



Estimating and comparing tax efforts among selected East African Community member states

Patrick Mwanza Nzula¹, Dr James Murunga², Dr. David Musimbi¹

¹ Department of Economics Machakos University, Kenya

² Lecturer, Department of Economics Machakos University, Kenya

Abstract

This study focuses on tax effort, the gap between mobilized and predicted tax revenue in the East African Community (EAC). The EAC countries exhibit significant disparities in tax performance despite their similar economic structures. The study employs self-constructed panel of 5 nations from 2013–2023 for Kenya, Tanzania, Rwanda, Uganda, and Burundi; the first step involved the estimation of a stochastic frontier tax capacity model based on structural determinants (GDP per capita, manufacturing share, trade openness, agriculture, financial depth, inflation, and exchange rates). The succeeding step was computation of tax effort scores as the ratio of actual tax revenue to this estimated capacity. The results reveal pronounced heterogeneity in tax effort, with Kenya operating above capacity at 1.12, Uganda and Rwanda near capacity, 0.95 and 0.92, respectively, while Tanzania and Burundi show significant underperformance, 0.78 and 0.85, respectively. These findings suggest that revenue shortfalls in the region are not solely due to structural economic limitations but are significantly influenced by disparities in tax administration efficiency, compliance cultures, and policy implementation. The study concludes that policymakers must prioritize institutional reforms, digitalization, and targeted formalization strategies to close the effort gap, particularly in underperforming nations, to achieve the domestic revenue mobilization goals of EAC Vision 2050 and Agenda 2063.

Keywords: Tax effort, tax capacity, revenue mobilization, east african community, fiscal efficiency, stochastic frontier analysis, institutional performance

Introduction

Synonymous with other countries across the globe, developing nations are striving to achieve sustainable development financing, placing domestic revenue mobilization at the forefront of policy agendas. However, macroeconomic and institutional conditions restrict the amount of taxes any nation can reasonably raise. A plausible question would therefore be, how much extra revenue can a country raise through taxation at a given time, and what factors influence this maximum capacity. Tax capacity refers to the highest attainable level of tax revenue under prevailing economic and institutional conditions. On the other hand, tax effort is the ratio of actual tax revenue to tax capacity and indicates how effectively a government is utilizing its full potential. Although tax-to-GDP ratio is a common metric for assessing revenue performance, it presents an incomplete picture. A low ratio could stem from a constrained economic base (low capacity) or from inefficiencies in harnessing that base (low effort). Disentangling these two components is critical for designing effective fiscal reforms. The existing literature employs diverse approaches to measure tax effort, including traditional econometric methods and stochastic frontier (SF) analysis. The first strand of research relies on linear regression models, which assess a country's tax performance by comparing actual revenues to predicted values. However, these estimates do not represent maximum tax capacity, as tax effort exceeds one whenever actual collection surpasses the regression prediction. As a result, their usefulness for policy guidance is limited. In contrast, the SF approach more effectively captures the concept of potential by estimating the maximum level of tax revenue a country could achieve, given its own characteristics relative to peer countries in the sample. The East African

Community (EAC) presents a compelling case study. Member states share similar economic structures characterized by large informal sectors, agricultural dependence, and emerging industrialization, yet exhibit notable variations in their tax-to-GDP ratios. Conventional wisdom often attributes these differences to varying levels of economic development. However, preliminary evidence suggests that administrative efficiency and institutional quality play an equally, if not more, important role.

In this paper, we provide new evidence on countries' tax effort, contributing to the existing literature in several ways. First, while many studies rely on broad, cross-country comparisons, we develop a focused and homogeneous panel dataset for five EAC nations, specifically, Kenya, Tanzania, Rwanda, Uganda, and Burundi from 2013 to 2023. This regional focus allows for a more controlled analysis, holding constant many of the unobserved geographic and cultural heterogeneities that often complicate global studies. Our data, sourced from the World Development Indicators (WDI) and International Financial Statistics (IFS), ensures standardized and internationally comparable metrics, addressing common limitations of data inconsistency, especially for lower-income countries.

Second, we apply a panel data methodology that directly addresses a key specification problem in the tax effort literature. Many earlier studies use models where country-specific fixed effects such as historical tax culture, geographic constraints, stable institutional features are conflated with persistent inefficiency. This conflation can produce a significant downward bias in the estimates of tax effort, mistakenly interpreting inherent country characteristics as inefficiency. In overcoming such limitation, this study employs a Fixed Effects (FE) panel model, confirmed by a Hausman specification test. This

approach effectively controls for time-invariant country-specific heterogeneity, ensuring that our measure of tax effort is not biased by unobserved fixed factors.

This methodological choice is crucial. For instance, consider two EAC countries with similar economic structures. One nation may have higher tax revenue due to a historical legacy of a stronger social contract or a more advantageous trade logistics position. A model that fails to control for these fixed factors would wrongly attribute this revenue difference to higher contemporary "effort." The FE model isolates these fixed characteristics, allowing us to more accurately measure the time-varying efficiency of tax collection based on controllable policy and administrative factors. By doing so, the study provides a clearer, less biased assessment of how effectively EAC governments utilize their taxable capacity.

Guided by the research question: "How does tax effort vary across EAC member states, and what are the implications for policy?", this paper aims to:

1. Estimate the tax capacity of each country using a robust panel data model that controls for country-specific fixed effects.
2. Calculate and compare unbiased tax effort scores from 2013 to 2023.
3. Provide targeted recommendations for enhancing revenue mobilization efficiency in the region.

The findings offer a better understanding of fiscal performance in the EAC, highlighting that improving tax ratios requires not only economic growth but also a dedicated focus on strengthening the institutions that convert economic potential into tangible public revenue.

Literature Review

The empirical literature on tax performance is broadly divided into two main branches, encompassing the traditional regression techniques that identify the determinants of tax revenue, and another that employs Stochastic Frontier Analysis (SFA) to estimate tax effort by distinguishing between a country's tax capacity and its efficiency in achieving it.

The first branch stretches back to the seminal work of Lotz and Morss (1967)^[19] and applies linear regression models to identify the macroeconomic and structural determinants of tax-to-GDP ratios. A wide consensus has emerged around a core set of variables that define a country's tax capacity. These include the level of economic development, consistently proxied by GDP per capita (Fox & Gurley, 2005; Gupta, 2007; Tanzi, 1987)^[11, 14, 23], and the sectoral composition of the economy, with a high dependence on agriculture typically associated with lower tax ratios due to informality (Jewell *et al.*, 2005)^[15]. Although complex, the degree of trade openness is another critical factor as it can generate customs revenue but may be eroded by trade liberalization (Agbeyegbe *et al.*, 2006; Baunsgaard & Keen, 2010)^[1, 5]. Subsequent studies expanded this framework to include socio-institutional determinants such as education levels (Cyan *et al.*, 2013)^[8], income distribution (Bird *et al.*, 2014; Gupta, 2007)^[7, 14], as well as the measures of institutional quality and informality (Grigorian & Davoodi, 2007)^[13]. This past literature firmly established that factors such as governance, rule of law, and corruption are important in achieving high levels of tax collection (Bird

et al., 2008; Le *et al.*, 2012)^[6]. Drummond and Wendell (2012)^[10] provide a comprehensive review of these determinants.

However, this traditional approach is more focused on estimating the average level of tax collection within the context of a given set of economic conditions. The predicted value from such a regression is often interpreted as tax capacity, with tax effort calculated as the ratio of actual revenue to this prediction. Langford and Ohlenburg (2015)^[17] pinpoint a core limitation by arguing that this method provides little information on a country's ability to raise additional revenues, given that effort can exceed one; hence, making its interpretation as "inefficiency" less intuitive.

Such a limitation informed the development of the second branch of literature, which utilises Stochastic Frontier Analysis (SFA). Unlike traditional regression, the SFA approach is designed to estimate a "true" tax potential, the maximum feasible revenue given a country's economic structure and characteristics. This approach is advantageous in that tax effort, measured as the ratio of actual collection to this stochastic frontier, ranges between 0 and 1, directly representing the degree of efficiency in revenue mobilization and the potential room for improvement.

The first literature pioneering the SFA approach was authored by Jha *et al.* (1999)^[16] for Indian states. The SFA method has been widely applied globally, as seen in studies focusing on Indonesia by Alfirman (2003)^[3], another on the Mexican context by Castaneda & Pardinas (2012)^[8], West African states by Ndiaye & Korsu (2014)^[21], and Brazil by Antonio & Postali (2015)^[3]. A study by Pessino and Fenochietto (2013)^[22] employed SFA on a large panel of developed and developing countries, moving beyond cross-sectional analysis.

Although the SFA approach has some advantages, its application has been met with some criticism due to its methodological challenges and inconsistencies. A primary issue is the misspecification of handling unobserved country-specific heterogeneity, such as the historical tax culture, geography, and stable institutional features. Early panel SFA models, like the basic formulation of Battese and Coelli (1992)^[4], assumed a deterministic trend for inefficiency, conflating these time-invariant fixed effects with persistent inefficiency. This conflation produces a downward bias in inefficiency estimates, which leads to overestimation of tax effort due to the mistaking of inherent national characteristics for efficient performance.

Later studies, such as those using the True Random Effects (TRE) model (Greene, 2005a; applied by McNabb *et al.*, 2021)^[12, 20], attempted to address this by incorporating all time-invariant effects as heterogeneity. However, this approach swings to the opposite extreme, often overestimating inefficiency as it underestimates tax effort by classifying government-controllable but persistent institutional factors, such as long-standing governance quality, as unchangeable heterogeneity. The impact of these choices is dramatic, with McNabb *et al.* (2021)^[20] showing that the average tax effort estimate can swing from 0.41 under an ordinary random effects model to 0.84 under the TRE specification.

A further critical limitation of traditional and SFA studies is the omission of key policy variables, most notably tax rates as Pessino and Fenochietto (2013)^[22] established that models that omit statutory rates can yield puzzling results,

such as surprisingly low tax effort estimates for advanced economies with low VAT rates like in Singapore and Korea; and implausibly high estimates for developing nations with high rates like the case of Belarus and Bolivia. This indicates that a significant portion of what is labelled "effort" or "capacity" may reflect differences in policy choices on tax rates, leading to inaccurate assessments and flawed policy recommendations. The contribution of the current Study within the EAC Context The existing literature on tax effort remains limited within the East African Community (EAC) context, with most studies focusing on individual countries or relying on traditional deterministic models. This study addresses the dual methodological and contextual gaps highlighted above. First, it contributes to the methodological literature by applying a robust empirical strategy that avoids the misspecification of earlier models. The choice and the application of the Fixed Effects (FE) panel model is deliberate and effectively controls for all time-invariant, country-specific heterogeneity such as historical legacies and geographic constraints. This allows us to isolate the time-varying components of tax performance, providing a clearer, less biased measure of taxable capacity based solely on observable economic determinants. This approach ensures that the subsequent calculation of tax effort is not confounded by fixed national characteristics, offering a more accurate measure of controllable efficiency. Second, while the study acknowledges the importance of tax rates as a policy variable, our focused regional analysis of the EAC provides a natural control for this omitted variable bias. The EAC member states have made significant strides in harmonizing their tax policies, including aligned VAT standards and a common external tariff. This regional integration creates a more homogeneous policy environment than global samples, meaning that differences in statutory rates are less likely to drive the variations in tax effort observed between Kenya, Tanzania, Rwanda, Uganda, and Burundi. This unique context allows for a more confident attribution of disparities in tax effort to differences in administrative efficiency and compliance rather than divergent policy choices. Therefore, this study provides a novel and refined analysis of tax effort in the EAC, offering policymakers evidence-based insights that are crucial for designing targeted reforms to enhance domestic revenue mobilization.

Methodology

This study aims to estimate and compare tax effort across the East African Community (EAC). The analysis proceeds in two stages where tax capacity for each country was estimated first; a subsequent step involving calculating tax effort as the ratio of actual revenue to this estimated capacity.

Model Specification: Estimating Tax Capacity

Tax capacity represents the potential tax revenue a country can collect given its economic structure. It is crucial to control for unobserved, time-invariant country-specific characteristics such as historical legacies, cultural attitudes towards taxation, or geographic constraints so as to estimate this without bias. Therefore, we employ a Fixed Effects (FE) panel regression model. The superiority of the FE model over a Random Effects alternative was statistically confirmed by a Hausman test ($\chi^2 = 21.83$, $p = 0.002$).

The econometric model is specified to capture the relationship between the tax-to-GDP ratio and its key macroeconomic determinants, informed by established theory (Bahl, 1971; Gupta, 2007) [14]. The model specification is derived from our prior analysis of tax ratio determinants in the EAC (Nzula, 2025), which established a robust set of macroeconomic and structural drivers. The core econometric model is specified as follows;

$$\ln(\text{TRGDP})_{it} = \beta_0 + \beta_1(\text{GDPPC})_{it} + \beta_2 \ln(\text{MANU})_{it} + \beta_3 \ln(\text{TRADEOP})_{it} + \beta_4 \ln(\text{AGRIC})_{it} \\ + \beta_5 \ln(\text{MINE})_{it} + \beta_6 \ln(\text{M2})_{it} + \beta_7 \ln(\text{INF})_{it} + \beta_8 \ln(\text{EXCRATE})_{it} + \sigma_i \\ + \mu_{it} \dots 1$$

Where

- TRGDP (it) is the Tax Revenue to GDP ratio for country *i* in year *t*.
- GDPPC (it) is GDP per capita, a measure of economic development and the ability to pay taxes.
- MANU (it) is the natural log of the manufacturing share of GDP, representing an easily taxable, formal sector.
- TRADEOP (it) is the natural log of trade openness (exports + imports as a % of GDP), a source of customs duties.
- AGRIC (it) is the natural log of the agricultural share of GDP, a typically hard-to-tax, informal sector.
- M2 (it) is the natural log of broad money supply, a proxy for financial deepening and monetization.
- INF (it) is the inflation rate, which can erode the real value of tax collections.
- EXCRATE (it) is the exchange rate, controlling for external sector effects.
- σ_i is the standard random error term.
- U (it) is a non-negative error term representing technical inefficiency.

For this study, we use the predicted values TRGDP (it) from the standard Fixed Effects version of this model (omitting $u(it)$ as our measure of tax capacity. This approach provides a consistent and unbiased estimate of potential revenue, controlling for fixed national characteristics, and is directly aligned with our initial research findings on the determinants of tax ratios in the EAC.

Calculating Tax Effort

Following the estimation of the fixed effects model, the predicted tax-to-GDP ratio (TRGDP (it) for each country-year observation was computed. This value represents the estimated tax capacity- the expected level of tax revenue given the economic and structural characteristics, that is, the independent variables of country *i* in year *t*.

Tax effort (TaxE) is a measure of how effectively a country utilizes its estimated tax capacity. It is computed for each country (*i*) in each year (*t*) as the ratio of the actual observed tax ratio to the predicted capacity derived from the model:

$$\text{TaxEit} = \frac{\text{Actual TRGDPit}}{\text{TRGDPit}}$$

A score of 1 indicates a country is collecting revenue exactly at its predicted potential. A score greater than 1 suggests over-performance, while a score below 1 indicates

under-performance and reveals a gap that may be addressed through improved tax policy and administration.

Data Sources

We utilize a balanced panel dataset from 2013–2023 for five EAC member states: Kenya, Tanzania, Rwanda, Uganda, and Burundi. Data for all variables are sourced from the World Development Indicators (WDI) and International Financial Statistics (IFS) databases. These sources were selected to ensure standardized, internationally comparable data, which is a critical requirement for robust cross-country analysis.

Results and Discussion

Estimated Tax Effort

ScoresThe calculated average tax effort scores over the period (2013-2023) are presented in Table 1.

Table 1: Tax Effort Estimates by Country (2013-2023)

| Country | Mean Tax Effort | Standard Deviation | Minimum | Maximum |
|----------|-----------------|--------------------|---------|---------|
| Burundi | 0.85 | 0.12 | 0.68 | 1.02 |
| Kenya | 1.12 | 0.18 | 0.89 | 1.45 |
| Rwanda | 0.92 | 0.15 | 0.73 | 1.18 |
| Tanzania | 0.78 | 0.10 | 0.62 | 0.95 |
| Uganda | 0.95 | 0.13 | 0.77 | 1.16 |

***Note:** Tax effort calculated as the ratio of actual tax revenue to predicted tax capacity based on a fixed effects regression model.

There are significant variations in revenue collection efficiency across the East African Community member states during the 2013-2023 period. Tax effort, measured as the ratio of actual tax revenue to predicted tax capacity, provides insights into how effectively countries mobilize resources given their economic structures and development levels. The tax effort analysis reveals Kenya has the highest tax effort (1.12) among the EAC countries. The indicator shows that Kenya collects approximately 12% more revenue than its economic fundamentals would predict. This suggests that the country has a relatively strong tax administration efficiency and compliance levels. Such an outcome reflects that Kenya has a more advanced revenue authority capabilities and broader tax base.

Uganda and Rwanda registers Tax efforts at a near-optimal levels at 0.95 and 0.92, respectively. This indicates that the two countries collect revenue close to their estimated capacity. Rwanda demonstrates a consistent performance that ranges between 0.73-1.18. Such outcome is potentially due to its renowned tax administration efficiency and digital innovation in revenue collection, despite structural economic constraints. Burundi and Tanzania have lower tax effort scores of 0.85 and 0.78, respectively, suggesting untapped revenue potential. Tanzania collects approximately 22% less than its predicted capacity. Such outcome could potentially reflect challenges in tax compliance, administration efficiency, or structural factors limiting revenue mobilization. The EAC region has a low standard deviation across countries of between 0.10 to 0.18. This outcome indicates that the region has generally stable tax effort patterns over the decade. However, Kenya shows slightly higher volatility with a SD = 0.18 which could potentially reflect its more responsive revenue policies to economic fluctuations.

These findings suggest that while all EAC countries have room for improved revenue mobilization, Tanzania and Burundi possess the greatest potential for increasing collections without major economic restructuring. The variations highlight the importance of institutional factors, tax administration efficiency, and compliance culture in determining revenue performance beyond mere economic fundamentals. The results underscore the need for targeted reforms where Kenya could serve as a regional benchmark for best practices. Tanzania and Burundi might benefit from administrative modernization and broadening the tax base.

Conclusion and Recommendations

This study has demonstrated that the challenge of low tax revenues in the EAC lies beyond the problem of economic structure to include fiscal efficiency. The study shifts the analytical focus from static tax ratios to dynamic tax effort, quantifying a significant "efficiency gap" across the region. The pronounced disparities in tax effort scores from Kenya's over-performance to Tanzania's significant under-performance reveal that revenue shortfalls are heavily influenced by disparities in tax administration efficiency, compliance cultures, and policy implementation, away from economic capacity alone. This finding challenges the conventional narrative that attributes low revenue solely to factors like a large agricultural sector or low-income levels. Instead, our analysis, which controlled for these very structural determinants, underscores that institutional quality is the primary differentiator in revenue performance.

The policy implications of this finding are immediate and actionable. The efficiency gap is largest in Tanzania and Burundi; hence the priority must be to increase effort through fundamental administrative reforms. This necessitates targeted investments in digitalization, strengthening audit and enforcement capabilities, and implementing innovative formalization strategies, such as value-chain taxation in agriculture. With Uganda and Rwanda demonstrating near-optimal efficiency, the focus should be on maintaining this high effort while carefully expanding capacity through economic diversification and growth, ensuring that hard-won efficiency gains are not eroded. Kenya should maintain consistency in current policy and identify any emerging issues that may hinder tax collection efficiency to *sustain* its high effort but also widen the tax base to reduce the burden on existing taxpayers and make the system more equitable and resilient to economic shocks.

This study disentangled capacity from effort, providing a clear and evidence-based roadmap for policymakers. The path to sustainable domestic revenue mobilization in the EAC requires a dual strategy: fostering long-term economic development to expand tax capacity, while simultaneously pursuing relentless short- and medium-term reforms to maximize tax effort. This involves prioritizing administrative digitalization, implementing cooperative compliance models for hard-to-tax sectors, enhancing regional collaboration to harmonize policies and combat tax avoidance, and designing economic incentives that explicitly promote formalization. Such a well pronounced approach would allow the EAC governments to unlock the substantial revenue potential that our model reveals is currently untapped, thereby paving the way for self-financed development, reduced dependency on external borrowing,

and greater fiscal autonomy in line with the goals of EAC Vision 2050 and Agenda 2063.

References

1. Agbeyegbe TD, Stotsky J, WoldeMariam A. Trade liberalization, exchange rate changes, and tax revenue in Sub-Saharan Africa. *Journal of Asian Economics*,2006;17(2):261-284. <https://doi.org/10.1016/j.asieco.2006.02.003>
2. Alfirman L. Estimating stochastic frontier tax potential: Can Indonesia get more tax revenues? *IMF Working Paper*,2003;(9).
3. Antonio A, Postali F A. Tax capacity and fiscal effort in Brazil: A subnational analysis. *Brazilian Journal of Political Economy*,2015;35:348–368. <https://doi.org/10.1590/0101-31572015v35n02a08>
4. Battese GE, Coelli TJ. Frontier production functions, technical efficiency and panel data: With application to paddy farmers in India. *Journal of Productivity Analysis*,1992;3(1–2):153–169. <https://doi.org/10.1007/BF00158774>
5. Baunsgaard T, Keen M. Tax revenue and (or?) trade liberalization. *Journal of Public Economics*,2010;94(9–10):563–577. <https://doi.org/10.1016/j.jpubeco.2009.11.007>
6. Bird R M, Martinez-Vazquez J, Torgler B. Tax effort in developing countries and high-income countries: The impact of corruption, voice and accountability. *Economic Analysis and Policy*,2008; 38(1):55–71. [https://doi.org/10.1016/S03135926\(08\)50006-3](https://doi.org/10.1016/S03135926(08)50006-3)
7. Bird R M, Zolt E M, Gendron PP. Taxing a developing financial sector. *ICTD Working Paper International Centre for Tax and Development*, 2014, 21.
8. Castaneda P, Pardinás J E. Tax potential and tax effort: An empirical estimation for the case of the Mexican states. *Serie documentos de trabajo del Centro de Estudios Económicos*, 2012-10. El Colegio de México, Centro de Estudios Económicos, 2012.
9. Cyan M, Martinez-Vazquez J, Vulovic V. Measuring tax effort: Does the estimation approach matter and should effort be linked to expenditure goals? *International Center for Public Policy Working Paper Andrew Young School of Policy Studies, Georgia State University*, 2013, 13-08.
10. Drummond P, Wendell G. Tax effort and the determinants of tax ratios in the Southern African Customs Union. *International Monetary Fund*, 2012.
11. Fox WF, Gurley T. An exploration of tax patterns around the world. *The World Bank*, 2005.
12. Greene W. Reconsidering heterogeneity in panel data estimators of the stochastic frontier model. *Journal of Econometrics*,2005a;126(2):269–303. <https://doi.org/10.1016/j.jeconom.2004.05.003>
13. Grigorian DA, Davoodi H R. Tax potential vs. tax effort: A cross-country analysis of Armenia's stubbornly low tax collection. *IMF Working Papers*, 2007, 2007(106). <https://doi.org/10.5089/9781451866391.001>
14. Gupta AS. Determinants of tax revenue efforts in developing countries. *IMF Working Papers*, 2007;2007(184):1–39. <https://doi.org/10.5089/9781451867480.001>
15. Jewell T, Knox C, IMF Institute. Revenue productivity of the VAT. *IMF*, 2005.
16. Jha R, Mohanty M S, Chatterjee S, Chitkara P. Tax efficiency in selected Indian states. *Empirical Economics*,1999;24(4):641–654. <https://doi.org/10.1007/s001810050072>
17. Langford B, Ohlenburg T. Tax revenue potential and effort an empirical investigation. *Overseas Development Institute*, 2015.
18. Le T M, Moreno-Dodson B, Bayraktar N. Tax capacity and tax effort, Extended cross-country analysis from 1994 to 2009. *World Bank Policy Research Working Paper*, 2012, 6252. <https://doi.org/10.1596/1813-9450-6252>
19. Lotz J R, Morss E R. Measuring tax effort in developing countries. *IMF Staff Papers*,1967: 14(3):478–499. <https://doi.org/10.2307/3866266>
20. McNabb K, Sjo B, Gutiérrez-Romero R. Tax effort revisited: How to measure the right amount of tax revenue. *International Centre for Tax and Development*, 2021.
21. Ndiaye A S, Korsu R D. Measuring tax effort: A test of the stochastic frontier approach in ECOWAS. *The West African Institute for Financial and Economic Management*, 2014.
22. Pessino C, Fenochietto R. What determines tax effort? *International Monetary Fund*, 2013.
23. Tanzi V. Quantitative characteristics of the tax systems of developing countries. In D. Newbery, N. Stern (Eds.), *The Theory of Taxation for Developing Countries*. Oxford University Press, 1987, 205-241.