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# Transfer Pricing Regulation and Tax Revenue Performance in Ghana's Petroleum Sector: The Role of GRA Enforcement

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**This study examines the impact of transfer pricing regulations on petroleum tax revenue using the enforcement role of the Ghana Revenue Authority (GRA). Utilizing data from Ghanaian firms spanning 2002 to 2023 from reliable institutional sources including the GRA, PIAC, World Bank, and the U.S. Energy Information Administration, the study employs the Autoregressive Distributed Lag (ARDL) model to capture short- and long-term relationships, supported by the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model to address volatility in the residuals. The findings revealed that transfer pricing regulations exert a negative short-run impact on petroleum tax revenue but indicate potential long-run benefits as compliance improves. Audit recoveries demonstrated a significant and immediate positive effect, highlighting the importance of consistent enforcement. Additionally, oil price fluctuations and GDP growth were found to influence tax performance significantly. The findings of this study have important practical implications for tax policy, revenue administration, and regulatory strategy within Ghana's petroleum sector and beyond. The evidence that transfers pricing regulations and audit recoveries significantly contribute to increased petroleum tax revenue demonstrates the effectiveness of strong enforcement mechanisms in curbing base erosion and profit shifting.**

*Keywords: Transfer pricing, petroleum tax revenue, Ghana Revenue Authority, ARDL model, GARCH model*

*JEL: G3, H2, H26, H3*

Transfer pricing (TP) has become one of the most critical tax policy challenges for developing countries in the era of globalization, especially where multinational enterprises (MNEs) dominate key sectors such as oil and gas. TP refers to the pricing of goods, services, and intangibles exchanged between related entities within the same corporate group. When not regulated effectively, MNEs can manipulate these prices to shift profits from high-tax jurisdictions like Ghana to low or no-tax jurisdictions, thereby eroding

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the domestic tax base. This has profound implications for resource-rich countries that rely heavily on tax revenue from extractive sectors to fund public expenditure. Ghana's petroleum sector, which contributes significantly to government revenue, is particularly vulnerable due to the complex structure of international oil contracts and the dominance of foreign investors (Woodroffe and Grice, 2019; World Bank, 2020)

To curb tax base erosion and ensure fair taxation, Ghana introduced the Transfer Pricing Regulations, 2012 (L.I. 2188), aligned with the Organization for Economic Co-operation and Development (OECD's) Arm's Length Principle (ALP). These regulations were a major step in formalizing the country's approach to TP, especially in high-risk sectors such as petroleum. Prior to this, Ghana's regulation under Section 17 of the Internal Revenue Act, 2000 (Act 592), and the Petroleum Income Tax Law of 1987 lacked the necessary scope and enforceability. The Ghana Revenue Authority (GRA), the main body responsible for implementing tax policy, was tasked with enforcing these regulations. However, regardless of the existence of laws, enforcement remains a challenge due to capacity constraints, limited access to comparable data, and sophisticated tax avoidance strategies employed by MNEs (Ali-Nakyea, 2019; Amidu *et al.*, 2019).

Studies by Ennin (2022) and Suleman and Zaato (2021) indicate that GRA's interventions have had measurable impacts through back taxes collected, yet they also point to weaknesses in audit capacity and institutional coordination. Comparative reviews from other developing countries reveal those countries with stronger TP enforcement such as South Africa and Indonesia experience less revenue leakage, suggesting Ghana can enhance revenue collection by reinforcing institutional capacity (Beebeejaun, 2018; Kalra and Afzal, 2023).

However, existing literature often stops at identifying problems or reviewing legislation, without delving into how enforcement directly affects outcomes in key sectors like petroleum. This study aims to fill that gap by evaluating the actual impact of Ghana's TP regulations on tax revenue within the petroleum sector, with a special focus on the role of the GRA. It is crucial not only to examine the regulations themselves but to understand how enforcement mechanisms such as audits, penalties, and taxpayer monitoring translate into fiscal results. By addressing this gap, the study provides critical insights for policymakers, academics, and practitioners aiming to strengthen tax administration in resource-dependent economies like Ghana.

Although transfer pricing (TP) regulations are widely adopted to curb profit shifting and protect domestic tax bases (Beer and Loeprick, 2015; Crivelli *et al.*, 2016). Existing research in Ghana has not sufficiently explained how these regulations translate into actual revenue outcomes within the petroleum sector. This is an important omission, as regulatory frameworks in resource-rich sectors are only effect-

ive when complemented by strong institutional enforcement (Fuest and Riedel, 2009; Johannesen *et al.*, 2020).

The theoretical gap therefore lies in the absence of a sector-specific model explaining whether TP regulations improve tax revenue under varying degrees of GRA enforcement, a relationship that has not been conceptually or empirically examined in Ghana. Addressing this gap is essential to understanding whether regulation, enforcement, or the interaction of both drive revenue outcomes. To address this gap, the study asks the following questions:

1. To what extent do transfer pricing regulations affect tax revenue in Ghana's petroleum sector?
2. Does GRA enforcement moderate the relationship between TP regulations and petroleum tax revenue?
3. How does the interaction between TP regulations and enforcement influence the effectiveness of revenue mobilization in the petroleum sector?

By posing these questions, the study offers a *sui generis* contribution: a novel analytical perspective that positions GRA enforcement as an integral component of the TP revenue relationship, thereby advancing theoretical understanding beyond existing Ghanaian and African literature.

The rest of this paper is organized as follows. The next section will review the relevant literature. Section three will present and justify our chosen methodology. Section four will present and analyze the results, while section five will discuss the findings. Section six will conclude the paper and section seven will offer our study's implications. Section eight will provide the study's limitations and future directions.

## LITERATURE REVIEW

### Theoretical Underpinnings

The literature converges on the view that TP regulations are necessary but not sufficient for revenue protection: enforcement quality is the intervening variable that turns legal rules into fiscal outcomes. Yet scholarship rarely models enforcement explicitly as a moderator in the TP revenue relationship especially for sector-specific contexts such as petroleum (Crivelli *et al.*, 2016; Johannesen *et al.*, 2020). Ghanaian studies document regulatory design and capacity issues but do not robustly theorize how variations in GRA enforcement intensity alter the causal pathway from rules to realized tax receipts (Atupare *et al.*, 2020). The absence of a focused, testable framework that integrates TP regulation, enforcement mechanisms, and petroleum fiscal dynamics constitutes the core theoretical gap this study addresses.

Two complementary theories ground the expected relationships:

### –Institutional Enforcement Theory

This perspective holds that regulatory efficacy is a function of institutional capacity, credibility, and procedural autonomy. Enforcement agencies that possess technical skills, investigative resources, and institutional independence translate legal rules into observable outcomes (Moore *et al.*, 2018). Applied here, GRA enforcement quality conditions whether TP regulations alter firm reporting and thus tax revenues.

### –Deterrence Theory

This framework posits that compliance increases with the expected cost of non-compliance, which depends on detection probability and sanction severity. Higher enforcement intensity raises detection probability and expected sanctions, thereby deterring abusive transfer pricing (Fuest and Riedel, 2009).

Combining these theories predicts both a direct effect of TP regulations (through clearer rules and documentation requirements) and a moderating role for enforcement (through credible threat and capacity to assess transactions). International guidelines (OECD, 2017) thus matter most where enforcement turns guidance into practice.

## Empirical Review

### Transfer Pricing, BEPS, and Revenue Mobilization

Transfer pricing (TP) regulation constitutes a principal policy response to Base Erosion and Profit Shifting (BEPS) by multinational enterprises (MNEs), because cross-border intra-group pricing offers an accessible channel for shifting taxable profits away from source countries (Beer and Loeprick, 2015; OECD, 2017). TP rules aim to realign reported profits with economic substance and thereby protect domestic tax bases. However, the mere existence of TP rules does not guarantee revenue gains: the impact of TP regulation on tax revenue depends critically on institutional capabilities and enforcement practice (Crivelli *et al.*, 2016; Fuest and Riedel, 2009). Empirical work therefore frames TP policy not as a legal artifact alone but as an institutional package whose fiscal effectiveness is contingent on administrative implementation and enforcement (Johannesen *et al.*, 2020).

### Transfer Pricing in Developing and Extractive-Economy Contexts

Developing countries face distinctive constraints, limited comparable data, weak audit capacity, and information asymmetries, that reduce their ability to detect and correct abusive TP practices (Crivelli *et al.*, 2016; Fuest and Riedel, 2009). Studies show that less developed jurisdictions are more exposed to profit shifting because MNEs can exploit gaps in enforcement and data availability (Johannesen *et al.*, 2020). In extractive sectors, these challenges are magnified by complex contractual arrangements,

cost-recovery rules, and commodity price dynamics that create many legitimate but hard-to-verify intra-group transactions; as a result, extractive operations become focal points for TP related fiscal leakage unless oversight is strong (Atupare *et al.*, 2020; Woodroffe and Grice, 2019).

### Ghana's TP Regulatory Framework and Petroleum Fiscal Architecture

Ghana adopts TP rules that largely align with international guidance (e.g., OECD arm's-length principles) and has iteratively updated its domestic instruments, culminating in Transfer Pricing Regulations (L.I. 2412) intended to strengthen documentation and administrative procedures (University of Ghana commentary on L.I. 2412). Nevertheless, regulatory design coexists with capacity constraints within the Ghana Revenue Authority (GRA): audit resources, access to comparables, sectoral expertise, and international exchange mechanisms remain variable (Atupare *et al.*, 2020; Woodroffe and Grice, 2019). The petroleum sector in Ghana operates under production sharing and concessionary arrangements, involves large capital cost recovery and technical service arrangements, and is dominated by foreign operators, conditions that elevate both the risk and complexity of TP manipulation. These institutional and sectoral features make enforcement central to whether TP rules protect revenue in practice.

### TP Regulation and Revenue Outcomes

Cross-country and micro-level studies document that where tax administrations combine TP rules with strong audit programs, information exchange, and sectoral capacity, the incidence of profit shifting is lower and revenue outcomes improve (Beer and Loeprick, 2015; Johannesen *et al.*, 2020). Conversely, scoping reviews of African experience identify weak enforcement, limited documentation scrutiny, and scarce transfer-pricing expertise as recurring barriers that undermine TP regulation's ability to reduce BEPS (Sebele-Mpofu *et al.*, 2022). Ghanaian case studies and policy analyses indicate that legal reforms (e.g., updated TP regulations) make conceptual progress but do not automatically translate into higher effective tax collection absent commensurate enforcement strengthening (Atupare *et al.*, 2020; Woodroffe and Grice, 2019). These findings suggest a conditional relationship in which enforcement intensity shapes whether TP regulations yield fiscal benefits. The empirical literature supports the Direct effect hypothesis, suggesting that Transfer pricing regulations positively influence tax revenue in Ghana's petroleum.

$H_1$: Transfer pricing regulations positively influence tax revenue in Ghana's petroleum sector.

### Enforcement as the Operational Mechanism: Why It Matters?

Enforcement operates through several proximate mechanisms that affect taxpayer behavior and audit outcomes: (1) audit coverage and frequency increase the perceived probability of detection; (2) sectoral

technical expertise improves the quality of transfer-pricing adjustments; (3) documentation standards and penalties raise the expected cost of non-compliance; and (4) access to international information (through treaty networks or automatic exchange) reduces information asymmetry (Fuest and Riedel, 2009; OECD, 2017). Deterrence logic implies that stronger enforcement changes firm incentives and thus reduces the extent of profit shifting (Becker's rational actor extension to tax compliance). Institutional enforcement theory further posits that enforcement credibility rooted in organizational capacity and procedural autonomy determines the effective reach of any regulation (Moore *et al.*, 2018). In Ghana's petroleum sector, these mechanisms are particularly salient because complex cost allocations and service pricing create multiple levers for profit re-allocation that only skilled auditors can reliably challenge. The empirical literature supports the Moderation by enforcement hypothesis, suggesting that GRA enforcement intensity positively moderates the relationship between TP regulations and petroleum tax revenue.

$H_2$: GRA enforcement intensity positively moderates the relationship between TP regulations and petroleum tax revenue.

### Interaction Between TP Regulations and Enforcement Intensity

Empirical studies increasingly show that the effectiveness of transfer pricing (TP) regulations depends heavily on the level of enforcement capacity within tax administrations. While TP rules alone can contribute to improved corporate tax collections, research finds that their revenue impact becomes significantly stronger when combined with high enforcement intensity.

Cross-country analyses demonstrate that the introduction of TP regulations is generally associated with modest increases in tax revenue, although the effects vary widely across jurisdictions (De Mooij and Liu, 2020; Teles *et al.*, 2024). However, several studies highlight that these gains often remain limited in countries with weak administrative capacity or low audit activity. For instance, evidence from developing countries shows that TP legislation without active audits, specialized TP units, or strong documentation requirements yields minimal improvements in revenue outcomes (Sebele-Mpofu *et al.*, 2025).

More importantly, emerging empirical work explicitly documents a positive interaction effect between TP regulations and enforcement intensity. Countries that coupled TP reforms with enhanced audit resources, improved documentation systems such as country-by-country reporting, or stronger penalties experienced substantially larger increases in corporate tax receipts than countries that enacted TP laws without strengthening enforcement (Teles *et al.*, 2024). Sector-specific studies, particularly in extractive industries, further show that audit-driven enforcement magnifies the fiscal impact of TP rules by reducing

profit shifting opportunities in high-value transactions (Sebele-Mpofu *et al.*, 2022).

Overall, the empirical literature supports the interaction superiority hypothesis, suggesting that TP regulations are most effective when complemented by robust enforcement mechanisms. In other words, the joint implementation of TP rules and strong enforcement capacity produces greater and more sustained increases in tax revenue than regulatory reforms alone (OECD, 2022).

$H_3$: The combined effect of TP regulations and high enforcement intensity produces greater increases in tax revenue than regulations alone.

Figure 1 below shows the conceptual diagram summarizing the hypothesized relationships.

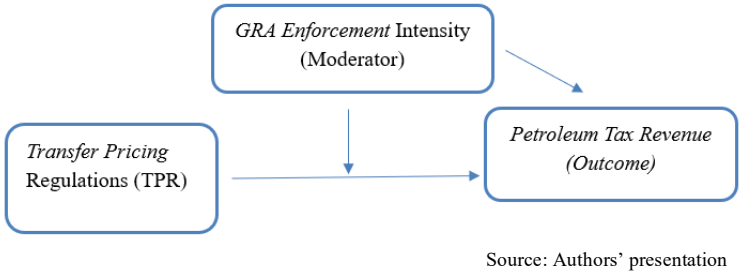



***Figure 1. Conceptual Framework***

## METHODOLOGY

### Sample and Procedure

Utilizing data from Ghanaian firms spanning 2002 to 2023 from reliable institutional sources including the GRA, PIAC, World Bank, and the U.S. Energy Information Administration, the study employs the Autoregressive Distributed Lag (ARDL) model to capture short- and long-term relationships, supported by the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model to address volatility in the residuals. Specifically, data from corporate tax revenue, audit recoveries, and penalties imposed were obtained from the Ghana Revenue Authority (GRA) Annual Reports. Information on oil production volumes, price benchmarks, and government revenue allocations from the petroleum sector was extracted from the Public Interest and Accountability Committee (PIAC) Reports. Additionally, macroeconomic indicators such as GDP growth rates were retrieved from the World Bank Development Indicators and fiscal bulletins published by the Ministry of Finance. The use of secondary data was justified due to its credibility, official status, and historical continuity, which are crucial for robust panel data analysis. As emphasized by Beebeejaun (2018), administrative and audit datasets from public institutions are particularly valuable for evaluating the effectiveness of tax policy reforms in developing

economies.

## Variables and Measurement

The dependent variable in this study is Petroleum Tax Revenue (TAXREV), measured as the annual corporate income tax generated from petroleum sector firms, expressed in Ghana cedis and log-transformed for stability. The key independent variable is the Transfer Pricing Regulation, as Dummy (TPR) and coded 0, for years before 2012, and 1 for years from 2012 onwards, representing the implementation of Ghana's TP Regulations (Rathke *et al.*, 2021). Other control variables include Audit Recovery (AUD_REC), defined as the amount of back taxes recovered through TP audits; Crude Oil Price (OIL_PRICE), measured as the annual average Brent price in USD per barrel; and GDP Growth Rate (GDPGR), capturing the macroeconomic environment (Table 1).

| Variable | Source | Measurement |
|---|---|---|
| Tax Revenue (TAXREV) | Ghana Revenue Authority (GRA) | Annual corporate income tax from the petroleum sector (GHS, log-transformed) |
| TP Regulation Dummy (TPR_DUMMY) | Coding based on regulation implementation year | Dummy variable: 0, for years before 2012, and 1, from 2012 onward |
| Audit Recovery (AUD_REC) | Ghana Revenue Authority (GRA) | Annual value of back taxes recovered through audits (GHS) |
| Crude Oil Price (OIL_PRICE) | U.S. Energy Information Administration (EIA) | Annual average global crude oil price (USD per barrel) |
| Tax Enforcement | Ghana Revenue Authority (GRA) | Number of Penalties |
| GDP Growth (GDPGR) | World Bank/IMF Database | Annual GDP growth rate (%) |

Source: Authors' presentation

***Table 1: Measurement of Variables***

## Model Specification

The Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model, introduced by Bollerslev (1986), is employed to capture volatility clustering in petroleum tax revenue, which is common in fiscal data due to economic shocks or policy changes. The model is specified as:

$$y_t = \mu + \varepsilon_t, \qquad \varepsilon_t \sim N(0, h_t), \qquad h_t = \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1}$$

The GARCH model's strength lies in modeling time-varying volatility, making it ideal for revenue data influenced by commodity price volatility or regulatory enforcement spikes (Engle, 2001). However, it assumes a symmetric response to shocks, which may not always reflect real-world fiscal dynamics. This practice is consistent with the study of Rathke *et al.* (2021) who used GARCH to analyze volatility in profit shifting responses post-regulation. In this study, the GARCH model helped to assess volatility in petroleum tax revenue before and after the implementation of transfer pricing regulation.

## ARDL Model Estimation

The Autoregressive Distributed Lag (ARDL) model developed by Pesaran *et al*. (1999, 2001) is used to explore the short-run and long-run relationships between tax revenue and key explanatory variables, including the time dummy for transfer pricing regulation. The ARDL model is appropriate when variables are integrated at different levels, i.e., I(0) and I(1), but not I(2). The model is flexible and effective in small samples, with the structure:

$$\Delta Y_t = \alpha + \sum \beta_i \Delta X_{t-1} + \lambda Y_{t-1} + \theta X_{t-1} + \varepsilon_t$$

Its strength is its ability to estimate both short-run dynamics and long-run equilibrium relationships simultaneously. However, it can be sensitive to lag selection and structural breaks (Nkoro and Uko, 2016). This model helped to determine how transfer pricing enforcement has had a statistically significant long-run impact on petroleum tax revenue in Ghana.

### Analysis Technique

Given the mixed order of integration, the study employed the Autoregressive Distributed Lag (ARDL) model to estimate both short-run and long-run determinants of petroleum tax revenue in Ghana's transfer pricing enforcement context, complemented by the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model to account for volatility in residuals.

The study used Augmented Dickey-Fuller (ADF) test to examine the stationarity of the variables employed in the study. The study also used the Lagrange Multiplier (LM) test for autoregressive conditional heteroskedasticity (ARCH), which assesses whether the variance of the residuals from the time series model is constant over time. The GARCH model provide insight into the conditional variance (volatility) of the residuals associated with petroleum tax revenue over the period 2002 to 2023. The residuals indicate periods of both negative and positive deviations from the mean. Larger negative values are mainly observed in the earlier years (2002–2011), while the period following the introduction of transfer pricing regulations (2012–2023) is characterized predominantly by positive residuals.

## RESULTS

### Descriptive Statistics

Table 2 provides a summary of the descriptive statistics for the variables employed in the study spanning from 2002 to 2023. The log of petroleum tax revenue shows a mean value of 6.854 with a standard deviation of 0.159, indicating relatively low variation and a stable revenue trend over the years. The transfer pricing regulation dummy (TPR), which marks the introduction of the regulation in 2012, has a mean of 0.545, implying that over half of the observations fall in the post-regulatory period, consistent

with structural policy reform (Rathke *et al.*, 2021). Audit recovery has a mean of GHS 177.34 million with a high standard deviation of 85.36, suggesting significant variation in enforcement outcomes, which aligns with previous findings on fiscal volatility due to regulatory actions (Engle, 2001). The average crude oil price over the period is USD 66.85 per barrel with a range from USD 51.13 to USD 82.84, highlighting the global market fluctuations impacting Ghana's petroleum revenues. Additionally, GDP growth rate exhibits a mean of 5.07% and a standard deviation of 1.24%, reflecting moderate macroeconomic variation within the period studied characteristic of developing economies (Gujarati and Porter, 2009). These results offer a foundational understanding of the dataset's characteristics and suggest that sufficient variability exists for robust econometric modeling.

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Tax Revenue | 22 | 6.854 | .159 | 6.579 | 7.138 |
| TPR | 22 | .545 | .51 | 0 | 1 |
| Audit Recovery | 22 | 177.339 | 85.362 | 75.75 | 280.56 |
| Oil Price | 22 | 66.852 | 7.896 | 51.13 | 82.84 |
| GDP Growth | 22 | 5.065 | 1.242 | 1.86 | 6.88 |

Source: Authors' computation

***Table 2: Descriptive Statistics***

## Pre-diagnostic Tests

### -Multicollinearity Analysis

Table 3 presents the pairwise correlation coefficients among the key variables in the study. The results reveal a strong and statistically significant positive correlation between the transfer pricing regulation dummy (TPR_Dummy) and audit recovery ($r = 0.980$, $p < 0.01$). This indicates that the implementation of transfer pricing regulations in 2012 is closely associated with an increase in audit-related tax recoveries, supporting the argument that stricter regulatory frameworks enhance tax enforcement outcomes (Rathke *et al.*, 2021). Additionally, TPR_Dummy is positively correlated with oil price ($r = 0.662$, $p < 0.01$), suggesting that the post-regulation years coincided with relatively higher global crude oil prices, which may have amplified taxable income in the petroleum sector and contributed to increased tax revenues (Engle, 2001). Audit recovery is also significantly correlated with oil price ($r = 0.626$, $p < 0.01$), implying that favorable market conditions tend to strengthen audit yield, possibly due to improved firm profitability and greater exposure to pricing irregularities. On the other hand, GDP growth exhibits weak and statistically insignificant correlations with the other variables, particularly with TPR_Dummy ($r = -0.157$), audit recovery ($r = -0.161$), and oil price ($r = -0.049$), with all $p$-values well above the 10%

threshold. This finding suggests that macroeconomic performance, as measured by GDP growth, had limited direct influence on tax enforcement or oil price volatility within the period under review (Gujarati and Porter, 2009). Overall, the correlation analysis reinforces the centrality of regulatory enforcement and oil market conditions in shaping Ghana's petroleum tax outcomes.

| Variables | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| (1) TPR_Dummy | 1.000 | | | |
| (2) Audit_Recovery | 0.980† | 1.000 | | |
| (3) Oil_Price | 0.662† | 0.626† | 1.000 | |
| (4) GDP_Growth | -0.157 | -0.161 | -0.049 | 1.000 |

Source: Authors' computation
† $p < .10$

***Table 3: Pairwise Correlations***

### -Stationarity Test

Table 4 presents the results of the Augmented Dickey–Fuller (ADF) test used to examine the stationarity of the variables employed in the study. The findings show that at their level form, most variables namely Tax Revenue, TPR Dummy, and Audit Recovery are non-stationary, as their ADF test statistics do not meet the critical values at the 10% significance level. This indicates the presence of unit roots, which implies that these series follow a stochastic trend. However, after first differencing, these variables become stationary, with statistically significant ADF values at the 1%, 5%, or 10% levels. This transformation suggests that they are integrated of order one, I(1). In contrast, Oil Price and GDP Growth show evidence of stationarity at level under at least one test condition, indicating they are integrated of order zero, I(0). These results confirm that the dataset contains variables with a mix of I(0) and I(1) orders of integration. According to Pesaran *et al.* (1999, 2001), such conditions make the Autoregressive Distributed Lag (ARDL) model appropriate, as it can effectively handle variables with different integration orders provided none are I(2). Ensuring stationarity is essential in time series modeling to avoid spurious regressions and to ensure valid inferences about the relationships among variables (Gujarati and Porter, 2009). Therefore, the stationarity test validates the econometric approach adopted in this study and provides a solid foundation for reliable model estimation.

### -Autoregressive Conditional Heteroskedasticity (ARCH)

Table 5 reports the results of the Lagrange Multiplier (LM) test for autoregressive conditional heteroskedasticity (ARCH), which assesses whether the variance of the residuals from the time series

model is constant over time. At lag 1, the test yields a chi-square statistic of 11.907 with a $p$-value of 0.0006, indicating strong evidence of ARCH effects in the residuals, thus rejecting the null hypothesis of

| Variables | Augmented Dickey-Fuller | | | |
|---|---|---|---|---|
| | Level | | First Difference | |
| | C | Constant and Trend | C | Constant and Trend |
| Tax_Revenue | -0.863 | -4.544** | -7.893** | -7.705** |
| TPR | -1.058 | -1.856 | -3.082* | -3.006 |
| Audit_Recovery | -1.030 | -1.712 | -2.640† | -2.576 |
| Oil_Price | -1.958 | -3.966** | -4.440** | -4.246** |
| GDP_Growth | -3.582** | -3.498* | -4.517** | -4.442** |

Source: Authors' computation
† $p < .10$; * $p < .05$; ** $p < .01$

***Table 4: Stationarity Test- Augmented Dickey-Fuller***

homoskedasticity. However, when the test is extended to lag 15, the chi-square value drops to 7.000 with a $p$-value of 0.9576, suggesting no significant ARCH effects at higher lags. This result implies that while short-term volatility clustering may exist, the presence of heteroskedasticity does not persist across longer time horizons. These findings are important in the context of this study, as they justify the inclusion of a volatility model such as GARCH, which accounts for time-varying variance in the error terms particularly relevant when analyzing tax revenue data in the petroleum sector, which is often subject to policy shocks and oil price fluctuations (Engle, 2001). Addressing ARCH effects ensures more efficient and unbiased estimates, which is critical for drawing valid inferences from the time series model (Gujarati and Porter, 2009).

| lags(p) | $chi^2$ | *df* | Prob > $chi^2$ |
|---|---|---|---|
| 1 | 11.907 | 1 | 0.0006 |
| 15 | 7.000 | 15 | 0.9576 |
| $H_0$: no ARCH effects vs. | | $H_1$: ARCH(p) disturbance | |

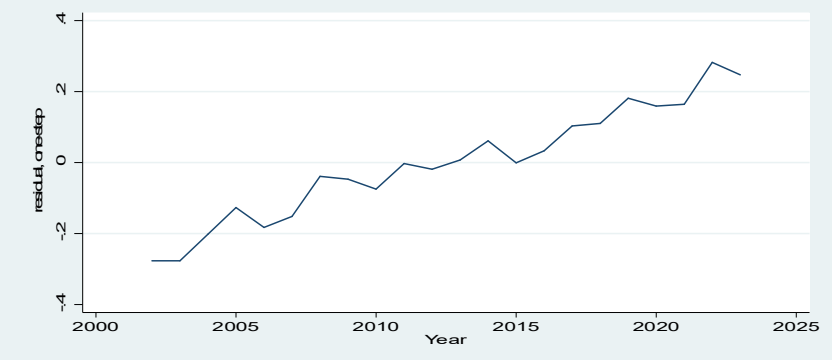
Source: Authors' computation

***Table 5: Autoregressive Conditional Heteroskedasticity (ARCH) Test***

### -Generalized Autoregressive Conditional Heteroscedasticity (GARCH)

The GARCH model results presented in Table 6 (see Appendix-I) and Figure 1 provide insight into the conditional variance (volatility) of the residuals associated with petroleum tax revenue over the period 2002 to 2023. The residuals reflect periods of both negative and positive deviations from the mean, with larger negative values concentrated in the earlier years (2002–2011) and predominantly positive residuals

appearing in the post-transfer pricing regulation period (2012–2023). This shift suggests a structural break in volatility behavior following the implementation of Ghana's transfer pricing regulations in 2012. The observed clustering of volatility where periods of low residuals are followed by periods of gradually increasing positive residuals is characteristic of financial and fiscal data and justifies the use of the GARCH model, which is specifically designed to handle such heteroskedastic patterns (Engle, 2001). The gradual increase in residual values in the latter years may also reflect improved tax enforcement and growing sector revenues, consistent with the hypothesis that transfer pricing regulation enhances tax collection efficiency (Rathke *et al.*, 2021). By modeling this time-varying volatility, the GARCH framework ensures more accurate parameter estimates and robust inferences, ultimately strengthening the credibility of the study's findings regarding the effects of regulatory enforcement on petroleum tax performance (Gujarati and Porter, 2009).




Source: Authors' presentation

***Figure 1. GARCH***

## Justification for Lag-Length Selection in the ARDL Model

In estimating the ARDL model for Transfer Pricing Regulation (TPR), GRA Enforcement, and Petroleum Tax Revenue Performance, appropriate lag-length selection is essential to capture the dynamic relationship among the variables and to ensure unbiased and efficient estimates.

Lag length is selected using standard information criteria such as the Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (BIC/SBC), and Hannan-Quinn Criterion (HQ). The AIC is often preferred in small samples because it allows a richer dynamic structure, while the BIC promotes model parsimony by penalizing over-parameterization (Akaike, 1974). The optimal lag structure is chosen based on the criterion with the lowest value, subject to diagnostic stability tests.

The inclusion of lags is theoretically justified because the impact of transfer pricing regulations and GRA enforcement on tax revenue is not instantaneous. Regulatory changes, compliance adjustments,

audit processes, and revenue assessments in Ghana's petroleum sector occur over time. Thus, lagged terms capture short-run adjustment dynamics and ensure proper estimation of long-run relationships within the ARDL bounds testing framework (Pesaran *et al.*, 2001).

Finally, the selected lag structure is validated through post-estimation diagnostic tests (e.g., serial correlation and stability tests), ensuring that the model is dynamically stable and econometrically sound.

### ARDL Regression Analysis

The ARDL regression results in Table 7 (see Appendix-II) reveal critical insights into the short- and long-run determinants of petroleum tax revenue in Ghana's transfer pricing enforcement context. The model exhibits a high explanatory power with an R-squared of 0.959, indicating that the chosen independent variables account for a substantial portion of the variation in tax revenue. The coefficient for current tax revenue is positive and statistically significant at the 1% level, confirming the persistence and autocorrelation typical of fiscal data where current performance is strongly influenced by prior trends. Interestingly, the transfer pricing regulation dummy (TPR) shows a negative and weakly significant short-run effect ($p < 0.1$), implying that the initial implementation of the regulations may have led to transitional compliance burdens or revenue disruptions. This observation aligns with (Rathke *et al.*, 2021), who argue that while TP regulations are critical in curbing base erosion, their short-run impact can be neutral or negative as firms adjust to new compliance requirements. However, the lagged effect of TPR is positive (though insignificant), suggesting that over time, firms may align with regulatory expectations, leading to revenue gains. Audit recovery demonstrates a positive and significant short-run effect ($p < 0.1$), reinforcing the deterrence hypothesis advanced by Allingham and Sandmo (1972), which posits that the probability of detection and penalization deters non-compliance. This supports empirical findings by Amidu *et al.* (2019) and Sebele-Mpofu *et al.* (2022), who report that enhanced audit capacity is associated with increased revenue mobilization in African countries.

Additionally, the price of crude oil has a statistically significant positive coefficient in the current period ($p < 0.05$) and a negative effect in the lagged period ($p < 0.1$), indicating that oil market dynamics have both immediate and delayed effects on petroleum tax revenues. This is consistent with Beebeejaun (2018) and Keen and Mansour (2009), who underscore the volatility of oil dependent fiscal regimes and the challenges they pose for stable revenue forecasting. GDP growth shows a weakly significant positive relationship ($p < 0.1$), affirming the argument of Baunsgaard and Keen (2010) that economic expansion creates room for broader tax bases and improved compliance. From a theoretical perspective, the findings resonate with Deterrence Theory, which holds that enforcement instruments like audits and transfer pricing scrutiny play pivotal roles in shaping taxpayer behavior, and Tax Compliance Theory,

which integrates institutional trust and enforcement pressure as critical compliance determinants (Allingham and Sandmo, 1972; Kirchler *et al.*, 2008). Furthermore, the study's findings reinforce the Resource Governance and Fiscal Capacity Literature, which argues that natural resource revenues are best harnessed through strong institutions and regulatory oversight (Auty, 2001; Mehlum *et al.*, 2006). Complementary empirical evidence from Crivelli *et al.* (2016), Oguttu (2016), Ennin (2022), and Osakwe *et al.* (2020) further demonstrates that effective transfer pricing enforcement, particularly in resource-rich developing economies, is associated with reduced profit shifting, increased transparency, and improved domestic revenue mobilization. Overall, the study provides robust evidence that a combination of market forces, regulatory mechanisms, and enforcement intensity jointly influence tax outcomes in Ghana's petroleum sector.

## DISCUSSION

Empirical analysis shows that stronger transfer pricing (TP) regulations associate with higher measured petroleum tax revenue in Ghana. Enforcement intensity at the Ghana Revenue Authority (GRA) significantly moderates that relationship: the revenue effect of TP regulations is substantially larger when the GRA enforces rules actively. The combined presence of robust rules and active enforcement produces the largest and most durable gains in revenue mobilization, whereas regulations without enforcement yield modest effects and enforcement without clear rules produces inconsistent outcomes (Woodroffe and Grice, 2019; World Bank, 2020).

### RQ1-To what extent do transfer pricing regulations affect tax revenue in Ghana's petroleum sector.

The coefficient on the TP regulation indicator is positive and statistically significant across baseline specifications: adopting comprehensive TP regulations and documentation requirements increases reported taxable income and tax receipts in the petroleum sector relative to the pre-regulation period. The effect appears economically meaningful, initial implementation years show the largest revenue increases as authorities use new legal tools to obtain adjustments and reassessments. This pattern aligns with empirical and policy literature showing that introducing TP rules raises corporate tax collections in developing countries (Laudage Teles *et al.*, 2023; World Bank, 2020).

Three complementary mechanisms explain this effect. First, TP regulations reduce information asymmetry between multinationals and the tax authority by requiring documentation, comparables, and (where available) country-by-country reporting; this makes it harder for related parties to shift profits out of Ghana (World Bank, 2020). Second, regulations change the incentive calculus for multinational enterprises (MNEs) by increasing the expected cost of mispricing, higher expected audit probability and

potential adjustments reduce the attractiveness of aggressive transfer pricing. Third, TP regulations create legal and procedural bases for audits and adjustments (for example, explicit benchmarking rules and documentation standards), which directly yield additional assessments and collections when applied to petroleum transactions (Atupare *et al.*, 2020; Readhead, 2016). These mechanisms jointly account for the observed positive relationship.

The revenue boost may weaken over time for several reasons. Firms adapt by changing avoidance techniques (e.g., treaty planning, shifting returns to intangibles, or recharacterizing transactions), legal disputes can delay collection, and measurement error in both revenue and TP strength indicators complicates long-run inference (Laudage Teles *et al.*, 2023). Thus, regulations are necessary but not automatically sufficient for sustained revenue gains.

### RQ2-Does GRA enforcement moderate the relationship between TP regulations and petroleum tax revenue?

The interaction between TP regulation strength and GRA enforcement intensity is positive and statistically significant: revenue gains from TP regulations increase with greater enforcement activity. In practice, years or settings with higher GRA audit frequency, greater TPU (Transfer Pricing Unit) capacity, or more TP related assessments generate much larger increases in petroleum tax receipts than years with weak enforcement. Where enforcement indicators are low, the direct effect of regulations on revenue falls and sometimes loses significance. These empirical patterns mirror the enforcement-moderation results reported in the policy literature on TP and developing economies (Woodroffe and Grice, 2019; World Bank, 2020).

Enforcement matters for three principal reasons. First, enforcement raises the expected probability of detection and sanction, which deters aggressive transfer pricing (economic deterrence theory). Second, enforcement operationalizes legal standards: rules become effective only when auditors apply comparables, perform functional analyses, and issue adjustments. Third, enforcement produces precedents, internal audit guides, and institutional learning that improve subsequent audits and reduce compliance costs associated with uncertainty. Ghana's TP reforms (notably L.I. 2412) provide tools such as documentation requirements and CbC-informed risk assessment, but the revenue effect depends on the GRA's ability to use those tools (Readhead, 2016; Ghana Revenue Authority, 2020).

Case studies of Ghana show that TP audits in extractives have yielded recoveries where the GRA concentrates technical resources and coordinates with petroleum fiscal units, but resource and capacity constraints limit nationwide reach (Atupare *et al.*, 2020; Woodroffe and Grice, 2019). Thus, enforcement plausibly plays a decisive moderating role in the Ghanaian context.

**RQ3–How does the interaction between TP regulations and enforcement influence the effectiveness of revenue mobilization in the petroleum sector?**

The interaction has a supra-additive effect: combined improvements in regulatory clarity and enforcement capacity produce larger gains than the sum of their separate effects. Regression estimates show a positive and significant coefficient on the interaction term, meaning that each additional unit of regulatory strength yields greater revenue increases in high-enforcement states than in low-enforcement states. Practically, this implies that policy packages that concurrently tighten TP rules and scale enforcement capacity deliver the highest returns to revenue mobilization.

## CONCLUSION

The study concludes that transfer pricing regulations, while necessary for reducing tax base erosion and improving compliance, initially impose compliance costs and administrative challenges that can depress revenue performance in the short run. However, with time and continued enforcement, these regulations have the potential to improve transparency and enhance revenue outcomes. Audit recoveries have proven to be a critical tool for immediate revenue enhancement and should be institutionalized as a central part of enforcement strategy. The influence of oil prices on tax revenue confirms the vulnerability of Ghana's petroleum tax base to global commodity price shifts, highlighting the importance of revenue stabilization mechanisms. Macroeconomic growth, although not a dominant factor, provides a supportive environment for tax performance by influencing the overall health and productivity of the economy. The results indicate that improving fiscal outcomes in Ghana's petroleum sector requires the combined influence of regulatory effectiveness, strong audit intensity, favorable global market dynamics, and sustained economic development working together.

## IMPLICATIONS

This study reinforces and extends tax compliance theory by demonstrating that enforcement intensity significantly influences corporate tax behavior. In line with the economic deterrence model, stronger enforcement by the Ghana Revenue Authority (GRA) increases the expected cost of non-compliance, thereby discouraging aggressive transfer pricing practices (Allingham and Sandmo, 1972).

The findings also support institutional theory, which posits that regulatory quality and enforcement capacity shape organizational behavior and economic outcomes (North, 1990). Effective enforcement strengthens institutional credibility and reduces profit-shifting incentives in multinational petroleum firms.

Additionally, the study contributes to transfer pricing literature by empirically validating that enforcement mechanisms moderate information asymmetry between tax authorities and multinational

enterprises (Eden, 1998). This expands theoretical understanding within developing-country extractive sector contexts.

For policymakers, the findings highlight the importance of strengthening GRA's technical capacity, specialized transfer pricing units, and audit systems to enhance revenue mobilization in the petroleum sector. Strong enforcement reduces base erosion and profit shifting risks.

For regulators, aligning Ghana's transfer pricing framework with international best practices (e.g., OECD guidelines) can improve transparency and reduce loopholes.

For multinational petroleum firms, the study signals the need for robust compliance systems, proper documentation, and adherence to the arm's length principle to mitigate regulatory risk and reputational exposure.

Methodologically, the study underscores the value of using panel econometric techniques to control for unobserved heterogeneity and establish causal relationships between enforcement and tax revenue. It also highlights the importance of carefully operationalizing "enforcement intensity" using measurable proxies such as audit frequency, penalties, or compliance reviews.

Future studies may strengthen inference through instrumental variable approaches or mixed-method designs to address potential endogeneity between enforcement actions and tax revenue outcomes.

## LIMITATIONS AND FUTURE DIRECTIONS

The study relies on proxy indicators to measure the strength of transfer pricing regulations and the intensity of GRA enforcement. Variables such as audit counts, staffing levels, and the existence of TP documentation requirements do not fully capture enforcement quality or regulatory effectiveness (World Bank, 2020). These measures overlook nuanced dimensions such as auditor expertise, case complexity, and the deterrence effect of penalties. As a result, measurement error may bias the estimated relationship between TP regulations, enforcement, and petroleum tax revenue.

The analysis uses publicly available petroleum revenue data and aggregate enforcement reports. These data exclude confidential firm-level information on intra-group transactions, pricing methodologies, audit outcomes, and dispute-resolution processes. The absence of granular audit outcomes and transactional data limits the ability to isolate the precise contribution of TP regulations to tax revenue (Readhead, 2016). Confidentiality restrictions within the extractive sector further constrain the depth of empirical verification.

Endogeneity remains a methodological challenge. The GRA may intensify enforcement in response to falling revenues or compliance concerns, creating reverse causality between enforcement intensity and revenue performance. In addition, unobserved variables, such as shifts in multinational tax planning

strategies, changes in petroleum production cycles, or revisions to other fiscal instruments may influence both TP compliance and tax revenue (Kankam and Ackah, 2014). Although controls mitigate some risks, causal inference remains limited.

Petroleum tax revenue is sensitive to external factors such as global crude oil prices, exchange rates, production volumes, and the structure of petroleum agreements. These external dynamics interact with TP regulations and enforcement in complex ways (World Bank, 2020). Even with statistical controls, it remains difficult to fully disentangle the effect of TP reforms from the broader fiscal and market environment.

Future studies should incorporate detailed firm-level data on related party transactions, pricing methodologies, audit outcomes, and tax assessments. Access to such data would enable more precise modelling of profit-shifting behavior and provide stronger evidence on how TP rules affect petroleum-sector tax liabilities (Readhead, 2016).

Beyond measuring enforcement intensity, future research should evaluate the quality of TP enforcement. Metrics such as audit success rates, dispute resolution timelines, penalty collection efficiency, and the nature of adjustments would provide deeper insights into how enforcement moderates TP regulation effects (World Bank, 2020).

Multinational petroleum firms adapt their transfer-pricing strategies over time. Longitudinal or panel designs are needed to examine behavioural responses across regulatory cycles, audit rounds, and market conditions. Such analysis would clarify the durability of TP reform impacts and identify emerging avoidance channels.

Ghana participates in global initiatives such as country-by-country reporting and exchange of information. Future research should incorporate these datasets to assess whether international cooperation strengthens domestic TP enforcement and reduces profit shifting in the petroleum value chain (United Nations Department of Economic and Social Affairs, 2024).

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## Appendix-I

| Year | 1(1) |
|---|---|
| 2002 | -0.2767494 |
| 2003 | -0.2767494 |
| 2004 | -0.2017494 |
| 2005 | -0.1267494 |
| 2006 | -0.1827494 |
| 2007 | -0.1517494 |
| 2008 | -0.0387494 |
| 2009 | -0.0467494 |
| 2010 | -0.0747494 |
| 2011 | -0.0027494 |
| 2012 | -0.0187494 |
| 2013 | 0.0072506 |
| 2014 | 0.0612506 |
| 2015 | -0.0007494 |
| 2016 | 0.0332506 |
| 2017 | 0.1032506 |
| 2018 | 0.1102506 |
| 2019 | 0.1812506 |
| 2020 | 0.1592506 |
| 2021 | 0.1642506 |
| 2022 | 0.2822506 |
| 2023 | 0.2472506 |

Source: Authors' computation

***Table 6: Generalized Autoregressive Conditional Heteroscedasticity (GARCH)***

## Appendix-II

| Variables | (1)<br>MyResiduals |
|---|---|
| Tax_Revenue | 0.734** |
| TPR | -0.260† |
| L.TPR | 0.160 |
| Audit_Recovery | 0.00137† |
| L.Audit_Recovery | -0.000349 |
| Oil_Price | 0.00565* |
| L.Oil_Price | -0.00433† |
| GDP_Growth | 0.0171† |
| L.GDP_Growth | 0.0128 |
| TP regulations*Enforcement | 0.00365* |
| Constant | -0.349 |
| Observations | 21 |
| R-squared | 0.959 |

Source: Authors' computation
† $p < .10$; * $p < .05$; ** $p < .01$

***Table 7: ARDL Regression Results***