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Abstract

This paper examines spillover effects in corporate tax policy for African economies. Using a balanced panel data in statutory corporate income tax (CIT) rate for 34 African countries over the period 1995-2013, we find positive interaction between CIT rates in Africa only when common time trend effects are not controlled. We conclude that the evidence of pure corporate tax competition among African countries is weak. These countries' tendency to implement similar fiscal policies under the common intellectual assistance may explain the positive slope reaction between their CIT rates. Regarding corporate tax base spillovers, estimation results indicate that cuts in foreign countries' average corporate tax rate reduce the host country's corporate tax base. When the host country reacts to a one percentage point cut in foreign countries' CIT rates by cutting its own CIT rate in the same proportion, this ultimately results in a net erosion of its corporate tax base by 0.4%. This represents a 2.3 % loss of corporate tax revenue. Moreover, we find strategic complement responses in corporate tax base policies suggesting that countries react to the uptake of measures that tend to reduce the corporate tax burden in other countries by also undertaking similar measures.

Keywords

Tax competition, Corporate income tax, Instrumental variable estimation, System GMM, Africa.

JEL Codes

E62, H25, H77, H87

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1. Introduction

For attracting foreign investments, countries may have strong incentives to engage in tax competition through the lowering of their corporate tax burden. From market economy perspective, competition is desirable as it could stimulate competitiveness. But, competition between countries for attracting foreign investments through special tax treatments could lead these countries to erode each other's tax revenues and thereby reducing their capacities to finance development. Corporate income tax (CIT) competition has particularly important implications for African economies because of the significant role played by the corporate income tax in tax revenue collection in these countries. The fact that corporate tax competition is likely to put downwards pressure into a key revenue source, namely corporate tax revenue is worrisome and therefore needs a particular attention. However, it is argued that tax competition may improve the efficiency of the public sector in the management of government revenue (the "starve the beast" argument). In fact, since the governments know that CIT competition is exerting downward pressures on tax revenues, they will be motivated to efficiently use the limited public revenue to properly respond to the demand of citizens and electors. International tax competition will remain for long at the heart of international taxation issues. This will be exacerbated with growing international mobility of capitals suggesting that multinationals can use transfer prices and other tax avoidance techniques to shift their real investments and profits from high tax jurisdictions to low tax jurisdictions. But they can't shift their real investments and profits out of our planet suggesting that coordination of tax rules among countries could somewhat mitigate tax competition related issues. To better understand this issue, it is important to analyze the cross-border impact of national corporate tax policies and how host governments react to changes in international corporate tax policies.

For OECD countries, Devereux et al. (2008) explain the fall in corporate tax rate by corporate income tax (CIT) rate competition between these countries. Casette and Paty (2008) find the existence of tax interdependence within Western European countries. These authors also find tax interactions between Western and Eastern European countries. Recently, Chen et al. (2014) test and find the existence of CIT rate competition among South Asian countries.

Except the paper of Klemm and Van Parys (2012), there is no study that has investigated on corporate tax rate interaction among African economies. However, the analysis of Klemm and Van Parys (2012) relies on uniform weight matrix to test interdependencies among African CIT rates whereas this connection matrix is usually used to test for the existence of common policy environment which steers tax rates in the same direction not for testing the existence of pure tax competition (Caldeira et al., 2015; Casette and Paty, 2008). Furthermore, these authors test corporate tax rate competition in Africa using a panel data including Latin America and Caribbean (LAC) countries. They capture African countries through the weighting matrix attributing the value 1 for economies belonging to Africa and 0 otherwise. This approach is likely to exacerbate the heterogeneity problems and one would wonder whether the results obtained for African economies are not driven by the presence of LAC countries in the panel. Furthermore, the sample which these authors used includes 22 African economies while our regressions are carried out on 34 African countries since it is better to include as much as possible a large number of countries for getting a robust and general conclusion regarding corporate tax rate interactions between African economies. Furthermore, the extension of the sample size reduces the risk of conducting the analysis with mainly cooperative tax jurisdictions or non-cooperative fiscal jurisdictions. For instance, Tunisia and Seychelles which are often been under radar as tax havens (see Jones and Temouri, 2016) are not in the sample used by Klemm and Parys (2012) for their analysis of tax competition in Africa.

Furthermore, Klemm and Van Parys (2012) have estimated two reaction functions to analyze strategic interactions in setting tax holidays and investments allowances. However, this approach does not capture the possibility for a country to react on changes in tax holidays in competing countries by changing its investments allowances rules while keeping unchanged its tax holidays and vice versa. Our study takes onboard this consideration by estimating interaction between the overall corporate tax base rather than interactions between each specific tax instrument which affects the corporate tax base. The present study therefore aims to advance the literature on tax competition through the analysis of the tax base effects of changes in foreign corporate tax rates and tax bases in Africa. In fact, tax competition could occur through interactions between tax bases on the one hand and between tax rates and tax bases of the competing tax jurisdictions on the other hand. To our knowledge, the first study that empirically tests the existence of tax competition by considering both strategic spillovers through interaction between tax rates and tax base on the one hand and between corporate tax bases among tax jurisdictions for African economies[1]. We emphasized that such spillovers have tax revenue implications for African countries.

The rest of the paper is structured as follows: Section 2 develops the econometric methodology used to test CIT rate competition in Africa. Section 3 presents the data and discusses the choice of the tax rate variable used as tax competition tool. The section 4 presents and analyses the results obtained from the estimation of tax rates reaction function. In section 5, we turn to the analysis of corporate tax base spillover effects in Africa and the section 6 concludes the study.

2. Empirical analysis on the existence of CIT rate competition among African economies

To achieve this study's objective, we specify a Nash tax reaction function (Chen et al., 2014; Devereux et al., 2008; Klemm and Van Parys, 2012) in which country's i CIT rate reacts to a change in its neighboring countries j CIT rates and a set of explanatory variables that are likely to affect its setting. Our empirical model is aligned with the model used in tax competition studies classified as "Second-Generation Direct Studies" by Leibrecht and Hochgatterer (2012) in their literature survey in tax competition. Second-generation direct studies use tax reaction functions for explicitly modeling strategic interaction in CIT rate settings between independent tax jurisdictions. There is strategic interaction when an action on the tax policy of country i for attracting capital influences country j capital stock. Consequently, country j may react by modifying its tax policy toward capital attractiveness suggesting that in addition to the domestic environment that govern tax policy setting, the optimal corporate tax rate choice of country i depends on country j's corporate tax rate and vice versa (Franzese and Hays, 2009). More

[1] Experts consider that corporate income tax bases interactions are more critical than corporate income tax rate interactions between tax jurisdictions.

specifically, cut in the CIT rate of country i would lead country j to also reduce its CIT rate (Devereux et al., 2008; Franzese and Hays, 2009).

Nash games and Stackelberg games are the theoretical framework used to model strategic interactions in tax rate settings. Nash tax reaction functions type consider simultaneous tax setting strategies while Stackelberg tax reaction functions are founded on the idea that other countries (followers) react to a change in the tax rate setting of a "leader" tax jurisdiction (Altshuler and Goodspeed, 2002).

Empirically, for modeling strategic interactions, Nash game framework included among the determinant of CIT rate in country i, (τ_{it}), the weighted average CIT rate of all countries in competition except i ($W\tau_{jt}$). The Stackelberg game framework included the 'leader's' lagged tax rate, among the explanatory variables of the host country's i CIT rate. The lagged tax rate is included to consider the fact that the Stackelberg leader is the first to modify its CIT rate in the tax competition game (Altshuler and Goodspeed, 2002). It should be noted that when the lagged tax rate for the host country i and the weighted average tax rate for the competing countries except the country i are simultaneously included among the set of explanatory variables of a tax reaction function, this result to an empirical model called 'mixed Nash and Stackelberg models').

Algebraically, the empirical model used to test the existence of CIT rate competition between African countries is as follows: $\tau_{it} = \rho(W\tau_{jt}) + \beta_1 X_{it} + \mu_i + \lambda_t + \varepsilon_{it}$ (1)
Where τ_{it} is the statutory CIT rate in country i at the year t. $W\tau_{jt}$ corresponds to other countries' CIT rates τ_{jt} multiplied by the spatial weighting matrix W[2]. ρ , is the spatial autocorrelation coefficient. X_{it} represents macroeconomic variables that are likely to affect CIT rate setting. These control variables include GDP per capita, trade openness, government consumption and population (Klemm and Van Parys, 2012). A government may lower the corporate tax burden while trying to maintain the tax revenues at a constant level to ensure the provision of public goods and services. Tax revenues is, therefore, a relevant control variable. μ_i is the country fixed effects to control for unobserved country heterogeneity, while λ_t is country specific time trend included to control for common shocks affecting African economies each year. ε_{it} is the independent and identically distributed error term.

Because countries may influence each other in setting CIT rate, $W\tau_{jt}$ is potentially endogenous in equation (1). If the endogeneity issue of the spatially lagged dependent variable is not addressed in the estimation of equation 1, it would lead to overestimate the interaction term ρ.We use an instrumental variable (IV) technique to address this endogeneity issue. We included some controls to explain the host country's CIT rate. This suggests that the same controls variables for abroad countries also impact the CIT rate in these countries (the endogenous variable). Accordingly, the impact of these variables on the host countries corporate tax rate will transit via the average CIT rate in foreign countries. In such setting, the control variables in other countries could be used as instrumental variables for the average CIT rate in foreign countries. We therefore follow the literature on tax competition and use as instruments for the average CIT rate in foreign countries, the average weighted of the control variables excepted tax revenues[3] in abroad countries (Chen et al., 2014; Devereux et al., 2008; Klemm and Van Parys, 2012; Overesch and Rincke, 2011). For each control variable $x_{it,}$ the weighted average for others countries is calculated as follows: $\bar{x}_{it} = \sum_{j \neq i} w_{ij}\, x_{jt}$, with w_{ij} the connection matrix[4] between the control variable in hand in the host country i (x_{it}) and in others countries (x_{jt}).

Control variables

In order to properly isolate the effect of tax competition on the host country's CIT rate, we need to control for the effect of key drivers of changes in CIT rate. Following the literature on corporate tax competition among countries, we include as control variables: trade openness, GDP per capita, total population, government consumption (Chen et al, 2014; Devereux et al, 2008; Hufe, 2014; Klemm and Van Parys, 2012).

Trade openness

Trade openness is employed as a proxy of economic openness to control for the impact of the exposure of the country to trade and competition for foreign capitals. We use imports, exports and GDP data from PWT9.0 to calculate trade openness as the sum of imports and exports in proportion of GDP. The relationship between trade openness and CIT rate is expected to be negative since preferences for international trade may put downwards pressure on CIT rates for stimulating the country's competitiveness. Nonetheless, as trade liberalization policies often induce cuts in tariffs and thereby losses in trade taxes revenues (Baunsgraad and Keen, 2010), Government may try to compensate for these losses in trade taxes by increasing corporate income tax revenue, through an increase in the CIT rate. To sum up, the impact of trade openness on CIT rate is a priori unknown.

GDP per capita

GDP per capita is used to measure the state level of development. An increase in the level of GDP per capita can be an attractive factor for foreign investors and therefore puts the government into strong position for increasing or maintaining unchanged its CIT rate. Moreover, countries with higher level of GDP per capita are more abler to construct infrastructures and set up other non-tax factors that are key drivers of FDI such that these countries do not need to cut their CIT rate for attracting FDI. However, if the higher level of GDP per capita is mainly driven by few sectors in the economy like in some natural resources and raw materials dependent African countries, the government can cut corporate tax rate for attempting to attract foreign investment in the less developed sectors in order to boost their contribution to the national income. These considerations make somewhat difficult the prediction of the nature of the relationship between GDP per capita and CIT rate.

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[3] Because of missing observations in this variable, the weighted average tax revenue in the others countries cannot be computed.

[4] We multiply the control variable by the same weighting matrix used for the spatially lagged dependent variable.

Total population

Total population is used as proxy of the size of the country for considering the fact that larger countries have less incentive to engage in tax competition since they are potentially the losers of cuts in CIT rates (IMF, 2014). Clearly, the increase of demand in public goods and services that follows a raise in the population size is likely to lead government to increase the corporate tax rate for responding to the growing demand for public goods and services. Moreover, governments of countries with large population size are in power position to insist on the level of CIT rate they judge acceptable to be applied to market seeking FDI (Durst, 2018). We therefore expect that CIT rate will be positively related to the population.

Government consumption

Government consumption expenditure is included to control for the effect of the government financing needs. The sign of the effect of government consumption expenditure on CIT rate is difficult to predict because government may satisfy its revenue needs by increasing taxes. However, with high demand for revenues, the government may choose to reduce CIT rate to attract tax base.

Time fixed effects

In econometric model, time dummies are usually included to control for shocks that affect all countries in each year. However, including time dummies in our specification is equivalent to include the average corporate tax rate of all countries (Klemm and Van Parys, 2012) Accordingly, the following equation would be estimated: $CIT_{it} = \rho WCIT_{it} + CIT_t + X\beta + \varepsilon$, with CIT_{it} the corporate tax rate for country i at the year t; and $WCIT_{it}$ the weighted average tax rate of all the other countries (except the host country i) in year t and CIT_t the average tax rate of all countries in year t. One cannot doubt on the fact that $WCIT_{it}$ and CIT_t are highly correlate making therefore hard the identification of the true impact of each of these two variables. To circumvent this problem, the literature suggested using linear time trend instead of including time dummies (see Klemm Van Parys 2012; Devereux et al, 2008). We therefore include time trend to control for potential common trend followed by the African countries in corporate taxation.

3. Data and Sample

We extract statutory CIT rates data from the Tax Rate Database of the International Monetary Fund, Fiscal Affairs Department (IMF-FAD). Data on GDP per capita are directly collected from the World Development Indicators (WDI) database of the World Bank. Data on Trade openness (calculated as the sum of imports and exports in proportion of GDP), government consumption and population are taken from the database Penn World Table, version 9.0 (PWT9.0) (Feenstra et al., 2015). Total tax revenue data are extracted from the Government Revenue Database of the International Conference on Taxation and Development-(ICTD-GRD) (Prichard et al., 2014). Finally, we obtain a balanced panel data in CIT rate for 36

countries[5] over the period 1995-2013[6]. The construction of balanced panel data for CIT rate is motivated by the fact that an unbalanced panel would cause year to year variations of the main explanatory, namely the average of CIT rate variables in other countries because of a change in the sample composition. In order to make sure that all variability in the weighted average tax rate is the result of tax policy, not sample composition, we base the calculation of the weighted averages tax rate only on a fully balanced panel in terms of the tax rate variables.
Descriptive statistics on all the variables are displayed in table 1 below. The average CIT rate in Africa is 33.4% with a minimum rate of 15% and a maximum rate of 60% (the maximum tax rate is observed in Sudan).

Table 1: Summary statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
CIT rate	646	33.404	6.650	15	60
PIT rate	477	35.716	10.884	10	78
CIT base	332	11.245	13.623	.0124	102.025
GDP per capita	646	2384.448	2633.004	168.931	13160.21
Agriculture value added	628	21.270	13.218	1.954	57.723
Trade openness	646	78.584	37.590	14.772	225.043
Natural resources rents	629	13.776	16.008	.002	77.054
Inflation	646	62.518	980.179	-18.222	24411.03
FDI net inflows	646	4.138	5.795	-8.589	43.329
Government consumption	646	17.694	14.514	.634	109.008

Source: Author's calculations from IMF-FAD, ICTD-GRD, PWT9.0 and WDI.

3.1 The relevant tax rate competition instrument

The statutory corporate tax rate (STR), the effective average corporate tax rate (EATR) and the effective marginal corporate tax rate (EMTR) are three potential candidates for being tax competition tool. The effective average corporate tax rate proxied by the ratio of corporate tax revenues to GDP is not a perfect measure because it is affected by all the factors that influence the GDP and therefore some factors outside the control of the government (Devereux et al., 2008).
For African economies, the required data (interest rate, allowances rules) to calculate EMTR, the tax rate applied to marginal investment, are quite difficult to collect over long periods. Alternatively, our choice falls on the STR. The STR is a highly visible and simple indicator comparable across countries of a corporate income tax structure (Keen and Mansour, 2010), and it reflects the intent of decisions makers (Chen et al., 2014). Moreover, the STR is most relevant for profits shifting behaviors across tax jurisdictions (Keen and Mansour, 2010). Furthermore, because of the high correlation between statutory CIT rate, effective rates and special regimes (IMF, 2014, Keen and Mansour, 2010), we believe that our approach is acceptable and suitable for the purpose of the present study.

[5] The list of countries is given in appendix.
[6] According to the experts, this period corresponds to the time when most of the corporate tax rate changes took place in Africa.

In figure 1, we present time series for the corporate income tax rate in the sample of African countries under investigation over the period 1995-2013. Figure 1 shows a tendency towards lower corporate income tax rates in Africa. Overall, the average corporate income tax rate declined from 38. 4% in 1995 to 29.1% in 2013.

Figure 1: Trends in statutory corporate income tax rates

Source: Author's calculations from IMF-FAD.

3.2 The choice of the spatial weighting matrix

We discuss in this paragraph the choice of the connectivity matrix for exploring CIT rate interaction between countries.

The contiguity matrix could be used as the spatial weighting matrix. The elements of the contiguity matrix are equals to 1 if the two spatial units share a common border and 0 otherwise. However, we do not use contiguity matrix as the spatial weighting matrix in our analysis for several reasons. First, with contiguity matrix, islands would have no neighbors. Second, because our dataset is not complete some countries may have no neighbors. Furthermore, basically, tax competition for attracting foreign investments is not restricted between first-order neighbors suggesting that contiguity matrix is not the appropriate weighting matrix to test for CIT rate interactions between tax jurisdictions (Klemm and Van Parys, 2012).

Previous studies on tax competition use geographic distance weighting matrix (Chen et al., 2014; Klemm and Van Parys, 2012; Overesch and Rincke, 2011) and economic distance weighting scheme. The rationale behind the use of geographic distance weighting matrix is related to the fact that geographically close countries are more relevant tax competitors since productive capitals are highly mobile between geographically close countries due to the relative lower cost of transport and information. This is in line with the first law of geography: "Everything is related to everything else, but near things are more related than distant things"

(Tobler, 1970: 236) explaining the wide use of geographical inverse distance in spatial econometrics for measuring connectivity.
Algebraically, after standardisation, the weights w_{ij} of the geographic distance weighting matrix are given as follows:

$$w_{ij} = \begin{cases} \frac{1/d_{ij}}{\sum_j 1/d_{ij}}, & for\ i \neq j \\ 0, & for\ i = j \end{cases}$$

With d_{ij} the Euclidian distance between the capital of country i and country j for $i \neq j$.
The economic distance weight matrix (Devereux et al., 2008; Casette and Paty, 2008) is used to reflect the idea that countries with the same economic patterns are more likely to engage in competition with each other for attracting corporate tax bases. After standardisation, the weights w_{ij} of economic distance weighting matrix defined as the inverse of the difference between GDP per capita of country i ($GDPpc_i$) and country j ($GDPpc_j$) are given as follows:

$$w_{ij} = \begin{cases} \frac{(|GDPpc_i - GDPpc_j|)^{-1}}{\sum_j (|GDPpc_i - GDPpc_j|)^{-1}}, & for\ i \neq j \\ 0, & for\ i = j \end{cases}$$

In contrast to most previous studies, ours' considers a spatial weight matrix that combines both geographic and economic distance. The underlining idea is the fact that tax competition can take place between both geographically and economically close countries (Martinez-Vasquez and Liu, 2014). Following Martinez-Vasquez and Liu (2014), the elements w_{ij} of this mixed weight matrix are computed as follows:

$$w_{ij} = \begin{cases} \frac{e_{ij} d_{ij}}{\sum_{j=1}^{N} e_{ij}\, d_{ij}}, & for\ i \neq j \\ 0, & for\ i = j \end{cases}$$

Where e_{ij} is the inverse of the absolute value of the difference in GDP per capita between countries i and j; d_{ij} is the inverse of the Euclidian distance between the capital cities of countries i and j. For robustness check, we separately use each of the weighting matrices e_{ij} and d_{ij}. Accordingly, to our knowledge, this is the first study that tests for tax competition using geographic or/and economic neighborhood matrices.

4. CIT rate interactions in Africa: Baseline results

Tables 2 and 3 presents the results obtained from IV estimation of equation (1). First step regressions from the instrumental variables estimations are reported in table 2 below. The results show that all the instrumental variables we retained[7] for each regression are significantly correlated to the endogenous variable (table 2), suggesting that the set of instrumental variables are not weak instruments.

Table 2: Instrumental variable estimation of CIT rate interactions in Africa: first step regressions

W(CIT rate)	(1)	(2)	(3)	(4)	(5)	(6)
Weighting schemes	Benchmark weights	Benchmark weights	Inverse distance	Inverse distance	GDP weights	GDP weights
W(Gov. consumption)[8]	0.419***	0.426***				0.523***
	(0.058)	(0.056)				(0.059)
W(Trade openness)	-0.12***	-0.082***	-0.097***		-0.06**	-0.126***
	(0.014)	(0.014)	(0.008)		(0.027)	(0.016)
W(Population)	-0.622***	-0.249***	-0.807***	-0.018**	-1.098***	-0.113
	(0.046)	(0.071)	(0.037)	(0.007)	(0.115)	(0.081)
GDP per capita	-0.001***	-0.003	-0.004***	-0.002**	-0.004	-0.001**
	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Trade openness	-0.009*	-0.004	-0.007***	-0.005***	-0.012*	-0.01
	(0.005)	(0.005)	(0.002)	(0.001)	(0.006)	(0.005)
Gov. consumption	-0.020	-0.012	-0.031***	0.001	-0.036	-0.011
	(0.023)	(0.022)	(0.009)	(0.007)	(0.030)	(0.026)
Population	-0.008	0.029	-0.010	-0.005	-0.001	0.012
	(0.025)	(0.025)	(0.011)	(0.008)	(0.034)	(0.030)
Tax revenue	-0.011	-0.001	-0.001	0.002	-0.008	0.035
	(0.022)	(0.021)	(0.009)	(0.007)	(0.029)	(0.024)
Time trend		-0.331***		-0.608***		-0.340***
		(0.049)		(0.017)		(0.057)
W(GDP per capita)			0.001**	0.003***	0.002*	
			(0.000)	(0.000)	(0.001)	
Constant	51.984***	41.322***	58.080***	35.559***	59.033***	40.438***
	(1.287)	(2.008)	(0.425)	(0.833)	(1.325)	(2.321)
Observations	594	594	594	594	594	594
R-squared	0.785	0.801	0.945	0.968	0.686	0.782
Number of countries	34	34	34	34	34	34
F-stat	252.3	247.4	1199	2088	151.2	219.8

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Regarding the diagnostic tests, as reported in the bottom of the results table 3, the Anderson's test of under-identification, the Cragg-Donald's test of weak identification and the Sargan test of overidentification indicate that the set of instruments applied in each regression are relevant and exogenous. In fact, for all the specification, the Cragg Donald statistic is higher than the Stock Yogo weak identification test critical value at 5% (16.85). The null hypothesis of weak identification is therefore rejected, suggesting that the instruments used are not weakly correlated to CIT rate in competing countries. In other words, the set of instrumental variables

[7] For each regression, in the set of potential instrumental variables, we keep only those that significantly affect the endogenous variable in the first step regression to avoid the problem of weak instruments

[8] In this paper, W(….) is the average weighted of the variables in parenthesis in the foreign countries. Thus, W(CIT rate) therefore represents the weighted average CIT rate for the foreign countries.

used are not weak instruments. The Anderson canonical correlation test rejects the null hypothesis of under-identification since the p-value associated to this test is null in all the specifications. This latter result suggests that the instrumental variables are correlated to the endogenous variable (CIT rate in competing countries) and therefore these instruments are relevant. Finally, the Sargan test does not reject the null hypothesis of absence of correlation between the instrumental variable and the error term indicating that the instruments are valid instruments.

In the results tables, the type of matrix of connectivity used in the regression is indicated at the head of columns. The label "inverse distance" indicated inverse geographic distance between countries is used as weights while "GDP weights" indicate that differences in GDP per capita between countries are used as weights. The label "Benchmark weights" indicates the weighting matrix combining economic (GDP per capita) and geographic distances (distance between capitals) as in Martinez Vasquez and Liu (2014).

The baseline results show that, using combined geographical and economic distance weighting scheme, the neighbors' average CIT rate [W(CIT rate)] positively affects the host country's CIT rate suggesting the existence of strategic interaction (strategic complementarity) in CIT rate between tax jurisdictions in Africa (Table 3, column 1). This result is consistent with the findings of Klemm and Van Parys (2012). Typically, one percentage point decrease in the statutory CIT rates of other countries causes, on average, a cut of 0.72 percentage points in the host country's corporate tax rate in response. However, when we control for time trend to control for correlated effects, that is, characteristics that the countries have in common, making them behave similarly (Jacobs et al., 2009), this impact is no longer statistically significant, and its magnitude remarkably decreases (table 3, column 2). These results are robust to the use of alternative weighting matrices; the geographic distance weight (table 3, columns 3 and 4) and economic distance weight (table 3, columns 5 and 6).

Regarding the control variables, GDP per capita has always positive and significant impact on CIT rate although the amplitude of the impact is relatively small (0.001) indicating that African countries with highest GDP per capita tend to set higher corporate tax rate. In all the specification, the impact of trade openness on CIT rate is negative and statistically significant at 5%. This result suggests that international trade considerations play a role in the downwards trend in CIT rate in Africa. The estimated parameter for government consumption is positive and significant at 1% in all the specifications suggesting that on average higher public spending exert upwards pressure on CIT rate in the countries under investigation. However, in contrast to the predictions, we find that as the size of the population increases, CIT rate decreases. Since higher population implies in some extent higher demand for jobs, we speculate that this result could be explained by the fact that government may cut CIT rate for supporting the competitiveness of firms and their capacity to hire more people. In fact, policy makers may consider CIT rate cuts as stimuli for reducing unemployment rate which tend to grow with the population size. Finally, the impact of tax revenue on CIT rate is negative in all the specifications, but it is not statistically significant at the conventional significance levels. This result suggests that the level of tax revenue in Africa does not provide support to cuts in CIT rate.

Table 3: **CIT rate interactions in Africa: baseline results.**

CIT rate	(1)	(2)	(3)	(4)	(5)	(6)
Weighting schemes	Benchmark weights	Benchmark weights	Inverse distance	Inverse distance	GDP per capita weights	GDP per capita weights
W(CIT rate)	0.726***	0.216	0.935***	0.119	0.833***	0.214
	(0.085)	(0.224)	(0.099)	(0.675)	(0.092)	(0.151)
GDP per capita	0.001*	0.001***	0.001***	0.001***	0.001**	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Trade openness	-0.036***	-0.034***	-0.031***	-0.035***	-0.029**	-0.034***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)	(0.011)
Gov. consumption	0.190***	0.190***	0.190***	0.189***	0.192***	0.190***
	(0.053)	(0.051)	(0.052)	(0.051)	(0.054)	(0.051)
Population	-0.168***	-0.115**	-0.0954	-0.110*	-0.104*	-0.113**
	(0.058)	(0.057)	(0.060)	(0.058)	(0.062)	(0.057)
Tax revenues	-0.075	-0.066	-0.079	-0.069	-0.076	-0.070
	(0.050)	(0.049)	(0.050)	(0.050)	(0.052)	(0.049)
Time trend		-0.361***		-0.424		-0.357***
		(0.139)		(0.359)		(0.104)
Time trend	No	Yes	No	Yes	No	Yes
Observations	594	594	594	594	594	594
R-squared	0.373	0.418	0.392	0.414	0.340	0.421
Number of countries	34	34	34	34	34	34
F(p)	0.000	0.000	0.000	0.000	0.000	0.000
Anderson(p)	0.000	0.000	0.000	0.000	0.000	0.000
CD (stat)	237.636	34.890	963.123	51.187	123.642	87.546
Sargan	0.171	0.905	0.634	0.752	0.412	0.830

Standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

It is possible that it has a delay in the response of other countries to changes in a host country tax rate (Heinemann et al, 2010), we test the robustness of our main finding by including one-year lag of the average weighted CIT rate in neighboring countries. Results reported in table 4 below clearly show that our results remain qualitatively unchanged to a delay in a host country's reaction to modification in others CIT rate. These findings provide signals that the positive slope obtained from the estimation of tax rate reaction function between African economies may be due to common trend affecting these countries rather than a purely corporate tax rate competition among these economies. Positive interaction over CIT rate among African economies could be attributable to the implementation of similar tax policies (reduction of tax rates and broadening of tax bases) under the same technical assistance from technical and financial partners (IMF, World Bank, AfDB and UE) by these countries.

Table 4: Allowing for a delay in host country's reaction to change in other countries CIT rate.

CIT rate	(1) **Benchmark weights**	(2) **Benchmark weights**
L.WCIT_rate	0.728***	0.189
	(0.088)	(0.232)
GDP per capita	0.001**	0.001***
	(0.000)	(0.000)
Trade openness	-0.039***	-0.036***
	(0.012)	(0.011)
Gov. consumption	0.185***	0.180***
	(0.055)	(0.053)
Population	-0.140**	-0.0846
	(0.061)	(0.061)
Tax revenues	-0.088*	-0.074
	(0.051)	(0.049)
Time trend		-0.394***
		(0.148)
Time trend	No	Yes
Observations	562	562
R-squared	0.359	0.404
Number of countries	34	34
F(p)	0	0
Anderson(p)	0	0
CD(stat)	207.803	29.677
Sargan(p)	0.224	0.939

Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1

We continue the robustness analysis of the main findings by analyzing the role of personal income tax rate in a context of CIT rate competition. In fact, downwards pressure on CIT rate in the framework of tax competition may encourage individuals from incorporating themselves to escape tax on their earnings. We take onboard this consideration by including the top statutory personal income tax rate **(**PIT rate) among the set of control variables in the tax reaction equation (equation 1). Data on PIT rate are obtained from the IMF-FAD tax rate

Indicators database. The regressions use the so-called benchmark weighting matrix, the combined geographic and economic inverse distance weighting matrix for the average weighted tax rate in competing countries. As usual, the control variables for competing countries are used as instruments. The inclusion of personal income tax rate among the explanatory variables does not change our main results. There is no longer positive interdependence in CIT rates when we control for common effects (table 5, columns 2). The personal income tax rate has a positive impact on CIT rate corroborating the theoretical prediction that personal income tax rate act as a backstop for corporate income tax rate for limiting tax avoidance behaviors (table 5, columns 1 and 2).

Furthermore, we also test whether our results remain unchanged to the use of FDI inflows weighting scheme. Since after all, one of the main purposes of tax competition is to attract and retain FDI, it is plausible that competition really occurs between the top recipient countries of FDI in the continent. More practically, competition will tend to be worse between countries that attract similar levels of FDI. We therefore take on board this aspect by using as weight matrix the inverse of the difference of FDI net inflows between countries. FDI net inflows data are taken from the WDI database, the World Bank. As reported in table 5 (columns 3 and 4), the main findings of this study are robust to the use of FDI net inflows distance as weighting matrix. The control for the effect of common factors renders insignificant the coefficient of the weighted average CIT rate for competing economies.

Table 5: CIT rate interactions in Africa: Controlling for the impact of PIT rate and using FDI weighting scheme.

CIT rate Weighting matrix	(1) Benchmark weights	(2) Benchmark weights	(3) FDI weights	(4) FDI weights
WCIT_rate	0.607***	-0.136	0.819***	0.447
	(0.126)	(0.436)	(0.108)	(0.369)
PIT rate	0.113***	0.112***		
	(0.032)	(0.033)		
GDP per capita	0.001	0.001	0.002***	0.001***
	(0.001)	(0.001)	(0.000)	(0.000)
Trade openness	-0.065***	-0.069***	-0.043***	-0.040***
	(0.017)	(0.018)	(0.012)	(0.012)
Gov. consumption	0.255***	0.229***	0.189***	0.187***
	(0.066)	(0.068)	(0.0557)	(0.0534)
Population	-0.136*	-0.048	-0.170***	-0.142**
	(0.078)	(0.085)	(0.060)	(0.063)
Tax revenue	0.029	0.012	-0.099*	-0.084
	(0.061)	(0.063)	(0.052)	(0.052)
Time trend		-0.513*		-0.216
		(0.266)		(0.212)
Observations	423	423	576	576
R-squared	0.428	0.414	0.314	0.371
Number of countries	32	32	33	33
F(p)	0	0	0	0
Anderson(p)	0.000	0.000	0.000	0.000
CD (stat)	120.8	11.18	118.7	12.80
Sargan (p)	0.546	0.707	0.136	0.138

Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1

Because it may take time to change corporate income tax regime due to adjustments costs for the private sector and resistance from some interest groups which think themselves as potential losers from the reform, there might be inertia in corporate tax policy in African countries (Klemm and Van Parys, 2012; Overesch and Rincke, 2011**)**. We check the robustness of our finding to potential inertia in corporate tax rate. To do so, we simply include in the baseline empirical model specification (equation 1) a one-period lagged dependent variable among the explanatory variable. This leads us to estimate a dynamic spatial lag model. The estimation of this model raises two endogeneity problems. First, it is well known that in dynamic panel data models, the lagged dependent variable is endogenous due to its correlation with the individual fixed effects in the error term. In such conditions, estimating the model with fixed effect estimators will produce downward biased estimates (Nickell bias). The second endogeneity problem is related to the spatial lagged dependent variables because of interaction between CIT rates. In fact, in setting its corporate tax policy, the host country may be influenced by other countries CIT rate and reciprocally the host country corporate tax policy could also influence the corporate tax setting abroad. In such circumstances, ordinary least squares (OLS) estimators are not consistent for estimating this model.

To overcome these endogeneity problems and obtained unbiased estimates, we rely on the system GMM estimator developed by Blundell and Bond (1998) for estimating dynamic panel data model. System GMM estimator is performing well for panel data with large N and small T. Moreover, Kukenova and Monteiro (2009) demonstrates that system GMM are consistent in estimating the coefficient of the spatial lag dependent variable in dynamic spatial lag models with large N and T fixed. Our dataset T=19 and N=34 is not properly fitting with this setting because the time length T=19 could not be considered as small. We therefore decide to divide the time span of our dataset in three-years non-overlapping intervals to obtain three-year panel data except the last sub-period which is four-year panel data (1995/1997=1 1998/2000=2 2001/2003=3 2004/2006=4 2007/2009=5 2010/2013=6).

In system GMM estimator, the variables in levels are instrumented by their lagged differences, and the differenced variables are instrumented by the lagged variables in levels leading to increase the efficiency of system GMM estimator. If we agree that the control variables *(*GDP per capita, trade openness, government consumption, population and tax revenues) included in the equation 1 affect the host country's corporate tax rate, it is also obvious that these variables for all the countries except the host countries also affect their corporate income tax rate suggesting that they can be used to instrument the average weighted corporate tax rate in equation 1. We therefore increase the set of instrumental variables by including the explanatory variables in other countries as external instruments for the weighted average corporate tax variable of other countries. To construct these instrumental variables, we use geographic inverse distance, economic distance (the difference in GDP per capita between countries i and j) weighting matrices and the combined geographic and economic distance matrix (benchmark matrix) used in the calculation of the spatially lagged dependent variable (average weighted CIT rate in foreign countries). Kukenova (2008), Foucault et al. (2008) and Klemm and Van Parys (2012) adopt the same approach for obtaining a set of instrumental variables to instrument the spatial lagged dependent variable for the system GMM estimations in their respective studies.

The system GMM estimator has the advantage to deal both with the endogeneity issue of the period lagged dependent variable and the other control variables that are potentially endogenous. This feature is interesting in our case as a control variable like trade openness may be endogenous because of reverse causality from trade openness to corporate tax policy. Indeed, trade liberalization policies for promoting competitiveness and trade may put downward pressures on corporate tax rates. Reciprocally, changes in corporate tax policy by affecting competitiveness may affect trade. We have therefore considered all the control variables as potentially endogenous except the total population for which the reverse causality with corporate tax rate is less evident.

The validity of the instrumental variables used in system GMM estimation is checked with the Hansen test of over-identifying restrictions and the Arellano and Bond's autocorrelation tests. The Hansen J test of over-identifying restrictions tests the hypothesis of no correlation between the instrumental variables and the residuals. The Arellano and Bond's autocorrelation tests determine whether there is first-order serial correlation in the error term [AR (1)] and no second-order autocorrelation in the residuals [AR (2).]

We also paid attention to the problem of instrument proliferation in system GMM estimations by collapsing the set of instrumental variables. To avoid the “instruments proliferation” or “too many instruments” problem, the total number of instruments should not exceed the number of countries used in the regression (Roodman, 2009).

Table 6 reports the results of estimating the dynamic specification of equation (1), using in turn the three different weighting matrices that have been discussed at the paragraph on the choice of weighting matrices above. The columns (1) and (2) use geographic distance weighted rates; columns (3) and (4) GDP-weighted rates; and columns (5) and (6) combined geographic and GDP distance weighted rates. Except the second regression (column 2, table 6) for which the number of instrumental variables (36) is slightly higher than the number of countries (34), all the regressions pass all the standard diagnostic tests. There is no evidence of second-order residual autocorrelation, and the Hansen test confirms that the set of instrumental variables are exogenous (see bottom lines in table 6 after the line for the number of observations, in the appendix). In addition, for each system GMM regression carried out, the number of instruments does not exceed the number of countries. The main findings remain unchanged, whenever we control for the effect of common time trend, the impact of the weighted average CIT rate on the host’ country CIT rate is no longer significant (columns 3 and 4, table 6). The estimated coefficient for the lagged dependent variable is positive and statistically significant at 1% in all the specifications thereby corroborating the prediction of path dependence in CIT rate for African economies.

Table 6 CIT rate interactions in Africa: Control for inertia in corporate income tax rate.

Dependent variable: CIT rate	(1)	(2)	(3)	(4)	(5)	(6)
Weighting matrix	Inverse distance	Inverse distance	GDP weights	GDP weights	Benchmark weights	Benchmark weights
L. (CIT rate)	0.893***	0.891***	0.938***	0.987***	0.874***	0.969***
	(0.036)	(0.027)	(0.040)	(0.038)	(0.038)	(0.061)
W (CIT rate)	0.108***	0.107	0.029	0.255	0.071	0.113
	(0.018)	(0.075)	(0.068)	(0.176)	(0.072)	(0.209)
GDP per capita	0.002***	0.001*	0.004	0.003	0.002**	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Trade openness	0.005	-0.001	-0.018	0.001	-0.030**	-0.037**
	(0.005)	(0.003)	(0.015)	(0.012)	(0.015)	(0.015)
Gov consumption	0.035	0.043*	-0.067	-0.091**	-0.024	-0.047
	(0.022)	(0.023)	(0.040)	(0.044)	(0.034)	(0.050)
Population	0.004	0.002	0.000	0.005	-0.014	-0.016
	(0.006)	(0.005)	(0.009)	(0.008)	(0.008)	(0.011)
Tax revenue	-0.054***	-0.054***	0.115*	0.026	0.044**	0.049
	(0.011)	(0.011)	(0.063)	(0.052)	(0.020)	(0.030)
Time trend		0.043		0.585*		0.306
		(0.122)		(0.321)		(0.378)
Observations	165	165	165	165	165	165
Nb. of countries	34	34	34	34	34	34
Hansen, pvalue	0.260	0.265	0.241	0.210	0.140	0.388
Instruments	33	36	22	27	25	21
ar2, pvalue	0.720	0.721	0.790	0.726	0.761	0.750
ar1, pvalue	0.011	0.012	0.011	0.011	0.012	0.011

Robust Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

In all the regressions, when time trend effect is controlled for, the positive interaction coefficient between CIT rates becomes statistically insignificant at the conventional significance levels. We interpret this result as an indication that the positive interdependence in CIT rate may be due to common conditions (correlated effects, intellectual trend). To comfort this explanation, we rerun the regressions using an approach extensively used in the literature to test whether the tax interactions are common trends and not a pure tax competition (Manski, 1993). The uniform weight matrix is commonly used to test the common intellectual trend in fiscal competition literature (Cassette and Paty, 2008; Caldeira et al., 2015). The weights of the uniform matrix is given by $w_{ij}=1/(n-1)$ with n the number of countries. Results indicate that we cannot reject

Manski's (1993) hypothesis of a common intellectual trend that drives countries' fiscal choices in the same directions in the absence of strategic behaviors in the countries. Specifically, with uniform weights, we find that the average tax rate in foreign countries positively affect the host country's CIT rate even if the effect of time trend is controlled (table 7, columns 1 and 2). This latter result supports the idea that CIT interdependences among African economies are govern by common intellectual trend that steers fiscal choices in the same direction rather than tax competition consideration. In fact, African economies face the same policy advise environment under the guidance of multinational institutions like the IMF, the World Bank and the AfDB which often suggest similar fiscal policy orientations to African countries.

Table 7 CIT rate interaction in Africa: Testing the hypothesis of common intellectual trend.

Dependent variable: CIT rate	(1)	(2)
Weighting matrix	Uniform weights	Uniform weights
L.CIT_rate	0.9128***	0.9541***
	(0.0284)	(0.0236)
W(CITrate)	0.1061***	0.3890***
	(0.0354)	(0.0936)
GDP per capita	0.0009***	0.0003
	(0.0001)	(0.0002)
Trade openness	-0.0269***	-0.0092
	(0.0067)	(0.0060)
Gov. consumption	0.0959***	-0.0117***
	(0.0171)	(0.0031)
Population	0.0158**	-0.0105**
	(0.0060)	(0.0040)
Tax revenue	0.0210	-0.0594**
	(0.0221)	(0.0222)
Time trend		0.193***
		(0.056)
Observations	545	545
Number of countries	33	33
Instruments	32	32
Hansen, pvalue	0.660	0.510
ar1(p)	0.015	0.014
ar2(p)	0.333	0.483

Robust Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

5 Empirical evidence on CIT base effects in Africa

So far, this study focused on corporate tax rates interaction among African economies. However, rather than using tax rates, national tax jurisdictions can use tax rules and tax instruments affecting the corporate tax burden to compete among each other's for attracting and keeping foreign capitals. In fact, beyond the tax rate, foreign investors may take into consideration tax rules such as depreciation rules, tax holidays to choose among countries the location of their investments. Accordingly, countries may compete via the tax base instead of the tax rate. After analyzing corporate income tax rate interactions, we turn to the analysis of corporate income tax base interactions among African national tax jurisdictions[9]

5.1 Specification

Tax competition has two properties namely strategic complementarity and base spillover (Rota Graziosi, 2018). By strategic complementarity, countries react to a decrease in one country's CIT rate by decreasing their own CIT rate. By base spillover, change in one country's CIT rate affect other countries corporate tax bases. We have tested the existence of strategic complementarity among CIT rate in Africa in the previous section. In this section, we turn to the analysis of the existence of CIT base spillovers among African economies. To do so, we borrow the IMF's empirical model specification (mixed Nash-Stackelberg tax game model) for testing the presence of base spillover among countries (IMF, 2014). The model is specified as follows:

$$\boldsymbol{B_{it} = \delta B_{it-1} + \beta \tau_{it} + \rho W_{-it} \tau_{it} + \gamma X_{it} + \alpha_i + \mu_t + \varepsilon_{it}}\ \textbf{(2)}$$

With B_{it} the corporate tax base in country i in year t. the corporate tax base is proxied by dividing corporate income tax revenue in proportion of GDP by the standard corporate tax rate (IMF, 2014; Keen and Mansour, 2010). B_{it-1} is the one-period lagged value of the corporate tax base. This variable is included to control for the inertia in tax base since it may take time to observe significant change in corporate tax base following a change in corporate tax rate because of adjustments costs. Technically, since there is inertia in CIT rate (Klemm and Van Parys, 2012; Overesch and Rincke, 2011) and dynamics in tax collection (Gnangnon and Brun, 2017; Gupta, 2007; Leuthold, 1991), a priori, there is no reason to cast doubt on the inertia of corporate tax base proxied as the ratio of CIT revenue to the CIT rate. τ_{it} is the home country's CIT rate in percent. $W_{-it}\tau_{it}$ represents the average weighted corporate tax rate in abroad countries. α_i and μ_t respectively represent country and time-specific effects. ε_{it} is the usual error term.

X_{it} is a vector of control variables that are likely to affect the corporate tax base. The variables include the GDP per capita, trade openness (sum of imports and exports in proportion of GDP), agriculture value added (in % GDP), inflation (changes in consumer price index) and natural resources rents (in %GDP). The GDP per capita is included to control for the effect of development level on corporate tax base while trade openness controls for the effect of international trade on corporate tax base. We include Agriculture value added to control for the sectoral composition of the economy on corporate tax base. We consider the effect of macroeconomic policies on corporate tax base by controlling for inflation. Natural resources rents are included to control for the role of the country's endowment in natural resources in size of the corporate tax base. IMF (2014) does not include a measure of natural resource wealth among the control variable in their specification for analyzing corporate tax base spillovers in

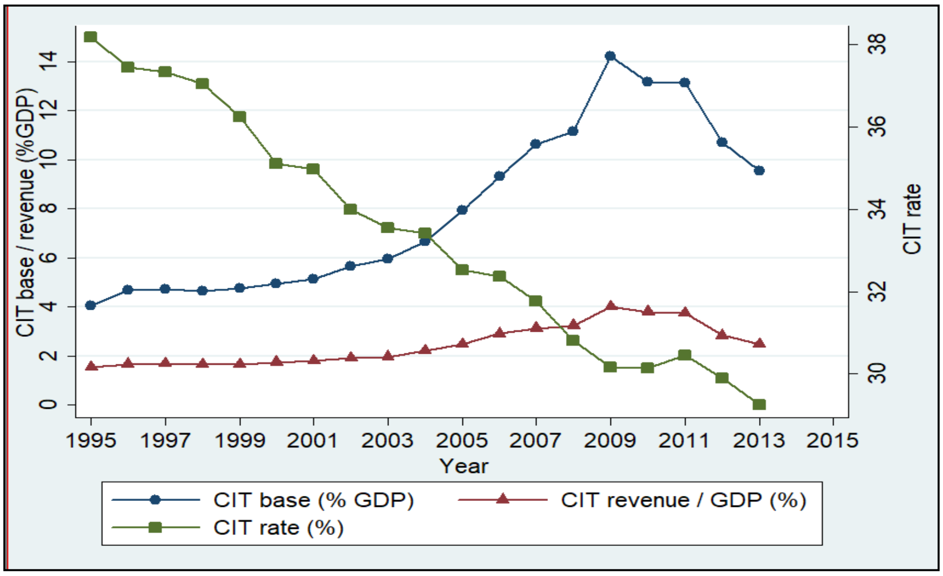
[9] Experts argue that the corporate tax bases interactions tend to be are more important than corporate tax rate interactions. This is reasonable, since given inertia in tax rate, countries may have strong incentive to use tax instruments, which affect tax liabilities' of corporations, other than tax rate to compete among themselves.

developing countries whereas natural resources are an important component of corporate tax base in these countries.

As high-income countries tend to attract more businesses, we expected that GDP per capita will positively affect the corporate tax base in our estimations. For promoting international trade, government can relax taxes on imports and grant tax incentives for firms whose activities are exported-oriented. From this perspective, trade openness may negatively affect corporate tax base in Africa. The agriculture sector is still under informality and dominated by subsistence agriculture. We therefore anticipated negative association between agriculture value added and corporate tax base. Inflation increase operating costs and reduces profits, thereby corporate tax base. Natural resources exploitation stimulates businesses and transactions. We therefore predict positive impact of natural resources on corporate tax base. Data on GDP per capita, Agriculture valued added, Inflation and natural resources rents have been extracted from the database WDI, the World Bank. Data on Corporate income tax revenue in percentage of GDP are taken from the IMF-FAD Tax Revenue Indicators database.

Figure 2 shows the evolution of CIT revenue in proportion of GDP between 1995 and 2013 for Africa. While CIT rates have dropped in Africa from 1995 to 2013, CIT revenue in percentage of GDP have almost doubled (from around 2%GDP in 1995 to 4% GDP in 2009) excepted for the sub-period from the global recession of 2009 to 2013 where the declining of CIT rates is associated with decrease in CIT revenues. This rate-revenue paradox of corporate taxes could be explained by improvement in corporate tax administration and enforcement, corporate tax broadening (as shown in figure 2), improvement in business climate which in turn increases corporate profitability and corporatization (see Abbas and Klemm, 2013; Keen and Mansour, 2010).

Figure 2: CIT revenue, CIT base and CIT rates in Africa



Source: Author’s construction from IMF-FAD.

5.2 Choice of the weighting matrix

In this section, we are exploring whether corporate tax rates abroad affect corporate tax base of a host country for African economies. In other terms, we are testing the existence of base spillovers effects in corporate taxation in Africa. Such effects mainly operate through two channels: investments decisions and profit shifting. Indeed, with capital mobility across countries, investors have strong incentive to reallocate their investments (assets) in countries with lower tax burden for ensuring a higher after-tax return on the investments. As discussed in the previous section above, countries with the same economic characteristics are most likely to compete each over through corporate tax policy as they offer similar business environment to investors. An advanced economy will be more sensible to changes in corporate tax policy of another advanced economy than for a small economy. Accordingly, the GDP per capita is a relevant candidate as a weighting matrix for the average tax rates abroad in equation 2. Practically, we use as weighting matrix the inverse of the absolute difference between the countries GDP per capita, such that the intensity of base spillovers effect will tend to be stronger for countries which have close development levels.

The effect of change in corporate tax rates abroad on domestic corporate tax base operate through profit shifting behaviours. Even if profit shifting behaviour is somewhat difficult to observe directly (Qian et al, 2017), one cannot cast doubt on the fact that it is highly motivated and fueled by the corporate tax rates differential between the host country and other countries abroad. Since profits shifting attitudes do not depend on macroeconomics or social factors but rather mainly depend on tax burden differential across tax jurisdiction, we use unweighted average tax rate in other countries to take into account profits shifting and base erosion consideration in corporate tax spillovers in Africa (IMF, 2014).

The dynamic nature of our model renders fixed effects estimators inappropriate for estimating it because of the correlation between unobserved fixed effects and the lagged dependent variable. In addition, because reforms affecting a host country corporate tax base could cause change in corporate tax policy abroad, the average corporate tax rate variable abroad is potentially endogenous in equation 2. The endogeneity problems of the lagged dependent variable and the average corporate tax rate abroad are addressed using the system GMM estimator (Blundell and Bond, 1998). Here again, to comply with the system GMM setting (large N and small T), we subdivide the time span of our dataset in three-year non-overlapping intervals. We obtain three-year panel data except the last sub-period which is four-year panel data (1995/1997=1 1998/2000=2 2001/2003=3 2004/2006=4 2007/2009=5 2010/2013=6).

5.3 Corporate income tax base effects in Africa: Estimation results

Table 8 displays results from the estimation of model (2) with system GMM estimator (two-step) using GDP weight and uniform weight for the average tax rate in other countries. The estimation results[10] pass all the standards validity tests. The Hansen test does not reject the null hypothesis of absence of correlation between the instruments and the error term. There is no second order serial correlation in residuals as indicated by the p-value of the autocorrelation

[10] The number of countries used in the regressions has declined because of missing values in corporate tax base due to missing values for the corporate tax income revenue data.

test and the estimation do not suffer from instruments proliferation problem. The variables tax base and GDP per capita are taken in logs while the other variables are in levels.

Results show that an increase in the host country's tax rate will deteriorate its corporate tax base (table 8, column 2). The effect of one percentage point increase in the host country's CIT rate will decrease its corporate tax base by 4. 6%. Regarding the spillovers effects, results suggest that reduction in the foreign corporate tax rate is likely to reduce the host country's corporate tax base. This effect is mainly significant for uniform weight (table 8, column 2) suggesting that corporate tax base erosion is Africa is operating through profit shifting activities. Typically, one percentage point reduction in the foreign countries' average corporate tax rate is likely to reduce the host country corporate tax base by 4.21% (table 8, column 2). However, if the host country reacts to one percentage point cut in foreign countries CIT rate by cutting by one percentage point its own CIT rate, this will increase the host country's CIT base by 4.6%, leaving a net corporate tax base loss of 0.4%. In terms of corporate tax revenue, our calculations indicate that, on average, these tax base losses represent 2.3 percent for the economies used in the econometric estimation[11]. As expected, the level if development and natural resources wealth contribute to broaden the corporate tax base. Inflation has negative impact on corporate tax base as predicted. In contrast to predictions, results show that agriculture value added, and trade openness positively affect corporate tax base in Africa. Results show that the estimated coefficient for the lagged value of the corporate tax base is positive and statistically significant at 1% (table 8, columns 1 and 2). This result corroborates the prediction of inertia in corporate tax base and therefore suggests that countries that manage to broaden its corporate tax base today are more likely to have large corporate tax base tomorrow.

[11] The economies include Algeria, Angola,Botswana, Côte d'Ivoire, Camerron, Congo republic, Cabo Verde, Ethiopia, Ghana, Kenya, Lesotho, Morocco, Madagascar, Mali, Malawi, Mauritius, Namibia, Senegal , Swaziland, Seychelles, Togo, Tunisia, Tanzania, Uganda, South Africa, Zambia and Zimbabwe,

Table 8: Impact of the average corporate tax rate of foreign countries on the corporate tax base of a host country.

Dependent variable: log(CIT_base) Weighting schemes	(1) GDP weights	(2) Uniform weights
Lagged dependent variable, t-1	0.719***	0.578***
	(0.126)	(0.077)
CIT_rate	0.004	-0.042***
	(0.010)	(0.011)
W(CIT_rate)	0.013*	0.046***
	(0.007)	(0.003)
Log (GDP per capita)	0.187	0.187**
	(0.206)	(0.081)
Trade openness	0.002	0.002**
	(0.001)	(0.000)
Agriculture value added	0.016	0.012*
	(0.020)	(0.006)
Inflation	-0.020**	-0.016***
	(0.008)	(0.004)
Natural resources rents	0.018***	0.020***
	(0.004)	(0.004)
Observations	90	90
Number of countries	27	27
Hansen, pvalue	0.487	0.600
Number of instruments	27	22
ar2, p	0.709	0.753
ar1, p	0.058	0.057

Robust Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

5.4 Further analysis

Corporate tax base spillovers analysis could not be limited to the assessment of the effect of foreign countries corporate tax rate on domestic corporate tax base. Spillovers effect may arise from changes (tax holidays, depreciation allowances rules) which affect the foreign countries corporate tax base while maintaining the CIT rate unchanged. In fact, an action on foreign countries corporate tax base could affect the host country's corporate tax base. We evaluate the impact of change in foreign countries' corporate tax base on the host country corporate tax base.

To take into account this consideration, we included among the explanatory variables in model (2), the foreign countries corporate tax base ($W_{-it}B_{it}$). We obtain the following specification:

$$\boldsymbol{B_{it} = \delta B_{it-1} + \beta \tau_{it} + \rho W_{-it}\tau_{it} + \theta W_{-it}B_{it} + \gamma X_{it} + \alpha_i + \mu_t + \varepsilon_{it}} \quad \textbf{(3)}$$

The average weighted corporate tax base abroad can be computed on balanced data in corporate tax base. Since corporate tax base are calculated by dividing corporate income tax revenue to the statutory corporate income tax rate, missing values in corporate tax revenue systematically translate into missing values for the corporate tax base data. We therefore manage to get as possible few missing values for the corporate tax base. For this purpose, we fulfill missing data on corporate tax revenue taken from IMF-FAD by corporate tax revenue data extracted from the International Conference for Taxation and Development Government Revenue Dataset (ICTD-GRD) where available[12]. This enables to have in the regressions 24 countries out of 34 countries for which we have balanced data on CIT rates.

Table 9 presents estimation results from the estimation of equation (3) by system GMM estimator using GDP and uniform weighting schemes. We find that with the GDP per capita weights, the impact of foreign countries tax base on the host country's corporate tax base is positive but not statistically significant (column 1, table 9) whereas this impact is positive and significant with the uniform weights (column 2, table 9) indicating strategic responses in corporate tax base policies. These results are indicating that the negative effect of tax incentives provision in foreign countries on the host country's corporate tax base is occurring through profit shifting but not through relocation of real asset investments.

Table 9: Effect of changes in abroad countries' CIT base and CIT rate on the host country's CIT base.

Dependent variable : CIT base Weighting schemes	(1) GDP weight	(2) Uniform weight
L.CIT base	0.953***	0.924***
	(0.034)	(0.054)
CIT rate	-0.123*	0.002
	(0.061)	(0.170)
WCIT_rate	0.282**	0.267
	(0.130)	(0.374)
WCIT_base	0.778	0.663**
	(0.491)	(0.299)
GDP per capita	-0.001*	0.0004
	(0.000)	(0.000)
Trade openness	-0.055**	-0.010
	(0.025)	(0.008)
Agriculture value added	-0.445***	-0.081*
	(0.102)	(0.046)
Inflation	-0.001*	-0.001***
	(0.000)	(0.000)
Natural resources rents	0.174**	0.147
	(0.069)	(0.087)
Observations	117	117
Number of countries	24	24
Hansen, pvalue	0.814	0.489
Instruments	20	20
ar 2, pvalue	0.450	0.365
ar1, pvalue	0.033	0.098

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

[12] Before doing so, we have compared the data on corporate tax revenue for the two datasets for the periods where data are available for both of them. We remarked few differences between these two data, there are even equal for certain years.

6 Conclusion

Globalization gives incentives to countries to compete against each other to attract foreign capitals through cuts in CIT rates and provision of tax incentives. This study analyzed in which extent African countries set CIT rate in response to each other. The paper also examines corporate tax base spillovers between African economies. We do not find strong evidence of CIT rate competition between African economies. More precisely, we found strategic interaction in CIT rate only if we do not control for the effects of time trend. We therefore conclude that positive slope of the tax rate reaction function between African economies may be attributable to the same tax policy environment within which these economies evolve, under the technical assistance from the same technical and financial partners. rather than a pure CIT rate competition between these economies. With respect to base spillovers, the findings from this study that cut in the average tax rates abroad reduce the host country's corporate tax base. If the host country reacts to cut in foreign countries tax rates but cutting in own CIT rate in the same proportion, this will ultimately result in a net loss of corporate tax base in proportion of GDP of 0.4% and corporate tax revenue in proportion of GDP of 2.3% for the host country. Moreover, we find strategic responses in corporate tax base policies suggesting that countries react to tax incentives in other countries by also offering tax incentives. The strategic responses mainly operate through profit shifting but not through relocation of real asset investments. From policy implications perspective, these latter results suggest limiting corporate tax cuts and tax incentive for preventing corporate tax base erosion and profits shifting in Africa.

Appendix

List of countries: Algeria, Angola, Botswana, Burkina faso, Comoros, Congo, Cabo verde, Cameroon, Côte d'Ivoire, Egypt, Ethiopia, Gabon, Ghana, Guinea, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Nigeria, Senegal, Seychelles, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe.

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