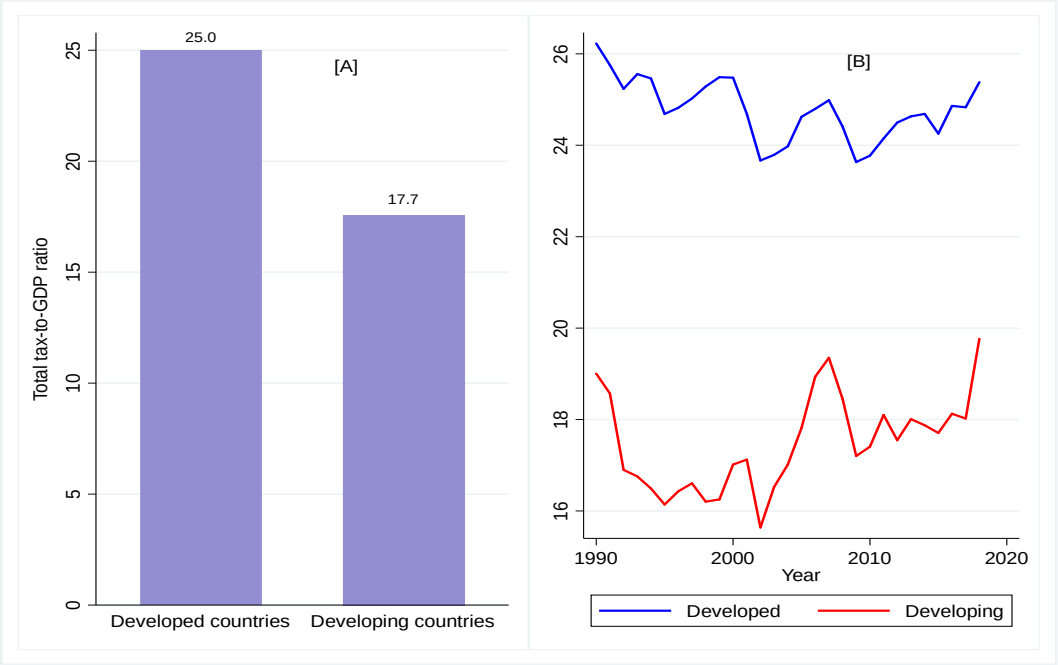
International development institutions including the World Bank Group, the International Monetary Fund, the United Nations (UN), and the Organization for Economic Co-operation and Development (OECD) have committed to support and strengthen domestic tax revenue mobilization in developing countries through multiple programs including capacity building and the development of a range of efficient taxation tools (*e.g.*, the Tax Administration Diagnostic Tools (TADATs) and the Tax Policy Assessment Framework (TPAF)[3]). For instance, the WBG tax engagements aim to support countries to reinforce their tax systems by facilitating the design and implementation of evidence-based tax capacity development and policy reforms with the target of 15% of GDP minimum tax revenue in all countries. The WBG is also supporting DCs in managing risks related to different tax avoidance behaviors and aggressive tax optimization, namely transfer pricing (TP) as well as tax base erosion and profits shifting (BEPS). The IMF has also long played a key role in supporting efforts to improve tax revenue mobilization and building strong, effective and fairer tax systems in developing countries, mainly through its tax technical assistance (TTA) work.

[3] TADAT assesses the performance of countries' tax administration, while TPAF (which is WBG-IMF joint program) evaluates the performance of the tax policy.

Levels and Composition of Tax Revenue in Developing Countries: Some Stylized Facts

We extracted tax data from the updated and most complete IMF's Government Financial Statistics database (GFS, 2020). The sample covers 102 developed and developing countries[4] over the period 1990-2018. From the panel [A] of Figure 1, it emerges that, on average, the tax ratio stands at respectively 17.7 and 25.0 in developing and developed countries.[5] Although the tax revenue ratio has been non-stable in developing countries over the period (red line, panel [A] of Figure 1), the level has improved on average and remains below that of developed countries. For instance, over the subperiod 2000-2015, the tax revenue ratio in low-income countries increased on average by 3.5 percent of GDP and reaching 16.4 percent in 2015.

Figure 1.1. Tax Ratio and Trend: DCs Vs Developed Countries



Source: Authors' calculations using IMF's GFS (2020)

Regarding the tax structure, while the major taxes components are income taxes and taxes and goods and services in developed economies, developing countries heavily rely on indirect taxes[6] including mainly taxes on consumption (value-added tax, excises, general sales tax, etc.),

[4] Country list by income group is provide in Appendix 1.1.

[5] Note that this is a simple average, considering each country as a single observation and treating countries as the same.

[6] As a rule of thumb, indirect taxes represent, about 40 percent of total tax revenue in DCs.

followed by direct taxes, namely personal and corporate income taxes (Figure 1.2.a). The common feature in the tax composition in both developed and developing countries is the importance of taxes on final consumption, including value-added tax (VAT). VAT represents a modern tax and has been widely adopted across the world since its introduction in the 1960s. According to the IMF, 160 countries have a VAT as of 2018.[7] Studies in the literature (*e.g.*, Tait, 1991; Le, 2003; Keen and Lockwood, 2010; Keen, 2013; Ulfier, 2014; Akitoby *et al.*, 2018; Acosta-Ormaechea and Morozumi, 2019) underscore the pivotal role of VAT in countries' tax systems. Indeed, VAT represents an important and solid source of tax revenue in developing countries and presents the advantage to be less distortionary and have the particularity to be self-enforcing (Kopczuk and Slemrod, 2006).

In addition to the VAT, another non-negligible source of tax revenue but which remains underexploited in DCs is property tax. Property tax is widely considered as an equitable and efficient source of raising revenue (Norregaard 2013) with no vertical tax base competition and low compliance cost on taxpayers (Bahl and Martinez-Vazquez, 2007). This tax, however, hardly raises on average less than 1 percent of GDP in developing countries (see *e.g.*, Bahl and Martinez-Vazquez, 2008), partly due to the weaknesses in the design and implementation of the tax combined with the unclear definition of property rights.

Exploring the trend in the composition of taxes in DCs (Figure 1.2.b), data reveal a change in the tax revenue structure over the period.[8] More specifically, Figure 1.2.b depicts a decrease in trade taxes ratio, in line with the global trade liberalization process (Devarajan and Rodrik, 1989, Ostry, 1991, Wacziarg and Welch, 2008) in these countries.[9]

In addition, although the low share of property tax revenue in the GDP, the level is gradually increasing as the result of the more and more resources devoted to identifying, capturing and valuing all relevant properties and upkeeping of fiscal cadaster (Akitoby *et al.*, 2018). Last, taxes

[7] https://www.imf.org/external/np/fad/tpaf/pages/vat.htm.

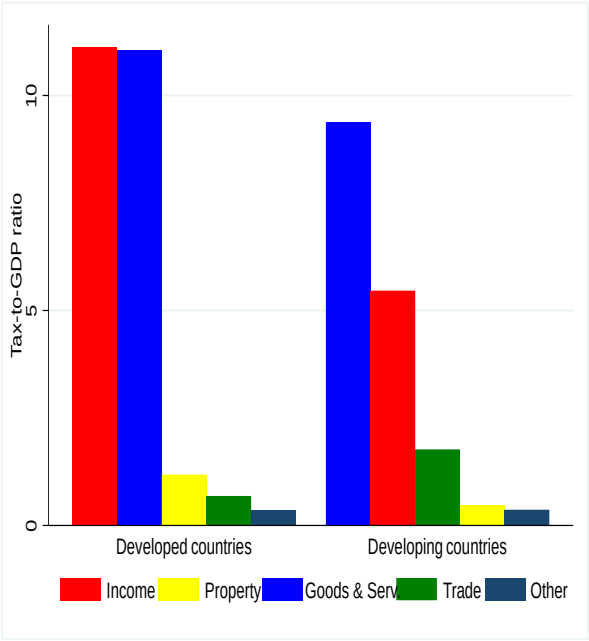
[8] We focus on the last two decades.

[9] Considering the whole period, trade tax ratio represented about 8 percent of GDP in the 1990s and has considerably dropped to about 2 percent of GDP as of 2018.

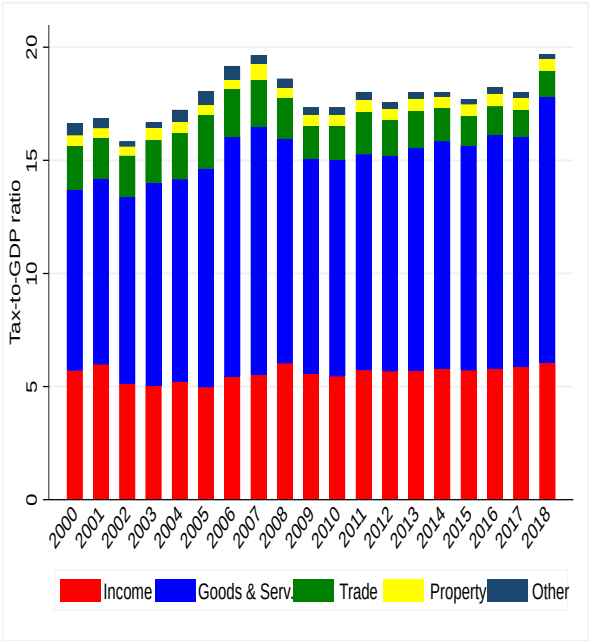
on goods and services and income taxes remain the most important components of total taxes revenues in DCs over the period.

Figure 1.2. Tax Revenue Structure

1.2.a. Composition



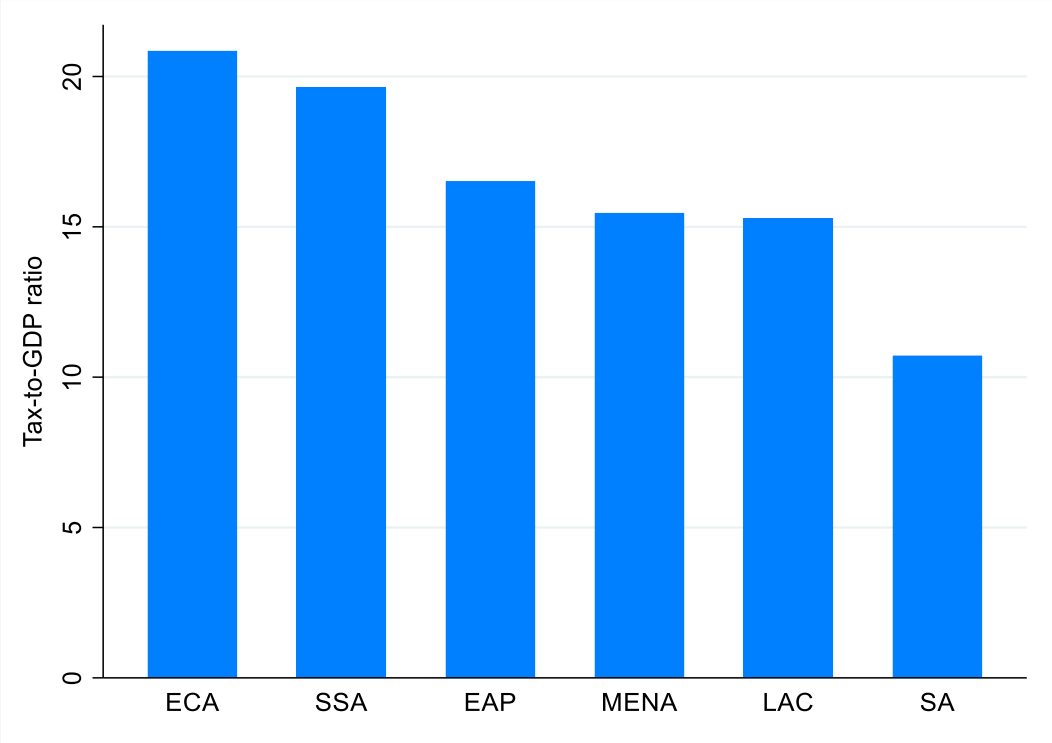
1.2.b. Change in the composition in DCs



Source: Authors' calculations using IMF's GFS (2020)

In Figure 1.3, we explore the regional disparities in tax revenue ratio in developing countries. Europe and Central Asia (ECA) is the top-performing region in terms of tax revenue mobilization followed by Sub-Saharan Africa region, while Latin America and Caribbean (LAC) countries as well as South Asian (SA) countries come to be the poor performers of the sample.

Figure 1.3. Regional Disparities (Average, 1990-2018)



Source: Authors' calculations using IMF's GFS (2020)

Why do developing countries still tax little?

While rich and extensive works in the literature explore the determinants of countries tax revenue performance (see *e.g.*, Lotz and Morss, 1967; Chelliah *et al.*, 1975; Leuthold, 1991; Tanzi, 1992; Stotsky and WoldeMariam, 1997; Davoodi and Grigorian, 2007; Gupta, 2007; Gordon and Li, 2009; Clist and Morrissey, 2011; Fenochietto and Pessino, 2013; Feger and Asafu-Adjaye, 2014; Balima *et al.*, 2016; Belinga *et al.*, 2017; Gnangnon and Brun, 2018), a parallel strand of the literature rather focuses on the hampering factors and challenges to higher tax ratios in DCs and the persisting tax gaps between advanced and developing economies (see *e.g.*, Andic, 1973; Bahl and Bird, 2008; Bird, 2007-2008; Mascagni *et al.*, 2014: Carnahan, 2015; Junquera-Varela *et al.*, 2017). Countries tax capacity is intrinsically related to their structural and institutional features, including history, the sectoral composition of the economy and the politico-institutional setup. Those factors are difficult to change in the short term. As recognized by Bird (2008), countries' characteristics define their tax systems and their capacity to administer taxes. Several factors in the literature are pointed out to compromise substantial

tax revenue mobilization in DCs. First, there is persisting large share of the informal sector[10] in these countries. In fact, informality represents a central challenge to establish efficient tax system and greater tax collection in developing countries. Developing economies are mostly composed of a multitude of small and micro enterprises implying very high administrative costs to identify and to tax (Mascagni *et al*.,2014). In addition, the bulk of the workers in DCs are employed in informal enterprises and agriculture and paid in cash. As a result, it is difficult to capture the tax base relying on modern tools of direct taxation fails to yield substantial results (Tanzi and Zee, 2000). As asserted in Auriol and Warlters (2005), tax ratio gaps between DCs and advanced economies mainly explained by the weakness of direct taxation of the informal sector in DCs.

In addition, the ongoing globalization induces a strong growth in the international capital and trade flows, which exacerbates difficulties in taxing multinational companies and transnational transactions in developing countries. Globalization provides to transnational corporations, greater incentives and opportunities to develop aggressive tax optimization and abusive transfer pricing practices, as well as profits shifting (Mascagni *et al*., 2014). This combined with the inadequate rules and laws on taxing multinational companies in DCs, as well as the weak tax administrative capacity, inevitably results in important tax revenues losses.[11] Similarly, until a certain period, trade taxes (customs duties) constitute a major tax revenue source in many developing and emerging market economies despite trade liberalization (Bird, 2007; Baunsgaard and Keen, 2010). However, with the recent trade liberalization waves across the globe, DCs experienced a considerable decline in trade tax revenues leaving them with serious challenges in replacing such revenues (Baunsgaard and Keen, 2010).

Moreover, the tightness of the tax base and the less diversified tax sources coupled with generous tax exemptions are common features of tax systems in DCs impeding tax collection. The literature widely agrees that broadening the tax base is fundamental to raise significant tax revenues (Toyes, 2000; Bird and Zolt, 2003; IMF, 2005-2006; Bird, 2007-2008; IMF, 2011;

[10] About 40 to 60 percent (See *e.g*., Schneider *et al*., 2010).

[11] About 10 percent (~US$240 billion, annually) of losses in the global corporate income tax revenues (Junquera-Varela *et al*., 2017).

Dabla-Norris and Lima, 2018). A broad tax base is associated for instance with lower taxation costs and economic inefficiencies, more redistribution (Heady, 2004) and less political opposition (Toye, 2000).

Furthermore, the low tax ratios in DCs is the result of low tax effort[12]– itself related to the tax system, the level of compliance and the tax culture. Tax system comprises not only tax administration, but also the tax policy (tax laws) as defined by Slemrod and Gillitzer (2014); the tax administration plays a central role in countries' tax system. Chang *et al*. (2020) for example, recently showed that improving the practices and characteristics of tax administration is beneficial to revenue collection agencies. Drawing on the International Survey on Revenue Administration dataset, the study finds that tax performance is positively and strongly associated with the operational strength of tax administrations. Though, significant progress has been made in reforming and strengthening tax administrations in DCs, more need to be done.

Greater access to financial services in DCs: A potential canal for greater tax revenue?

Parallel to the substantial works on taxation, a flourishing strand of the literature is concerned with financial inclusion and its related implications to the economic environment. An inclusive financial system supposes that individuals as well as businesses, especially those at the bottom of the pyramid, have access to basic financial services in the formal financial system (Allen *et al*., 2016; Ozili, 2018). The World Bank defines financial inclusion as the process of ensuring that individuals and businesses have access to useful and affordable financial products and services (*i.e*., transactions, payments, savings, credit and insurance) that meet their needs delivered responsibly and sustainably. Considered as a policy framework for socio-economic development that focuses on getting more people to use and have access to formal banking services (Mitchell and Scott, 2019), financial inclusion is increasingly receiving proper attention over recent years. Greater access to financial services is considered as a major strategy and a key enabler to achieve the 2030 development agenda on sustainable development goals. Yet, nearly half of the world's adult population (2 billion adults), is still financially excluded (Fu *et al*.

[12] The first chapter of the thesis discusses the concept of tax effort.

2017) despite the global rise in mobile and digital banking. As of 2017, about 1.7 billion adults remain unbanked (*i.e.*, without an account at a financial institution or through a mobile money provider) in developing countries, specifically.[13]

Previous works on financial inclusion focused mainly on exploring the impact of financial inclusion on economic growth, poverty reduction, employment, and inequality (see *e.g.*, Kpodar and Andrianaivo, 2011; Sarma and Pais, 2011; Cull *et al.*, 2014; Sahay *et al.*, 2015a,b; Sharma, 2016; Bayar and Gavriletea, 2018; Kim *et al.*, 2018; Neaime and Gaysset, 2018; Fouejieu *et al.*, 2020, among others). In developing countries, the bulk of the economy is still operating in the informal sector, dubbed as "*hard-to-tax* sector". Increased access to and use of formal financial services including banking (credit and savings), insurance, electronic transactions (money transfer and bill payments) is associated to a shift in consumption away from informal to formal markets and a cashless economy, provides opportunities for easy taxation and more tax collection. For instance, Sung *et al.* (2017) show that electronic transactions in South Korea reduced the shadow economy, while Mitchell and Scott (2019) highlight that cashless economies are prone to higher and more stable VAT-to-GDP ratio in Latin America countries (*i.e.*, Argentina, Brazil, and Chile). Thus, financial inclusion may *a priori* offer an opportunity for raising more tax revenues in developing countries through, not only a shift in transactions from informal markets into formal markets and less cash use but also a clear identification of taxpayers as well as the traceability of transactions and a good calculation of the tax base.

Surge in number of conflicts and political unrest in developing countries: What impact on the financial sector?

The recent decade has also witnessed a considerable rise in the number *conflict-affected* of countries across the globe, specifically *conflict-affected* developing countries. Indeed, the world has incredibly become more violent, with a drastic deterioration of internal unrest in developing countries. This is characterized by different forms of violence including protests (Lebanon, Hong Kong, Iraq, Chile), geopolitical competition (Yemen, Syria), insurgencies (Somalia, Afghanistan), political violence (Mali, Cote d'Ivoire, Cameroon, Guinea) and terrorist

[13] World Bank's Global Findex Database, 2017.

threat in the Sahel[14] (ACLED, 2010). For instance, only in 2019, the Sahel recorded more than 2,100 political violence and protest events resulting in over 5,360 reported fatalities (ACLED, 2010).[15]

The negative macroeconomic consequences of conflicts and political instabilities are well established in the literature (see *e.g*., Alesina and Perotti, 1996; Alesina *et al*.,1996; Collier and Hoeffler, 1998,2004; Abadie and Gardeazabal, 2001; Neumayer, 2004; Jong-A-Pin, 2009; Aisen and Veiga, 2013; Rother et al., 2016; IMF, 2019; Qureshi, 2013; Huang, 2019) as well as their spillover effects (Hegre and Sambanis, 2006). For instance, the IMF (2019) estimates that an increase in conflict intensity in SSA countries is associated with a decrease of about 12 percent in the total revenue, while the fiscal deficit increases of about 1.7 percent of GDP. In addition, conflicts worsen the fiscal balance position in *conflict-affected* countries. In the first two years of conflict in SSA, the public debt ratio rises about 16 percentage points of GDP, with the effect culminating to almost 20 percent of GDP by the fifth year of conflict (IMF, 2019).

The effect of conflicts and internal unrest on financial variables, surprisingly received much less attention, particularly in developing countries. The existing few studies rather focus more on the United States (see *e.g*., *Willard et al*., 1995; Chen and Siems, 2004; Amihud and Wohl, 2004; Schneider and Troeger, 2006;). Rigobon and Sack (2005), using an heteroskedasticity-based estimation technique explored the impact of the risks associated with the Iraq war on financial indicators in the United States (US). The study finds evidence that rises in war risk result in significant declines in equity prices and treasury yields, a fall in the dollar as well as a widening of lower-grade corporate spreads, and an increase in oil prices. Similarly, Leigh *et al*. (2003) analyzed the consequences of the US-Iraq war on an *ex-ante* assessment framework. The results reveal that the war has large effects on equity markets lowering the value of US equities by around 15 percent. Furthermore, Wolfers and Zitzewitz (2009) point that a 10 percent increase in the probability of war leads to a 1½ percent decline in the S&P 500. This may raise the empirical question about the potential impact of conflicts and political instabilities on the banking sector in developing countries.

[14] Sahel includes Burkina Faso, Chad, Mali, Mauritania, and Niger.

[15] See Appendix 1.2.

Value Added and theoretical foundations of the thesis

In sum, the aforementioned empirical literature is quite unambiguous that tax revenue constitutes the important source of finance for sustainable development in DCs, and there is imperative need to enhance and strengthen tax revenue mobilization in these countries. In addition, the low tax effort and the non-diversification of tax sources are pointed out as the main impeding factors to greater tax collection in DCs.

Thus, this thesis, drawing essentially on empirical analyses and mainly focusing on developing countries,[16] aims to extend the reflection on the challenges to higher tax revenue mobilization in DCs and improve upon the existing works with particular attention on issues not yet addressed but important. More specifically, the thesis analyses the tax effort in developing countries taking into the natural resources as most of these countries have recently discovered new resources, while examining how these countries may tap more tax revenue from a diversified tax structure and increased access to financial services. The recent proliferation and surge of violence in DCs countries are raising concerns about the effects of conflicts and political instabilities on macroeconomics variables. The thesis also gives the first attention to the consequences on the financial sector, specifically on the banking sector, in *conflict-affected* developing countries since financial sector has a paramount role in countries capacity to mobilize tax revenues.

However, the thesis, though empirical relates to several strands of the theoretical literature. First, it relies on the theory of taxation and development (Ramsey, 1927; Kendrick 1939; Kaldor, 1936; Oakland, 1967; Diamond and Mirrlees, 1971; Feldstein, 1976; Atkinson and Stiglitz, 1976; Mirrlees, 1976; Deaton, 1981; Bradley *et al*., 1984; Bates and Lien 1985; Chamley, 1986; Newbery and Stern, 1987; Burgess and Stern, 1993; Boadway, 1994; Lemieux *et al*., 1994; Simpson, 1994; Andreoni *et al*., 1998; Pirttilä and Tuomala, 2001; Duane and Steinmo, 2002; Herb, 2003; Cremer *et al*., 2003; Sandmo, 2005; Emran and Stiglitz, 2005; Auriol and Warlters, 2005; Kaplow, 2006; Kopczuk and Slemrod, 2006; Besley and Persson, 2009; Kaplow, 2010; Golub, 2011; Besley and Persson, 2013; Weinzierl, 2018) which emphasizes various issues related to implementing

[16] Developing countries include the low-income countries and the middle-income countries, but not exclusively they are more concerned with domestic tax revenue mobilization than developed ones.

taxation including the level and structure of taxation in developing countries, optimal taxation, tax evasion, capital and income taxation, tax distortions, tax reforms, etc.

Second, the thesis draws upon the theoretical literature on economic diversification (McLaughlin, 1930; Tress, 1938; Chenery, 1979; Kort, 1981; Grossberg, 1982; Jackson, 1984; Syrquin, 1988; Scherer and Ross,1990; Kort 1991; Ghosh and Ostry, 1994; Siegel *et al*., 1995; Bleaney and Greenaway, 2001; Koren and Tenreyro, 2013 among others) which evidences that diversification is conducive to higher and more stable economic performance and growth (Chenery, 1979; Syrquin, 1988). Economic concentration plays an important role in explaining the volatility of the growth of GDP per capita (Miklûs and Tenreyro, 2007). For instance, focusing on exports, Ghosh and Ostry (1994), Bleaney and Greenaway (2001), and McMillan *et al*. (2014) stress that export diversification could help to stabilize export earnings in the long run and makes countries more resilient to shocks.

Finally, this thesis relates to the finance and growth theories (Gurley and Shaw, 1955; Goldsmith, 1969; Greenwood and Jovanovic, 1990; Benhabib and Rustichini, 1996; Levine, 2004), as well as the theoretical literature on conflicts (*e.g.*, see Acemoglu *et al*., 2004; Powell, 2004; Acemoglu, 2005; Acemoglu and Robinson, 2006; Blattman and Miguel, 2009; Yared, 2010; Acemoglu *et al*., 2010 among others). Financial intermediaries and more access to financial services encourage high-yield investments and growth, thereby opportunities for taxation, while conflicts are found to be harmful to macroeconomic variables.

Summary and Main Results

This thesis is made up of five chapters. In its first Chapter, the thesis lays the conceptual framework and provides an overview of taxation in modern economies with special attention to developing economies. More precisely, **Chapter 1** provides a comprehensive definition and describes the various role and importance of implementing tax policy. It also identifies the different factors impeding greater tax revenue mobilization in developing countries with a detailed review of the related existing evidence. From this conceptual and empirical background, the next three chapters of the thesis (**Chapter 2**, **Chapter 3**, and **Chapter 4**) focus on tax revenue mobilization in developing countries. More precisely, **Chapter 2** examines the

tax effort in Sub-Saharan African (SSA) region[17] by introducing a new database of tax revenue, while challenging some previous evidence through replication exercises. The database is compiled from statistical information of the African Department of the International Monetary Fund covering 42 SSA countries over the period 1980-2015. This chapter is innovative in two ways: first, the dataset compiled allows to distinguish tax revenue from the natural resource sector from the other sectors (hereafter, non-resource taxes), in line with recent works in the literature emphasizing a *crowding-out effect* of natural resource bonanza on tax revenue. Second, to analyze the tax effort, it employs a stochastic frontier parametric model which distinguishes countries' structural factors and the tax system. The results show that over the considered period, SSA countries scored an average estimated tax effort of 0.57 corresponding to a tax-to-GDP ratio of 13.2, on average. This result also implies a low use of the tax potential in SSA countries and the existence of room for more tax revenue collection compromised mainly by a weak tax system. More precisely, SSA countries could raise 23.2 percent of GDP in non-resource taxes if they fully used their tax potential. Regarding the pressing financing need in this region, countries will benefit by strengthening their tax system, namely improving tax administration, broadening tax sources, and reducing tax exemptions. Our replication exercises broadly confirm previous analyses on the determinants of tax revenue in DCs, though our results show relative smaller coefficients for some variables suggesting a smaller effect when non-resources tax ratio is used instead of central government tax revenue.

Chapter 3 moves to analyzing the effect of diversified tax sources on tax performance as well as tax revenue stability. Specifically, the chapter tests the idea that relying on a diversified tax structure may enhance resilience to fiscal risks. This chapter is the first of its kind in the literature to explore this avenue by proposing a new cross-country tax revenue diversification index (RDI). Unlike the few existing tax diversification indices, which are constructed only at the state level for the United States (US), the RDI is computed at the national level, covering a large panel of

[17] The reason of focusing on this region in this chapter is twofold: First, the Sub-Saharan Africa region faces the most sizable financing needs compared to other low-income countries region. For instance, to meet the Sustainable Development Goals, the median Sub-Saharan African country additional spending need amounts about 19 percent of GDP compared to 15.4 percent of GDP for low-income countries (Gupta and Liu, 2020). Second, the nature and the availability of the data justifies this choice.

127 countries over the period 2000-2015 and built on the Theil index. We find suggestive evidence that tax revenue diversification reduces tax revenue volatility, thus, comforting the long-held views about the prominence of tax revenue diversification for fiscal resilience strengthening. While exploring the drivers of the RDI, we find that tax revenue diversification is not just a reflection of economic diversification, but also an outcome of macroeconomic, political and institutional factors. Interestingly, a non-monotone relationship is also at play between RDI and economic development. Moreover, countries' portfolio of tax sources is getting more diversified as their economy develops, until a tipping point, where richer countries start finding it harder to diversify further their tax revenue sources.

Chapter 4 analyses how developing countries may tap tax resources from the financial sector, mainly through greater access to formal financial services. It contributes to the existing literature on the drivers of tax revenue by exploring tax revenue opportunities from unlocking access to financial services in developing countries. Evidence based on a sample of 62 developing countries over the period 2004-2017 shows that greater access to financial services captured by the number of ATMs per 100,000 adults increases government non-resources tax-to-GDP ratio, and this result is driven by households consumption and business expansion. The chapter provides insights on tax resources-harnessing opportunities from implementing and promoting financial inclusion policies for developing economies.

Based on the finding that the financial sector provides opportunities to reap tax revenue in DCs, the **fifth** and last **Chapter** of the thesis, analyzes the consequences of the increasing internal unrest across the world, specifically in DCs, on the financial sector.[18] Unlike the extensive existing literature examining the economic impact of conflict and political instability, of particular importance, the chapter investigates whether rising conflicts and political instabilities lead to increased occurrence of banking crises in developing countries. The analysis is based upon a panel dataset of 92 countries, covering both emerging and developing countries, over the period 1970-2016. The results show a strong evidence that conflicts and political instability are indeed associated with higher probability of systemic banking crises and the primary channel of transmission is the occurrence of fiscal crises following a conflict or political

[18] Although indirectly, this Chapter might pretend to show how conflicts and political instabilities may compromise tax revenue collection through their consequences on the financial sector.

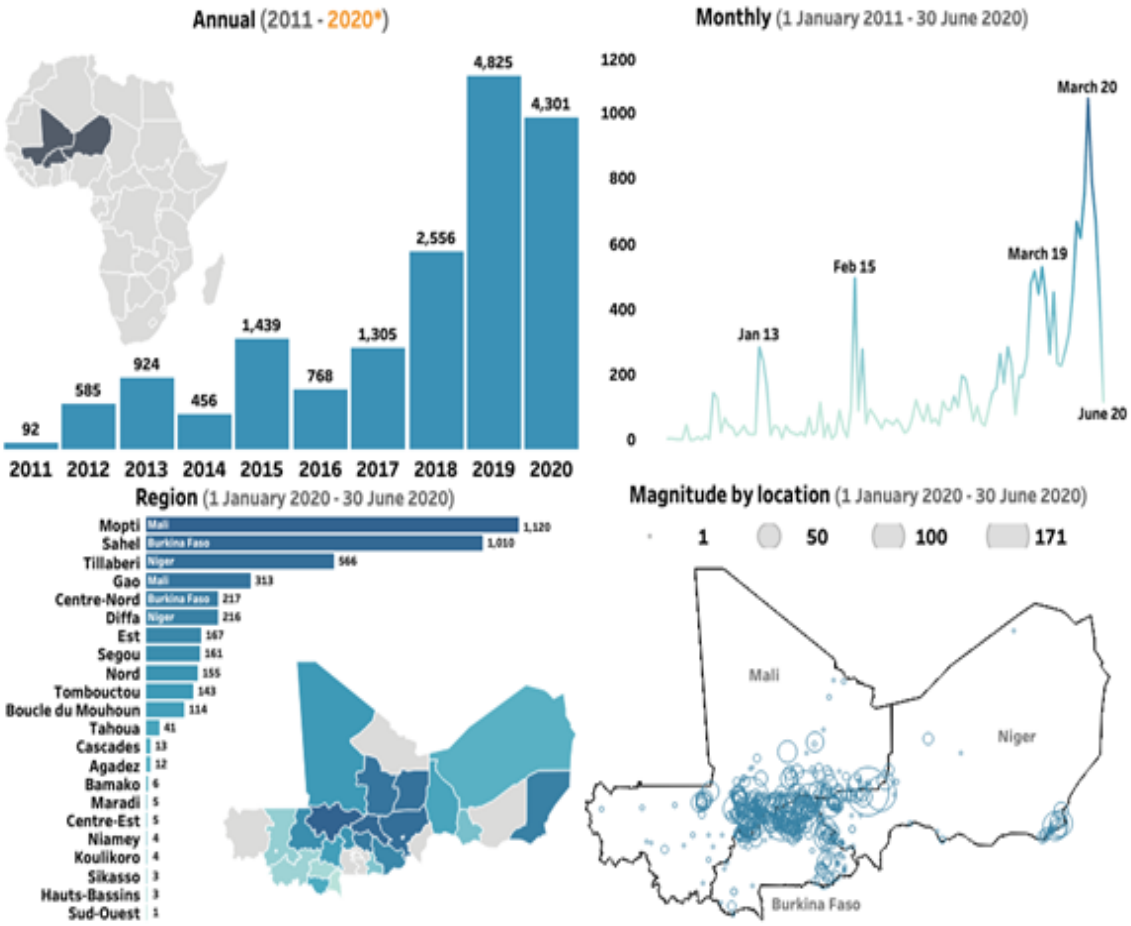
instability. Besides, we find that the duration of a conflict is positively associated with the rising probability of a banking crisis. Interestingly, the chapter also highlights that conflicts and political instability in one country can have negative spillover effects on neighboring countries' banking systems. This chapter clearly emphasizes the need for governments of countries infested by conflict and/or political instability to address their root causes and try to mitigate their negative effects with the appropriate design and implementation of economic policies. Creating adequate fiscal space in normal times can reduce the likelihood of fiscal crises and in turn lower the probability of systemic banking crises. Our results also suggest that policymakers should pay attention to conflicts in neighboring countries even if they are not conflict-afflicted as their banking systems may suffer negative spillovers from their neighbors. Finally, the thesis concludes and draw some policy recommendations (**General Conclusion**).

Appendices

Appendix 1.1. Country List

Developing countries		Developed countries	
Afghanistan, Islamic Republic of	Mauritius	Argentina	Japan
Albania	Mexico	Australia	Korea, Republic of
Armenia, Republic of	Moldova	Austria	Latvia
Azerbaijan, Republic of	Mongolia	Barbados	Lithuania
Belarus	Morocco	Belgium	Luxembourg
Bolivia	Myanmar	Canada	Malta
Bosnia and Herzegovina	North Macedonia, Republic of	Chile	Nauru
Brazil	Paraguay	China, P.R.: Hong Kong	Netherlands
Bulgaria	Peru	China, P.R.: Macao	New Zealand
Cabo Verde	Philippines	Croatia	Norway
China, P.R.: Mainland	Romania	Cyprus	Poland
Colombia	Russian Federation	Czech Republic	Portugal
Congo, Republic of	Rwanda	Denmark	San Marino
Costa Rica	Samoa	Estonia	Seychelles
Egypt	Senegal	Finland	Singapore
El Salvador	Serbia, Republic of	France	Slovak Republic
Georgia	South Africa	Germany	Slovenia
Honduras	Tajikistan	Greece	Spain
Indonesia	Tanzania	Hungary	Sweden
Jordan	Thailand	Iceland	Switzerland
Kazakhstan	Timor-Leste, Dem. Rep. of	Ireland	United Arab Emirates
Kenya	Tonga	Israel	United Kingdom
Kiribati	Tunisia	Italy	United States
Kosovo, Republic of	Turkey		
Kyrgyz Republic	Uganda		
Lesotho	Ukraine		
Malaysia	Uzbekistan		
Maldives	Yemen, Republic of		

Appendix 1.2. Conflict in Sahel: Reported Fatalities



Source: ACLED data (2020).
Note: * **First half of 2020 (01/01/2020-06/30/2020)**.

Chapter 2. Tax Effort in Sub-Saharan African Countries: Evidence from a New Dataset*

*This chapter was written with E. Caldeira, A. A. Dama, M. Mansour, and G. Rota-Graziosi and a version of it has been published in the journal *Revue d'Économie du Développement*.

2.1. Introduction

Since the Addis Ababa Conference in July 2015, Domestic Revenue Mobilization (DRM) became one of the main tools of financing Sustainable Development Goals (SDGs). DRM is now a well-discussed topic to address the issue of economic development (see *e.g.,* Besley and Persson, 2014) and is a privileged tool for donors as for international and regional institutions (African Development Bank, International Monetary Fund, World Bank, European Union Commission).

In this paper, we propose *(i)* an update and complete version of the tax revenue dataset published in Mansour (2014), *(ii)* an estimate of tax effort for these countries, and *(iii)* some replication analyses of previous tax effort estimations by Gupta (2007) and Fenechietto and Pessino (2013). The database covers 42 Sub-Saharan African (SSA) countries over the period 1980-2015. It results from statistical information collected in the African Department of the International Monetary Fund (IMF)—most of which is included in public IMF documents. We distinguish tax revenue from the natural resource extractive industry, from those from other economic sectors.

Tax revenue excluding natural resources is on average 13.2 percent of GDP. The average estimated total tax effort is 0.57. In other words, SSA countries could raise on average 23 percent of GDP of non-resource taxes if they fully utilized their potential. We decompose the total tax effort score into time-varying and persistent tax effort and conclude that the total tax effort score is mainly driven by time-varying factors. Moreover, consistent with previous literature, we find that countries' stage of development measured by per-capita income, financial development, and trade openness are important factors improving tax revenue in the region, while natural resource endowment and the importance of the agriculture sector reduce unambiguously the non-resource tax-to-GDP ratio. Regarding the replication exercise, the estimations broadly confirm previous analyses such as Fenechietto and Pessino (2013). However, our verification test failed to replicate the exact results of Gupta (2007) in terms of robust coefficients and significance of the variables, which might be caused from the use of less detailed data than we provide here.

Our analysis contributes to the existing literature by providing a new estimation of SSA countries' total tax efforts and their composition. We decompose tax effort in terms of direct taxation (Corporate Income Tax, CIT, and Personal Income Tax, PIT). In addition, beyond the originality of the database itself and the empirical results, our work participates explicitly to the replication principle given its online application developed with R-Shiny. The need for replicability appears highly relevant for tax effort analysis given the primacy of DRM in the agenda of developing countries, donors, and international organizations. The database is dynamic and is hosted on a webpage that allows users to interact with the data and generate new analytical results, including quick descriptive statistics and running alternative specifications of regressions.

The rest of the chapter is organized as follows: Section 2 presents the dataset; Section 3 briefly reviews the literature on the determining factors of tax effort in developing countries; Section 4 describes the empirical methodology and variables. Section 5 presents and discusses the results; section 6 proposes a replication analysis of Gupta (2007) and Fenechietto and Pessino (2013), and section 7 concludes.

2.2. Tax Revenue Dataset for Sub-Saharan Africa over 1980-2015

The study of tax policy in developing countries has long been constrained by the availability and the quality of detailed relevant data. Moreover, extractive industries have played and still play a crucial role in the economic development of SSA countries. More than half of these countries are resource-dependent, that is natural resources represent 25 percent or more of total country's exports. Tax revenues from this sector are usually large and at high risk of being taken out of the source country through various licit or illicit channels, including generous tax incentives provided in mining or petroleum codes and other laws; aggressive tax planning such as the use of thin capitalization, trade mispricing, or plain tax evasion; and double taxation agreements that do not always protect appropriately source countries' taxation rights.

We provide here an updated version of the tax revenue dataset published in Mansour (2014), which covered the period 1980-2010 for 41 countries (see https://data.cerdi.uca.fr/taxeffort/).[19] It participates to recent efforts to better apprehend tax revenues in Africa, in particular the revenue statistics from the OECD, which cover 26 countries in its last release[20] and the Government Revenue Dataset initiated by the International Centre for Tax and Development (ICTD) and updated by UNU-WIDER.[21] There are three advantages that our dataset provides relative to these two alternatives. First coverage for SSA countries is generally broader, and deeper for each of the tax series. Second, the definition of the variable is consistent across all countries,[22] Finally, the isolation of resource revenue from non-resource (tax) revenue allows for a better understanding of the interaction of these two fundamentally different (economically) sources. [23]

Distinguishing resource from non-resource revenue is highly relevant to understand countries' tax effort. For instance, Bornhorst *et al*. (2009), Crivelli and Gupta (2014), and James (2015) emphasize a crowding-out effect between resource revenue and non-resource tax revenue: an increase of the former reduces the latter. McGuirk (2013) explains this effect through the strategy of the government to remain in power by reducing its accountability or equivalently the tax pressure. Caldeira *et al*. (2020) provide an alternative explanation of the negative relationship between resource and non-resource tax revenue in terms of an inter-ministerial

[19] See https://ferdi.fr/publications/a-tax-revenue-dataset-for-sub-saharan-africa-1980-2010.

[20] See https://www.oecd.org/ctp/revenue-statistics-in-africa-2617653x.htm.

[21] See https://www.wider.unu.edu/project/government-revenue-dataset.

[22] The ICTD database, now Government Revenue Dataset (https://www.wider.unu.edu/project/government-revenue-dataset), combines revenue data primarily from OECD revenue statistics, IMF staff reports' statistical tables, and IMF GFS. This produces asymmetries in the definition of resource revenues. For instance, ICTD reports no resource tax revenue for Australia and Canada, and only aggregated corporate income tax (CIT), which include profit taxes from the resource sector if the source is OECD of GFS. These asymmetries are less important in SSA countries since the primary source for ICTD for these countries is IMF staff reports, and Keen and Mansour (2009)—and both report a different concept of resource revenue. For instance, the average resource revenue-to-GDP ratio during 1980-2015 in ICTD is 8.16 percent, which is close to the 8.6 percent in our database. However, the average CIT ratio in ICTD is 1.82 percent over the same period, slightly higher than the 1.7 percent in our database—possibly because CIT revenue for SSA taken from OECD revenue statistics for Africa includes some resource revenue.

[23] The OECD statistics do not report resource revenues unless they are accounted for as corporate taxes. This may not be an issue in OECD countries, where oil revenue is derived primarily through the tax system. However, in SSA countries, production sharing agreements and turnover-based royalties are prominent.

tax competition: the Minister in charge of Mining and Petroleum can tax partly the same base than the Minister of Finance. The inter-ministerial tax competition reduces total tax revenue and deteriorates the economic development of these countries by favoring a concentration of the economic activity in the extractive industry.

The dataset covers 9 tax series and 42 SSA countries over the period 1980-2015. The series are: 1. Total Taxes; 2. Trade Taxes; 3. Indirect Taxes; 4. VAT with a decomposition for some countries between domestic VAT, VAT collected at the border, and VAT refunds; 5. Excises; 6. Direct Taxes; 7. Personal Income Tax; 8. Corporate Income Tax with additional information for some countries concerning CIT from extractive industry; 9. Other tax revenues.

To isolate the impact of resource revenue on the tax effort, the database reports revenue from extractive activities separately and irrespective of the policy tool used to raise them. As such, resource revenues include royalties and other fees, dividends, and bonuses from extractive activities, the government share of production and related agreements, and (importantly) corporate income taxes. The latter is included because it is similar in design to production sharing, and hence subject to the same extent as volatility in commodity prices. However, resource revenues do not include non-refundable VAT on inputs, which we were not able to identify separately—presumably. This is not very important in aggregate given that extractive companies often seek and obtain an exemption from VAT on input, knowing that VAT refund mechanisms in SSA countries are not very efficient.

Figure 2.1.a. displays the evolution of the average tax revenue in Africa, in percent of GDP.[24] Note that the volatility of commodity prices explains a large share of revenue variations over the period. However, an improvement of non-resource tax revenue is perceptible since 2000: This revenue stagnated around 12.5 percent of GDP from 1980 to 2000 and reached 15 percent by 2015.

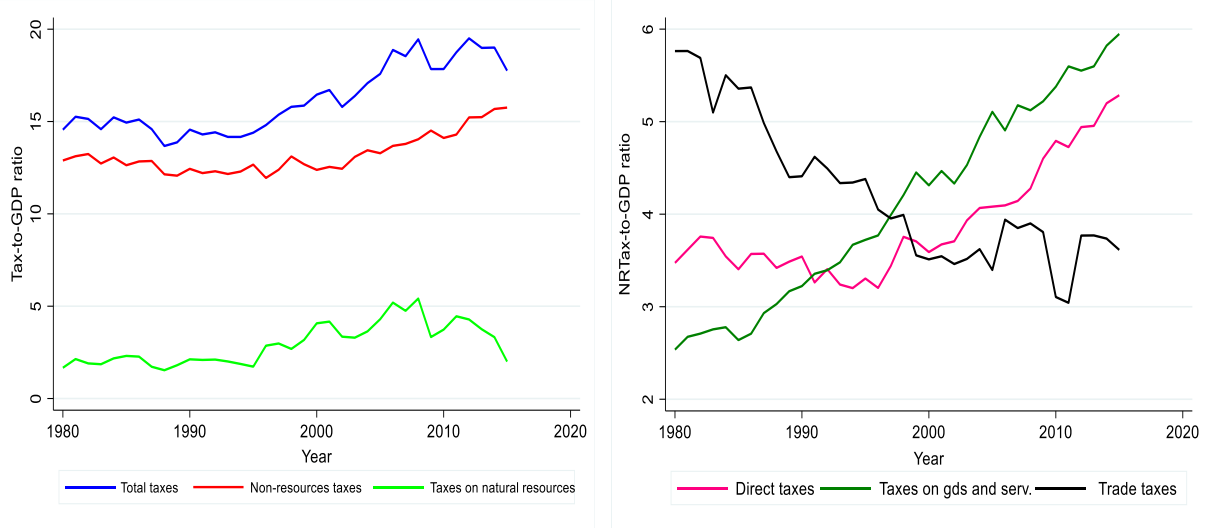
In the Figure 2.1.b., the chapter highlights the tremendous change in the structure of *non-resource* tax revenue over the period. The reduction of tariff duties (*i.e.*, trade taxes) was offset

[24] More interesting and insightful figures are provided through the dedicated website (see Graphics rubric).

by an increase in the revenue of taxes on goods and services, which results from the introduction of the Value Added Tax (VAT).

Figure 2.1. Tax Revenue (percent of GDP) in SSA Over Time (1980-2015)

2.1.a. Total tax revenue 2.1.b. Tax composition



Source: Tax Revenue Dataset for SSA and authors' calculations.

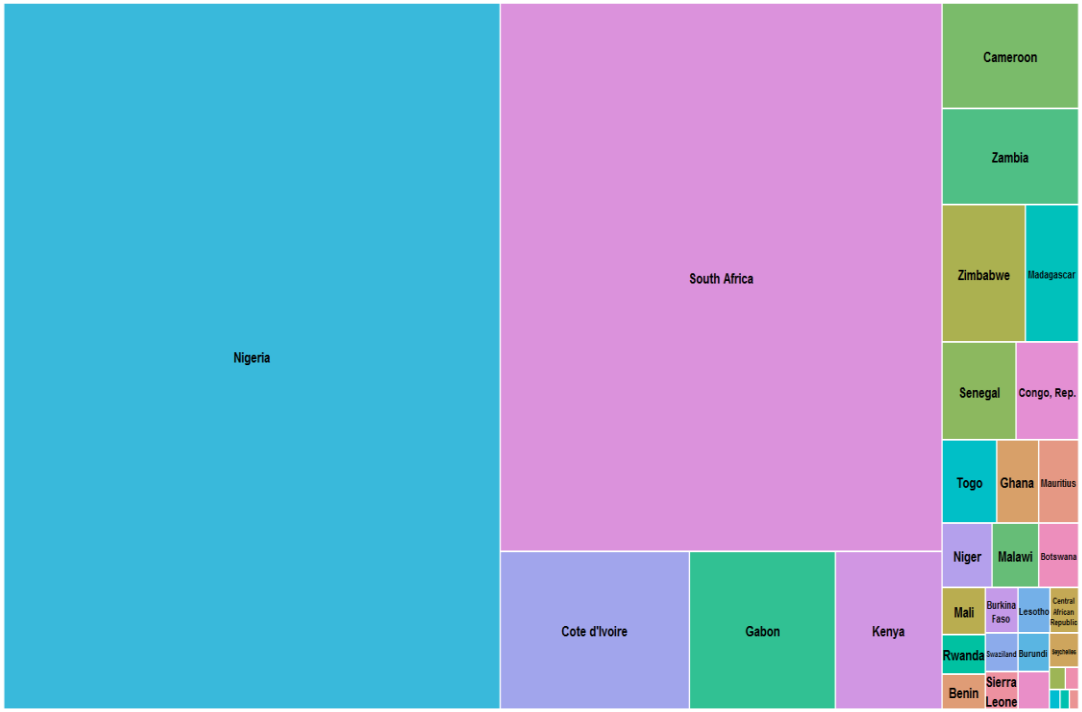
Figure 2.2 shows the tax performance (*i.e.*, total tax revenue collected) across SSA countries in 1980 (Figure 2.2.a), 1990 (Figure 2.2.b) and 2015 (Figure 2.2.c).[25] Total tax revenue amounted to 91, 117, and 259 billion USD[26] in 1980, 1990, and 2015, respectively. Exploring the country-based tax performance, it emerges that South Africa and Nigeria are the top performers. More precisely, South Africa collected in percent of total revenue (including resource revenue) 32, 39, and 40 percent of tax revenue, while Nigeria raised 46, 36.2, and 13 percent of taxes in the concerned years, respectively. This highlights the main role of the natural resource sector in aggregate for SSA and the sharp decrease of total tax revenue collected in Nigeria. The variation of total tax revenue over the period 2000-2015 displays contrasting results: while tax revenue decreases by 49 percent in Nigeria, they increase significantly in Mozambique by 615 percent reaching 3.1 billon USD in 2015, in Rwanda by 403 percent (1,2 billon USD), in Chad by 376 percent (1.1 billon USD), and in Ghana by 341 percent (8 billon USD).

[25] Some countries are missing for 1980.

[26] Data are reported in constant 2010 prices.

Figure 2.2. Total Tax Revenue in SSA

2.2.a. For the Year 1980



2.2.b. For the Year 1990

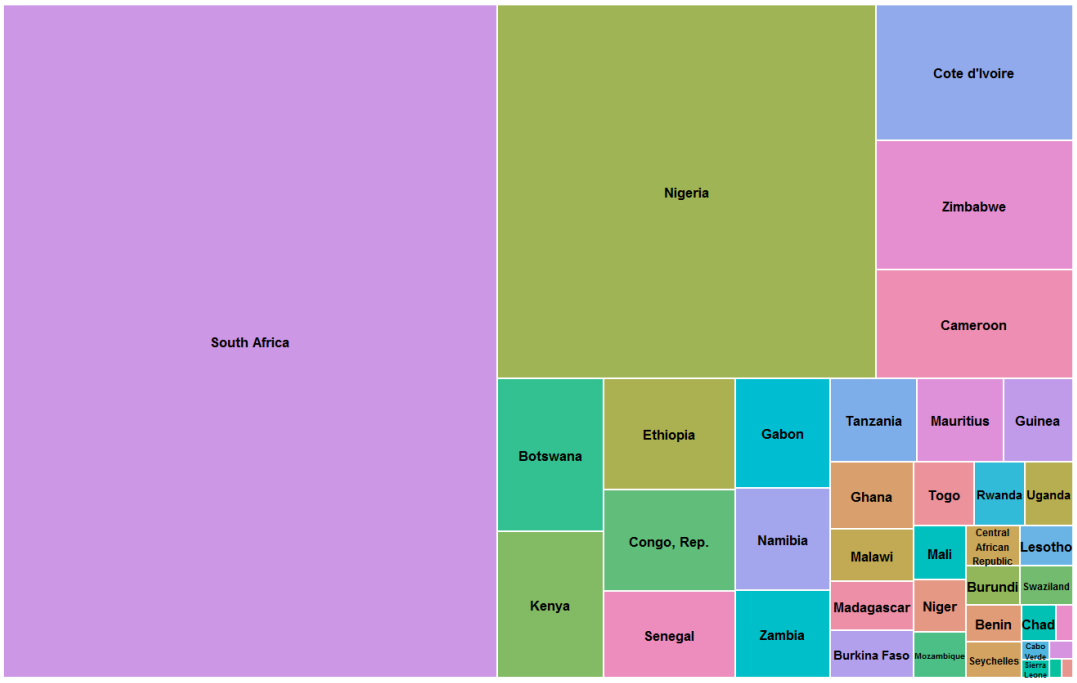
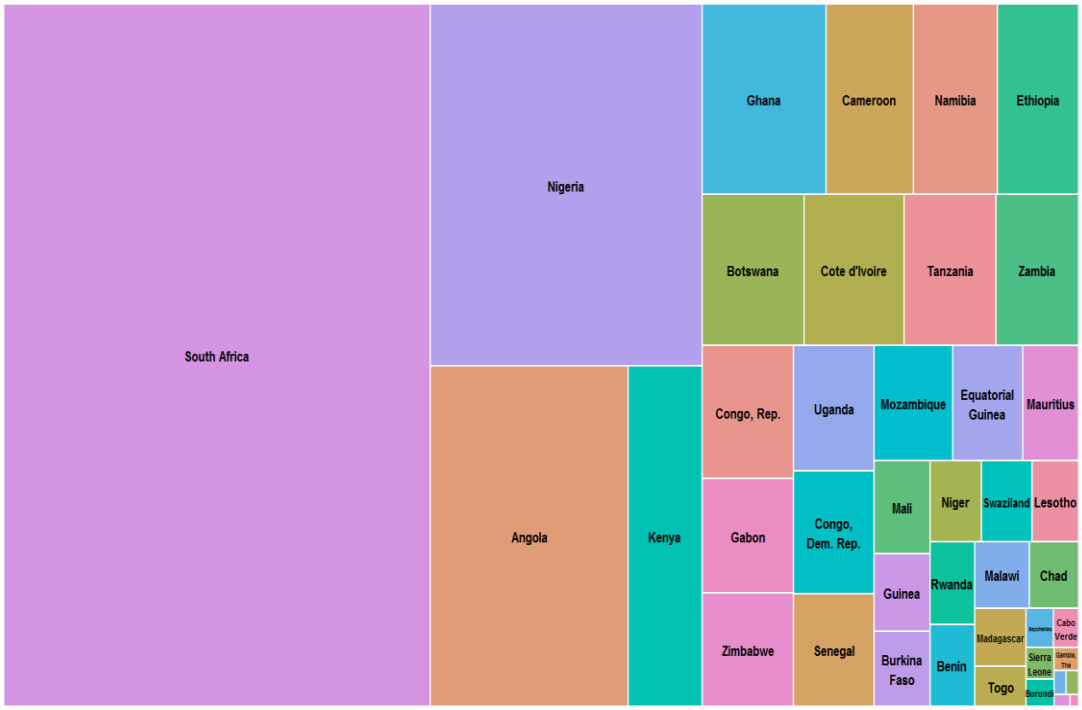


Figure 2.2.c. For the Year 2015



Source: Tax Revenue Dataset for SSA and authors' calculations.:

2.3. Brief Literature Review on Tax Effort

DRM would be a more reliable and sustainable source of financing than its domestic alternative (debt, seigniorage) or international financial flows (*i.e.,* remittances, official development assistance and foreign direct investment). Hence, a *non-negligible* literature has investigated how countries, specifically developing countries, which face important financial constraints, can levy more domestic resource to finance development and wean themselves from aid.

Several empirical analyses study the macroeconomic and institutional driving factors of countries tax-to-GDP ratio. A first generation of empirical works establishes that agriculture, mining (resource rent), and share of external debt in total debt are significant determinants of countries tax ratios. Agriculture share, which is still important in the least developed economies, is negatively associated with the level of tax revenue (Chelliah *et al*., 1975; Leuthold, 1991; Tanzi, 1992; Stotsky and WoldeMariam, 1997), while mining and external debt are positively associated with tax revenues (Cheliiah *et al*., 1975; Tait *et al*., 1979 and Tanzi, 1992).

However, the relationship between natural resource sector and tax revenue remains controversial. Indeed, in line with the resource curse debate, recent studies point out a negative association between resource rent and government tax revenue. For instance, Belinga et al. (2017) highlight a crowding-out effect of resource revenue on non-resource revenue for a panel of 30 resource-rich countries over the period 1992-2012. Natural resource boom is associated with less incentive in tax collection. Brun *et al*. (2014) consider tax revenue from the natural resource sector as an explanatory variable of the non-resource tax effort. They establish a negative effect of the former on tax revenue potential.

A second generation of empirical works outlined the pivotal role of inflation, institutional quality, education, political stability, external aid, and financial development in addition to the previous economic factors (Tanzi and Davoodi, 1997, Grigorian and Davoodi, 2007, Gupta, 2007, Gordon and Li, 2009, Clist and Morrissey, 2011, Fenochietto and Pessino, 2013, Feger and Asafu-Adjaye, 2014).

We provide here a new dataset and focus on the effort of countries to raise tax revenue. We define tax effort as the extent to which the actual tax revenue collected is from the maximum level of tax revenue given their characteristics. These characteristics correspond to the determinant variables previously studied in the literature, which are mainly: the level of development, trade openness, the size of the agricultural sector, natural resource rent, and financial development. Given these characteristics, we compute for each country potential tax revenue. Tax effort results then from the comparison between potential tax revenue and actual collected tax revenue. The closer they are, the greater is the tax effort. We do not study the details of countries' tax code, nor the organization of their revenue administration or authorities.

Our approach is then purely economic since it does not rely on countries' tax system[27] but only on economic characteristics. It allows some international comparisons among countries, which share similar economic features. This analysis could be then complemented by some tax policy

[27] Gillitzer and Slemrod (2015) define tax system as the combination of tax policy (tax laws) and revenue administration.

and revenue administration diagnostics. Indeed, differences in tax effort across countries may result from some distinctions in existing taxes, their statutory rates, their respective tax bases, tax expenditures, the efficiency of revenue administration (organization, IT technology, the number of tax inspectors, and even their remunerations' modalities).[28] Other determinants such as tax morale, the ethnolinguistic fragmentation of the countries, political regimes (presidential or parliamentary), inflation rate are variables, which may be added in our empirical assessment of tax effort.[29]

Tax effort is complementary to the tax gap analysis,[30] which measures the difference between expected revenue and collected one. The tax gap approach is legal and microeconomic, while the tax effort analysis relies only on macroeconomic data. Indeed, the computation of expected revenue differs from potential revenue in the tax effort analysis, since the former requires the use of statutory tax rates, tax base's definition, and eventually some assumptions on the behavior of consumers and producers. The tax gap has usually two components: the policy gap and the compliance or administrative gap. The former, roughly equivalent to the cost of tax expenditures, results directly from a political decision to reduce the tax burden of the investor or the consumer. This policy aims at stimulating investments or at protecting the poorest. For instance, investment or sectorial (Petroleum or Mining) codes may provide tax exemptions or reduce tax rates, which would reduce tax revenues. Similarly, one of the main justifications of VAT exemptions or reduced rates is to protect the poorest consumer. For instance, developing countries use to exempt completely the agricultural sector and some SSA countries exempt even from VAT the importations of some foodstuff such as rice and wheat. The rationale is the assumption of a tax incidence close to one, *i.e.*, such exemptions would reduce the price for households.[31] The second element of the gap is the administrative or compliance gap. This gap

[28] See for instance Caldeira and Rota-Graziosi (2019) for a detailed analysis of relative tax revenue performance between Benin and Togo, which begins with a tax effort analysis of these two countries and is completed by a review of countries' tax systems.

[29] The devoted website to this paper allows adding any variable and running new estimates of tax efforts (see https://data.cerdi.uca.fr/taxeffort/).

[30] Several countries provide some tax gap analyses. One of the most exhaustive exercises is the VAT Gap work done by the European Union (EU) commission. The VAT gap amounts to 137 billion Euro in 2017, or equivalently to 11.2 percent of total VAT revenue.

[31] We do not discuss here the efficiency or the equity of these tax expenditures.

corresponds to the capacity of tax and customs administration or tax authorities to enforce current tax laws and to the compliance behavior of firms and individuals to pay their taxes.

2.4. Empirical Methodology: The Stochastic Frontier Analysis

The literature proposes several approaches to capture the countries' tax effort. The usual indicator to compare countries' tax effort is the tax-to-GDP ratio. However, Stotsky and WoldeMariam (1997) point out that this simple approach is inappropriate to measure the taxable capacity since not all taxes are explicitly linked to income and to its distribution. Using panel data on 42 Sub-Saharan African countries, during the period 1990-1995, they propose another measure of tax effort consisting of the ratio of the actual to the predicted tax share in GDP. They find that countries with high tax shares tend to have a relatively high tax effort index, even though some disparities remain across countries. Following a similar approach, Gupta (2007) computes the tax effort for 105 developing countries over 25 years but clearly recognize some shortcomings related to this approach.

Cyan *et al*. (2013) propose a method of estimating tax effort that closely relies on the revenue adequacy approach. This method consists in looking at the deviations between what a country would like to raise in tax revenues – as revealed by the structural choice of the level of public expenditures – and its actual tax revenue level. This approach corroborates the empirical evidence that changes in expenditures induce changes in tax levels (see Baicker and Skinner, 2011). Recently, Yohou and Goujon (2017) proposed a Vulnerability-Adjusted Tax Effort Index (VATEI) for a sample of 120 developing countries over 1990-2012. Their approach consists in building the tax effort as the residual of a standard panel regression model (random effects model) of non-resource tax ratio on the economic vulnerabilities and human asset indices, in addition to the usual determinants of tax revenue. This adjusted tax effort index is assumed to measure the willingness and capacity of governments to collect tax beyond the structural factors.

An alternative and increasingly used approach to capture countries' tax effort is the Stochastic Frontier Analysis (SFA) method, which has been followed by Alfirman (2003), Fenochietto and

Pessino (2013), Langford and Ohlenburg (2015), Brun and Diakite (2016). Aigner *et al*. (1977) and Meeusen and van Den Broeck (1977) developed SFA approach to model firms' production behavior. The rationale is that economic agents cannot exceed an "ideal frontier" of production, which is the optimal level of output given the limited endowment of inputs. In our context, the tax frontier refers to the tax capacity, which is the maximum potential tax revenue, given a country's institutional, demographic, and economic features, while the tax effort is the actual revenue in relation to the frontier. Hence, the closer a country is to that frontier, the greater is its tax effort.

The stochastic frontier approach encompasses parametric and non-parametric models. Data Envelopment Analysis (Charnes *et al*. 1997) and the Free Disposal Hull (Deprins *et al*. 1984) are the two main and increasingly popular methods used for non-parametric stochastic frontier models. These methods use linear optimization programs to construct the efficiency curve. They display the advantage that no restrictive assumptions on the production function are necessary (except the standard convexity assumption). However, they remain sensitive to random variations in data and measurement errors. Any variation between production units is therefore likely to be interpreted as inefficiency. Furthermore, the inefficiencies estimated by these models are very sensitive to variations in the sample, to the heterogeneity between the units and to the presence of outliers.

Regarding parametric models in panel data analysis, they are single output-based and categorized into five groups: (i) time-invariant technical inefficiency models (Pitt and Lee, 1981; Schmidt and Sickles, 1984); (ii) time-varying technical inefficiency models Cornwell *et al*. (1990), Kumbhakar (1990), Battese and Coelli (1992), Lee and Schmidt (1993), and Kumbhakar and Wang (2005); (iii) models that separate firm heterogeneity from inefficiency (Greene, 2005; Wang and Ho, 2010); (iv) models distinguishing persistent and time-varying inefficiency (Kumbhakar and Heshmati, 1995); (v) and finally models separating firm effects, persistent inefficiency, and time-varying inefficiency (Colombi *et al*., 2014;. Kumbhakar *et al*., 2014; Filippini and Greene, 2016). In panel data, such models offer the possibility for richer specifications, deal with stochastic noise, and allow testing hypotheses (Hjalmarsson *et al*. 1996; Odeck, 2007).

We follow a parametric approach to estimate the tax effort since we focus on a single output: the total non-resource tax-to-GDP ratio.[32] More precisely, we use the model that separates the error into four components: Generalized True Random Effects model (GTRE). This model was introduced by Colombi *et al*. (2014), Kumbahkar *et al*. (2014), and Tsionas and Kumbahkar (2014). It presents several advantages: (i) it takes into account random shocks; (ii) it is robust to the presence of heterogeneity within the panel; (iii) it allows distinguishing country heterogeneity, and persistent and time-varying factors affecting countries' tax effort. Persistent (*i.e.*, structural) factors are for instance colonial history, culture, geography, the economic structure of the country, which have a long-lasting influence on the tax effort. The time-varying factors are both country- and time-specific. They include tax policy, tax administration performance, natural resources discoveries, and commodity price cycles. For example, countries might improve their tax administration performance by clamping down on tax evasion, training their tax officers, or using more sophisticated tax tools. Also, countries' tax effort might change following the discovery of natural resources or a boom in commodity prices.

Different methods are proposed in the literature to estimate the parameters of the GTRE model: Colombi *et al*. (2014) use a maximum likelihood estimator (MLE); Kumbahakar *et al*. (2014) propose a multi-step procedure; Tsionas and Kumbahakar (2014) develop a Bayesian approach; Filipini and Greene (2016) use a simulated maximum likelihood approach.

We estimate the following model:

$$\tau_{i,t} = \alpha + f\left(X_{i,t}, \beta\right) + \mu_i + \nu_{i,t} - \eta_i - \varphi_{i,t} \quad (2.1)$$

The dependent variable, $\tau_{i,t}$, represents the logarithm of the total *non-resource* tax-to-GDP, the subscripts i and t denote respectively country and time dimensions and $X_{i,t}$ is a vector of covariates explaining countries tax ratio. $\eta_i > 0$ and $\varphi_{i,t} > 0$ are the persistent and *time-varying*

[32] We exclude natural resource revenue, which variations are mainly driven by commodities' prices.

inefficiencies respectively, while μ_i and $\nu_{i,t}$ represent the random effects and the stochastic noise, respectively.[33]

Starting from hypotheses on the distribution of the four errors, the MLE approach of Colombi *et al*. (2014) makes it possible to obtain a form of the log-likelihood. Indeed, assuming that $\nu_{i,t}$ is independent and identically distributed (*iid*) with a normal distribution and $\varphi_{i,t}$ is iid with a half-normal distribution, the error $\varepsilon_{i,t} = \nu_{i,t} - \varphi_{i,t}$ has an asymmetric normal distribution with parameters $\lambda = \sigma_\nu/\sigma_\varphi$ and $\sigma = {\sigma_\nu}^2 + {\sigma_\varphi}^2$. Similarly, the error $\psi_i = \mu_i - \eta_i$ has an asymmetric normal distribution with parameters $\lambda = \sigma_\mu/\sigma_\eta$ and $\sigma = {\sigma_\mu}^2 + {\sigma_\eta}^2$. The *two-term* error $\varepsilon_i = \varepsilon_{i,t} + \psi_i$ is the sum of two asymmetric normal distributions and then admits a known density. It is, therefore, possible to define the function of the log-likelihood and to deduce from it the MLE of the parameters. However, the complexity of the likelihood function, which, in his form, involves T_i integrations, makes very hard the implementation in practice.[34] Hence, Filippini and Greene (2016) propose a computation method based on Butler and Moffitt (1982) formulation to simplify the log-likelihood function and subsequently estimate the MLE using a simulation-based optimization. With the same assumptions on the parameters as before, the idea is to obtain the conditional density $f(\varepsilon_i/\psi_i)$, which is defined on ψ_i. Unlike the previous case, the manipulation, then, involves only one integration. To simplify the implementation of the estimation, we use the multi-step procedure of Kumbhakar *et al*. (2014).[35] The model based on equation 1 is estimated in three stages:

In stage 1, a standard random-effect based regression is used to estimate $\hat{\beta}$ and predicts the values of $\varepsilon_{i,t}$ and ψ_i. We estimate the following equation:

$$\tau_{i,t} = \alpha^* + f\big(X_{i,t}, \beta\big) + \varepsilon_{i,t} + \psi_i \qquad (2.2)$$

[33] We use the logarithm of non-resource tax-to-GDP as dependent. The predictor variables, except the real GDP per capita, are scaled to unit *i.e.,* in percent of GDP and not in logarithm. By doing so, we do not assume implicitly the functional form linking the output to the inputs. The *log-log* form is the most used in the stochastic frontier literature. Note that our results remain robust to the use of the log-log form.

[34] For these authors, a direct optimization of the log-likelihood of the model appears complex.

[35] Kumbhakar *et al*. (2015).

Where $\alpha^* = \alpha - E(\eta_i) - E(\varphi_{it}), \psi_i = \mu_i - \eta_i + E(\eta_i), \varepsilon_{i,t} = \nu_{i,t} - \varphi_{i,t} + E(\varphi_{i,t}), E(\eta_i) = \sqrt{\frac{2}{\pi\sigma_\eta}}$, and $E(\varphi_{i,t}) = \sqrt{\frac{2}{\pi\sigma_\varphi}}$.

In stage 2, by performing a standard stochastic frontier technique, the time-varying tax inefficiency $\varphi_{i,t}$ is estimated using the predicted values of $\varepsilon_{i,t}$ from the first stage. Following Battese and Coelli (1988), this procedure gives the prediction of the time-varying tax effort $\exp(-\varphi_{i,t}|\varepsilon_{i,t})$.

In stage 3, we estimate the persistent tax inefficiency component, denoted by η_i by performing a stochastic frontier model as in the previous stage. The persistent tax effort is then defined by $\exp(-\eta_i)$.

Finally, the overall tax effort is obtained by the product of the *time-varying* tax effort and the persistent tax effort.

Considering the relevant literature on the determinants of domestic resource mobilization, we identify the following driving factors of government tax revenue and consider them as inputs $X_{i,t}$:

- The level of development: Countries' tax capacity depends on their level of economic development assessed through the level of real GDP per capita. High-income countries should raise more tax revenue than developing countries since they have more efficient tax administration, better institutions, and a higher demand for public goods and services (see Lotz and Morss, 1967; Pessino and Fenechietto, 2010; Crivelli and Gupta, 2014).
- Trade openness: Trade liberalization policies implemented in most developing countries starting in the early 1970s and stretching well into the 1990s have substantially increased trade volume in these countries. Therefore, trade openness expressed as total trade (value of imports and exports) as a share of GDP is expected to positively influence tax revenue through households' consumption and domestic corporate profits. This reinforces the role of customs administration in collecting taxes, both the external tariff and domestic taxes, on imported goods (see Stotsky and WoldeMariam, 1997; Pessino and Fenechietto, 2010; Gnangnon and Brun, 2018 among others).

- Agriculture value-added as a percent of GDP: Agriculture is often largely tax-exempt in SSA countries from income taxes and other production taxes, and is frequently either tax exempt or out-of-scope of VAT. The first argument in favor of this treatment is that the sector is dominated by small and medium-size farmers that are scattered across geography, and hence hard to tax; and even if taxes can be effectively levied, such farmers cannot be significant contributors to tax revenues.[36] A second explanation is the political will to reduce foodstuff prices in order to limit the risk of malnutrition or even famine. This assumes a tax incidence close to one, which means an almost perfectly competitive market. However, the tax (VAT mainly) exemptions of foodstuffs involve the inability of farmers to deduce the VAT paid on their inputs. The collected VAT on the intermediary consumption of farmer can generate some revenue and may have then an ambiguous effect of total tax revenue.
- Natural resource rent as a percent of GDP: The negative effect of natural resource rent on tax revenue is widely evidenced in the literature. Natural resource endowment is associated with lower tax revenue (Sachs and Warner, 2001; Eltony, 2002; Belinga *et al*., 2007). During commodity prices upswings, governments in resources-rich countries have less incentive to mobilize other tax revenues; resource rent crowds-out tax revenue (Bornhorst *et al*., 2009, Crivelli and Gupta, 2014, James, 2015) or an inter-ministerial tax competition occurs (Caldeira *et al*., 2020).
- Financial development: Financial development may favor higher tax collection (see Gordon and Li, 2009). Combined with improved access to credit, it allows individuals and companies to finance profitable projects and improve the national information system on economic activities—hence, favor tax collection. On the other hand, in a presence of an ineffective financial system, firms could successfully evade tax payment by conducting business in cash, which is harder for tax administrations to monitor.
- Aid received: In the literature, empirical studies on the relation between aid and taxes are quite not consensual. While some studies emphasize a positive effect of aid on tax revenue mobilization (see *e.g.,* Brun *et al*., 2008; Clist and Morrissey, 2011; Morrissey *et al*., 2014 among others), other works including Pack and Pack (1990), Azam *et al*. (1999), Pivovarsky

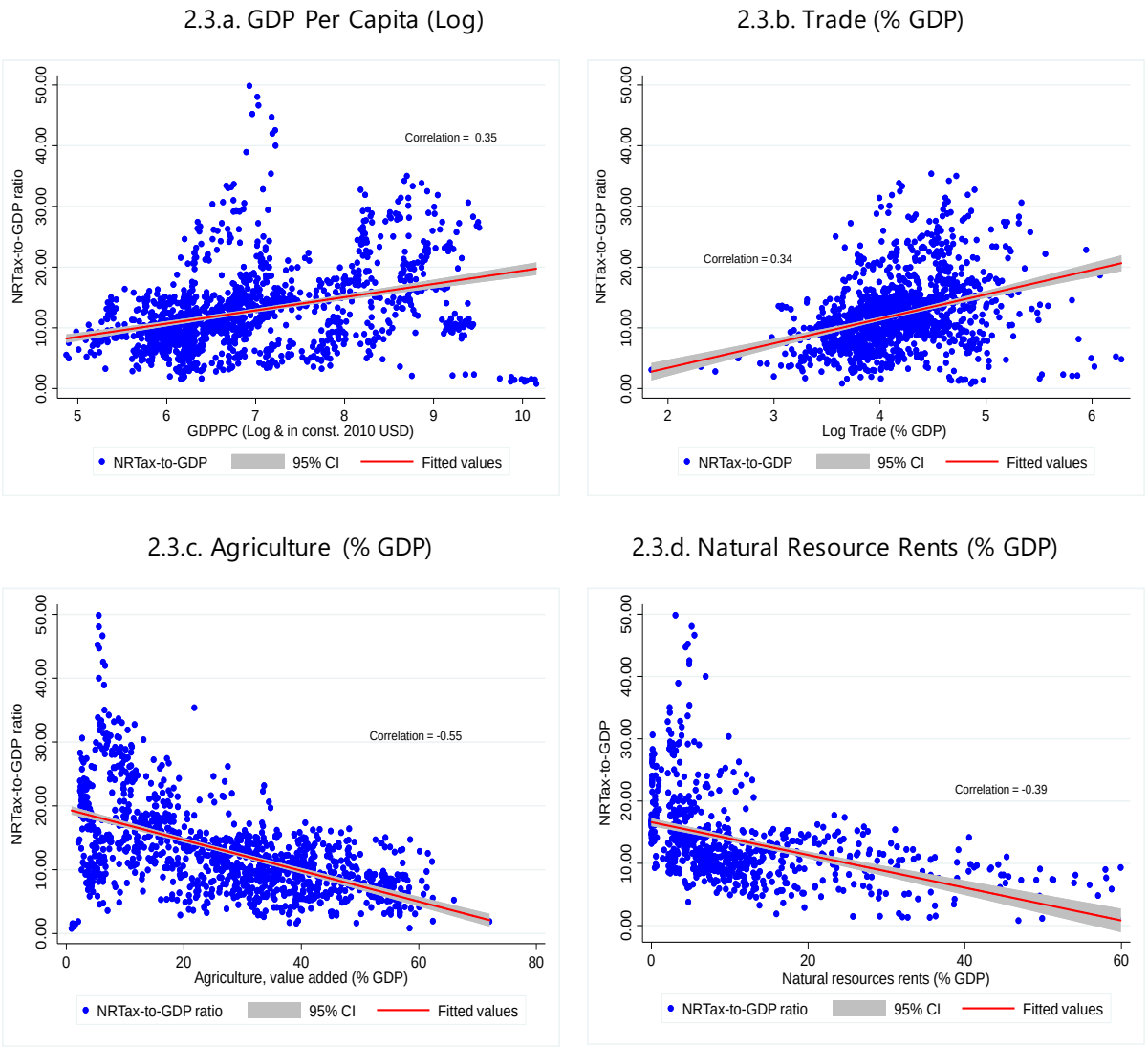
[36] The improvement in technologies for farming, including in SSA, and the increase of large farming firms over the past two decades, weaken such arguments. Nevertheless, countries have been very slow in rethinking the taxation of agriculture.

et al. (2003), and Benedek *et al.* (2012) find a negative relationship. For instance, Diakité *et al.* (2019), focusing on conflict-affected countries, show that aid granted during a period of conflict has a positive impact on revenue collection, and this effect is important when aid is coupled with technical assistance and appears to be *non-linear*.

-

Descriptive statistics and more details on variables' sources and definitions are provided in Appendix 2.2 and 2.3, respectively. Figure 2.3 displays scatter a plot of total *non-resource* tax revenue for each of the explanatory variables used in the baseline specification. These graphs tend to confirm the expected relationships.

Figure 2.3. Correlation between Total *Non-resource* Tax Revenue and Covariates



Source: Tax revenue Dataset for SSA, World Development Indicators, and authors' calculations.

2.5. Results

Table 2.1 displays the three-stage estimation results.[37] Dependent variables in column (1) to column (4) are total *non-resource* tax revenue, total income taxes, corporate income tax, and personal income tax, respectively. In line with previous studies (Stotsky and WoldeMariam, 1997; Gordon and Li, 2009; Pessino and Fenochietto, 2010; Crivelli and Gupta, 2014) all the variables have the expected sign and are statistically significant. The coefficients associated with the level of development (*i.e.*, GDP per capita, logged) and trade openness (logged) are positive and significant at the one-percent level. More precisely, a one percentage increase in per-capita GDP is associated with an increase in the total tax revenue by 0.003 percentage points. Similarly, an increase of one percent in the total trade-to-GDP ratio is associated with a rise in non-resource tax ratio of 0.002 percentage points. Agriculture and natural resources sectors harm tax revenue collection. The coefficients associated with these variables are all negative and statistically significant and are consistent with previous analyses (Stotsky and WoldeMariam, 1997; Sachs and Warner, 2001; Eltony, 2002; Brun *et al.*, 2014; Belinga *et al.*, 2017). These results also hold mostly for tax revenue subcomponents columns (2)-(4).

For the rest of the analysis (stages 2 and 3), we consider the total non-resource tax revenue as the dependent variable (*i.e.,* column 1). Panel A and Panel B of Table 2.1 report the second and third stages. We then deduce the time-varying and persistent tax effort scores, and we compute the total tax effort (Panel C). The higher is the tax effort score, the closer is the country to the "*frontier*". Table A4 presents the summary of tax effort for columns (2)-(4).

[37] We exclude Zimbabwe from the sample in all regressions.

Table 2.1. The three-stage Estimation Results

Dependent variable: NRTax ratio	NRTAX	Direct	CIT	PIT
	(1)	(2)	(3)	(4)
GDP per capita (log)$_{(-1)}$	0.265***	0.407***	0.331***	0.410***
	(0.0301)	(0.0450)	(0.0596)	(0.0695)
Total trade (% GDP)$_{(-1)}$	0.002***	0.005***	0.008***	0.004***
	(0.0004)	(0.0006)	(0.0010)	(0.0011)
Agriculture value added (% GDP)$_{(-1)}$	-0.003**	-0.007***	0.002	-0.022***
	(0.0014)	(0.0021)	(0.0029)	(0.0033)
Total natural resource rent (% GDP)$_{(-1)}$	-0.002*	-0.002	-0.001	-0.008**
	(0.0014)	(0.0020)	(0.0029)	(0.0035)
Constant	0.579**	-1.832***	-2.622***	-2.265***
	(0.2299)	(0.3435)	(0.4537)	(0.5285)
Observations	1165	1,165	1,086	1,081
R-squared	0.163	0.240	0.142	0.183
Number of countries	39	39	38	38

Panel A: Stage 2 - Estimation of the Time-varying Tax Inefficiency (Stochastic Frontier)

				Number of obs.		1165
				Wald chi2(1)		317.84
Log likelihood = 104.87				Prob > chi2		0.0000
	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
frontier (one)	0.215	0.012	17.830	0.000	0.191	0.239
usigmas (_cons)	-2.597	0.106	-24.520	0.000	-2.804	-2.389
vsigma (_cons)	-3.759	0.100	-37.690	0.000	-3.954	-3.563

Panel B: Stage 3 - Estimation of the Persistent Tax Inefficiency (Stochastic Frontier)

				Number of obs.		1165
				Wald chi2(1)		1400.00
Log likelihood = -371.66				Prob > chi2		0.0000
	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
frontier (one)	0.446	0.012	37.420	0.000	0.423	0.470
usigmas (_cons)	-1.275	0.060	-21.340	0.000	-1.392	-1.158
vsigma (_cons)	-3.790	0.116	-32.630	0.000	-4.018	-3.563

Panel C: Summary of Tax Effort Estimation Results

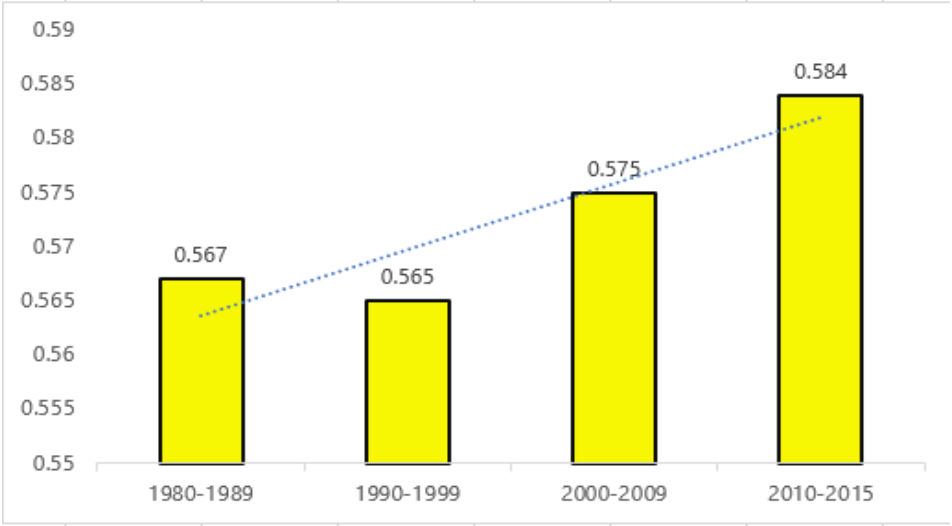
	Obs.	Mean	Std. Dev.	Min	Max
Time-varying tax effort	1165	0.817	0.092	0.318	0.967
Persistent tax effort	1165	0.698	0.167	0.101	0.942
Total tax effort	1165	0.572	0.153	0.057	0.847

*, **, and *** denote statistical significance at 10 percent, 5 percent and 1 percent level, respectively. Standard errors are reported in brackets. Note: NRTAX: Total non-resource tax revenue; Direct: Total income tax revenue; CIT: Corporate income tax revenue; PIT: Personal income tax revenue.

The full sample average stands at 0.817 and 0.698 for time-varying and persistent tax effort, respectively over 1980-2015. The average total tax effort score is equal to 0.572, suggesting that SSA countries mobilize 57 percent of their tax potential. In other words, given their

economic features, SSA countries would raise on average 23.16 percent of GDP of non-resource taxes if they fully used their tax potential, rather than the actual 13.22 percent. Furthermore, it is worth underscoring that time-varying factors account for only 36 percent of the total tax effort. Thus, SSA countries would gain significant additional tax revenue by addressing issues related to time-varying factors. In the sample, the minimum tax effort score is 0.057 (Equatorial Guinea in 2011) and the maximum is 0.847 (Burundi in 1998). Note that the tax effort has improved slightly over the period (Figure 2.5)—from 0.57 during 1980-1989 to 0.58 during the most recent period. An important result is that the number of countries that have improved their tax effort over time is significantly higher than those for which the tax effort has declined (Figure 2.6).

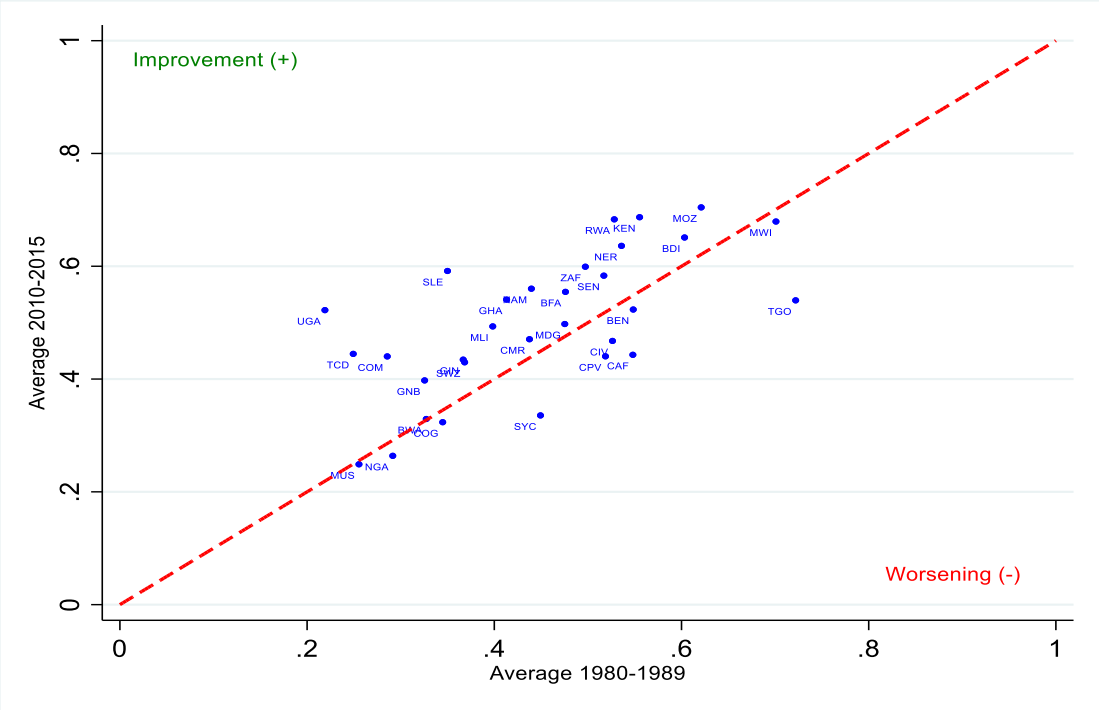
Figure 2.4. Tax Effort over Time (Average Values)



Source: Tax revenue Dataset for SSA and authors' calculations.

In Figure 2.6, we show the evolution of countries tax effort. Most of SSA countries have improved their tax effort over time, particularly Uganda, Sierra Leone, and Senegal.

Figure 2.5. Evolution of Countries Tax Effort Over Time



Source: Tax revenue Dataset for SSA and authors' calculations.

Table 2.2 provides a country ranking over different sub-periods (1980-1989, 1990-1999, 2000-2009, and 2010-2015) based on total tax effort scores. Focusing on the last sub-period (*i.e.*, 2010-2015), it emerges that Mozambique, Togo, Burundi, Senegal, and The Gambia are top performers with a tax effort score of 0.804, 0.774, 0.769, and 0.755, and 0.742 respectively, while the five poor performers over the sub-period are Congo Republic (0.361), Chad (0.325), Gabon (0.319), Nigeria (0.232) and Equatorial Guinea (0.071). The *non-resource* tax to GDP has a decreasing trend in Equatorial Guinea, Congo Republic and Gabon. These countries rely a lot and increasingly on revenue from natural resources. As for Nigeria and Chad, they have generally a non-resource tax below 7 percent of GDP over the period 1980-2015.

The poverty level in Mozambique and Burundi paradoxically explains their performance in terms of tax effort. Table 2.1 highlights the crucial role of GDP per capita to determine the tax revenue to GDP ratio. The coefficient of this variable is not only highly significant, but its level is more important. Togo (as Benin) has a substantial transit activity with Nigeria. Given the Nigerian trade policy to foster domestic production especially (for instance, rice and wax fabrics) or for other considerations (such as environmental and security reason for second-

hand cars), some goods subject to high tariff rates are imported in Togo and then smuggled to Nigeria. These importations raise revenue in terms of tariffs and VAT even if these goods are not consumed in Togo.

Table 2.2. Full Sample Tax Effort-based Ranking (Baseline Specification)

	1980-1989		1990-1999		2000-2009		2010-2015		
Country	**Tax Effort**	**Rank**	**Tax Effort**	**Rank**	**Tax Effort**	**Rank**	**Tax Effort**	**Rank**	**Average Tax Ratio**
Angola	-	-	0.265	34	0.279	36	-	-	8.197
Benin	0.616	14	0.627	12	0.691	8	0.696	12	14.672
Botswana	0.390	28	0.361	30	0.411	30	0.455	31	20.963
Burkina Faso	0.611	15	0.660	10	0.689	9	0.702	11	13.150
Burundi	0.757	5	0.806	1	0.792	1	0.769	3	13.402
Cabo Verde	0.543	19	0.605	16	0.619	19	0.589	22	18.706
Cameroon	0.474	24	0.482	25	0.532	26	0.548	28	12.745
Central African Republic	0.607	16	0.560	21	0.569	23	0.557	26	7.795
Chad	0.241	32	0.312	31	0.314	32	0.325	34	5.994
Comoros	0.557	18	0.605	15	0.593	21	0.603	21	11.469
Congo, Dem. Rep.	-	-	-	-	-	-	-	-	9.142
Congo, Rep.	0.422	26	0.375	29	0.307	34	0.361	33	10.867
Cote d'Ivoire	0.730	6	0.682	9	0.645	13	0.624	15	14.019
Equatorial Guinea	-	-	-	-	0.082	37	0.071	37	2.794
Ethiopia	-	-	-	-	-	-	0.724	8	12.010
Gabon	-	-	-	-	0.310	33	0.319	35	11.584
Gambia, The	-	-	-	-	0.735	3	0.742	5	14.933
Ghana	0.391	27	0.480	26	0.534	25	0.550	27	14.820
Guinea	0.494	22	0.422	28	0.521	27	0.570	25	13.383
Guinea-Bissau	0.382	29	0.303	32	0.380	31	0.422	32	8.147
Kenya	0.674	8	0.704	6	0.702	7	0.714	10	15.608
Lesotho	0.808	1	-	-	-	-	-	-	40.971
Madagascar	0.638	11	0.574	19	0.626	18	0.607	19	9.797
Malawi	0.793	3	0.752	3	0.686	10	0.740	6	14.017
Mali	0.620	13	0.585	17	0.634	17	0.617	17	10.846
Mauritius	0.541	20	0.492	24	0.461	29	0.462	30	18.276
Mozambique	0.702	7	0.685	8	0.663	12	0.804	1	19.952
Namibia	0.634	12	0.717	5	0.708	5	0.734	7	31.133
Niger	0.604	17	0.546	22	0.640	14	0.689	13	12.585
Nigeria	0.259	31	0.269	33	0.298	35	0.232	36	4.867
Rwanda	0.659	9	0.623	14	0.703	6	0.717	9	13.704
Sao Tome and Principe	-	-	-	-	-	-	-	-	15.403
Senegal	0.658	10	0.689	7	0.739	2	0.755	4	19.041
Seychelles	0.784	4	0.767	2	0.635	16	0.583	24	30.933
Sierra Leone	0.318	30	0.448	27	0.517	28	0.516	29	9.327
South Africa	0.491	23	0.573	20	0.585	22	0.587	23	22.829
Swaziland	0.519	21	0.542	23	0.606	20	0.633	14	25.526
Tanzania	-	-	0.649	11	0.558	24	0.605	20	10.821
Togo	0.799	2	0.625	13	0.729	4	0.774	2	15.895
Uganda	0.452	25	0.578	18	0.638	15	0.616	18	11.278
Zambia	-	-	0.719	4	0.671	11	0.623	16	14.583

Source: Tax revenue Dataset for SSA and authors' calculations

Natural resource endowment, especially oil, significantly reduces the computed tax effort (see Figure and 7a). The worst performers are *resource-rich* SSA countries (Nigeria, Equatorial Guinea) given the crowding out effect (Bornhorst *et al*., 2009, Crivelli and Gupta, 2014, James, 2015) or the inter-ministerial tax competition weakening the institution in charge of tax policy (Caldeira *et al*., 2020).

For robustness purpose, specifically, to deal with the omitted variables bias, we control successively for the financial development and for official development assistance. The three-stage estimation results are reported in Appendix 2.5 and 2.7, respectively. For each variable, the summary of tax effort for tax subcomponents – columns (2)-(4) – is reported in Appendix 2.6 and Appendix 2.8, respectively.

Focusing on *non-resource* tax, the average total effort does not change when controlling for financial development: the average tax effort remains 0.572. The top performers in the sub-period 2010-2015 also remain unchanged, namely Togo, Senegal,[38] Burundi, and The Gambia. These countries are resources poor, and their tax potential is particularly low (except for Senegal) given their level of poverty and the share of their agricultural sector in their respective GDP. Moreover, Togo and The Gambia raise significant revenue from the transit activities towards landlocked countries or regions. The average tax effort scores for subcomponents are slightly higher (+0.01) than those from the baseline results.

Controlling for development aid received results in a slight change in the average tax effort: the average tax effort varies from 0.572 to 0.570. The top performers over the sub-period 2010-2015 are Burundi, Togo, Senegal, and Namibia.[39] The average effort to collect direct tax increases driven by an increase in the effort to collect personal income tax and a decrease in the effort to collect corporate income tax.

To test the sensibility of our results to the change of production technology between the *non-resource* tax and its determinants, we use the *log-log* functional form. The average tax effort varies from 0.572 to 0.571 for the baseline estimation (see Table 2.1 and Appendix 2.9). The

[38] Note that Senegal comes one place higher.

[39] Namibia replaces The Gambia as the fifth.

average tax efforts are 0.581 and 0.566 when using the *log-log* specification and controlling for financial development and official development assistance, respectively.

To further test the robustness of our results, we compute the tax effort using some second general stochastic frontier models.[40] We first estimate tax effort using the model of Battese and Coelli (1992). The average tax effort is 0.573 relying on the baseline.

The average tax effort is 0.626 and 0.576 when controlling respectively for financial development and development assistance and aid. Using the model of Kumbhakar (1990), the average tax effort becomes 0.493 for the baseline model, and 0.626 and 0.587 when controlling for financial development and official development assistance, respectively.

2.6. Replications

Our analysis participates explicitly to the replication effort, which ensures the reliability of produced works. Over recent years, there has been a growing interest in replication, particularly in economic research.[41] Following Hamermesch (2007) and Clemens (2017) approach, we undertake a replication of two papers analyzing tax effort: Gupta (2007) and Fenechietto and Pessino (2013). This replication approach consists in three stages: verification, reproduction, and robustness. Verification means the use of the same sample, population, and empirical specification,[42] while reproduction uses the same econometric model on different samples from

[40] Second-generation models have their limitation in measuring inefficiency, hence our choice of Generalized True Random Effects model. While they allow for time-varying inefficiency, hence improvement over time, the intercept is the same across all countries. Unfortunately, in the presence of time-invariant unobservable factors, they are subject to misspecification bias. Moreover, they are not fitted to deal with heterogeneity between countries. For more discussion, see Wang (2002), Green (2005), and Belotti and Ilardi (2018).

[41] For instance, the top five Reviews in Economics, for a paper to be accepted and published, request the inputs including dataset and program of the paper for replication purpose (Sukhtankar, 2017). The American Economic Review particularly has dedicated a whole volume to replication. In addition, Anderson and Kichkha (2017)], after a discussion of the three main methods of research synthesis (*i.e.*, traditional literature surveys, meta-analysis and replication), *argue that only pure replication does not contain a substantial judgement*.

[42] Hamermesch (2007) calls this procedure.

the same population.[43] Regarding robustness,[44] it consists either in running the same specification on different samples and populations or applying different econometric specifications on the same sample and population. In our replication exercise,[45] we estimate the same specification for the same sample (same countries and period) as in the original paper for the verification. The reproduction consists in running the same specification on the same sample of countries but including all the available observations for the variables used in the author(s)'s specification(s). Finally, for the robustness, we expand the sample and the time period by using all the countries and years on which data are available to test the author(s)'s specification(s). It is worth mentioning that some differences with respect to the original paper on variables characteristics (*i.e.*, mean, standard deviation, minimum and maximum) emerge even though the sources are the same. This could be due to changes and adjustments in dataset over time. These differences could be also related to some minor treatments by the authors during the dataset compilation, which are not reported in the paper. Furthermore, in the case we do not find a variable from the same source as the author, we take one from another source, if applicable. Otherwise, if the variable is not used in the baseline specification, we do not run the regression for that given specification.

2.6.1. Replication of Gupta (2007)

The author estimates countries' revenue potential for a panel of 105 developing countries over the period 1980-2004 using central government revenue dataset. The estimates explained the ratio of central government revenue (excluding grants) to GDP as a function of a set of structural variables (*i.e.*, the log of per capita GDP, the share of agriculture in GDP, the ratio of imports to GDP, the share of aid and debt in GDP) and politico-institutional variables

[43] For Hamermesch (2007), this is called a statistical replication.

[44] Hamermesch (2007).

[45] Our replication process is applied based on the following conditions: First, the paper must be an empirical investigation of countries' tax effort (*i.e.*, employing econometric specification) with an actual computation of tax effort. Second, it must be an international comparison of tax effort among countries. In addition, we choose not to replicate a number of seminal papers on tax effort prior to the 1990s such as Bahl, (1971, 1972), Chelliah (1971), Chelliah, Baas, and Kelly (1975), Leuthold (1991), Lotz and Morss (1970), Tait, Grätz, and Eichengreen (1979).

(corruption, law and order, government stability, political stability and economic stability). An important limitation of this paper is the inclusion of natural resources revenue into tax revenue. Gupta (2007) uses various methods of panel data estimation including Fixed Effect (FE), Random Effects (RE), Common Correlation Coefficient (CCC), Panel Specific Correlation (PSC), and Dynamic Panel Specification (DPS). The results show that the per capita GDP, trade openness, and the share of agriculture in GDP are statistically significant and strong determinants of countries revenue performance. In addition, certain forms of foreign aid improve revenue performance while external debt does not. Regarding politico-institutional factors, the author found that political and economic stability affect revenue performance positively revenue performance, and corruption significantly and negatively alters revenue performance. The author also emphasizes that countries' tax revenue performance depends on their tax structure. More precisely, countries that depend on indirect taxation as their main source of tax revenue, tend to perform less than countries raising more from direct taxation.

We replicate the key specifications despite a few issues with some variables (economic stability, political stability, and average tariff). The verification test failed to replicate the exact results as in the paper in terms of coefficient and significance of the variables. We have more significant variables than in the original paper (see Appendix 2.6 and 2.7).[46] Moreover, the robustness exercise yields smaller coefficients for all the variables than in the paper, suggesting a smaller effect when non-resources tax is used instead of central government revenue, and when the sample is expanded to all available countries and years (see Appendix 2.8 and 2.9).

2.6.2. Replication of *Fenochietto and Pessino (2013)*

Fenochietto and Pessino (2013) estimated countries tax capacity and tax effort using a Stochastic Frontier Analysis for 113 countries. They first estimated the tax capacity for 96 non-natural resources dependent countries and then on the whole sample using tax and pension

[46] Although we replicated all the forms of panel data estimations, we present the results for the common correlation coefficient and the panel specific correlation estimations. The reason is that the author expressed his preference for these results in the paper (see Gupta, 2007 p. 26).

contributions revenue collected by central and sub-national governments as percent of GDP from the IMF's WEO. The authors considered a set of structural and institutional variables (level of development, inflation, education, trade, income inequality, corruption, and the ease of tax collection) explaining countries' tax capacity and estimated tax effort using Battese and Coelli (1992) Half Normal (HN) and Truncated Normal (TN) models incorporating heterogeneity. They also relied on Mundlak (1978) Random Effects Model (REM) to deal with the 'unobserved' heterogeneity.

Our verification test on this paper yield almost the same results: the sign and the magnitude are close. As in the paper, the coefficients for non-resource countries are slightly lower than those for all countries (First two columns of Appendix 2.10 and 2.11).

For the robustness analysis, in addition to broadening the sample to all available countries and year while replacing the dependent variable with the ICTD non-resource tax, we also estimate the parameters of Stochastic Frontier (SF) tax function for ICTD non-resource tax while limiting it to the non-resource dependent countries defined in the paper. The robustness results show stable coefficients for all the variables. Nevertheless, the logarithm of the GDP per capita and the logarithm of the GDP per capita square do not have the expected sign or are not significant. We went further in robustness analysis, by relaxing the nonlinear relationship assumption between tax revenue and GDP per capita. Thus, we dropped the logarithm of the GDP per capita squared from the specification. Results in last two columns of Appendix 2.10 and 2.11 show that once we relax the nonlinear relationship assumption, all the variables get the expected sign.

2.7. Conclusion

In this chapter, we offer a new dataset of tax revenue, which updates and completes the dataset published in Mansour (2014). We collect statistical information from the African Department of the International Monetary Fund (IMF), most of which is publicly available, covering 42 SSA countries over the period 1980-2015 and distinguishing resource revenue from non-resource (tax) revenue. This work participates to recent efforts to better apprehend tax revenues in Sub-

Saharan Africa, in particular the revenue statistics in Africa from the OECD, the Government Revenue Dataset initiated by the International Centre for Tax and Development (ICTD) and updated by UNU-WIDER.

We provide an estimate of tax effort adopting the Stochastic Frontier Analysis approach. First, we confirm the impact of previously studied factors on countries' DRM capacity such as level of development, financial development, trade openness, natural resource rent, and the size of the agriculture sector. The two latter factors have a negative effect on the domestic revenue mobilization capacity. We estimate on average the total tax effort to be 0.58. Given that non-resource tax revenue amounts to 13.2 percent of GDP, potential tax revenue would be on average 22.75 percent of GDP. Mozambique, Burundi, Togo, Senegal, and The Gambia are top performers with a tax effort score above 0.75, while the five lowest performers are resource-rich countries such as Congo Republic (0.366), Chad (0.333), Gabon (0.327), Nigeria (0.243) and Equatorial Guinea (0.073). The poverty level in Mozambique and Burundi explains paradoxically their performance in terms of tax effort. Finally, we did some replication analyses of previous works on tax effort, in particular Gupta (2007) and Fenechietto and Pessino (2013). We fail to replicate the results of Gupta (2007) in terms of robust coefficients and significance of the variables. Some explanatory variables are missing. However, we confirm broadly the analysis of Fenechietto and Pessino (2013).

Appendices

Appendix 2.1. Country List

Angola, Benin, Botswana, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Congo, Dem. Rep., Congo, Rep., Côte d'Ivoire, Equatorial Guinea, Ethiopia, Gabon, Gambia, The, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Seychelles, Sierra Leone, South Africa, Swaziland, São Tomé and Principe, Tanzania, Togo, Uganda, Zambia, Zimbabwe

Appendix 2.2. Data Sources and Definition

Variables	Definition	Sources
Total non-resource tax (% GDP)	Total tax revenues excluding resource rent	Tax revenue dataset, Mansour (2019)
Corporate income tax (% GDP)	Tax imposed on corporate income in countries that have a corporate tax	
Total direct taxes (% GDP)	Taxes on all income sources (*i.e.*, business profits, wages, portfolio income, income from real property, capital gains, etc.)	
Personal income taxes (% GDP)	Taxes on individual income	
Total resource rent (% GDP)	Sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents over GDP.	World Development Indicators, World Bank
GDP PC (constant 2010 US $)	Sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products	
Total Trade (% GDP)	Volume of imports and exports over GDP	
Agriculture, value added (% GDP)	Net output of forestry, hunting, and fishing, as well as cultivation of crops and livestock production after adding up all outputs and subtracting intermediate inputs, divided by GDP	
Gini index	Index measuring the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution	
Net official development assistance and official aid received (% GDP)	Net official development assistance is disbursement flows (net of repayment of principal). Net official aid refers to aid flows (net of repayments).	
Financial development index	Aggregate of nine indices that summarize how developed financial institutions and financial markets are in terms of their depth, access, and efficiency.	Svirydzenka (2016)

Appendix 2.3. Descriptive Statistics

Variables	Obs.	Mean	Std. Dev.	Min	Max
Total Taxes	1473	16.19	8.97	0.57	53.33
Total non-resource taxes (% GDP)	1473	13.22	7.09	0.55	50.81
Total income taxes	1473	3.89	2.74	0.18	18.69
Corporate Income Tax	1373	1.64	1.24	0.00	9.06
Personal Income Tax	1368	1.84	1.79	0.00	13.33
GDP per capita (constant 2010 US$)	1474	1892.50	2780.36	131.65	20333.94
Total trade (% of GDP)	1323	71.3	36.48	6.32	265.98
Agriculture, value added (% of GDP)	1345	27.42	15.70	0.89	72.03
Total natural resources rents (% of GDP)	1431	11.61	11.92	0.00	89.17
Financial development (% of GDP)	1435	0.11	0.08	0.00	0.64
Net ODA and aid received (% of GDP)	1448	10.79	10.49	-0.25	94.44

Source: Authors' calculations

Appendix 2.4. Summary of Tax Effort Estimation Results - Baseline Estimation (2)-(4)

Dependent	Tax Effort Components	Obs.	Mean	Std. Dev.	Min	Max
Direct	Time-varying tax effort	1165	0.756	0.109	0.223	0.936
	Persistent tax effort	1165	0.620	0.157	0.064	0.866
	Total tax effort	1165	0.470	0.139	0.031	0.755
CIT	Time-varying tax effort	1086	0.701	0.114	0.092	0.919
	Persistent tax effort	1086	0.443	0.221	0.045	1.000
	Total tax effort	1086	0.311	0.165	0.019	0.834
PIT	Time-varying tax effort	1081	0.648	0.148	0.031	0.940
	Persistent tax effort	1081	0.539	0.182	0.035	0.834
	Total tax effort	1081	0.350	0.142	0.006	0.676

Source: Authors' calculations

Appendix 2.5. The Three-stage Estimation Results: Controlling for Financial Development

Dependent variable: NRTax ratio	NRTAX	Direct	CIT	PIT
	(1)	(2)	(3)	(4)
GDP per capita (log)$_{(-1)}$	0.228***	0.337***	0.288***	0.339***
	(0.0309)	(0.0459)	(0.0617)	(0.0716)
Total trade (%GDP)$_{(-1)}$	0.001***	0.004***	0.008***	0.004***
	(0.0004)	(0.0006)	(0.0010)	(0.0011)
Agriculture value added (%GDP) $_{(-1)}$	-0.003**	-0.007***	0.002	-0.021***
	(0.0014)	(0.0021)	(0.0029)	(0.0033)
Total natural resource rent (%GDP) $_{(-1)}$	-0.001	-0.000	-0.000	-0.007*
	(0.0014)	(0.0021)	(0.0029)	(0.0035)
Financial development $_{(-1)}$	0.776***	1.259***	0.666	1.070**
	(0.1821)	(0.2718)	(0.4225)	(0.4803)
Constant	0.739***	-1.500***	-2.411***	-1.912***
	(0.2303)	(0.3418)	(0.4534)	(0.5273)
Observations	1165	1165	1,086	1,081
R-squared	0.170	0.245	0.140	0.181
Number of countries	39	39	38	38

Panel A: Stage 2 - Estimation of the Time-varying Tax Inefficiency (Stochastic Frontier)

				Number of obs.		1165
				Wald chi2(1)		318.74
Log likelihood = 111.52				Prob > chi2		0.0000
	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
frontier (one)	0.214	0.012	17.850	0.000	0.191	0.238
usigmas (_cons)	-2.605	0.106	-24.640	0.000	-2.813	-2.398
vsigma (_cons)	-3.773	0.100	-37.740	0.000	-3.969	-3.577

Panel B: Stage 3 - Estimation of the Persistent Tax Inefficiency (Stochastic Frontier)

				Number of obs.		1165
				Wald chi2(1)		1568.67
Log likelihood = -339.46				Prob > chi2		0.0000
	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
frontier (one)	0.445	0.011	39.610	0.000	0.423	0.467
usigmas (_cons)	-1.278	0.058	-22.180	0.000	-1.391	-1.165
vsigma (_cons)	-4.016	0.125	-32.070	0.000	-4.261	-3.770

Panel C: Summary of Tax Effort Estimation Results

	Obs.	Mean	Std. Dev.	Min	Max
Time-varying tax effort	1165	0.818	0.091	0.322	0.968
Persistent tax effort	1165	0.698	0.171	0.108	0.946
Total tax effort	1165	0.572	0.156	0.061	0.848

*, **, and *** denote statistical significance at 10 percent, 5 percent and 1 percent level, respectively. Standard errors are reported in brackets. Note: NRTAX: Total non-resource tax revenue; Direct: Total income tax revenue; CIT: Corporate income tax revenue; PIT: Personal income tax revenue.

Appendix 2.6. Summary of Tax Effort Estimation Results – Robustness Check: Controlling for Financial Development (2)-(4)

Dependent	Tax Effort Components	Obs.	Mean	Std. Dev.	Min	Max
Direct	Time-varying tax effort	1165	0.757	0.108	0.209	0.941
	Persistent tax effort	1165	0.637	0.152	0.080	0.874
	Total tax effort	1165	0.483	0.136	0.038	0.766
CIT	Time-varying tax effort	1086	0.700	0.115	0.088	0.919
	Persistent tax effort	1086	0.456	0.217	0.054	1.000
	Total tax effort	1086	0.320	0.164	0.019	0.840
PIT	Time-varying tax effort	1081	0.646	0.149	0.030	0.941
	Persistent tax effort	1081	0.555	0.177	0.045	0.838
	Total tax effort	1081	0.360	0.141	0.006	0.676

Sources: Authors' calculations

Appendix 2.7. The Three-stage Estimation Results: Controlling for ODA and Aid

Dependent variable: NRTax ratio

	NRTAX	Direct	CIT	PIT
	(1)	(2)	(3)	(4)
GDP per capita (log)$_{(-1)}$	0.253***	0.367***	0.280***	0.324***
	(0.0325)	(0.0483)	(0.0643)	(0.0755)
Total trade (% GDP)$_{(-1)}$	0.002***	0.005***	0.009***	0.004***
	(0.0004)	(0.0006)	(0.0010)	(0.0012)
Agriculture value added (%GDP)$_{(-1)}$	-0.003**	-0.007***	0.001	-0.022***
	(0.0014)	(0.0021)	(0.0030)	(0.0034)
Total natural resource rent (% GDP)$_{(-1)}$	-0.002	-0.001	-0.000	-0.006*
	(0.0014)	(0.0020)	(0.0029)	(0.0035)
ODA (% GDP)$_{(-1)}$	-0.001	-0.006***	-0.008***	-0.009***
	(0.0011)	(0.0017)	(0.0025)	(0.0027)
Constant	0.669***	-1.539***	-2.209***	-1.603***
	(0.2491)	(0.3696)	(0.4939)	(0.5760)
Observations	1137	1137	1062	1057
R-squared	0.159	0.251	0.155	0.175
Number of countries	39	39	38	38

Panel A: Stage 2 - Estimation of the Time-varying Tax Inefficiency (Stochastic Frontier)

				Number of obs.		1137
				Wald chi2(1)		305.96
Log likelihood = 106.30				Prob > chi2		0.0000
	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
frontier (one)	0.213	0.012	17.490	0.000	0.189	0.237
usigmas (_cons)	-2.617	0.108	-24.270	0.000	-2.828	-2.406
vsigma (_cons)	-3.752	0.099	-37.750	0.000	-3.947	-3.557

Panel B: Stage 3 - Estimation of the Persistent Tax Inefficiency (Stochastic Frontier)

				Number of obs.		1137
				Wald chi2(1)		1387.37
Log likelihood = -376.46				Prob > chi2		0.0000
	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
frontier (one)	0.451	0.012	37.250	0.000	0.427	0.475
usigmas (_cons)	-1.233	0.060	-20.640	0.000	-1.350	-1.116
vsigma (_cons)	-3.819	0.120	-31.760	0.000	-4.055	-3.583

Panel C: Summary of Tax Effort Estimation Results

	Obs.	Mean	Std. Dev.	Min	Max
Time-varying tax effort	1137	0.819	0.090	0.319	0.967
Persistent tax effort	1137	0.694	0.170	0.099	0.941
Total tax effort	1137	0.570	0.155	0.056	0.842

*, **, and *** denote statistical significance at 10 percent, 5 percent and 1 percent level, respectively. Standard errors are reported in brackets. Note: NRTAX: Total non-resource tax revenue; Direct: Total income tax revenue; CIT: Corporate income tax revenue; PIT: Personal income tax revenue.

Appendix 2.8. Summary of Tax Effort Estimation Results – Robustness Check: Controlling for ODA and Aid (2)-(4)

Dependent	Tax Effort Components	Obs.	Mean	Std. Dev.	Min	Max
Direct	Time-varying tax effort	1137	0.763	0.104	0.232	0.935
	Persistent tax effort	1137	0.619	0.155	0.066	0.863
	Total tax effort	1137	0.474	0.137	0.033	0.758
CIT	Time-varying tax effort	1062	0.699	0.115	0.089	0.917
	Persistent tax effort	1062	0.419	0.214	0.042	1.000
	Total tax effort	1062	0.294	0.160	0.018	0.823
PIT	Time-varying tax effort	1057	0.647	0.148	0.030	0.940
	Persistent tax effort	1057	0.554	0.172	0.045	0.829
	Total tax effort	1057	0.360	0.138	0.006	0.655

Source: Authors' calculations

Appendix 2.9. The three-stage Estimation Results: Baseline, Controlling for Financial Development and Official Development Assistance and Aid – Log-Log Specification

Dependent variable: NRTax ratio	NRTAX					
	(1)		(2)		(3)	
GDP per capita (log)$_{(-1)}$	0.329***	(0.0350)	0.287***	(0.0349)	0.358***	(0.0370)
Total trade (% GDP)(-1)	0.279***	(0.0289)	0.282***	(0.0294)	0.296***	(0.0301)
Agriculture value added (%GDP)$_{(-1)}$	0.068**	(0.0339)	0.098***	(0.0335)	0.098***	(0.0349)
Total natural resource rent (% GDP)$_{(-1)}$	-0.006	(0.0148)	-0.000	(0.0151)	0.004	(0.0149)
Financial development $_{(-1)}$			0.204***	(0.0292)		
ODA and Aid (% GDP)$_{(-1)}$					-0.001	(0.0112)
Constant	-1.222***	(0.3231)	-0.580*	(0.3404)	-1.600***	(0.3393)
Observations	1155		1126		1125	
R-squared	0.229		0.261		0.238	
Number of countries	39		39		39	

Panel A: Stage 2 - Estimation of the Time-varying Tax Inefficiency (Stochastic Frontier)

	(1)	(2)	(3)
Number of obs.	1155	1126	1125
Wald chi2(1)	226.97	254.58	224.92
Prob > chi2	0.0000	0.0000	0.0000

Log likelihood	(1) 141.42	(2) 169.20	(3) 149.50

	(1)		(2)		(3)	
frontier (one)	0.192***	(0.0127)	0.194***	(0.0121)	0.1896***	(0.0126)
usigmas (_cons)	-2.828***	(0.1254)	-2.812***	(0.1184)	-2.852***	(0.1258)
vsigma (_cons)	-3.680***	(0.0943)	-3.794***	(0.0981)	-3.6974***	(0.0940)

Panel B: Stage 3 - Estimation of the Persistent Tax Inefficiency (Stochastic Frontier)

	(1)	(2)	(3)
Number of obs.	1155	1126	1125
Wald chi2(1)	1511.43	1382.52	1515.57
Prob > chi2	0.0000	0.0000	0.0000

Log likelihood	(1) -452.54	(2) -385.76	(3) -473.43

	(1)		(2)		(3)	
frontier (one)	0.478***	(0.0123)	0.447***	(0.0120)	0.488***	(0.0125)
usigmas (_cons)	-1.125***	(0.0581)	-1.240***	(0.0597)	-1.056***	(0.0580)
vsigma (_cons)	-3.661***	(0.1092)	-3.710***	(0.1089)	-3.638***	(0.1098)

Panel C: Summary of Tax Effort Estimation Results

	Tax Effort Components	Obs.	Mean	Std. Dev.	Min	Max
(1)	Time-varying tax effort	1155	0.834	0.078	0.379	0.965
	Persistent tax effort	1155	0.683	0.175	0.090	0.940
	Total tax effort	1155	0.571	0.158	0.056	0.865
(2)	Time-varying tax effort	1126	0.833	0.082	0.365	0.965
	Persistent tax effort	1126	0.696	0.169	0.113	0.941
	Total tax effort	1126	0.581	0.154	0.070	0.866
(3)	Time-varying tax effort	1125	0.836	0.078	0.382	0.963
	Persistent tax effort	1125	0.676	0.179	0.085	0.939
	Total tax effort	1125	0.566	0.161	0.054	0.866

*, **, and *** denote statistical significance at 10 percent, 5 percent and 1 percent level, respectively. Standard errors are reported in brackets.

Appendix 2.10. Replication results of Gupta (2007) – Common Correlation Coefficients (Verification)

Dependent variable: Tax ratio								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP per capita (log)	3.624***	3.874***	3.080***	3.360***				
	(0.398)	(0.363)	(0.401)	(1.103)				
Agriculture (% GDP)					-0.208***	-0.181***	-0.125***	-0.243***
					(0.0362)	(0.0382)	(0.0352)	(0.0754)
Import (% GDP)		0.0330	0.112***	0.0484*		0.0338**	0.0821***	0.0741**
		(0.0213)	(0.0207)	(0.0260)		(0.0158)	(0.0212)	(0.0310)
Aid (% GDP)			-0.00778	0.0371			-0.00711	0.0419
			(0.0252)	(0.0645)			(0.0442)	(0.0771)
Debt (% GDP)			0.00512	0.0308*			-0.0111**	0.00927
			(0.00332)	(0.0164)			(0.00485)	(0.0153)
Government stability				0.231				0.297*
				(0.173)				(0.170)
Corruption				-0.305				-0.433
				(0.553)				(0.539)
Law and Order				0.348				0.476
				(0.352)				(0.321)
Tax on Goods and Services				0.337**				0.0674
				(0.169)				(0.181)
Tax on Income				0.521***				0.441**
				(0.171)				(0.179)
Tax on Trade				1.151***				0.852***
				(0.199)				(0.191)
Constant	-8.578***	-12.16***	-9.976***	-21.63*	25.51***	23.50***	20.82***	12.97***
	(3.270)	(2.907)	(3.014)	(11.09)	(0.678)	(0.843)	(1.039)	(2.104)
Observations	954	926	595	120	1,046	1,022	677	118
R-squared	0.419	0.443	0.534	0.662	0.312	0.311	0.364	0.614
Number of countries	93	89	62	20	85	83	59	19

*, **, and *** denote statistical significance at 10 percent, 5 percent and 1 percent level, respectively. Standard errors are reported in brackets.

Appendix 2.11. Replication results of Gupta (2007) – Panel Specific Correlation Coefficients (Verification)

Dependent variable: Tax ratio								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP per capita (log)	3.668***	4.304***	3.259***	3.543***				
	(0.365)	(0.354)	(0.395)	(1.216)				
Agriculture (% GDP)					-0.215***	-0.188***	-0.174***	-0.299***
					(0.0301)	(0.0343)	(0.0313)	(0.0686)
Import (% GDP)		0.0306	0.128***	0.0268		0.0153	0.0624**	0.0436
		(0.0220)	(0.0209)	(0.0230)		(0.0163)	(0.0297)	(0.0267)
Aid (% GDP)			-0.0169	0.0338			-0.00306	0.0792
			(0.0244)	(0.0626)			(0.0500)	(0.0669)
Debt (% GDP)			0.00674*	0.0404***			-0.00510	0.0121
			(0.00352)	(0.0151)			(0.00578)	(0.0156)
Government stability				0.275				0.348**
				(0.181)				(0.159)
Corruption				-0.297				-0.353
				(0.463)				(0.384)
Law and Order				0.173				0.403
				(0.328)				(0.350)
Tax on Goods and Services				0.577***				0.309*
				(0.143)				(0.168)
Tax on Income				0.571***				0.309*
				(0.166)				(0.166)
Tax on Trade				1.135***				0.690***
				(0.217)				(0.186)
Constant	-8.602***	-15.32***	-12.04***	-24.46**	26.21***	25.12***	23.07***	14.33***
	(2.993)	(2.636)	(2.829)	(11.11)	(0.660)	(0.860)	(1.340)	(2.159)
Observations	954	926	595	120	1,046	1,022	677	118
R-squared	0.678	0.685	0.773	0.801	0.606	0.594	0.602	0.860
Number of countries	93	89	62	20	85	83	59	19

*, **, and *** denote statistical significance at 10 percent, 5 percent and 1 percent level, respectively. Standard errors are reported in brackets.

Appendix 2.12. Replication results of Gupta (2007) – Common Correlation Coefficients (Robustness)

Dependent variable: Tax ratio								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP per capita (log)	2.330***	2.409***	1.993***	0.0881*				
	(0.207)	(0.206)	(0.197)	(0.0485)				
Agriculture (% GDP)					-0.169***	-0.162***	-0.103***	-0.00172
					(0.0117)	(0.0120)	(0.0122)	(0.00275)
Import (% GDP)		0.0166***	0.0537***	0.00266**		0.0280***	0.0555***	0.00315**
		(0.00453)	(0.00691)	(0.00122)		(0.00430)	(0.00670)	(0.00132)
Aid (% GDP)			-0.0206**	-0.00231			-0.0218**	-0.00264
			(0.00829)	(0.00159)			(0.00973)	(0.00179)
Debt (% GDP)			-0.00464***	6.78e-05			-0.00450**	1.76e-05
			(0.00143)	(0.000302)			(0.00194)	(0.000411)
Government stability				0.00737				0.00693
				(0.0124)				(0.0116)
Corruption				-0.0110				-0.0248
				(0.0348)				(0.0344)
Law and Order				-0.0305				-0.0313
				(0.0356)				(0.0331)
Tax on Goods and Services				1.045***				1.039***
				(0.0156)				(0.0159)
Tax on Income				0.969***				0.983***
				(0.0175)				(0.0166)
Tax on Trade				1.015***				1.015***
				(0.0174)				(0.0169)
Constant	-3.919**	-5.465***	-3.817**	-0.226	19.15***	17.67***	14.32***	0.515***
	(1.735)	(1.710)	(1.576)	(0.338)	(0.374)	(0.405)	(0.431)	(0.189)
Observations	3,874	3,729	2,317	1,256	4,195	4,073	2,552	1,321
R-squared	0.321	0.337	0.348	0.953	0.307	0.324	0.341	0.956
Number of countries	187	183	116	73	181	177	112	71

*, **, and *** denote statistical significance at 10 percent, 5 percent and 1 percent level, respectively. Standard errors are reported in brackets.

Appendix 2.13. Replication results of Gupta (2007) – Panel Specific Correlation Coefficients (Robustness)

Dependent variable: Tax ratio								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP per capita (log)	2.027***	2.097***	1.984***	0.00538				
	(0.169)	(0.159)	(0.197)	(0.0509)				
Agriculture (% GDP)					-0.154***	-0.145***	-0.106***	-0.00234
					(0.0117)	(0.0126)	(0.0130)	(0.00262)
Import (% GDP)		0.0202***	0.0612***	0.00529***		0.0326***	0.0622***	0.00510***
		(0.00423)	(0.00712)	(0.00116)		(0.00486)	(0.00730)	(0.00128)
Aid (% GDP)			-0.0198**	-0.00344**			-0.0237**	-0.00340*
			(0.00912)	(0.00168)			(0.0103)	(0.00190)
Debt (% GDP)			-0.00383***	-0.000193			-0.00518***	-8.41e-07
			(0.00133)	(0.000346)			(0.00191)	(0.000430)
Government stability				0.00524				0.00243
				(0.0110)				(0.0102)
Corruption				-0.0272				-0.0332
				(0.0328)				(0.0322)
Law and Order				-0.0471				-0.0378
				(0.0354)				(0.0332)
Tax on Goods and Services				1.056***				1.042***
				(0.0132)				(0.0146)
Tax on Income				0.985***				0.999***
				(0.0186)				(0.0176)
Tax on Trade				1.009***				1.020***
				(0.0197)				(0.0182)
Constant	-1.206	-2.878**	-3.451**	0.352	18.69***	16.87***	14.40***	0.431***
	(1.382)	(1.289)	(1.504)	(0.373)	(0.352)	(0.447)	(0.488)	(0.154)
Observations	3,874	3,729	2,317	1,256	4,195	4,073	2,552	1,321
R-squared	0.613	0.620	0.633	0.984	0.559	0.541	0.555	0.984
Number of countries	187	183	116	73	181	177	112	71

*, **, and *** denote statistical significance at 10 percent, 5 percent and 1 percent level, respectively. Standard errors are reported in brackets

Appendix 2.14. Parameter of the SF tax function for Non-resource dependent countries

	Verification		Robustness			
	BC–HN	**BC–TN**	**BC–HN**	**BC–TN**	**BC–HN**	**BC–TN**
GDP per capita (log)	0.523**	0.534***	-7.745*	10.66**	5.883***	2.494***
	(0.203)	(0.206)	(4.680)	(5.161)	(0.450)	(0.490)
Agriculture (% GDP)	-0.005***	-0.005***	-0.03	-0.03	0.017	-0.057
	(0.002)	(0.002)	(0.04)	(0.04)	(0.036)	(0.038)
PEE (% GDP)	0.031***	0.031***	1.268***	0.809***	1.184***	0.888***
	(0.006)	(0.006)	(0.136)	(0.142)	(0.134)	(0.134)
Trade (% GDP)	0.0006**	0.0006**	0.04***	0.005	0.037***	0.008
	(0.0002)	(0.0002)	(0.007)	(0.007)	(0.007)	(0.006)
GINI index	-0.008***	-0.008***	-0.140***	-0.125***	-0.159***	-0.128***
	(0.001)	(0.001)	(0.025)	(0.028)	(0.026)	(0.028)
GDP_pc (log)_Squared	-0.022**	-0.023**	0.772***	-0.463		
	(0.011)	(0.011)	(0.264)	(0.290)		
Constant	0.966	0.925	32.35	-16.60	-24.63***	23.90
	(0.961)	(0.968)	(20.23)	(23.33)	(5.035)	(0)
Sigma	-1.880***	-2.066***	4.273***	2.983***	4.575***	2.868***
	(0.185)	(0.455)	(0.220)	(0.180)	(0.205)	(0.151)
Gamma	3.558***	3.367***	3.196***	1.840***	3.514***	1.678***
	(0.204)	(0.475)	(0.243)	(0.226)	(0.224)	(0.192)
Mu	(omitted)	0.0892	(omitted)	20.25***	(omitted)	25.09***
		(0.184)		(5.366)		(5.152)
Eta	-0.004*	-0.004**	-0.024***	-0.002	-0.019***	-0.002
	(0.002)	(0.002)	(0.003)	(0.001)	(0.002)	(0.0008)
Observations	533	533	561	561	561	561
Number of countries	68	68	70	70	70	70
sigma2	0.153	0.127	71.73	19.75	97.01	17.60
gamma	0.972	0.967	0.961	0.863	0.971	0.843
sigma_u	0.385	0.350	8.301	4.129	9.706	3.851
sigma_v	0.065	0.065	1.679	1.645	1.675	1.664

*, **, and *** denote statistical significance at 10 percent, 5 percent and 1 percent level, respectively. Standard errors are reported in brackets. Note: HN: Half Normal, BC: Battese and Coelli, TN: Truncated Normal, PEE: Public Expenditure in Education

Appendix 2.15. Parameter of the SF Tax Function for Non-resource Dependent and Resources Dependent Countries

	Verification		Robustness			
	BC–HN	**BC–TN**	**BC–HN**	**BC–TN**	**BC–HN**	**BC–TN**
GDP per capita (log)	0.599***	0.615***	-9.203*	7.646	5.454***	2.188***
	(0.193)	(0.197)	(4.740)	(4.732)	(0.441)	(0.493)
Agriculture (% GDP)	-0.005***	-0.005***	-0.071**	-0.0758**	-0.029	-0.093***
	(0.002)	(0.002)	(0.034)	(0.036)	(0.032)	(0.033)
PEE (% GDP)	0.035***	0.034***	1.310***	0.838***	1.215***	0.857***
	(0.006)	(0.006)	(0.137)	(0.132)	(0.134)	(0.130)
Trade (% GDP)	0.0007***	0.0007***	0.028***	0.002	0.023***	0.002
	(0.0002)	(0.0003)	(0.007)	(0.006)	(0.007)	(0.006)
GINI index	-0.008***	-0.008***	-0.130***	-0.096***	-0.144***	-0.097***
	(0.001)	(0.001)	(0.024)	(0.026)	(0.026)	(0.026)
GDP_pc (log)_Squared	-0.026***	-0.027***	0.829***	-0.306		
	(0.010)	(0.011)	(0.267)	(0.266)		
Constant	0.592	0.536	41.10**	-3.334	-20.41***	20.64***
	(0.909)	(0.923)	(20.47)	(20.87)	(4.878)	(6.686)
Sigma	-1.888***	-2.171***	4.332***	3.161***	4.647***	3.127***
	(0.181)	(0.417)	(0.205)	(0.146)	(0.187)	(0.136)
Gamma	3.487***	3.196***	2.938***	1.723***	3.279***	1.677***
	(0.200)	(0.437)	(0.232)	(0.188)	(0.209)	(0.174)
Mu	(omitted)	0.132	(omitted)	20.66***	(omitted)	20.52***
		(0.158)		(2.212)		(3.569)
Eta	-0.003	-0.003	-0.018***	-0.0007	-0.014***	-0009
	(0.002)	(0.002)	(0.003)	(0.001)	(0.002)	(0.001)
Observations	566	566	681	681	681	681
Number of countries	73	73	95	95	95	95
sigma2	0.151	0.114	76.13	23.59	104.3	22.82
gamma	0.970	0.961	0.950	0.849	0.964	0.842
sigma_u	0.383	0.331	8.503	4.474	10.03	4.384
sigma_v	0.067	0.067	1.957	1.890	1.946	1.896

*, **, and *** denote statistical significance at 10 percent, 5 percent and 1 percent level, respectively. Standard errors are reported in brackets. Note: HN: Half Normal, BC: Battese and Coelli, TN: Truncated Normal, PEE: Public Expenditure in Education

Chapter 3. Fiscal Resilience Building: Insights from a New Tax Revenue Diversification Index*

*A version of this chapter, co-authored with R. Ouedraogo, N. Mousse Sow, and R. Tapsoba, was published in IMF Working Paper Series and is currently under review in *Journal of Public Economics*.

3.1. Introduction

Securing stable domestic resources is part of the multiple objectives of tax policy. Strengthening resilience to fiscal risks arising from government revenue volatility is critical for ensuring a sustainable delivery of public services throughout different phases of the business cycle. A large body of the literature shows that government revenue volatility weighs on economic growth and welfare, including through its adverse effects on the stability of public spending (Bleaney *et al.*, 1995; Furceri, 2007; and Loayza *et al.*, 2007). Delinking public spending from revenue volatility, through the implementation of rules-based fiscal frameworks, is referred to as a credible option for indirectly strengthening resilience to government revenue volatility (IMF, 2009; and Budina *et al.*, 2012). Although not analytically grounded, a long-held intuitive view suggests that tax revenue diversification, that is the reliance on more diversified sources for levying revenue, can serve as an alternative for tackling more directly the root causes of government revenue volatility. The basic tenet is that given the responsiveness to the business cycle fluctuations varies across taxes, relying on a more diversified portfolio of tax streams makes the government's overall tax revenue less subject to as large volatility as compared to relying on a concentrated portfolio of taxes sources.

But is this long-held intuitive view borne out by the data? A few existing studies find evidence supportive of the view that greater tax diversification is conducive to lower revenue shortfalls during recessions (Suyderhound, 1994; and Carroll, 2005) and lower tax revenue volatility (Schunk and Porka, 2005). But other studies found limited evidence supportive of this view in the US during the recent Great Recession (Kilby, 2014). That said, all these few existing studies relied on Herfindahl-Hirschman (HHI)-based revenue diversification indices computed at the state level for the US. Other studies captured tax diversification indirectly, including through the share of tax revenue coming from the extractive sector (see *e.g.*, IMF, 2016).

This chapter refreshes the literature by proposing a new cross-country tax revenue diversification index (RDI). To the best of our knowledge, this is the first study to construct a homogenous cross-country dataset directly capturing the diversification of tax sources structure. Our proposed RDI is computed at the national level, covering a broad panel of 127

countries over 2000-2015, based on data availability. We focus on tax revenue, leaving non-tax revenues aside, as non-tax revenues are not primarily designed for revenue-enhancing purposes, but rather to get consumers' incentives right. The construction of the RDI rests on six major categories of taxes, as reported in the GFSM 2014, namely corporate income tax (CIT), personal income tax (PIT), property tax, tax on goods and services, tax on international trade, and other taxes. Another novelty of the paper is that our RDI builds on the Theil index (as opposed to the HHI), which offers more interesting properties, notably in terms of stability and robustness to outliers. Finally, this paper sheds light not only on the stability-enhancing role of tax revenue diversification but also on the RDI drivers.

Key stylized facts stand out on the RDI dynamics. On average, AEs relied on more a diversified structure of tax sources than EMEs and LIDCs, by as high as the double in terms of RDI over the period 2000-2015. Resources-rich countries and fragile states exhibit the most concentrated structure of tax sources, reflecting their over-dependence on commodity revenues and weak tax administration capacity, respectively. Regional disparities in the RDI are also noticeable, with North American and EU countries exhibiting the most diversified taxation sources, while GCC, South Asian, Latin American, and Sub-Saharan African countries present the least diversified revenue streams.

We also uncover the following results from our econometric analyses. First, the RDI exhibits high persistency over time, with up to 60-74 percent of the current level of RDI predicted by its lagged value. Second, our empirical investigations suggest that tax revenue diversification is not just a reflection of economic diversification, but also the outcome of macroeconomic, political and institutional factors. A non-monotone relationship is also at play between the RDI and economic development, with countries' portfolio of tax sources getting more diversified as their institutions and tax administration capacity keep improving, until a tipping point, where richer countries start finding it more difficult to diversify further their sources of tax revenue. Third, and not the least, our findings lend support to the long-held view that tax revenue diversification matters a great deal for mitigating government revenue volatility. And it does not stop there: tax revenue diversification also improves tax revenue collection.

The remainder of the chapter is structured as follows. Section 2 introduces the data, while section 3 lays out the detailed steps of the construction of the RDI, and highlights key patterns standing out from the RDI, along with a few pair-wise correlations. Section 4 explores the drivers of the RDI, while section 5 assesses its effects on both volatility and level of government revenue. Section 6 presents some concluding remarks.

3.2. Data

3.2.1. The GFS database

Our sample covers 127 countries from all regions and across all income groups, based on data availability over the period 2000-15. It is made up of 47 advanced economies (AEs), 31 Emerging Market Economies (EMEs), and 49 low-income developing countries (LIDCs). 25 are from Sub-Saharan Africa (SSA), two from North America (NA), 7 from South Asia (SA), 19 from Latin America & the Caribbean (LAC), 14 from the Middle East & North Africa (MENA) of which 5 from the Gulf Cooperation Council (GCC), 21 from East Asia & Pacific (EAP), and 39 from Europe & Central Asia (ECA) (See Appendix 3.1).

We rely on the IMF's Government Financial Statistics (GFS) dataset to extract tax revenue data. The GFS dataset provides detailed public finance data in line with international standards (GFSM 2014), thus allowing for comparability across countries and over time (Aldasoro and Seiferling, 2014). The GFSM 2014 represents the latest internationally accepted methodology for compiling government finance statistics in a systematic manner, with well-established definitions and classifications.

The GFS presents additional appealing features. First, data from the GFS are actual, not estimates or projections as in the IMF's WEO. Second, unlike alternative databases (WEO, ICTD), the GFS provides the most detailed classification of government's tax revenues for a large coverage across countries and over time. Third, the GFS is compiled by the IMF's Statistics

Department, which ensures consistency across countries, the quality and the accuracy of data under a common methodology for all countries.[47]

3.2.2 Tax revenue components

The GFS provides the most comprehensive and detailed cross-country data in a uniform format. Table 3.1 below provides an overview of tax revenue classification along the GFSM 2014 format.[48]

Given data limitations, notably for LIDCs, we restrict data disaggregation to a level that ensures a reasonably large but homogenous sample. We focus on tier-3 of tax revenue disaggregation, which encompasses taxes on income, profits and capital gains, payroll and workforce, on property, goods and services, international trade and transactions, and other taxes. We exclude social contributions and grants, as they do not meet the definition of a tax.[49] Taxes are expressed in percent of GDP and are regrouped in two blocks: (i) direct taxes, which include taxes on income, profits, property, and on capital gains for both individuals and corporations, and (ii) indirect taxes, consisting of taxes on goods and services, taxes on international trade and transactions, and other taxes.[50]

[47] Despite these differences across databanks, their associated data are highly correlated: the correlation coefficient of total tax revenue between the GFS and the WEO is 0.92, and 0.93 between the GFS and the ICTD.

[48] GFSM 2014, pp. 88.

[49] Social contributions are actual or imputed revenue receivable by social insurance schemes to make provision for social insurance benefits payable, while grants are transfers receivable by government units, from other resident or nonresident government units or international organizations (GFSM, 2014).

[50] Full definition of each category of tax can be found in the Government Finance Statistics Manual (2014).

Table 3.1. Classification of Tax Revenues

11	Taxes
111	Taxes on income, profits, and capital gains
1111	Payable by individuals
1112	Payable by corporations and other enterprises
1113	Other taxes on income, profits, and capital gains
112	Taxes on payroll and workforce
113	Taxes on property
1131	Recurrent taxes on immovable property
1132	Recurrent taxes on net wealth
1133	Estate, inheritance, and gift taxes
1135	Capital levies
1136	Other recurrent taxes on property
114	Taxes on goods and services
1141	General taxes on goods and services
11411	Value-added taxes
11412	Sales taxes
11413	Turnover and other general taxes on goods and services
11414	Taxes on financial and capital transactions
1142	Excise
1143	Profits of fiscal monopolies
1144	Taxes on specific services
1145	Taxes on use of goods and on permission to use goods or perform activities
11451	Motor vehicle taxes
11452	Other taxes on use of goods and on permission to use goods or perform activities
1146	Other taxes on goods and services
115	Taxes on international trade and transactions
1151	Customs and other import duties
1152	Taxes on exports
1153	Profits of export or import monopolies
1154	Exchange profits
1155	Exchange taxes
1156	Other taxes on international trade and transactions
116	Other taxes
1161	Payable solely by business
1162	Payable by other than business or unidentifiable

Source: GFSM 2014

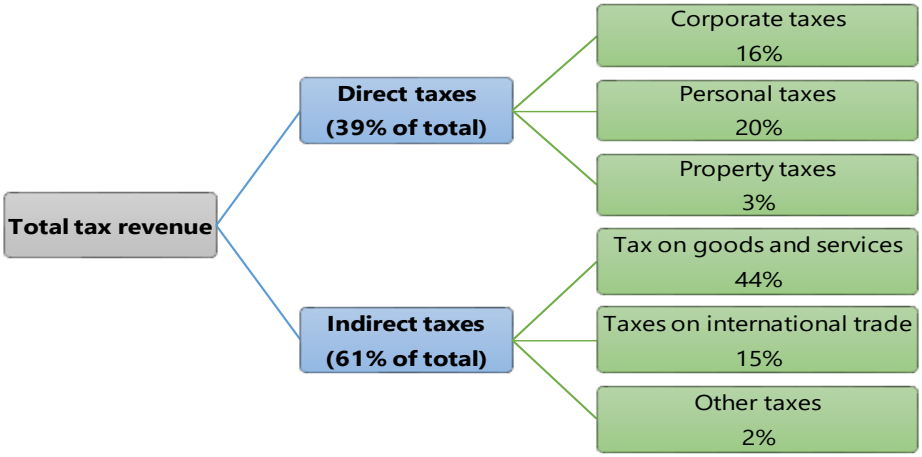
3.2.3. Dealing with Missing Data

We fill missing observations in the GFS using available data from the IMF's Worldwide Revenue Database. We take great care at ensuring consistency between these data and our baseline dataset (GFS). To this end, we first check whether the historical data available in both databases match. Then, we make sure that filling the missing data does not lead to inconsistencies in the resulting database. Particularly, we refrain from filling a gap when this is likely to result in a substantial discrepancy between the total tax figure and the sum of the sub-components. Appendix 3.3 provides an overview of the missing observations that were filled with data from the IMF's Worldwide Revenue Database.

3.2.4. Composition of tax revenues

Figure 3.1 below provides a snapshot of the different tax categories, along with their relative share during 2000-2015 (full sample average values). Indirect taxes (notably taxes on goods and services) stand as the largest tax component, accounting for about 60 percent of total taxes, against 40 percent for direct taxes. This pattern reflects the growing reliance on tax on goods and services over the past two decades (160 countries are currently using some forms of VAT), most likely owing to its relative ease of administration and its economic neutrality.[51]

Figure 3.1. Composition of Tax Revenues, 2000-15



Source: GFS, and authors' calculations

Table 3.2 provides more detailed trends on tax revenue and its associated components. Not surprisingly, on average, tax revenue is higher in AEs (25 percent of GDP), more than twice the level in developing countries. Non-resource-rich countries and non-fragile states mobilize larger tax revenue (20.2 and 19.7 percent of GDP, respectively) compared to their resource-rich and fragile peers (11.6 and 14.8 percent of GDP, respectively).[52] Surprisingly, small states mobilize greater tax revenue than their non-small peers (20.4 and 18.8 percent, respectively). This could be explained by a "*size effect*", in that smaller states tend to be easier to administer, from a tax collection and administration standpoint.

[51] The VAT was first introduced in France in 1954.

[52] The low level of tax revenue in non-OECD high-income countries owes much to the fact these are mostly oil-exporting countries.

Table 3.2. Descriptive Statistics of Tax Revenues (Percent of GDP)

	Total taxes	Corporate tax	Personal tax	Property tax	Tax on goods & services	Tax on international trade	Other taxes
Full sample	19.0	2.9	4.3	0.5	8.5	2.5	0.3
By income level							
High income: OECD	25.8	3.1	9.3	1.3	11.6	0.1	0.3
High income: non-OECD	15.6	2.5	2.5	0.4	7.3	2.3	0.4
Upper middle income	19.4	3.7	2.5	0.3	8.7	3.7	0.3
Lower middle income	16.8	2.9	2.3	0.2	7.2	3.4	0.4
Low income	11.2	1.6	1.4	0.0	5.5	2.5	0.2
By region							
EU	25.3	2.7	9.0	1.0	12.3	0.1	0.3
Non-EU and CA	21.0	2.7	4.8	0.5	10.2	2.3	0.2
NA	19.1	2.7	3.2	10.8	2.1	0.2	0.0
EAP	19.2	2.8	4.4	0.8	8.6	1.5	0.4
LAC	16.9	2.4	1.9	0.4	7.5	4.1	0.3
MENA: Non-GCC	18.9	4.7	2.8	0.3	8.5	1.6	0.8
MENA: GCC	5.8	2.9	0.2	0.0	1.8	0.9	0.0
SA	10.6	2.2	0.8	0.0	4.7	2.7	0.2
SSA	18.2	3.6	2.4	0.1	6.1	5.8	0.3
By size							
Small states	20.4	3.0	3.5	0.3	7.3	6.1	0.3
Non-small states	18.8	2.9	4.5	0.6	8.9	1.3	0.3
Fragility status							
Fragile states	11.6	1.8	1.9	0.3	4.4	3.2	0.6
Non-fragile states	19.7	3.0	4.4	0.5	8.8	2.4	0.3
Natural resource endowment							
Resource rich countries	14.9	5.2	1.8	0.2	5.4	1.6	0.5
Non-resource rich countries	20.2	2.6	4.8	0.6	9.2	2.5	0.3

Source: GFS, and authors' calculations

3.3. Construction of the RDI

3.3.1. Methodological Approach

Our RDI is based on the Theil index approach. The Theil's entropy index (Theil, 1972) is preferred to the HHI (Hirschman, 1964), as it features more appealing properties, notably in terms of stability and robustness to outliers. The Theil index has been proven to be more stable regardless of the level of disaggregation, given it incorporates the *within* and *between* components, and is more adapted to grouped data (World Bank, 2014). For instance, in exports diversification analysis, the Theil index can be computed along export lines and split up additively into between-groups and within-groups components (Cadot *et al*., 2011). In addition, for income distribution analysis, the Theil index allows decomposing inequality into the part that is due to inequality within areas (*e.g*., urban, rural) and the part that is due to differences

between areas (*e.g.*, the rural-urban income gap). The main drawback of the HHI relates to its instability and sensitivity to the level of disaggregation, as it assigns greater weight to the larger categories. Furthermore, the HHI underestimates the values of small categories, as it uses the square terms, which can be quite problematic for analyzing tax revenue patterns, as any percentage point of additional revenue can make a significant difference in thousands of people's lives.[53] These appealing properties of the Theil index go a long way to explaining its growing popularity in recent studies, including on exports diversification (*e.g.*, Cadot *et al.*, 2011; Papageorgiou and Spatafora, 2012).

We use the Theil index formula to calculate the RDI, as follows:

$$T = \frac{1}{n}\sum_{i=1}^{n}\frac{Tax_i}{\mu} \times log\left(\frac{Tax_i}{\mu}\right) \quad (3.1)$$

T refers to the Theil index; Tax_i to a specific direct or indirect tax subcomponent (corporate income tax, personal income tax, or taxes on goods and services), and $\mu = \frac{1}{n}\sum_{i=1}^{n} tax_i$ is the average of the tax subcomponent into consideration. T is a measure of concentration, with a higher value of T referring to a more concentrated structure of tax sources, or a lower diversification of tax revenue. Given the construction of the RDI rests on six categories of taxes, the resulting Theil index will vary between 0 (perfect diversification) and 1.8 (reliance on one type of tax only).[54]

3.3.2. Results

3.3.2.1. Stylized Facts

We highlight key patterns standing out of the RDI. As discussed above, the higher the RDI, the stronger the concentration structure of tax sources. The full sample average RDI stands at 0.51 (Figure 3.2). Japan records the lowest RDI (0.05), while the Kingdom of Bahrain records the

[53] For robustness purposes, we compute an HHI-based RDI (see Appendix 3.6), which turns out highly correlated with the Theil-based (correlation coefficient of 0.98). For a comprehensive review of possible approaches for computing concentration indexes, see Roberts (2014).

[54] The maximum value of the Theil index is *ln (n)*, with *n* referring to the number of considered tax categories.

highest RDI (1.39), thus standing as the country with the most and least diversified structure of tax sources, respectively.

Table 3.3 provides an RDI-based country ranking over the period 2000-2015. The top 5 countries with the most diversified structure of tax sources belong to the AEs and EMEs, while the bottom 5 countries are either commodity-dependent or fragile/small countries. Over the most recent period (2010-2015), Japan emerges as the top performer in terms of tax revenue diversification (RDI of 0.06), followed by France and the United Kingdom (RDI of 0.15 and 0.17, respectively). Bolivia, Kuwait, and Anguilla display the least diversified structure of tax sources (RDI of 1.34, 1.34 and 1.32, respectively). These least diversified economies tend to rely mostly on taxes on goods and services, and international trade.

Table 3.3. An excerpt of RDI-based Country Ranking[55]

2000-2004			2005-2009			2010-2015		
Rank	**Country**	**RDI**	**Rank**	**Country**	**RDI**	**Rank**	**Country**	**RDI**
1	Japan	0.053	1	Japan	0.055	1	Japan	0.057
2	France	0.160	2	United Kingdom	0.140	2	France	0.153
3	United Kingdom	0.167	3	France	0.149	3	United Kingdom	0.172
4	United States	0.188	4	United States	0.156	4	United States	0.176
5	South Africa	0.192	5	Switzerland	0.182	5	South Africa	0.178
...	...	...	...	...	...	...	...	...
95	Bolivia	1.040	113	Maldives	1.141	120	Bahrain, Kingdom of	1.169
96	Bahamas, The	1.203	114	Bahamas, The	1.162	121	United Arab Emirates	1.218
97	Maldives	1.213	115	Qatar	1.173	122	Anguilla	1.317
98	Qatar	1.215	116	Anguilla	1.350	213	Kuwait	1.336
99	Anguilla	1.340	117	Burkina Faso	1.350	124	Bolivia	1.336

Source: Authors' calculations.

3.3.2.2. Geographical Distribution of RDI

Significant differences emerge across regions (Figure 3.2.b). NA and EU exhibit the lowest RDI (below the full sample average), while the GCC, LAC and SSA record the highest RDI. This points to lower tax revenue diversification in these latter compared to the former groups.

The RDI also varies by income levels. Figure 3.2.a shows that OECD countries have the most diversified structure of tax sources, followed by middle-income countries. High-income non-OECD and low-income countries record the highest RDI, meaning that they have the most

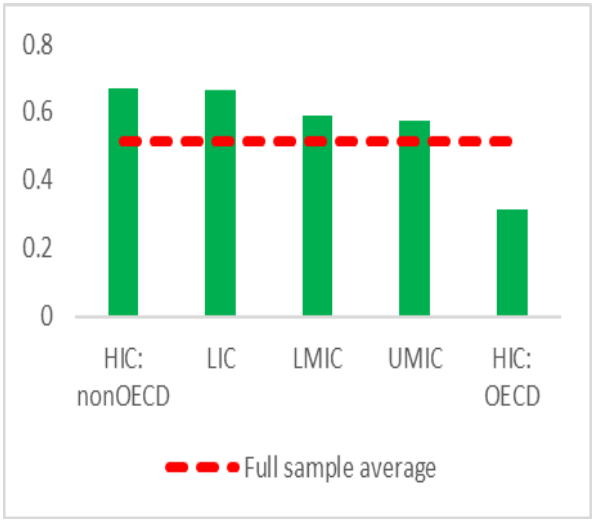
[55] The full RDI-based country ranking can be found in Appendix 3.4.

concentrated structure of tax sources. Overall, tax revenue diversification appears positively correlated with countries' level of development, as confirmed by Figure 3.3, which shows that the concentration of tax revenue decreases as per capita GDP increases.

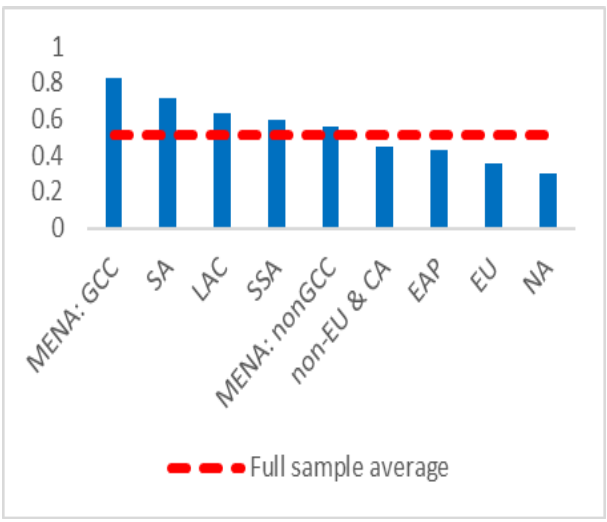
Fragile countries, small states, and resource-rich countries feature more concentrated structure of tax sources. This may stem from the fact that fragile countries face structural impediments, including conflicts, which makes it harder to effectively administer diverse tax revenue streams (Figure 3.2.c). Small States tend to specialize in a few economic activities, thus limiting their ability to diversify their sources of tax revenue (Figure 3.2.c). Small and fragile countries mostly rely on taxes on international trade as a major source of government revenue (see Table 3.2). Finally, resource-rich countries have RDI standing above the full sample average, and higher than their non-natural resource rich peers (Figure 3.2.d). This implies that resources-dependent countries have more concentrated portfolios of tax revenue streams, owing, among other factors, to weak incentives to diversify away from the resource bonanza. Tax revenue in these countries mostly comes from corporate income taxes from the resource exploitation.

Figure 3.2. RDI by Region, Income Group, Fragility Status and Size (Average Values)

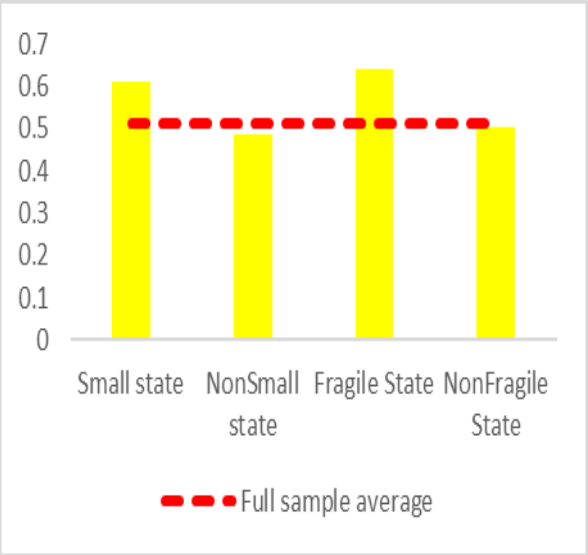
3.2.a. RDI by Region



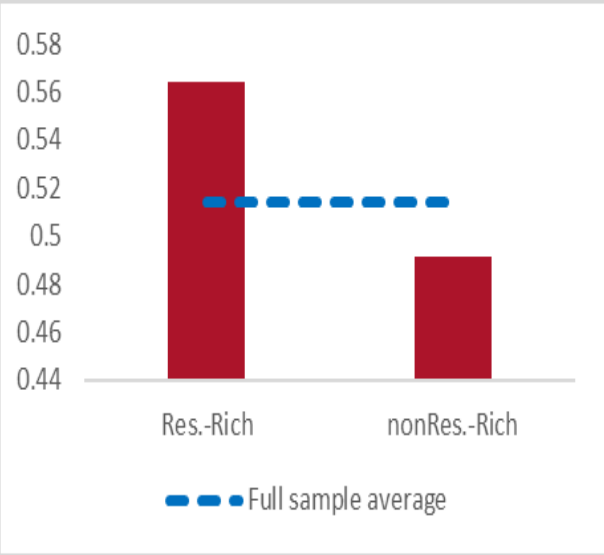
3.2.b. RDI by Income Group



3.2.c. RDI by Fragility Criteria & Country Size

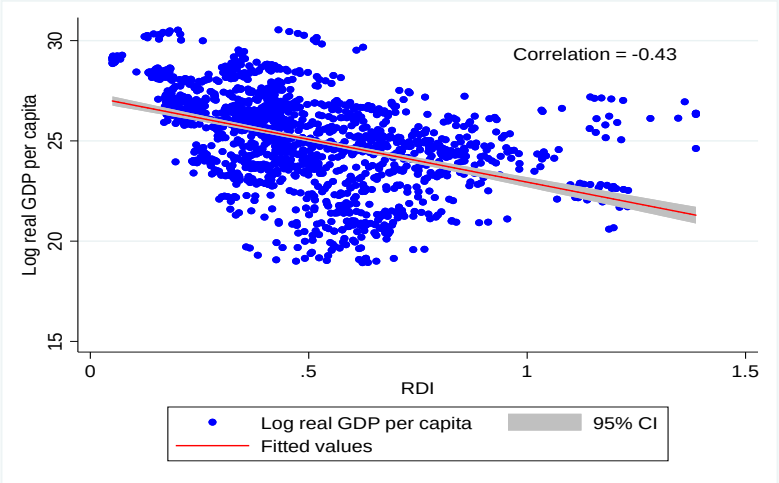


3.2.d. RDI by Resource-rich Criteria



Source: Authors' calculations. Note: SA stands for South Asia, LAC for Latin America and Caribbean, SSA for sub-Saharan Africa, MENA for Middle East and North Africa, EU for European Union, NA for North America, CA for Central Asia; GCC for Golf Cooperation Council. HIC stands for high-income country, LIC for low-income country, LMIC for lower middle-income country, UMIC for upper middle-income country, and OECD for Organization for Economic Cooperation and Development.

Figure 3.3. Correlation between Per Capita GDP and RDI



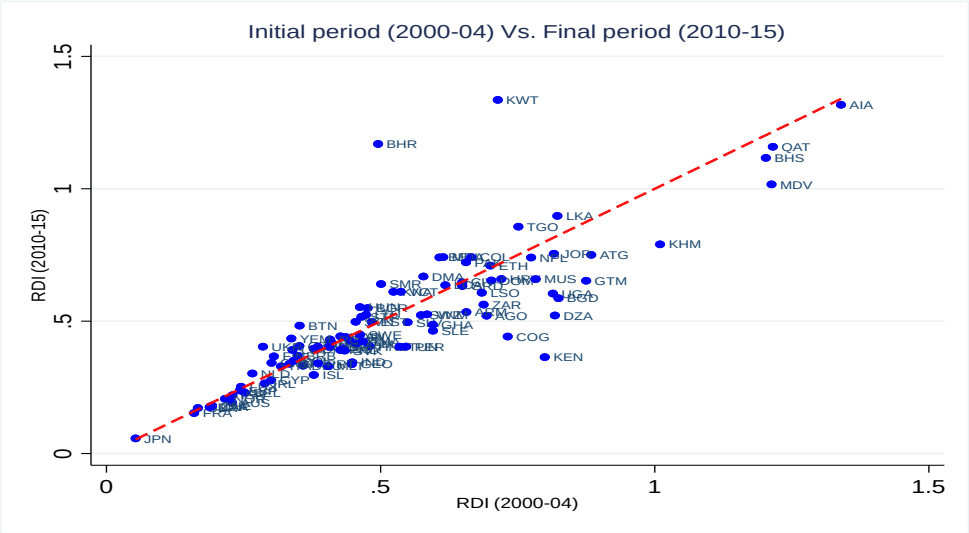
Source: WEO and authors' calculations

3.3.2.3. RDI Over Time

Figure 3.4 plots the evolution of the RDI between the initial (2000-2004) and final period (2010-2015). While some countries diversified their structure of tax sources over time, particularly AEs and some EMEs (Austria, Denmark, France, Germany, Japan, Morocco and South Africa), others displayed a more concentrated structure of tax sources in recent years (Kuwait, Bahrain and Sri Lanka). Another set of countries experienced mixed diversification patterns. While their RDI

remains below the sample average, it shrunk over time (Bhutan, Dominica, Estonia, Finland, Netherlands). Finally, some countries diversified their taxation sources (Algeria, Côte d'Ivoire, Ghana, Kenya, Mauritius and Uganda).

Figure 3.4. RDI Over Time



Source: GFS and authors' calculations

3.3.3. Putting the RDI in Perspective with Macroeconomic Developments

We provide preliminary correlations between the RDI and key macroeconomic variables, such as total tax revenue and its volatility, spending volatility, growth volatility, income inequality and exports concentration (Figure 3.5).[56] The following patterns stand out:

- Concentrated structure of tax sources is associated with both lower tax revenue (Figure 3.5.a) and greater volatility – tax revenue, growth, and spending (Figure 3.5.b, 3.5.c, and 3.5.d, respectively). This seems in line with the intuitive view that a more diversified portfolio of tax revenue streams helps strengthen fiscal resilience to government revenue volatility.

- The RDI is correlated with export diversification (Figure 3.5.f), which also proxies for the level of economic diversification. This may stem from the fact that various taxes from

[56] Volatility is captured through the standard deviation of each variable.

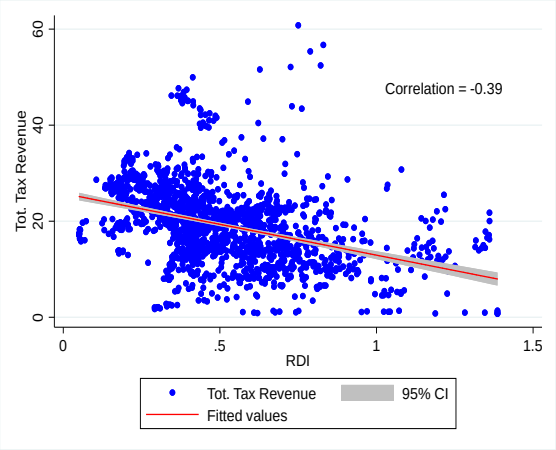
export-related activities, including from the mining sector, accounts for a big chunk of government revenue in many countries, particularly in LIDCs (Table 3.2).

- Concentrated tax revenue is correlated with income inequality (Figure 3.5.e). A possible explanation is that the more concentrated the tax sources structure, the more likely its incidence gets unequally distributed within the population. This may also suggest that in countries with weak institutions, corrupt leaders may impose highly unequal redistribution of wealth, which in turn translates into more concentrated tax sources structure.

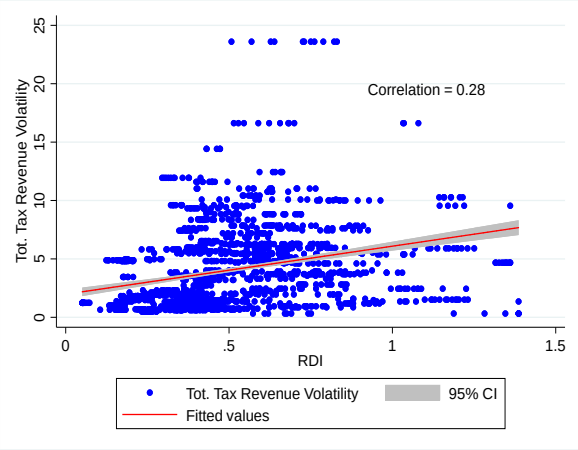
- Tax revenue concentration is negatively associated with tax collection efficiency (Figure 3.5.h) and taxpayer's compliance (Figure 6.g), suggesting that the diversification of tax sources and the capacity to administer tax compliance might be mutually-reinforcing.

Figure 3.5. Correlation between the RDI and Key Macroeconomic Variables, 2000-2015

3.5.a. RDI and Tax Revenue

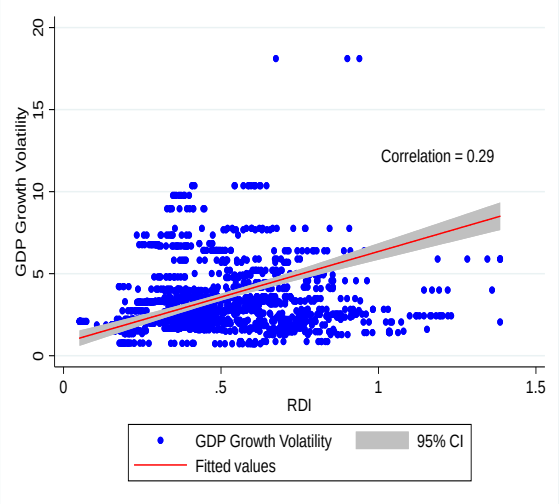


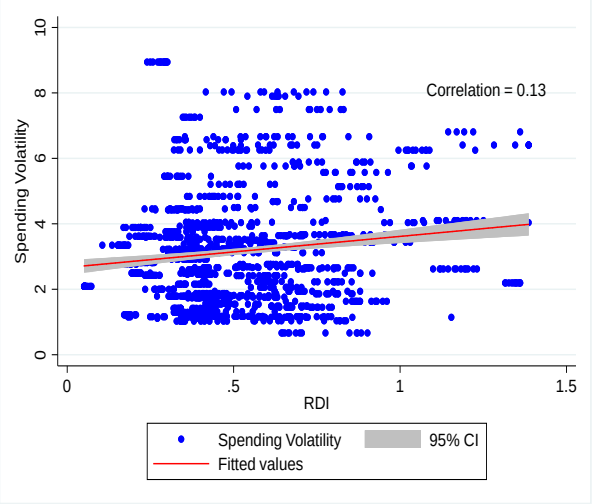
3.5.b. RDI and Tax Revenue Volatility



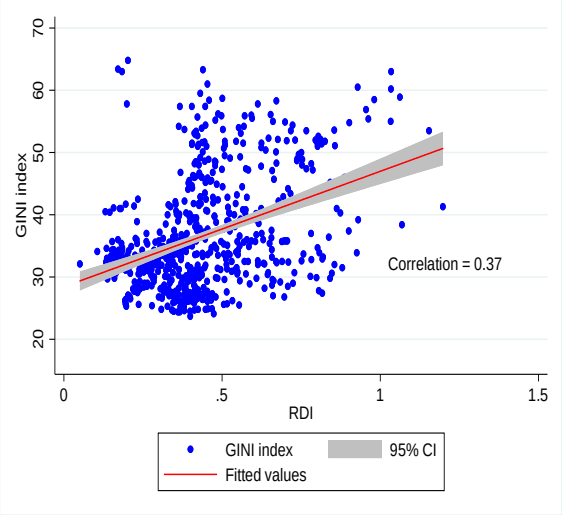
3.5.c. RDI and GDP Growth Volatility

3.5.d. RDI and Spending Volatility

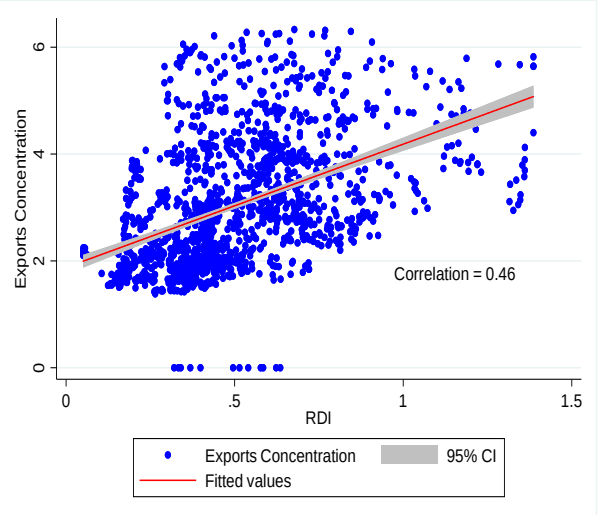




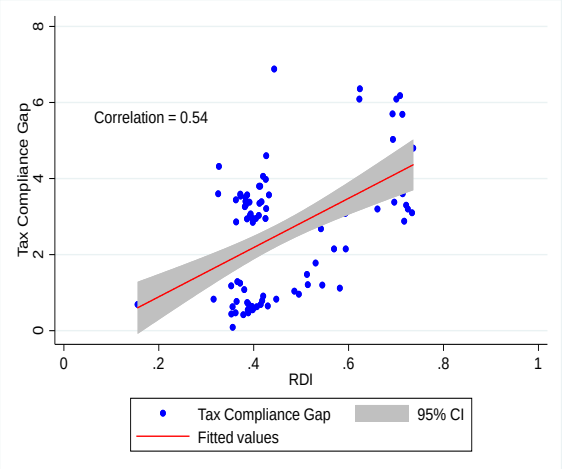
3.5.e. RDI and Income Inequality



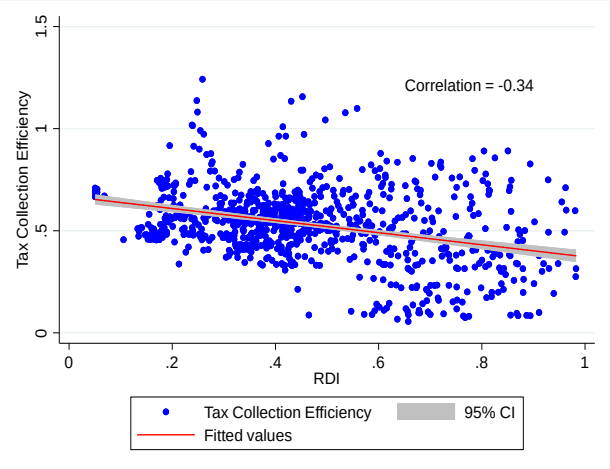
3.5.f. RDI and Export Concentration



3.5.g. RDI and Tax Compliance Gap



3.5.h. RDI and Tax Collection Efficiency



Source: Authors' calculations

3.4. Drivers of Tax Revenue Diversification: An Econometric Analysis

We turn now onto assessing the key drivers of cross-country variations in the RDI. We carry out panel regressions linking the RDI to potential explanatory variables, using the full sample over the period 2000-15. The following econometric specification is considered.

$$RDI_{it} = \alpha + \beta RDI_{i,t-1} + \gamma X_{i,t-1} + \lambda K_{i,t-1} + \sum_{k=1}^{K} \varphi_k Z_{k,i,t-1} + \eta_i + \varepsilon_{it} \quad (3.2)$$

Revenue diversification index (RDI) is the dependent variable, and three sets of potential covariates are considered drawing on the existing related literature (*e.g.,* Murphy *et al*., 1993; Acemoglu and Zilibotti, 1997; Agosin *et al*., 2012; Ahmadov, 2012; Elhiraika *et al*., 2014; Cuberes and Jerzmanowski, 2009; Malik and Temple, 2009; Klinger and Lederman, 2010; Starosta de Waldemar, 2010 among others): (i) factors capturing the country economic structure (X_{it}); (ii) variables reflecting the macroeconomic (domestic and external) environment ($K_{i,t}$); and (iii) factors featuring countries' political and institutional context along with their development status ($Z_{k,it}$).[57] We run dynamic panel regressions using system-GMM estimators, to better address likely endogeneity problems while accounting for the persistency in the RDI over time. All covariates are introduced with one-year lag, to account for likely delays in the influence of these variables on the RDI, and to mitigate likely reverse causality bias.

Table 3.4 reports the estimates of the RDI drivers, focusing first on the role of the structure of the economy and the macroeconomic environment.[58] Before going any further, it is worth signaling that the RDI exhibits high persistency over time, as captured by the strongly significant coefficient associated with the lagged RDI variable. Up to 60-74 percent of the current level of tax diversification is predicted by its lagged value, suggesting a strong inertia in the RDI dynamics.

[57] Detailed definitions and sources of all variables can be found in Appendix 3.2.

[58] The regressions passed the standard diagnostic tests for the validity of instruments – the AR (2) test for the absence of second-order autocorrelation of the error term and Hansen's overidentification test.

Countries' level of development (proxied by per capita real GDP) has a significant non-linear impact on their ability to diversify their tax revenue sources. There is a significant inverted U-shaped relationship between per capita real GDP and the RDI. The coefficient associated with per capita real GDP is negative, while the coefficient associated with its squared term is positive. This suggests that countries' level of tax revenue diversification tends to increase as their economy develops. Insofar as they strengthen their institutional framework and improve tax administration capacity, until they reach a tipping point beyond which further diversification of tax revenue becomes harder.[59] This somehow reflects the specialization on a few high skills-based economic activities that characterize some AE's growth model (*e.g.*, shifting to an innovation-based growth model).

The structure of the economy matters for shaping a country's tax revenue diversification. First, a less diversified economy, proxied by the export concentration index, is conducive to a more concentrated structure of tax revenue. Columns 2-9 show that higher export concentration goes hand-in-hand with higher tax revenue concentration, as reflected by the positive and significant coefficient associated with the export concentration index. Second, there is also suggestive evidence of some form of "natural resources curse" being at play, as captured by the positive and statistically significant coefficient associated with natural resource rents (column 3). This suggests that countries with larger natural resource endowments face less incentives to diversify their structure of taxation sources. Indeed, most resource-rich countries tend to over-rely on the resource bonanza –the GCC countries for example introduced the VAT for the first time in 2018, amid the recent oil price shocks. Third, the coefficient associated with per capita official development assistance is positive and statistically significant (column 4). This suggests a stronger dependence to donor support weakens policymakers' incentives to diversify taxation sources, bringing to the data long-held views about moral hazard in domestic revenue mobilization in contexts of dependence to public aid, notably unconditional grants (Thornton, 2014). Fourth, a larger informal sector makes it harder to identify taxpayers and assess their compliance, thus rendering more arduous any steps to bring taxpayers into the tax net (column 5).

[59] The average per capita GDP threshold level is $ 4222, corresponding broadly to the current levels recorded by countries such as Georgia, and Tunisia.

Table 3.4. Macroeconomic and Structural Drivers of RDI, 2000-2015

Dependent variable: *Revenue diversification index (RDI)*									
	Baseline estimates and additional controls								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$RDI_{(t-1)}$	0.679***	0.604***	0.599***	0.737***	0.683***	0.598***	0.608***	0.619***	0.610***
	(0.061)	(0.019)	(0.018)	(0.030)	(0.029)	(0.015)	(0.019)	(0.018)	(0.011)
Log real $GDP\_pc_{(t-1)}$	-0.460*	-0.395***	-0.450***	-0.274*	-0.539**	-0.533***	-0.336**	-0.308**	-0.786***
	(0.255)	(0.144)	(0.143)	(0.165)	(0.249)	(0.133)	(0.137)	(0.148)	(0.080)
Log real $GDP\_pc\_squared_{(t-1)}$	0.025*	0.025***	0.028***	0.017	0.037**	0.034***	0.022**	0.021**	0.050***
	(0.014)	(0.009)	(0.009)	(0.011)	(0.016)	(0.008)	(0.009)	(0.009)	(0.005)
Financial $development_{(t-1)}$		-0.381***	-0.349**	0.079	-0.653**	-0.523***	-0.371***	-0.492***	-0.721***
		(0.139)	(0.149)	(0.166)	(0.273)	(0.143)	(0.135)	(0.158)	(0.115)
Trade $openness_{(t-1)}$		-0.026	-0.015	0.011	-0.033	-0.037	-0.022	-0.038	-0.049**
		(0.025)	(0.028)	(0.018)	(0.044)	(0.023)	(0.025)	(0.025)	(0.021)
Export concentration $index_{(t-1)}$		0.018**	0.013*	0.008	0.007	0.012	0.015*	0.023*	0.014*
		(0.009)	(0.008)	(0.005)	(0.023)	(0.009)	(0.008)	(0.013)	(0.008)
Natural resource $rents_{(t-1)}$			0.272**						
			(0.125)						
Log net ODA $received\_pc_{(t-1)}$				0.011**					
				(0.005)					
Log of informal $share_{(t-1)}$					0.137*				
					(0.080)				
Log of inflation $rate_{(t-1)}$						0.010*			
						(0.005)			
De jure globalization $index_{(t-1)}$							-0.018		
							(0.061)		
Human capital $index_{(t-1)}$								-0.037	
								(0.036)	
IMF program dummy									-0.017*
									(0.009)
Constant	2.163*	1.734***	1.965***	1.106*	1.742*	2.335***	1.572**	1.441**	3.387***
	(1.111)	(0.594)	(0.594)	(0.641)	(0.911)	(0.553)	(0.614)	(0.613)	(0.351)
Nb. of observations	1218	1141	1141	639	943	1061	1141	960	1125
Countries	104	97	97	65	83	95	97	79	94
AR(1)	0.06	0.09	0.09	0.00	0.08	0.10	0.09	0.09	0.09
AR(2) *p-value*	0.31	0.30	0.30	0.20	0.27	0.28	0.30	0.31	0.30
Hansen OID (*p-value)*	0.58	0.15	0.15	0.71	0.88	0.37	0.17	0.34	0.16
Nb. of instruments	29	58	59	53	48	61	59	59	72
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Region FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

*, **, and *** denote statistical significance at 10 percent, 5 percent and 1 percent level, respectively. Standard errors are reported in brackets. Note: Our measure of revenue diversification (RDI) is considered endogenous, along with the GDP per capita, its squared term, and the financial development variables. These endogenous variables are instrumented using their own respective lags. We follow Roodman (2009) and collapse the number of instruments to avoid the overidentification problem. In all specifications, we reject the null of the AR (1) test of no autocorrelation in the error terms. Thus, lagged variables can be safely used as instruments. Hansen's p-value robust to heteroskedasticity and autocorrelation validates the over-identification restrictions. The remaining variables are considered exogenous.

Macroeconomic conditions play a role in countries' tax revenue diversification patterns.[60] First, larger trade openness is positively correlated with greater tax revenue diversification. The coefficients associated with trade openness (columns 2-9) are negative, though statistically insignificant in most cases. Second, greater macroeconomic instability (proxied by inflation) is also found to be associated with lower tax diversification (column 6). This may point to the macroeconomic uncertainties brought about by greater instability, which ultimately results in

[60] The statistical significance of the coefficients associated with the degree of globalization and human capital (columns 7-8) is weak.

the instability of the tax revenue, and likely its shrinkage. Third, the coefficient associated with financial development is significantly negative (columns 2 to 9). This suggests that deeper financial systems may allow for greater formalization of the economy, which in turn makes it easier to broaden the portfolio of tax revenue streams (Medina *et al*., 2017). Fourth, having an IMF-supported program may also help diversify the structure of tax sources. This may reflect countries' efforts to improve revenue collection performance under IMF-supported programs (column 9).

There are significant heterogeneities across income levels and regions (Table 3.5). Compared with AEs, LIDCs and EMEs have more room to diversify further their portfolio of tax revenue streams (column 2), insofar as they strengthen their institutional framework and improve their tax administration capacity (Gaspar *et al*., 2016; and Akanbi and Akitoby, 2018). Column 1 confirms the regional disparities in RDI, with South Asia, Latin America, and the Middle East and North Africa displaying the least diversified structure of tax sources. Resource-rich countries also exhibit less diversified structure of tax revenue sources compared to other countries (column 3).

Table 3.5. Macroeconomic and Structural drivers of RDI, by Region and Income Level

Dependent variable: *Revenue diversification index (RDI)*			
	Baseline	Advanced vs EME/LIDC	Resource rich
	(1)	(2)	(3)
$RDI_{(-1)}$	**0.611*** **	**0.784*** **	**0.597*** **
	(0.011)	(0.077)	(0.019)
RDI × Dummy $ADV_{(-1)}$		**-0.172***	
		(0.096)	
Dummy $ADV_{(-1)}$		0.014	
		(0.091)	
Real $GDP\_pc_{(-1)}$	-0.617***	-0.534	-0.407***
	(0.080)	(0.342)	(0.146)
Real $GDP\_pc\_squared_{(-1)}$	0.038***	0.032	0.026***
	(0.005)	(0.021)	(0.009)
Financial $development_{(-1)}$	-0.396***	0.003	-0.357**
	(0.108)	(0.238)	(0.149)
Trade $openness_{(-1)}$	-0.032*	-0.034	-0.012
	(0.019)	(0.042)	(0.027)
Export concentration $index_{(-1)}$	0.025***	0.043***	-0.004
	(0.007)	(0.015)	(0.021)
Dummy_EAP	0.027		
	(0.041)		
Dummy_LAC	0.081***		
	(0.031)		
Dummy_MENA	0.240***		
	(0.047)		
Dummy_SA	0.140***		
	(0.039)		
Dummy_SSA	-0.002		
	(0.033)		
Resource rich dummy			0.095**
			(0.043)
Constant	2.631***	2.195	1.822***
	(0.346)	(1.360)	(0.601)
Nb. of observations	1141	1141	1141
Countries	97	97	97
AR(1)	0.08	0.07	0.09
AR(2) *p-value*	0.30	0.31	0.29
Hansen OID *(p-value)*	0.07	0.71	0.17
Nb. of instruments	70	35	58
Year FE	*Yes*	*Yes*	*Yes*
Region FE	*Yes*	*No*	*Yes*

*, **, and *** denote statistical significance at 10 percent, 5 percent and 1 percent level, respectively. Standard errors are reported in brackets. Note: Same as in Table 3.4.

Table 3.6. Political and Institutional Drivers of RDI, 2000-2015

Dependent variable: *Revenue diversification index (RDI)*										
	Political and institutional factors									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$RDI_{(-1)}$	0.610***	0.627***	0.605***	0.624***	0.598***	0.593***	0.597***	0.599***	0.580***	0.643***
	(0.019)	(0.011)	(0.012)	(0.008)	(0.010)	(0.010)	(0.015)	(0.012)	(0.018)	(0.015)
Real $GDP\_pc_{(-1)}$	-0.606***	-0.701***	-0.779***	-0.968***	-0.721***	-1.062***	-0.324*	-0.550***	-0.432**	-0.490**
	(0.156)	(0.117)	(0.086)	(0.079)	(0.082)	(0.099)	(0.179)	(0.114)	(0.184)	(0.198)
Real $GDP\_pc\_squared_{(-1)}$	0.040***	0.044***	0.050***	0.062***	0.046***	0.071***	0.022*	0.036***	0.029**	0.034***
	(0.010)	(0.007)	(0.006)	(0.005)	(0.005)	(0.006)	(0.011)	(0.007)	(0.012)	(0.012)
Financial $development_{(-1)}$	-0.729***	-0.521***	-0.668***	-0.687***	-0.614***	-0.719***	(0.195)	-0.363***	(0.183)	-0.504***
	(0.156)	(0.132)	(0.136)	(0.088)	(0.120)	(0.093)	(0.126)	(0.100)	(0.129)	(0.152)
Trade $openness_{(-1)}$	-0.071**	0.010	-0.051*	-0.048**	-0.061**	(0.034)	0.009	(0.010)	(0.007)	(0.049)
	(0.035)	(0.031)	(0.029)	(0.023)	(0.025)	(0.027)	(0.026)	(0.021)	(0.029)	(0.030)
Export concentration $index_{(-1)}$	0.003	0.010	0.015*	0.010	0.009	(0.005)	0.016*	0.017**	0.019**	0.008
	(0.011)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)	(0.013)
$Democracy_{(-1)}$	-0.005*									
	(0.003)									
Political $polarization_{(-1)}$		-0.026**								
		(0.012)								
Government $fractionalization_{(-1)}$			-0.149***							
			(0.025)							
Political $stability_{(-1)}$				-0.003**						
				(0.001)						
Largest gov. party $orient._{(-1)}$					-0.011***					
					(0.004)					
Quality of $bureaucracy_{(-1)}$						-0.150***				
						(0.019)				
Rule of $law_{(-1)}$							-0.047*			
							(0.027)			
Government $effectiveness_{(-1)}$								-0.062***		
								(0.020)		
Voice and $accountability_{(-1)}$									-0.104***	
									(0.022)	
Control of $corruption_{(-1)}$										-0.027***
										(0.010)
Constant	2.674***	2.978***	3.350***	4.359***	3.092***	4.542***	1.302*	2.253***	1.743**	2.089**
	(0.670)	(0.506)	(0.363)	(0.379)	(0.356)	(0.455)	(0.707)	(0.463)	(0.747)	(0.859)
Nb. of observations	970	909	1025	911	1015	911	1082	1082	1082	911
Countries	81	86	90	73	88	73	97	97	97	73
AR(1)	0.10	0.09	0.09	0.09	0.09	0.10	0.09	0.09	0.09	0.09
AR(2) *p-value*	0.28	0.37	0.32	0.30	0.30	0.30	0.27	0.28	0.26	0.30
Hansen OID *(p-value)*	0.42	0.19	0.20	0.22	0.24	0.29	0.13	0.10	0.24	0.48
Nb. of instruments	60	71	71	71	71	71	60	70	59	59
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Region FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

*, **, and *** denote statistical significance at 10 percent, 5 percent and 1 percent level, respectively. Standard errors are reported in brackets. Note: Same as in Table 3.4.

Political and institutional factors are also at play (Table 3.6). First, deeper democracy seems to foster tax revenue diversification. The coefficient associated with the degree of democracy (the Polity 2 index), is negative and significant (column 1). This finding may reflect that stronger democracy, including through greater checks and balances, strengthens the "sincerity" of the social contract between the government and taxpayers, thereby increasing the latter's willingness to pay taxes in exchange for improved quality of public services. Second, polarized political systems (captured either through the government fractionalization or political polarization index, columns 2-3) and stronger political stability (column 4) are conducive to

greater diversification of tax revenue. Indeed, a polarized political system may lead to a more diversified portfolio of revenue streams, in that politicians in these contexts have less room to manipulate the tax system disproportionately in favor of given constituencies, thus ending up sharing the tax burden more equally across all segments of the population and of economic activities, consistently with the *common pool* problem (Alesina and Perotti, 1995). Stronger political stability makes it easier for the government to focus on implementing its declared policies, including strengthening resilience to revenue volatility through diversifying the taxation sources, instead of embarking on rent-seeking activities. Third, more socialist-oriented governments are more prone to diversifying the taxation sources across all segments of the population and economic activities, as reflected by the negative coefficient associated with the largest government party's orientation (column 5).[61] Fourth, institutional quality, as captured by the quality of bureaucracy (column 6), the rule of law (column 7), government effectiveness (column 8), and government accountability (column 9), strengthens policymakers' ability to diversify tax revenue streams. The coefficients associated with these variables are negative and significant, suggesting that countries with strong institutions have greater capacity to administer compliance on diverse tax instruments. Similarly, stronger control of corruption helps diversify taxation sources (columns 10), as less corruption allows for better tax administration and reduced leakages in tax revenue, hence for greater tax compliance.

3.5. Impacts of Tax Revenue Diversification on Tax Revenue Volatility and Collection

This section investigates the potential benefits associated with the diversification of tax revenue sources. We rely on the econometric specification below to assess the influence of the RDI on both tax revenue collection and its volatility.

$$Y_{it} = \alpha + \beta Y_{i,t-1} + \gamma RDI_{it-1} + \sum_{k=1}^{K} \varphi_k Z_{k,it-1} + \eta_i + \pi_t + \varepsilon_{it} \quad (3.3)$$

[61] Largest Government Party orientation with respect to economic policy is coded as follows: (i) Right, if the party is defined as conservative, Christian democratic, or right-wing, and assigned a value of 1; (ii) Center, if the party is defined as centrist or when the party position can best be described as centrist, and assigned a value of 2; (iii) Left if the party is defined as communist, socialist, social democratic, or left-wing, and assigned a value of 3; (iv) the variable equals zero if no information is available (Database on Political Institutions, 2015).

RDI_{it}, which stands for tax revenue diversification, is the explanatory variable of interest. We focus on two outcome variables (Y_{it}). On the one hand, we investigate the impact of tax revenue diversification on revenue collection performance, as captured by the tax-to-GDP ratio. On the other hand, we assess the effect of revenue diversification on the volatility of tax revenue.[62] Subscripts *i* and *t* denote the country and time dimensions, respectively. We follow the existing literature and include a set of variables $Z_{k,it}$ in both specifications to isolate the effects of factors that influence revenue collection performances (per capita GDP, trade openness, informality, share of agricultural Value added, natural resource rents, social conflicts and political unrests, the exchange rate, public debt and FDI) and the volatility of tax revenue (GDP per capita, growth volatility, trade openness, natural resource rents, financial development, economic diversification, political stability and polarization, institutional quality, and the presence of fiscal rules), other than the RDI. η_i captures the country-specific and time-invariant effects, and ε_{it} is the error term. Time dummies are also included in our specifications to control for common shocks affecting our left-hand-side variables. Equations (3.3) is estimated using the GMM estimators.

We uncover suggestive evidence that greater tax revenue diversification improves non-oil revenue collection (Table 3.7).[63] A higher RDI score, which reflects a high level of tax revenue concentration, is associated with lower tax revenue. In other terms, diversifying the portfolio of tax revenue streams improves revenue collection. In terms of magnitude, the results suggest that a 10 percent increase in the RDI score can yield additional tax revenue of up to 0.2-0.4 percentage points of GDP.

[62] Volatility of tax revenue is measured as the standard deviation over a 3-year rolling window.

[63] The regressions passed the standard diagnostic tests for the validity of instruments – the AR (2) test for the absence of second-order autocorrelation of the error term and Hansen's overidentification test.

Table 3.7. Effects of RDI on tax revenue mobilization

Dependent variable: *Tax revenue (in % GDP)*												
	Baseline and additional controls					Additional controls					Political and institutional controls	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Tax revenue$_{(-1)}$	0.866***	0.933***	0.925***	0.929***	0.928***	0.966***	0.955***	0.912***	0.917***	0.929***	0.938***	0.922***
	(0.013)	(0.010)	(0.010)	(0.014)	(0.011)	(0.013)	(0.010)	(0.013)	(0.010)	(0.015)	(0.012)	(0.008)
RDI$_{(-1)}$	-0.036***	-0.025***	-0.028***	-0.016***	-0.021***	-0.017*	-0.021***	-0.028***	-0.018**	-0.029***	-0.015*	-0.012**
	(0.010)	(0.008)	(0.006)	(0.006)	(0.008)	(0.009)	(0.008)	(0.008)	(0.007)	(0.009)	(0.009)	(0.005)
Real GDP_pc$_{(-1)}$	0.177***	0.073	0.142***	0.151***	0.089*	-0.170***	-0.137***	0.173***	0.234***	0.039	-0.021	0.118***
	(0.051)	(0.050)	(0.051)	(0.044)	(0.054)	(0.042)	(0.034)	(0.052)	(0.061)	(0.049)	(0.049)	(0.043)
Real GDP_pc_squared$_{(-1)}$	-0.010***	-0.005*	-0.009***	-0.010***	-0.006*	0.008***	0.006***	-0.011***	-0.014***	-0.003	-0.001	-0.008***
	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Trade openness$_{(-1)}$		0.002	-0.001	-0.001	0.001	0.002	0.002	0.016*	0.001	0.003	0.000	-0.001
		(0.005)	(0.005)	(0.005)	(0.006)	(0.003)	(0.003)	(0.009)	(0.006)	(0.004)	(0.004)	(0.009)
Informality$_{(-1)}$			-0.038*									
			(0.023)									
Agricultural VA$_{(-1)}$				-0.018**								
				(0.008)								
Natural ress. rents$_{(-1)}$					-0.102***							
					(0.024)							
Internal conflicts$_{(-1)}$						0.004*						
						(0.002)						
Political risks$_{(-1)}$							0.001***					
							0.000					
Official ER$_{(-1)}$								0.015***				
								(0.005)				
Public Debt/GDP$_{(-1)}$									0.028***			
									(0.006)			
FDI net inflows$_{(-1)}$										0.003*		
										(0.001)		
Quality of bureaucracy$_{(-1)}$											0.040***	
											(0.007)	
Democracy$_{(-1)}$												0.002**
												(0.001)
Constant	-0.318	-0.050	-0.136	-0.264	-0.093	0.924***	0.785***	-0.457**	-0.769***	0.059	0.401**	-0.168
	(0.208)	(0.199)	(0.178)	(0.168)	(0.212)	(0.180)	(0.164)	(0.200)	(0.258)	(0.184)	(0.200)	(0.173)
Nb. of observations	1223	1191	958	1139	1191	930	930	989	1174	1109	930	991
Countries	104	102	84	101	102	75	75	90	100	100	75	83
AR(1)	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0.00	0.00
AR(2) *p-value*	0.43	0.49	0.11	0.78	0.48	0.08	0.08	0.48	0.46	0.97	0.08	0.29
Hansen OID *(p-value)*	0.25	0.16	0.10	0.13	0.17	0.86	0.79	0.41	0.33	0.27	0.64	0.22
Nb. of instruments	80	81	87	96	82	84	84	84	84	84	82	83
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Region FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

*, **, and *** denote statistical significance at 10 percent, 5 percent and 1 percent level, respectively. Standard errors are reported in brackets. Note: The RDI variable, GDP per capita and its squared term are considered endogenous, and instrumented using their own respective lags. The number of internal instruments is restricted to avoid the overfitting problem. All specifications reject the null of the AR (1). Hansen's p-value validates the over-identification restrictions across all specifications.

Tax revenue diversification is also found to be associated with lower tax revenue volatility (Table 3.8).[64] This is reflected in the positive and statistically significant coefficient associated with the RDI (tax revenue concentration), which lends support to the long-held informal view that greater reliance on a diversified portfolio of tax revenue streams mitigates the volatility of tax revenue significantly. Put simply, there is suggestive evidence that countries with the more diversified structure of tax sources are more likely to exhibit stronger resilience to revenue volatility arising from the business cycle fluctuations. In terms of magnitude, the

[64] Standard diagnostic tests for the validity of instruments are passed in most cases (except in columns 7 and 9, where the P-value associated with Hansen's overidentification test did not pass the conventional 5 percent threshold).

results suggest that a one-point improvement in tax revenue diversification is associated with a reduction in tax revenue volatility of up to 0.5-2.8 points.

Table 3.8. Effects of RDI on Tax Revenue Volatility

Dependent variable: *Volatility of revenue*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Revenue volatility$_{(-1)}$	0.694***	0.657***	0.502***	0.466***	0.681***	0.779***	0.756***	0.758***	0.755***	0.828***
	(0.019)	(0.009)	(0.005)	(0.025)	(0.009)	(0.016)	(0.007)	(0.005)	(0.007)	(0.015)
RDI$_{(-1)}$	2.422***	2.801***	1.644***	1.397**	2.006***	0.981*	0.487**	1.020***	1.019***	2.217***
	(0.636)	(0.317)	(0.243)	(0.545)	(0.233)	(0.516)	(0.229)	(0.199)	(0.239)	(0.560)
Real GDP_pc$_{(-1)}$	3.455***	2.908***	3.801***	10.047***	6.918***	4.798***	7.070***	5.070***	6.818***	13.302***
	(1.240)	(0.918)	(0.913)	(2.051)	(0.971)	(1.052)	(0.795)	(0.671)	(0.618)	(1.063)
Real GDP_pc_squared$_{(-1)}$	-0.170**	-0.139***	-0.153***	-0.564***	-0.363***	-0.270***	-0.399***	-0.287***	-0.398***	-0.613***
	(0.071)	(0.051)	(0.054)	(0.114)	(0.058)	(0.064)	(0.046)	(0.040)	(0.035)	(0.057)
Trade openness$_{(-1)}$	-2.255***	-1.610***	-0.332**	0.986**	-1.970***	0.098	0.121	0.206	0.074	-2.924***
	(0.514)	(0.311)	(0.135)	(0.432)	(0.346)	(0.241)	(0.162)	(0.151)	(0.177)	(0.428)
Growth volatility$_{(-1)}$	0.075***	0.031	-0.058	0.082	0.093**	0.030	0.028**	0.023*	0.030**	-0.005
	(0.026)	(0.048)	(0.039)	(0.065)	(0.045)	(0.019)	(0.011)	(0.013)	(0.012)	(0.034)
Natural res. rent$_{(-1)}$	0.009	0.016***	0.104***	0.086***	0.109***	0.018**	-0.016***	0.008***	-0.014***	0.094***
	(0.011)	(0.006)	(0.003)	(0.009)	(0.010)	(0.008)	(0.003)	(0.003)	(0.004)	(0.005)
Export concent.$_{(-1)}$	0.217	0.276***	-0.419***	0.046	0.689***	0.369***	0.315***	0.303***	0.368***	-0.420***
	(0.134)	(0.087)	(0.056)	(0.174)	(0.122)	(0.085)	(0.055)	(0.027)	(0.060)	(0.128)
Financial development$_{(-1)}$	0.222	0.394	-4.655***	3.401**	-0.401	6.704***	5.489***	6.029***	5.796***	-4.900**
	(1.527)	(0.933)	(0.925)	(1.654)	(0.889)	(1.457)	(0.756)	(0.558)	(0.855)	(2.146)
Polity_2$_{(-1)}$		-0.035***								
		(0.013)								
Control of corruption$_{(-1)}$			0.096**							
			(0.048)							
Government stability$_{(-1)}$				-0.465***						
				(0.067)						
Political polarization$_{(-1)}$					0.129*					
					(0.074)					
Voice and accountatbility$_{(-1)}$						-0.961***				
						(0.167)				
Regulatory quality$_{(-1)}$							-0.893***			
							(0.113)			
Rule of law$_{(-1)}$								-0.607***		
								(0.122)		
Government effectivness$_{(-1)}$									-0.312***	
									(0.107)	
Fiscal rules$_{(-1)}$										-0.663***
										(0.215)
Nb. of observations	1167	988	919	919	930	1108	1108	1108	1108	751
Countries	96	80	72	72	85	96	96	96	96	57
AR(1)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AR(2) *p-value*	0.71	0.68	0.39	0.46	0.54	0.76	0.73	0.73	0.72	0.35
Hansen OID *(p-value)*	0.07	0.26	0.17	0.94	0.06	0.08	0.01	0.13	0.02	0.95
Nb. of instruments	74	88	88	100	81	75	86	102	86	77
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Region FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

*, **, and *** denote statistical significance at 10 percent, 5 percent and 1 percent level, respectively. Standard errors are reported in brackets. Note: Same as in Table 7.

3.6. Conclusion

This chapter proposed a new tax revenue diversification index (RDI) for a broad panel of 128 countries over the period 2000-15. To the best of our knowledge, this is the first study to create such an index at the national level. Existing tax revenue diversification indexes were only

computed at the states level for the US. In addition, our RDI builds on the Theil index, which features more appealing properties, notably in terms of stability and robustness to outliers.

Key patterns stand out of the RDI. On average, AEs relied on a more diversified structure of tax sources than EMEs and LIDCs, by as high as at least the double in terms of RDI score. Resources-rich countries and fragile states exhibit the largest tax revenue concentration, reflecting their overdependence on commodity revenues and official development assistance, and their weak tax administration capacity, respectively. From a regional perspective, North American and EU countries record the most diversified structure of tax sources, while GCC, South Asian, Latin American, and Sub-Saharan African have the least diversified portfolio of tax revenue streams.

Empirical investigations suggest that beyond economic diversification, tax revenue diversification is shaped by macroeconomic, political and institutional conditions. On the macroeconomic front, countries' taxation sources get more diversified as their economy develops, insofar as they strengthen their institutions and improve their tax administration capacity, until a tipping point, with richer countries then finding it harder to further diversify their structure of tax sources. Additionally, countries with more concentrated and informal economic structures, stronger dependency to aid, and plagued with macroeconomic instability, are more prone to relying on a concentrated portfolio of tax revenue streams. Political and institutional factors are also at play: deeper democracy makes it easier to diversify the portfolio of tax revenue streams, while greater stability and polarization of the political system are more conducive to greater tax revenue diversification.

Last but not the least, we find evidence supportive of the long-held view that tax revenue diversification matters a great deal for mitigating government revenue volatility. And it does not stop there: tax revenue diversification also improves tax revenue collection. Tax revenue diversification thus stands as a key factor for strengthening resilience to fiscal risks arising from government revenue volatility, critical for ensuring a sustainable delivery of public services throughout different phases of the business cycle. The current coronavirus pandemic adds further credence to this criticality of relying on a diversified portfolio of tax revenue streams for strengthening fiscal policy resilience to large swings to business cycle fluctuations.

Appendices

Appendix 3.1. Sample and Country Groups

Country	Income group	Region	Small country	Fragile country	Resource rich country
Algeria	UMIC	MENA	No	No	Yes
Angola	UMIC	SSA	No	No	Yes
Anguilla	HIC	ECA	No	No	No
Antigua and Barbuda	HIC	LAC	Yes	No	No
Armenia, Republic of	LMIC	ECA	No	No	No
Australia	HIC	EAP	No	No	Yes
Austria	HIC	ECA	No	No	No
Azerbaijan, Republic of	UMIC	ECA	No	No	Yes
Bahamas, The	HIC	LAC	Yes	No	No
Bahrain, Kingdom of	HIC	MENA	Yes	No	Yes
Bangladesh	LIC	SA	No	No	No
Barbados	HIC	LAC	Yes	No	No
Belgium	HIC	ECA	No	No	No
Benin	LIC	SSA	No	No	No
Bhutan	LMIC	SA	Yes	No	No
Bolivia	LMIC	LAC	No	No	Yes
Botswana	UMIC	SSA	Yes	No	Yes
Brazil	UMIC	LAC	No	No	No
Bulgaria	UMIC	ECA	No	No	No
Burkina Faso	LIC	SSA	No	No	No
Burundi	LIC	SSA	No	Yes	No
Cabo Verde	LMIC	SSA	Yes	No	No
Cambodia	LIC	EAP	No	No	No
Canada	HIC	NA	No	No	Yes
China, P.R.: Mainland	UMIC	EAP	No	No	No
Colombia	UMIC	LAC	No	No	Yes
Congo, Democratic Republic of	LIC	SSA	No	Yes	Yes
Congo, Republic of	LMIC	SSA	No	No	Yes
Costa Rica	UMIC	LAC	No	No	No
Côte d'Ivoire	LMIC	SSA	No	Yes	Yes
Croatia	HIC	ECA	No	No	No
Cyprus	HIC	ECA	Yes	No	No
Czech Republic	HIC	ECA	No	No	No
Denmark	HIC	ECA	No	No	No
Dominica	UMIC	LAC	Yes	No	No
Dominican Republic	UMIC	LAC	No	No	No
Egypt	LMIC	MENA	No	No	No
El Salvador	LMIC	LAC	No	No	No
Equatorial Guinea	UMIC	SSA	Yes	No	Yes
Estonia	HIC	ECA	Yes	No	No
Ethiopia	LIC	SSA	No	No	No
Finland	HIC	ECA	No	No	No
France	HIC	ECA	No	No	No
Georgia	LMIC	ECA	No	No	No
Germany	HIC	ECA	No	No	No
Ghana	LMIC	SSA	No	No	Yes
Greece	HIC	ECA	No	No	No
Grenada	UMIC	LAC	Yes	No	No
Guatemala	LMIC	LAC	No	No	No
Honduras	LMIC	LAC	No	No	No
Hungary	UMIC	EAP	No	No	No
Iceland	HIC	EAP	Yes	No	No
India	LMIC	SA	No	No	No
Indonesia	LMIC	EAP	No	No	Yes
Ireland	HIC	EAP	No	No	No
Israel	HIC	EAP	No	No	No
Italy	HIC	ECA	No	No	No
Jamaica	UMIC	LAC	Yes	No	No
Japan	HIC	EAP	No	No	No
Jordan	UMIC	EAP	No	No	No
Kenya	LIC	SSA	No	No	No
Kiribati	LMIC	EAP	Yes	Yes	No
Korea, Republic of	HIC	EAP	No	No	No
Kosovo, Republic of	LMIC	ECA	No	Yes	No
Kuwait	HIC	MENA	No	No	Yes
Kyrgyz Republic	LMIC	ECA	No	No	No
Latvia	HIC	ECA	No	No	No
Lebanon	UMIC	MENA	No	Yes	No
Lesotho	LMIC	SSA	Yes	No	No
Lithuania	HIC	ECA	No	No	No
Luxembourg	HIC	ECA	No	No	No
Malawi	LIC	SSA	No	No	No
Malaysia	UMIC	EAP	No	No	No
Maldives	UMIC	SA	Yes	No	No
Malta	HIC	MENA	Yes	No	No
Marshall Islands, Republic of	UMIC	EAP	Yes	Yes	No
Mauritius	UMIC	SSA	Yes	No	No
Micronesia, Federated States of	LMIC	EAP	Yes	Yes	No
Moldova	LMIC	ECA	No	No	No
Montserrat	HIC	ECA	No	No	No
Morocco	LMIC	MENA	No	No	No
Mozambique	LIC	SSA	No	No	Yes
Namibia	UMIC	SSA	Yes	No	No
Nepal	LIC	SA	No	No	No
Netherlands	HIC	ECA	No	No	No
Norway	HIC	ECA	No	No	Yes
Oman	HIC	MENA	No	No	Yes
Pakistan	LMIC	SA	No	No	No
Paraguay	LMIC	LAC	No	No	No
Peru	UMIC	LAC	No	No	Yes
Philippines	LMIC	EAP	No	No	No
Poland	HIC	ECA	No	No	No
Portugal	HIC	ECA	No	No	No
Qatar	HIC	MENA	Yes	No	Yes
Romania	UMIC	ECA	No	No	No
Samoa	LMIC	EAP	Yes	No	No
San Marino	HIC	ECA	Yes	No	No
São Tomé and Príncipe	LMIC	SSA	Yes	No	No
Serbia, Republic of	UMIC	ECA	No	No	No
Seychelles	UMIC	SSA	Yes	No	No
Sierra Leone	LIC	SSA	No	Yes	No
Singapore	HIC	EAP	No	No	No
Slovak Republic	HIC	ECA	No	No	No
Slovenia	HIC	ECA	No	No	No
Solomon Islands	LMIC	EAP	Yes	Yes	No
South Africa	UMIC	SSA	No	No	Yes
Spain	HIC	ECA	No	No	No
Sri Lanka	LMIC	SA	No	No	No
St. Kitts and Nevis	HIC	LAC	Yes	No	No
St. Lucia	UMIC	LAC	Yes	No	No
St. Vincent and the Grenadines	UMIC	LAC	Yes	No	No
Swaziland	LMIC	SSA	Yes	No	No
Sweden	HIC	ECA	No	No	No
Switzerland	HIC	ECA	No	No	No
Syrian Arab Republic	LMIC	MENA	No	Yes	Yes
Thailand	UMIC	EAP	No	No	No
Togo	LIC	SSA	No	Yes	No
Tunisia	UMIC	MENA	No	No	No
Turkey	UMIC	ECA	No	No	No
Uganda	LIC	SSA	No	No	No
Ukraine	LMIC	ECA	No	No	No
United Arab Emirates	HIC	MENA	No	No	Yes
United Kingdom	HIC	ECA	No	No	No
United States	HIC	NA	No	No	No
Vietnam	LMIC	EAP	No	No	No
West Bank and Gaza	LMIC	MENA	No	Yes	No
Yemen, Republic of	LMIC	MENA	No	Yes	Yes

Income groups: HIC: High Income Country; UMIC: Upper Middle Income Country; LMIC: Lower Middle Income. Country; LIC: Low Income Country. Regions: ECA: Europe and Central Asia; EAP: East Asia and Pacific; SA: South Asia; LAC: Latin America; SSA: Sub-Saharan Africa; NA: North America; MENA: Middle East and North Africa

Appendix 3.2. Data Sources and Descriptions

Variables	Description	Data sources
Real GDP_pc	Real GDP per capita	IMF's World Economic Outlook (WEO) database
Real GDP_pc_squared	Square of real GDP per capita	Authors' calculations
Financial development	Index of financial development	Svirydzenka (2016)
Trade openness	Sum of imports and exports over GDP	World Bank's World Development Indicators
Exports concentration index	Theil index of exports concentration	IMF datasets
Natural resource rents	Natural resource rents in percentage of GDP	World Bank's World Development Indicators
Net ODA received_pc	Net Official Development Assistance received per capita	World Bank's World Development Indicators
Informal share	Share of the informal sector in the economy (percentage)	Medina, Jonelis and Cangul (2017)
Inflation rate / Informality	Consumer price index growth rate (in percentage)	IMF's World Economic Outlook (WEO) database
De jure globalization index	It measures the extent of investment restrictions, capital account oppenness and international investment agreements.	Gygli et al. (2019)
GDP growth	Rate of real GDP growth	IMF's World Economic Outlook (WEO) database
Human capital index	Human capital index, based on years of schooling and returns to education	Penn World Tables 9.1
IMF program dummy	Binary variable taking the value of 1 if the country has an IMF program and 0 otherwise	IMF datasets
Democracy	Degree of democracy. The polity 2 score ranges from -10 to +10, with higher value representing more democracy.	Marshall and Gurr (2018)
Political polarization	It measures the maximum polarization between the executive party and the four principle parties of the legislature.	Database of Political Institutions
Government fractionalization	It measures the probability that two deputies picked at random from among the government parties will be of different parties.	Database of Political Institutions
Political/Government stability	It measures the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means.	World Bank's Worldwide Governance Indicators
Largest gov. party orient.	It measures the largest party orientation with respect to economic policy	Database of Political Institutions
Quality of bureaucracy	It measures the institutional strength and quality of the bureaucracy	International Country Risk Guide (ICRG)
Rule of law	It measures the extent to which agents have confidence in and abide by the rules of society	World Bank's Worldwide Governance Indicators
Government effectiveness	It measures the quality of public services, the quality of the civil service and the degree of its independence from political pressures and the quality of policy formulation	World Bank's Worldwide Governance Indicators
Voice and accountability	It measures the extent to which a country's citizens are able to participate in selecting their government, and freedom of expression, association and a free media	World Bank's Worldwide Governance Indicators
Control of corruption	It represents the extent to which public power is exercised for private gain, including petty and grand forms of corruption.	World Bank's Worldwide Governance Indicators
Agriculture VA	Agriculture valued added (in percentage of GDP)	World Bank's World Development Indicators
Growth volatility	Standard deviation of GDP growth (using rolling window method)	Authors' calculations
Regulatory quality	It measures the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.	World Bank's Worldwide Governance Indicators
Polity 2	Measure of the degree of democracy/ autocracy ranging from +10 (strongly democratic) to !10 (strongly autocratic)	Marshall and Gurr (2018)
Political risk	Assessment of countries's political stability	International Country Risk Guide (ICRG)
Internal conflicts	Assessment of political violence in the country and its actual or potential impact on governance	
Fiscal rules	Dummy: 1 if numerical fiscal rule in place, 0 otherwise	IMF Fiscal Rules Dataset
Foreign direct investment (FDI), net inflows	Direct investment equity flows in the reporting economy. It is the sum of equity capital, reinvestment of earnings, and other capital.	World Bank's Worldwide Governance Indicators
Public debt (% GDP)	General government total debt, percent of fiscal year GDP	
Overall fiscal balance	Overall fiscal balance percentage of GDP	IMF's World Economic Outlook (WEO) database
Exchange rate	Official exchange rate (LCU per US$, period average)	World Bank's Worldwide Governance Indicators

Appendix 3.3. Countries with filled up missing observations

Country	Year(s)
Armenia, Republic of	2003
Brazil	2000-2005
Burundi	2010 & 2015
Cabo Verde	2010-2015
Canada	2010 & 2015
China, P.R: Mainland	2000-2004
Congo, Republic of	2000-2003
Costa Rica	2000-2001
Croatia	2000-
Egypt	2000-2001
Georgia	2000-2002
Honduras	2000-2002
Indonesia	2000 & 2007
Jamaica	2000-2002
Korea, Republic of	2000 & 2006
Lesotho	2000-2002
Mauritius	2000-2001
Moldova	2000-2001
Seychelles	2000-2004
Turkey	2000 & 2007

Appendix 3.4. Full RDI-based Country Ranking

2000-2004			2005-2009			2010-2015		
Rank	**Country**	**RDI**	**Rank**	**Country**	**RDI**	**Rank**	**Country**	**RDI**
1	Japan	0.053	1	Japan	0.055	1	Japan	0.057
2	France	0.160	2	United Kingdom	0.140	2	France	0.153
3	United Kingdom	0.167	3	France	0.149	3	United Kingdom	0.172
4	United States	0.188	4	United States	0.156	4	United States	0.176
5	South Africa	0.192	5	Switzerland	0.182	5	South Africa	0.178
6	Switzerland	0.193	6	South Africa	0.187	6	Switzerland	0.181
7	Norway	0.216	7	Israel	0.192	7	Singapore	0.186
8	Australia	0.229	8	Australia	0.193	8	Australia	0.193
9	Israel	0.230	9	Norway	0.204	9	Norway	0.207
10	Spain	0.243	10	Spain	0.209	10	Korea, Republic of	0.217
11	Luxembourg	0.245	11	Belgium	0.235	11	Israel	0.220
12	Belgium	0.252	12	Cyprus	0.254	12	Belgium	0.230
13	Netherlands	0.266	13	Luxembourg	0.255	13	Spain	0.238
14	Ukraine	0.285	14	Korea, Republic of	0.266	14	Luxembourg	0.252
15	Ireland	0.289	15	Netherlands	0.287	15	Ireland	0.265
16	Cyprus	0.300	16	Ireland	0.297	16	Cyprus	0.277
17	Oman	0.301	17	Barbados	0.310	17	Iceland	0.297
18	Finland	0.305	18	Germany	0.323	18	Netherlands	0.302
19	Italy	0.318	19	Poland	0.330	19	Italy	0.330
20	Greece	0.334	20	Italy	0.335	20	Malta	0.330
21	Yemen, Republic of	0.337	21	Finland	0.335	21	Germany	0.332
22	Latvia	0.339	22	Ukraine	0.338	22	Georgia	0.338
23	Poland	0.341	23	Oman	0.340	23	Greece	0.339
24	Barbados	0.349	24	Greece	0.344	24	Portugal	0.341
25	Czech Republic	0.352	25	Iceland	0.344	25	Oman	0.342
26	Bhutan	0.352	26	Indonesia	0.347	26	India	0.345
27	Germany	0.359	27	Latvia	0.350	27	Poland	0.350
28	Denmark	0.378	28	Malta	0.355	28	Kenya	0.364
29	Iceland	0.378	29	Czech Republic	0.358	29	Finland	0.367
30	Malaysia	0.385	30	India	0.363	30	Azerbaijan, Republic of	0.368
31	Portugal	0.386	31	Denmark	0.374	31	Barbados	0.370
32	Malta	0.405	32	Azerbaijan, Republic of	0.375	32	Indonesia	0.379
33	Montserrat	0.406	33	Yemen, Republic of	0.382	33	Slovak Republic	0.389
34	Romania	0.408	34	Portugal	0.383	34	Malawi	0.391
35	Austria	0.409	35	Lithuania	0.385	35	Philippines	0.391
36	Philippines	0.427	36	Jamaica	0.387	36	Latvia	0.392
37	Morocco	0.427	37	Montserrat	0.389	37	Denmark	0.396
38	Egypt	0.431	38	Slovenia	0.391	38	Egypt	0.398
39	Slovak Republic	0.434	39	Thailand	0.402	39	Montserrat	0.403
40	Canada	0.436	40	Egypt	0.407	40	Malaysia	0.403
41	Namibia	0.444	41	Romania	0.409	41	Tunisia	0.404
42	Georgia	0.447	42	Austria	0.414	42	Ukraine	0.404
43	India	0.448	43	Slovak Republic	0.415	43	Peru	0.404
44	Slovenia	0.454	44	Philippines	0.419	44	Honduras	0.405
45	Jamaica	0.455	45	Canada	0.427	45	Czech Republic	0.406
46	Sweden	0.462	46	Malaysia	0.428	46	Jamaica	0.415
47	Hungary	0.462	47	Malawi	0.428	47	Brazil	0.415
48	São Tomé and Príncipe	0.465	48	Georgia	0.432	48	Thailand	0.424
49	Thailand	0.468	49	Tunisia	0.433	49	Austria	0.424
50	Lithuania	0.473	50	Kenya	0.434	50	Namibia	0.427
51	Bulgaria	0.476	51	Morocco	0.443	51	Romania	0.431
52	Honduras	0.480	52	Hungary	0.443	52	Yemen, Republic of	0.435
53	Estonia	0.484	53	Peru	0.444	53	Costa Rica	0.435
54	Bahrain, Kingdom of	0.495	54	Honduras	0.445	54	Canada	0.440
55	San Marino	0.501	55	Sweden	0.452	55	Congo, Republic of	0.442
56	St. Kitts and Nevis	0.523	56	El Salvador	0.454	56	Morocco	0.443
57	Tunisia	0.534	57	Brazil	0.465	57	Sweden	0.449
58	St. Vincent and the Grenadines	0.537	58	Namibia	0.481	58	Solomon Islands	0.454
59	Peru	0.547	59	Estonia	0.484	59	Sierra Leone	0.464
60	El Salvador	0.549	60	Congo, Republic of	0.491	60	Micronesia, Federated States of	0.470
61	Swaziland	0.574	61	Turkey	0.518	61	Mozambique	0.473
62	Dominica	0.578	62	Costa Rica	0.533	62	China, P.R.: Mainland	0.474
63	Vietnam	0.585	63	Bhutan	0.542	63	Bhutan	0.483
64	Ghana	0.595	64	Bulgaria	0.543	64	Ghana	0.487

Appendix 3.4. Full RDI-based Country Ranking (Cont'd)

65	Sierra Leone	0.595	65	China, P.R.: Mainland	0.558	65	Kiribati	0.491
66	Benin	0.607	66	Cabo Verde	0.568	66	El Salvador	0.496
67	Moldova	0.614	67	São Tomé and Príncipe	0.575	67	Estonia	0.497
68	St. Lucia	0.618	68	Ghana	0.589	68	Slovenia	0.498
69	Grenada	0.649	69	Vietnam	0.590	69	São Tomé and Príncipe	0.516
70	Côte d'Ivoire	0.649	70	Armenia, Republic of	0.593	70	Angola	0.521
71	Pakistan	0.656	71	Côte d'Ivoire	0.594	71	Algeria	0.522
72	Armenia, Republic of	0.656	72	Grenada	0.603	72	Swaziland	0.523
73	Colombia	0.665	73	St. Kitts and Nevis	0.608	73	Lithuania	0.524
74	Lesotho	0.684	74	St. Vincent and the Grenadines	0.609	74	Vietnam	0.526
75	Congo, Democratic Republic of	0.688	75	San Marino	0.610	75	Seychelles	0.531
76	Angola	0.693	76	Sierra Leone	0.615	76	Armenia, Republic of	0.534
77	Syrian Arab Republic	0.700	77	Colombia	0.621	77	Turkey	0.544
78	Ethiopia	0.700	78	Congo, Democratic Republic of	0.623	78	Bulgaria	0.550
79	Dominican Republic	0.702	79	Marshall Islands, Republic of	0.629	79	Hungary	0.553
80	Kuwait	0.714	80	St. Lucia	0.632	80	Congo, Democratic Republic of	0.563
81	Croatia	0.720	81	Dominica	0.644	81	Burundi	0.566
82	Congo, Republic of	0.732	82	Croatia	0.647	82	Cabo Verde	0.568
83	Togo	0.751	83	Serbia, Republic of	0.652	83	Bangladesh	0.587
84	Nepal	0.774	84	Benin	0.671	84	Uganda	0.604
85	Mauritius	0.783	85	Swaziland	0.684	85	Lesotho	0.607
86	Kenya	0.799	86	Mauritius	0.688	86	St. Vincent and the Grenadines	0.611
87	Uganda	0.814	87	Uganda	0.702	87	St. Kitts and Nevis	0.611
88	Jordan	0.816	88	Guatemala	0.706	88	Marshall Islands, Republic of	0.628
89	Algeria	0.818	89	Algeria	0.707	89	Serbia, Republic of	0.631
90	Sri Lanka	0.822	90	Moldova	0.716	90	Grenada	0.633
91	Bangladesh	0.824	91	Bangladesh	0.721	91	Samoa	0.635
92	Guatemala	0.875	92	Angola	0.729	92	St. Lucia	0.636
93	Antigua and Barbuda	0.884	93	Dominican Republic	0.736	93	San Marino	0.640
94	Cambodia	1.010	94	Togo	0.738	94	Côte d'Ivoire	0.647
95	Bolivia	1.040	95	Antigua and Barbuda	0.742	95	Guatemala	0.653
96	Bahamas, The	1.203	96	Seychelles	0.749	96	Dominican Republic	0.654
97	Maldives	1.213	97	Jordan	0.749	97	Mauritius	0.659
98	Qatar	1.215	98	Micronesia, Federated States of	0.752	98	Croatia	0.659
99	Anguilla	1.340	99	Kuwait	0.765	99	Dominica	0.669
100	Azerbaijan, Republic of	...	100	Ethiopia	0.773	100	Ethiopia	0.710
101	Botswana	...	101	Syrian Arab Republic	0.779	101	Pakistan	0.722
102	Brazil	...	102	Lesotho	0.790	102	Nepal	0.740
103	Burkina Faso	...	103	Paraguay	0.805	103	Benin	0.741
104	Burundi	...	104	Nepal	0.824	104	Moldova	0.742
105	Cabo Verde	...	105	Equatorial Guinea	0.838	105	Colombia	0.742
106	China, P.R.: Mainland	...	106	Botswana	0.860	106	Antigua and Barbuda	0.750
107	Costa Rica	...	107	Sri Lanka	0.875	107	Jordan	0.755
108	Equatorial Guinea	...	108	Kyrgyz Republic	0.876	108	Paraguay	0.772
109	Indonesia	...	109	Cambodia	0.906	109	Kyrgyz Republic	0.781
110	Kiribati	...	110	Bolivia	0.966	110	Cambodia	0.790
111	Korea, Republic of	...	111	Bahrain, Kingdom of	1.029	111	Kosovo, Republic of	0.833
112	Kosovo, Republic of	...	112	West Bank and Gaza	1.087	112	Botswana	0.842
113	Kyrgyz Republic	...	113	Maldives	1.141	113	Togo	0.857
114	Lebanon	...	114	Bahamas, The	1.162	114	Sri Lanka	0.898
115	Malawi	...	115	Qatar	1.173	115	Lebanon	0.942
116	Marshall Islands, Republic of	...	116	Anguilla	1.350	116	Maldives	1.017
117	Micronesia, Federated States of	...	117	Burkina Faso	1.350	117	West Bank and Gaza	1.041
118	Mozambique	...	118	Burundi	...	118	Bahamas, The	1.117
119	Paraguay	...	119	Kiribati	...	119	Qatar	1.159
120	Samoa	...	120	Kosovo, Republic of	...	120	Bahrain, Kingdom of	1.169
121	Serbia, Republic of	...	121	Lebanon	...	121	United Arab Emirates	1.218
122	Seychelles	...	122	Mozambique	...	122	Anguilla	1.317
123	Singapore	...	123	Pakistan	...	123	Kuwait	1.336
124	Solomon Islands	...	124	Samoa	...	124	Bolivia	1.336
125	Turkey	...	125	Singapore	...	125	Burkina Faso	...
126	United Arab Emirates	...	126	Solomon Islands	...	126	Equatorial Guinea	...
127	West Bank and Gaza	...	127	United Arab Emirates	...	127	Syrian Arab Republic	...

Sources: Authors' calculations

Appendix 3.5. Alternative Estimates

Dependent variable: *Revenue diversification index (RDI)*				
	Baseline	Controling for VA share of services		
	(1)	(2)	(3)	(4)
$RDI_{(t-1)}$	0.611***	0.478***	0.459***	0.453***
	(0.011)	(0.024)	(0.022)	(0.023)
Log real $GDP\_pc_{(t-1)}$	-0.6170***	-0.8073***	-0.7172***	-0.7804***
	(0.080)	(0.123)	(0.128)	(0.135)
Log real $GDP\_pc\_squared_{(t-1)}$	0.038***	0.051***	0.0442***	0.0487***
	(0.005)	(0.008)	(0.008)	(0.009)
Financial $development_{(t-1)}$	-0.3958***	-0.6439***	-0.5385***	-0.6052***
	(0.108)	(0.133)	(0.138)	(0.139)
Trade $openness_{(t-1)}$	-0.0318*	-0.0212	-0.0257	-0.0116
	(0.019)	(0.026)	(0.026)	(0.028)
Export concentration $index_{(t-1)}$	0.0252***	0.0294***	0.0339***	0.0302***
	(0.007)	(0.009)	(0.009)	(0.009)
VA Services / VA Agri.		-0.0001***		-0.0001***
		0.000		0.000
VA Services / VA Manuf.			0.0023**	0.0020**
			(0.001)	(0.001)
Constant	2.631***	3.486***	3.137***	3.361***
	(0.346)	(0.518)	(0.540)	(0.564)
Nb. of observations	1141	1089	1074	1074
Countries	97	96	95	95
AR(1)	0.08	0.04	0.05	0.06
AR(2) *p-value*	0.3	0.14	0.25	0.25
Hansen OID (*p-value)*	0.07	0.11	0.2	0.22
Nb. of instruments	70	71	71	72
Year FE	*Yes*	*Yes*	*Yes*	*Yes*
Region FE	*Yes*	*Yes*	*Yes*	*Yes*

*, **, and *** denote statistical significance at 10 percent, 5 percent and 1 percent level, respectively. Standard errors are reported in brackets.

Appendix 3.6. Full HHI RDI-based Country Ranking

2000-2004			2005-2009			2010-2015		
Rank	**Country**	**RDI**	**Rank**	**Country**	**RDI**	**Rank**	**Country**	**RDI**
1	Japan	0.276	1	Japan	0.276	1	Japan	0.277
2	France	0.326	2	United Kingdom	0.316	2	France	0.322
3	Norway	0.328	3	France	0.321	3	South Africa	0.325
4	United Kingdom	0.329	4	Norway	0.322	4	Norway	0.326
5	South Africa	0.329	5	South Africa	0.323	5	United Kingdom	0.332
6	Switzerland	0.341	6	Australia	0.331	6	Switzerland	0.335
7	Oman	0.342	7	United States	0.334	7	Australia	0.335
8	Australia	0.35	8	Switzerland	0.335	8	Singapore	0.342
9	Luxembourg	0.351	9	Israel	0.343	9	United States	0.346
10	United States	0.351	10	Spain	0.347	10	Belgium	0.355
11	Israel	0.356	11	Belgium	0.356	11	Luxembourg	0.356
12	Yemen, Republic of	0.364	12	Luxembourg	0.357	12	Spain	0.362
13	Belgium	0.364	13	Oman	0.368	13	Israel	0.363
14	Spain	0.366	14	Ireland	0.379	14	Korea, Republic of	0.364
15	Ukraine	0.369	15	Cyprus	0.381	15	Ireland	0.368
16	Ireland	0.373	16	Netherlands	0.384	16	Oman	0.371
17	Finland	0.377	17	India	0.385	17	India	0.372
18	Bhutan	0.379	18	Germany	0.389	18	Iceland	0.382
19	Netherlands	0.379	19	Korea, Republic of	0.390	19	Malta	0.383
20	Italy	0.392	20	Finland	0.391	20	Cyprus	0.385
21	Malaysia	0.395	21	Yemen, Republic of	0.394	21	Kenya	0.389
22	Cyprus	0.401	22	Italy	0.396	22	Netherlands	0.390
23	Germany	0.404	23	Iceland	0.403	23	Germany	0.393
24	Czech Republic	0.405	24	Indonesia	0.403	24	Italy	0.396
25	Iceland	0.414	25	Malta	0.406	25	Malawi	0.407
26	Austria	0.416	26	Czech Republic	0.406	26	Finland	0.408
27	Latvia	0.419	27	Ukraine	0.408	27	Malaysia	0.409
28	Denmark	0.425	28	Jamaica	0.414	28	Philippines	0.410
29	Greece	0.429	29	Austria	0.417	29	Portugal	0.416
30	Malta	0.43	30	Barbados	0.418	30	Georgia	0.417
31	Montserrat	0.431	31	Latvia	0.419	31	Tunisia	0.419
32	Philippines	0.438	32	Malaysia	0.420	32	Indonesia	0.419
33	Poland	0.438	33	Egypt	0.420	33	Egypt	0.419
34	Barbados	0.438	34	Azerbaijan, Republic of	0.421	34	Austria	0.422
35	Namibia	0.441	35	Denmark	0.423	35	Azerbaijan, Republic of	0.423
36	Portugal	0.442	36	Lithuania	0.425	36	Jamaica	0.428
37	Jamaica	0.448	37	Montserrat	0.425	37	Yemen, Republic of	0.430
38	Egypt	0.449	38	Poland	0.427	38	Montserrat	0.431
39	India	0.45	39	Philippines	0.429	39	Greece	0.432
40	San Marino	0.455	40	Thailand	0.432	40	Peru	0.435
41	São Tomé and Príncipe	0.46	41	Slovenia	0.433	41	Poland	0.439
42	Lithuania	0.46	42	Malawi	0.434	42	Denmark	0.439
43	Slovenia	0.462	43	Greece	0.434	43	Bhutan	0.439
44	Bahrain, Kingdom of	0.466	44	Kenya	0.439	44	Latvia	0.442
45	Hungary	0.467	45	Tunisia	0.441	45	Thailand	0.444
46	Romania	0.469	46	Portugal	0.443	46	Sierra Leone	0.445
47	Canada	0.469	47	Morocco	0.457	47	Namibia	0.447
48	Estonia	0.471	48	Hungary	0.459	48	Czech Republic	0.449
49	Sweden	0.475	49	Peru	0.459	49	Ukraine	0.452
50	Morocco	0.476	50	Bhutan	0.459	50	Slovak Republic	0.452
51	Slovak Republic	0.482	51	Canada	0.462	51	Micronesia, Federated States of	0.457
52	Thailand	0.485	52	Sweden	0.465	52	Sweden	0.459
53	Bulgaria	0.498	53	Slovak Republic	0.468	53	Barbados	0.460
54	Vietnam	0.5	54	Romania	0.472	54	Mozambique	0.462
55	Georgia	0.506	55	Namibia	0.478	55	Congo, Republic of	0.462
56	Syrian Arab Republic	0.507	56	Estonia	0.482	56	Algeria	0.464
57	Tunisia	0.51	57	Georgia	0.484	57	Canada	0.471
58	Colombia	0.512	58	El Salvador	0.485	58	Honduras	0.471
59	St. Kitts and Nevis	0.53	59	San Marino	0.490	59	Morocco	0.476
60	El Salvador	0.532	60	Marshall Islands, Republic of	0.491	60	Solomon Islands	0.477
61	Honduras	0.534	61	Vietnam	0.494	61	Ghana	0.477
62	St. Vincent and the Grenadines	0.537	62	Honduras	0.495	62	Vietnam	0.478
63	Swaziland	0.539	63	Congo, Republic of	0.498	63	Kiribati	0.479
64	Peru	0.543	64	Colombia	0.507	64	Romania	0.488

Appendix 3.6. Full HHI RDI-based Country Ranking (Cont'd)

65	Ghana	0.553	65	Brazil	0.518	65	Marshall Islands, Republic of	0.490
66	Sierra Leone	0.554	66	Turkey	0.519	66	Brazil	0.493
67	Dominica	0.561	67	Cabo Verde	0.534	67	Estonia	0.495
68	Pakistan	0.573	68	Costa Rica	0.539	68	Seychelles	0.496
69	Benin	0.587	69	São Tomé and Príncipe	0.541	69	Costa Rica	0.500
70	Angola	0.588	70	Ghana	0.550	70	San Marino	0.502
71	St. Lucia	0.59	71	Bulgaria	0.558	71	Angola	0.503
72	Moldova	0.599	72	China, P.R.: Mainland	0.561	72	Swaziland	0.503
73	Lesotho	0.608	73	Côte d'Ivoire	0.563	73	Slovenia	0.505
74	Côte d'Ivoire	0.611	74	Sierra Leone	0.566	74	El Salvador	0.509
75	Ethiopia	0.613	75	Micronesia, Federated States of	0.575	75	China, P.R.: Mainland	0.520
76	Congo, Democratic Republic of	0.618	76	Congo, Democratic Republic of	0.576	76	Lithuania	0.523
77	Kuwait	0.619	77	St. Kitts and Nevis	0.580	77	São Tomé and Príncipe	0.527
78	Grenada	0.623	78	St. Vincent and the Grenadines	0.581	78	Congo, Democratic Republic of	0.531
79	Kenya	0.633	79	Armenia, Republic of	0.582	79	Burundi	0.532
80	Armenia, Republic of	0.633	80	Syrian Arab Republic	0.583	80	Cabo Verde	0.534
81	Congo, Republic of	0.634	81	Algeria	0.585	81	Pakistan	0.537
82	Dominican Republic	0.637	82	Guatemala	0.589	82	Hungary	0.537
83	Croatia	0.64	83	Croatia	0.593	83	Turkey	0.540
84	Togo	0.656	84	St. Lucia	0.596	84	Bangladesh	0.542
85	Uganda	0.662	85	Serbia, Republic of	0.599	85	Guatemala	0.547
86	Nepal	0.669	86	Grenada	0.605	86	Armenia, Republic of	0.548
87	Algeria	0.7	87	Swaziland	0.615	87	Uganda	0.553
88	Mauritius	0.701	88	Kuwait	0.620	88	Bulgaria	0.563
89	Jordan	0.706	89	Angola	0.620	89	St. Kitts and Nevis	0.580
90	Bangladesh	0.714	90	Benin	0.622	90	St. Vincent and the Grenadines	0.580
91	Guatemala	0.717	91	Uganda	0.624	91	Lesotho	0.582
92	Antigua and Barbuda	0.727	92	Dominica	0.626	92	Serbia, Republic of	0.592
93	Sri Lanka	0.728	93	Seychelles	0.631	93	Samoa	0.596
94	Bolivia	0.806	94	Mauritius	0.631	94	St. Lucia	0.600
95	Cambodia	0.819	95	Bangladesh	0.640	95	Côte d'Ivoire	0.604
96	Bahamas, The	0.914	96	Togo	0.653	96	Colombia	0.610
97	Maldives	0.92	97	Jordan	0.659	97	Croatia	0.613
98	Qatar	0.921	98	Moldova	0.664	98	Dominican Republic	0.615
99	Anguilla	0.984	99	Botswana	0.665	99	Ethiopia	0.615
100	Azerbaijan, Republic of	...	100	Dominican Republic	0.669	100	Mauritius	0.615
101	Botswana	...	101	Paraguay	0.669	101	Grenada	0.625
102	Brazil	...	102	Ethiopia	0.672	102	Paraguay	0.640
103	Burkina Faso	...	103	Antigua and Barbuda	0.684	103	Dominica	0.641
104	Burundi	...	104	Nepal	0.688	104	Nepal	0.645
105	Cabo Verde	...	105	Lesotho	0.692	105	Botswana	0.650
106	China, P.R.: Mainland	...	106	Equatorial Guinea	0.721	106	Jordan	0.655
107	Costa Rica	...	107	Sri Lanka	0.737	107	Kyrgyz Republic	0.661
108	Equatorial Guinea	...	108	Kyrgyz Republic	0.740	108	Benin	0.664
109	Indonesia	...	109	Bolivia	0.749	109	Cambodia	0.676
110	Kiribati	...	110	Cambodia	0.750	110	Moldova	0.676
111	Korea, Republic of	...	111	Bahrain, Kingdom of	0.796	111	Antigua and Barbuda	0.698
112	Kosovo, Republic of	...	112	West Bank and Gaza	0.871	112	Lebanon	0.728
113	Kyrgyz Republic	...	113	Maldives	0.882	113	Togo	0.736
114	.ao People's Democratic Republi	...	114	Bahamas, The	0.889	114	Kosovo, Republic of	0.737
115	Lebanon	...	115	Qatar	0.896	115	Sri Lanka	0.746
116	Malawi	...	116	Anguilla	0.988	116	Maldives	0.787
117	Marshall Islands, Republic of	...	117	Burkina Faso	0.896	117	West Bank and Gaza	0.846
118	Micronesia, Federated States of	...	118	Burundi	0.988	118	Bahamas, The	0.859
119	Mozambique	...	119	Kiribati	...	119	Bahrain, Kingdom of	0.868
120	Nicaragua	...	120	Kosovo, Republic of	...	120	Qatar	0.887
121	Nigeria	...	121	Lebanon	...	121	United Arab Emirates	0.920
122	Palau	...	122	Mozambique	...	122	Anguilla	0.974
123	Paraguay	...	123	Pakistan	...	123	Kuwait	0.977
124	Samoa	...	124	Samoa	...	124	Bolivia	...
125	Serbia, Republic of	...	125	Singapore	...	125	Burkina Faso	...
126	Seychelles	...	126	Solomon Islands	...	126	Equatorial Guinea	...
127	Singapore	...	127	United Arab Emirates	...	127	Syrian Arab Republic	...

Sources: Authors' calculations

Appendix 3.7. Adjusted (accounting for non-tax revenue) RDI-based Country Ranking

2000-2004			2005-2009			2010-2015		
Rank	**Country**	**RDI**	**Rank**	**Country**	**RDI**	**Rank**	**Country**	**RDI**
1	Japan	0.044	1	Japan	0.049	1	Japan	0.054
2	Switzerland	0.151	2	Switzerland	0.143	2	Switzerland	0.142
3	Israel	0.195	3	United Kingdom	0.153	3	Singapore	0.147
4	United Kingdom	0.197	4	Israel	0.169	4	United Kingdom	0.176
5	Netherlands	0.210	5	Korea, Republic of	0.209	5	Korea, Republic of	0.187
6	Luxembourg	0.238	6	Netherlands	0.225	6	Israel	0.196
7	Ukraine	0.241	7	Spain	0.230	7	Belgium	0.225
8	Finland	0.244	8	Belgium	0.243	8	Luxembourg	0.231
9	Spain	0.258	9	Luxembourg	0.250	9	Netherlands	0.237
10	Belgium	0.264	10	Finland	0.260	10	Spain	0.243
11	Iceland	0.323	11	Ukraine	0.264	11	Iceland	0.254
12	Malta	0.333	12	Indonesia	0.273	12	Malta	0.282
13	Morocco	0.339	13	Iceland	0.289	13	Finland	0.283
14	India	0.346	14	Malta	0.306	14	Indonesia	0.293
15	Czech Republic	0.347	15	India	0.313	15	India	0.309
16	Austria	0.352	16	Jamaica	0.335	16	Ukraine	0.315
17	Jamaica	0.364	17	Austria	0.336	17	Honduras	0.330
18	Philippines	0.379	18	Czech Republic	0.338	18	Peru	0.335
19	Honduras	0.382	19	Thailand	0.356	19	Egypt	0.339
20	San Marino	0.387	20	Honduras	0.359	20	Austria	0.346
21	Hungary	0.398	21	Peru	0.366	21	Georgia	0.365
22	Egypt	0.399	22	Egypt	0.368	22	Czech Republic	0.371
23	Thailand	0.405	23	Barbados	0.372	23	Montserrat	0.372
24	Estonia	0.407	24	Hungary	0.374	24	Thailand	0.374
25	Sweden	0.426	25	El Salvador	0.375	25	Morocco	0.376
26	Barbados	0.426	26	Morocco	0.386	26	Jamaica	0.376
27	Montserrat	0.435	27	Philippines	0.387	27	Tunisia	0.390
28	Bhutan	0.435	28	Montserrat	0.388	28	Costa Rica	0.391
29	São Tomé and Príncipe	0.448	29	Georgia	0.403	29	Philippines	0.395
30	St. Kitts and Nevis	0.451	30	Tunisia	0.404	30	China, P.R.: Mainland	0.395
31	Georgia	0.454	31	Estonia	0.404	31	Sweden	0.409
32	Peru	0.464	32	Sweden	0.411	32	Barbados	0.416
33	Moldova	0.471	33	China, P.R.: Mainland	0.444	33	El Salvador	0.418
34	St. Vincent and the Grenadines	0.495	34	Costa Rica	0.472	34	Estonia	0.426
35	Tunisia	0.506	35	Kenya	0.507	35	Solomon Islands	0.429
36	El Salvador	0.517	36	Armenia, Republic of	0.524	36	Lithuania	0.438
37	Angola	0.520	37	Croatia	0.551	37	Kenya	0.455
38	Dominica	0.527	38	Colombia	0.556	38	Hungary	0.460
39	Namibia	0.560	39	Angola	0.560	39	Bhutan	0.464
40	St. Lucia	0.598	40	Serbia, Republic of	0.568	40	Namibia	0.470
41	Armenia, Republic of	0.617	41	San Marino	0.572	41	Armenia, Republic of	0.477
42	Swaziland	0.629	42	Congo, Democratic Republic of	0.573	42	Ghana	0.481
43	Grenada	0.629	43	Namibia	0.582	43	Sierra Leone	0.523
44	Croatia	0.637	44	Azerbaijan, Republic of	0.589	44	São Tomé and Príncipe	0.526
45	Jordan	0.642	45	Bangladesh	0.600	45	Angola	0.530
46	Bangladesh	0.650	46	Moldova	0.605	46	Algeria	0.541
47	Colombia	0.651	47	St. Kitts and Nevis	0.614	47	Serbia, Republic of	0.544
48	Mauritius	0.658	48	St. Vincent and the Grenadines	0.616	48	Malawi	0.544
49	Nepal	0.697	49	São Tomé and Príncipe	0.617	49	Seychelles	0.551
50	Sierra Leone	0.747	50	Mauritius	0.625	50	Congo, Democratic Republic of	0.561
51	Lesotho	0.749	51	Jordan	0.635	51	Lesotho	0.563
52	Dominican Republic	0.750	52	Dominica	0.635	52	Croatia	0.569
53	Congo, Democratic Republic of	0.757	53	Marshall Islands, Republic of	0.635	53	St. Kitts and Nevis	0.578
54	Algeria	0.786	54	Malawi	0.648	54	St. Vincent and the Grenadines	0.578
55	Sri Lanka	0.787	55	Grenada	0.649	55	Samoa	0.594
56	Ghana	0.808	56	St. Lucia	0.658	56	Dominica	0.597
57	Togo	0.837	57	Ghana	0.697	57	Mauritius	0.602
58	Antigua and Barbuda	0.902	58	Bhutan	0.708	58	Bangladesh	0.603
59	Syrian Arab Republic	0.911	59	Cabo Verde	0.731	59	Paraguay	0.603
60	Guatemala	0.950	60	Paraguay	0.734	60	Azerbaijan, Republic of	0.607
61	Congo, Republic of	0.960	61	Seychelles	0.739	61	Swaziland	0.610
62	Cambodia	1.021	62	Algeria	0.740	62	Mozambique	0.610
63	Kenya	1.142	63	Swaziland	0.757	63	Colombia	0.612
64	Uganda	1.196	64	Dominican Republic	0.784	64	San Marino	0.614

Appendix 3.7. Adjusted (accounting for non-tax revenue) RDI-based Country Ranking (Cont'd)

65	Maldives	1.335	65	Botswana	0.784	65	Marshall Islands, Republic of	0.633
66	Bahrain, Kingdom of	1.340	66	Antigua and Barbuda	0.786	66	St. Lucia	0.661
67	Qatar	1.379	67	Lesotho	0.792	67	Jordan	0.679
68	Oman	1.686	68	Nepal	0.812	68	Grenada	0.693
69	Anguilla	1.779	69	Sierra Leone	0.814	69	Nepal	0.694
70	Kuwait	1.846	70	Guatemala	0.823	70	Moldova	0.694
71	Bahamas, The	1.888	71	Togo	0.888	71	Cabo Verde	0.694
72	Australia	...	72	Equatorial Guinea	0.897	72	Dominican Republic	0.709
73	Azerbaijan, Republic of	...	73	Kyrgyz Republic	0.901	73	Burundi	0.732
74	Benin	...	74	West Bank and Gaza	0.930	74	Antigua and Barbuda	0.732
75	Bolivia	...	75	Micronesia, Federated States of	0.946	75	Kyrgyz Republic	0.738
76	Botswana	...	76	Cambodia	0.975	76	Botswana	0.766
77	Brazil	...	77	Congo, Republic of	0.993	77	Guatemala	0.779
78	Bulgaria	...	78	Maldives	1.003	78	Togo	0.819
79	Burkina Faso	...	79	Uganda	1.013	79	Micronesia, Federated States of	0.839
80	Burundi	...	80	Syrian Arab Republic	1.022	80	Cambodia	0.894
81	Cabo Verde	...	81	Sri Lanka	1.031	81	Congo, Republic of	0.898
82	Canada	...	82	Qatar	1.358	82	Maldives	0.910
83	China, P.R.: Mainland	...	83	Oman	1.603	83	Uganda	0.925
84	Costa Rica	...	84	Bahamas, The	1.765	84	Sri Lanka	1.047
85	Cyprus	...	85	Anguilla	1.784	85	West Bank and Gaza	1.077
86	Côte d'Ivoire	...	86	Kuwait	2.013	86	Kiribati	1.086
87	Denmark	...	87	Bahrain, Kingdom of	2.324	87	Lebanon	1.150
88	Equatorial Guinea	...	88	Australia	...	88	Qatar	1.382
89	Ethiopia	...	89	Benin	...	89	United Arab Emirates	1.465
90	France	...	90	Bolivia	...	90	Anguilla	1.648
91	Germany	...	91	Brazil	...	91	Oman	1.682
92	Greece	...	92	Bulgaria	...	92	Bahamas, The	1.691
93	Indonesia	...	93	Burkina Faso	...	93	Bahrain, Kingdom of	2.927
94	Ireland	...	94	Burundi	...	94	Kuwait	3.383
95	Italy	...	95	Canada	...	95	Australia	...
96	Kiribati	...	96	Cyprus	...	96	Benin	...
97	Korea, Republic of	...	97	Côte d'Ivoire	...	97	Bolivia	...
98	Kosovo, Republic of	...	98	Denmark	...	98	Brazil	...
99	Kyrgyz Republic	...	99	Ethiopia	...	99	Bulgaria	...
100	Latvia	...	100	France	...	100	Burkina Faso	...
101	Lebanon	...	101	Germany	...	101	Canada	...
102	Lithuania	...	102	Greece	...	102	Cyprus	...
103	Malawi	...	103	Ireland	...	103	Côte d'Ivoire	...
104	Malaysia	...	104	Italy	...	104	Denmark	...
105	Marshall Islands, Republic of	...	105	Kiribati	...	105	Equatorial Guinea	...
106	Micronesia, Federated States of	...	106	Kosovo, Republic of	...	106	Ethiopia	...
107	Mozambique	...	107	Latvia	...	107	France	...
108	Norway	...	108	Lebanon	...	108	Germany	...
109	Pakistan	...	109	Lithuania	...	109	Greece	...
110	Paraguay	...	110	Malaysia	...	110	Ireland	...
111	Poland	...	111	Mozambique	...	111	Italy	...
112	Portugal	...	112	Norway	...	112	Kosovo, Republic of	...
113	Romania	...	113	Pakistan	...	113	Latvia	...
114	Samoa	...	114	Poland	...	114	Malaysia	...
115	Serbia, Republic of	...	115	Portugal	...	115	Norway	...
116	Seychelles	...	116	Romania	...	116	Pakistan	...
117	Singapore	...	117	Samoa	...	117	Poland	...
118	Slovak Republic	...	118	Singapore	...	118	Portugal	...
119	Slovenia	...	119	Slovak Republic	...	119	Romania	...
120	Solomon Islands	...	120	Slovenia	...	120	Slovak Republic	...
121	South Africa	...	121	Solomon Islands	...	121	Slovenia	...
122	Turkey	...	122	South Africa	...	122	South Africa	...
123	United Arab Emirates	...	123	Turkey	...	123	Syrian Arab Republic	...
124	United States	...	124	United Arab Emirates	...	124	Turkey	...
125	Vietnam	...	125	United States	...	125	United States	...
126	West Bank and Gaza	...	126	Vietnam	...	126	Vietnam	...
127	Yemen, Republic of	...	127	Yemen, Republic of	...	127	Yemen, Republic of	...

Sources: Authors' calculations

Chapter 4. Access-for-all to Financial Services: Non-resources Tax Revenue-harnessing Opportunities in Developing Countries

4.1. Introduction

Over recent years, increasing attention has been paid to financial inclusion among both, policy-makers and academics considered as a key factor to achieve the 2030 Sustainable Development Goals (SDGs). Financial inclusion has become a priority of policy agenda in a number of economies across the globe, with more than 50 countries having adopted a National Financial Inclusion Strategy (Espinosa-Vega *et al*., 2020).

Financial inclusion refers to access to and use of formal financial services by individuals and businesses (Sahay *et al*., 2015a).[65] A broader definition considers, in addition to the access and use of financial services, further aspects including the quality and range, usefulness and appropriateness, affordability, sustainability, and awareness of financial services and products as well as the consumer protection (Grace *et al*., 2014; SBS 2014; BSP 2015; World Bank 2018; Jahan *et al*., 2019; and Espinosa-Vega *et al*., 2020), making financial inclusion a multifaced concept. The measurement of financial inclusion also remains an important issue in the empirical literature given to its multidimensional aspect. While some components are particularly more easily capturable, other dimensions are not readily observable.[66] For instance, the emergence of informal financial institutions deemed as "shadow banking" in most developing countries is often unrecorded yet provide non-negligible financial assistance to individuals and small businesses.

The consensus in the literature is that access-for-all to financial services is conducive to broader economic and development outcomes, though access to finance still constitutes a major constraint for business creation and expansion in developing countries (World Bank, 2014; Demirgüç-Kunt *et al*., 2015). Financial inclusion is crucial for inclusive and sustainable economic growth and non-access to formal financial services like bank account entails greater cash transactions is associated with higher transaction fees and financial risks (Lusardi, 2010). Greater financial inclusion positively affects the GDP, while reducing inequality in developing

[65] Financial inclusion is different from financial development. The latter occurs when financial instruments, markets, and intermediaries ameliorate – the effects of information, enforcement, and transactions costs and therefore do a correspondingly better job at providing the five financial functions (Levine, 2005) – though the former is a dimension of the latter (see *e.g*., Sahay *et al*., 2015). In addition, more financial development may allow greater access to financial services as emphasized in Rajan and Zingales (2003).

[66] See Espinosa-Vega *et al*. (2020) for a complete discussion.

and emerging (Dabla-Norris *et al*.,2015). Similarly, focusing on Latin America and the Caribbean (LAC) countries, Dabla-Norris *et al*. (2015) conclude that easing financial services access and relaxing collateral constraints helps reduce inequality and spur growth. Using a wide sample of 123 countries, Allen *et al*. (2015) highlight that financial inclusion is associated with stronger legal rights and more politically stable environments.

Micro-level and field experiment studies evidenced that microfinance branch expansion and access to credit facilities is conducive to business expansion and entrepreneurial activities development (Bruhn and Love, 2014; Angelucci, *et al*., 2015; Fareed *et al*., 2017). Similarly, Banerjee *et al*. (2010) show that access to microcredit increases small business investment and profits of preexisting businesses in India. Focusing on the Bosnia, Augsburg *et al*. (2015) also highlight that lower rejection of households' formal loans applications induces higher self-employment, increases in inventory and an increase in the labor supply in the household's business. Similarly, in rural Kenya, Dupas and Robinson (2011) provide strong evidence that extending basic banking services (*e.g*., saving accounts) is associated to an increase in the size of market women businesses. In line with the disciplining effect of group lending, Attanasio *et al*., (2011) find a positive impact of access to group loans on entrepreneurship in Mongolia. Access to group loans increases the likelihood of owning an enterprise by 10 percent.
Financial inclusion is found to be an important tool for empowering women and strengthening female decision-making power in developing countries. Relying on a randomized controlled trial, Ashraf *et al*. (2010) find that access to basic financial service such as saving accounts is associated to an increase in female decision-making power within the household in the Philippines.

The literature also asserted that financial inclusion positively affects households consumption as well as households income (Banerjee *et al*. 2010; Karlan and Zinman, 2010; Attanasio *et al*., 2011; Dupas and Robinson, 2011; Bruhn and Love, 2014; Zhang and Posso, 2017). Access to financial services allows households to respond to income shocks by raising their current consumption (Bhattacharya and Patnaik, 2015), facilitates households consumption smoothing and softens output volatility cost (Mehrotra and Yetman, 2015). In addition, greater access to financial services encourages households saving. Aportela (1999), based on natural experiment shows that the financial inclusion increased the average saving rate of households by around

5 percentage points and this effect was even higher for the poorest households in Mexico. Furthermore, access to financial service favors human capital development and increases jobs opportunities (Demirgüç-Kunt *et al*., 2008). For instance, De Gregorio (1996) on an overlapping generations model with endogenous growth, highlights that access to financial services is associated with an increase in human capital accumulation and growth in OECD and developing countries.

Subsequent studies explored the impact of access to financial services on the level of poverty (Burgess *et al*., 2005; Burgess and Pande, 2005; Honohan, 2004a,b; Honohan, 2005, 2006; Karlan and Zinman, 2010; Kiendrebeogo and Minea, 2013; Bruhn and Love, 2014; Banerjee *et al*., 2015; Rewilak, 2017) and find that access to basic financial services is associated with a decrease in the poverty rates. For instance, Coulibaly and Yogo (2018) recently evidenced that improving financial outreach through additional bank branches reduces the number of poor workers in developing countries.

Nevertheless, parallel to this literature, some studies have documented that greater access to financial services without proper financial supervision might be harmful to economic outcomes and result into financial distress (Rajan, 2010; Han and Melecky, 2013; Sahay *et al*., 2015). For instance, high financial inclusion combined with a boom in access to credit is associated to a deterioration in credit quality and thereby leading to financial risks (Mehrotra and Yetman, 2015). In addition, Dabla-Norris *et al*. (2015) analyzing factors constraining firms to access to finance find that greater access to credit could result in bank instability by increasing non-performing loans.

Although Čihák and Sahay (2018) postulate that inclusive financial systems can increase the effectiveness of fiscal policy by broadening the tax base, studies exploring the potential effect of accessing to financial services on government tax revenue are very scarce (Oz-Yalaman, 2019). Also, studies particularly focusing in developing countries and using non-resources tax revenue is non-existent. To the best of our knowledge, our paper is therefore the first to provide a strong and convincing evidence on the nexus between financial inclusion and non-resources tax ratio in developing countries. Our contribution to the literature relies on the use

of comparable[67] tax revenue ratio excluding natural resources revenue. As underscored in Caldeira *et al*. (2020), distinguishing resource from non-resource revenue is highly relevant to understand tax capacity in developing countries and the literature has well-documented a *crowding-out* effect between resources revenue and non-resource tax revenue (Bornhorst *et al*., 2009; Crivelli and Gupta, 2014; James, 2015 among others). In addition, unlike the empirical method employed in Oz-Yalaman (2019), we adopted a dynamic specification to account for the inertia in government tax revenue.

Using a sample of 62 developing countries over the period 2004-2017 and drawing on the dynamic generalized method of moments (GMM) to solve the endogeneity and any reverse causality issue, the chapter shows that greater access to financial services captured by the number of ATMs per 100,000 adults increases government non-resources tax-to-GDP ratio. Looking at the tax revenue structure, the results show that indirect taxes revenue accounts the most sizeable positive effect of increased penetration of ATMs on tax revenue. Exploring the channels through which financial inclusion influences non-resource tax ratio, our empirical results highlight that the positive effect of greater access to financial services mainly operates through private consumption and business expansion. Our results survived to a battery of robustness exercises including (1) adding more control variable namely the level of education, inflation, the population size, external aid received, domestic financial sector development, remittances inflows and the tax structure, (2) the use of alternative financial inclusion measures to capture the multifaceted aspect of our interest variable and (3) using alternative tax data source.

This chapter provides insights to countries that have implemented or are in the process of implementing financial inclusion policies, on tax revenue-harnessing opportunities from access-for-all financial services.

The remainder of the chapter is structured as follows: the second section describes the econometric methodology and introduces the dataset with some stylized facts. Section 3

[67] Oz-Yalaman (2019) explored the nexus between financial inclusion and tax revenue but using different sources of total tax revenue and tax subcomponents. This entails important shortcomings since the datasets are not strictly comparable (Sahay *et al*., 2015).

presents the baseline results from the empirical specification and considers some robustness checks. Section 4 provides concluding remarks and draws policy implications.

4.2. Empirical Methodology and Data

4.2.1. Econometric Model

The following dynamic panel model that captures the impact of financial inclusion on non-resources tax revenue was estimated:

$$NRTax_{i,t} = \alpha + \beta NRTax_{i,t-1} + \psi FInc_{i,t} + Z_{i,t}\delta + \lambda_i + \zeta_t + \varepsilon_{it} \quad (4.1)$$

$NRTax_{i,t}$ is the natural logarithm of non-resource tax-to-GDP ratio for country i at time t. We included the one-period lagged value of the dependent variable –$NRTax_{i,t}$– because of the inertia in the total tax revenue. $FInc_{i,t}$ is the financial inclusion indicator and $\boldsymbol{Z}_{i,t}$ is a set of variables that explain the government tax revenue ratio. λ_i and ζ_t denote time-invariant country-level characteristics and time-varying factors, respectively that could potentially affect the tax ratio. The last term, ε_{it} is an idiosyncratic disturbance.

Taking stock of previous literature on the principal determinants of the tax share in GDP, the vector $\boldsymbol{Z}_{i,t}$ includes *inter alia* the level of development, the sectoral composition of value-added (*i.e.*, agriculture and natural resources), the trade openness and the quality of institutions. The **real GDP per capita** is commonly used to capture countries' overall level of development. Countries' tax capacity is intrinsically related to their level of development (Lotz and Morss, 1967; Tanzi 1983; Pessino and Fenochietto, 2010; Fenochietto and Pessino, 2013; Crivelli and Gupta, 2014). High-income countries are expected to raise more tax revenue than developing countries due to the more efficient and strong tax administration, higher degree of economic and institutional sophistication. To capture the non-linearity effect of the level of development and tax capacity, we include the squared of this variable in the specification.

Trade openness refers to the volume of international trade in the GDP. Substantial increase in trade volume makes it more amenable to taxation through domestic consumption and corporate profits (Chelliah *et al.*, 1975; Leuthold, 1991; Tanzi, 1992; Stotsky and WoldeMariam,

1997; Stotsky and WoldeMariam, 2006; Pessino and Fenochietto 2010; Gnangnon and Brun, 2018).

The effect of **natural resources rents** on tax revenue ratio is widely evidenced in the literature but remains controversial. While pioneering studies evidenced a positive effect of natural resource rent on tax revenue (Cheliiah et al., 1975 and Tanzi, 1992), recent resource curse literature highlights a negative association between natural resources rents and government tax revenue, suggesting a *crowding-out effect* (Sachs and Warner, 2001; Eltony, 2002; Bornhorst *et* al., 2009; McGuirk, 2013; Crivelli and Gupta, 2014; James, 2015; Belinga *et al*. 2017). Therefore, the effect of natural resources rents on tax revenue is *a priori* ambiguous.

The share of **agriculture in the GDP** is found to be negatively associated with non-resource tax ratio (Cheliiah *et al*., 1975; and Tanzi, 1992; Stotsky and WoldeMariam, 2006). Developing countries are still featured by large shares of the subsistence agricultural sector which is not generating taxable surpluses. In addition, this sector is more often subject to tax exemptions considered as sector providing food for subsistence (Stotsky and WoldeMariam, 2006).

We proxy the **quality of institutions** by the polity2 index assessing the degree of democracy. High and strong economic and political institutions are expected to promote tax administrations allowing more tax revenue collection (Davoodi and Grigorian, 2007); Gupta, 2007; Gordon and Li, 2009; Clist and Morrissey, 2011; Fenochietto and Pessino, 2013; Feger and Asafu-Adjaye, 2014), while the lower quality of institutions portrayed by higher corruption is a threat for tax revenue collection as it affects tax administration and tax officers and occasioning tax evasion.

Equation (4.1) is a dynamic specification since the non-resource tax-to-GDP ratio at period t depends on its past realizations. Thus, relying on classical linear Ordinary Least Squares (OLS) estimator would lead to inconsistent and biased results (Nickel, 1981; Wooldridge, 2002). The appropriate estimator for dynamic panel data models appears to be the popular Generalized Method of Moments (GMM). The GMM estimator is designed for dynamic specifications with

"*small-T, large-N*"[68] panels and allows to tackle potential issues of endogeneity, simultaneous and omitted variables bias. Hence, this estimator will allow, not only to correct the possible endogeneity of our interest variable –financial access– but also to correct for endogeneity of all right-hand side variables by using the lagged values as instruments (one to two lags). Our analysis specifically relied on the system-GMM proposed by Blundell and Bond (1998) with the two-step estimator. However, the validity of the GMM estimation relies on the main assumption that instruments are exogenous (Roodman, 2009). Therefore, we resort to Hansen's test for over-identifying restrictions to check the validity of the instruments. Another condition that validates the GMM estimator is the absence of second-order serial correlation in the residuals in difference. Accordingly, the Arellano-Bond's test is used to check that condition.

4.2.2. Data and Some Stylized Facts

The study is conducted on a sample of 62 developing countries over the period 2004-2018, based on data availability.[69] The dataset consists in a yearly unbalanced panel because of missing observations and is compiled from various sources including the World Bank' Worldwide Development Indicators (WDI), the International Monetary Fund's World Economic Outlook (WEO), Penn World Tables (PWT9.1) and the Polity4 project.[70]

Thought there are currently several of available sources of cross-country tax revenue data including the World Bank, the Organization for Economic Co-operation and Development (OECD), and the Comisión Económica para América Latina y el Caribe (CEPAL), tax revenue data used in this study come from the most recent ICTD/UNU-WIDER, Government Revenue Dataset[71] (henceforth ICTD dataset). This dataset combines several major international databases, as well as drawing on data compiled from all available International Monetary Fund

[68] Meaning few time periods and many individuals, which is the case with our sample.

[69] The developing countries category considered in this paper refers to the World Bank income classification, hence including low-income and middle-income countries. The complete country list by region is provided in Table A1 of Appendices.

[70] See Table A2 for complete definition and sources of variables.

[71] The database is available at https://www.ictd.ac/dataset/grd/.

(IMF) Article IV reports (Prichard *et al*., 2014). ICTD dataset has the advantage to be available for a large number of developing countries which is the focus of this study. More importantly, unlike alternative databases, ICTD dataset has the particularity to exclude natural resource revenue tax revenue[72], then providing a non-resource tax revenue data. Many studies in the literature show that natural resource rents have crowded out incomes from taxation (Bornhorst *et al*. 2009; Ossowski and Gonzáles-Castillo, 2012; McGuirk, 2013; Thomas and Trevino, 2013; Crivelli and Gupta, 2014). In addition, distinguishing revenue from non-resource revenue is of particular importance when it comes to analyze countries' tax effort (Caldeira *et al*., 2020). A competing rich non-resource tax revenue dataset was developed by Mansour (2010) covering 1980-2010 and recently updated to 2015 (see Caldeira et *al*.,2020). However, this database only focuses on 42 Sub-Saharan African countries. We, therefore, relied on ICTD dataset for coverage purpose. Tax data used in this paper cover six tax series namely: (i) total tax revenue; (ii) indirect taxes; (ii) direct taxes; (iv) income taxes; (v) taxes on goods and services, and (vi) value-added tax, all expressed as percentage of GDP.

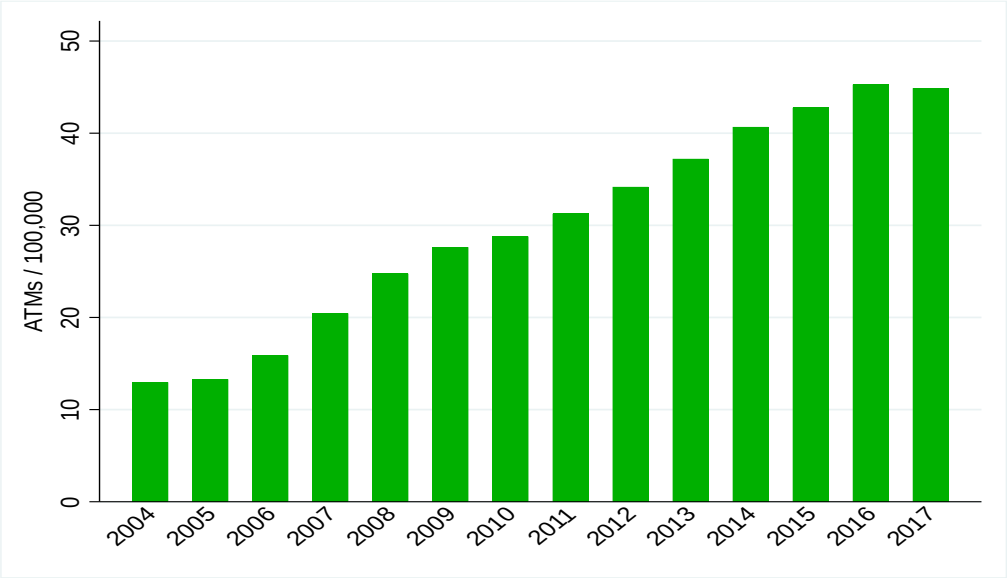
Data on financial inclusion are extracted from the IMF's Financial Access Survey database[73] and include 8 indicators of financial access : (i) the number of automated teller machines (ATMs) per 100,000 adults; (ii) the number of commercial bank branches per 100,000 adults; (iii) the number of loan accounts with commercial banks per 1,000 adults; (iv) number of depositors with commercial banks per 1,000 adults; (v) number of credit unions and credit cooperatives; (vi) outstanding deposits with commercial banks; (vii) number of depositors with commercial banks, and (viii) loan accounts with commercial banks. Higher values of these indicators suggest a greater degree of financial access.

Focusing on the number of ATMs per 100, 000 adults, Figure 4.1 shows an upward trend in developing countries, suggesting that financial access is advancing. More precisely, the number of ATMs/ 100,000 adults recorded considerable progress moving from 13 ATMs per 100,000 adults in 2004 to 45 ATMs in 2017, on average. However, this remains low compared to developed countries with 21 and 63 ATMs for 100,000 people in 2004 and 2017, respectively.

[72] See Prichard *et al*. (2014) and Caldeira *et al*. (2020) for further discussion.

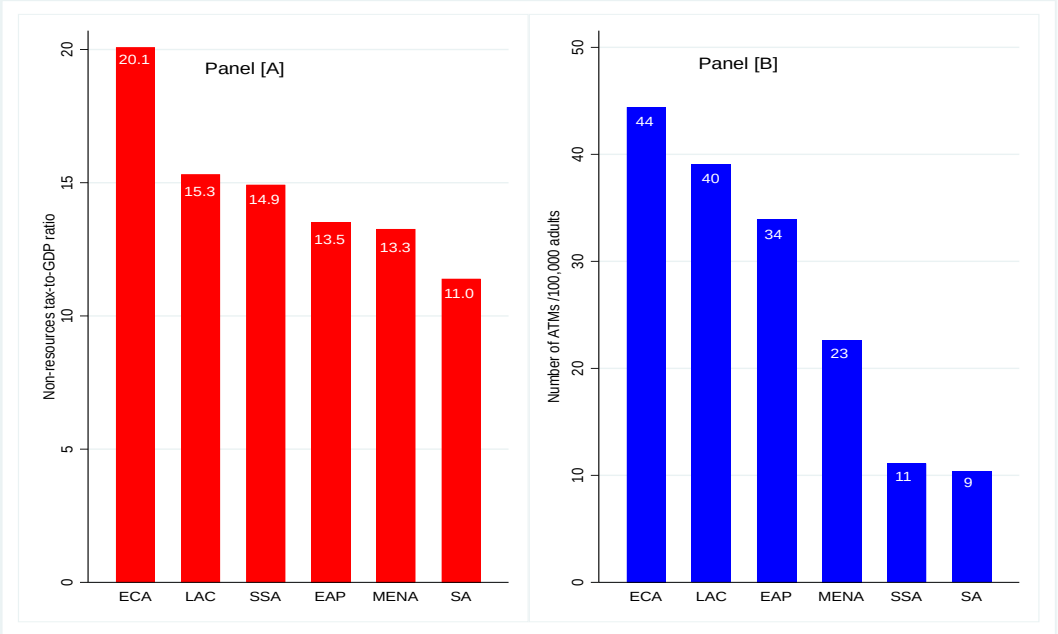
[73] Data available at https://data.imf.org/?sk=E5DCAB7E-A5CA-4892-A6EA-598B5463A34C.

Figure 4.1. Financial Inclusion Over Time (Average Number of ATMs)



Source: Authors' calculations using IMF-FAS Database, 2019

Figure 4.2. Non-resource Tax-to-GDP Ratio and ATMs, by Region (Average Values)



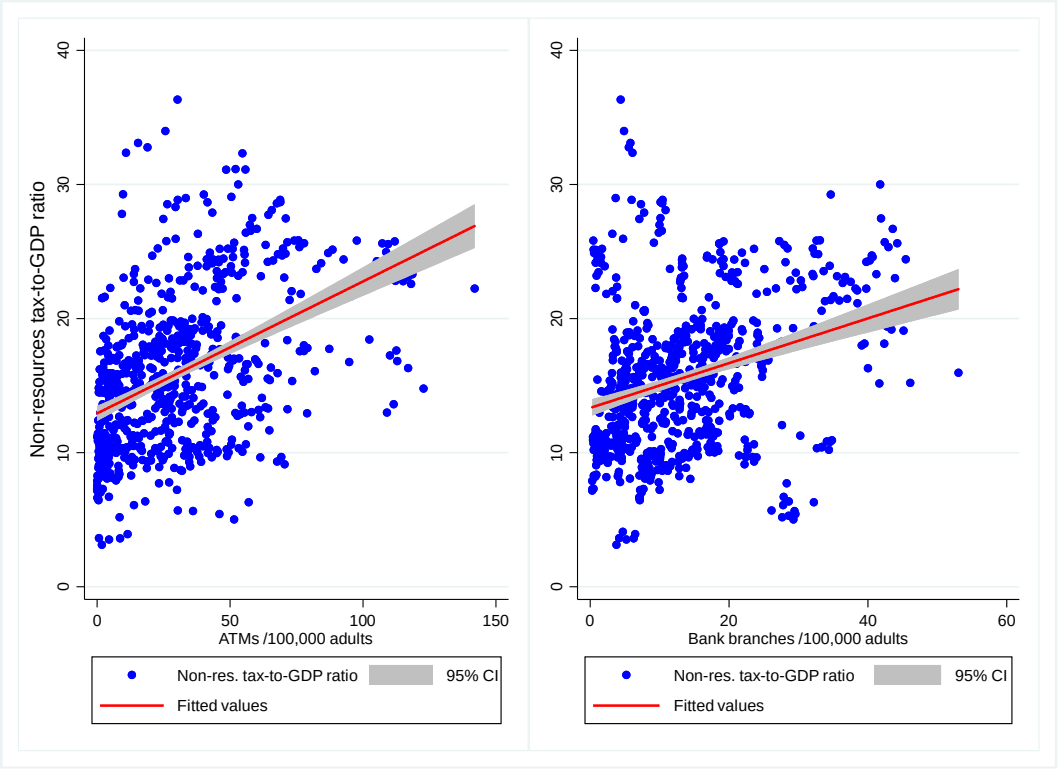
Source: Authors' calculations using ICTD/UNU-WIDER GRD, 2019 and IMF-FAS Database, 2019. Note: ECA= Europe and Central Asia; LAC= Latin America & Caribbean; SSA= Sub-Saharan Africa; EAP: East Asia & Pacific; MENA=Middle East and North Africa; SA= South Asia.

Figure 4.2 depicts countries' tax collection performance measured by the non-resource tax-to-GDP ratio as well as the level of financial access proxied by the number of ATMs per 100,000 adults across regions (Panel [A] and [B], respectively). It emerges that Europe and Central Asia (ECA) and Latin America and Caribbean (LAC) countries have the higher level of financial access in the sample, with on average 44 and 40 ATMs for 100,000 adults, respectively. At the same

time, those countries appear to be the top performers in terms of tax revenue collection with a non-resource tax-to-GDP ratio of 20.1 and 15.3 per cent on average, respectively. In contrast, it comes out that the level of accessing to financial services is very low in South Asia (SA) and Sub-Saharan Africa (SSA) countries with on average, 9 and 11 ATMs for 100,000 adults, respectively. SA is the lower performer region of the sample in terms of tax revenue raising, with an average tax-to-GDP ratio of 11.9. SSA countries have been making tremendous efforts to collect tax revenue (14.9 percent of GDP on average) over recent years as a result of important tax policy and administration reforms (Mansour and Rota-Graziosi, 2013; Ebeke *et al*., 2016) but still have room for greater tax collection. For instance, Caldeira *et al*, (2020) stressed that SSA countries could raise up to 22.75 percent of GDP in non-resource taxes if they fully exploited their tax potential.

In figure 4.3 we provide the correlation between to financial access indicators –the number of ATMs and branches per 100,000 adults – and the total non-resource tax-to-GDP ratio. It clearly appears that more access to financial services is associated with greater tax revenue mobilization.

Figure 4.3. Correlation Between the Number of ATMs and Branches and Non-resource Tax Ratio



Source: Authors' calculations using ICTD/UNU-WIDER GRD, 2019 and IMF-FAS Database, 2019.

4.2. Results

4.2.1. Baseline results

Table 4.1 reports the system GMM-based estimates of the effect of financial inclusion on the non-resource tax-to-GDP ratio in developing countries as specified in equation (4.1). Column [1] shows the results for total non-resources tax ratio, while remaining columns (Columns [2]-[6]) display the results for different tax revenue subcomponents as mentioned above.

Resorting to the number of ATMs as a proxy for access to financial services, our empirical results evidence a positive relationship between financial inclusion and non-resources tax revenue. Indeed, the coefficient associated with financial inclusion is positive and strongly significant at 1 percent level for total non-resource tax (Column [1]). Thus, financial inclusion increases tax revenue mobilization. More precisely, a 1 percentage increase in the number of ATMs leads to an unconditional rise in the non-resource tax revenue ratio by 0.42 percent. Besides, statistical tests do validate our econometric method and the significance (1 percent) in the coefficients associated with the lagged dependent variable underscore an inertia effect which legitimates the choice of dynamic panel specification. The *p-values* of the Hansen test and the Arellano–Bond tests for serial correlation (AR (1) and AR (2)) are reported at the bottom of the table and confirm all the validity of our econometric approach.[74]

Regarding, the composition of tax revenue, the results also support a positive relationship between financial access and all subcomponents of total tax revenue (Column [2] -[6]). More specifically, the coefficient associated with financial inclusion is more sizeable for indirect taxes (Column [2]) compared to the one for direct taxes (Column [3]). This might suggest that more access to financial services allows for greater total tax revenue mobilization through increased consumption and thereby more consumption taxes to collect. This is confirmed by the positive and statistically positive coefficient of financial inclusion on taxes on goods and services (Column [5]), as well as on value-added taxes (Column [6]).

[74] See Roodman (2009) for a complete discussion on GMM method.

Turning to the control variables, the results indicate that the level of development measured by the real GDP per capita and the quality of the institution appears to be relevant determinants of non-resources tax ratio in developing countries and are positively and significantly associated with tax ratio. These findings are consistent with previous evidence (Pessino and Fenochietto, 2010; Fenochietto and Pessino, 2013; Crivelli and Gupta, 2014; Davoodi and Grigorian, 2007); Gupta, 2007; Gordon and Li, 2009; Clist and Morrissey, 2011; Fenochietto and Pessino, 2013; Feger and Asafu-Adjaye, 2014) that strong and good institutional quality is favorable to greater tax revenue collection, and countries' tax capacity is positively related to their level of development. The results also confirm our hypothesis of non-linearity between the level of development and the capacity captured by the negative a significant coefficient associated with the squared of real GDP per capita.

Table 4.1. Baseline Results

Dependent variable: Non-resource tax (in % GDP)	(1) Tot. Tax	(2) Indirect	(3) Direct	(4) Income	(5) Gds & Serv.	(6) VAT
Dep. variable$_{(-1)}$	0.88087***	0.95022***	0.89339***	0.86664***	0.89699***	0.85310***
	(0.040)	(0.029)	(0.046)	(0.028)	(0.063)	(0.049)
ATMs /100,000 adults (Log)	**0.41695*** **	**0.21179***	**0.13574** **	**0.21482** **	**0.20143** **	**0.14093** **
	(0.111)	(0.112)	(0.069)	(0.100)	(0.089)	(0.068)
Real GDP_pc	0.00023**	0.00008	0.00017**	0.00020**	0.00018**	0.00007
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Squared real GDP_pc (Log)	-0.09120**	-0.04770**	-0.05683**	-0.07897***	-0.08599***	-0.03524
	(0.039)	(0.024)	(0.028)	(0.029)	(0.028)	(0.027)
Log total natural resources rents /GDP	0.01585	0.05669	0.13293**	0.15840***	-0.04089	0.02269
	(0.069)	(0.044)	(0.061)	(0.049)	(0.053)	(0.033)
Trade openness	0.90547	0.68684**	0.63542*	0.46477*	0.12896	0.30823
	(0.566)	(0.326)	(0.335)	(0.269)	(0.356)	(0.316)
Agriculture value added / GDP	-0.01669	-0.03456	-0.02782	-0.05122***	-0.04956	-0.00905
	(0.033)	(0.025)	(0.028)	(0.019)	(0.031)	(0.027)
Polity2 index	0.03620***	0.01396	0.02366	0.01393*	0.02252**	0.03557**
	(0.013)	(0.011)	(0.024)	(0.008)	(0.009)	(0.015)
Constant	0.00000	0.00000	0.00000	3.19583	0.00000	0.00000
	(0.000)	(0.000)	(0.000)	(2.053)	(0.000)	(0.000)
Nb. of observations	566	534	494	522	548	478
Countries	61	58	55	59	58	54
AR(1) *p-value*	0.000	0.001	0.000	0.003	0.000	0.001
AR(2) *p-value*	0.826	0.267	0.443	0.552	0.710	0.852
Hansen OID (*p-value*)	0.226	0.187	0.653	0.041	0.443	0.120
Nb. of instruments	35	38	30	41	27	26
Year FE	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent level, respectively. Standard errors are reported in brackets. Note: The number of instruments is strongly limited-starting with the second lag of the dependent variable and the first lag of the control variables- to avoid the over-fitting problem. In all specifications, the null hypothesis for lack of first-order (AR (1)) serial correlation in the first-differenced error terms is rejected, while not rejected for the second-order (AR (2)). In addition, the robust (to heteroskedasticity and autocorrelation) Hansen's p-value validates the over-identification restrictions. All of these statistical tests validate the econometric method, and the lagged variables can be safely used as instruments. This applies to all regressions in the chapter.

In line with previous findings (Tanzi, 1992; Stotsky and WoldeMariam, 2006; Bornhorst *et* al., 2009; Pessino and Fenochietto, 2010; McGuirk, 2013; Crivelli and Gupta, 2014), natural resources rents, trade openness and agriculture value-added are also determining factors of non-resources tax subcomponents (columns [2], [3] an [4]), while they appear to be non-significant on the total tax ratio.

4.2.2. Transmission channel

This section explores the main channels through which financial inclusion influences non-resource tax ratio. As stressed above, financial inclusion leads to increased household consumption and business development. Relying on this literature, we expect financial inclusion to affect tax revenue through increased business development and private consumption. Easy access to financial services allows both households and firms (*e.g.*, SMEs) with credit facilities to finance productive investments and increase their consumption. That in turn generates, both, income[75] and consumption tax opportunities for government. Besides, financial inclusion would positively affect tax revenue through business development based on the rational that business expansion is associated with job creation[76] (*i.e.,* decrease in the unemployment rate) and income generation for households, thereby income taxes to collect. We proxy the households' consumption by the private consumption per capita, while the business development *induced-effect* of financial inclusion is captured through the unemployment rate. However, since these transmission channels might be direct or indirect, we proceeded in two steps: first, we estimate the effects of financial access on each channel, then we estimate the effects of each variable on the total non-resource tax ratio.[77]

[75] Taxes on income, profits, & capital gains: corporations.

[76] Teima *et al.* (2010) highlighted that SMEs contribute up to 45 percent of employment in developing countries. It is also worth mentioning that the employment effect from greater access to financial services could be dived into two sub-effects: (i) new job creation and (ii) an increase in labor demand from existing businesses. However, data unavailability on such a variables does not allow to distinguish these specific effects in the analysis that could be of policy-relevant recommendations.

[77] An alternative popular approach in the literature to test whether the effect of financial inclusion on non-resource tax-to-GDP ratio would transmit through the considered channels, consists to run our baseline regression interacting the financial inclusion indicator with each transmission channel (see *e.g.*, Caballero, 2016; Compaore *et al.*, 2020 among other). If the coefficients associated with financial inclusion indicator works out to be non-significant when the interactive terms and the transmission channels are included, we then conclude that the effect financial

The first step estimation results are reported in Tables 4.2. The results show that more access to financial services is associated with greater private consumption (column [1]) and a lower unemployment rate (column [2]), confirming previous findings.

Table 4.2. Transmission Channels

	Private consumption_pc	*Unemployment*
	(1)	(2)
ATMs /100,000 adults (Log)$_{(-1)}$	0.09155***	-3.07251*
	(0.018)	(1.638)
Debt to GDP ratio$_{(-1)}$	-0.00007	0.00961
	(0.001)	(0.026)
Real GDP_pc$_{(-1)}$	0.00012***	0.00164
	(0.000)	(0.001)
GDP growth$_{(-1)}$	0.00125	0.01854
	(0.001)	(0.041)
Gross fixed capital formation / GDP$_{(-1)}$	-0.00136	-0.34860**
	(0.002)	(0.138)
GINI index$_{(-1)}$	-0.00117	-0.09378
	(0.003)	(0.108)
Trade openness$_{(-1)}$	-0.00325	-5.84236*
	(0.052)	(3.184)
Log inflation$_{(-1)}$	-0.00820***	0.02292
	(0.002)	(0.124)
Human capital index$_{(-1)}$	0.04621	-3.31473
	(0.118)	(6.625)
Constant	6.97473***	52.15080*
	(0.347)	(27.423)
Observations	204	220
Countries	33	39
R-squared	0.814	0.396

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent level, respectively. Robust standard errors are reported in brackets. Note: fixed effects are included.

In Table 4.3, we report the results of the effect of the transmission channels on our tax variable. In line with our main hypothesis, households private consumption is positively and significantly associated with total non-resources tax ratio, as well as different tax subcomponents (Panel [A], columns [1]-[6]). Greater private consumption means an increase in consumption tax revenue such as the VAT. It is worth noting that value-added tax has become one of the most important tools of revenue mobilization in the developing world about one-quarter of total tax revenue

inclusion on tax revenue can be assumed to operate through private consumption and job creation as a result of business development and expansion. Based on this approach, the results also confirm our hypothesis.

is raised through value-added tax. (Keen and Lockwood, 2006, 2016, Gerard and Naritomi, 2018). The value-added tax also presents the advantage to be less distortionary in addition to its *self-enforcing* properties (Kopczuk and Slemrod, 2006).

In Panel [B] of Table 3, we present the results using the unemployment rate. It emerges that the unemployment rate is negatively linked to total tax ratio (column [1]), as well as income taxes and value-added tax (columns [1] and [6], respectively). Financial inclusion reduces unemployment by increasing business and enhancing income-generating activities, hence providing opportunities to collect income taxes both on individuals and corporates.

Overall, our results confirm that financial inclusion is conducive to higher tax revenue collection through private consumption and business expansion.

Table 4.3. Effects of Transmission Channel Variables on Tax Revenue Variable

Dependent variable: Non-resource tax ratio	Tot. Tax	Indirect	Direct	Income	Goods & Serv.	VAT
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel [A]: Private consumption					
Private consumption_pc (log)	4.47171***	2.23892***	2.69600***	1.93726***	2.15500***	1.57607**
	(1.061)	(0.807)	(0.474)	(0.610)	(0.750)	(0.665)
Constant	-17.83325**	-6.19513	-14.90227***	-8.93711*	-7.90796	-6.69822
	(7.979)	(6.065)	(3.576)	(4.588)	(5.649)	(4.996)
Observations	416	383	364	381	384	326
Countries	37	35	35	36	35	32
R-squared	0.180	0.073	0.272	0.109	0.110	0.133
	Panel [A]: Unemployment					
Unemployment	-0.05045*	-0.01662	-0.02540	-0.05030**	0.00001	-0.02348*
	(0.025)	(0.021)	(0.019)	(0.024)	(0.018)	(0.013)
Constant	16.60980***	11.10105***	5.66047***	6.12380***	8.85711***	6.10331***
	(0.205)	(0.174)	(0.156)	(0.197)	(0.149)	(0.107)
Observations	443	416	385	416	426	381
Countries	56	55	51	55	56	53
R-squared	0.015	0.003	0.011	0.023	0.000	0.013

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent level, respectively. Robust standard errors are reported in brackets. Note: fixed effects are included

4.2.3. Robustness Checks

In this section, we undertake three robustness exercises to check the validity of our findings. First, we test the sensitivity of the results from the baseline specification to additional control

variables, including the level of education, inflation, the population size, external aid received, domestic financial sector development, remittances inflows and the tax structure.[78]

A higher level of education is expected to increase tax compliance. Similarly, a large population, a well-functioning financial sector and remittances flows received are positively associated with tax ratio, while higher inflation episodes and external assistance are negatively linked to tax collection capacity.

Results are reported in Table 4.4 and are similar to the baseline findings. The coefficients associated to the population size, financial sector development and tax diversification index are positive and significant (columns [3], [5] and [7], respectively). A large population constitutes a potential for tax collection. In addition, a well-developed financial sector and greater access to credit allow individuals and corporates to finance profitable projects, which in turn favor tax contribution. Having a diversified tax base is associated with greater tax revenue collection. The results also show that inflation harms tax revenue mobilization (column [4]), corroborating the *Tanzi effect*.

[78] These variables are considered in the literature as possible determinants of tax revenue (see *e.g.*, Tanzi, 1977, Gupta *et al.* 2014, Gordon and Li, 2009, Pessino and Fenochietto, 2010, Clist and Morrissey 2011, Ebeke, 2011, Benedek *et al.* 2012, Asafu-Adjaye (2014), and Compaore *et al.*, 2020 among others).

Table 4.4. Robustness Check: Adding more Control Variables

Dependent variable: Total non-resource tax-to-GDP ratio							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. variable$_{(-1)}$	0.83851***	0.85198***	0.84004***	0.84156***	0.92508***	0.89801***	0.96098***
	(0.065)	(0.068)	(0.053)	(0.066)	(0.044)	(0.047)	(0.049)
ATMs /100,000 adults (Log)	0.37651**	0.35622**	0.41247***	0.37169***	0.40795***	0.43021***	0.67880**
	(0.161)	(0.163)	(0.115)	(0.132)	(0.140)	(0.158)	(0.327)
Human capital index	0.26274	0.06969	0.19853	0.00372	-0.34542	-0.34912	-1.07822
	(0.565)	(0.649)	(0.437)	(0.569)	(0.425)	(0.423)	(0.704)
Log inflation		-0.01366	-0.00528	-0.01874	0.00513	0.01492	0.00361
		(0.028)	(0.027)	(0.032)	(0.021)	(0.020)	(0.034)
Log total population			0.18675*	0.15694	-0.27982	-0.25708	0.13004
			(0.107)	(0.169)	(0.174)	(0.184)	(0.520)
Log Net ODA received_pc				-0.27082*	-0.09633	-0.04720	0.07013
				(0.148)	(0.082)	(0.090)	(0.277)
Financial markets efficiency					1.56812***	1.39023**	1.60892**
					(0.567)	(0.639)	(0.753)
Remittances (% GDP)						0.00880	-0.01429
						(0.022)	(0.029)
Tax diversification							2.17651*
							(1.121)
Control variables	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Nb. of observations	460	454	454	431	431	424	248
Countries	55	55	55	54	54	53	34
AR(1) *p-value*	0.000	0.000	0.000	0.000	0.000	0.000	0.025
AR(2) *p-value*	0.930	0.774	0.978	0.743	0.440	0.263	0.866
Hansen OID (*p-value*)	0.419	0.183	0.534	0.584	0.370	0.144	0.177
Nb. of instruments	26	26	36	32	35	37	37
Year FE	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent level, respectively. Standard errors are reported in brackets. Note:: Constant terms, as well as vector X variables are included but not reported for space purpose.

Second, up to now, we used the number of ATMs per 100,000 adults to measure financial inclusion in developing countries. However, financial inclusion is a multifaceted concept which encompasses various dimensions (Espinosa-Vega *et al*., 2020). In addition, the access to banking services widely varies across countries and is changing over time. For instance, developing countries are increasingly shifting from traditional banking toward digital banking and finance with an important use of mobile money. Hence, relying on traditional banking may poorly capture the real state of financial inclusion.[79] Furthermore, as stressed in Coulibaly and Yogo (2019), ATMs as well as bank branches in developing countries may be unevenly distributed within countries and tend to be more often concentrated in large cities (Guerineau and Jacolin, 2014). Hence, people in rural areas will not get access to financial services. Finally, our baseline financial inclusion measure does take into account microfinance institutions

[79] We point out this fact, but data scarcity does not allow us include a financial inclusion indicator capturing mobile and digital banking (*e.g*., the number of registered and active mobile money agent outlets).

(MFIs), credit unions or financial cooperatives which play a pivotal role in providing financial services in developing countries. We, therefore, paid particular attention to these shortcomings by considering several alternative indicators to capture financial access in a more comprehensive way. The results are reported in Appendix 4.4 and overall, they support those presented in Table 4.1.

We finally exploit an alternative data source to test the validity of our findings. As mentioned above, several tax data sources have been used in the literature. In this robustness exercise, we use the IMF's GFS tax database which also provides detailed classification of government's tax revenues. Appendix 4.5 of appendices reports the estimation results. The results show that the coefficients associated financial inclusion are positive and strongly significant at the 1 percent level for total tax revenue (column [1]) and some tax subcomponents (columns [3], [4] and [6]). Therefore, our baseline findings remain valid.

4.3. Conclusion

The present chapter adds to the literature on tax revenue mobilization, by empirically examining the relationship between access to financial services and non-resources tax-to-GDP ratio in developing countries. Relying on the popular system-GMM estimator of Blundell and Bond (1998), this chapter is the first, to the best of our knowledge, to take into account the inertia in the tax revenue ratio and the possible endogeneity of financial inclusion as well all control variables. Based on a panel data of 62 developing countries over the period 2004-2017, the chapter finds that financial inclusion is positively and significantly associated with non-resources tax revenue. Exploring the effect on the tax structure, the results show that access to financial services has a more sizeable effect on indirect taxes than the rest of total tax subcomponents. The chapter also provides empirical evidence that financial inclusion is inducive to higher tax revenue, mainly through increased private consumption and business expansion. Furthermore, in line with previous evidence, our results show that the level of development as well as the quality of institutions are important determinants of tax ratio and are positively associated with tax revenue performance in developing countries. However, the

relationship between the level of overall development turns out to be non-linear, suggesting the existence of a tipping point.

In terms of policy recommendations, our study concurs with previous findings and call for an improved and greater access to financial services. In view of the pressing financing needs to finance structural investments in the developing world, our paper provides insights to countries that have implemented or are in the process of implementing financial inclusion policies, on tax resources harnessing opportunities from better access to financial services. In addition, in the current particular context of coronavirus (Covid-19) pandemic causing severe economic despair across the world and requiring important financial resources for a timely and appropriate response, unlocking access to financial services will help to better cope with the income shock and to smooth households consumption.

Appendices

Appendix 4.1. Country List

Region	Country	Region	Country
LAC	Argentina	ECA	Albania
	Bolivia		Armenia
	Brazil		Azerbaijan
	Chile		Belarus
	Colombia		Georgia
	Costa Rica		Kazakhstan
	Dominican Republic		Kyrgyz Republic
	Ecuador		Macedonia
	El Salvador		Moldova
	Guatemala		Montenegro
	Honduras		Russia
	Mexico		Serbia
	Nicaragua		Tajikistan
	Panama		Turkey
	Paraguay		Ukraine
	Peru	EAP	Cambodia
	Uruguay		Indonesia
	Venezuela		Malaysia
SSA	Central African Republic		Mongolia
	Madagascar		Philippines
	Malawi		Thailand
	Mali		Vietnam, Democratic Republic of
	Namibia	SA	Bangladesh
	Niger		Bhutan
	Nigeria		India
	Rwanda		Pakistan
	Senegal		Sri Lanka
	South Africa	MENA	Egypt
	Togo		Iran
	Uganda		Jordan
	Zambia		Tunisia

Appendix 4.2. Descriptive Statistics

Variables	Obs.	Mean	Std. Dev.	Min	Max
Real GDP_pc	739	4,220	3,529	284.4	14,688
GDP growth (annual %)	739	4.908	4.247	-36.7	34.5
Total natural resources rents (% of GDP)	738	7.327	7.84	0.071	44.56
Population, total	741	3.92E+07	5.44E+07	613,353	2.58E+08
Trade (% of GDP)	738	78.54	34.05	21.45	210.4
Number of credit unions and credit cooperatives	373	4,193	18,916	1	111,797
Depositors with commercial banks	455	1.75E+07	2.73E+07	37,746	1.32E+08
Loan accounts with commercial banks	450	1.46E+07	4.91E+07	1,400	4.67E+08
Outstanding deposits with commercial banks	836	1.61E+08	8.53E+08	170.7	1.10E+10
Number of commercial bank branches/ 100,000 adults	822	13.68	11.66	0.289	71.21
Number of depositors with commercial banks/ 1,000 adults	455	568.5	531.8	7.513	3,380
Number of loan accounts with commercial banks/ 1,000 adults	450	323.9	359.3	0.529	2,909
Automated teller machines (ATMs) /100,000 adults	785	30.95	29.05	0	185.3
GINI index	473	41.33	8.939	24	64.8
Agriculture value added / GDP	852	13.3	8.996	2.089	43.4
Tax-to-GDP ratio	781	15.76	5.674	3.133	36.33
Direct taxes	680	5.208	2.717	0.0182	17.44
Taxes on income	731	5.403	2.8	0	18.01
Taxes on property	601	0.307	0.399	0	1.847
Indirect taxes	749	10.57	4.233	1.619	26.54
Total taxes on goods and services	761	8.319	3.77	0.422	18.91
Value-added tax (VAT)	675	5.326	2.98	0	14.68
Taxes on trade	748	1.749	1.759	0.169	13.13
Debt-to-GDP ratio	711	41.36	22.25	3.89	160.5
Polity2 index	739	4.453	5.202	-10	10
Inflation	742	7.314	7.802	-3.109	121.7
Gross fixed capital formation / GDP	858	25.12	8.071	6.812	69.53
Net ODA received_pc	852	45.88	48.88	-49.54	304.6
Human capital index	616	2.359	0.55	1.137	3.357
Financial markets efficiency	671	0.188	0.283	0	1
Private consumption_pc	430	2,434	1,709	311.5	8,406
Remittances/ GDP	840	5.93	7.208	0.0106	44.13
Unemployment	476	8.049	6.181	0.914	46.03
Tax revenue diversification index	381	0.622	0.276	0.155	1.539
Private credit bureau	374	17.631	17.063	0	54

Appendix 4.3. Sources and Definitions of Data

Variables	Definition	Sources
ATMs / 100,000 adults	Automated teller machines (ATMs) (per 100,000 adults)	IMF, FAS 2019 Dataset
Bank branches/ 100,000 adults	Number of commercial bank branches per 100,000 adults	
Loan accounts/ 1000 adults	Number of loan accounts with commercial banks per 1,000 adults	
Depositors/ 1000 adults	Number of depositors with commercial banks per 1,000 adults adults	
Credit unions and cooperatives	Number of credit unions and credit cooperatives	
Outstanding deposits	Outstanding deposits with commercial banks	
Depositors with CBs	Depositors with commercial banks	
Loan accounts with CBs	Loan accounts with commercial banks	
Tax-to-GDP ratio	Non-resource tax excluding social contributions	ICTD/UNU-WIDER, GRD 2019
Indirect taxes-to-GDP ratio	Indirect taxes excluding social contributions and resource revenue	
Direct taxes-to-GDP ratio	Direct taxes excluding social contributions and resource revenue	
Taxes on income-to-GDP ratio	Taxes on income, profits, and capital gains	
Taxes on goods-to-GDP ratio	Taxes on goods and services, Total	
Value-added tax-to-GDP	Value-added tax	
Tax on property-to-GDP	Taxes on property	
Taxes on trade-to-GDP	Taxes on international trade and transactions	
Tax diversification index	Theil index-based tax revenue diversification index	Compaore *et al*. (2020)
Real GDP_pc	Real GDP_pc	World Bank's World Development Indicators (WDI, 2019)
Resources rent	Total natural resources rents (% of GDP)	
Trade openness	Sum of total imports and exports (% of GDP)	
Agriculture VA	Agriculture value added (% of GDP)	
Population	Total population	
Aid_pc	Net official development assistance received per capita (current US$)	
Remittances	Personal remittances, received (% of GDP)	
Public investment	Gross fixed capital formation (% of GDP)	
GDP growth	GDP growth (annual %)	
GINI index	GINI index	
Private consumption_pc	Households and NPISHs Final consumption expenditure per capita	
Unemployment	Unemployment with advanced education (% of total labor force with advanced education)	
Inflation	Inflation, average consumer prices	World Economic Outlook (WEO, 2019)
Financial sector efficiency	Financial markets efficiency	IMF's Financial Development Index Database
Public debt-to-GDP ratio	Debt to GDP ratio	Ali Abbas *et al*. (2010)
Human capital index	Human capital index	Penn World Table (PWT9.1)
Polity2 index	Polity2 index	Polity4 Project

Appendix 4.4. Robustness Check: Using Alternative Financial Inclusion Variables

Dependent variable: Total non-resource tax-to-GDP ratio							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. variable$_{(-1)}$	0.98195***	0.91934***	0.99999***	0.97207***	0.96158***	0.94884***	0.93131***
	(0.026)	(0.034)	(0.065)	(0.039)	(0.035)	(0.047)	(0.039)
Bank branches /100,000 adults (Log)	0.39697*						
	(0.216)						
Loan accounts with CBs / 1,000 adults		0.00085**					
		(0.000)					
Depositors with CBs/ 1,000 adults (Log)			0.39437***				
			(0.130)				
Credit unions and credit cooperatives (Log)				0.17861*			
				(0.094)			
Outstanding deposits with CBs (Log)					0.22248**		
					(0.104)		
Depositors with CBs (Log)						0.26622**	
						(0.130)	
Loan accounts with CBs (Log)							0.00000**
							(0.000)
Control variables	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Nb. of observations	585	320	341	282	591	341	320
Countries	61	38	37	31	61	37	38
AR(1) *p-value*	0.000	0.003	0.000	0.000	0.000	0.000	0.005
AR(2) *p-value*	0.938	0.277	0.933	0.345	0.726	0.971	0.324
Hansen OID (*p-value*)	0.145	0.276	0.308	0.257	0.113	0.334	0.350
Nb. of instruments	34	37	27	30	33	32	27
Year FE	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent level, respectively. Standard errors are reported in brackets.

Appendix 4.5. Robustness Check: Using Alternative Tax Data Source

Dependent variable: Non-resource tax-to-GDP ratio						
	(1)	(2)	(3)	(4)	(5)	(6)
	Tot. Tax	Indirect	Direct	Income	Gds & Serv.	VAT
Dep. variable$_{(-1)}$	0.93419***	0.94664***	0.72407***	0.55052***	0.83982***	0.84138***
	(0.054)	(0.019)	(0.048)	(0.073)	(0.043)	(0.026)
ATMs /100,000 adults (Log)	0.57344***	0.03778	0.09862***	0.17310**	0.03613	0.09707***
	(0.221)	(0.038)	(0.035)	(0.084)	(0.069)	(0.038)
Real GDP_pc	0.00051**	0.00041***	0.00004	-0.00007	0.00025***	0.00030***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Squared real GDP_pc (Log)	-0.22008**	-0.09573***	-0.01931	0.01345	-0.06755**	-0.09786***
	(0.096)	(0.022)	(0.035)	(0.048)	(0.033)	(0.017)
Total natural resources rents (Log)	0.24967	-0.08976*	0.32007***	0.41351***	-0.18594**	0.04066
	(0.155)	(0.047)	(0.073)	(0.117)	(0.079)	(0.038)
Trade openness	2.61191***	-0.01759	1.55332***	1.70134***	-0.01693	0.98626***
	(0.993)	(0.279)	(0.511)	(0.383)	(0.375)	(0.274)
Agriculture value added	-0.15356*	-0.01422	-0.06269**	-0.05246	-0.03955	-0.05176***
	(0.082)	(0.014)	(0.029)	(0.051)	(0.034)	(0.018)
Polity2 index	0.05684**	0.01377	0.02256	0.00114	0.01302	0.03541***
	(0.029)	(0.009)	(0.022)	(0.021)	(0.014)	(0.013)
Constant	1.90469	5.33194***	-3.96212	-5.64911	5.34860**	1.76028
	(7.966)	(1.773)	(3.056)	(3.996)	(2.613)	(1.610)
Nb. of observations	431	321	320	431	421	411
Countries	52	37	37	52	52	51
AR(1) *p-value*	0.000	0.003	0.006	0.009	0.000	0.023
AR(2) *p-value*	0.234	0.213	0.858	0.241	0.370	0.581
Hansen OID (*p-value*)	0.121	0.290	0.249	0.766	0.176	0.377
Nb. of instruments	27	32	26	27	27	36
Year FE	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent level, respectively. Standard errors are reported in brackets.

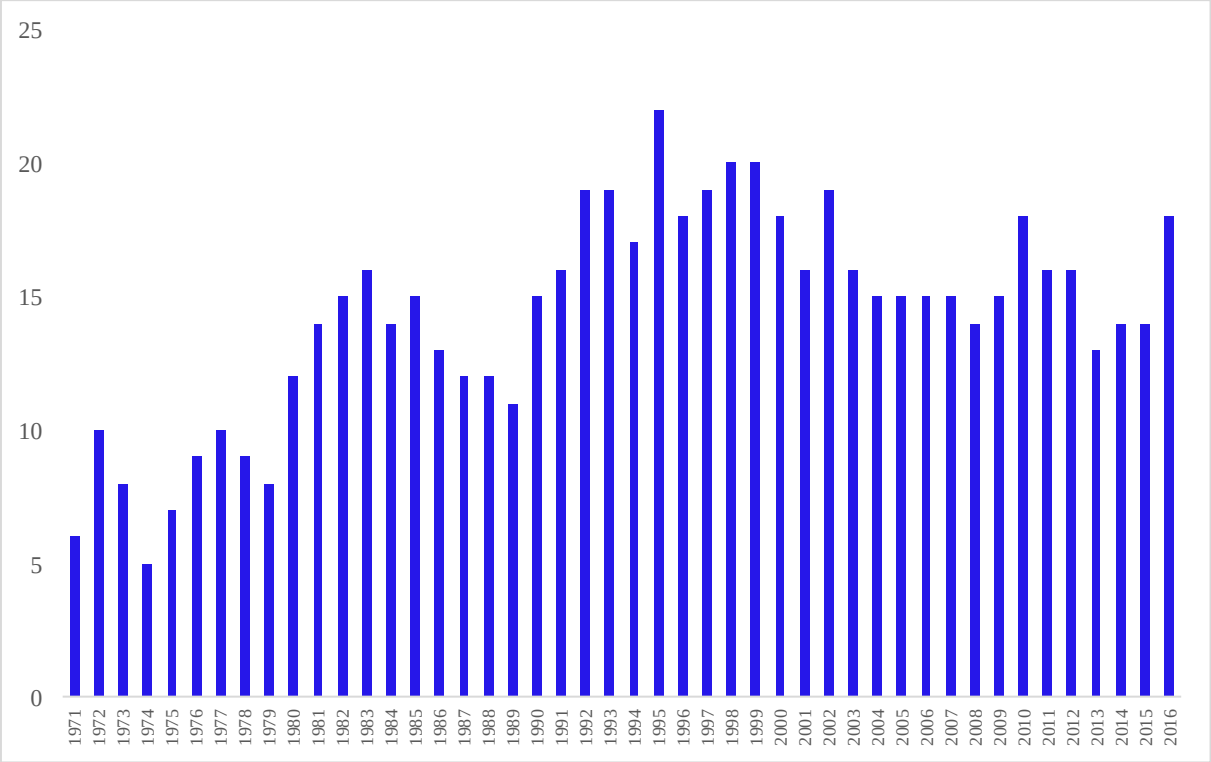
Chapter 5: The Impact of Conflicts and Political Instability on Banking Crises in Developing Countries*

*This chapter is co-authored with M. Mlachila, R. Ouedraogo, and W. Sandrine Sourouema. A version was published in IMF Working Paper Series and is currently under advanced review in *The World Economy*.

5.1. Introduction

There has been a marked proliferation of violence and conflicts across the developing countries over the past two decades, especially in the wake of the Arab spring from 2011 (Figure 5.1). The nature of the violence is diverse and includes ethnic and religious conflicts, terrorism, post-electoral conflicts, civil wars, and most importantly armed conflicts. Violence has undoubted deep socio-economic impact on affected countries and their neighbors. For instance, the World Bank (2017) estimates at more than 400,000 the death toll and US$200-300 billion the loss in GDP in Syria since the conflict started in 2011.

Figure 5.1. Number of Countries in Conflict



Source: Uppsala Conflict Data Program and authors' calculations.

Conflicts and violence have severe negative consequences on the affected economies, and which can spill over to their neighboring countries. In addition to the loss of lives, human displacement and the material destruction caused, conflicts can result in deep economic recession stemming from high inflation, worsened fiscal and financial positions, and lower institutional quality (Rother *et al.*, 2016). In addition, internal instability entails a decline in investor and consumer confidence, and trade disruption (Rother *et al.*, 2016). According to the

IMF (2019), on average, in conflict-affected countries annual real GDP growth is 3 percentage points lower and the cumulative impact on per capita GDP increases over time. Furthermore, internal conflicts have negative spillovers on neighboring countries, whose GDP growth typically declines by about 1 percentage point on average.

In this chapter, we explore the impact of conflicts on the probability of banking crises, a channel that has hitherto received little attention in the literature. The literature has largely focused on the potential consequences of risks of instability on other socio-economic outcomes. It is well-documented that instability has adverse effects on countries' long-run economic performance (Alesina *et al*.,1996; Alesina and Perotti, 1996; Jong-A-Pin, 2009; Aisen and Veiga, 2013; Rother *et al*., 2016, Murdoch and Sandler, 2002), public investment (Alesina *et al*. 1996, IMF 2019), trade (Qureshi, 2013), tourism (Neumayer, 2004) and fiscal outcomes (IMF 2019). Surprisingly, to the best of our knowledge, there is no empirical study on the potential impact of conflict on banking crises. Although IMF (2019) and Rother *et al*. (2016) allude to the fact that conflicts can lead to lower performance in the banking sector, they do not provide empirical evidence on whether conflicts and political instability can trigger actual systemic banking crises.

Conflicts and political instability can indeed be associated with a greater risk of systemic banking crisis. Conceptually, there are several channels through which conflicts can lead to banking crises. These include lower economic growth, higher bank non-performing loans, lower bank deposits and liquidity, and fiscal channels. Rother et al. (2016) emphasized that conflicts weaken the performance of the financial sector and deteriorate banks' ability to sustain financial intermediation and payment systems. A recent study by Huang (2019) found that political instability decreases banks' balances, liabilities and assets. Beim (2005) enumerated several cases of systemic banking crises that occurred in times of conflict and political instability. For instance, in 1995, during the civil war in Sierra Leone, 40 to 50 percent of banking system loans were non-performing (NPLs) and a license of one of the banks was suspended in 1994. Gobat and Kostial (2016) found that the Syrian conflict deeply affected the banking sector by causing deposit and assets runs and raising NPLs from less than 5 to 35% over 2010-2013.

This chapter fills the gap in the literature by rigorously studying the potential impact of conflict and political instability on systemic banking crisis in 92 developing countries over the period 1970-2016. First, it explores this by using various measures of conflict and political instability on the probability of banking crises. Second, the paper analyzes spillovers of conflict and political instability from one country to another. Third, it examines whether the duration of conflict and political instability increases the probability of banking crises. Fourth, it explores the channel through which conflict and political instability affect the likelihood of banking crises.

The chapter has three main results. First, it shows that conflicts and political instability are indeed associated with higher probability of systemic banking crises. Specifically, it finds that the odds of a banking crisis are 2.5 times greater when a country is affected by a conflict. Second, conflicts and political instability in neighboring countries do increase the likelihood of banking crises in a given country, although the spillover effects are less impactful than primary channels. Third, the duration of a conflict is positively associated with rising probability of a banking crisis. In terms of magnitude of the impact, the probability of experiencing a banking crisis is 25 percent when the conflict lasts 10 years, against 16.4 percent when it lasts two years.

The chapter provides evidence that the likely channel of transmission is the occurrence of fiscal crises following a conflict or political instability. The findings are robust to the use of alternative conflict and political instability indicators from 10 different sources, alternative empirical strategy, and the inclusion of additional covariates. This paper contributes to the vast literature on the adverse effects of conflict and political instability. It is the first to provide a comprehensive empirical study about the impact of conflict and political instability on the likelihood of banking crises in developing countries. Previous studies have provided several claims on the specific cases of some countries (Beim, 2005; Rother *et al*., 2016), but they lacked strong empirical evidence on a large sample of countries to back up or substantiate the claims.

The rest of the chapter is organized as follows. Section 2 briefly reviews the literature on the determinants of banking crises and the potential mechanisms through which conflicts can provoke banking crises. Section 3 describes the data and provides some stylized facts, and Section 4 discusses the empirical strategy. Section 5 presents the results from the empirical

analysis. Section 6 undertakes an extensive battery of robustness tests. Section 7 provides some concluding remarks.

5.2. Review of the Literature

There is an increasing literature on the economic consequences of conflicts and political instability, with a particular emphasis on economic growth, income inequality and poverty (Collier, 1999; Murdoch and Sandler, 2004; Lai and Thyne, 2007; Polachek and Sevastianova, 2012; Mueller, 2013). For instance, Gates *et al*. (2012) showed that armed conflicts led to development gaps and compromised the progress in meeting the United Nation's Millennium Development Goals (MDGs) by undermining the efforts to reduce poverty, hunger and infant mortality, improve life expectancy as well as access to potable water. Ghobarah *et al*. (2003) also emphasized the adverse long-lasting effects of conflicts on development outcomes. Beyond the impact on the economy at the aggregate level, some papers looked at the change in the structure of economies affected by conflict. Depetris Chauvin and Rohner (2009) found that the manufacturing sector is the most affected in conflict-affected countries, while natural resource sector appears to be over-exploited in times of conflict.

Another wave of the literature has focused on the fiscal implications of conflicts and political instability (IMF 2019; Gupta *et al*., 2004; Rother *et al*., 2016). Internal instability impedes on government revenue by disrupting economic activity, destroying the tax base, and lowering the efficiency of tax administration (IMF 2019). Barrett (2018) revealed that the conflict in Afghanistan led to a total revenue loss of about $3 billion between 2005 and 2016, resulting mainly from a significant decline in revenue collection efficiency. Similarly, Rother *et al*. (2016) emphasized that central government revenue collapsed by about 60 percent following the outbreak of the conflict in Yemen in 2015. They also argued that the decline in both internal revenue collection and external financing combined with the increase in government spending have resulted in worsened fiscal positions in the Middle East and North African countries in conflict.

Focusing on sub-Saharan Africa, IMF (2019) found that conflicts entail, on average, a loss of tax revenue by about 2 percent of GDP, affect the composition of government expenditures and

worsen the fiscal balance. Using an intertemporal model, Pasten and Cover (2010) highlighted that political instability result in fiscal deficits, and this happens because political instability gives the government an incentive to implement a myopic fiscal policy in order to increase its chances of remaining in office.

However, there is a paucity of studies about the effects of conflicts and political instability on the banking sector. Rother *et al*. (2016) argued that conflicts weaken the performance of the financial sector and deteriorate bank's ability to sustain financial intermediation and payment systems, but they did not provide any empirical findings. Recently, IMF (2019) found that conflicts result in lower credit to the private sector. Huang (2019) investigated the impact of political instability on banking sector development on a panel of 49 countries over 1960-2004. The paper found that political instability deteriorates banks' balance sheets, generates inefficiencies in the operational management of banks and affects asset and liability allocation. Hasanov and Bhattacharya (2019) explored the effect of political factors on the likelihood of a banking crisis using a sample of OECD countries. They shed light that countries with higher government stability tend to have lower likelihood of a banking crisis. Gobat and Kostial (2016) asserted that the Syrian conflict deeply affected the banking sector by causing deposit and assets runs, and rising NPLs from less than 5 to 35% over 2010-2013.

As described above, several papers have found that conflict and political instability often lead to a deterioration of government fiscal positions. We draw on the literature about the transmission of crises from the government fiscal positions to the banking sector (Von Hagen and Ho, 2007; Reinhart and Kaminsky, 1999; Dornbusch *et al*., 1995). According to this literature, banking crises often happen after a fiscal crisis. Worsened fiscal positions can trigger a banking crisis due to the balance-sheet linkages and banks' direct portfolio exposures (Caprio and Honohan, 2008; Caruana and Avdjiev, 2012) and the potential impact of debt defaults on the economy (lower growth, high non-performing loans, etc.) (Gertler and Kiyotaki, 2010). Budgetary pressures erode the government ability to pay its bills, which can cause an accumulation of arrears to commercial enterprises and banks and increasing banks non-performing loans. Moreover, sovereign debt is often used by banks as collateral to secure wholesale funding. Higher sovereign risk can reduce the eligibility of collateral, and hence banks' funding capacity and increase banks vulnerabilities (Popov and Van Horen, 2013).

5.3. Data Sources and Stylized Facts

5.3.1. Data Sources

The dataset consists of yearly data for 92 emerging and developing countries during the period 1970–2016. The selection of the sample is exclusively based on data availability.

We first focus on the dependent variables. The data on systemic banking crisis are from Laeven and Valencia (2018). The authors define a banking crisis as an event that meets two conditions: (i) significant signs of financial distress in the banking system (as indicated by significant bank runs, losses in the banking system, and/or bank liquidations); (ii) significant banking policy intervention measures in response to significant losses in the banking system. On the second condition, Laeven and Valencia (2018) consider policy interventions in the banking sector to be significant if at least three out of the following six measures have been used: (a) deposit freezes and/or bank holidays; (b) significant bank nationalizations; (c) bank restructuring fiscal costs (at least 3 percent of GDP); (d) extensive liquidity support (at least 5 percent of deposits and liabilities to non-residents); (e) significant guarantees put in place; and (f) significant asset purchases (at least 5 percent of GDP). Our sample covers 191 episodes of banking crises.

Regarding the data on conflict and political instability, we collected a range of indicators from several sources, covering most of those that have been used in the literature. First, we extract the data on civil wars from the Uppsala Conflict Data Program (UCDP) provided by the Department of Peace and Conflict Research, Uppsala University. In this database, internal armed conflicts are defined as a contested incompatibility concerning government and/or territory with the use of armed force between two parties, of which at least one is the government of a state. The database provides an intensity-scaled measure of internal armed conflicts, which takes the value of 1 if the internal conflict's related death toll in a given year is 25–999, 2 if it is 1000 or more, and 0 otherwise. Based on this definition, we also construct an additional binary variable equal to 1 if a civil conflict happens in the country and 0 otherwise as in Miguel *et al*. (2014) and Holder and Raschky (2014).

Second, we extract some indicators of political instability from Banks and Wilson (2019)'s Cross-National Time-Series Data Archive. We use 6 indicators from this database that have been widely used in the literature as proxies of political instability (see Alesina *et al*. 1996; Aisen and Veiga, 2013; Neumayer 2004):

(i) *Government cabinet changes*. Represents the number of time in a year that a new premier minister is named and/or 50% of the cabinet posts are assumed by new ministers;

(ii) C*hanges in effective executive*. Measures the number of times in a year that effective control of executive power changes hands. Such a change requires that the new executive be independent of his predecessor. This variable addresses one of the drawbacks of the indicator related to major government changes as some cabinet changes may not entail change in executive power;

(iii) *Anti-government demonstrations*. Captures any peaceful public gathering of at least 100 people for the primary purpose of displaying or voicing their opposition to government policies or authority, excluding demonstrations of a distinctly anti-foreign nature;

(iv) *Major government crises*. Denotes any rapidly developing situation that threatens to bring the downfall of the present regime - excluding situations of revolt aimed at such overthrow;

(v) *General strikes*. Measures any strike of 1,000 or more industrial or service workers that involves more than one employer and that is aimed at national government policies or authority; and

(vi) *Political assassinations*. Represents any politically motivated murder or attempted murder of a high government official or politician.

These indicators are the most used in the literature, and we will use them in our baseline estimates. Appendix 5.1 presents the correlations between the different conflicts and political variables. While some variables are highly correlated, the vast majority of them have low degrees of correlation (less than 0.3), providing some comfort that they provide additional

information when used in different equations. This also allows us to cover several dimensions of conflict and political instability.

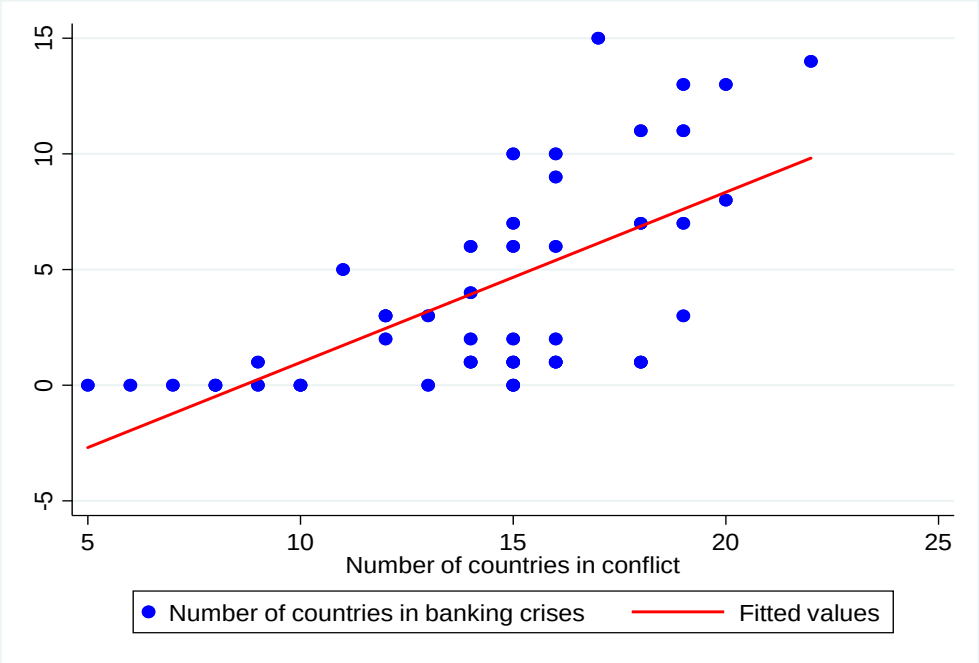
Third, in robustness checks, we use several other sources including: the International Country Risk Guide (ICRG), Correlates of Wars (COW), the Political Terror Scale of Amnesty International, the Global Terrorism Database (GTD), The Major Episodes of Political Violence Database (Marshall, 2017), the Coup d'État Events Database (Marshall and Marshall, 2018) and the State Fragility Index (Marshall and Marshall, 2017) (see Appendix 5.2).

Regarding the remaining control variables, they are from different sources. We extract the real exchange rate, inflation rate, external debt in percentage of GDP, GDP per capita, real GDP growth, and terms of trade from the IMF's *World Economic Outlook* database. The data on M2/reserves and credit growth are from the World Bank's *World Development Indicators*. We finally draw the data on the degree of democracy from the Polity IV Project (Marshall and Gurr, 2018).

5.3.2. Stylized Facts

Figure 5.2 displays the relationship between the number of countries in banking crises and conflict. It shows a positive relationship between the occurrence of conflict and banking crises and provides evidence that major waves of conflict tend to be associated with a higher rate of occurrence of banking crises.

Figure 5.2. Number of Countries in Conflict and Experiencing Banking Crises



Source: Uppsala Conflict Data Program, Laeven and Valencia (2018) and authors' calculations.

Table 5.1 presents the unconditional and conditional probabilities of a banking crisis for all conflict and political instability variables included in our baseline estimates. For each variable, we present the number of observations, the number of banking crises and the probability of a banking crisis. Column (3) considers the sample for all country-year observations and describes the unconditional probability of a banking crisis, which is the proportion of country-year observations identified with the start of a banking crisis. In columns (4) and (5), we report the conditional probability of a banking crisis, which is the proportion of country-year observations during which a banking crisis occurred in the absence of conflict and political instability (column 4), and the proportion of conflict and political instability that ended up in a banking crisis (column 5). In column (6), we compute the difference in the conditional probability of a banking crisis in years without a conflict and political instability and years of conflict and political instability, while the p-value of the T-test about the significance of the difference is reported in column (7). In the last column, we report the Pearson chi-squared statistic about the independence of the occurrence of banking crises and conflict or political instability. The Pearson test shows that there a is statistically significant relationship between banking crises and conflict or political instability.

Table 5.1. Number of Countries in Conflict and Experiencing Banking Crises

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		All	**No. conflict or political instability**	**Conflict or political instability**	**Difference ((5)-(4))**	**T-test p-value**	**Pearson Chi2**
Conflict	Observations	3026	2364	662			
	Number of banking crises	191	125	66			19.17***
	Probability of a banking crisis	6.3	5.3	10.0	4.68	0.00	
Cabinet change	Observations	2975	1768	1207			
	Number of banking crises	191	88	103			17***
	Probability of a banking crisis	6.4	5.0	8.5	3.56	0.00	
Change in effective executive	Observations	2975	2532	443			
	Number of banking crises	191	151	40			8.08*
	Probability of a banking crisis	6.4	6.0	9.0	3.07	0.02	
Anti-government demonstrations	Observations	2994	2160	834			
	Number of banking crises	191	115	76			54.61**
	Probability of a banking crisis	6.4	5.3	9.1	3.79	0.00	
Government crises	Observations	2994	2679	315			
	Number of banking crises	191	158	33			16.03***
	Probability of a banking crisis	6.4	5.9	10.5	4.58	0.00	
General strikes	Observations	2994	2689	305			
	Number of banking crises	191	153	38			27.69***
	Probability of a banking crisis	6.4	5.7	12.5	6.77	0.00	
Assassinations	Observations	2994	2636	358			
	Number of banking crises	191	149	42			46.19***
	Probability of a banking crisis	6.4	5.7	11.7	6.08	0.00	

Source: Uppsala Conflict Data Program, Laeven and Valencia (2018) and authors' calculations. *, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent level, respectively.

As can be observed, the conditional probability of a banking crisis is higher when conflict and political instability occur than in the absence of conflict and political instability. For instance, the conditional probability of a banking crisis in a year without a conflict is 5.3 percent; that probability almost doubles in years of conflict (10 percent). The difference is even stronger if we consider general strikes and political assassinations: the probability of a banking crisis increases from 5.7 percent in years without general strikes and political assassinations to 12.5 and 11.7 percent, respectively, in years of general strikes and political assassinations. The t-test in column (7) shows that the differences are statistically different. The unconditional probability of a banking crisis is around 6.4 percent regardless of the variable considered.

Table 5.2. Banking and Fiscal Crises in Years of Conflict and Political Instability

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		All	**No. fiscal crisis**	**Fiscal crisis**	**Difference ((5)-(4))**	**T-test p-value**	**Pearson chi2**
Conflict	Observations	641	330	311			
	Number of banking crises	66	14	52			26.98***
	Probability of a banking crisis	10.3	4.2	16.7	12.48	0.00	
Cabinet change	Observations	1176	583	593			
	Number of banking crises	102	24	78			32.05***
	Probability of a banking crisis	8.7	4.1	13.2	9.04	0.00	
Change in effective executive	Observations	425	232	193			
	Number of banking crises	39	9	30			19.06***
	Probability of a banking crisis	9.2	3.9	15.5	11.66	0.00	
Anti-government demonstrations	Observations	783	441	342			
	Number of banking crises	75	20	55			29.52***
	Probability of a banking crisis	9.6	4.5	16.1	11.55	0.00	
Government crises	Observations	308	146	162			
	Number of banking crises	33	5	28			16.02***
	Probability of a banking crisis	10.7	3.4	17.3	13.86	0.00	
General strikes	Observations	295	153	142			
	Number of banking crises	38	8	30			16.82***
	Probability of a banking crisis	12.9	5.2	21.1	15.90	0.00	
Assassinations	Observations	353	161	192			
	Number of banking crises	42	6	36			19.65***
	Probability of a banking crisis	11.9	3.7	18.8	15.02	0.00	

Source: Uppsala Conflict Data Program, Laeven and Valencia (2018) and authors' calculations. *, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent level, respectively.

Table 5.2 presents the statistics about the occurrence of banking and fiscal crises following a conflict or political instability. In column (3), we report the conditional probability of a banking crisis following a conflict or political instability, which is closely similar to what we reported in column (5) of Table 1 (the small differences are due to missing data). In column (4) and (5), we have the conditional probabilities of a banking crisis following a conflict without the occurrence of a fiscal crisis (column 4) and with the occurrence of a fiscal crisis (column 5).

Table 5.2 shows that the conditional probability of a banking crisis following the simultaneous occurrence of a conflict or political instability and a fiscal crisis is at least three times higher than the conditional probability of a banking crisis following a conflict or political instability but without the occurrence of a fiscal crisis. For instance, the conditional probability of a banking crisis after a joint occurrence of a conflict and a fiscal crisis is 16.7 percent, while that probability declines significantly to only 4.2 percent if a fiscal crisis does not materialize following the conflict. Furthermore, the conditional probability of a banking crisis following the

occurrence of a conflict or political instability is higher than the conditional probability of a banking crisis after a conflict when a fiscal crisis does not occur (column 3, Table 2) and the unconditional probability of a banking crisis (column 3, Table 5.1).

5.4. Empirical Strategy

The empirical specification used in this paper consists of a binary outcome model given that the dependent variable equals to 1 for all observations in the data for which a banking crisis happens, and 0 for the remaining ones (non-occurrence of a banking crisis). The binary response model is written as follows:

$$Pr(Y_{it} = 1|X_{it-1}, C_i) = F(X_{it-1}\beta + C_i) = X_{it-1}\beta + C_i + \varepsilon_{it} \quad (5.1)$$

where Y_{it} is a binary response variable taking the value of 1 if there is a banking crisis in a given country i at time t; X_{it-1} is a vector of observed explanatory variables including conflict and political instability; β is a vector of parameters, C_i is an unobserved time-invariant country fixed effect, and ε_{it} is the error term with a zero-mean residual uncorrelated with all the terms on the right-hand side. We lag all control variable by one year to avoid the problem of simultaneity and endogeneity.[80]

The composite error term in equation (5.1), $C_i + \varepsilon_{it}$, is an important feature of panel data models. C_i, also called country-specific heterogeneity, includes historical factors that can affect the probability of experiencing a banking crisis. The key issue is whether the unobserved heterogeneity can be assumed to be independent, or at least uncorrelated, with the observed covariates X_{it}. A usual assumption is that the set of explanatory variables X_{it} is contemporaneously exogenous conditional on C_i: $E(\varepsilon_{it}|X_{it}, C_i)=0$, t = 1,..., T. However, this assumption is difficult to be proven valid. In fact, country-specific factors such as religion, language, regulatory framework (common or civil law), and ethnic diversity have been widely shown to affect the degree of economic development and growth (see Barro and McCleary, 2003; Campante and Yanagizawa-Drot, 2015; Mahoney, 2001; Alesina and La Ferrara, 2005;

[80] The results remain consistent even if we lag the control variables by up to five years.

Montalvo and Reynal-Querol, 2005). Given that economic growth is among the explanatory variables, thus the uncorrelation hypothesis between the time-invariant factors and the explanatory variables is violated. Moreover, treating the time-invariant factors C_i as parameters to estimate causes inconsistency in β because of the incidental parameters problem (Neyman and Scott, 1948; Lancaster, 2000).

The fixed effects approach could be used to estimate equation (5.1). The most important appealing reason is that by controlling out the time invariant variables, the model accounts for biases that occur with omitted and unobserved variables. Unfortunately, the power of the fixed effects approach results in an undesirable consequence: even where we do have data for time invariant variables, that information is excluded from the model. In addition, as noted by Caballero (2014), Eberhardt and Presbitero (2018), and Kinda *et al.* (2016), all countries that have not experienced banking crises will be excluded from the estimates. In our sample, 40 percent of countries (37 out of 92) have not experienced at all banking crises over our study period 1970-2017. Excluding these countries in the estimates raises the issue of selection bias and inconsistent results. As argued by Bell and Jones (2015), the fixed effects models are only modelling one part of the data structure, the within-country effects at the expense of between-country effects.

Mundlak (1978) provides a method by which it is possible to incorporate both the time-invariant variables with the demeaned coefficients from the fixed effects model and at the same time use the framework of a random effects model (hence a hybrid model). This method, called the correlated random effects, assumes that the unobserved heterogeneity is a function of the country-level time averages of X_{it}, which we denote as $\overline{X_i}$. That is, $C_i = \omega + \overline{X_i}\delta + a_i$, where $\overline{X_i}$ is an average of X_{it} over time for country i (hence time invariant); a_i is assumed uncorrelated with $\overline{X_i}$ and normally distributed. Therefore, the random effects-Mundlak (1978) model allows for modeling the distribution of the omitted variable conditional on the means of the strictly exogenous variables, instead of treating the omitted variable as a parameter to estimate. The probability that $Y_{it} = 1$ can now be written as:

$$Pr(Y_{it} = 1|X_{it}, C_i) = Pr(Y_{it} = 1|X_{it}, \overline{X_i}, C_i) = F(X_{it}\beta + \omega + \overline{X_i}\delta + a_i) = X_{it}\beta + \overline{X_i}\delta + a_i + \varepsilon_{it} \quad (5.2)$$

In this chapter, we employ the random effects-Mundlak model by including the means of all time-varying covariates for the countries in the estimates. These averages have the same value for a given country across years but vary across countries. By including the vector of time-averaged variables, we still control for time-constant unobserved heterogeneity, as with fixed effects, while avoiding the problem of incidental parameters in nonlinear models. At the same time, the Mundlak model allows measurement of the effects of time-constant independent variables, just as in a traditional random effects model (Wooldridge, 2010). Therefore, by taking care of all country-specific and time-invariant characteristics that may affect the likelihood of a crisis or the occurrence of conflict and political instability, or both, the Mundlak model allows for different within and between-country effects (Caballero, 2014). Contrary to the simple fixed effects model which excludes all countries that have not experienced banking crises from the sample, the random effects-Mundlak model takes into account all these countries in the estimates.

In robustness checks, we will use the traditional probit and logit models, as well as the probit fixed-effects model of Fernández-Val and Weidner (2016). The approach by Fernández-Val and Weidner (2016) accounts for the bias arising from the inclusion of country fixed-effects and corrects for the incident parameter bias problem by subtracting from the maximum likelihood estimator a plug-in estimator of the bias. As explained above, the main drawback of this method is that it excludes all countries that have not experienced banking crises.

Relying on the extensive literature on the determinants of banking crises, we control for a number of variables:

- *Real effective exchange rate:* the literature shows that a sharp decline in the real exchange rate is associated with a greater risk of banking system distress (De Bock and Demyanets, 2012; Kaminsky and Reinhart, 1999; Reinhart *et al*., 2000). For instance, De Bock and Demyanets (2012) found that exchange rate depreciation implies increasing rates of NPLs and banking turmoil on a sample of 25 emerging markets over 1996-2010. Hence, we expect a depreciation of the real exchange rate to be positively associated with an increase in the likelihood of a banking crisis.

- *M2/reserves*: it measures banks' exposure to foreign exchange risk and a country's vulnerability to currency crises which often coincide with banking crises (Davis and

Stone, 2004; Kinda *et al.,* 2016). Thus, we expect a positive correlation between M2/reserves and banking crises.

- *Inflation*: we include this variable to capture the macroeconomic mismanagement as previous studies clearly evidenced that high rates of inflation are associated with banking crises (Demirgüç-Kunt and Detragiache, 1998-2000; Davis *et al*., 2011; Joyce, 2011). High inflation tends to undermine long-run economic growth and distorts macroeconomic and financial stability. Therefore, a positive correlation between inflation and banking crises is expected.

- *Credit growth*: an important body of the literature argues that high credit growth is conductive to banking sector problems (Cihák, 2007; Joyce, 2011; Acosta-Gonzalez *et al*., 2011). For instance, Beck *et al*. (2006) underline that a credit boom could induce an asset price bubble that may cause a crisis when it bursts. Moreover, Büyükkarabacak and Valev (2010) provided evidence that a rapid credit boom generates vulnerabilities that increase the probability of a banking crisis. However, a few studies including Von Hagen and Ho (2007) and Rose and Spiegel (2011) do not find evidence that a boom in the credit-to-GDP ratio is associated with greater probability of a banking crisis.

- *External debt*: high debt-to-GDP ratio indicates greater tighter financial conditions and reduced fiscal space (Kinda *et al*., 2016) and is likely to lead a banking crisis. In countries where banks are the main holders of government debt, worsened financial conditions or sovereign debt defaults would undoubtedly weaken banks' balance sheets. Moreover, heavily-indebted economies are more likely to face high-risk premium in international capital markets. As a result, government capacity to intervene in case of banking liquidity shortage becomes very limited. We expect a positive correlation between external debt and the likelihood of a banking crisis.

- *GDP per capita*: it captures the level of development in a country. Some studies (Demirgüç-Kunt and Detragiache, 2000-2005; Kinda *et al*. 2016) found that banking crises are negatively associated with real GDP per capita.

- *GDP growth*: according to the literature, deteriorating growth prospects are associated with greater risk of a banking crisis as lower economic growth negatively affects banks'

balance sheets by increasing the share of non-performing loans (Klomp, 2010). Some studies found that in most cases, banking crises followed an episode of growth slowdown (Demirgüç-Kunt and Detragiache, 1998-2005; Von Hagen and Ho, 2007; Angkinand and Willett, 2011). We thus expect a negative association between economic growth and banking crises.

- *Terms of trade*: a deterioration of the terms of trade reduces the ability of bank's customers to service their financial commitments, leading to an increase of NPLs and rendering banking crises more likely (Goldstein and Turner, 1996; Caprio and Klingebiel, 1999). Hence, we expect a negative correlation between terms of trade and banking crises.

- *Degree of democracy*: it refers to the quality of the politico-institutional environment and is expected to be negatively associated with the occurrence of a banking crisis. Countries with good institutions and governance tend to implement sound financial regulations to promote banking system stability that can potentially, in turn, reduces the probability of banking crisis (Francis, 2003; Beck *et al*., 2006). In addition, financial fraud and the excessive risk-taking in weak institutional countries increase the vulnerability of the banking sector and result in banking collapses (Kinda *et al*., 2016). A negative correlation between the degree of democracy and the likelihood of a banking crisis is expected.

5.5. Empirical Results

5.5.1. Baseline Results

The baseline evidence on the relationship between conflicts, political instability and banking crises is reported in Table 5.3. We present in each column the results obtained through the estimates of equation (2) employing the random effect model of Mundlak (1978) and using several indicators of conflicts and political instability. The first two columns are about the effects of conflicts, while the remaining columns deal with the effects of political instability. In column (1), we use a binary variable taking the value of 1 if the country experiences a conflict

and 0 otherwise. The results show that the coefficient associated with this binary variable is positive and statistically significant at the 1 percent level. This finding suggests that being in conflict affects positively the likelihood of occurrence of banking crises.

The test statistics suggest that the Mundlak (1978) approach used in the estimates is accurate and that the model classifies properly the group of countries that experienced banking crises and those that did not experience banking crises. We report at the bottom of the table the area under the ROC curve (AUROC) statistics and their standard errors to test the goodness of fit of the model. The AUROC statistic is between 0 and 1, with higher values representing a strong performance of the model. In Table 3, the AUROC statistic is above 0.73 in all the columns.

To give an idea about the magnitude, we follow Caballero (2014) in analyzing our results in terms of odds ratios. Given that we are using a logit model, the odds ratios are the exponentiated values of the coefficients reported in Table 5.3. Therefore, based on the results in column (1), the odds of a banking crisis are 2.5 times greater when a country is affected by a conflict. The probability of experiencing a banking crisis raises from 6.3 percent (unconditional probability) to 13.5 percent when a country is in conflict.[81] In column (2), we use the intensity of conflict instead of the binary variable used in column (1). The results remain consistent as the coefficient associated with conflict is positive and significant at the 1 percent level.

Turning to the effects of political instability, we present in column 3 the results when we use the change in government cabinet as an indicator of political instability following Alesina *et al.* (1996) and Aisen and Veiga (2013). We find that the coefficient associated with the variable cabinet changes is positive and highly significant at the 1 percent level. That said, political instability is correlated with a higher occurrence of banking crises. Quantitatively, an increase in the number of cabinet changes from zero to four (which is the maximum observed in the

[81] The odds are the ratio of the probability of a positive outcome to the probability of no positive outcome: odds = p/q, where $q=1-p$ and $p = Pr(Y = 1|X)$. In our sample, the unconditional probability of a crisis is 6.3 percent (191 crises out of 3,026 observations), which implies $odds(crisis) = 0.0631$. In column 1 of Table 5.3, the odds of a crisis, conditional on the occurrence of a conflict, increase by 2.5 times (this is the exponentiated coefficient associated with conflict: 0.9097). Then, the estimated conditional probability of a crisis is 0.1355 = (2.5* 0.0631)/[1 + (2.5* 0.0631)]. All analyzes in the subsequent sections follow this methodology.

sample) is associated with an increase in the likelihood of banking crises to 21.17 percent, from the unconditional probability of experiencing a banking crisis of 6.3 percent.

Table 5.3. Baseline Results

Dependent variable: Banking crisis	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Conflict (binary)	Conflict (intensity)	Cabinet changes	Changes in Effective Executive	Anti-Government Demonstrations	Government Crises	General Strikes	Assassinations
Variable in column (X)$_{(-1)}$	0.9097***	0.4483***	0.3620***	0.3277**	0.0295*	0.2894**	0.2211**	0.0788*
	(0.245)	(0.167)	(0.126)	(0.150)	(0.017)	(0.134)	(0.094)	(0.042)
Exchange rate$_{(-1)}$	-0.0903**	-0.0892**	-0.0931**	-0.0959**	-0.0910**	-0.1024**	-0.0987**	-0.0899**
	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)	(0.040)	(0.039)	(0.039)
M2/reserves$_{(-1)}$	0.5660***	0.5531***	0.5605***	0.5658***	0.5691***	0.5675***	0.5666***	0.5675***
	(0.124)	(0.124)	(0.123)	(0.123)	(0.123)	(0.123)	(0.123)	(0.123)
Inflation$_{(-1)}$	1.0096***	1.0140***	1.0163***	1.0224***	1.0509***	1.0638***	1.0106***	1.0148***
	(0.172)	(0.173)	(0.169)	(0.172)	(0.170)	(0.172)	(0.172)	(0.172)
Credit growth$_{(-1)}$	0.4867*	0.3878	0.3468	0.2923	0.3007	0.3571	0.2995	0.3088
	(0.293)	(0.286)	(0.281)	(0.281)	(0.280)	(0.283)	(0.280)	(0.281)
External debt$_{(-1)}$	0.7992***	0.7981***	0.8284***	0.8410***	0.8267***	0.8388***	0.8137***	0.8282***
	(0.144)	(0.145)	(0.144)	(0.144)	(0.144)	(0.144)	(0.144)	(0.144)
GDP per capita$_{(-1)}$	-0.3966	-0.3913	-0.3530	-0.3983	-0.4916	-0.3989	-0.4452	-0.4245
	(0.315)	(0.317)	(0.318)	(0.316)	(0.317)	(0.316)	(0.313)	(0.317)
Economic growth$_{(-1)}$	-0.0324*	-0.0312	-0.0257	-0.0277	-0.0324*	-0.0289	-0.0331*	-0.0340*
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.020)	(0.019)	(0.019)
Terms of trade$_{(-1)}$	0.0286	0.0910	-0.1673	-0.0626	0.0235	-0.0540	0.0422	-0.0172
	(1.206)	(1.207)	(1.218)	(1.218)	(1.206)	(1.210)	(1.204)	(1.210)
Degree of democracy$_{(-1)}$	-0.0460**	-0.0469**	-0.0524***	-0.0540***	-0.0466**	-0.0514***	-0.0518***	-0.0483***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
Nb. of observations	3,026	3,026	2,972	2,972	2,991	2,991	2,991	2,991
Countries	92	92	92	92	92	92	92	92
Log likelihood	-598.7	-602.1	-599.5	-600.6	-603.3	-602.4	-602.2	-603.1
Wald chi2	326.9	323.8	335.6	333.5	327.5	328.1	335	323.8
Rho(LR)	0.482	0.484	0.460	0.457	0.471	0.469	0.465	0.476
P-value(Rho)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AUROC	0.751	0.744	0.742	0.739	0.734	0.734	0.740	0.737
seAUROC	0.0174	0.0174	0.0175	0.0183	0.0181	0.0178	0.0177	0.0177

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent level, respectively. Standard errors are reported in brackets.

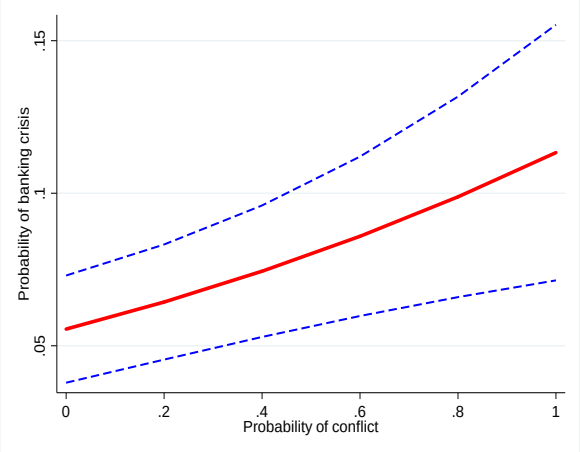
In column 4, we use the number of changes in effective executive as a proxy of political instability (Alesina *et al*., 1996). We find a positive correlation between the number of changes in effective executive and the occurrence of banking crises. In the remaining columns, we use the number of anti-governmental demonstrations, government crises, general strikes and political assassinations as proxies of political instability. We still find that the coefficients associated with these variables are positive and significant, although the level of significance differs between columns.

Figure 5.3 presents the predicted values of the likelihood of banking crises for different levels of conflict probability and intensity, and political instability. The predicted values are obtained from the regressions in Table 5.3. The blue lines represent the predicted probability of a banking crisis given the probability of a conflict (panel 3.A), the intensity of conflict (panel 3. B) or the intensity of political instability (panel 3. C-H). The dashed lines indicate the 95 confidence

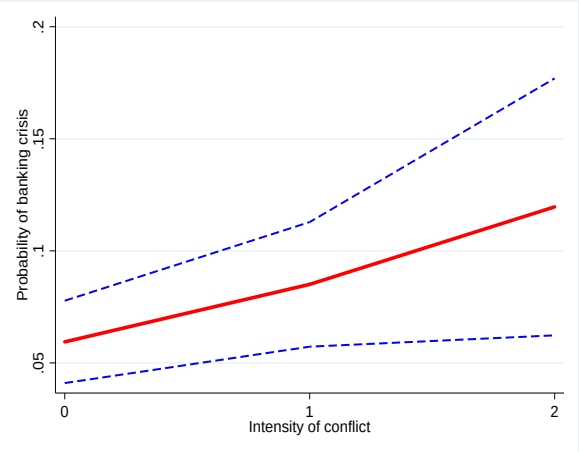
intervals. Figure 5.3 shows clearly that the higher the likelihood or intensity of conflict and political instability, higher the likelihood of experiencing a banking crisis.

Figure 5.3. Predicted Probability of a Banking Crisis

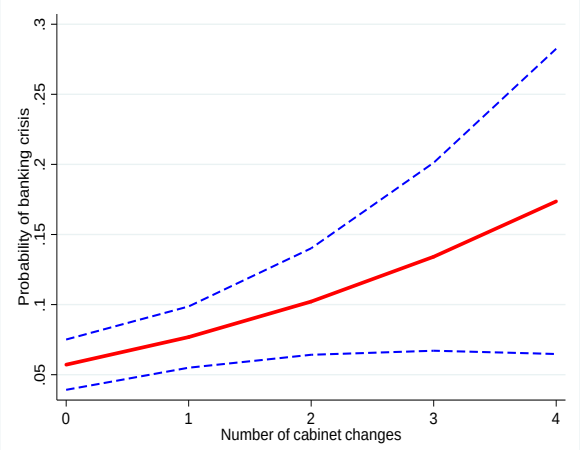
5.3.a. Probability of Conflict



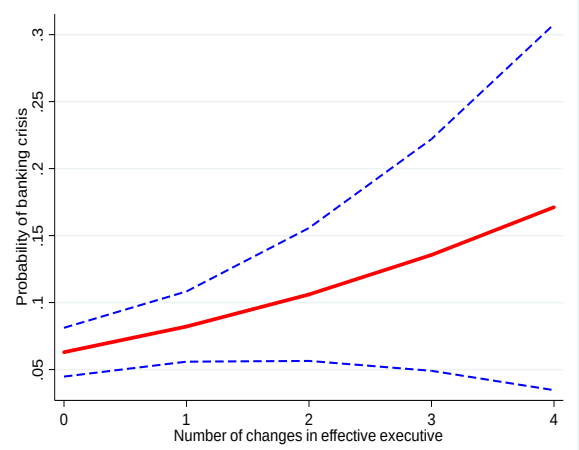
5.3.b. Intensity of Conflict



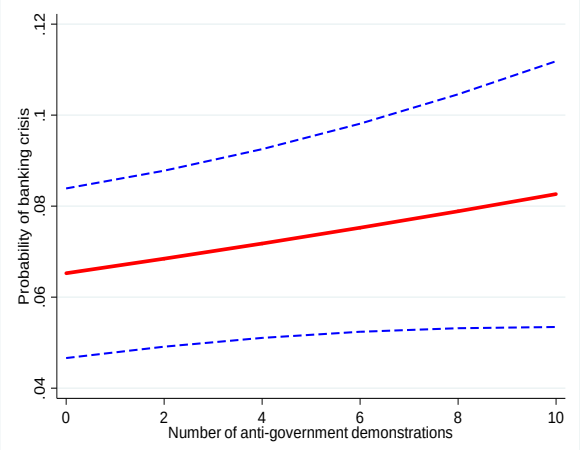
3.c. Number of Cabinet Changes



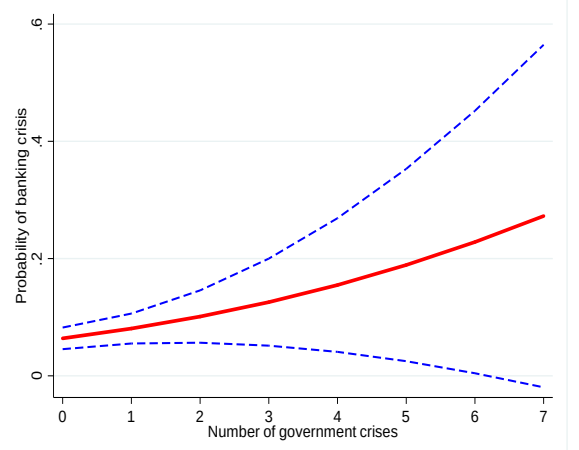
5.3.d. Number of Changes in Effective Executive



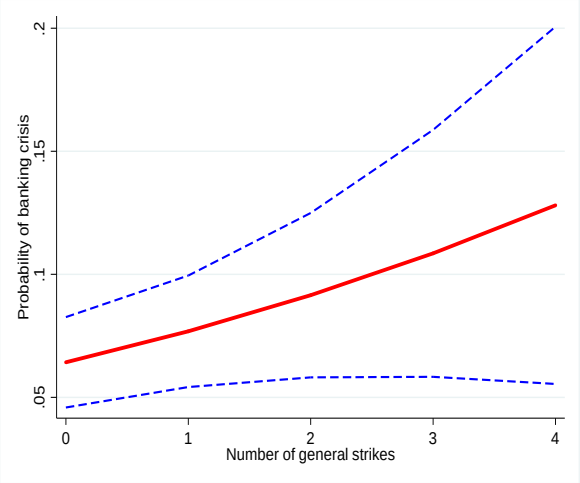
5.3.e. Number of Anti-government Demonstrations



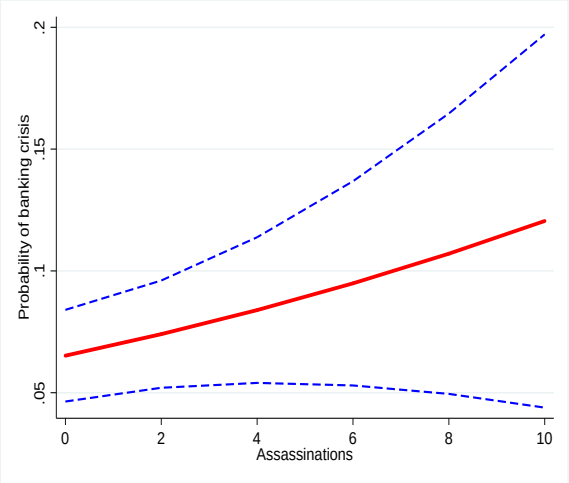
5.3.f. Number of Government Crises



5.3.g. Number of General Strikes



5.3.h. Number of Assassinations



Source: Authors' calculations

Regarding the remaining control variables, with a few exceptions, they are significant and consistent with the literature. We find that the coefficients associated with M2/reserves, inflation, credit growth, and external debt are all positively correlated with banking crises. It has been shown that an increase in broad money compared to the level of reserves is positively associated with a high occurrence of banking crises (Demirgüç-Kunt and Detragiache, 2000-2005; Davis and Stone, 2004; Von Hagen and Ho, 2007; Kinda *et al.*, 2016). High inflation rates negatively affect the banking sector stability (Davis *et al.*, 2011 and Joyce, 2011), while amounting debt level is often considered as a predictor of banks failures.

On the other hand, the coefficients associated with exchange rate, economic growth, and the degree of democracy are negatively associated with banking crises. As shown in the literature, a depreciation of the exchange rate can potentially lead to a banking crisis (Reinhart *et al.*, 2000; Duttagupta and Cashin, 2011; De Bock and Demyanets, 2012). A sound politico-institutional environment is less favorable to the occurrence of banking turmoil (Beck *et al.*, 2006; Kinda *et al.*, 2016). However, as in Demirgüç-Kunt and Detragiache (2000), the level of development measured by the GDP per capita is not statistically significant. Similarly, the terms of trade are found to be a non-significant determinant of banking crisis.

Table 5.4 reports the results when we split the sample into two subsamples: emerging markets and low-income countries, following the IMF classification of countries. The results show that

conflict and political instability are a predictor of banking crises in both emerging economies and low-income economies. However, the results differ slightly between the two groups of countries. For emerging markets, the coefficients associated with conflict and political instability variables are all positive and significant in all columns, except for government crises and political assassinations. For low-income countries, all coefficients are positive and significant, except those associated with effective changes in the executive, anti-government demonstrations, and general strikes.

Table 5.4. Baseline Results, by Income Group

Dependent variable: Banking crisis	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Conflict (binary)	Conflict (intensity)	Cabinet changes	Changes in Effective Executive	Anti-Government Demonstrations	Government Crises	General Strikes	Assassinations
				Emerging countries				
Variable in column $(X)_{(-1)}$	0.9573***	0.5454**	0.3021*	0.3582*	0.0551*	0.1899	0.2515**	0.0412
	(0.347)	(0.230)	(0.163)	(0.190)	(0.030)	(0.153)	(0.111)	(0.053)
Nb. of observations	1,638	1,638	1,637	1,637	1,637	1,637	1,637	1,637
Countries	49	49	49	49	49	49	49	49
Log likelihood	-366.1	-367.2	-368	-367.9	-368.5	-368.6	-367.5	-369.6
Wald chi2	196.7	193.4	209.1	203	200.2	202.5	211.7	196.2
Rho(LR)	0.438	0.444	0.403	0.421	0.424	0.411	0.407	0.430
P-value(Rho)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AUROC	0.743	0.737	0.727	0.734	0.727	0.726	0.729	0.730
seAUROC	0.0173	0.0171	0.0176	0.0178	0.0174	0.0174	0.0174	0.0174
				Low-income developing countries				
Variable in column $(X)_{(-1)}$	1.1874***	0.4909*	0.4627**	0.2014	0.0478	0.7460**	0.2996	0.2972***
	(0.368)	(0.272)	(0.211)	(0.270)	(0.043)	(0.341)	(0.207)	(0.089)
Nb. of observations	1,306	1,306	1,253	1,253	1,272	1,272	1,272	1,272
Countries	43	43	43	43	43	43	43	43
Log likelihood	-210.5	-213.8	-209.1	-213.6	-213.8	-212.2	-213.4	-210.4
Wald chi2	139.2	135.4	145	134.3	134.9	138.8	135.3	139.4
Rho(LR)	0.474	0.477	0.400	0.452	0.458	0.452	0.458	0.460
P-value(Rho)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AUROC	0.656	0.642	0.642	0.648	0.638	0.645	0.646	0.651
seAUROC	0.0213	0.0215	0.0216	0.0211	0.0213	0.0213	0.0213	0.0213
Control variables	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent level, respectively. Standard errors are reported in brackets.

Considering the case of conflict, its effect on banking crises is higher in low-income countries than in emerging markets. The probability of experiencing a banking crisis increases to 14.12 percent when an emerging market is hit by a conflict, while that probability jumps to 17.15 percent in a low-income country.

5.5.2. Do Conflicts and Political Instability in Neighboring Countries Matter?

In this subsection, we assess whether conflicts and political instability in neighboring countries affect the likelihood of experiencing a banking crisis in a given country. Such spillover effects can occur as banks perform their activities in bordering countries in search of portfolio diversification and the last two decades have been marked by an increase in financial globalization (Mishkin, 2007; Kose *et al*. 2006). Previous studies have shown that conflicts in bordering countries matter. For instance, Qureshi (2013) found a significant negative effect of both intrastate and international conflicts on the bilateral trade of neighboring countries that may not be directly involved in any conflict. Murdoch and Sandler (2004) and De Groot (2010) highlighted that conflicts have negative spillover effects on neighboring countries by inducing a significant decline in output growth in the short-run.

We define the variables of conflicts and political instability in neighboring countries as follows. For conflict, we define two variables: one being the number of bordering countries in conflict and another being the simple average of conflict intensity in bordering countries. For political instability variables, we generate the simple average of the number of cabinet changes, changes in effective executive, anti-government demonstrations, government crises, general strikes and political assassinations in bordering countries. We then run the same regressions as in Table 5.3.

The results are reported in Table 5.5. We find that the coefficients associated with our variables of interest are positive and statistically significant in columns 1-4, although the spillover effect is generally lower than the direct one. This suggests that conflicts and political instability in neighboring countries increase the likelihood of banking crises in a given country. More specifically, for a given country, an increase in the number and intensity of conflict, and the number of changes in government cabinet and effective executive and the number of general strikes in bordering countries are associated with an increase in its probability to experience a banking crisis.

For instance, if we focus on column (1), a rise in the number of bordering countries affected by conflict from 0 to 3 (which is the median number of bordering countries in conflict)

would result in an increase of the likelihood of banking crises from 6.3 percent to 11.2 percent. On the other hand, we find the coefficient associated with the number of anti-government demonstrations, government crises and political assassinations in bordering countries have no significant spillover effects.

Table 5.5. Effect of Conflict and Political Instability in Neighboring Countries

Dependent variable: Banking crisis	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Conflict (number of states)	Conflict (intensity)	Cabinet changes	Changes in Effective Executive	Anti-Government Demonstrations	Government Crises	General Strikes	Assassinations
Neighbor at war or pol. Instability$_{(-1)}$	0.2077***	2.2675***	0.4742**	0.7325***	-0.0171	0.1919	0.1633	-0.0210
	(0.060)	(0.735)	(0.235)	(0.262)	(0.038)	(0.156)	(0.146)	(0.064)
Variable in column (X)$_{(-1)}$	0.7820***	0.3618**	0.3983***	0.3027*	0.0300	0.2480*	0.1869*	0.0785*
	(0.238)	(0.163)	(0.132)	(0.160)	(0.019)	(0.138)	(0.099)	(0.043)
Exchange rate$_{(-1)}$	-0.1035**	-0.1013**	-0.0899**	-0.0924**	-0.0878**	-0.0989**	-0.0955**	-0.0855**
	(0.041)	(0.041)	(0.039)	(0.039)	(0.039)	(0.040)	(0.039)	(0.039)
M2/reserves$_{(-1)}$	0.5593***	0.5543***	0.5673***	0.5758***	0.5707***	0.5724***	0.5705***	0.5772***
	(0.130)	(0.129)	(0.130)	(0.130)	(0.130)	(0.131)	(0.130)	(0.131)
Inflation$_{(-1)}$	0.9740***	0.9838***	0.9887***	0.9884***	1.0153***	1.0432***	0.9819***	0.9900***
	(0.173)	(0.173)	(0.172)	(0.176)	(0.172)	(0.176)	(0.175)	(0.177)
Credit growth$_{(-1)}$	0.3985	0.3132	0.3431	0.2536	0.2684	0.3222	0.2480	0.2771
	(0.294)	(0.287)	(0.290)	(0.288)	(0.288)	(0.291)	(0.287)	(0.289)
External debt$_{(-1)}$	0.6859***	0.7398***	0.7800***	0.8003***	0.8266***	0.8257***	0.7702***	0.8081***
	(0.151)	(0.148)	(0.152)	(0.152)	(0.152)	(0.152)	(0.151)	(0.151)
GDP per capita$_{(-1)}$	0.2945	0.3251	-0.3198	-0.3818	-0.4205	-0.3571	-0.4468	-0.4374
	(0.367)	(0.380)	(0.349)	(0.345)	(0.350)	(0.348)	(0.342)	(0.348)
Economic growth$_{(-1)}$	-0.0352*	-0.0327*	-0.0219	-0.0243	-0.0322	-0.0290	-0.0337*	-0.0342*
	(0.019)	(0.019)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Terms of trade$_{(-1)}$	-0.0879	-0.0942	-0.0264	0.0804	0.2944	0.2047	0.2899	0.2313
	(1.218)	(1.217)	(1.291)	(1.273)	(1.244)	(1.272)	(1.251)	(1.262)
Degree of democracy$_{(-1)}$	-0.0422**	-0.0384**	-0.0514**	-0.0513**	-0.0495**	-0.0513**	-0.0519**	-0.0496**
	(0.019)	(0.019)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Nb. of observations	2,775	2,775	2,627	2,626	2,633	2,633	2,633	2,633
Countries	91	91	80	80	80	80	80	80
Log likelihood	-570.3	-575.1	-520.5	-521.8	-525.5	-525.1	-524.9	-526.1
Wald chi2	321.4	316	287	280.3	279.5	274.4	282.3	269.3
Rho(LR)	0.471	0.475	0.479	0.484	0.479	0.494	0.486	0.502
P-value(Rho)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AUROC	0.756	0.745	0.756	0.752	0.746	0.741	0.748	0.741
seAUROC	0.0178	0.0177	0.0183	0.0185	0.0185	0.0188	0.0182	0.0185

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent level, respectively. Standard errors are reported in brackets.

5.5.3. Duration of Conflict and Political Instability

We explore whether the duration of conflict and political instability matter. For each variable, we redefine a new variable taking the value of 1 if the conflict or political instability lasts 1 year, or at least 2 years, 3 years, and up to 10 years. We then estimate equation (2) using the Mundlak (1978) estimator. The results are reported in Table 5. We find that conflict and political instability that last only one year has no significant effect on the occurrence of banking crises.

However, when the conflict lasts longer, its impact on the occurrence of banking crises become apparent and stronger.

Table 5.6 shows that the coefficient associated with conflict is positive and significant at the 1 percent level when the conflict lasts at least two years. We can also observe that the coefficient is higher when the conflict lasts 10 years than when it lasts only 2 years. In terms of magnitude of the impact, the probability of experiencing a banking crisis is 25 percent when the conflict lasts 10 years, against 16.4 percent when it lasts two years. This finding can be explained by the fact that when the conflict is becoming prolonged, its adverse impact on the economy and the banking sector intensifies.

Table 5.6. Duration of Conflict and Political Instability

Dependent variable: Banking crisis	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Conflict (binary)	Conflict (intensity)	Cabinet changes	Changes in Effective Executive	Anti-Government Demonstrations	Government Crises	General Strikes	Assassinations
Panel A: Lasting only one year								
Variable in column $(X)_{(-1)}$	0.0402	-0.0610	0.0215	0.1698	0.0277	0.0368	0.1251	0.0772
	(0.380)	(0.349)	(0.158)	(0.173)	(0.087)	(0.185)	(0.191)	(0.273)
Panel B: Lasting at least two years								
Variable in column $(X)_{(-1)}$	1.1330***	0.4942***	0.4795***	0.5990**	0.0291*	0.4784***	0.2162**	0.0902**
	(0.286)	(0.172)	(0.142)	(0.238)	(0.017)	(0.157)	(0.099)	(0.042)
Panel C: Lasting at least three years								
Variable in column (X), t-1	1.2874***	0.5474***	0.3223*	0.6230*	0.0260	0.6454**	0.2094**	0.0934**
	(0.298)	(0.174)	(0.176)	(0.337)	(0.018)	(0.272)	(0.104)	(0.042)
Panel D: Lasting at least four years								
Variable in column $(X)_{(-1)}$	1.1588***	0.4514**	-0.0168	0.6500	0.0258	1.2352***	0.1421	0.1883***
	(0.302)	(0.183)	(0.238)	(0.595)	(0.019)	(0.432)	(0.125)	(0.060)
Panel E: Lasting at least five years								
Variable in column $(X)_{(-1)}$	1.0238***	0.3308*	-0.0762	1.1809*	0.0263	1.4419***	-0.0577	0.4256***
	(0.306)	(0.191)	(0.317)	(0.699)	(0.020)	(0.470)	(0.213)	(0.106)
Panel F: Lasting at least six years								
Variable in column $(X)_{(-1)}$	1.3082***	0.4562**	-0.1093	1.3174*	0.0188	1.6203**	-0.2888	0.5313***
	(0.311)	(0.191)	(0.384)	(0.743)	(0.025)	(0.782)	(0.462)	(0.156)
Panel G: Lasting at least seven years								
Variable in column $(X)_{(-1)}$	1.4018***	0.5400***	0.0460	1.4833*	0.0070	0.8735	0.0235	0.6380***
	(0.324)	(0.197)	(0.426)	(0.810)	(0.035)	(1.129)	(0.394)	(0.202)
Panel H: Lasting at least eight years								
Variable in column $(X)_{(-1)}$	1.5458***	0.6565***	0.3641	1.4833*	-0.0107	0.9207		1.5646***
	(0.337)	(0.211)	(0.397)	(0.810)	(0.051)	(1.112)		(0.572)
Panel I: Lasting at least nine years								
Variable in column $(X)_{(-1)}$	1.6883***	0.6740***	0.9237**	1.4833*	-0.0490	-	-	1.1000*
	(0.350)	(0.214)	(0.451)	(0.810)	(0.079)	-	-	(0.573)
Panel J: Lasting at least ten years								
Variable in column $(X)_{(-1)}$	1.6462***	0.6257***	1.0215**	1.4833*	-0.0764	-	-	0.5283
	(0.375)	(0.223)	(0.448)	(0.810)	(0.094)	-	-	(0.402)
Control variables	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent level, respectively. Standard errors are reported in brackets.

We find similar results in columns 3, 4, 6 and 8, suggesting that the probability of a banking crisis increases when political instability persists. The coefficient associated with anti-government demonstrations and general strikes become insignificant when they last more than 2 and 3 years, respectively, due to the significant reduction in the number of cases.

5.5.4. Transmission Channels

In this subsection, we explore the channel through which conflict and political instability influence the likelihood of banking crises. As outlined above, we assert that conflict and political instability affect the likelihood of banking crises by creating some fiscal pressures, which in turn transmit to the banking sector. To test this hypothesis, we extract the data on fiscal crises from Gerling *et al*. (2017). Fiscal crises are defined as episodes of extreme fiscal distress. Our variable fiscal crisis is a binary variable taking the value of 1 if the country is under tight budgetary conditions and 0 otherwise.

We then include an interactive variable between conflict or political instability and fiscal crisis and the latter itself as additional variables. This allows us to test whether the effect of conflict and political instability on banking crises partly or totally transmit through the occurrence of fiscal crises. If the coefficients associated with conflict and political instability remain highly significant and their magnitudes do not change, thus conflict and political instability influence the likelihood of banking crises even in the absence of fiscal crises. However, if the coefficients associated with conflict and political instability become insignificant when the interactive term and fiscal crisis are included, then the effect of conflict and political instability on banking crisis can be assumed to operate through a simultaneous occurrence of fiscal crises.

The results are reported in Table 5.7. They show that the effect of conflict and political instability operates mainly through a simultaneous fiscal crisis. Indeed, the coefficients associated with the different variables of conflict and political instability become insignificant in all columns when the interactive term and fiscal crisis are included, suggesting that the budgetary constraints are key determinants of banking crises, and that some fiscal crises take place simultaneously with the occurrence of conflict and political instability. The coefficient

associated with fiscal crisis is positive and significant in all columns. This finding is in line with our main hypothesis.

Table 5.7. Transmission Channels

Dependent variable: Banking crisis	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Conflict (binary)	Conflict (intensity)	Cabinet changes	Changes in Effective Executive	Anti-Government Demonstrations	Government Crises	General Strikes	Assassinations
Variable in column $(X)_{(-1)}$	0.5134	0.3031	0.3006	-0.0032	-0.0903	-0.5423	-0.0607	0.0495
	(0.340)	(0.256)	(0.190)	(0.296)	(0.086)	(0.429)	(0.254)	(0.060)
Fiscal $crisis_{(-1)}$	0.3734**	0.4307**	0.4307**	0.4179**	0.3953**	0.3967**	0.4514**	0.4510**
	(0.190)	(0.188)	(0.192)	(0.185)	(0.185)	(0.183)	(0.183)	(0.183)
Variable in column (X) x Fiscal $crisis_{(-1)}$	0.5597*	0.1554	0.0733	0.4469	0.1528*	1.1221**	0.3469	0.0589
	(0.338)	(0.255)	(0.212)	(0.326)	(0.087)	(0.449)	(0.256)	(0.080)
Exchange $rate_{(-1)}$	-0.0787**	-0.0783**	-0.0815**	-0.0827**	-0.0794**	-0.0988**	-0.0890**	-0.0771**
	(0.038)	(0.038)	(0.039)	(0.039)	(0.039)	(0.041)	(0.038)	(0.038)
$M2/reserves_{(-1)}$	0.5483***	0.5362***	0.5416***	0.5502***	0.5565***	0.5679***	0.5493***	0.5493***
	(0.125)	(0.124)	(0.123)	(0.123)	(0.123)	(0.124)	(0.123)	(0.123)
$Inflation_{(-1)}$	0.9128***	0.9217***	0.9223***	0.9156***	0.9529***	0.9344***	0.9043***	0.9048***
	(0.169)	(0.170)	(0.167)	(0.169)	(0.168)	(0.172)	(0.171)	(0.171)
Credit $growth_{(-1)}$	0.5211*	0.4208	0.3800	0.3317	0.3045	0.4215	0.3154	0.3570
	(0.295)	(0.287)	(0.282)	(0.281)	(0.280)	(0.284)	(0.281)	(0.282)
External $debt_{(-1)}$	0.6656***	0.6769***	0.7102***	0.7141***	0.7036***	0.6954***	0.6952***	0.7031***
	(0.148)	(0.148)	(0.147)	(0.147)	(0.146)	(0.147)	(0.147)	(0.147)
GDP per $capita_{(-1)}$	-0.3676	-0.3679	-0.3278	-0.3554	-0.3619	-0.4238	-0.3938	-0.3983
	(0.323)	(0.322)	(0.323)	(0.321)	(0.326)	(0.323)	(0.320)	(0.322)
Economic $growth_{(-1)}$	-0.0321*	-0.0321*	-0.0267	-0.0251	-0.0298	-0.0229	-0.0336*	-0.0355*
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
Terms of $trade_{(-1)}$	-0.0412	0.0720	-0.1641	-0.0686	0.0289	0.0669	0.0202	-0.0491
	(1.204)	(1.208)	(1.219)	(1.221)	(1.218)	(1.224)	(1.211)	(1.214)
Degree of $democracy_{(-1)}$	-0.0441**	-0.0452**	-0.0498***	-0.0515***	-0.0416**	-0.0520***	-0.0492***	-0.0465**
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
Nb. of observations	2,986	2,986	2,934	2,934	2,953	2,953	2,953	2,953
Countries	92	92	92	92	92	92	92	92
Log likelihood	-592.5	-597.3	-594.8	-594.5	-595.5	-592.3	-595.8	-598
Wald chi2	344.8	341.8	355.5	360.1	353.3	354.5	359.3	345.5
Rho(LR)	0.459	0.457	0.432	0.424	0.435	0.442	0.434	0.445
P-value(Rho)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AUROC	0.759	0.752	0.749	0.747	0.747	0.749	0.750	0.747
seAUROC	0.0173	0.0172	0.0172	0.0178	0.0177	0.0179	0.0176	0.0175

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent level, respectively. Standard errors a re reported in brackets.

5.6. Robustness Checks

We now estimate a set of different specifications to test the robustness of our results.

5.6.1. Use of Alternative Data Sources

As highlighted in Section 3, several indicators of conflicts and political instability have been used in the literature. In this robustness exercise, we use multiple indicators in an attempt to test the different indicators used so far in the literature to capture the occurrence of conflict

and political instability. In Appendix 5.2, we use the indicators of country risk from the International Country Risk Guide (ICRG) as in Neumayer (2004). These variables include the risks of internal conflict (civil war, civil disorder and terrorism), external conflict (cross border conflict, interstate war and foreign pressures) and political risk which is an aggregate index combining both internal and external conflict. The results reported in Appendix 5.2 are in line with our baseline findings as the coefficients associated with the different indicators are positive and highly significant.

Appendix 5.3 presents the results obtained using various indicators of conflict and political instability from multiple sources. In column (1-4) we use some data from the Marshall (2017)'s Major Episodes of Political Violence (MEPV) dataset as in Quereshi (2013) and IMF (2019). In this database, the minimum threshold to be qualified as conflict (500 related deaths) is higher than in our baseline database (25 related deaths). We use a binary variable taking a value of 1 if the country experiences a civil war and 0 otherwise in column (1). Marshall (2017) also defines some scores reflecting the intensity of civil war and civil violence based on an eleven-point scale score (0-10), with higher values representing extreme civil war and violence. In column (2), we use the score of civil war, while the score of civil violence is used in column (3). In column (4), we use the aggregate index of total violence, which is the simple average of civil war and civil violence scores. The results show that all four variables are positive and strongly significant at the 1 percent level. Therefore, our baseline findings remain unchanged.

In column (5), our indicator of conflict is from the Correlates of Wars (COW) dataset. In this database, the threshold to be considered as civil war is high as the minimum of conflict-related deaths is 1000 deaths, compared to only 25 in UCDP database used in our baseline specification. The COW database is used in some papers (Bazzi and Blattman, 2014). Appendix 5.3 shows that using this data source does not change our findings. The coefficient associated with conflict is highly significant and higher than that of column (1) in Table 5.3. With this database, being in conflict raises the probability of a banking crisis from 6.3 percent to 17.7 percent.

In the baseline results in Table 5.3, we used the number of political assassinations as proxy indicator of political instability. We now use a very similar indicator from Marshall and Marshall

(2018) in column (6), which focuses on the assassinations of the ruling executives. This variable takes the value of 1 if the ruling executive is assassinated and 0 otherwise. We still find that the coefficient with our variable of interest is positive and strongly significant, suggesting that the assassinations of the ruling executive is a predictor of banking crises.

We now look at the cases of terrorism. One data source widely used to capture the occurrence of terrorism attacks is the Global Terrorism Database (Asongu and Nwachukwu, 2017; Lis, 2018). Recent years have been marked by an increase in terrorist attacks in the world, particularly in sub-Saharan Africa (see IMF 2019), leading to severe macroeconomic consequences as infrastructure and human capital are being damaged, businesses delay investment decisions and increase unemployment (Rother *et al*. 2016). In columns (7) we use a binary variable taking the value of 1 if a terrorist attack occurs in the country and 0 otherwise. The results show that terrorism-related attacks are positively associated with higher occurrence of banking crises. The coefficient associated with the variable is strongly significant at the 1 percent level.

As in Neumayer (2004), we use the indicator of political terror from the Political Terror Scale (PTS) database in column (8). This variable captures the violations of basic human rights and includes torture and cruel treatment and punishment, killings and unlawful use of deadly force, political assassinations, kidnappings, forced disappearances, and many other forms of treatments. Given that the source of this database is Amnesty International, the database provides an assessment of political instability made by the humanitarian community, which is very important as they often work closely with the conflict-affected populations. The coefficient associated with the variable PTS is positive and significant at the 10 percent level.

Some authors use *coups d'état* as an indicator of political instability (Fosu, 2002). Several countries have been subject to repetitive military coups, particularly in sub-Saharan Africa (Fosu, 2002; McGowan, 2003). Following these studies, we use the number of *coups d'état* in column (9). We find that the coefficient associated with this variable is statistically not significant.

Finally, we use the index of state fragility from Marshall and Marshall (2017) and the share of deaths caused by conflict in columns (10) and (11). The state fragility index captures the degree to which a country is vulnerable to political violence. The use of the proportion of the population killed during conflict aims at taking into account the size of countries, in line with IMF (2019). As shown in column (10) and (11), the coefficients associated with these two variables are positive and significant at the 5 percent level, and thus our core finding still holds.

5.6.2. Including More Covariates

To avoid the problem of omitted variables, we include several additional control variables in Appendix 5.4. In the first two panels, we check whether controlling for the global conditions will change our results. To this end, we include the S&P 500 index in panel A and the US 3-years bond yields in panel B. Given the dominance of the US economy and financial sector in the world, there is no doubt that what is happening in the US affect developing countries. Previous literature on the contagion effects and market transmission from US markets shows that what happens in US markets affects the markets in other countries (Bekaert *et al*., 2011). The results in panel A and B show that the coefficient associated with conflict and political instability remains broadly positive and strongly significant even if we control for global conditions.

We control for the role of natural resource endowments in panels C and D. Kinda *et al*. (2018), and Eberhardt and Presbitero (2018) have found that commodity price fluctuations can lead to banking crises. To capture this potential effect, we include in panel C the index of commodity prices as in Kinda *et al*. (2018) and in panel D the total rents from natural resources as percentage of GDP. The results in these two panels are consistent with our baseline findings in Table 5.3.

In panel E, we include portfolio investment, net inflows, as percentage of GDP, while in panel F we include the real interest rate. Some studies have found that short-term flows (such as portfolio flows) (Caballero, 2014; Ghosh *et al*., 2016) are positively associated with the likelihood of a banking crisis. Furthermore, an increase in the real interest rate is a proxy for a tightening of financial conditions which is likely to squeeze banks' balance sheets and increase the

probability of a banking crisis (Duttagupta and Cashin, 2011). After controlling for these important covariates, we still find that conflict and political instability increases the likelihood of banking crises, even if the level of significance drops when the interest rate is included. This is due to the significant reduction in the number of observations because of the lack of data on real interest rate.

Finally, we include control of corruption, the degree of exports diversification and financial development in panels G, H and I, respectively. Previous studies stress the importance of institutions that enforce and secure property rights for financial development and the probability of financial fragility being positively associated with weaker institutions (Demirgüç-Kunt and Detragiache 1998). Barth *et al*. (2009); and Beck *et al*. (2006) have shown that when bank supervisors or bank controlling shareholders abuse their power and get involved in corrupted activities, the likelihood of bank failure increases. Regarding exports diversification, some studies have found that countries with relatively low export diversification are more susceptible to banking crises (Kinda *et al*. 2018; Hausmann and Rojas-Suárez, 1996), other studies found that the level of financial development matters (Mathonnat and Minea, 2018). We find that controlling for these variables does not alter our baseline findings.

5.6.3. Alternative Econometric Methods

In this section, we use the simple probit and logit models, and the profit fixed effects model as robustness checks. As we underlined in Section 4, although the random-effects of Mundlak (1978) is our preferred econometric method, the other methods are also used in some papers either as baseline specification or as robustness check (Caballero, 2016; Ghosh *et al*., 2016). We estimate equation (2) using these three empirical estimators. The results are reported in Appendix 5.5. We find that the coefficients associated with our variable of interest (conflict and political instability) are all positive and significant in all panels. Therefore, our baseline results still hold regardless of the econometric method used.

5.7. Concluding Remarks

Against the background of rising conflict and political instability over the past several decades, the paper investigates whether this phenomenon has led to increased occurrence of banking crises. While there is an extensive literature examining the economic impact of conflict and political instability, surprisingly there have been few studies on their impact on the probability of banking crises. This paper has attempted to fill this void.

The chapter provides strong evidence that conflicts and political instability are indeed associated with higher probability of systemic banking crises. Unsurprisingly, it also finds that the duration of a conflict is positively associated with rising probability of a banking crisis. Interestingly, the paper finds that conflicts and political instability in one country can have negative spillover effects in neighboring countries, by raising the probability of banking crises, albeit with lower likelihood.

The paper finds that the primary channel of transmission is the occurrence of fiscal crises following a conflict or political instability. Conflicts and political instability can have a negative impact on the productive capacity of a country and this in turn can reduce government revenue and increase military or other unproductive spending, leading to fiscal crises. More generally, this can generally lead to government dysfunctionality and weakening of institutions.

In terms of policy implications, it is obvious that conflict and political instability have deleterious and far-reaching socio-economic impacts. We concur with Aisen and Veiga (2013) that governments facing conflict and/or political instability need to address their root causes and try to mitigate their negative effects with the appropriate design and implementation of economic policies. Creating adequate fiscal space in normal times can reduce the likelihood of fiscal crises and in turn lower the probability of systemic banking crises. Our results also suggest that policy makers should pay attention to conflicts in neighboring countries even if they themselves are not conflict-afflicted as their banking systems may suffer negative spillovers from their neighbors.

Appendices

Appendix 5.1. Correlations Among Conflict and Political Instability Variables

	Conflict (binary)	Conflict (intensity)	Cabinet changes	Changes in effective executive	Anti-gov. demonstrations	Government crises	General strikes	Assassinations
Conflict (binary)	1							
Conflict (intensity)	0.9311*	1						
Cabinet changes	0.1139*	0.1143*	1					
Changes in effective executive	0.0560*	0.0560*	0.4969*	1				
Anti-government demonstrations	0.1116*	0.1082*	0.0567*	0.0643*	1			
Government crises	0.1137*	0.1065*	0.2234*	0.2469*	0.1118*	1		
General strikes	0.0960*	0.0843*	0.0617*	0.0818*	0.4531*	0.1330*	1	
Assassinations	0.2287*	0.2390*	0.0683*	0.0814*	0.0866*	0.1504*	0.0800*	1

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent level, respectively.

Appendix 5.2. Robustness Checks: Using ICRG Data

Dependent variable: Banking crisis	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Civil war	Civil disorder	Terrorism	Internal conflict	Cross border conflict	Interstate war	Foreign pressures	External conflict	Aggregate index
Variable in column (X)$_{(-1)}$	3.0991***	4.6497***	3.2275***	3.6649***	3.0990***	2.7336***	3.3649***	3.0938***	3.3785***
	(0.444)	(0.664)	(0.524)	(0.530)	(0.472)	(0.388)	(0.513)	(0.451)	(0.486)
Exchange rate$_{(-1)}$	-0.2234***	-0.2238***	-0.2074***	-0.2224***	-0.2042***	-0.2233***	-0.2124***	-0.2167***	-0.2207***
	(0.072)	(0.073)	(0.071)	(0.072)	(0.069)	(0.073)	(0.072)	(0.072)	(0.072)
M2/reserves$_{(-1)}$	0.5673***	0.5663***	0.5826***	0.5743***	0.5416***	0.5591***	0.5794***	0.5570***	0.5657***
	(0.161)	(0.162)	(0.161)	(0.163)	(0.157)	(0.160)	(0.161)	(0.160)	(0.161)
Inflation$_{(-1)}$	0.9080***	0.9188***	0.9192***	0.9085***	0.9090***	0.9305***	0.9355***	0.9262***	0.9194***
	(0.218)	(0.218)	(0.220)	(0.218)	(0.217)	(0.221)	(0.221)	(0.220)	(0.220)
Credit growth$_{(-1)}$	0.5585	0.5326	0.6598*	0.5623	0.5260	0.5108	0.5542	0.5318	0.5434
	(0.401)	(0.399)	(0.401)	(0.401)	(0.400)	(0.399)	(0.401)	(0.400)	(0.400)
External debt$_{(-1)}$	0.6255***	0.6075***	0.6346***	0.6243***	0.5963***	0.5850***	0.6137***	0.5942***	0.6086***
	(0.198)	(0.197)	(0.197)	(0.198)	(0.196)	(0.198)	(0.198)	(0.197)	(0.198)
GDP per capita$_{(-1)}$	1.8020***	1.8420***	1.2280**	1.7393***	1.4614***	1.7248***	1.5160***	1.6287***	1.7091***
	(0.589)	(0.583)	(0.546)	(0.582)	(0.563)	(0.579)	(0.564)	(0.573)	(0.579)
Economic growth$_{(-1)}$	-0.0480*	-0.0488*	-0.0475*	-0.0488*	-0.0493*	-0.0498*	-0.0480*	-0.0492*	-0.0488*
	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
Terms of trade$_{(-1)}$	-0.2272	-0.2700	-0.1309	-0.2496	-0.2605	-0.3036	-0.2713	-0.2847	-0.2834
	(1.627)	(1.641)	(1.648)	(1.636)	(1.629)	(1.633)	(1.634)	(1.633)	(1.635)
Degree of democracy$_{(-1)}$	0.0009	-0.0017	-0.0064	-0.0006	0.0040	0.0020	0.0007	0.0031	0.0019
	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)
Nb. of observations	1,847	1,847	1,847	1,847	1,847	1,847	1,847	1,847	1,847
Countries	71	71	71	71	71	71	71	71	71
Log likelihood	-362.1	-361.6	-371.4	-363.9	-367.5	-363.4	-367.6	-365.3	-364.2
Wald chi2	252.4	250.5	252.6	251.8	252.4	251.4	249.3	251.6	251.9
Rho(LR)	0.376	0.380	0.389	0.384	0.385	0.390	0.399	0.391	0.388
P-value(Rho)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AUROC	0.816	0.820	0.803	0.814	0.808	0.816	0.809	0.812	0.813
seAUROC	0.0171	0.0180	0.0190	0.0178	0.0183	0.0178	0.0187	0.0181	0.0179

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent level, respectively. Standard errors are reported in brackets.

Appendix 5.3. Robustness Checks: Using Data from Different Sources

Dependent variable: Banking crisis	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Civil war (binary)-Polity IV	Civil war score-Polity IV	Civil violence-Polity IV	Total violence-Polity IV	COW	Assassination of Executive	Terrorism - GTD	PTS	Number of Coups d'Etat	State fragility	Conflict deaths over population
Variable in column $(X)_{(-1)}$	0.8967***	1.2454***	0.2466***	3.2782***	1.2276***	1.9710***	0.8284***	0.1941*	-0.0674	5.3679**	0.3518**
	(0.239)	(0.337)	(0.062)	(0.820)	(0.310)	(0.607)	(0.184)	(0.103)	(0.423)	(2.733)	(0.160)
Exchange $rate_{(-1)}$	-0.0846**	-0.0892**	-0.0853**	-0.0860**	-0.1848***	-0.0958**	-0.0943**	-0.0857**	-0.0938**	-0.5146**	-0.0912**
	(0.038)	(0.039)	(0.039)	(0.039)	(0.051)	(0.039)	(0.041)	(0.043)	(0.039)	(0.246)	(0.039)
$M2/reserves_{(-1)}$	0.5684***	0.5555***	0.5603***	0.5536***	0.5007***	0.5763***	0.6137***	0.6528***	0.5646***	0.5459	0.5621***
	(0.123)	(0.123)	(0.123)	(0.124)	(0.141)	(0.124)	(0.128)	(0.131)	(0.122)	(0.337)	(0.124)
$Inflation_{(-1)}$	0.9868***	1.0115***	1.0015***	1.0062***	0.8236***	1.0628***	1.0184***	0.9763***	1.0402***	2.6818***	1.0188***
	(0.169)	(0.168)	(0.170)	(0.171)	(0.187)	(0.173)	(0.173)	(0.179)	(0.170)	(0.910)	(0.172)
Credit $growth_{(-1)}$	0.4463	0.4162	0.3722	0.3741	0.3372	0.3051	0.2782	0.3315	0.2926	0.0636	0.3694
	(0.292)	(0.294)	(0.289)	(0.288)	(0.317)	(0.282)	(0.285)	(0.299)	(0.281)	(0.614)	(0.285)
External $debt_{(-1)}$	0.8192***	0.8288***	0.8222***	0.8368***	0.6302***	0.8286***	0.7155***	0.5986***	0.8507***	0.6295*	0.8085***
	(0.146)	(0.145)	(0.146)	(0.146)	(0.164)	(0.145)	(0.146)	(0.158)	(0.144)	(0.342)	(0.144)
GDP per $capita_{(-1)}$	-0.3039	-0.1790	-0.2186	-0.1923	2.1684***	-0.4121	-0.4042	-0.4382	-0.3935	-1.2565	-0.3925
	(0.318)	(0.323)	(0.327)	(0.330)	(0.540)	(0.320)	(0.319)	(0.343)	(0.316)	(0.917)	(0.317)
Economic $growth_{(-1)}$	-0.0320*	-0.0365*	-0.0271	-0.0265	-0.0345*	-0.0251	-0.0324*	-0.0316	-0.0350*	-0.0154	-0.0324*
	(0.019)	(0.019)	(0.019)	(0.018)	(0.019)	(0.019)	(0.019)	(0.020)	(0.019)	(0.038)	(0.019)
Terms of $trade_{(-1)}$	-0.0406	0.0700	-0.0736	-0.1068	-0.3437	-0.0980	0.1038	0.0933	0.0251	-3.5220	0.0445
	(1.203)	(1.193)	(1.212)	(1.210)	(1.269)	(1.224)	(1.194)	(1.209)	(1.201)	(2.742)	(1.205)
Degree of $democracy_{(-1)}$	-0.0457**	-0.0391**	-0.0422**	-0.0434**	-0.0202	-0.0468**	-0.0541***	-0.0454**	-0.0498***	0.0317	-0.0470**
	(0.019)	(0.019)	(0.019)	(0.019)	(0.022)	(0.019)	(0.019)	(0.019)	(0.019)	(0.048)	(0.019)
Nb. of observations	3,026	3,025	3,025	3,025	1,645	3,025	3,026	2,360	2,973	1,769	3,026
Countries	92	92	92	92	83	92	92	91	92	91	92
Log likelihood	-598.4	-596.9	-597.2	-597.3	-443.7	-601.7	-594.6	-537.5	-603	-243.2	-603.3
Wald chi2	330.3	345.8	327.8	324.2	216.3	319.8	334.2	294.8	331.1	79.53	322.3
Rho(LR)	0.476	0.454	0.476	0.480	0.478	0.489	0.474	0.424	0.459	0.848	0.484
P-value(Rho)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AUROC	0.751	0.756	0.752	0.751	0.749	0.736	0.753	0.733	0.740	0.756	0.741
seAUROC	0.0172	0.0174	0.0170	0.0171	0.0189	0.0183	0.0178	0.0193	0.0179	0.0253	0.0177

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent level, respectively. Standard errors are reported in brackets.

Appendix 5.4. Robustness Check: Including More Covariates

Dependent variable: Banking crisis	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Conflict (binary)	Conflict (intensity)	Cabinet changes	Changes in Effective Executive	Anti-Government Demonstrations	Government Crises	General Strikes	Assassinations
Panel A: Adding S&P 500 index								
Variable in column $(X)_{(-1)}$	0.9866***	0.5156***	0.3466***	0.2928**	0.0412***	0.2916**	0.1872*	0.0814*
	(0.244)	(0.170)	(0.125)	(0.147)	(0.016)	(0.132)	(0.101)	(0.044)
S & P 500 index(-1)	-0.0015***	-0.0015***	-0.0014***	-0.0014***	-0.0015***	-0.0014***	-0.0014***	-0.0014***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Panel B: Adding US 3-years bond yield								
Variable in column $(X)_{(-1)}$	0.9029***	0.4127**	0.3713***	0.3425**	0.0262	0.3742***	0.2000**	0.0855*
	(0.246)	(0.170)	(0.130)	(0.152)	(0.018)	(0.133)	(0.098)	(0.045)
US bond yield(-1)	0.2251***	0.2247***	0.2257***	0.2247***	0.2269***	0.2358***	0.2261***	0.2289***
	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)	(0.032)	(0.031)	(0.031)
Panel C: Adding commodity price index								
Variable in column $(X)_{(-1)}$	1.0015***	0.3948**	0.3450***	0.3978***	0.0323**	0.3792**	0.1854*	0.0637
	(0.254)	(0.175)	(0.130)	(0.154)	(0.016)	(0.149)	(0.100)	(0.043)
Commodity prices index, t-1	-0.0229***	-0.0222***	-0.0213***	-0.0217***	-0.0223***	-0.0216***	-0.0220***	-0.0222***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Panel D: Adding natural resource rents (% GDP)								
Variable in column $(X)_{(-1)}$	0.9469***	0.4551***	0.3553***	0.3416**	0.0279	0.2775**	0.2299**	0.0723*
	(0.246)	(0.167)	(0.126)	(0.149)	(0.017)	(0.134)	(0.094)	(0.043)
Natural resource $rents_{(-1)}$	-0.0356*	-0.0330*	-0.0322*	-0.0337*	-0.0330*	-0.0336*	-0.0316*	-0.0336*
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Panel E: Adding portfolio investment, net flows (% GDP)								
Variable in column $(X)_{(-1)}$	0.7540***	0.3123*	0.3804***	0.3640**	0.0307*	0.4046***	0.3382***	0.0808*
	(0.258)	(0.175)	(0.131)	(0.157)	(0.016)	(0.144)	(0.100)	(0.042)
Portfolio $invesment_{(-1)}$	0.0177	0.0173	0.0180	0.0187	0.0173	0.0146	0.0179	0.0172
	(0.023)	(0.023)	(0.024)	(0.024)	(0.023)	(0.023)	(0.023)	(0.023)
Panel F: Adding real interest rate								
Variable in column $(X)_{(-1)}$	0.7762**	0.2566*	0.4334***	0.4262**	0.0295	0.6636***	0.1324	0.0587
	(0.341)	(0.131)	(0.166)	(0.211)	(0.020)	(0.184)	(0.146)	(0.054)
Real interest $rate_{(-1)}$	0.0056	0.0054	0.0031	0.0048	0.0038	0.0042	0.0029	0.0044
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Panel G: Adding control of corruption								
Variable in column $(X)_{(-1)}$	0.9095***	0.4487***	0.3622***	0.3277**	0.0295*	0.2892**	0.2224**	0.0788*
	(0.245)	(0.167)	(0.126)	(0.150)	(0.017)	(0.134)	(0.094)	(0.042)
Control of $corruption_{(-1)}$	-0.0521	-0.0876	-0.0365	0.0068	-0.0997	-0.1245	-0.1255	-0.1102
	(0.329)	(0.329)	(0.324)	(0.319)	(0.320)	(0.324)	(0.315)	(0.326)
Panel H: Adding exports diversification								
Variable in column $(X)_{(-1)}$	0.9500***	0.4488***	0.3499***	0.2867*	0.0433*	0.2890**	0.2512**	0.0729*
	(0.248)	(0.169)	(0.126)	(0.153)	(0.024)	(0.137)	(0.099)	(0.042)
Exports $diversification_{(-1)}$	-0.3619**	-0.3471**	-0.3754**	-0.3715**	-0.3403**	-0.3586**	-0.3568**	-0.3415**
	(0.147)	(0.147)	(0.149)	(0.149)	(0.147)	(0.146)	(0.147)	(0.146)
Panel I: Adding financial development index								
Variable in column $(X)_{(-1)}$	0.9353***	0.3809**	0.4075***	0.3906**	0.0411*	0.4576***	0.2380**	0.0684
	(0.256)	(0.174)	(0.131)	(0.155)	(0.024)	(0.152)	(0.100)	(0.042)
Financial $development_{(-1)}$	1.4132	1.6558	1.4800	1.5385	1.5286	1.5748	1.6867	1.6488
	(1.304)	(1.301)	(1.295)	(1.284)	(1.307)	(1.303)	(1.291)	(1.301)
Control variables	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent level, respectively. Standard errors are reported in brackets.

Appendix 5.5. Robustness Check: Using Alternative Econometric Method

Dependent variable: Banking crisis	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Conflict (binary)	Conflict (intensity)	Cabinet changes	Changes in Effective Executive	Anti-Gov. Demonstrations	Government Crises	General Strikes	Assassinations
Panel A: Using probit model								
Variable in column $(X)_{(-1)}$	0.3132***	0.1570***	0.2163***	0.2328***	0.0117*	0.1593**	0.1246***	0.0538***
	(0.086)	(0.061)	(0.061)	(0.079)	(0.007)	(0.066)	(0.044)	(0.021)
Panel B: Using logit model								
Variable in column $(X)_{(-1)}$	0.6187***	0.2864**	0.4357***	0.4817***	0.0216*	0.3167***	0.2200***	0.0985***
	(0.176)	(0.121)	(0.120)	(0.152)	(0.011)	(0.120)	(0.077)	(0.035)
Panel C: Using probit fixed effects model								
Variable in column $(X)_{(-1)}$	0.5607***	0.2775***	0.1917**	0.2192**	0.0167	0.1243	0.1508**	0.0610**
	(0.153)	(0.106)	(0.078)	(0.095)	(0.012)	(0.089)	(0.064)	(0.030)
Control variables	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

*, **, and *** denote statistical significance at 10 percent, 5 percent, and 1 percent level, respectively. Standard errors are reported in brackets.

Appendix 5.6. Definition of conflict and political instability variables used in robustness checks

- *International Country Risk Guide (ICRG)*. This database contains two important variables that provide an assessment of the risk of instability: internal conflict and external conflict. The index of internal conflict is an assessment of political violence in the country and its actual or potential impact on governance, and comprises three subcomponents: civil war, terrorism, and civil disorder. The index of external conflict is an assessment both of the risk to the incumbent government from foreign action, ranging from non-violent external pressure to violent external pressure. It encompasses three subcomponents: war, cross-border conflict, and foreign pressures. In the paper, we use not only the indices of internal and external conflicts, but also the different sub-indices. We also compute an aggregate index of conflict, which is the simple average of the internal and external conflict indices.

- *Correlates of Wars (COW)*. In this database, civil war is defined as an armed conflict between an internationally recognized state and (mainly) domestic challengers, able to mount an organized military opposition to the state. A war must have caused more than 1,000 battle-related deaths in total and within at least a three-year period. We define a binary variable taking the value of 1 if the condition is met, and 0 otherwise.

- *Political Terror Scale of Amnesty International*. This database provides a measure of political terror defined as violations of physical integrity rights carried out by states or their agents. It refers to state-sanctioned killings, torture, disappearances, and political imprisonment. The data are ranged from 1 to 5, with higher values representing widespread and systemic violations of civil and political rights where murders, disappearances, and torture are a common part of life.

- *Global Terrorism Database (GTD) by the National Consortium for the Study of Terrorism and Responses to Terrorism (START) (University of Maryland)*. Terrorism is defined as the threatened or actual use of illegal force and violence by a non-state actor to attain a political, economic, religious or social goal through fear, coercion or intimidation. In order to be considered as a terrorist incident, 3 conditions should be met: (i) the incident must be intentional: the result of a conscious calculation on the part of a

perpetrator; (ii) the incident must entail some violence or threat of violence, including violence against property or/and against people; and (iii) the perpetrator of the incident should be sub-national actors. We use the number of terrorism-related incidents per year.

- *Marshall (2017)'s major episodes of political violence database (Center for Systemic Peace)*. Major episodes of political violence are defined by the systematic and sustained use of lethal violence by organized groups that result in at least 500 directly-related deaths over the course of the episode. We define a binary variable taking the value of 1 if such event occurs and 0 otherwise. The database also contains an eleven-point scale score (0-10) providing an assessment of the intensity of civil war and civil violence. We also use these two scores and an additional aggregate score for total violence, which is the simple average of the civil war and civil violence scores.

- *Marshall and Marshall (2018)'s coup d'état events database (Center for Systemic Peace)*. We use two variables from this database capturing whether a military coup occurred in the country and whether the ruling executive was assassinated. A *coup d'état* is defined as a forceful seizure of executive authority and office by a dissident/opposition faction within the country's ruling or political elites that results in a substantial change in the executive leadership and the policies of the prior regime. We generate a binary variable taking the value of 1 if a *coup d'état o*ccurs and 0 otherwise. We also define a binary variable equal to 1 if the ruling executive is assassinated and 0 otherwise.

- *Marshall and Marshall (2017)'s state fragility index (Center for Systemic Peace)*. The state fragility index is a composite index based on four dimensions: security, political, economic and social and measures the degree to which a country is vulnerable to political and social violence. The variable ranges between 0 and 25, with higher values meaning extreme fragility.

General Conclusion

Tax revenue mobilization emerged as a main tool to finance the 2030 international development agenda since the United Nation General Assembly on Financing for Development in 2015. Alternatively, to the international development assistance – the historical source of financing in developing countries–, which the literature points out some limitations (*e.g.*, perverse effects, volatility, etc.), tax revenues constitute a strong and sustainable source of development financing in emerging markets economies. However, despite of the pressing financing needs, developing countries still face important impediments in raising significant tax revenues to finance essential public expenditures. Developing countries are typically collecting between 10 to 20 percent of GDP, while advanced economies collect on average about the double, 40 percent. In addition to the pressing policy challenge that represents tax revenue mobilization, developing countries face not only a limited access to formal financial services which may be a factor of greater tax revenue collection, but also a rise in violence and internal unrest with devastating macroeconomic consequences.

This thesis was concerned with tax revenue mobilization and the consequences of conflict and political instability on the financial sector in developing countries. More specifically, four important issues are empirically addressed in this thesis: *(i)* What is the tax effort in Sub-Saharan Africa countries over the past decades? *(ii)* Does the reliance on diversified tax structure enhance resilience to fiscal risks? *(iii)* Does greater access to formal financial services in developing countries favors more tax revenue collection? *(iv)* What are the consequences of the increasing conflicts and political instabilities on the financial sector – particularly, the banking sector– in developing countries?

In Chapter 2, the thesis provided new evidence on tax effort based on a new and original database of tax revenue covering 42 Sub-Saharan African countries over 1980-2015, while replicating some previous empirical works on tax effort. The stochastic frontier analysis shows a tax effort score of 0.57 over the period in SSA countries. This corresponds to an average tax-to-GDP ratio of 13.2, suggesting a low tax effort and the presence of room for more tax revenue collection. In line with previous analyses, the chapter also found that countries' stage of development measured by per-capita income, financial development and trade openness are important factors improving tax revenue in the region, while natural resource endowment and the importance of the agricultural sector reduce unambiguously the non-resource tax-to-GDP ratio. Finally, the replication exercises broadly confirm previous analyses on the determinants

of tax revenue in DCs. Though our results display relative smaller coefficients for some variables suggesting a smaller effect when non-resource tax ratio is used instead of the central government tax revenue.

Chapter 3 was devoted to providing strong evidence that relying on a diversified tax structure contributes to higher tax revenue mobilization and may enhance resilience to fiscal risks. To the best of our knowledge, this chapter is the first of its kind in the empirical literature to propose such a new cross-country tax revenue diversification index (RDI). We find that diversifying the portfolio of tax revenue streams improves revenue collection. In terms of magnitude, the results suggest that a 10 percent increase in the RDI score can yield additional tax revenue of up to 0.2-0.4 percentage points of GDP. The results also evidenced that tax revenue diversification reduces tax revenue volatility, thus bringing to the data long-held views about the prominence of tax revenue diversification for fiscal resilience strengthening. Furthermore, focusing on the potential drivers of the RDI, we find that tax revenue diversification is not just a reflection of economic diversification, but also an outcome of macroeconomic, political and institutional factors. Interestingly, a non-monotone relationship is also at play between the RDI and economic development, with countries' portfolio of tax sources getting more diversified as their economy develops, until a tipping point, where richer countries start finding it harder to diversify further their tax revenue sources.

Chapter 4 empirically assessed the effect unlocking access to financial services on tax capacity in developing countries. We find that greater access to financial services captured by the number of ATMs per 100,000 adults increases government non-resource tax-to-GDP ratio. More precisely, an increase of 1 in the log of the number of ATMs per 100,000 adults increases the total *non-resources* tax ratio by 0.4. This result is driven by household's consumption and business expansion. Greater access to formal financial and banking services favors household's consumption and thereby VAT to collect. Furthermore, easy access to banking services encourages entrepreneurship and *income-generating* activities which are potential opportunities for taxation. The chapter also extends the analysis to tax revenue composition and finds that financial inclusion is associated with greater indirect taxes mobilization, compared direct taxes.

Finally, Chapter 5 analyzed the impact of conflict and political instability on the probability of banking crises. It shows that conflicts and political instability indeed significantly increase the

probability of systemic banking crises in developing countries. In terms of magnitude, the chapter highlights that the odds of a banking crisis are 2.5 times greater when a country is affected by a conflict. Interestingly, the results show that conflicts and political instability in neighboring countries also increase the likelihood of banking crises in a given country. Moreover, the probability of experiencing a banking crisis is 25 percent when the conflict lasts 10 years, against 16.4 percent when it lasts two years. Finally, fiscal crises turned out to be the primary channel through which conflict and political instability lead to a higher likelihood of turmoil of the banking sector.

The analysis of tax effort in the Chapter 2 of the thesis shows that Sub-Saharan Africa countries, and developing countries in general, still have considerable untapped room for substantial tax revenue collection. This calls for urgent adequate fiscal policies and reforms to improve and strengthen the tax system and reinforce compliance.

The chapter 3 brightly provided evidence that diversifying tax revenue sources matters a great deal for improving tax revenue collection and mitigating government revenue volatility. Tax revenue diversification stands as a key factor to strengthen resilience to fiscal risks arising from government revenue volatility, critical to ensure sustainable delivery of public services throughout different phases of the business cycle in developing countries. The current coronavirus pandemic, for instance, requiring additional public expenditures to cope with its adverse social and economic impact, adds further credence to the criticality of relying on a diversified portfolio of tax revenue streams for strengthening fiscal policy resilience to large swings to business cycle fluctuations.

In chapter 4, the thesis points out that unlocking access to formal financial services is an effective means of raising tax revenue in developing countries. This chapter provides useful insights on tax *revenue-harnessing* opportunities from pursuing, implementing and reinforcing financial inclusion strategies and policies for developing economies. Beyond the tax opportunities that financial inclusion offers, it may also serve as a social safety net for the ongoing Covid-19 through supporting populations to withstand better the income losses and the consumption decline.

Chapter 5 reveals that the increasing violence and internal unrest in developing countries characterized by conflicts and political instabilities may have disastrous consequences on the

banking sector, therefore calling for strong and firm policy action from *non-conflict* affected countries to prevent from them. In addition, policymakers should pay great attention to conflicts in neighboring countries even if, they are not *conflict-afflicted* as their banking systems may suffer negative spillovers from their neighbors given that banks operate across borders. Furthermore, once broken out, governments in conflict-affected countries need to address, as quickly as possible, their root causes and try to mitigate their negative effects with the appropriate design and implementation of economic policies. It finally calls for building adequate fiscal space in normal times can reduce the likelihood of fiscal crises and in turn lower the probability of systemic banking crises.

The present thesis also provides and opens avenues for possible interesting extensions and future research. First, in the estimate of tax effort, for instance, one possible extension might be considering the characteristics and performance of tax administrations in developing countries by taking advantage of tax administration information database recently developed, including the International Survey on Revenue Administration (ISORA). Besides, the tax effort estimation provided in the thesis is subject to some caveats in addition to the low coverage of the dataset which only covers SSA countries. Indeed, additional explanatory variables, in particular regarding political regimes, may be taken into account in the estimation, which could then modify the ranking of countries. Fully aware of that, the thesis provides a **R-Shiny-based website** including several additional variables allowing users not only to download the original dataset but also to replicate our empirical analysis and run their own regressions based on alternative specifications with more covariates. Besides, data on GDP across countries significantly change over the years due to the regular update in the base year necessary to their calculation. Second, future research related to tax revenue diversification could take the analysis further by delving into the causal links behind the empirical regularity observed in the data between per capita GDP and tax revenue diversification, along with its transmission channels. The influence of tax revenue diversification on income inequality as well as on policymakers' leeway for implementing countercyclical fiscal policies is additional interesting avenues for future research.

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Abstract:

Drawing essentially on empirical analyses and mainly focusing on developing countries, the present thesis is concerned with tax revenue mobilization (**Chapter 2**, **Chapter 3**, and **Chapter 4)** and conflicts (**Chapter 5**) and provides key policy messages. **Chapter 2** estimates the tax effort in Sub-Saharan Africa (SSA) based on a new and original *non-resources* tax revenue database over 1980-2015. It finds an average tax effort score of 0.57 over the period in SSA countries, corresponding to an average *non-resources* tax-to-GDP ratio of 13.2. This result suggests a low tax effort and the existence of room for more tax revenue collection. SSA countries could raise up to 23.2 percent of GDP in taxes in full-use their tax potential through an improved tax system. In **Chapter 3**, the thesis explores the impact of relying on a diversified tax structure on tax revenue mobilization and the fiscal resilience, while proposing a new and the first cross-country tax revenue diversification index (RDI). Results show that diversifying the portfolio of tax revenue streams improves revenue collection. Interestingly, the results suggest that tax revenue diversification reduces tax revenue volatility, thus bringing to the data long-held views about the prominence of tax revenue diversification for fiscal resilience strengthening. Finally, we find that tax revenue diversification is not just a reflection of economic diversification, but also an outcome of macroeconomic, political and institutional factors. **Chapter 4** studies the impact of unlocking access to financial services on tax capacity. Its finds strong evidence that greater access to financial services increases *non-resources* tax revenue, highlighting tax revenue-harnessing opportunities from a more inclusive financial sector for developing countries. In the **fifth** and last **Chapter**, the thesis analyses the impact of conflict and political instability on the probability of crises in the banking sector –a key sector for domestic development financing. It shows that conflicts and political instability indeed significantly increase the probability of systemic banking crises in developing countries. Interestingly, this chapter finds that conflicts and political instability in neighboring countries also increase the likelihood of banking crises in a given country, highlighting the *spillover-effects* of conflicts and political instability.

Keywords: Tax Effort, *Non-resource* tax revenue, Sub-Saharan Africa, Revenue Diversification Index (RDI), Fiscal Resilience, Financial Inclusion, Conflict, Political Instability, Developing Countries

Résumé:

Cette thèse s'intéresse à la mobilisation des recettes fiscales principalement dans les pays en développement en s'appuyant sur des analyses empiriques (**chapitres 2, 3 et 4**). Elle aborde également la question des conflits (**chapitre 5**) et propose d'importantes recommandations de politiques économiques. **Le chapitre 2** évalue l'effort fiscal dans les pays d'Afrique au Sud du Sahara (ASS) entre 1980 et 2015 en utilisant une base de données nouvelle et originale des recettes fiscales (hors ressources naturelles) développée à cet effet. Sur la période considérée, les pays d'Afrique au Sud du Sahara ont enregistré un score moyen d'effort fiscal de 0,57 correspondant à une pression fiscale moyenne de 13,2 pour cent du PIB. Ce résultat révèle un faible effort fiscal dans ces pays et indique l'existence de possibilités d'accroitre d'avantage le niveau de recettes fiscales. En utilisant pleinement leur potentiel fiscal, les pays d'Afrique Subsaharienne pourraient mobiliser un ratio de taxe de l'ordre de 23,2 pour cent du PIB. Dans le **chapitre 3**, la thèse analyse la diversification des recettes fiscales comme, non seulement un facteur de résilience budgétaire, mais aussi un moyen de mobilisation accrue des recettes fiscales. Ce chapitre développe le tout premier indicateur de diversification des recettes fiscales (IDR) couvrant un large échantillon de pays qui puisse exister dans la littérature économique. Les résultats empiriques montrent que la diversification des recettes fiscales accroit significativement la perception des recettes et réduit la volatilité des revenus du gouvernements constituant donc un important facteur de résilience budgétaire. Aussi, l'environnement macroéconomique, politique et institutionnel ainsi que le niveau de développement constituent les principaux déterminants de la diversification des recettes fiscales dans les pays. Le **chapitre 4** étudie l'impact de l'accès aux services financiers sur la pression fiscale. Il révèle qu'un plus grand accès aux services financiers améliore considérablement la mobilisation des recettes fiscales mettant ainsi en évidence les opportunités potentielles de revenus fiscaux liées à l'inclusion financière. Dans le **cinquième et dernier** chapitre, la thèse examine l'impact des conflits et de l'instabilité politique sur l'occurrence de crises dans le secteur bancaire –un secteur clé pour le financement domestique. Les résultats montrent que les conflits et l'instabilité politique alimentent significativement la probabilité de crises bancaires systémiques dans les pays en développement. Fait intéressant, ce chapitre souligne que les conflits et l'instabilité politique dans les pays voisins augmentent également la probabilité de crises bancaires dans un pays donné mettant ainsi en évidence les effets de débordement des conflits.

Mots clés: Effort Fiscal, Recettes Fiscales hors Ressources, Afrique Subsaharienne, Indice de Diversification des Revenus (IDR), Résilience Fiscale, Inclusion Financière, Conflit, Instabilité Politique, Pays en Développement