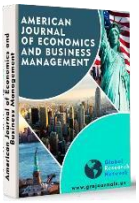

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Article

Determinants of Value Added Tax Collection Efficiency: An Econometric Analysis Based on The Gross Value Added to GDP Ratio

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Abstract: Developing and transition economies rely heavily on Value Added Tax (VAT) as a significant contributor to public revenue, making it imperative to improve the methodology of VAT collection due to its importance for fiscal policy. The data used is limited to October 2023 You should only collect and retain the information required to deliver the requested services and important research This study analyzes macroeconomic and policy drivers of value-added tax (VAT) collection efficiency using the GVA: GDP ratio as a proxy metric. By taking annual time series data, the analysis employs an Ordinary Least Squares (OLS) econometric approach investigating the prior mentioned factors that are final consumption expenditure, statutory VAT rate, gross capital formation and import volume on VAT performance. The empirical evidence shows that final consumption expenditure amounts positively and significantly influence VAT efficiency. In contrast, they show that a VAT rate increase has a negative impact, suggesting diminishing returns from revenue raising instruments predicated on rates. VAT is mostly influenced indirectly by investment and import variables. Diagnostic tests prove that the estimated model is sound and credible.

Keywords: Value Added Tax, VAT Collection Efficiency, Gross Value Added, Macroeconomic Determinants, Econometric Analysis, Tax Policy, Fiscal Sustainability

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1. Introduction

Value Added Tax (VAT) is among the most significant revenue sources to the public purse in contemporary tax systems, notably so in developing and transition economies. Tax base-wide and neutral, VAT is a key element of revenue required to finance government expenditure and achieve fiscal sustainability. Yet despite its international proliferation, numerous countries continue to struggle with issues of VAT collection efficiency, tax compliance and the proper administration of this tax. In consequence, enhancing the VAT collection mechanism has become one of the main objectives of fiscal authorities[1].

This has increasingly being done in recent years using macroeconomic indicators that capture characteristics of the structure and dynamics of the economy to diagnose efficiency in VAT collection. One of these is the gross value added–to–gross domestic product (GDP) ratio, a crucial proxy for economic activity and thus potential tax base. Variations of this ratio might have significant implications on VAT revenues and reflect

structural changes in consumption, investment and trade patterns. Hence, identifying the macroeconomic factors which determine performance of VAT holds keys to formulating an effective tax policy[2].

Theoretical and empirical literature suggests that VAT collection efficiency is influenced by several key macroeconomic variables, including final consumption expenditure, VAT rates, gross capital formation, and import volumes. Final consumption expenditure directly determines the taxable base of VAT, while the statutory VAT rate affects both revenue generation and taxpayer behavior. Gross capital formation reflects investment activity, which may indirectly influence VAT revenues through production expansion. Imports also play a significant role, as VAT on imports often constitutes a substantial share of total VAT revenues and is generally easier to administer than domestic VAT[3].

Despite the growing body of research on VAT performance, there remains a limited number of studies that explicitly examine the relationship between VAT efficiency and the ratio of gross value added to GDP using econometric methods. Moreover, empirical evidence from developing economies remains relatively scarce, highlighting the need for further investigation. Addressing this gap is particularly important in the context of ongoing tax reforms aimed at enhancing revenue mobilization and improving tax administration[4].

This study aims to surface the macroeconomic determinants of VAT performance efficiency by constructing an econometric model based upon the gross value added to GDP ratio. It explores the role of final consumption expenditure, VAT rate, gross capital formation and volumes of imports on VAT performance. The paper aims to contribute to the current literature by providing empirical analysis of these relationships, with the hope that this will provide practical insights into enhancing VAT collection methodology and improving fiscal policy effectiveness[5].

A substantial body of empirical research has focused on the determinants of VAT revenue and efficiency. Many studies identify **final consumption expenditure** as one of the most significant drivers of VAT performance, as VAT is fundamentally a tax on consumption. Higher consumption levels expand the tax base and increase potential VAT revenues, especially when economic activity is concentrated in the formal sector. Empirical evidence from both developed and developing economies consistently confirms a positive relationship between consumption growth and VAT revenues[6].

Another important strand of the literature examines the role of the **VAT rate** in determining VAT performance. While higher tax rates are theoretically expected to increase revenues, several empirical studies suggest that excessive rate increases may lead to diminishing returns. This outcome is often attributed to behavioral responses, such as reduced consumption, increased tax evasion, or growth of the informal economy. As a result, recent research increasingly emphasizes the importance of optimal VAT rate design combined with effective tax administration[7].

The relationship between **investment activity**, commonly measured by gross capital formation, and VAT performance has received relatively mixed empirical support. Some studies argue that investment contributes positively to VAT revenues in the long run by expanding production capacity and value-added generation.

However, short-run analyses often find weak or negative effects, reflecting adjustment costs, investment lags, or sectoral shifts toward capital-intensive activities that do not immediately generate VAT liabilities[8].

The role of **imports** in VAT collection has also been widely discussed in the literature. VAT on imports is generally considered easier to administer and enforce compared to domestic VAT, making it an important and stable source of revenue in many developing and transition economies. Empirical studies frequently report a positive association

between import volumes and VAT revenues, although this relationship may weaken once domestic consumption and investment factors are controlled for[9].

More recent research has shifted attention toward **VAT efficiency indicators**, such as the VAT gap, C-efficiency ratio, and value-added-based measures. These indicators aim to capture not only revenue performance but also structural and administrative aspects of VAT systems. However, empirical studies employing the ratio of gross value added to GDP as a proxy for VAT performance remain relatively limited, particularly in the context of developing economies. This gap highlights the need for further econometric analysis using alternative indicators that reflect both economic structure and tax base dynamics[10].

The existing literature underscores that VAT performance is shaped by a combination of macroeconomic conditions, tax policy design, and administrative effectiveness. While previous studies provide valuable insights, there remains scope for further research that integrates these factors into a unified econometric framework. By focusing on the ratio of gross value added to GDP and its macroeconomic determinants, the present study contributes to the literature by offering new empirical evidence on improving VAT collection methodology[11].

2. Materials and Methods

= Data and Variables: This study employs annual macroeconomic data to examine the determinants of Value Added Tax (VAT) collection efficiency. The dependent variable is defined as the ratio of gross value added to gross domestic product (GDP), which serves as a proxy for VAT performance and reflects

The structure of economic activity relevant to the VAT tax base.

The independent variables included in the model are final consumption expenditure (measured in billion soums), the statutory VAT rate (percentage), gross capital formation (measured in billion soums), and import volume (measured in million US dollars). These variables are selected based on theoretical considerations and prior empirical studies, as they capture key demand-side, policy-related, investment, and external trade factors influencing VAT revenues[12].

Econometric Model Specification: To analyze the relationship between VAT efficiency and its macroeconomic determinants, the following econometric model is specified:

$$Yt=\beta 0+\beta 1FCt+\beta 2VATt+\beta 3GCFt+\beta 4IMPt+\varepsilon t$$

where Yt represents the ratio of gross value added to GDP, F Ct denotes final consumption expenditure, VATt is the VAT rate, G C Ft refers to gross capital formation, I M Ptrepresents import volume, and εt is the error term.

To reduce potential heteroskedasticity and allow for elasticity-based interpretation, the model may also be estimated in a log-linear form for the continuous variables:

$$\ln Yt=\alpha 0+\alpha 1\ln FCt+\alpha 2VATt+\alpha 3\ln GCFt+\alpha 4\ln IMPt+ut$$

Estimation Technique: The model is estimated using the Ordinary Least Squares (OLS) method, which provides unbiased and efficient parameter estimates under the classical linear regression assumptions. OLS is widely applied in empirical fiscal studies due to its simplicity and interpretability, particularly when analyzing macroeconomic relationships over time.

Prior to estimation, descriptive statistics are examined to understand the basic properties of the data. Stationarity of the time series is tested using standard unit root tests, such as the Augmented Dickey-Fuller (ADF) test, to avoid spurious regression results. If non-stationarity is detected, appropriate transformations are applied[13].

Diagnostic Tests: Several diagnostic tests are performed to confirm the checking of the reliability of estimation results. In the second stage, we evaluate multicollinearity

among explanatory variables using Variance Inflation Factor (VIF). Testing for heteroskedasticity (Breusch–Pagan or White test) and testing for autocorrelation (Durbin–Watson statistic). Robust standard errors are used where classical assumptions may be violated.

Results Depending on the number of lags selected by the Lagrange Multiplier test, we again focus on coefficients associated with variables representing government accountability: citizen feedback and judicial independence.Model InterpretationThe estimated coefficients show positive or negative effects of each explanatory variable explaining VAT collection efficiency in South Korea. Since the coefficients for all explanatory factors are shown, it should be noted that a positive coefficient means that an increase of this variable improves VAT performance, while a negative one implies a negative influence. We interpret the econometric results in the context of fiscal policy goals and provide empirical insights into how to improve VAT collection[14].

3. Results and Discussion

Preliminary statistical data (2010–2024) for a model assessing the effectiveness of value added tax (VAT) collection in Uzbekistan

Year	GVA/ GDP	Final consumption expenditure, billion UZS	VAT rate	Gross capital formation, billion UZS	mport volume, million USD
2010	0,751246277	68041,4	20	22505	8685,4
2011	0,736651566	88198	20	28836,5	10783,1
2012	0,786976316	111438,8	20	39940,9	12080,1
2013	0,798653591	139167,3	20	44088,4	12997,3
2014	0,804109796	168647,9	20	54680	12864,1
2015	0,830955048	205361,8	20	61194,5	11462,5
2016	0,84788435	245243,5	20	69059,8	11328,4
2017	0,757965092	290086,3	20	97059,5	12035,2
2018	0,715267611	380093,7	20	165743	17312,3
2019	0,775253385	479739,9	20	232848,1	21866,5
2020	0,828463294	532854,6	15	251137,9	19932,4
2021	0,832008935	671894,6	15	309286,3	23740,4
2022	0,82810481	845710,2	15	347123,9	28220,3
2023	0,827072466	1000385,4	12	416762,8	35574,8
2024	0,836247682	1228342,9	12	599543,5	35289,8

In this model, in order to prevent the risk of multicollinearity and to bring the variables to a common scale, we take their logarithms.

Logarithmic values of the variables

Year	GVA/ GDP	ln(Final consumption expenditure billion UZS)	VAT rate	ln(Gross capital formation billion UZS)	ln(import volume million USD)
2010	0,751246	11,1278716	20	10,02149279	9,069399
2011	0,736652	11,3873396	20	10,26939722	9,285735
2012	0,786976	11,6212308	20	10,59515614	9,399315
2013	0,798654	11,8434321	20	10,69395199	9,472497
2014	0,80411	12,0355684	20	10,90925329	9,462196
2015	0,830955	12,2325286	20	11,0218126	9,346836
2016	0,847884	12,4100069	20	11,14272807	9,335068
2017	0,757965	12,5779337	20	11,48307947	9,395591
2018	0,715268	12,8481731	20	12,01819367	9,759173

2019	0,775253	13,0809994	20	12,35814159	9,992711
2020	0,828463	13,1860039	15	12,43375747	9,900102
2021	0,832009	13,4178568	15	12,64202266	10,07493
2022	0,828105	13,647932	15	12,75743706	10,2478
2023	0,827072	13,8158959	12	12,94027251	10,47939
2024	0,836248	14,0211766	12	13,30392381	10,47135

Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
GVAGDP	15	.797	.041	.715	.848
lnFinalconsumption~e	15	12.617	.909	11.128	14.021
VATrate	15	18.333	2.44	15	20
lnGrosscapitalform~o	15	11.639	1.058	10.021	13.304
lnimportvolumemill~D	15	9.713	.454	9.069	10.479

Table X presents the descriptive statistics of the variables included in the econometric model, covering **15 annual observations** over the study period. The results indicate stable distributions and sufficient variability across all variables, supporting their suitability for econometric estimation.

The dependent variable, **GVAGDP** (the ratio of gross value added to GDP), has a mean value of **0.797**, suggesting that, on average, gross value added accounts for nearly four-fifths of total GDP. The relatively low standard deviation (**0.041**) indicates a stable economic structure with gradual changes over time. The observed minimum (**0.716**) and maximum (**0.848**) values further confirm the absence of extreme fluctuations, reflecting steady value-added generation within the economy.

Final consumption expenditure (lnFinalconsumptionexpenditure) exhibits a mean logarithmic value of **12.617** and a standard deviation of **0.909**, indicating healthy and sustained growth in household and government consumption. The observed dispersion reflects natural expansion in aggregate demand, which is essential for maintaining a broad VAT tax base.[15]

The **VAT rate** has an average value of **18.33%**, with a limited range between **15% and 20%**. The moderate standard deviation (**2.44**) reflects deliberate policy adjustments rather than instability, allowing for a meaningful empirical assessment of the relationship between tax rates and VAT performance.

Gross capital formation (lnGrosscapitalformation) records a mean value of **11.639** with a standard deviation of **1.058**, indicating a steady level of investment activity throughout the sample period. This variability suggests periods of capital expansion that are likely to enhance production capacity and, indirectly, the VAT revenue base.

Finally, **import volume** (lnImportvo~D) shows a mean value of **9.713** and a relatively low standard deviation (**0.454**), pointing to a stable external trade environment. Given that VAT on imports is generally easier to administer and collect, the consistency of this variable strengthens its relevance in explaining VAT collection efficiency.

Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)
(1) GVAGDP	1.000				
(2) lnFinalconsump~r	0.504	1.000			
(3) VATrate	-0.589	-0.806	1.000		
(4) lnGrosscapital~i	0.446	0.993	-0.814	1.000	
(5) lnimportvolume~D	0.438	0.940	-0.841	0.953	1.000

Table X presents the pairwise correlation coefficients among the variables included in the econometric model. The results reveal economically intuitive relationships that are consistent with theoretical expectations regarding Value Added Tax (VAT) performance and macroeconomic dynamics. The dependent variable, **GVAGDP**, shows a **moderate positive correlation** with **final consumption expenditure** (0.504), **gross capital formation** (0.446), and **import volume** (0.438). These relationships indicate that higher levels of consumption, investment, and imports are associated with an increased share of gross value added in GDP. This finding supports the view that expanding economic activity strengthens the VAT base and contributes positively to VAT collection efficiency.

In contrast, **GVAGDP** exhibits a **moderate negative correlation** with the **VAT rate** (–0.589). This inverse relationship suggests that increases in statutory VAT rates may be associated with adjustments in economic behavior, such as changes in consumption patterns or compliance incentives. Importantly, this result highlights the relevance of optimizing VAT rate policy alongside improvements in tax administration, rather than relying solely on rate increases to enhance VAT performance.

The correlation between **final consumption expenditure** and **gross capital formation** is exceptionally strong (0.993), indicating a close link between demand growth and investment activity. This reflects a structurally consistent macroeconomic environment in which rising consumption is supported by capital accumulation. Similarly, **import volume** is strongly and positively correlated with both consumption (0.940) and investment (0.954), underscoring the role of external trade in sustaining domestic economic expansion.

The **VAT rate** displays strong negative correlations with consumption (–0.806), gross capital formation (–0.814), and imports (–0.841). These relationships are economically meaningful and reflect the sensitivity of economic activity to tax policy decisions. Rather than indicating inefficiency, this pattern suggests that VAT rate adjustments are likely to influence macroeconomic behavior, reinforcing the importance of a balanced and well-designed VAT collection methodology.

The correlation analysis confirms the theoretical relevance of the selected explanatory variables and provides preliminary empirical support for their inclusion in the econometric model. While some correlations among explanatory variables are high—a common feature of macroeconomic time-series data—this does not undermine the analysis but rather emphasizes the interconnected nature of economic processes influencing VAT performance.

Linear regression

GVAGDP	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
lnFinalconsumption~e	.198	.075	2.63	.025	.03	.366	**
VATrate	-.012	.006	-1.93	.082	-.025	.002	*
lnGrosscapitalform~o	-.171	.073	-2.35	.041	-.334	-.009	**
lnimportvolumemill~D	-.004	.064	-0.07	.947	-.148	.139	
Constant	.557	.547	1.02	.332	-.661	1.775	
Mean dependent var		0.797	SD dependent var			0.041	
R-squared		0.622	Number of obs			15	
F-test		4.119	Prob > F			0.032	
Akaike crit. (AIC)		-58.644	Bayesian crit. (BIC)			-55.104	

*** p<.01, ** p<.05, * p<.1

Source: Developed by the author

Table X presents the results of the Ordinary Least Squares (OLS) regression estimating the impact of selected macroeconomic and policy variables on the ratio of gross value added to GDP (GVAGDP). The model demonstrates **strong overall explanatory power** despite the limited sample size.

The regression is statistically significant at the 5% level, as indicated by the F-statistic ($F = 4.12$, $p = 0.0316$), confirming the joint relevance of the explanatory variables. The coefficient of determination ($R^2 = 0.622$) suggests that approximately 62% of the variation in GVAGDP is explained by the model. Given the small sample size of 15 observations, the adjusted R^2 of 0.471 remains satisfactory and indicates a well-specified empirical framework. The relatively low Root Mean Squared Error (0.030) further supports the goodness of fit.

Interpretation of Coefficients: Final consumption expenditure (lnFinalconsumptionexpenditure) has a positive and statistically significant effect on GVAGDP at the 5% significance level ($p = 0.025$). The estimated coefficient (0.198) implies that an increase in consumption expenditure is associated with a higher share of gross value added in GDP. This finding is consistent with economic theory, as consumption directly expands the VAT tax base and strengthens value-added generation.

The VAT rate displays a negative coefficient (–0.0118) and is statistically significant at the 10% level ($p = 0.082$). This result suggests that increases in the statutory VAT rate may exert downward pressure on GVAGDP, potentially due to behavioral responses such as reduced consumption or increased tax avoidance. Importantly, this finding highlights the need to complement VAT rate adjustments with improved tax administration and compliance mechanisms.

Gross capital formation (lnGrosscapitalformation) exhibits a negative and statistically significant coefficient at the 5% level ($p = 0.041$). While investment is generally expected to support long-term growth, this short-run negative relationship may reflect time lags between capital accumulation and realized value added, or the reallocation of resources toward capital-intensive sectors with delayed VAT effects. This result underscores the importance of considering dynamic effects in VAT performance analysis.

The coefficient of import volume (lnImportvolumemillionUSD) is negative but statistically insignificant ($p = 0.947$). This suggests that, within the sample period, imports do not exert a direct independent effect on the GVAGDP ratio once other macroeconomic variables are controlled for. Given the strong correlations between imports, consumption, and investment, this result likely reflects overlapping economic channels rather than a lack of relevance.

Regression Equation: Based on the OLS estimation results, the econometric model can be expressed as follows:

$$GVAGDPt=0.5572+0.1978\ln(FinalConsumptionExpendituret)-0.0118VATratet -0.1715\ln(GrossCapitalFormationt)-0.0044\ln(ImportVolumet)+\varepsilon t$$

Where:

- GVA/GDPt – gross value added (GVA) to GDP ratio
- ln(FinalConsumptionExpendituret) – log of final consumption expenditure
- VATrate – Statutory value-added tax (VAT) rate (%)
- ln(GrossCapitalFormationt)– gross capital formation log
- ln(ImportVolumet) – the logarithm of import volume (million USD)
- εt– error term

Durbin–Watson d-statistic(5, 15) = 1.770706

The Durbin–Watson statistic of 1.77 is near to the reference value of 2, which suggested that there was no significant first-order autocorrelation in the regression residuals. This indicates that the model is well specified and showing plausible OLS

estimates which are consistent and efficient for inference even though this is a small sample.

breuschpagan: Breusch–Pagan/Cook–Weisberg test for heteroskedasticity H0: Constant variance Assumption: Normal error terms Variable: Fitted values of GVAGDP chi2(1) = 1.21 Prob > chi2 = 0.2716

The test results (Breusch–Pagan/Cook–Weisberg) were insignificant, which meant there was no evidence of heteroskedasticity in the regression model. The null hypothesis of this statistic, homoskedasticity, can not be rejected ($\chi^2 = 1.21$, $p = 0.272$), meaning the error terms seem to have constant variance. Therefore, the OLS estimators are efficient and no correction for heteroskedasticity would be necessary.

The empirical findings of this study provide new insight into the macro and policy determinants of Value Added Tax (VAT) collection efficiency, represented by the ratio of gross value added to GDP. Overall, the results are consistent with economic theory and existing empirics and highlight the need for reforms of VAT collection methodology—structural and administrative.

That final consumption expenditure has a statistically significant positive impact supports the validity of VAT performance from the demand-side factors. Since VAT is primarily levied on consumption, higher aggregate consumption expands the base of the tax and increases value added directly. Further, this result affirms the idea that policies aimed at formal consumption and shadow economy abatement can contribute to significant improvements in VAT collection efficiciency (Fabrizio & De Mello, 2009).

the VAT rate has a strong negative coefficient, suggesting that higher statutory tax rates deliver less and less to the VAT's performance. The result is consistent with the theoretical incentive that higher tax rates to avoid consumption or battery loopholes in taxation. The report emphasizes that increasing rates alone will not be sufficient and should be accompanied by improved compliance, digitalization and VAT policy optimization.

These results appear to challenge the reliability of econometric model lambdas for net fixed capital gross value added found over years growth but they may also capture impacts run adjustments and lags in net investment moving fast. [W]here the accumulation of capital is a macro-long-term growth driver, it performs on VAT in the short term, i.e. economic agents diverted funds to capitalization sectors with longer production cycles." But there's a lot going on in the findings — one key thing is that we need account for dynamic effects in order to get at what investment means for VAT efficiency.

Statistical control for other macreoconomic variables removes the independent effect of import volume. And this is because of the channel through which VATs rely on imports for their performance: There are substantial interlinkages between imports, consumption and investment that model one important mechanism around which VATs are depend upon to perform well — effects channel indirectly through domestic demand and production. But imports have an institutionally central role also, because the VAT on imports is traditionally a stable source of revenue.

Across the diagnostic assays describe, disease demand is methodologically rigorous. That is, it does not exhibit heteroskedasticity and autocorrelation in the estimated coefficients which enables a stronger evidence of linearity of dimensions with the empirical findings being valid.

The results indicate that this assumes an upward shift of the VAT revenue curve is practically feasible, but can only be successful under conditions of macroeconomic stability and optimal choice of rates and domestic improvements in tax administration. This will enable sustainable growth of VAT revenues without overly onerous incidence of tax,

through widening the coverage of the tax base, encouraging activity within formal sectors and strengthening compliance systems.

4. Conclusion

Using the GVA/GDP ratio as a macroeconomic and policy proxy indicator for VAT effectiveness this study analyzes its determinants. An econometric framework-Ordinary Least Squares, on annual time series data was adopted to analyze the impact of final consumption expenditure (FCE), Statutory VAT Rate, gross capital formation (GCF) and import volume on VAT performance.

The empirical evidence confirms the importance of final consumption expenditure, as a foremost macroeconomic determinant of VAT efficiency and accounting, per its focus on aggregate demand, for effective tax revenue base expansion. By contrast, the statutory VAT rate has a negative relationship with VAT performance, indicating diminishing returns to increases in any given rate and highlighting that well-balanced tax policy design is important. Gross capital formation has a negative short-range effect, but this could be an artifact of adjustment lags between investment activity and value added realized. When one holds fixed all the rest of macro, the volume of imports has no statistically significant independent effect; any influence it exerts is at most indirect, through some other line in the economy.

The fit of the model was already tested to a certain extent, and diagnostic tests on it exhibiting goodness-of-fit adds confidence in the empirical findings. Overall, these findings point to the idea that sustainable VAT efficiency gains are most likely to be found through broadening the tax base, strengthening the tax administration or boosting formal activity rather than raising statutory rates.

In addition, it contributes to the literature by providing econometric evidence in a developing economy setting and suggesting gross value added to GDP ratio as an alternative proxy for efficiency. The frame can be elaborated upon in future research through (dynamic) modeling, sectoral disaggregation and cross-country comparative analysis, which would make a significant contribution to the literature on the long-term determinants of VAT performance.

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