

# **DO TAX STRUCTURES OPTIMIZE PRIVATE FIXED INVESTMENT IN SUB-SAHARAN AFRICA?**

*A Data Envelopment Analysis*



**The Horn Economic and Social Policy Institute (HESPI)**

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## **The Horn Economic and Social Policy Institute (HESPI)**

HESPI is a non-profit, non-political research institute that conducts economic, social and policy oriented research to promote high quality policy analysis and advisory services to assist African governments, the private sector and other stakeholders with a special focus on the IGAD sub-region. HESPI conducts commissioned studies and interacts with principal institutions and entities to address the challenges the region faces. HESPI's focus also covers institutional capacity building and instilling values for better management of social and broad based sustainable economic growth aimed at prosperous future for the region.

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# DO TAX STRUCTURES OPTIMIZE PRIVATE FIXED INVESTMENT IN SUB-SAHARAN AFRICA?

## *A Data Envelopment Analysis*

### **Abstract**

The paper discovers a tax structure that optimizes Private Fixed Investments (PFI) in Sub-Saharan Africa (SSA). It applies Data Envelopment Analysis technique to drive a country-by-country and a year-on-year PFI efficiency scores (for each of the sampled 25 SSA countries, for 2001–12). The scores helped disintegrate observed PFI figures into tax-induced and non-tax-induced sub-components. Using the efficiency scores, potential PFI at existing tax structure are derived for each country-year pair. Gaps between actual and potential PFIs implied room for PFI growth without maneuvering tax structure (i.e. by changing solely the non-tax determinants of PFI). A panel data model was then constructed and estimated, under assumed nonlinear association between tax-induced PFI sub-component and tax structure indicators— *tax ratio (tax revenue share of GDP) and tax mixes (tax revenue share of direct, domestic-indirect, and international trade taxes)*. Using these estimates, tax structures that optimize PFI of each country-year pair are derived. Results reveal that for most of these countries, ‘tax ratio’ and ‘revenue share of international trade tax’ are well below their estimated PFI optimizing levels, while ‘direct-to-domestic-indirect tax mixes’ are fairly closer. These countries would be better-off, in their PFI, by re-engineering tax ratio and mixes towards estimated PFI-optimizing levels. The fact that SSA countries are at best similar (not identical); however, necessitates detailed country level studies for more concrete results.

**Keywords:** Private Fixed Investment; tax ratio; tax mix; tax structure; sub-Saharan Africa,

JEL Classifications: H21, H25, H32

## **1 Introduction**

Tax policy shapes the environment in which international trade and investment take place. Thus, a core challenge for African countries is finding the optimal balance between a tax regime that is business and investment friendly, and one which can leverage enough revenue for public service delivery to enhance the attractiveness of the economy. (NEPAD-OECD Africa Investment Initiative, 2009:5)

Instituting appropriate tax policies to minimize efficiency losses; to generate sufficient revenue for the public sector; to ensure equitable income and wealth distributions is an overwhelmingly challenging task. We know little about the justice and efficiency outcomes of taxes levied on diverse segments of economies. Tax-policy recommendations are often blunt, indiscriminate, and less considerate of the huge socioeconomic, political, and institutional variations inherent in developed and developing nations. The heavy lifting in

this regard is enormous for developing countries that endure immense institutional and structural constraints.

The large majority of scholarly works on taxation pay emphasis to overall effect of tax policies on aggregate economic performance than to a disaggregated assessment of what tax policies mean to segments of economies<sup>1</sup>. Key, yet less obvious, issues are the appropriateness of tax policies to sub-components of economies, such as Private Fixed Investment (PFI). Some studies, however, exist on taxation-private investment nexus (see Njuru, Ombuki , Wawire and Okeri (2013); Vergara (2004)).

What is the extent that tax revenue mobilization (tax ratio) and modes of mobilization (tax mixes) affect private sector investment decisions? It is tough to find tax structures (tax-ratio and tax-mixes) that concurrently attain all policy objectives. For instance, PFI optimizing tax structure may not optimize other goals (equity, consumption and production efficiencies, economic growth etc.). This paper finds PFI optimizing tax structures for sub-Saharan African (SSA) countries. The determinants of PFI can be tax and non-tax related. The identification and measurement of the non-tax factors is difficult and ignoring them cause's biases and inconsistencies.

Thus, a two-stage procedure is followed to estimate the nexus between tax structure (tax ratio and mixes) and PFI. The initial stage uses Data Envelopment Analysis (a linear programming model) to split observed PFI in to tax induced and non-tax induced subcomponents. In the second stage, panel data regression models (25 SSA countries for the period 2001-12) are employed to estimate the PFI optimizing tax structure. The findings would play ,at best, implicative roles on how close or distant countries are from such estimated PFI optimizing tax structure, i.e. it is only suggestive to individual countries than is substitute for exhaustive country level studies.

It is not clear cut how taxes translate to be costs or benefits to investors. The statutory tax incidence could be less of a use to estimate overall incidences of taxation and public sector expenditure activities. The ultimate economic incidence is net of direct and indirect costs of taxes and that of benefits from public sector expenditure activities. It is argued that without tracing actual transmission mechanisms, net effects of public sector activities (revenue and expenditure activities) can be captured by relating three-year moving average tax structures with current year tax-induced PFI sub-component. This would be so if three years are considered sufficient time to convert public revenues into pro-PFI public expenditures, and if changes in tax structure today are highly associated with changes in public investment tomorrow and thereby affects private investment tomorrow. Public expenditure is hence considered intermediary between tax today and PFI tomorrow.

The paper is structured as follows. The next section reviews the literature. Section three discusses the state of tax structure and private fixed investment in SSA. Section four presents

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<sup>1</sup> See for instance: Branson and Lovell (2001) for New Zealand; Keho (2010) for Cote d'Ivoire; Arisoy and Unlukaplan (2010). (2010) for turkey; Ruhashyankiko (2006) for Africa; Bleane, Gemmell , Kneller,(2001)for the OECD countries; and Acosta and Yoo (2012) cross country study.



the approaches to frontier analysis and the econometric techniques employed. Section five summarizes the key findings. And the last section concludes the study.

## **2 Literature Review**

It is debatable whether public investment complements or distorts private investment. Public capital hypothesis claims that public capital stock directly or indirectly boosts private sector output, productivity, and capital formation. The direct effect is when public capital provides intermediate services to the private sector and the indirect effect is through complementary relationships between private and public sector productions (Conrad and Seitz, 1992). The complementary relationships between public and private capital is often temporary and eventually dwindles to make the public spending crowd out private investments (Addison, Alan, and Smith, 2006).

Public sector investment may compete with the private sector in both product and factor markets. In factor markets, the competitions rest on human, physical and financial resources and in product markets on better market penetration. Yet, public sector through investment in infrastructure and provision of public goods does complement private investments (Blejer and Khan, 1984). Ultimately, the relative magnitude of the two effects, along with tax burdens, determine the net effect. If the net effect is positive for private investment, as public investment increases, we would expect more private investment. Thus, private investment behavior can partly be shaped by government revenue and expenditure policies.

Taxation is core to such debates. It is almost certain that tax policies impact on the decisions of domestic investors, and foreign investors decisions of where to invest. A priori investors consider tax policies of a destination nation in their investment decisions. The relatively freer cross-border capital mobility, these days, makes it decisive to consider the effects on private sector investment of tax policy reforms. Tax policies do affect investment levels (Hall and Jorgenson, 1967). Taxes may not be ranked top in determining PFI but uncontested is its being one amongst few issues investors often consider, the frequent lead determinants of investment that come before tax are infrastructure availability and quality, cost and quality of labor, and availability of good governance (Keen and Mansour, 2009). Thus, the effect of taxes on private investment is not something to be ignored for it affects both the demand and supply side factors.

Taxes and public spending should be analyzed simultaneously in any tax structure designs. Taxes can be costs or benefits to economic agents only after the feedback effects of public sector expenditures activities are fully incorporated. Taxes have immediate and lagging impacts on public and private sector activities and the transmission mechanisms from taxation to private sector activities are not clear cut. In the event private investors pay taxes, the immediate effect could be distortionary to investment. However, in later years, increased public sector expenditure activities, out of funds collected from taxation, could incentivize back private sector activities. The net effect depends on the modes of taxes collection, and properness of and discipline in public expenditure undertakings.

The optimal tax debate should lie on two grounds. First, on what should be the optimal amount of tax to be collected (tax ratio). Secondly, on what should be the modes of mobilization (tax mix) of a given tax amount. The former has been thoroughly discussed in line with optimal government size. The literature is full of arguments for government and against government activism in an economy (Ram, 1986). However, excessive market failures that led to series of crises and poor growth and the success from government activisms, for instance in Southeast Asia and more recently in Africa has skewed the debate in favor of the latter.

On the question of optimal tax ratio, the Marginal Cost (MC) of taxation and Marginal Benefit (MB) of Public Funds are the basis to determine costs and benefits of an additional unit of tax revenue collected from the private sector and invested or consumed by the public sector. Ultimately, what counts for private investment is the relative magnitude of MB of taxation to investors (in current and later years) and MC of taxation (directly upon compliance and indirectly through market competition).

On the question of optimal tax mixes, it is possible to improve PFI by replacing tax types of higher MC and lower MB by those with lower MC and higher MB (adjustment of the tax mix). Dahlby (2001) claims that marginal efficiency gains of substituting a highly distortive tax with less distortive one is simply half the difference of Marginal cost of public funds (MC) of the forgone tax minus MC of the added tax. Auriol and Warlters (2010) counter argues that MC is an aggregate figure that underestimates marginal tax rates incurred by those who actually pay taxes. Besides, in high informal sector economies, the MC is higher as economic agents tend to substitute formal sector activity with informal sector (which is often unaccounted).

Alm (1996) view of tax mix is dependent on whether tax is meant to bring efficiency or equity. The optimal tax mix for efficiency is to have only lump-sum income tax. But for equity, both income and uniform commodity taxes are needed. He argues that it is not optimal to tax commodities at different rates. His final take is that both indirect and direct taxes should be used as this, by lowering marginal tax rate of each, reduces distortions and increases compliance. Besides, establishing such tax mixes provide governments with extra flexibility to meeting equity and revenue-yield goals. Therefore, a combination of direct and indirect consumption taxes would produce a more efficient and equitable tax system than simple reliance on one form of consumption tax (Dahlby, 2001).

Atkinson and Stiglitz (1976) claim that taxation is optimized on two levels—*on the choice of optimal tax base and on the choice of the structure of taxes imposed*. They recommended sole direct taxation if governments seek for efficiency and if constraints in implementations can be abolished (such as constraints related to compliances and tax administrations, which is not the case in the real practice). However, they acknowledge that existence of implementation constraints could justify use of indirect taxation.

The optimal tax theories that advocate for zero indirect taxation argue that a given tax objective can be attained by an arbitrary direct and indirect tax mixes; and if tax evasions can be abolished, a uniform commodity tax can be equivalent to an income tax. If uniform commodity taxes and income tax are levied, all or part of the former can be incorporated into the latter. However, tax evasion distorts the equivalence between reported earnings and consumption (Boadway, March, and Pestieau, 1992). According to them, differences in evasion characteristics of tax types leads to a natural adjustment of tax mixes to some optimal level. For instance, Income tax evasion maybe positively related to one's earnings ability and may not be the case for indirect taxes evasion.

On the other hand, Advocates of broad-based consumption taxes (an indirect tax) over direct taxes (for instance; Hall and Rabushka, 1995; Fjeldstad and Rakner, 2003) claim that such taxes give the administrative advantage of easy and less costly tax collections. Value Added Tax (VAT) is one of those. VAT is preferred to other taxes for better allocate efficiency and higher yield (Fambon, 2006).

Theories on tax mix often consider the direct-indirect tax rates than the direct-indirect revenue mixes. In setting tax mixes, practitioners often are grounded on incentives and compliances. Several tax literatures give prominence to corporate taxes in investment analysis. It is, however, not just the statutory levy of corporate taxes that matter to investments but the whole set of taxes have indirect routs to matter. For instance, taxes levied on consumers would affect those producing consumption items, consumption taxes affect demand, and demand in turn determines investors' scale of input employment and production.

Developing countries focus on indirect taxation is for it gives a convenient tax-handle, but this tax overlooks ability-to-pay considerations. The complexities arise from governments' limited knowledge about the ability-to-pay of all economic agents. Knowledge of such abilities would have made direct taxes absolutely appropriate and non-distortionary. The real world, however, is full of information asymmetry to make access to ability-to-pay information so limited.

Empirical studies on tax structure are focused on aggregate economic performance (such as economic growth) and yielded mixed results. Acosta and Yoo (2012) cross-country study of 69 countries with proportional representation of low, middle and high income countries found income tax replaced for property and consumption taxes deters long term growth prospects. The study recommended value added and sales taxes for faster growth. Skinner (1987) study of SSA for 1974-82 found for every five percent increase in tax financed public investment, economic growth falls by 0.6 percent. Ruhashyankiko (2006) concluded tax systems that are designed to collect short term revenues than pursuing long-term developments do discourage investments and growth. According to Fjeldstad and Rakner (2003), tax policies in Africa inappropriately address private sector's incentive to invest productively, to create jobs, and to boost growth. There are few SSA country specific studies on private investment and taxation (for instance Ahiawodzi and Tsorhe (2013) for Ghana; Njuru, Ombuki, Wawire, and Okeri (2013) for Kenya). Such studies are generally scant in the literature.

Watrin and Ullmann (2008) experimental study concluded that tax mixes indeed determine compliances and found that median compliance is 10.2 percentage points higher for the income tax. They also found the reaction towards a change in detection rates is higher in the consumption tax scheme and concluded that behavioral patterns should be considered in direct-indirect tax mix determination. It is argued in several public finance literatures that general consumption taxes are less distortionary than income taxes, particularly in their effect on labor supply and with the choice between present and future consumption. Thus, tax design, besides efficiency and equity, should consider fiscal administration and enforcement issues, and the optimal tax theories often ignore these (Watrin, Ullmann, 2008; Alm, 1996).

Vazquez, Vulovic, and Liu (2011) study on a sample of 116 countries concluded that the direct-indirect tax ration followed an increasing trend and there disaggregated view indicated that the increase is more profound in developed countries than in the developing ones. Although, developing countries are advised to reduce tariffs and taxes on international trade and to revert into domestic consumption taxes (revenue-neutral reforms), the result is the domestic consumption taxes fail to compensate for the fall in international trade taxes. It is widely believed that existence of tax evasion and heterogeneity among tax payers could justify mixing direct and indirect taxes, however, the literature has not established full understanding of the determinants of direct-indirect tax mixes (Kenny and Winer (2006) cited in Vazquez, Vulovic , and Liu (2011)).

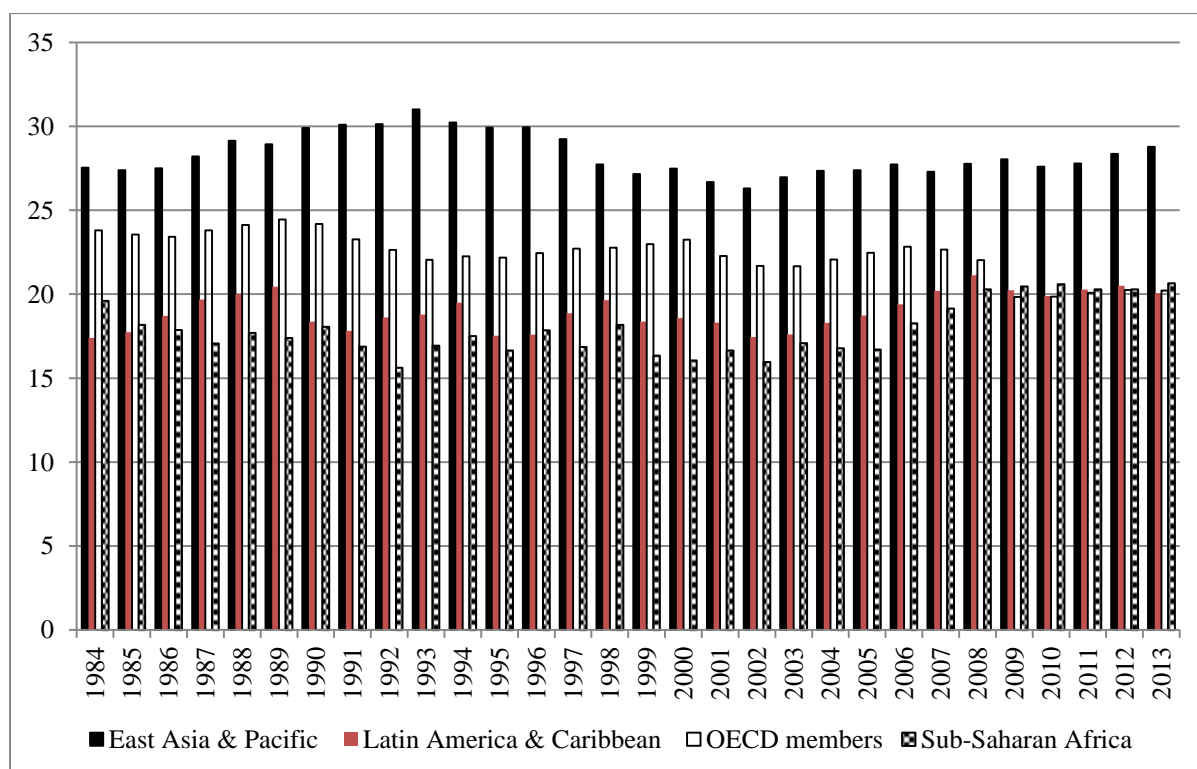
### **3 The State of Fixed Investments and Tax Structure in SSA**

#### **3.1 Fixed Investments in SSA:**

Domestic or other private sector constitutes the lion's share of total gross fixed investment in SSA. The SSA average gross fixed investment share of GDP for the years 2000-2012 were 21 percent (13 percent private and 7 percent public investments). For most of the years, public sector's share remains under 10 percent of GDP, with few exceptions such as 23 percent for Eritrea in 2001 and 22 percent for Burundi in 2008. In some SSA countries private investments are quite high. The highest was registered in 2005 in Mauritania (52 percent of GDP). For the years 2000-2012, the highest gross fixed investment (Public + Private) was observed in 2002 in Chad (60 percent of GDP), of which the private sector accounted 84 percent. The case of Chad could be attributed to the huge investment in oil extraction and intensification of the privatization policy.

The SSA aggregate gross fixed investment share of GDP around 20 percent since 2008 is at par with the average for the World, the Organization for Economic Cooperation and Development (OECD) countries, and the Latin America and Caribbean regions. For instance, the average for 2010-12 was 21 percent for the world, 20 percent for SSA, and 19 percent for the OECD countries (see World Bank's WDI, 2014). However, there remains a lot to be done to reach the all-time high investment records of the East Asian and Pacific Region (Figure 3-1).

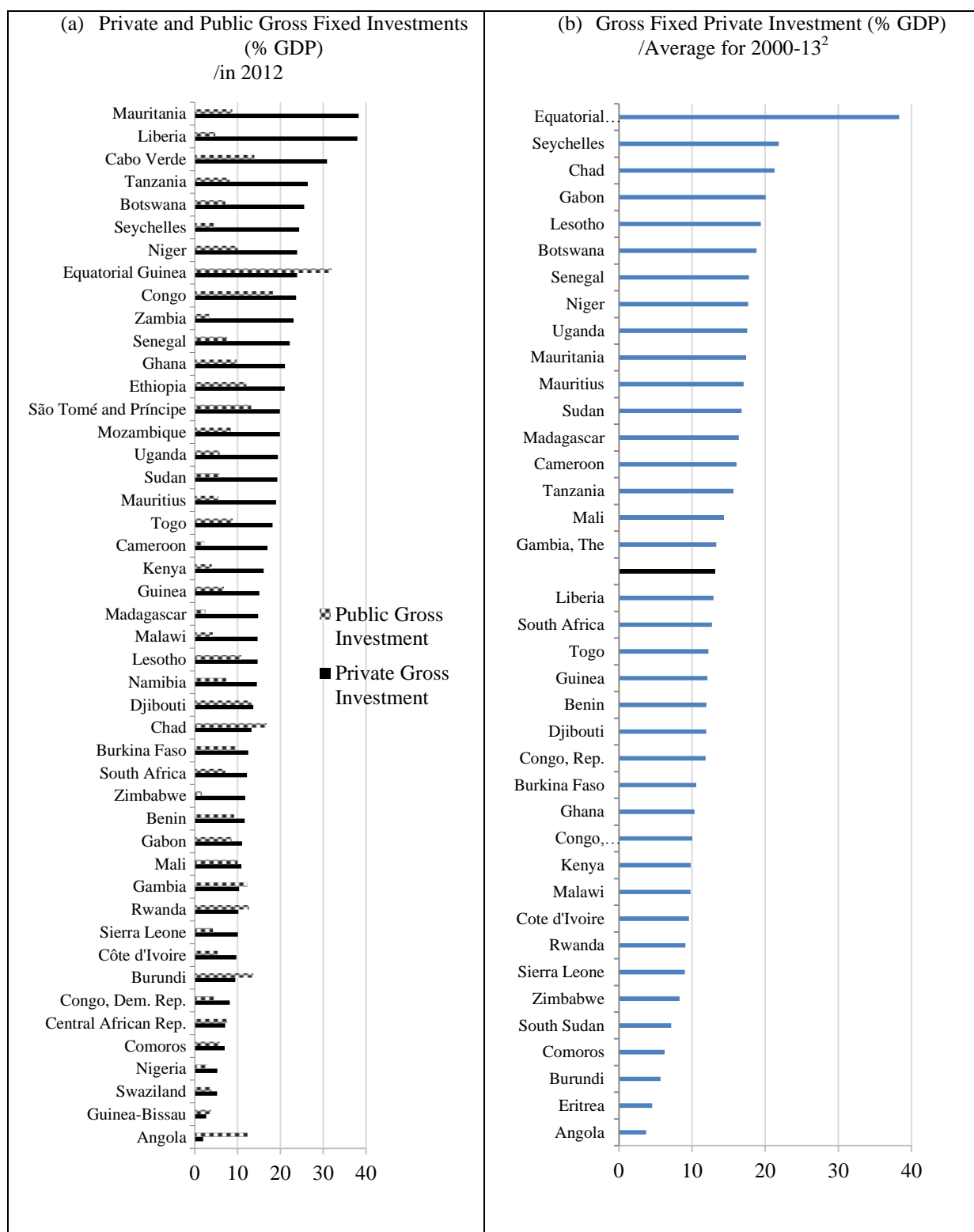
**Figure 3-1** Gross Fixed Investment SSA Compared to Other Regions



Source: WB's WDI (2014)

In 2012, with the exception of Guinea-Bissau, Swaziland and Nigeria, the rest of the SSA countries (Figure 3-2a) had over 10 percent investment (public plus private) share of GDP. For most of the countries, public investment has at best a marginal share. In countries with low private investment share of GDP, public investment is relatively higher (for instance: Angola, Guinea-Bissau, Swaziland, Comoros, and Central African Republic). Countries with high total investment share of GDP tend to have lesser public investment share (see the upper most countries of Figure 3-2a). Equatorial Guinea is the only one from the top 27 high investment SSA countries that registered higher public sector investment share. And it was the only country with investment share of GDP exceeding 50 percent in 2012. The irony is some of the natural resource rich countries performed less in their share of private investment (for instance: Angola had the lowest private investment and Nigeria the fourth lowest). In 2012, Even South Africa, which is laudable for better economic performance and resource base, is preceded by 29 SSA countries in its PFI share of GDP (Figure 3-2a).

**Figure 3-2 Private and Public Investments in SSA**



Source: Author's construction using data from AfDB, OECD, and UNDP (2014) and WB-WDI (2014)

<sup>2</sup> It is average for the available data between 2000 and 2010 i.e. not necessarily balanced. For instance data for South Sudan exists only for 2008 and after.

## 3.2 Tax Structure in SSA

### 3.2.1 Tax Revenue Size and Foreign Financial flows in SSA Countries

Taxes are the prime sources of government revenue for countries in the SSA. In 2005-12, tax revenue of the region ranged between 200 and 350 percent of net foreign official financial flow. Tax ratio (tax revenue share of GDP) in SSA between 13 and 18 percent for most of the recent years can be considered low. The variation amongst the countries is huge. The range since the turn of the millennium extends highest tax ratio of 61 percent registered for Lesotho in 2006 and lowest ratio registered for Nigeria in 2004. The Nigerian tax ratio is single digit for most of the years, while Lesotho's tax grew steadily from 40 percent in 2001 to 61 percent in 2006. For instance, the VAT rate in Nigeria at 5 percent contributed only 1.5 percent tax revenue share of GDP. To give a context, the average VAT rates for low income, lower middle income, and upper middle income of 16.4, 17.4, and 17.3 percent yielded 5.5, 6.6, and 6.6 percent tax revenue share of GDP, respectively (IMF, 2011).

The real tax burden on actual tax payers is expected to be high in SSA as most of the countries have huge share of agriculture and informal sectors that often are untaxed or underrated. The GDP share of Agriculture in the world is below 10 percent while the SSA average is near 20 percent. For Addison, Roe, and Smith (2006), the start of tax reforms in Mid-1980s signaled a reduction of tax burden on the Agriculture sectors of SSA nations. The reductions of the burden were through sectoral and macroeconomic reforms; reforms in customs and excise services and through deliberate reduction of international trade taxes.

The growth in average tax ratio of the SSA since the late 1990s are mainly driven by marked increases in revenue from natural resources and between late 1990s and 2005, tax ratios of natural resource rich SSA countries grew by 7.7 percentage points, whereas it remained unchanged when natural resource revenues are excluded. When only non-resource revenues are considered, the SSA countries average tax ratio that was about 13 percent in 1990 increased only by 1 percent after 25 years. The situations are even worse for natural resource rich countries that showed a 2 percent fall after 25 years (Keen and Mansour, 2009; NEPAD-OECD Africa Investment Initiative, 2009)

**Table 3.1** Foreign Financial Flows and Tax Revenue in Africa (Current USD, billion)

Indicators	2005	2006	2007	2008	2009	2010	2011	2012
a. Foreign Direct Investments (FDI)	34	35	53	66	55	46	50	52
b. Portfolio Investments	6	23	14	-25	0	22	7	22
c. Remittances	33	37	44	48	45	52	56	60
d. Official Development Assistance (ODA)	36	45	40	45	48	48	52	51
e. Net Official Foreign Inflow (NOFI) <sup>3</sup> (= a+b+c+d)	109	140	151	135	148	167	164	185
f. Total Tax revenue	259	305	335	433	331	409	467	527
<b>Tax revenue as percent of NOFI (= (e/f)*100</b>	<b>237</b>	<b>219</b>	<b>222</b>	<b>321</b>	<b>224</b>	<b>245</b>	<b>285</b>	<b>285</b>

Source: Author's Summary of AfDB, OECD, and UNDP (2014).

<sup>3</sup> The illicit flows are not included here. With total illicit flows the significance of foreign net inflows could be much lower and even negative.

### 3.2.2 Tax Mixes in SSA

Choice of tax mixes is a contentious issue. Choice of direct vs. indirect taxes and within indirect taxes, international trade vs. domestic-indirect taxes; and so on are widely debated. The fact that a given amount of tax revenue can be collected at varying distortionary effects stages choices of tax mixes at the heart of tax policy designs. The tax reforms in developing countries since early late 80s were meant to change tax mix favoring taxes that are easier to administer and less distortionary (UNCTAD, 2007). The mix in developing nations favors domestic-indirect tax over direct and international trade taxes.

There are large differences in the tax mix patterns in Africa. A country like South Africa obtains most of its tax revenues from direct taxation, while countries like Senegal and Uganda rely mostly on indirect taxation. Kenya and Mauritania show a relatively balanced mix of different types of taxes. Other countries, however, such as Angola, Equatorial Guinea, and Nigeria almost entirely rely on one single type of tax (AfDB, OECD, and UNDP, 2014).

Until the fiscal crises of 1980s, pre-independence tax regimes persisted in most of Africa. Later, tax reforms such as flattening tax rates and broadening tax bases formed essential components of structural adjustment programs. The reform included introduction of Value-Added Tax (VAT), lowering and broadening of personal and corporate incomes taxes, simplification of tax brackets, revision of excise taxes, reductions of import duties, and eliminations of export taxes (Fjeldstad and Rakner, 2003).

South Africa, Togo, and Zambia have a growing direct taxation while countries like Uganda and Senegal depend much on indirect taxation. Kenya keeps a balance between direct and indirect taxation. According to Osei and Quartey (2005), direct and indirect taxes in Ghana, averaged 26.1 per cent and 73.9 percent between 1999 and 2002, the share of direct taxes has increased steadily. The strength of direct taxes in SSA is in large part due to South Africa; without it, natural resource rich countries raise about 40 percent less in direct taxes than non-resource rich countries (Mansour, 2014).

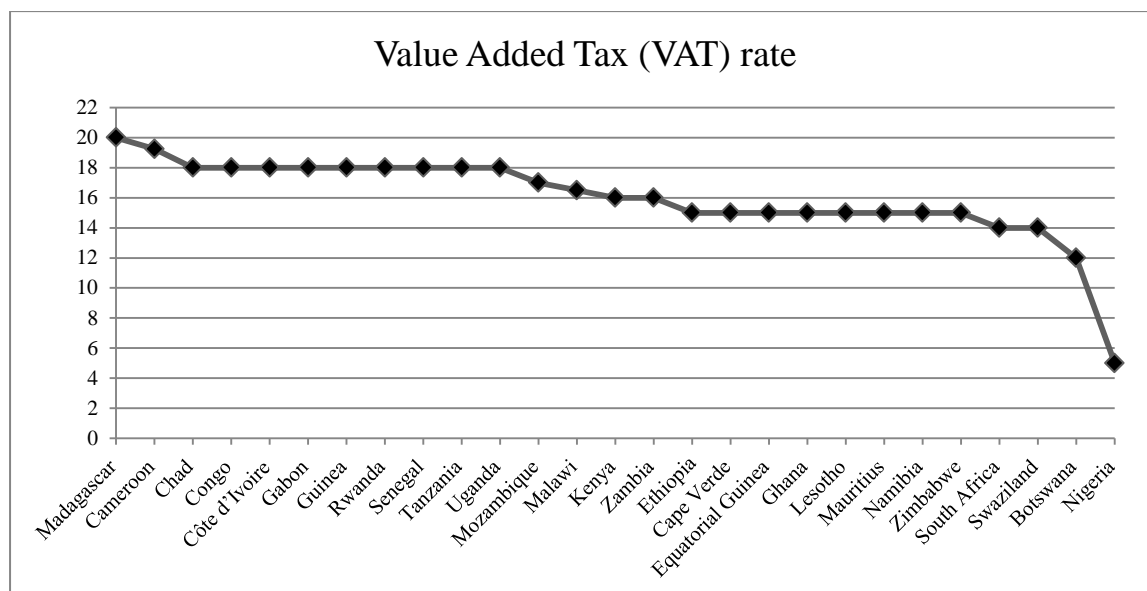
The last two to three decades, domestic-indirect taxation in SSA has heavily relied on VAT. Many of these countries introduced VAT in 1990s and some in early 2000s. For instance, Ethiopia replaced VAT for sales tax in 2003 (Geda and Shimeles, 2005). Introduction of VAT, replacing the turn over tax, in 1999 was Cameroon's most important tax reform during the 1990s. The late 1990s introduction of VAT in Ghana has led to the falling contribution to revenue of taxes on international trade, which used to be the lead source accounting 38.8 per cent for the period 1980-93 (Osei and Quartey, 2005).

The SSA countries have slight deviation in their VAT rates ranging from 20 percent for Madagascar to 12 percent for Botswana to 5 percent for Nigeria (Figure 3-3). Deviations are lesser for countries under functioning regional integrations. For instance, most of the Economic Community of West African States (ECOWAS) member countries have a uniform VAT rate of 18 percent (although Nigeria with 5 percent and Ghana with 15 percent remain outliers). This is well below the rates in most of the advanced economies that mainly range between 20 and 25 percent. There are however advanced nations with much less VAT rate



(e.g. Switzerland 8 percent and South Korea 10 percent). The VAT rate in SSA is significantly higher than many Asian nations (Thailand 7 percent, Taiwan 5 percent, Philippines 12, Singapore 7 percent, Vietnam 10 percent, China 17 percent, Indonesia 10 percent, India 12.5-15 percent, and Malaysia 5-10 percent).

**Figure 3-3** Value Added Tax Rates in SSA



Source: Authors construction from PricewaterhouseCoopers /PWC (2014).

Introduction of VAT as source of indirect taxation has been designed to substitute for possible loss of revenue from customs duties when tariff rates are cut to liberalize trade. The presupposition has been that all what could be lost from tariff reduction will be compensated by increased domestic-indirect tax revenues, primarily VAT (called in the literature “revenue neutral changes” of tax structure). Emrana and Stiglitz (2005) are critical about the revenue neutral international trade tax reductions that blames trade taxes as double distortionary through its interference in both consumers and producers prices. For them, such policy undermines existence of large informal sectors in developing countries or it ignores the fact that revenue neutral reduction of trade taxes increases the distortions between formal and informal sectors. In high informal sector economies, imposing additional burden on formal sector actors is a drive to encourage informal sector activities.

Keen and Mansour’s (2009) counter argued that fall in average tariff rate from over 20 percent to below 13 percent between 1980 and 2005 ,although led to dwindling trade tax revenues both relative to GDP and as a share of total tax revenue , it had brought about high over all tax revenue share of GDP.

All middle income countries lost trade revenues, except one (Cape Verde). And the losses have been significant: 2.7 percentage points of GDP for Lower Middle Income Countries (LMICs) and 5.7 points for Upper Middle Income Countries (UMICs). Nevertheless, both groups managed to increase their total tax ratio, with the former relying mainly on indirect taxes and the latter on revenue from natural resources. For Low Income Countries (LICs), the story is mixed, with roughly 1/3 gaining trade tax revenue and 2/3 losing. Importantly, even

those LICs that lost trade tax revenue nevertheless managed, on average, to increase their total tax ratio over the full sample period (Keen and Mansour, 2009:31).

The above observations of Keen and Mansour have not been consistent in SSA for the periods after 2005. The SSA's average tariff rates in 2006-12 has stagnated with a record high of 11.57 in 2008 and a low of 10.92 in 2010, whereas tax revenue share of GDP steadily declined from 18.43 in 2006 to 13.83 in 2012. And the revenue share of international trade taxes declined from 17.86 to 13 percent (according to WDI 2014 data). The importance of trade tax in the tax mix of SSA registered a declining trend since mid-1990s (AfDB, 2014). Thus; revenue neutral substitution of trade taxes for domestic-indirect taxes has not been supported by the recent trends.

#### **4 Approaches to Frontier Analysis and Econometric Techniques**

The determinants of PFI can be tax and non-tax related. For the purpose of this study, the tax related factors (tax structure) embraces tax mix (the relative compositions of direct, indirect and international trade tax) and tax ratio (tax revenue share of GDP). And the non-tax factors could be enumerable. The identification and measurement of the non-tax factors is likely to be difficult, and omitting them will cause estimation biases and inconsistencies.

The empirical approach follows a two-stage procedure to estimate the nexus between tax structure and PFI. The first stage splits observed PFI figures into tax induced and non-tax induced sub-components, using Data Envelopment Analysis (DEA) technique (a mathematical programming technique that measures relative efficiency scores). The DEA allows us to construct a best-practice PFI frontier that utilizes information from each country and year in the sample. Observations located on the frontier define best practice PFI levels at prevailing tax structure. The DEA provides PFI efficiency score for each country-year pair. The scores are between 0 and 1. A score of 1 implies the given country-year pair has achieved the maximum PFI level possible at the prevailing tax structure. The farther the score is from 1 and the closer to zero, the lesser the efficiency.

These scores are used to proxy for cumulative effects of the non-tax PFI determinants. For instance, if score for a country-year pair is found 0.6, the inefficiency becomes 0.4 ( $=1 - 0.6$ ). This inefficiency is indication of unfavorable non-tax environment for PFI. Had non-tax factors been cumulatively fully favorable, it would have been possible to reach an efficiency score of 1 without having to change existing (observed) tax structure. The efficiency scores are also used to normalize observed PFIs to get potential PFIs. The normalization converts the observed PFI data to its level if non-tax factor were fully favorable (i.e. potential PFI at existing tax structure).

The second stage of the empirical approach is to estimate the effect of tax structure on PFI using panel data regression models. PFI is regressed on tax structure (tax ratio and tax mixes) in their quadratic functional forms and on the proxy for cumulative non-tax determinants, as explained above. Then, using the panel estimates and application of standard mathematical

optimization (finding tax structure values that make the first derivatives of estimated PFI equation to zero), PFI-optimizing tax structure is computed.

#### 4.1 Initial Stage: Data Envelopment Analysis:

Data Envelopment Analysis (DEA) is a linear programming technique used to evaluate performances of a set of peer entities. DEA is based on a relative efficiency concept that compares performance of an entity (in this study country-year pair), to other entities. The entities are called Decision Making Units /DMUs. There are various approaches to the DEA models, this study employs the CCR (Charnes, Cooper, and Rhodes) model proposed by Charnes, Cooper, and Rhodes (1978). DEA is superior to regression analysis, for it requires only few assumptions; and for it is a frontier analysis as opposed to estimating average tendencies. Besides, DEA does not require specifying the form of relationship between tax structure (inputs) and PFI (output).

#### CCR DEA Model:

Private Fixed Investment ( $PFI_{it}$ ) is considered an output partly determined by the level and mixes of taxes. Suppose  $X_{j,it}$  is value of a tax structure indicator  $j$  in country- $i$  in the year  $t$ . The proposition is that PFI is an output to be produced using only tax inputs, after isolating the non-tax sub component of PFI.

$$PFI_{it} = f[(Taxmix_{j,it}, tax\ ratio_{it}); non-tax\ factors_{it}]$$

Where,  $i = country = 1, 2, 3 \dots 25$ ;  $t = year = 2003, 2004, \dots 2012$ ,  $j = tax\ mix\ variable$

Inputs (three-year moving average)	Output (one year value/current year)
1. Tax ratio	
2. Tax mix:	
2.1 Domestic-indirect-to-Direct Tax Ratio	Private Fixed Investment (% of GDP,)
2.2 International Trade-to- Direct Tax Ratio	

The ratio of virtual output (PFI) to virtual inputs (Tax structure) measures the relative efficiency of a given country-year combination. The ratio of the virtual output to virtual input is the maximum attainable level of PFI possible with existing tax structure i.e. the maximum PFI a SSA country in a given year could have attained with no change to any of the tax variables. Thus, the unconstrained maximization problem becomes:

$$\text{Max } PFI_{it} = \sum W_{it} PFI_{it} / \sum V_{it} X_{j,it}$$

$PFI_{it}$  and  $X_{j,it}$  are observed actual values of PFI and tax structure for a given country at a given year, respectively. The maximization problem is to find  $W_{it}$  and  $V_{it}$  weights that maximize the above problem ( $PFI_{it}$ ).

However, since we are setting a practical frontier against which efficiency is measured, we ought to follow constrained optimization problem.

$$\text{Max PFI}_{it} = \Sigma W_{it} \text{PFI}_{it} / \Sigma V_{it} X_{j,it}$$

Subject to

- $\Sigma W_{it} \text{PFI}_{it} / \Sigma V_{it} X_{j,it} \leq 1$ , a restriction to keep the efficiency score at or below 1, frontier is 1. The closer the efficiency score is to 1, the higher the efficiency; and the closer to zero, the lesser the efficiency)
- $W_{it}$  and  $V_{it} \geq 0$
- $\Sigma V_{it} x_{j,it} = 1$ , a restriction to keep the impute level constant

To give an intuitive meaning to the model: Say a country in the sample has observed PFI and tax structure for the entire sample years 2001-12. Let's see how the efficiency score is measured for this country at the year 2001. The above linear programming model computes a virtual PFI by assigning weights ( $W_{it}$ ) to the actual PFI observations and weights ( $V_{it}$ ) to the input tax variables, and this is done across all country-year pairs. The maximization is possible by varying the weights until a maximum virtual PFI is obtained (this is the frontier private fixed investment level) against which the actual investment of a given country in a given year is to be evaluated. The closer the value to 1 is the more efficient. And this maximization is repeated  $N \times T$  times for each country-year combination. The more the number of country-year combinations, the better is the explanatory power of the DEA model. The more the diversity, the lesser is the likelihood to compare similar DMUs

Higher efficiency scores are associated with favorability of other non-tax determinants of PFI. The difference between maximum possible efficiency (efficiency=1) and the actual efficiency score measures the non-tax factors' effects on PFI. For instance, Benin has such efficiency score of 0.409 for 2001-3 (which you will see in Table 5-1), using this score the proxy for non-tax determinants altogether becomes 0.591 (1 minus 0.409). This is done for all country-year pairs (panel). In effect PFI is being decomposed into tax induced and non-tax induced sub-components.

For each country-year pair, PFI divided by corresponding efficiency score gives potentially reachable PFI level at existing tax structure of the country-year pair. When efficiency score is 1, actual PFI and potential PFI are equaled, which intern means the non-tax factors are fully favorable to PFI in the given country-year pair. On the other hand, when the efficiency scores get closer to zero, deviations between actual (observed) and potential (transformed) PFI gets bigger and bigger, which again means the non-tax determinants are unfavorable in the given pair.

Two approaches are possible in the panel data estimation that will follow in later sections. (i) Either regressing observed PFIs on the tax and the non-tax factors (using the formulated proxy) or (ii) dividing observed (actual) PFI of a given country-year pair by the efficiency score to get potential PFI. Since the potential PFI is when the effect of non-tax actors is kept

at zero, it can be consistently estimated using tax structure variables as only right hand side variables. Both approaches would give the same result and the first approach is followed in this study as it allows estimating the cumulative effects of non-tax factors along with the tax factors.

Similar methodologies have been used by Branson and Lovell (2001) to estimate a growth maximizing tax structure for New Zealand; and Marire and Sunde (n.d.) to estimate economic growth and tax structure nexus in Zimbabwe. However, no prior study has been found using this methodology in private investment and tax structure context. This research also deviates, methodologically, from the above two studies in that it applies the technique in a panel data setting; it generates a proxy for the cumulative effects of non-tax factors and estimates the effect on PFI.

## **4.2 Second Stage: Panel Data Models**

The Army Curve, popularized by Richard Armev (Armev ,1995; cited in Vedder and Gallaway ,1998), theorizes that mix of private and government allocation of resources gives larger output than if only one of them does the allocation. Initially, increase in governmental size, along with private actors, leads to high growth. Beyond certain size of government, however, expansion of government no longer leads to output expansion i.e. at this level the growth reducing aspects of government over grows its growth enhancing features. If the Armev model holds for economic growth and government spending, it is likely to hold for private investment and taxation, as private investment is nothing but a component of an overall economic performance and size of taxation is so directly linked to government spending (size). This is also true of Kuznet's inverted U hypothesis that proclaims quadratic relationship among some economic variables, as applied in most environmental and inequality literatures. Thus, a non-linear inverted-U shape (quadratic) relationship between tax structure and PFI is assumed in this study.

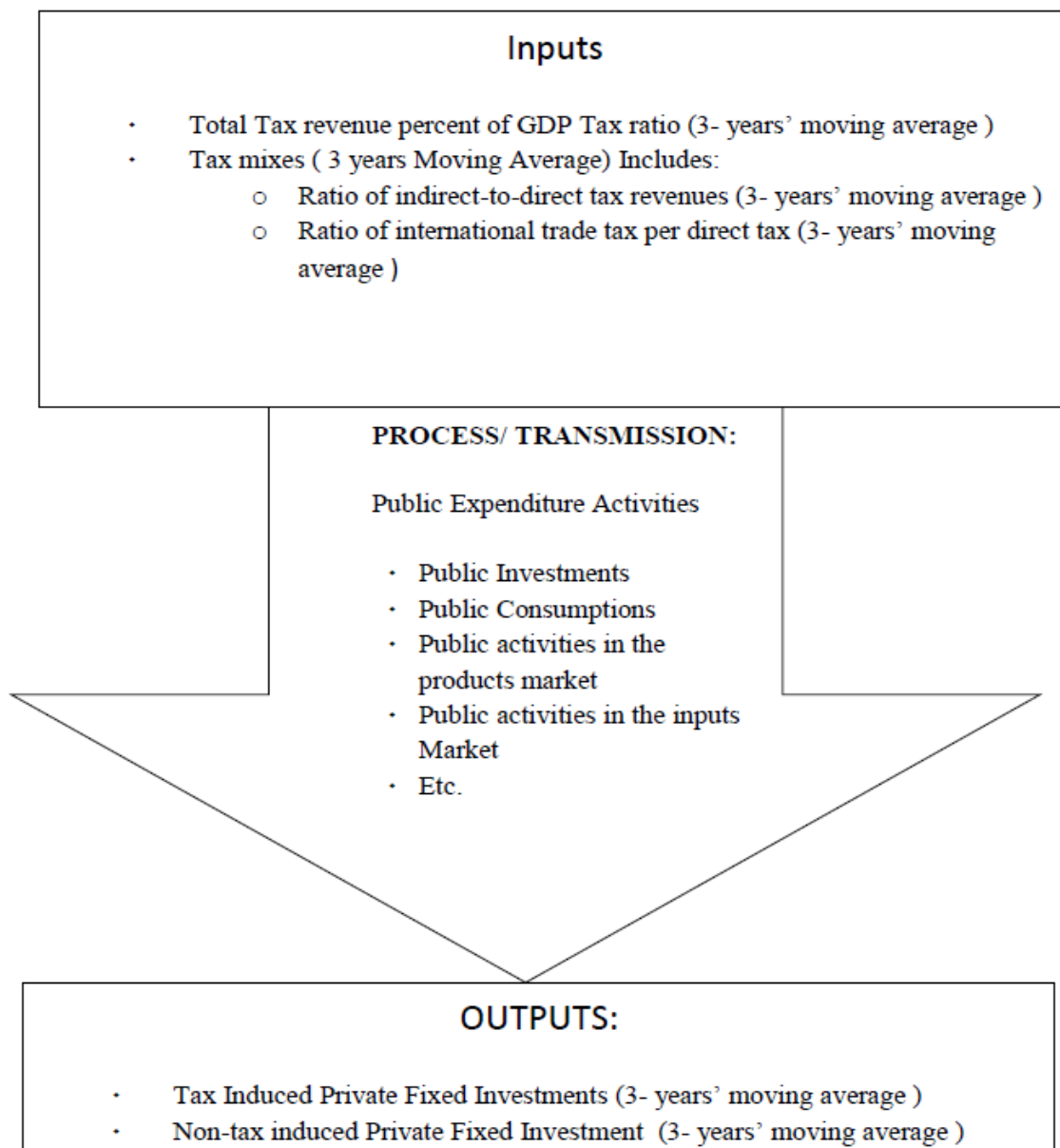
This paper deviates from overall economic performance analysis by focusing on private fixed investment. However, the government spending is made implicit by relating current year's PFI to three-years moving average tax structure variables (average of current and two lags). The PFI is affected not just by tax revenue but also by government spending.

The effect of tax structure on PFI has double routs. Firstly, on the negative side, increase in current year tax revenue (be it from corporate or personal incomes) may discourage private investment as private investors are paying taxes that affect their current year cash flows. If it is levied on personal income, the current year's cash flow could be affected through loss of demand for private investors' outputs as buyers would have to redirect their incomes to comply with their tax obligations. This remains a valid argument as long as government spending is not substituting for the lost private spending.

Secondly, on the positive side, government would do some investment (such as infrastructure) with the collected tax revenue or extend pro-private investment incentives of

any sort in return. In a three-year moving average approach, both the first and second effects interplay. What matters in the end is the net effect. A schematic theoretical framework is presented below. The three-years moving average besides current year figures for tax variables is to control for the time lag between policy reforms and the ensuing changes in economic variables such as private investment. There are time lags between tax policy changes and the real effect on economic variables as economic agents take some time to readjust their behavior in response to policy shocks

**Figure 4-1** Schematic representation of the theoretical framework



$$PFI_{it} = \alpha_0 + \beta_1 TRav_{it} + \beta_2 TRav_{it}^2 + \sum_{k=1}^2 (Taxmixav)_{it,j} + \sum (Taxmixav)_{it,j}^2 \beta_j + v_i + \mu_{it} \quad (1)$$

Where:

$i = 1,2,3,\dots,25$  is the cross sectional dimension (countries)

$t = 2003, 2002,\dots, 2012$  is the time dimension

$TRav_{it}$ : Total Tax revenue percent of GDP, 3- years' moving average

$\sum (Taxmixav)_{it,j}$  : Ratio of indirect-to-direct tax revenues, 3- years' moving average (j=1);and Ratio of international trade tax to direct tax ,3- years' moving average (j=2)

$PFI_{it}$  = Private Fixed Investment share of GDP;  $TR_{it}$ = Total tax revenue share of GDP;  $TRav_{it}$  = 3-year moving average of total tax revenue share of GDP;  $Taxmix$  is a vector of tax mix variables that includes (A): of indirect-to-direct tax revenue ratio (3-year moving average), (B): of international trade tax to direct tax ratio (3- year moving average);  $\beta_j$  is a vector of tax mix parameters;  $\alpha_0$ = constant;  $v_i, \mu_{it}$  are time invariant individual heterogeneity and the idiosyncratic error components, respectively.

The quadratic model is constructed assuming a certain threshold level exists for the positive relationship between tax structure and PFI, beyond which the relationship reverts. The threshold level is the maximum attainable PFI possible with changing the tax structure. Thus, the first and second differential of PFI with respect to each of the left hand side tax variables and equating them to zero would give the PFI optimizing tax ratio and tax mixes. For instance, the PFI optimizing tax ratio obtained from differentiating PFI with respect to the corresponding tax variables and setting the result to zero is:

$$\frac{dPFI}{dTR} = 0 \text{ implies ,PFI optimizing Tax Ratio } x = -\beta_1 / 2 \beta_2 \quad (2)$$

To be the optimal tax rate, we should have  $\beta_1 > 0$  and  $0 < \beta_2$ . The optimization equation of PFI with respect to the rest of the right hand side variables will follow the same procedure as in the Tax ratio.

Choice of the panel data model to follow [choice of Random Effects (RE) vs. Fixed Effects (FE) model] has been dictated by the standard Hausman test procedure. The Hausman test result validated use of the FE estimators (see Wooldridge, 2002; Baltagi, 2005; and Green, 2003 for more on these models, and for the hausman test results see the annex section).

<b>Variable</b>	<b>definition</b>
Domestic-Indirect tax (Taxes on goods and services)	Taxes on goods and services include general sales and turnover or value added taxes, selective excises on goods, selective taxes on services, taxes on the use of goods or property, taxes on extraction and production of minerals, and profits of fiscal monopolies.
Taxes on international trade	Taxes on international trade include import duties, export duties, profits of export or import monopolies, exchange profits, and exchange taxes.
Tax revenue (% of GDP)	Tax revenue refers to compulsory transfers to the central government for public purposes. Certain compulsory transfers such as fines, penalties, and most social security contributions are excluded. Refunds and corrections of erroneously collected tax revenue are treated as negative revenue.
Direct tax (Taxes on income, profits and capital gains)	Taxes on income, profits, and capital gains are levied on the actual or presumptive net income of individuals, on the profits of corporations and enterprises, and on capital gains, whether realized or not, on land, securities, and other assets. Intra-governmental payments are eliminated in consolidation.
Gross fixed capital formation, private sector (% of GDP)	Private investment covers gross outlays by the private sector (including private nonprofit agencies) on additions to its fixed domestic assets.

**Data:** World Bank's World Development Indicators database and the IMF's government financial statistics database are the principal sources of data for the study; (SSA countries for the years 2000-2012).

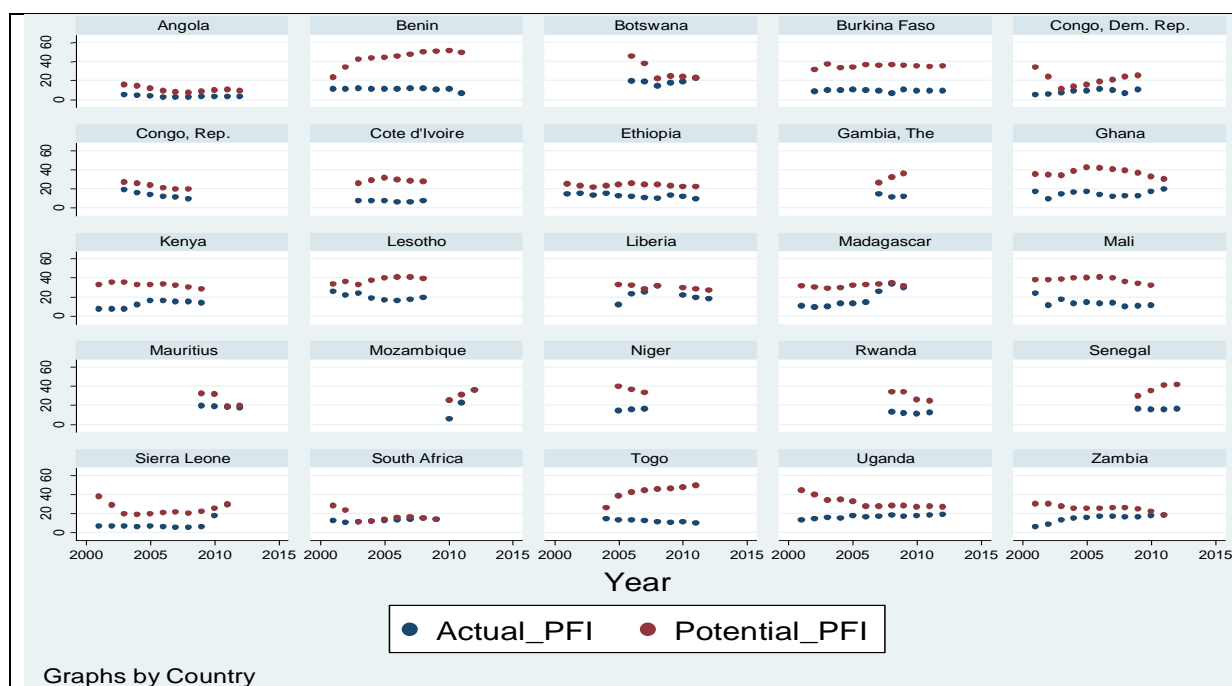
## 5 Results:

### 5.1 Initial Stage: Data Envelopment Analysis

The results from an output oriented analysis of the CCR DEA model (see Figure 5-1) shows significant efficiency variation amongst SSA countries. Most of the SSA countries remain far away from reaping their potential PFI levels. The vertical axis of Figure 5-1 measures the efficiency scores, which ranges from 0 to 1. A closer a country is to score 1 indicates higher efficiency. The trend lines show that some SSA countries have performed well to reach their potential PFI at existing tax structure and others remain far below their potential. For instance, Botswana, Madagascar, Mozambique, Sierra Leone, South Africa, Uganda, and Zambia have attained steady efficiency gains in the recent years, while countries like Benin, Ethiopia, Gambia, Lesotho, Mali, Senegal, Togo, faced efficiency losses; during the same period. This efficiency scores are not because some countries have got their tax structure right and others have not. What it tells us is that at any given tax ratio and mixes, some countries perform well and others not i.e. efficiency in this case is an issue of the non-tax factors favorability to private investments.



**Figure 5-1** Potential and Actual PFI in SSA (A Scatter Plot)



Source: DEA Result

The efficiency scores are higher for some of the South African Customs Union (SACU) members (for instance, in 2010-12 Botswana scored 0.892, and in 2007-09 South Africa scored 0.955), however Lesotho’s score has fallen from a high efficiency of 0.702 in 2001-03 to below 5 for the periods after, while Botswana and south Africa showed remarkable improvement in the same period. The low efficiency score for Lesotho compared to the other two could be because of the 2002 SACU agreement that sets joint decision and revenue sharing process amongst members, which might have eroded Lesotho’s incentive to lay the ground work for efficiency. However, it is still better than most of the non SACU countries. The SACU member states economic performance report (2013) indicated a dwindling manufacturing industry in Lesotho which had contributed 20.1 percent of GDP drastically dropped to 10.3 percent contribution in 2012, while Lesotho received 16 percent of GDP tax revenue from the Union (SACU, 2013).

Historically South Africa administered the union, which gathered excise duties on local production and customs duties on member states’ imports from outside the SACU area. These were then paid to all the member states in quarterly installments, using an agreed revenue-sharing formula. SACU revenues are important for Lesotho as they accounts for at least 50 per cent of the Government’s total revenue (IFC and WB, 2007:3). The contribution from the SACU Customs and Excise pool has grown from 48% in 2002/3 to an estimated 53% in 2005/6 (IFC and WB, 2007: viii)

Other SSA countries with high efficiency scores in 2010-12 were Zambia (0.903), Sierra Leone (0.843), Mauritius (0.816), Liberia (.697), Uganda (0.665), and Mozambique (0.652). These scores tell us about the favorability of the non-tax structure factors to private investments; for instance, favorability of other country specific factors to private investments (see Table 5.1)

**Table 5.1** SSA Countries' Average PFI Efficiency Scores for a Range of Years<sup>4</sup>

Country	Average Non-tax PFI Efficiency Scores			
	2001-03	2004-06	2007-09	2010-12
Angola	0.323 (2003 only)	0.272	0.296	0.281 (2010 & 2011 only)
Benin	0.370	0.257	0.237	0.185
Botswana	N/A	0.426 (2006 only)	0.618	0.892 (2010 & 2011 only)
Burkina Faso	0.2779 (2002 & 2003 only)	0.297	0.243	0.268
Congo, Dem. Rep.	0.348 (2003 only)	0.607	0.392	N/A
Congo, Rep.	0.695	0.578	0.525 (2007 & 2008 only)	N/A
Cote d'Ivoire	0.271 (2003 only)	0.226	0.235 (2007 & 2008 only)	N/A
Ethiopia	0.610	0.536	0.466	0.480 (2010 & 2011 only)
Gambia, The	N/A	N/A	0.400	
Ghana	0.383	0.381	0.314	0.584 (2010 & 2011 only)
Kenya	0.226	0.450	0.499	N/A
Lesotho	0.702	0.442	0.456 (2007 & 2008 only)	N/A
Liberia	N/A	0.547 (2005 & 2006 only)	0.942 (2007 & 2008 only)	0.697
Madagascar	0.343	0.438	0.885	N/A
Mali	0.464	0.347	0.318	0.361 (2010 only)
Mauritius	N/A	N/A	0.608 (2009 only)	0.816
Mozambique	N/A	N/A		0.652
Niger	N/A	0.403 (2005 & 2006 only)	0.493 (2007 only)	N/A
Rwanda	N/A	N/A	0.372 (2008 & 2009 only)	0.467 (2010 & 2011 only)
Senegal	N/A	N/A	0.557 (2009 only)	0.410
Sierra Leone	0.246	0.311	0.269	0.843 (2010 & 2011 only)
South Africa	0.634	0.925	0.955	N/A
Togo	N/A	0.392	0.246	0.218 (2010 & 2011 only)
Uganda	0.371	0.517	0.618	0.665
Zambia	0.315	0.619	0.641	0.903 (2010 & 2011 only)
<b>Average for all countries</b>	<b>0.411</b>	<b>0.449</b>	<b>0.483</b>	<b>0.545</b>

Source: DEA result

<sup>4</sup> N/A -Data Not Available. In cases when three-year data are not available, averages of the existing data are computed (indicated by years in parenthesis for some efficiency score entries).

## 5.2 Second Stage: Panel Data Models

**Table 5.2** Fixed Effects (FE) and Random Effects (RE) Estimates:

Explanatory Variables	Dependent Variable: Gross Private Fixed Investment ( current year)	
	RE <sup>5</sup>	FE
(A) Tax Ratio (3- year moving average )	0.479*** (0.109)	0.302** (0.128)
(B) (B) Indirect-to-Domestic direct Tax revenues Mix (3- year moving average )	12.700*** (1.433)	12.13*** (1.600)
(C) International Trade-to-Direct Tax Mix (3-year moving average )	5.131*** (0.834)	4.778*** (0.996)
(A) <sup>2</sup>	-0.00636*** (0.00186)	-0.00440** (0.00208)
(B) <sup>2</sup>	-3.086*** (0.396)	-2.984*** (0.426)
(C) <sup>2</sup>	-1.088*** (0.227)	-1.033*** (0.253)
(D) Non Tax Factors (cumulative)	-23.89*** (0.949)	-23.84*** (1.020)
Constant	6.398*** (2.101)	9.403*** (2.293)
Observations	196 (Obs per group: min = 3; avg = 7.8; max = 12)	196
Number of countries	25	25
R <sup>2</sup>		
within	0.7801	0.7843
between	0.8025	0.7382
Over all	0.7875	0.7526

### 5.2.1 Optimal Tax ratio:

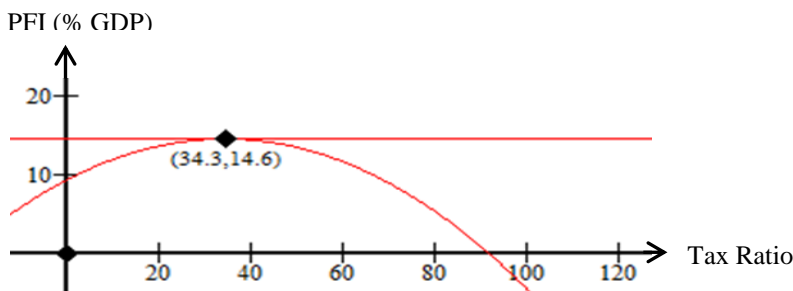
The PFI optimizing Tax Ratio applying the optimal formula  $-\beta_1/2*\beta_2$  and inserting the FE estimates in Table 5-2 is:

$$\text{Tax Ratio (optimal)} = -0.302 / (2 * -0.0044) = 34.32$$

<sup>5</sup> Hausman test rejects RE at 10 percent significance level.

The PFI optimizing tax ratio (the threshold level) is 34.32 percent of GDP. For the tax ratio below this threshold, PFI can be improved by upward adjustment of the ratio. In the event that tax ratio overgrows this threshold, PFI can be improved by downward adjustment of the ratio. The threshold is suggestive to each country and it is in no way a substitute for further country level detailed studies.

**Figure 5-2** Private Fixed Investment Optimizing Tax Ratio for SSA



Source: Derived from FE Estimates

The patterned bars of figure 5-3 are the optimal tax ratio/mix (thresholds) against which the observed tax structure of each country is gauged. The farther the countries are from these thresholds, the unfriendly to PFI they become. Tax ratios of all of the sampled SSA countries are well below the estimated threshold (Figure 5-3a). Among these countries, only two had tax ratio above 20 percent, the highest registered for South Africa (27.5%), followed by Botswana (24.5%). Congo Democratic, Ethiopia, and Sierra Leone have to at least triple their current tax ratio to get closer to the estimated threshold tax ratio. The recent figure for 2012 put Botswana above South Africa in tax ratio size. The global picture in 2012 showed highest ratio of 45.7% for Lithuania, SSA countries in the global top list are: Botswana at 26.7% (9<sup>th</sup>), South Africa at 25.5% (11<sup>th</sup>), and Liberia at 20.89% (29<sup>th</sup>) (WB\_WDI,2014).

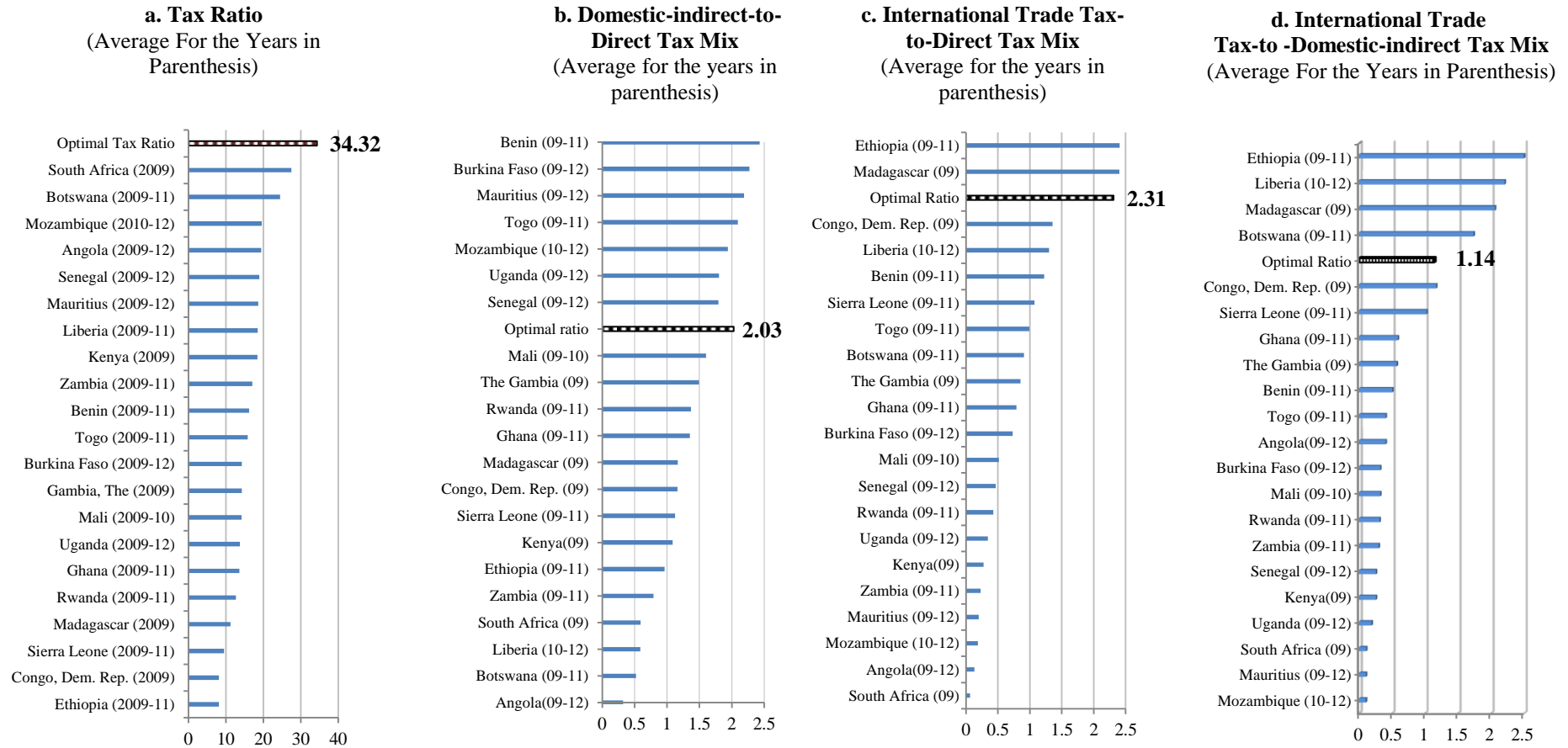
### 5.2.2 Optimal Tax mixes:

#### a. Optimal Indirect-to- Domestic Direct Tax Mixes (B):

The PFI optimizing Indirect-to-Direct Taxes Ratio using the formula  $-\beta_1/2*\beta_2$  is:  
 $= -\beta_1/2*\beta_2 = -12.13/ (2*-2.984) = 2.03$

Replacing indirect taxes for direct taxes is pro-private investment as long as the ratio is kept at or below 2.03. Replacements beyond this will reverse the relationship and is detrimental to private investment. This indicates that PFI optimum can be attained by setting indirect taxes at double the domestic direct tax revenue levels. Generally, most SSA countries have performed well in getting this mix right (Figure 5.3b). The irony; however, is that SSA countries with high tax ratio (presented in 5.2.1 above) performed low in getting optimal indirect-to-domestic direct tax mixes right; for instance, Angola, Botswana, Liberia, and South Africa. The overall assessment can be that SSA countries have done better in setting investment friendly direct-to-domestic-indirect tax mix than the rest of the tax mix variables presented in following section.

**Figure 5-3 Actual Data Vs Optimal Tax Ratio and Tax Mixes in SSA**



Source: DEA results and World Bank's WDI (2014)

### **b. Optimal International Trade-to-Direct Tax Mixes (C):**

With the same formula as above, the optimal Trade-to-Direct Tax ratio is at:  $= -4.778 / (2 * -1.033) = 2.31$

Again, substituting trade taxes for direct taxes is pro-private investment until the optimum ratio of 2.31 is hit (Figure 5-3c). Most of the countries can be better-off by substituting trade taxes for direct taxes. Apart from Madagascar and Ethiopia, the rest of the countries in the sample performed poorly to attain the right international trade and direct tax mixes. Ethiopia and Madagascar have outperformed in this line.

### **c. Optimal International Trade-to-Domestic-indirect Tax Ratio**

This ratio is not directly estimated in the model. But we should be able to compute using other estimates as in below:

$$\text{Int. Trade - to - Domestic Indirect Tax Ratio} = \frac{\text{International Trade Tax} / \text{Direct Tax}}{\text{Indirect Tax} / \text{Direct Tax}} = 2.31 / 2.03 = 1.14$$

Thus, the optimal international trade-to-domestic-indirect tax ratio rests at 1.14, i.e. it is optimal to keep international trade tax at 14 percent higher than domestic-indirect tax. Sierra Leon and Congo Democratic did better in this, yet other countries either are well above or well below the optimum (Figure 5-3d). Generally this mix invites large variations among SSA nations. The deviations from the optimal mix could be attributable to, sluggish on one hand and speedy on the other, responses to revenue neutral substitution of trade taxes for domestic- indirect taxes. Ethiopia, Botswana, Madagascar, and Liberia can be considered too sluggish. And Kenya, Mauritius, Mozambique, South Africa, and Uganda are among the speedy liberalizers. Both groups have lost track of the optimal mix.

### **d. Overall Tax Induced PFI**

Using the fixed effect estimators presented in Table-5 that applied equation (1) of sub section 4.2 ,other beings being equal, the private investment share of GDP that is possible with tax structure maneuver can be simulated by inserting the above computed optimal tax ratio and mixes in to the equation.

$$\begin{aligned} \text{Tax induced PFI (optimal)} &= 0.302*(A) - 0.0044*(A)^2 + 12.13*(B) - 2.984*(B)^2 + 4.778*(C) - 1.033*(C)^2 \\ &= 0.302*(34.32) - 0.0044*(34.32)^2 + 12.13*(2.03) - 2.984*(2.03)^2 + 4.778*(1.14) - 1.033*(1.14)^2 \\ &= \underline{\underline{21.61\%}} \end{aligned}$$

It can be inferred from the above analysis that tax structure is indeed a critical determinant of PFI in SSA. The simulated optimum indicates PFI share of GDP can be improved increased

by 21.61 % through choice of appropriate tax structure alone i.e. with tax structure policies; it is possible to gain PFI of up to 21.61 percent GDP. Again, in the result table (Table-5), the coefficient estimate for “Non Tax Factors (cumulative)” at -23.84 tells us the net effect of non-tax determinants of PFI in SSA is a big negative. This however is an aggregate figure that fails to indicate which of the non-tax determinants is positively affecting PFI and which ones affect to the reverse.

## 6 Concluding Remarks

Private investment is a prime contributor of overall investments in SSA; it has apparent contributions to growth and employment; and its performance is highly subject to policies, in the current context tax structure policies. Taxes are the prime sources of government revenue in SSA, though it remains between 13 and 18 percent of GDP for most of the recent years, much lower than the South East Asian averages. The historical record shows that variation in tax ratios amongst the SSA countries is huge, ranging from single digit to over 60 percent of GDP.

This paper explores how tax obligations and incentives in SSA countries interfere with Private Fixed Investment (PFI). The determinants of PFI can be tax and non-tax related. The tax related factors also called tax structure embraces tax mix (*the relative tax revenue compositions of direct, domestic-indirect, and international trade taxes*) and tax ratio (*tax revenue share of GDP*). A two-stage procedure is followed to estimate tax structure and PFI nexus. The initial stage, using Data Envelopment Analysis technique, disintegrates PFI into tax induced and nontax induced sub-components. In the second stage, panel data regression models (25 countries, 200-12) have been estimated, and using the estimates, private fixed investment optimizing tax structures are derived.

The PFI optimizing tax ratio of SSA (the threshold level) is found at 34.32 percent of GDP. Actual tax ratios of sampled SSA countries are not just below, but far below, the estimated threshold, with only two countries registered a ratio of over 20 percent (average for 2009-12).

The fact that a given amount of tax revenue can be collected at varying distortionary effects stages choices of tax mixes at the heart of tax policy designs. Choice of direct vs. indirect taxes and within indirect taxes, international trade vs. domestic indirect taxes; and so on are widely debated. It is found that replacing indirect taxes for domestic direct taxes is pro-private investment, if observed indirect-to-domestic direct tax ratio is below 2.03. Replacements beyond this will reverse the relationship and is detrimental to private investment. PFI optimum can be attained by setting indirect taxes at about double the domestic direct tax revenue levels. Generally, most SSA countries have performed well in getting this mix right.

The irony; however, is that SSA countries with high tax ratio performed low in getting optimal indirect-to-domestic direct tax mixes right( e.g. Angola, Botswana, Liberia, and South Africa). Again, substituting trade taxes for direct taxes is pro-private investment until

the optimum ratio of 2.31 is reached. Most of the countries can be better-off, in their PFI, by substituting international trade taxes for direct taxes.

It is found optimal to keep international trade tax at 14 percent higher than domestic-indirect tax. Sierra Leone and Congo Democratic did better in this, yet other countries either are well over or well under this optimum. This mix varies a lot among SSA countries. The deviations from the optimal mix could be attributable to, sluggish on one hand and speedy on the other, responses to revenue neutral substitution of trade taxes for domestic-indirect taxes. Ethiopia, Botswana, Madagascar, and Liberia can be considered too sluggish. And Kenya, Mauritius, Mozambique, South Africa, and Uganda are among the speedy liberalizers; albeit, both groups have lost track of the optimal mix.

The overall assessment can be that SSA countries have done better in setting investment friendly direct-to-domestic indirect tax mix than in setting the rest of the tax mixes. The simulation done in this study suggests that tax structure policies alone, keeping all other policies constant, are able to boost PFI share of GDP by 21 percent. It can be concluded that tax structure is indeed a critical determinant of PFI in SSA.

The non-tax factors cumulative effect on PFI at minus 23.84 indicates that non-tax distortions to PFI outgrow the non-tax incentives to it in SSA. This, however, is an aggregate figure that fails to fully disintegrate the nontax distortions from nontax incentives.

Lastly, Private investment is only a sub-component of the multitude of goals that can be addressed with tax policies. Such investment optimizing tax structure may not optimize other goals. Thus, the findings of this paper are usable under considerations of the effects of tax policies on other economic and social goals. It, however, informs policy makers on how private investment is effected when tax policies are changed for various reasons. The fact that SSA countries are at best similar (not identical); however, necessitates detailed country level studies for more concrete results.



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# Annexes

## Annex 1 Fixed Effect Estimation Result

```

Fixed-effects (within) regression              Number of obs   =       196
Group variable: cntry                        Number of groups =       25

R-sq:  within = 0.7843                       Obs per group:  min =        3
        between = 0.7382                      avg =       7.8
        overall = 0.7526                      max =       12

corr(u_i, Xb) = -0.0628                      F(7,164)        =      85.17
                                                Prob > F         =      0.0000
    
```

pfi_per_gdp	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
Taxratio_MA	.3017553	.1279184	2.36	0.020	.0491759	.5543347
indirect_to_direct_MA	12.12729	1.599845	7.58	0.000	8.968341	15.28624
trade_to_direct_MA	4.77772	.9955389	4.80	0.000	2.811994	6.743446
T_ratio_MA_sq	-.0043961	.0020796	-2.11	0.036	-.0085024	-.0002898
id_MA_sq	-2.983711	.4261621	-7.00	0.000	-3.825182	-2.142239
tr_dr_MA_sq	-1.033124	.2534564	-4.08	0.000	-1.533583	-.5326659
nontax	-23.83532	1.020359	-23.36	0.000	-25.85005	-21.82058
_cons	9.403356	2.293323	4.10	0.000	4.875111	13.9316
sigma_u	2.3075139					
sigma_e	1.9085671					
rho	.59378528	(fraction of variance due to u_i)				

```

F test that all u_i=0:      F(24, 164) =      7.39      Prob > F = 0.0000
    
```

## Annex 2 Random Effect Estimation Result

```

Random-effects GLS regression              Number of obs   =       196
Group variable: cntry                        Number of groups =       25

R-sq:  within = 0.7801                       Obs per group:  min =        3
        between = 0.8025                      avg =       7.8
        overall = 0.7875                      max =       12

corr(u_i, X) = 0 (assumed)                  Wald chi2(7)    =     678.59
                                                Prob > chi2     =      0.0000
    
```

pfi_per_gdp	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
Taxratio_MA	.4788263	.1086452	4.41	0.000	.2658856	.6917669
indirect_to_direct_MA	12.69954	1.43305	8.86	0.000	9.890811	15.50826
trade_to_direct_MA	5.131347	.834296	6.15	0.000	3.496157	6.766537
T_ratio_MA_sq	-.0063605	.001859	-3.42	0.001	-.0100042	-.0027169
id_MA_sq	-3.086209	.3963617	-7.79	0.000	-3.863064	-2.309355
tr_dr_MA_sq	-1.088288	.2274585	-4.78	0.000	-1.534099	-.6424775
nontax	-23.88764	.9485075	-25.18	0.000	-25.74668	-22.0286
_cons	6.397616	2.101014	3.05	0.002	2.279705	10.51553
sigma_u	1.8179825					
sigma_e	1.9085671					
rho	.47570645	(fraction of variance due to u_i)				

### Annex 3 Hausman Test Result

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	(b) fe	(B) re		
Taxratio_MA	.3017553	.4788263	-.177071	.067523
indirect_t~A	12.12729	12.69954	-.572247	.7112471
trade_to_d~A	4.77772	5.131347	-.353627	.5431831
T_ratio_MA~q	-.0043961	-.0063605	.0019644	.0009321
id_MA_sq	-2.983711	-3.086209	.102499	.1565614
tr_dr_MA_sq	-1.033124	-1.088288	.0551637	.1118157
nontax	-23.83532	-23.88764	.0523238	.3761208

b = consistent under Ho and Ha; obtained from xtreg  
 B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(7) = (b-B)'[(V\_b-V\_B)^(-1)](b-B)  
 = 12.51  
 Prob>chi2 = 0.0851

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