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The Influence of Macroeconomics on GDP Growth

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ABSTRACT

This study investigates the relationship between macroeconomic factors and GDP Growth, with a focus on their collective impact on GDP growth across 185 countries from 2001 to 2022. Utilizing a panel data approach, this research explores how variables such as Aggregate Effective Tax Rate (AETR), Statutory Tax Rate (STR), Employment Growth (EG), Population (P), Control of Corruption (COC), and Tax Visit (TV) affect economic performance. The Fixed Effects Model is selected as the most appropriate estimation technique based on Chow and Hausman tests. The results reveal that AETR, EG, and P have significant positive effects on GDP growth, indicating that effective tax collection, labor expansion, and demographic growth are key drivers of macroeconomic performance. In contrast, STR, COC, and TV are found to have no statistically significant influence. Furthermore, Random Forest analysis identifies Population, Employment Growth, and Control of Corruption as the most important predictors, while model refinement shows that excluding the TV variable improves explanatory power. These findings suggest that tax policy effectiveness relies more on enforcement and demographic support than on nominal tax rates alone. The study offers insights for policymakers to design tax systems that align with broader economic goals and institutional capacities.

Keywords: Macroeconomics, GDP Growth, Random Forest

INTRODUCTION

Macroeconomics exists because it is important for understanding and managing the economy, including markets, businesses, consumers, and government. This can be interpreting changes in economic output, inflation, interest rates, foreign currency exchange rates, and balance of payments on a global scale (Mankiw, 2009). Apart from this definition, macroeconomics examines economic phenomena such as price levels, inflation, national income, economic growth rates, gross domestic product (GDP), and changes in unemployment (Blanchard & Johnson, 2013). Also, it primarily focuses on the economy, such as buyers, sellers, and owners of any business.

Gross Domestic Product (GDP) growth is a fundamental indicator of a nation's economic performance and development (Shevlin et al., 2019a). As economies strive for sustainable growth, the role of macroeconomic variables becomes increasingly central in shaping policy outcomes. Among these, fiscal and demographic indicators such as the Aggregate Effective Tax Rate (AETR), Statutory Tax Rates, Employment Growth, Population, Control of Corruption, and Tax Visits are pivotal in influencing the direction and magnitude of GDP growth.

The relationship between taxation and economic growth is particularly crucial. The Aggregate Effective Tax Rate (AETR) represents the actual tax burden experienced by firms and households, reflecting the efficiency and fairness of a country's tax system (Shevlin et al., 2019a). In parallel, Statutory Tax Rates serve as formal benchmarks set by governments, influencing investment decisions, business expansion, and ultimately, economic output. An overly

burdensome or poorly designed tax system can deter entrepreneurship and slow GDP growth, while an efficient structure may foster a favorable business climate and boost economic activity.

Employment Growth is another essential determinant of GDP expansion. As more individuals are employed, productivity and consumption tend to increase, fueling further economic development. Meanwhile, Population size determines the labor force and consumption potential of a country; a growing population can enhance GDP growth if matched with sufficient employment and infrastructure.

Institutional quality, captured by Control of Corruption, significantly affects economic growth. Corruption distorts market mechanisms, undermines public trust, and misallocates resources, all of which can hamper economic performance. Strong governance and low corruption levels contribute to a more stable and attractive environment for investment and production.

Finally, Tax Visits, referring to the frequency and intensity of tax authority interactions with taxpayers, play a dual role (Besley & Persson, 2014). While effective audits and enforcement can improve compliance and revenue, excessive or arbitrary visits may discourage business activities and hinder growth. Balancing enforcement with taxpayer trust is essential for a tax system that supports rather than inhibits economic growth.

Given these dynamics, this study aims to explore the multifaceted influence of key macroeconomic factors on GDP growth. By analyzing the interaction between taxation, labor, population dynamics, and institutional quality, the research seeks to provide comprehensive insights into how these elements collectively shape a country's economic trajectory.

LITERATURE REVIEW

Real GDP Growth

Gross Domestic Product Growth (GDPG) is used as a measure of economic growth. Specifically, it refers to Real GDP growth, which represents the proportional annual change in real GDP, adjusted for inflation, and measured at constant prices (Shevlin et al., 2019b). It includes the sum of consumer spending, government expenditures, business investments, and net exports (exports minus imports). GDP serves as a key indicator of economic health, providing insights into the size and performance of an economy. It helps policymakers, economists, and businesses make informed decisions about fiscal policies, investment strategies, and economic planning. A growing GDP generally signifies a thriving economy, while a shrinking GDP may indicate economic challenges. Applying reasonable standards, such as management standards, product standards, and measurements, directly affect productivity (Delmas & Pekovic, 2013).

Aggregate ETR

The Aggregate Effective Tax Rate (AETR) is defined as the total asset-weighted average of firm-level cash effective tax rates (ETR) for publicly listed firms in a country (Shevlin et al., 2019b). Also referring to the overall effective rate of taxation imposed on a corporation's income (Watson & McBride, 2021). This measure encompasses all types of taxes that a corporation might face, including federal, state, local, and international taxes, and provides a comprehensive picture of the total tax burden on the corporation. It provides a comprehensive view by combining taxes

from different income streams and divided by total income. This method helps individuals also companies assess their total tax liability and compare the tax efficiency.

Saez analyzed data from multiple OECD countries, focusing on the impact of Aggregate ETR on the GDP growth over the period from 1980 to 2009. The study concentrated on the corporate sector and utilized econometric modeling techniques, and the findings indicated that higher Aggregate ETR generally results in higher GDP growth. In conclusion Aggregate ETR has a positive impact on GDP growth (Diamond & Saez, 2011).

Alfo et al. utilized a sample comprising data from several countries from OCED. The analysis covered a period from 1965 to 2010, focusing on national economic growth across multiple sectorsr and examining how Aggregate Effective Tax Rate (ETR) influences GDP growth. The study finds that taxation has a generally negative impact on GDP growth. Specifically, a 10% cut in the corporate income tax rate is associated with a 0.9% increase in the GDP growth rate, while a 10% cut in the personal income tax rate leads to a 1% increase in GDP growth. In conclusion aggregate ETR has a negative impact on GDP growth (Alfo et al., 2020).

Arnold conducted analysis using data from 35 OECD countries. The analysis spans studies published from 1995 until 2019, and focused primarily on the Aggregate economy, examining how changes in Aggregate ETR affect GDP growth. Using Empirical analysis using regression, the study results revealed a strong positive relationship between Aggregate ETR and GDP Growth (Arnold, 2008).

H1: AETR has a positive significant association on GDPG

Statutory Tax Rate

Statutory corporate income tax rates (STR) are defined as the top marginal corporate tax rate established by law in a country (Shevlin et al., 2019b). It show the headline tax rate faced by corporations and can be used to compare the standard tax rate on corporations across jurisdictions and over time (OECD, 2024). Unlike the effective tax rate, which considers deductions and credits to calculate the actual rate paid, the statutory tax rate is the percentage set by law that applies to a company's or individual's income or profits before any adjustments.

Mertens analyze data from U.S. economy, and the study draws from corporate tax data from 1946 until 2012. The analysis spans individual income taxation, using Time-series analysis high-frequency data to evaluate the impact of statutory tax rate on GDP growth. The result concludes that statutory tax rates have a significant impact on GDP growth, higher statutory tax often lead to lower GDP growth. Therefore, there is negative impact of statutory tax rate on GDP growth (Mertens & Montiel Olea, 2018).

Nguyen et al. analyze data from United Kingdom focuses on U.K. economy, the data taken from 1973-2009, and focuses on the individual and corporate income taxes sectors. Using Time-series analysis, the study results that higher statutory corporate tax rates would lead to lower GDP growth. Therefore, there is negative impact of statutory tax rate on GDP growth (Nguyen et al., 2020).

Hassett and Mathur's used a sample covering 72 countries, focusing on both OECD and non-OECD countries, the data was taken from 1980 to 2005, and the analysis focuses on corporate sectors. The study found that lower statutory corporate tax rates are strongly associated with higher economic growth. The result revealed there is a positive impact of statutory tax rate on GDP growth (Hassett & Mathur, 2015).

H2: STR has a negative significant association on GDPG

Employment Growth

Employment growth is defined as the annual percentage change in population employed within a country from year to year (Shevlin et al., 2019b). Also referred to the number of increase jobs available in an industry over a specific time (Borjas, 2013). It can be measured at various levels, such as regional, national, or industry specific. When the number of employment growth positive, it means that more jobs are available, which means company expanding the economy. Whereas negative growth of employment means that the company has economic trouble in the job market. This growth can be affected by business expansion, increased demand, or technological advancement.

Bassanini et al. utilized a sample covering 21 OECD countries. The analysis covers data primarily from 1980 to 2003 and examines mmultiple sectors, including manufacturing and services. Panel data analysis with fixed effects was used. Employment growth had a positive and significant impact on GDP growth, especially in economies with more flexible labor markets and active employment policies. This suggests that labor market policies are crucial for fostering both employment and economic growth. (Bassanini & Duval, 2006).

Kapsos analyze data from around the world, with a focus on developing and developed nations from 1991 to 2003. The study examined all sectors across the world. Using Cross-country Regression Analysis. The study finds a robust positive relationship between employment growth and GDP growth, especially in developing countries where employment elasticity to GDP was higher. Kapsos suggests that employment is key to driving growth in less developed economies. In conclusion employment growth has a positive impact on GDP growth (Kapsos, 2006).

Feldstein analyze data from U.S. Economy over the period from 1970 to 2007 to assess the impact of employment growth on GDP growth. The study focused on Various sectors, primarily focusing on the labor market. Feldstein found that in certain cases, rapid employment growth, particularly in low-productivity sectors, can have a negative effect on GDP growth. The study highlights how employment growth in less productive industries or sectors that offer lower wages can drag down overall GDP growth by diverting resources away from more productive, higher-value sectors. The study concludes that the quality of employment plays a significant role in determining whether employment growth contributes positively or negatively to GDP growth. In conclusion employment growth has a negative impact on corporate tax (Feldstein, 2008).

H₃: Employment growth has a positive significant association on GDPG

Population

Population usually refers to the total number of people living in a given country or region at a certain time, impacting factors like labor supply and market size (Shevlin et al., 2019b). In economic studies, the term population refers to the entire group of individuals or entities that researchers aim to analyze, which can include specific demographics, regions, or economic sectors. This concept encompasses both the population of interest, the exact group under study, and the statistical population, the broader set from which samples may be drawn. Understanding the population is essential for accurate data collection and analysis, ensuring that conclusions about economic trends or behaviors are valid and representative.

Lee and Mason analyze cross country comparison using global data and the data taken from 1994 - 2004. The study focuses on general economy sector, and uses empirical estimation based on panel data. The outcome of the study is population growth can spur economic growth in the short term by increasing the labor supply, but the long-term impact depends on how much a country invests in education and human capital. In conclusion, population growth has positive impact on GDP growth (R. Lee & Mason, 2010).

Abebaw analyze the relationship between population and GDP growth using data from Ethiopia, the data taken from 1981 to 2018 and focuses on general economy. The study uses long run econometric modelling. The result of the study is a long-term positive effect of population growth on GDP growth in Ethiopia, showing that, with appropriate policies, population growth can spur economic development. In conclusion, population has positive impact on GDP growth (Abebaw, 2019).

Ali et al. analyze data from Pakistan economic data over the period of 1975 – 2008. The study focuses on general economy sector and uses Granger causality test and econometric analysis method. The result of this study is population growth initially supports economic growth, uncontrolled growth without corresponding investments in infrastructure and human capital leads to negative long-term effects. In conclusion, population has negative impact on GDP growth (Ali et al., 2013).

H₄: Population has positive significant association on GDPG

Control of corruption

Corruption is referring to the effectiveness of institutions and governance mechanisms in preventing and mitigating corruption within both public and private sectors (Shevlin et al., 2019b). It's generally described an exploitation using public power for personal benefit (Qureshi et al., 2021). Corruption control refers to the measures and strategies implemented to prevent, detect, and address corrupt practices within organizations, governments, or societies. It involves creating robust systems of transparency, accountability, and enforcement to combat bribery, fraud, and other forms of misconduct. Effective corruption control typically includes mechanisms such as audits, ethical guidelines, whistleblower protections, and legal frameworks designed to deter unethical behavior and ensure integrity.

Huang analyze the relationship between control of corruption and GDP growth using a sample of publicly listed firms from 21 countries from, primarily focusing on Asia – pacific region over the period from 1990- 2013. Huang focuses on general economy section and uses panel data regression. The study found that corruption has an impact on economic growth in developing countries, where it weakens institutions and lowers investment. Strong control of corruption correlates with higher growth rates by fostering trust in institutions and increasing investment flows. So, there is positive impact of control corruption on GDP growth (Huang, 2016).

Pulok and Ahmed analyze data from Bangladesh and other South Asian countries, period over 1995 to 2015. The study focuses on public sector and general economy and uses dynamic panel data model. The study showed that corruption in developing countries like Bangladesh has a negative impact on growth by undermining government effectiveness and reducing public sector efficiency. So, there is negative effect of control corruption on GDP growth (Pulok & Ahmed, 2017).

Gründler & Potrafke study uses data for 175 countries, covered a global dataset that includes countries from various regions across the world. The data covers the period from 2012 to 2018 and focuses on the public sector and its perceived corruption levels and their impact on economic growth. The study uses dynamic panel data model, the result finds that an increase in corruption, as measured by the reversed CPI (Corruption Perception Index), has a significant negative effect on economic growth. So, it concludes that control corruption has negative impact on GDP growth (Gründler & Potrafke, 2019).

H5: Control of corruption has a negative significant association on GDPG

Tax Visit

A tax visit typically refers to official audits or inspections conducted by tax authorities to ensure compliance with tax regulations (Shevlin et al., 2019b). During a tax visit, tax officials examine financial documents, verify reported income and expenses, and assess adherence to tax regulations to ensure accuracy and prevent tax evasion.

Lee & Gordon study uses cross-country data. They focus on OECD countries, the data taken from 1970 to 1997, and the research covers a corporation taxation sector. The study uses panel data analysis to focus on tax visits and corporate tax. The study finds higher corporate tax rates correlate with reduced GDP growth rates. So there is negative impact of tax visit on corporate tax (Y. Lee & Gordon, 2005).

Gemmell et al study the effects of tax rates on economic growth within the OECD, using panel data from various sectors, primarily over the 1990s and early 2000s. The study employs dynamic panel estimation technique. In conclusion that corporate taxes have the strongest negative impact on GDP growth (Gemmell et al., 2014).

Bucci et al. investigates broader determinants of growth, including tax policy, in both high-income and middle-income countries. Using data from 2000–2015, the study uses a a mixed-effects model, which allows for both fixed and random effects, to capture country-specific influences on economic growth. The results confirmed highlight that tax policies encouraging

competitive markets positively influence economic growth. So, there is a positive effect of tax visit on GDP growth (Bucci et al., 2021).

H₆: Tax visit has a negative significant association on GDPG

METHODOLOGY

Data

The data used in the study spans from 2001 to 2022 from world countries. The dataset covers a broad spectrum of 185 countries, representing a substantial portion of the 195 countries worldwide (BBC Science Focus, 2023). This data cover yearly from 2001 to 2022. The data is taken from World Bank Database and Tax Foundation. The data is winsorized at 1% to reduce bias (Shevlin et al., 2019b).

Empirical Model

The regression model that will be used in this study is (Shevlin et al., 2019b).

$$GDPG_{it+1} = \alpha + \beta_1 AETR_{it} + \beta_2 STR_{it} + \beta_3 EG_{it} + \beta_4 P_{it} + \beta_5 COC_{it} + \beta_6 TV_{it} + \beta_7 CFE_{it} + \beta_8 YFE_{it} + \epsilon_{it+1}$$

Table 0-1 Variables

Variable	Definition	Formula
GDPG	GDP Growth is a measure of country's overall economic activity.	The data taken from World Bank
AETR	Aggregate ETR is an actual tax paid on each dollar of income, considering tax credits, and other factors that affect from the statutory tax rate.	The data taken from World Bank
STR	Statutory Tax Rates established by law for taxable income.	The data taken from Tax Foundation
EG	Employment Growth is a business metric that measures the percentage change in a company's headcount (total number of employees) over a specific period.	$Employment\ Growth = \dfrac{Ending\ number - Beginning\ number}{Beginning\ number\ employees} \times 1$
P	Population refers to the log of total number people residing in a country at a given time (in Million).	The data taken from World Bank and will be transform into log
COC	Control of Corruption is a measures and strategies implemented to prevent, detect, and address corrupt practices within organizations, and governments.	The data taken from World Bank

Variable	Definition	Formula
TV	Tax visit function is to audit ensure compliance with tax laws and regulations.	The data taken from World Bank

RESULTS

Descriptive Statistics

This chapter provides descriptive statistics for six variables: Aggregate Effective Tax Rate (AETR), Statutory Tax Rate (STR), Economic Growth (EG), Population (P), Control of Corruption (COC), and Tax Visit (TV). These statistics include the mean, standard deviation, median, minimum, and maximum values, allowing for a better understanding of each variable's distribution and variability.

Table 0-1 Descriptive Statistics

Variable	Mean	Std. dev.	Median	Min	Max
GDPG	3.1169	4.6650	3.3463	-13.7394	17.3280
AETR	9.4973	9.6920	9.3746	0	33.5467
STR	21.7120	11.9041	25.0000	0	40.0000
EG	1.5226	2.0031	1.4347	-4.3879	8.2972
P	1.3087	2.4095	1.7973	-4.4012	7.0231
COC	-0.0077	0.9407	-0.0481	-1.6043	2.2472
TV	0.1701	0.6450	0	0	3.6000

The mean GDP growth rate is 3.116%, which indicates moderate average economic growth across the dataset. However, the high standard deviation of 4.665 suggests that GDP growth rates vary substantially among observations. This variation is further highlighted by the range, with a minimum of -13.739% and a maximum of 17.328%. The presence of such extreme values indicates that some countries or periods may have experienced economic shocks, such as recessions or rapid growth spurts. The median GDP growth is 3.346%, which is close to the mean, suggesting a symmetric distribution in growth rates for most observations. However, the outliers are likely to contribute to the high variability, making GDPG an essential variable to investigate when analyzing economic performance differences.

The mean AETR is 9.497%, representing the aggregate effective tax rate across different countries or regions. The high standard deviation of 9.692 indicates substantial variation, with AETR values ranging from 0% to a maximum of 147.64%. This wide range suggests that certain observations might benefit from complete tax exemptions, while others face extremely high effective tax rates, possibly due to specific country policies or tax burdens. The median of 9.374% is similar to the mean, showing a relatively balanced distribution in effective tax rates. The high maximum value is notable and could reflect cases with exceptionally high tax liabilities relative to income, perhaps due to unique tax structures or extraordinary circumstances.

The mean statutory tax rate is 21.712%, which reflects the average nominal tax rate that governments set in different jurisdictions. The standard deviation is 11.904, showing considerable variation in statutory tax rates, with a minimum of 0% and a maximum of 40%. This range captures the differences in tax policies, with some countries setting high statutory tax rates while others impose very low rates or even exemptions. The median statutory tax rate is 25%, slightly higher than the mean, suggesting that most countries have statutory tax rates around this level. The variation in STR indicates that statutory rates can differ significantly depending on fiscal policy decisions, with countries using different approaches to tax corporate or individual income.

The mean employment growth rate is 1.522%, suggesting modest growth in employment across the observations. The standard deviation of 2.003 indicates substantial differences in employment growth rates, with values ranging from -4.387% to a maximum of 8.297%. The minimum value of -100% suggests some extreme cases where employment contracted sharply, possibly due to economic crises or structural changes in the labor market. The median employment growth is 1.435%, close to the mean, which shows that employment growth is generally centered around low single-digit percentages. However, the extreme minimum and maximum values imply that employment growth can vary widely, likely reflecting country-specific economic conditions or labor market policies.

The mean population size across observations is 1.308 million, but the standard deviation of 2.409 highlights a significant disparity in population sizes. The range is also wide, with the smallest population at -4.401 million and the largest at 7.023 million. The median population is 1.797 million, which is considerably lower than the mean, indicating that the distribution is skewed by a few very large countries. This suggests that while most observations represent smaller populations, a handful of highly populous countries (such as China or India) disproportionately impact the average. Such variation in population size is critical for comparative studies, as large differences in population may affect economic indicators and tax revenue potential.

The mean value for control of corruption is -0.0077, suggesting a slight average inclination toward negative values in control of corruption. The standard deviation of 0.940 indicates relatively modest variability compared to other variables, with values ranging from -1.604 to 2.247. A median of -0.0481, close to zero, indicates that the control of corruption scores is relatively balanced, with some countries scoring positively (indicating better control) and others negatively (indicating poorer control). This variable is essential in understanding governance quality, as higher corruption levels can affect economic performance and tax compliance, influencing other economic metrics.

The mean tax visit frequency is 0.170, and the median is 0, suggesting that most observations report little to no tax visits. The standard deviation of 0.645, coupled with the maximum value of 3.60, implies that while tax visits are generally infrequent, there are outliers where tax visits are more common. The high maximum value could indicate that in some jurisdictions, tax authorities may conduct frequent inspections or audits, possibly enforce tax

compliance. The distribution of tax visits is skewed, with most observations clustered around zero, but a few outliers suggest a considerable variation in enforcement intensity across the dataset.

Results and Interpretation

The table summarizes the results of factors influencing GDPG. Several independent variables AETR, STR, EG, P, COC, and TV are tested to see their effects on GDPG. Driscoll-Kray standard errors are used to address all diagnostic problems. The panel model is fixed effect.

Table 0-2 Regression Results

Independent Variable	GDPG	
	Coef	p-value
AETR	0.0232	0.01293*
STR	-0.0088	0.40186
EG	0.6538	0.00069*
P	0.0040	0.00000*
COC	-0.3773	0.28880
TV	0.0753	0.72670
Adj. R-Squared		0.0724
Prob>F		0.0000

The Adjusted R-Squared (R^2) value in this model is 0.0724 (7.24%), indicating that the independent variables collectively explain only 7.24% of the variation in GDP growth (GDPG). This suggests that the model has relatively low explanatory power, meaning other external factors not included in the model may have a more significant impact on GDPG. Compared to the reference journal, where the Adjusted R^2 was reported as 8%, the current model has a slightly lower explanatory power. The difference could be due to variations in data, sample size, or additional variables included in the reference study. Despite the low Adjusted R^2, the Prob > F value of 0.00 indicates that the overall regression model is statistically significant. A p-value of 0.00 (typically interpreted as $p < 0.05$) suggests that at least one of the independent variables is significant when considered together.

AETR shows a positive effect on GDPG (coefficient = 0.0232, p = 0.01293). Therefore, Hypothesis H_1 is supported. This result suggests that an increase in the effective tax rate contributes to economic growth, potentially through improved government revenue allocation. The previous studies (Shevlin et al., 2019b) found a negative impact, this result might indicate a different tax structure or economic environment. This finding aligns with taxation and public finance theories (Kaplow, 2008), which state that efficient tax collection enhances public services and infrastructure, leading to GDPG.

Policymakers should ensure tax rates are set at a level that maximizes revenue without discouraging investment and productivity. Setting optimal tax rates is a delicate balancing act, rates that are too high can deter private investment, reduce entrepreneurial activity, and encourage tax avoidance or evasion, while rates that are too low may lead to insufficient public revenue to finance essential services and infrastructure.

STR has no impact on GDPG (coefficient = -0.0088, p = 0.40186). Therefore, H_2 is not supported. Although the coefficient suggests that higher statutory tax rates may reduce economic growth by discouraging investment and consumption, the p-value indicates that this result is not statistically significant. Previous research by Shevlin et al. (2019a) often associates higher tax burdens with lower economic expansion due to reduced disposable income and business profits (Shevlin et al., 2019b). Romer, finds that economies with higher tax revenues relative to GDP have lower fiscal crises risks, leading to stable economic growth (Romer & Romer, 2010).

Governments should carefully structure tax policies to remain competitive in attracting businesses while ensuring sufficient public revenue. In an increasingly globalized economy, capital is highly mobile, and businesses often choose to invest in jurisdictions with favorable and predictable tax regimes. Therefore, a well-designed tax policy must strike a balance between competitiveness and fiscal sustainability.

EG has a positive and significant impact on GDPG (coefficient = 0.6538, p = 0.00069). Therefore, H_3 is not rejected. This result highlights the crucial role of employment in driving GDPG, as more jobs lead to higher consumer spending, increased productivity, and industrial development. Thum-Thysen & Vandeplas study finds that countries with more skill-aligned employment experience higher GDP growth, while countries with a mismatch see weaker growth (Thum-Thysen & Vandeplas, 2019). Burggraeve et al. (2015) study indicates that while employment growth can lead to economic growth, it can also result in negative outcomes such as increased informal employment and underemployment, which may not contribute positively to GDP growth (Burggraeve et al., 2015).

Governments and businesses should implement policies that foster job creation, such as skills training, business incentives, and labor market reforms, to sustain economic growth. A dynamic labor market is crucial for inclusive and sustainable development, particularly in economies experiencing demographic shifts or technological transformation. One effective strategy is to invest in education and upskilling programs that align with industry demands, thereby reducing skills mismatches and increasing employability.

P also has a positive and significant effect on GDPG (coefficient = 0.0040, p = 0.00000). Therefore, H_4 is not rejected. This suggests that a growing population contributes to economic expansion, likely due to a larger workforce and increased consumer demand. This finding is consistent with research showing that population growth, when managed well, drives economic progress. The previous study, Shevlin said that a larger population can lead to a larger labor force, which may positively impact GDP growth (Shevlin et al., 2019). This study from Headey and Hodge examines the relationship between population growth and economic growth over the world, finding that high population growth can lead to lower per capita income growth due to increased competition for jobs and resources (Headey & Hodge, 2009).

Governments should ensure that population growth translates into economic benefits by investing in education, healthcare, and employment opportunities. A growing population, particularly in countries with a high proportion of young people, presents both a challenge and an opportunity. If managed well, it can lead to a demographic dividend, where a larger working-age

population contributes to increased productivity and economic growth. To harness this potential, governments must prioritize investment in quality education and skills development, equipping the workforce with competencies relevant to a changing labor market.

COC has no impact on GDPG (coefficient = -0.3773, p = 0.28880). Therefore, H_5 is not supported. This result contrasts with previous studies from Shevlin et al. (2019) that typically show a negative relationship between reducing corruption and economic growth (Shevlin et al., 2019). Other studies has found that, countries with lower levels of corruption tend to attract more FDI, as investors seek stable and transparent environments for their investments (Cieślik & Goczek, 2018). One possible explanation is that in some economies, informal or corrupt practices might facilitate business operations, especially where bureaucratic inefficiencies exist.

The managerial implication is that while anti-corruption measures remain essential for long-term development, policymakers should ensure that reforms are accompanied by improvements in bureaucracy, transparency, and business facilitation. Efforts to curb corruption – such as stricter enforcement, independent oversight bodies, and legal reforms – are critical, but their effectiveness can be undermined if not supported by a broader institutional framework that promotes efficiency and accountability.

Lastly, TV has no impact on GDP growth (coefficient = 0.0753, p = 0.72670). Therefore, H_6 is not supported. This suggests that more frequent tax visits may contribute to economic expansion by improving compliance and tax revenue collection. However, since the p-value is not significant, this effect is uncertain. Vermeer found that a reduction in tax rates has a positive impact on economic growth by stimulating overall economic activity. Empirical studies indicate that a one-percentage-point decrease in taxes as a share of Gross Domestic Product (GDP) can lead to a 0.6% increase in GDP within the first quarter, with a more significant long-term effect of 2.5% growth over three years. These findings emphasize that lower tax policies can serve as a positive stimulus for GDP growth by enhancing investment and consumer spending (Vermeer, 2022). Belnap found that tax visits negatively impact GDP growth, particularly for small businesses that undergo tax audits. These businesses, especially those with a history of underreporting taxes, are more likely to shut down after an audit. The study also revealed that audited firms experienced a 21.8% decline in revenues in the years following the audit (Belnap et al., 2024).

The managerial implication is that tax authorities should implement a balanced approach, ensuring compliance without creating excessive burdens on businesses. Achieving this balance requires tax authorities to design and enforce policies that are not only effective in generating revenue but also considerate of the operational realities that businesses face. One approach is to simplify the tax code, reducing administrative complexities that disproportionately affect small and medium-sized enterprises (SMEs). By offering clear guidelines, streamlined reporting processes, and accessible support, tax authorities can help businesses comply with tax regulations without diverting excessive resources toward tax-related tasks.

In conclusion, the model highlights the importance of AETR, EG, and P as significant drivers of GDP growth. Variables such as STR, COC, and TV, while theoretically relevant, did not demonstrate statistical significance in this context. These findings emphasize the need for

policy approaches that combine effective tax collection, job creation, and demographic planning, rather than focusing narrowly on nominal tax rate adjustments or audit frequency.

Improve Model Performance with Random Forest

Using random forest test to estimate all variable importance in the macroeconomic factors. To conduct random forest regression, mtry and ntree are involved. The formula of mtry is the square root of the number of independent variables (Breiman, 2001).
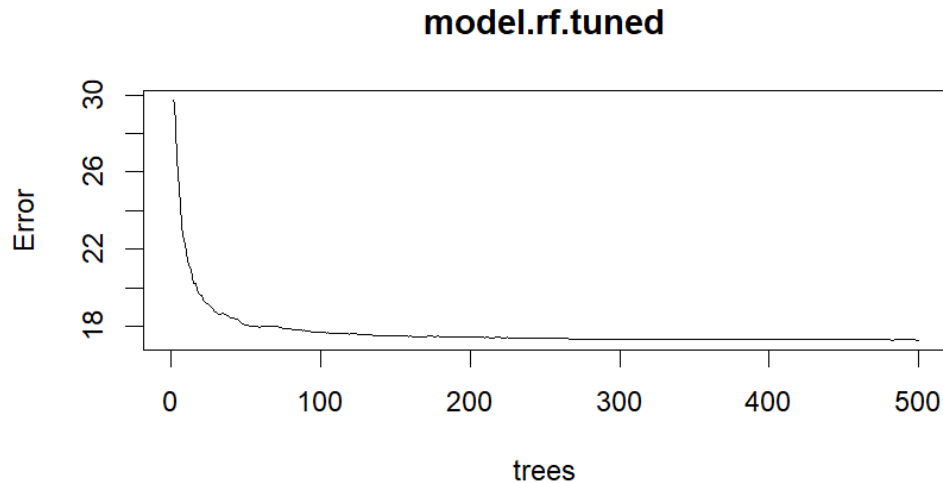
model.rf.tuned

Figure 0-1 Out of Bag Error

The figure above tells that after 500 trees, the Out of Bag error stabilizes, indicating that adding more trees does not significantly improve the model's accuracy. This is typical for random forests, as they tend to reach a point where additional trees yield diminishing returns on reducing error.

Figure 0-2 Tuned Random Forest Mtry
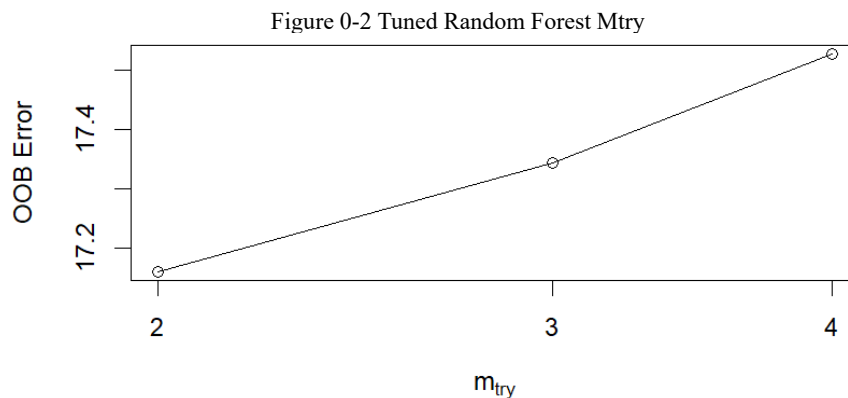
The initial discussion will focus on using a parameter setting of mtry equal to 3 in the context of a Random Forest model. This setting allows the model to randomly select 3 features at each split when constructing the decision trees, providing a baseline for understanding the model's performance and its ability to capture the underlying patterns in the data. Following this, the data will fine-tune the model by adjusting the mtry parameter to 2. This adjustment aims to enhance

the model's predictive accuracy by allowing it to consider a broader set of features during the training process. By comparing the results from both mtry settings, we can assess the impact of this parameter on the Random Forest model's effectiveness and make informed decisions about the optimal configuration for our analysis.

Table 0-3 Random Forest RMSE

Random Forest	RMSE Before Tuned	4.1603
	RMSE After Tuned	4.1343

The table presents the variable importance rank from a Random Forest model, which measures the contribution of different factors in predicting GDP Growth (GDPG). A higher importance rank indicates a stronger influence on the model's predictive accuracy.

Table 0-4 RF Variable Importance
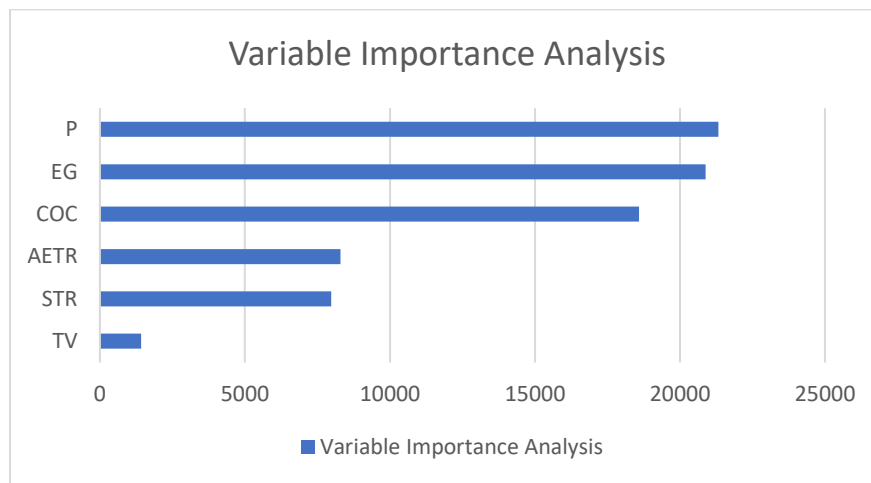
Based on Table 4-9, the order of variable importance analysis are P, EG, COC, AETR, STR, and lastly TV. The most important variables are P, EG, and COC.

Table 0-5 Model Improvement Scenarios

No	Scenarios	Independent Variables	Adj. R^2
1	Original Model	AETR + STR + EG + P + COC + TV	0.0724
2	3 Variables used	AETR + STR + EG	0.0633
3	4 Variables used	AETR + STR + EG + P	0.0675
4	5 Variables used	AETR + STR + EG + P + COC	**0.0735**
5	Without COC	AETR + STR + EG + P + TV	0.0713

Based on the Model Improvement scenarios, the best Adj. R^2 value was obtained by the new model, which is without TV variables. In conclusion, the best-performing model is Scenario 4, which excludes the TV variable while retaining all other predictors. This configuration yields the highest Adjusted R² and is therefore considered the most suitable model specification for subsequent analysis.

CONCLUSION

This study aims to examine the impact of macroeconomic variables and corporate tax policy indicators on GDP growth using panel data from 185 countries over the period 2001–2022. The independent variables included in the model are Aggregate Effective Tax Rate (AETR), Statutory Tax Rate (STR), Employment Growth (EG), Population (P), Control of Corruption (COC), and Tax Visit (TV), with GDP growth as the dependent variable. The estimation results are derived using the Fixed Effects Model, which was selected as the most appropriate panel data model based on the Chow and Hausman tests. Diagnostic testing further identified the presence of heteroskedasticity, autocorrelation, and cross-sectional dependence, all of which were addressed to improve the model's validity.

The empirical findings reveal that AETR, EG, and P have a significant and positive effect on GDP growth. This result suggests that effective tax collection, employment expansion, and population growth are important factors in stimulating macroeconomic performance. In contrast, STR, COC, and TV do not show statistically significant effects on GDP growth. The insignificance of STR implies that changes in headline tax rates may not directly influence economic performance unless they are accompanied by corresponding structural reforms or improvements in tax administration. The insignificant role of COC and TV in the model may indicate that institutional and enforcement quality varies widely across countries, thus limiting their measurable impact in a global panel context.

Furthermore, the model improvement analysis suggests that excluding the TV variable produces the highest Adjusted R^2 (0.0735), indicating a marginal yet measurable enhancement in model performance. Additionally, machine learning analysis using the Random Forest algorithm highlights that Population, Employment Growth, and Control of Corruption are the most influential predictors of GDP growth, reinforcing the role of demographic and institutional factors in driving macroeconomic outcomes.

This study provides insights into the relationship between macroeconomic variables and GDP growth. However, several avenues remain open for future research. First, future studies are encouraged to incorporate additional explanatory variables such as inflation, interest rates, foreign direct investment (FDI), political stability, or ease of doing business. These factors may offer a more holistic view of the determinants of GDP growth. Second, this study assumes linear relationships among variables; therefore, future researchers could explore non-linear models or interaction effects to uncover more complex dynamics. For example, the influence of population on GDP may depend on levels of employment or governance quality. Furthermore, qualitative or mixed-method approaches, such as country-specific case studies, may complement statistical analysis by capturing institutional or historical context that numbers alone cannot fully explain. Lastly, improvements in data accuracy and consistency particularly for variables such as Tax Visit and Control of Corruption are essential. Future researchers should seek more standardized data sources or construct alternative proxies to enhance measurement validity. Addressing these aspects

would significantly enrich future studies and improve the explanatory power of empirical models examining macroeconomic and fiscal policy interactions.

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