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Sectoral and Policy Shocks on Corporate Tax Revenues in Colombia: A VAR Analysis (1995–2023)

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Research article

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Abstract

This study aims to analyze the response of corporate income tax collection in Colombia to shocks in macroeconomic variables, economic policies, and sectoral performance (1995–2023). Using a vector autoregression model, we examine impulse-response functions (IRFs) and variance decomposition to trace the temporal effects of these shocks. Robustness is checked using forecasting tests and tested by estimating IRFs via local projections. The results reveal that income tax collections respond positively to shocks in high-productivity, high-output sectors such as industry and commerce. Conversely, the financial and real estate sectors show no effects. Policy variables, especially the tax rate and the monetary policy interest rate, significantly influence short-term tax collection. Variance decomposition indicates a strong inertial component in revenue collection. The tax rate and the monetary policy interest rate each explain 9 % of the variability. Key sectors such as construction and manufacturing account for approximately 35 % of the dynamics in revenue collection.

Keywords: corporate income tax; tax collection; multisectoral impacts; macroeconomic impacts.

JEL Classification: H25; H21; E62; E52; C32

Choques sectoriales y de política sobre el recaudo del impuesto de renta corporativo en Colombia: un análisis VAR (1995-2023)

Resumen

Este estudio pretende analizar la respuesta del recaudo del impuesto de renta corporativo en Colombia ante choques en las variables macroeconómicas, en las políticas económicas y en el desempeño sectorial (1995-2023). Utilizando un modelo VAR, se examinaron las funciones de impulso-respuesta y la descomposición de la varianza para rastrear los efectos temporales de dichos choques. Se realizaron pruebas de robustez mediante ejercicios de pronóstico y funciones de impulso-respuesta mediante proyecciones locales. Los resultados revelan que el recaudo reacciona positivamente ante choques en sectores de alta productividad y alto producto. En contraste, los sectores financiero e inmobiliario no muestran efectos. Las variables de política influyen significativamente en el recaudo a corto plazo. La descomposición de la varianza indica un fuerte componente inercial: la tasa de impuesto y la tasa de interés de política monetaria explican el 9 % de la variabilidad. Sectores clave, como la construcción, explican el 35 % de la dinámica del recaudo.

Palabras clave: impuesto de renta corporativo; recaudo tributario; repercusiones multisectoriales; repercusiones macroeconómicas.

INTRODUCTION

Since the 1990s, Colombia has experienced sustained growth in public spending, rising from 24 % to 34 % of GDP between 1990 and 2020, creating an intertemporal budget constraint that limits fiscal maneuverability in the face of external shocks. This scenario worsened in 2023, when the country recorded economic growth of just 6.8 %, with critical declines in strategic sectors such as manufacturing (-4.2 %) and construction (-8.5 %) (The World Bank, 2023). The contraction, exacerbated by the aftermath of the pandemic, strained a tax system heavily reliant on corporate income tax, which accounts for 51 % of total tax collection (Bolaños, 2019). In response, Law 2277 of 2022 modernized tax collection by adjusting taxable bases and deductions. However, its implementation coincides with a context of political uncertainty, linked to simultaneous structural reforms in healthcare and pensions that affect investor confidence (Muñoz, 2021), as well as rising inequality, reflected in the increase in the Gini coefficient from 0.52 to 0.54 between 2019 and 2023 (Cetrángolo & Gómez-Sabaini, 2006). These developments have called into question the progressivity and resilience of Colombia's tax system.

The importance of tax systems lies in their role as the primary source of revenue for state budgets, which are critical to funding investment programs, public spending, subsidies, debt service, and other public policies. The Colombian economy has undergone significant structural transformations in recent decades, according to Muñoz (2021), driven by political factors that, while contributing to macroeconomic stability, have also increased regulatory uncertainty. This context is critically relevant for businesses, which face dual risks: financial risks from sharp fluctuations in tax burdens and legal risks from exposure to abrupt regulatory changes, such as the recent Law 2277 of 2022, which substantially reforms corporate income tax.

The income tax is the most significant levy in Colombia's fiscal system. According to Bolaños (2019), it accounts for approximately 51 % of the country's current collections. Additionally, Colombia's current tax structure has been shaped by recent historical changes, driven by economic modernization and globalization. According to the World Bank, in 2023, this tax alone accounted for 9.3 % of GDP, underscoring its importance to public finances. Given that a state's collection base is determined by tax collection, understanding these dynamics fosters competitiveness among stakeholders in business continuity and reveals how collection can be affected by various factors.

In Latin America, the sustained increase in tax burdens over recent decades has paradoxically coexisted with rising socioeconomic inequality, particularly in countries like Colombia. This phenomenon raises critical questions about the redistributive efficacy of existing tax systems and the need to reevaluate the design of specific levies, such as income tax, within the fiscal structure (Cetrángolo & Gómez-Sabaini, 2006). This research contributes to understanding the dynamics of tax collection in Colombia, establishing a foundation for formulating more effective fiscal policies. It offers a comprehensive perspective that will enable the government to consider the diverse variables influencing tax collection when implementing changes to the tax system.

Based on this, the following research question arises: How does corporate income tax collection in Colombia respond to changes in economic performance variables and economic policy during the period 1995–2023? The economic performance variables include real GDP by major sectors, while the economic policy variables include the corporate income tax rate and the monetary policy interest rate. Additionally, the market exchange rate, occupation rate, and unemployment rate are analyzed.

Using a vector autoregression (VAR) model, this study explores the dynamics among economic policies, sectoral performance, and corporate tax collection in Colombia from 1995 to 2023. Unlike traditional approaches, our method incorporates parametric uncertainty and prioritizes variable interdependencies, providing evidence to inform fiscal reforms in emerging economies. The study contributes to the literature in three dimensions: (1) it fills a contextual gap by analyzing income tax revenue by sector in Colombia, instead of relying only on macro aggregates from developed countries; (2) it fills an empirical gap by integrating into a single model the GDP of 12 sectors together with fiscal, monetary, and labor market variables, thereby capturing heterogeneous effects; and (3) it innovates methodologically by using a VAR with 18 endogenous variables and local projections as a robustness check. In doing so, it identifies which sectors and policies drive tax revenue, quantifies their relative contribution and their dynamics over time, and provides inputs for designing more effective fiscal policies in emerging economies.

This document is structured as follows: the following section presents a literature review related to the study's key analytical categories; the third section details the study type, scope, data, variables, and adopted methods and techniques; the fourth section discusses the results considering the conceptual framework and

prior research; and the last section concludes with empirical findings, policy implications, and future research directions.

LITERATURE REVIEW: FROM AGGREGATE TAX THEORY TO SECTORAL DYNAMICS

The importance of tax systems lies in their role as the primary source of revenue for state budgets, which are critical to funding investment programs, public spending, subsidies, debt service, and other public policies. As noted by Besley and Persson (2014), these resources not only ensure fiscal sustainability but also enable the implementation of essential public policies. Understanding the characteristics of corporate income tax in Colombia and the macroeconomic variables that affect its collection is crucial for businesses, as highlighted by Avellaneda Bautista and Trujillo Rendón (2008), who face challenges such as double taxation when expanding operations, and for governments seeking to guide fiscal policies toward efficiency and effectiveness. Tax structure and tax burdens facilitate efficient tax planning, compliance with legal provisions, and the formulation of national budgets. Furthermore, a sound understanding of tax systems enables organizations to optimize financial resources. The following section presents the theoretical foundations and research background relevant to the research problem addressed in this study.

The analysis of tax revenue dynamics is rooted in classical public finance. Musgrave's (1969) seminal work established that tax systems are essential for financing state functions and influencing economic production, a principle that remains central to modern fiscal policy. Expanding on this, Kaldor (1963) argued that a nation's tax capacity reflects its level of development, highlighting the stark contrast in collection ratios between developed and underdeveloped economies. These foundational insights remain particularly relevant for understanding fiscal capacity in developing contexts like Colombia, according to Besley and Persson (2014).

Empirical Evidence on Fiscal Policy and Tax Collection

The empirical research demonstrates that tax collection responds strongly to policy reforms, though effects are often non-linear and context-specific. Perry's (1977) analysis of Colombia documented a remarkable 29 % increase in collection following the 1974-75 reforms, illustrating the potential for short-term gains from well-designed policies. However, the relationship between tax rates and revenue is

more complex than simple linear models suggest. As articulated in the Laffer curve framework, there exists a revenue-maximizing rate beyond which further increases become counterproductive, potentially discouraging economic activity and eroding the tax base (Herrera Saavedra *et al.*, 2022; Laffer, 2004). This non-linearity carries important implications for designing tax systems that balance revenue objectives with economic incentives.

Beyond rate adjustments, collection outcomes are shaped by multiple interacting factors. Evasion, regulatory instability, and policy inertia all play significant roles. Parra Jiménez and Patiño Jacinto (2010) and Villabona Robayo and Quimbay Herrera (2017) emphasize that evasion and frequent regulatory changes can substantially undermine collection efforts in the Colombian context. Bejarano Navarro (2014) further emphasizes the inertial character of revenues, showing that current collection levels depend heavily on past economic activity and policy decisions. This inertial dynamic becomes even more complex when considering informality: Busato *et al.* (2011) show that evasion and underground activities can generate significant macroeconomic indeterminacy, even when the shadow economy remains relatively small.

The Critical Shift to a Sectoral Perspective

While aggregate analyses provide useful overviews, they inevitably mask important heterogeneity across economic sectors. A growing literature demonstrates that sectoral disaggregation is essential for accurately modeling tax revenue dynamics. Each sector's fiscal contribution depends on its distinctive characteristics. Along this line, Tang (2024) shows that high-value service sectors, such as professional and technical activities, contribute directly through taxable profits, while Li and Yu (2022) find that capital-intensive sectors, such as real estate, exhibit pronounced volatility linked to macroeconomic cycles. For emerging economies specifically, Cardona-Arenas *et al.* (2023) and Drenik and Perez (2021) demonstrate that external shocks, particularly currency depreciation, can disproportionately affect consumption-dependent sectors, with cascading effects on both indirect and corporate tax revenues.

The effectiveness of sector-specific policies, however, cannot be assumed. Evidence from Colombia reveals that tax incentives have often benefited low-productivity sectors without generating broader growth spillovers (Castañeda & Villabona, 2020). Moreover, Bolaños (2019) documents cases in which reforms increased fiscal pressure, only to see gains offset by reduced economic activity.

These findings underscore a fundamental policy challenge: designing interventions that are simultaneously efficient and equitable. Castañeda and Villabona (2020), together with Cardona-Arenas *et al.* (2020), emphasize the importance of evaluating effective sectoral tax rates to ensure fairness across activities. International evidence from Calderón (2015) further reinforces that robust anti-fraud controls consistently emerge as key determinants of collection success across different institutional contexts.

Methodological Approaches and Identified Gaps

The empirical modeling of tax revenues has increasingly relied on econometric techniques capable of capturing dynamic interactions. VAR models, pioneered by Sims (1986), have become a standard tool for analyzing the interplay between fiscal and monetary variables without imposing strict exogeneity assumptions. For example, Sean (2019) applied a VAR model in Cambodia to trace the effects of monetary policy. However, a clear gap persists in the literature. Most studies focus on developed or middle-income countries and rely on aggregate macroeconomic variables, paying limited attention to sectoral heterogeneities and their distinct responses to policy shocks. Furthermore, few studies adopt a comprehensive approach that jointly assesses the impact of exchange rates, inflation, interest rates, and sectoral GDP on corporate tax collection within the specific institutional context of an emerging economy.

Gaps and Contribution of This Study

This review identifies three interconnected gaps that motivate our research. First, a contextual gap emerges from the scarcity of studies examining the sectoral anatomy of tax collection in emerging economies. Second, an empirical gap exists: there are no integrated models that combine sectoral GDP, policy variables, and collection dynamics within a unified framework. Third, a methodological gap arises from the limited application of comprehensive VAR approaches to this specific question in the Colombian context. Our study directly addresses these gaps by examining how corporate income tax collection in Colombia responds to shocks arising from both economic policies and sector-specific performance. Using a VAR model that incorporates disaggregated sectoral data alongside traditional macroeconomic and policy variables, we provide nuanced evidence on revenue drivers that go beyond aggregate analysis to inform more targeted and effective fiscal policy design.

Problem Statement

Corporate income tax is one of Colombia's main tax revenue sources (50 % of total), yet its stability is vulnerable to macroeconomic shifts, frequent reforms, and sectoral contractions. A key research gap exists in understanding how specific economic policy variables and sectoral performance dynamically impact this tax, particularly in an emerging economy. While most studies focus on personal taxes or aggregate GDP, we address the lack of analysis on heterogeneous sectoral effects and the interaction between fiscal and monetary policies. Our research question is:

> RQ: *How did corporate income tax collection in Colombia respond to shocks in economic performance (GDP by sector), economic policy (tax rate, interest rate), and the labor market (unemployment rate) from 1995 to 2023?*

We hypothesize that corporate income tax collection responds heterogeneously to these shocks. Given that the largest proportion of GDP is concentrated in the service sector, we expect that the dynamics of the GDP of commerce, professional and technical activities, and artistic and entertainment activities explain the largest proportion of variability in corporate income tax collection, while contractionary policies (e.g., higher interest rates) could have a negative effect.

RESEARCH DESIGN AND EMPIRICAL STRATEGY

This research adopts a quantitative longitudinal design with an explanatory scope, employing a VAR model as its empirical strategy. The study utilizes quantitative data from official sources. For economic activity, real monetary values (in COP) of GDP disaggregated by economic sectors are considered, sourced from the National Administrative Department of Statistics (DANE, 2025). The sectors include Arts, entertainment, and recreation; Finance and insurance; Real estate; Professional, scientific, and technical activities; Public administration and defense; Agriculture, livestock, hunting, forestry, and fishing; Wholesale and retail trade; Construction; Mining and quarrying; Manufacturing industries; Information and communications; Electricity, gas, steam, and air conditioning supply. Tax-related variables include corporate income tax collection (income tax) in COP and the applicable tax rate as a percentage, both sourced from the National Tax and Customs Directorate (DIAN, 2025). Macroeconomic indicators include annual inflation (inflation) as a percentage

and the market exchange rate (TRM) in COP per USD, provided by the Central Bank (Banco de la República de Colombia, 2025).

Labor market variables, such as the occupation rate (TO) and unemployment rate (TD), are measured as percentages (DANE, 2025). Monetary policy is evaluated through the monetary policy interest rate (Banco de la República de Colombia, 2025). All data cover official time series updated to 2024, with monetary values reported in COP, except for the TRM (USD). Seasonal series were deseasonalized using the TRAMO-SEATS method. Next, we present Table 1, which summarizes the definitions, sources, and types of the variables for this work.

Corporate income tax has shown sustained growth from 1995 to 2023, with notable accelerations after 2000, driven by fiscal reforms and stricter collection policies (Figure 1). Minor fluctuations observed between 2020 and 2021 are attributed to the COVID-19 pandemic. Collections reached historic highs at the end of 2023, largely due to economic formalization and the 2022 tax reform, which generated approximately 20 trillion COP (Gonzales Rodríguez, 2023). The income tax rate remained stable, fluctuating between 30 % and 35 %, with a notable exception from 2013 to 2016, when it was reduced to 25 % and coincided with lower collection. Regarding macroeconomic variables, inflation has trended downward from the 1990s until 2020, though it rebounded significantly between 2021 and 2023, in line with global disruptions. The COP/USD exchange rate has depreciated steadily, though volatility has been high at times. Unemployment and occupation rates exhibited marked fluctuations, reflecting economic crises, especially around the years 2000 and 2020. Meanwhile, the Central Bank's monetary policy rate was drastically reduced from 1995 to 2000, remaining stable until 2022. The performance of GDP by sector (Figure 2) shows heterogeneous dynamics. Financial and real estate activities have experienced consistent, sustainable growth (Kanga *et al.*, 2024), whereas GDP from artistic and entertainment activities has grown intermittently. The agricultural sector has shown a gradual increase, and wholesale and retail trade contributed 17.2 % to GDP in 2023. In contrast, construction GDP has fluctuated significantly, affected by cuts in public investment and rising interest rates (Morales Martínez & Dathein, 2024).

Table 1.

Variables, Definitions, and Sources

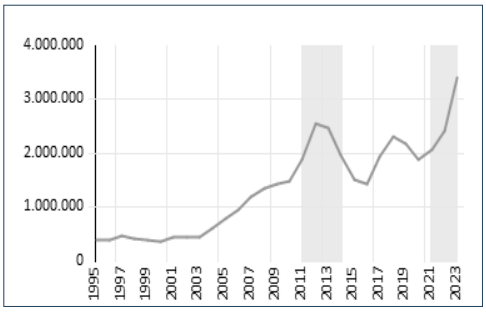
Category	Variable	Short definition	Source
Economic activity by production sectors	Arts, entertainment, recreation	Real GDP of the arts, entertainment, and recreation sector	DANE (2025)
	Finance and insurance	Real GDP of the finance and insurance sector	DANE (2025)
	Real estate	Real GDP of the real estate sector	DANE (2025)
	Professional, scientific, and technical activities	Real GDP of the professional, scientific, and technical sector	DANE (2025)
	Public administration and defense	Real GDP of the public administration and defense sector	DANE (2025)
	Agriculture, livestock, hunting, forestry, and fishing	Real GDP of agriculture and related sectors	DANE (2025)
	Wholesale and retail trade	Real GDP of wholesale and retail trade	DANE (2025)
	Construction	Real GDP of the construction sector	DANE (2025)
	Mining and quarrying	Real GDP of mining and quarrying	DANE (2025)
	Manufacturing industries	Real GDP of the manufacturing sector	DANE (2025)
	Information and communications	Real GDP of the information technology and communication sectors	DANE (2025)
	Electricity, gas, steam, and air conditioning	Real GDP of energy supply sectors	DANE (2025)
Fiscal policy: tax variables	Income tax collection	Collection from corporate income tax (constant prices in USD)	DIAN (2025)
	Tax rate	Applicable corporate income tax rate (%)	DIAN (2025)
Macroeconomic indicators	Inflation	Annual inflation rate in percentage	Banco de la República de Colombia (2025)
	Exchange rate	COP per USD, market exchange rate	Banco de la República de Colombia (2025)
Labor market	Unemployment rate	Percentage of unemployed labor force	DANE (2025)
Monetary policy	Monetary policy interest rate	Central Bank's interest rate	Banco de la República de Colombia (2025)

Source: Own elaboration

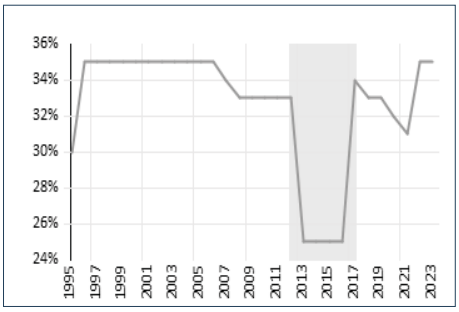
Figure 1.

Income Tax Collection, Rate, Inflation, Market Exchange Rate, Unemployment Rate, and Monetary Policy Intervention Rate (1995 to 2023)

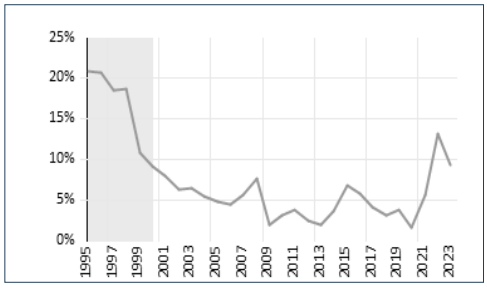
a. Corporate tax collection



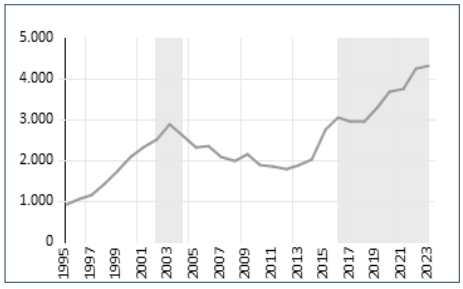
b. Tax rate



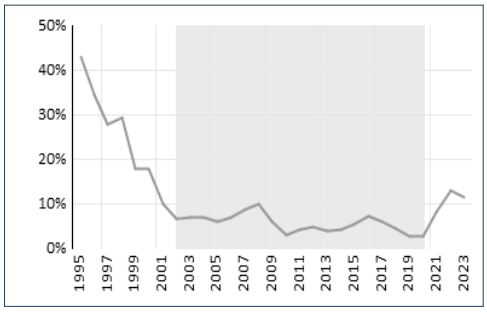
c. Inflation rate



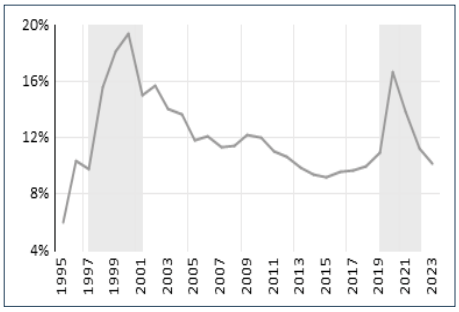
d. Market exchange rate



e. Monetary policy interest rate



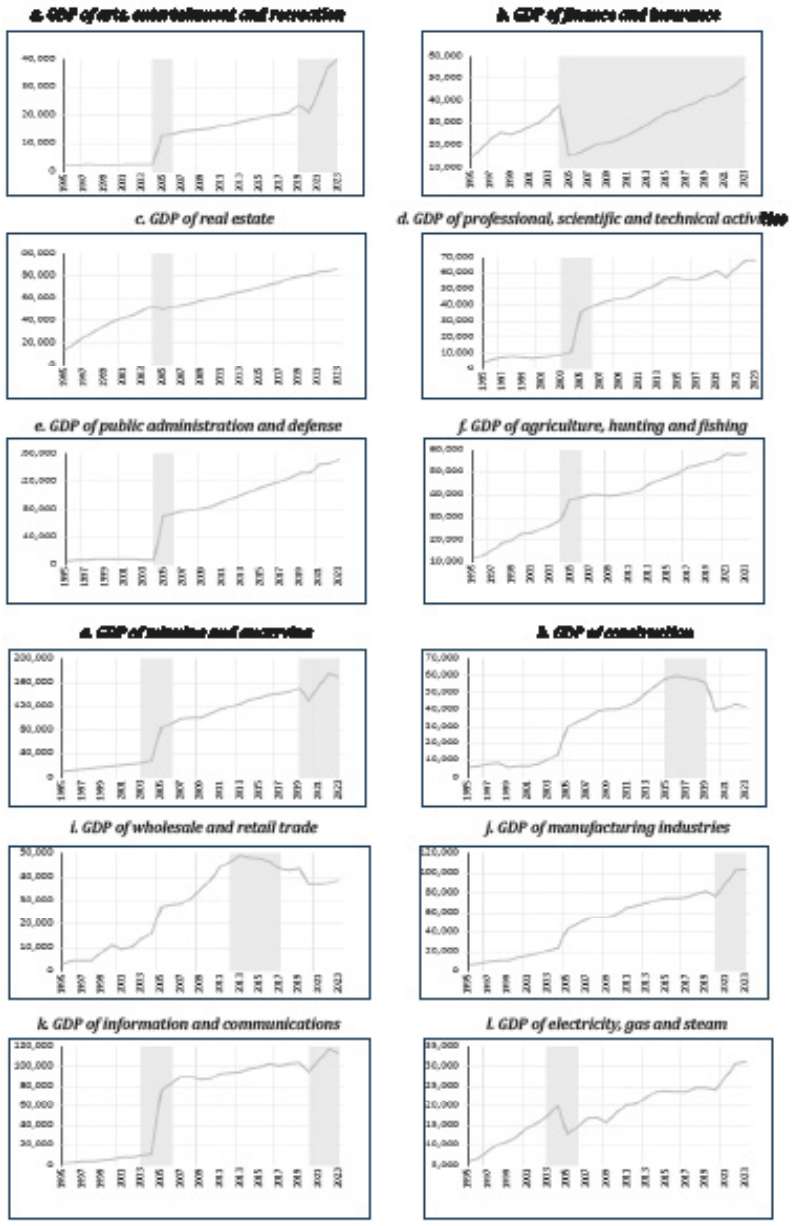
f. Unemployment rate



Source: Own elaboration based on the DANE annual and historical statistical report for 1995–2023

Figure 2.

Data Series from 1995 to 2023 of Variables: Real GDP by Economic Sector



Source: Own elaboration based on the DANE annual and historical GDP statistical report by economic sectors (1995–2023)

Empirical Strategy: Identification of a VAR Model for Modeling Shocks and Accumulated Generalized Responses

Our empirical strategy focuses on the estimation of VAR models, consistent with the framework established by Sims (1986). A key advantage of this methodology is its ability to address endogeneity by assuming that endogenous variables are influenced by the lagged values of all other variables in the system. Following Cardona-Arenas et al (2021) and Cardona-Arenas *et al.* (2024), this approach is particularly suitable in contexts where the theoretical justification for exogeneity is lacking. Consequently, VAR models provide a more robust and practical alternative to traditional multi-equation systems. We begin our analysis by specifying a reduced-form VAR(1) model (Equation 1).

$$Y_t = \sum_{i=1}^{\rho} \beta_i Y_{t-1} + \gamma D_t^{COVID} + \epsilon_t \qquad (1)$$

The model is defined by a vector of variables; $Y_t = (x_1, x_2, x_3, ..., x_4)$ is a vector of (n x 1) series of I(1) variables, stationary after first differencing. To capture the immediate impact of the pandemic on the endogenous variables[1] (y), we include it in the system as an exogenous variable that helps prevent the atypical 2020–2021 shock from distorting the estimation of the β_i parameters and the impulse-response functions (IRFs).

Where i is the number of lags, and ϵ_t is a vector n x1of innovations or processes without serial autocorrelation (see Appendix A for LM serial autocorrelation test[2]), white noise, and with zero expectation and matrix of variances $\sigma_{\varepsilon i}^2$ and covariances σ_{ij} constant over time. Thus, the residuals are distributed as white noise identically in time with zero mean and constant variance: $\varepsilon_t \sim N(0,\sigma^2)$, $cov(\varepsilon_{ti}, \varepsilon_{tj}) = 0$, $\forall t_i \neq t_j$. It explains how the estimated shock in each endogenous variable is incorporated into the IRF, assuming that all variables in the system are endogenous (Beaton *et al.*, 2009). Now, the immediate reactions and the subsequent effects following the shock in the endogenous variables can be examined through generalized impulse–response

1 Exogenous dummy variables (such as the COVID-19 dummy) are included to control for atypical effects that could bias the estimation of the model's parameters. Their purpose is to isolate transitory shocks, not to analyze their temporal dynamics. Standard IRFs are computed for shocks to endogenous variables (e.g., sectoral GDP and the interest rate), since they capture how shocks propagate through the system over time. Exogenous variables are not part of this dynamic system.

2 It is important to note that once the VAR model has been estimated, the serial autocorrelation test is performed, showing that there are no serial autocorrelation problems.

functions (GIRFs), following Pesaran and Shin (1998), typically represented as Equation 2:

$$IRF_t = \sum_{j=1}^{n} \left[\sum_{i=1}^{m} r_{t,jt-i} \right] \qquad (2)$$

Where $r_{t,jt-i}$ measures the response of the variation in the income tax collection to each endogenous variable j of the system in the previous periods, that is, in its lag corresponding to the vector Y_t, each of the variables is expressed as a function of the accumulated random disturbances. Consequently, the identification issue in this study aligns with Sims' (1986) perspective, which imposes no arbitrary restrictions on the model.

The analysis of decomposition of variance will be carried out to determine the proportions of movements in the explained variables due to their "own" shocks, compared to those of other endogenous variables.[3] A shock to variable (i) will not only directly affect that variable through its autoregressive component but will also be transmitted to all other variables in the system via the VAR's dynamic structure. The vector of endogenous variables of the system of equations is composed by (Equation 3):

$$Y_t = (RC_1, T_2, UR_3, MPR_4, RMR_5, IR_6, GDP_{5.i=12\ sector}) \qquad (3)$$

Where *RC* stands for real collection, *T* for tax rate, *U* for unemployment rate, *MPR* for monetary policy rate, *I* for inflation rate, and *GDP* for gross domestic product by production sectors. Unit root tests indicate that all variables are integrated of order one (I(1)), i.e., non-stationary in levels. After first differencing, all series become stationary; see the results of the augmented Dickey-Fuller test and Phillips-Perron test in Table 2.

3 The innovations in each variable are measured in standard deviations of their units. Confidence intervals, typically around ±2 standard errors, indicate that the true value of the response is likely to fall within this range 95 % of the time.

Table 2.

Augmented Dickey-Fuller Test and Phillips-Perron Test for Unit Roots

Variable	Specification	ADF (levels)	ADF (first difference)	PP (levels)	PP (first difference)	Integration order
Income tax collection	Trend, intercept, and structural change	0.600659 (0.987)	-4.51046 (0.0014)***	2.184765 (0.9999)	-0.453594 (0.8862)	I(1)
Inflation	Trend and intercept	-2.60579 (0.1033)	-3.76062 (0.0087)***	-2.756426 (0.0771)*	-5.194848 (0.0002)***	I(1)
Market exchange rate	Trend and intercept	-1.49393 (0.5224)	-4.67561 (0.0009)***	-1.42292 (0.5573)	-4.75907 (0.0007)***	I(1)
Income tax rate	Trend and intercept	-2.174653 (0.2192)	-5.42864 (0.0001)***	-2.228972 (0.2009)	-5.429237 (0.0001)***	I(1)
Unemployment rate	Trend and intercept	-2.848206 (0.0641)*	-7.20403 (0.0000) ***	-2.912857 (0.0561)*	-7.346778 (0.0000)***	I(1)
Monetary policy rate	Trend and intercept	-1.121958 (0.6927)	-3.75303 (0.0088)***	-0.706819 (0.8297)	-2.900882 (0.0579)*	I(1)
GDP: Arts and recreation	Trend, intercept, and structural change	1.323594 (0.9981)	-4.51777 (0.0013)***	1.303642 (0.9980)	-4.51648 (0.0013)**	I(1)
GDP: Finance and insurance	Trend, intercept, and structural change	-0.994837 (0.7416)	-5.29280 (0.0002)***	-1.005261 (0.7379)	-5.331233 (0.0002)***	I(1)
GDP: Real estate	Trend and intercept	-3.932691 (0.0054)**	-3.25437 (0.0272)**	-3.405161 (0.0190)**	-3.245127 (0.0277)**	I(1)
GDP: Professional and technical activities	Trend, intercept, and structural change	-0.599734 (0.8558)	-4.999977 (0.0004)***	-0.606446 (0.8543)	-4.999897 (0.0004)***	I(1)
GDP: Public administration	Trend, intercept, and structural change	-0.251083 (0.9207)	-5.42711 (0.0001)***	-0.169468 (0.9319)	-5.482212 (0.0001)***	I(1)
GDP: Agriculture and fishing	Trend and intercept	-1.369005 (0.5833)	-5.12437 (0.0003)***	-1.584977 (0.4773)	-5.126722 (0.0003)**	I(1)
GDP: Wholesale and retail trade	Trend and intercept	-0.507075 (0.8760)	-5.48890 (0.0001)***	-0.452550 (0.8868)	-5.502766 (0.0001)***	I(1)
GDP: Construction	Trend and intercept	-1.246588 (0.6401)	-3.83514 (0.0071) ***	-1.275858 (0.6269)	-3.881575 (0.0063)***	I(1)
GDP: Mining and quarrying	Trend, intercept, and structural change	-1.532013 (0.5035)	-3.93111 (0.0056) ***	-1.439208 (0.5494)	-4.002877 (0.0047)***	I(1)
GDP: Manufacturing	Trend and intercept	-0.963941 (0.7524)	-5.06508 (0.0003) ***	-0.968758 (0.7508)	-5.064766 (0.0003)***	I(1)
GDP: Information and communications	Trend, intercept, and structural change	-0.800472 (0.8040)	-6.06100 (0.0000) ***	-0.646248 (0.8449)	-6.304661 (0.0000)***	I(1)
GDP: Utilities (electricity, gas, etc.)	Trend, intercept, and structural change	-2.772839 (0.0746)*	-5.82516 (0.0000) ***	-2.739690 (0.0797)*	-5.866793 (0.0000)***	I(1)

Note. Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests were employed. **Hypothesis ($p < 0.05$)**; *P*-values are reported in parentheses. *: significant at the 10 % significance level; **: significant at the 5 % significance level or less; ***: significant at the 1 % significance level or less . The results indicate that all variables are integrated of order one [I(1)], exhibiting non-stationarity at levels but stationarity after first differencing.

Source: Own elaboration

To determine the most appropriate model, a cointegration analysis was conducted. Specifically, the Johansen cointegration test indicated no long-run cointegrating relationships among the variables, despite their nonstationarity in levels. This outcome indicates the absence of a shared long-term trend, which justifies the use of a standard VAR model rather than a VEC model (Aljandali & Tatahi, 2018). See Table 3 for the Johansen cointegration test.

Table 3.

Johansen Cointegration Test

Hypothesized No. of CEs	Eigenvalue	Trace statistic	Critical *p*-value
None *	0.9048	171.5905	0.0000
At most 0	0.5820	66.2526	0.0931
At most 1	0.5213	42.6992	0.1401
At most 2	0.3378	22.8081	0.2556
At most 3	0.2230	11.6782	0.1730
At most 4	0.1648	4.8654	0.0274

Note. CE: cointegration equation.

Source: Own elaboration

Given that all variables are I(1) and the Johansen test fails to detect cointegration at the 99 % confidence level, we estimate the VAR in first differences. This avoids spurious regressions and ensures the stationarity required for valid inference in the IRFs and the variance decomposition (Aljandali & Tatahi, 2018). To determine the appropriate lag order for the VAR model, the Akaike, Schwarz, and Hannan-Quinn information criteria were employed. All selected a lag order of 1, resulting in a VAR(1) model (see Appendix B). Finally, after estimating the model, we conducted the stability test known as the Inverse Roots of the AR Characteristic Polynomial. The results indicate that all roots lie within the unit circle, which confirms that the model is stable (see Table 4).

It is important to note that, although Structural Vector Autoregression (SVAR) models allow for the imposition of theoretical restrictions to identify structural shocks, this study opts for a reduced-form VAR model. This decision is based on two fundamental reasons. First, the primary objective of the research is not to identify structural causalities based on strong theoretical restrictions, but rather to analyze the dynamic response of tax revenue to shocks in the system's endogenous variables, a task adequately captured by the IRFs of a standard VAR (Sims, 1986). Second, the

Table 4.

Order VAR Selection Criterion

Lag	Log L	LR	AIC	SC	HQ
0	82.8411108	NA*	-5.1918	-2.5042	-4.3926
1	192.5005	59.0319	-6.4815*	-5.2819*	-5.5179*

Note. * indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at a 5 % level); FPE: final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn.

Source: Own elaboration

inclusion of 18 variables within a 29-year sample limits the ability to impose credible, parsimonious identification restrictions without incurring overparameterization or theoretical assumptions difficult to justify in the Colombian context. Therefore, a more flexible and robust approach was chosen, which was further validated through local projections following Jordá and Taylor (2025), confirming the consistency of the estimated dynamics.

Statistical Robustness Test Strategy

In line with Jordá and Taylor (2025), we are interested in characterizing how an intervention today affects the average outcome at some point in the future relative to income collection. Formally, Jordá and Taylor (2025) defines an impulse response as Equation 4:

$$R_{s\to y}(h,\delta) \equiv E[y_{t+h} | s_t = s_0 + \delta; x_t] - E[y_{t+h} | s_t = s_0; x_t]; \forall h = 0,1,..,H \qquad (4)$$

Where δ is the size of the shock (e.g., 1% percentage shock or perturbation in an explanatory variable). R$s\to y$ (h, δ) indicates the response of y_t, so the subscript $s \to y$ indicates that the intervention s affects the outcome y_t. To assess the robustness of our findings, we compare the IRFs of local projections. First, we use local projections to estimate the response of observed real GDP to a shock in observed income tax revenue. Second, we estimate the response of observed real GDP to a shock in forecasted income tax revenue. Finally, we conduct a test of differences on the IRF coefficients from both approaches (with and without forecast). If the test reveals no statistically significant differences between the two groups of coefficients, this supports the robustness of our empirical strategy.

RESULTS

Short-Term Dynamics: Interpretation and Analysis of Impulse-Response Functions

Our findings, derived from the IRFs, reveal how income tax revenue reacts to shocks in various fiscal and macroeconomic variables. The results have been analyzed over time, with the "x" axis representing the periods and the "y" axis the magnitude of the response as a percentage change. The response horizon was set at 10 years. The choice of horizon remains on the specific dynamics of the variables (see Blanchard & Perotti, 2002); a 10-period window is technically sufficient to capture the full transmission mechanism of fiscal shocks. This timeframe ensures that the IRFs have enough space to exhibit their peak impact.

Variables with the Biggest and Most Immediate Impact

An increase in the tax rate generated a significant and sustained rise in tax collection, climbing from 0 % to 0.2 % between periods 1 and 6. However, we observed potentially non-linear effects and a downward correction, suggesting a dynamic in line with the Laffer curve.

On the other hand, a positive shock in the industrial sector triggered a substantial and sustained response in revenue, with a significant effect across periods 1–5. This is due to its high productivity and elevated salaries, which increase withholdings and taxable profits. Similarly, a shock in the retail and wholesale sector had a positive and significant effect from period 1 to 6, driven by high sales volumes and profits that boost the corporate tax base.

The professional sector responded quickly and significantly, with positive effects from period 1 to 6. Services such as those of lawyers and consultants generate high and stable incomes that are quickly converted into higher tax payments. Public administration and the defense sector also exhibited positive and significant responses during the same period, given their special fiscal treatment.

Sectors with Delayed or Limited Impact

A positive shock in the construction sector generated a positive response between periods 1 and 5. Although this activity boosts employment and income, tax revenue is delayed, as taxes are collected after projects are completed. Meanwhile, a shock in

the agricultural sector caused a positive response, albeit at a low level and of short duration, mainly between periods 4 and 5.

The arts sector showed a positive and significant effect from period 1 to 6, indicating that its growth generates taxable income. However, its fiscal impact was limited due to its smaller size in the economy. In the mining sector, a positive shock had a significant response in tax take only in the first period, as, being capital-intensive, taxable profits and royalties were reflected immediately.

Variables with Negative or Insignificant Effects

An increase in the monetary policy interest rate negatively affected revenue, with a gradual decline from 0 % to −0.2 % between periods 4 and 5. This contractionary shock reduces tax income by slowing down economic activity. The rise in the unemployment rate also had a negative effect, though of smaller magnitude and significant only in the first period. Conversely, shocks to the financial and real estate sectors' GDP did not have a significant effect on revenue. Similarly, no significant effects were observed in the electricity and gas sectors or in the exchange rate. In the latter case, this suggests that exchange rate fluctuations do not translate into higher income through taxes on dividends or capital gains.

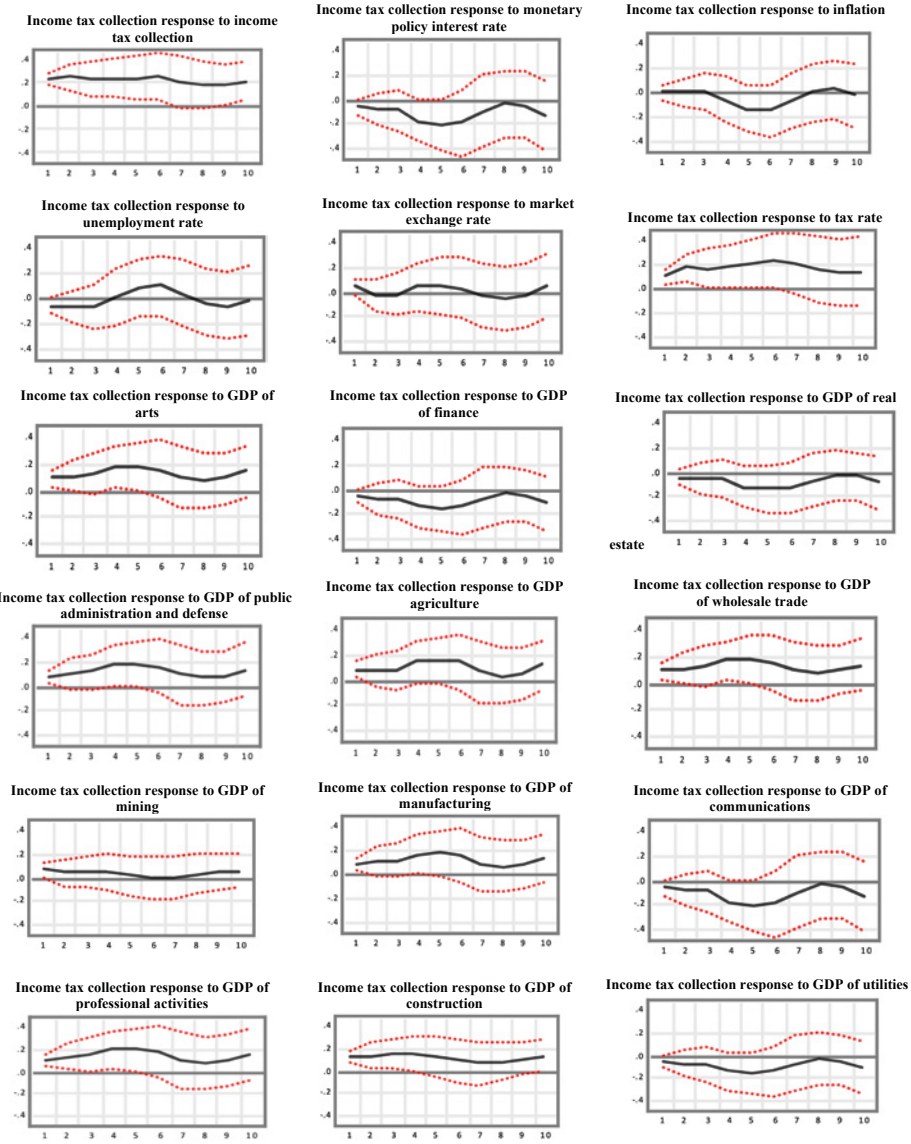
Finally, the communications sector showed a negative effect on revenue between periods 4 and 5, although the cause could not be clearly determined. For its part, inflation had a cyclical and statistically insignificant impact. Despite a possible initial "bracket *creep effect*," tax revenue stabilized at negative levels from period 4 onward, once the data were deflated. Figure 3 shows the generalized cumulative response of income tax collection to an endogenous shock in each variable.

Variance Decomposition Analysis: Effect of GDP Sectors' Behavior and Economic Policies on the Variability of Tax Collection

This section presents the variance decomposition analysis, following the interpretative framework developed by Cardona-Arenas and Sierra (2020) and Cardona-Arenas *et al.* (2024) for VAR estimation. Figure 4 shows the bar charts corresponding to the variance decomposition process. It is observed that the variance stabilizes in periods 8 and 10, contrasting with period 1, where sectors such as arts and finance and insurance exert significant influence, accounting for approximately 12 % and 10 % of the variance, respectively. This aligns closely with the findings of

Figure 3.

Generalized Cumulative Responses of Income Tax Collection to an Endogenous Variable Shock in the VAR Model



Note. The dashed red lines represent the 95 % confidence bands obtained via bootstrap (10,000 replications).

Source: Own elaboration based on VAR estimation

Cardona-Arenas *et al.* (2024), who found that stability in these variables indicates that these sectors are pivotal to economic dynamics and positively affect corporate income tax collection in Colombia. Conversely, sectors such as wholesale and retail trade and mining and quarrying show smaller contributions to GDP, around 4 %. Other variables, such as the tax rate and the monetary policy interest rate, also have a considerable impact, contributing approximately 10 %.

The variance decomposition reveals that in the first period, shocks to real tax collection explain nearly 35 % of their own variability. However, over time, the contribution of these shocks decreases slightly and stabilizes around 25 % after the tenth period. This pattern reflects a typical stabilization trend, where other factors—such as business development and their returns—begin to influence taxable surpluses and, consequently, long-term tax collection (Peren Arin *et al.*, 2024).

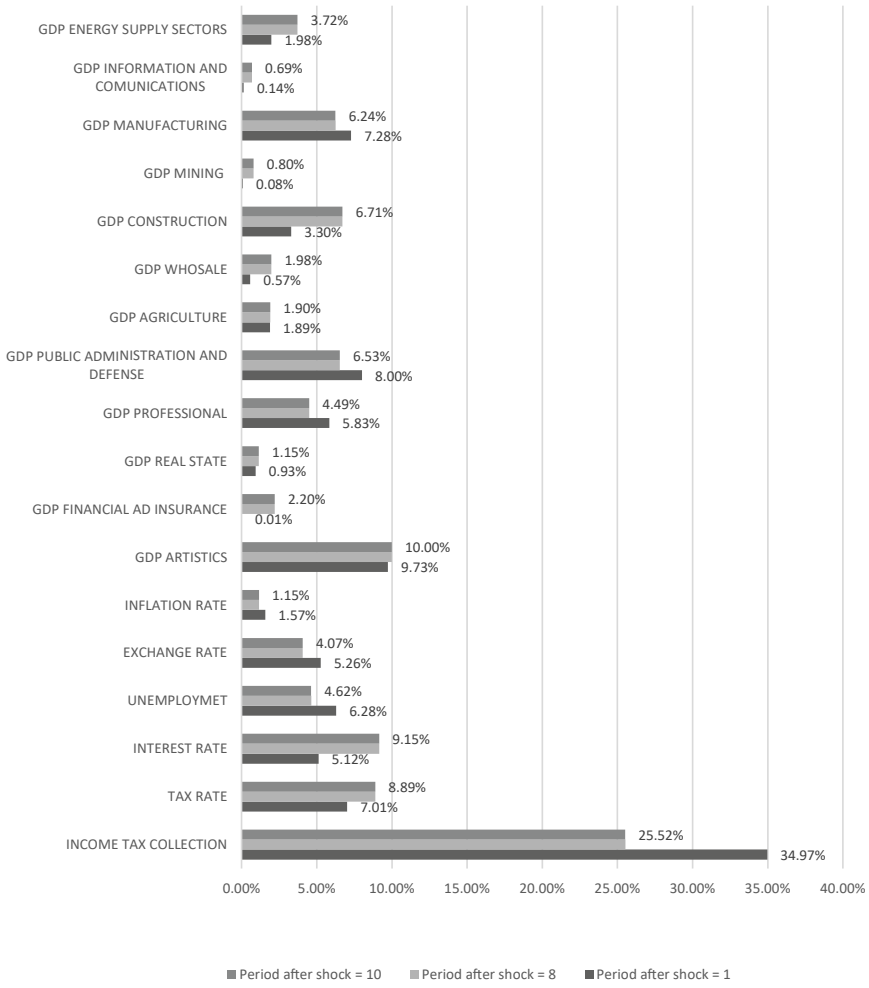
The tax rate has a moderate but persistent effect on tax collection over 10 periods. In the initial periods, changes in this variable explain between 7 % and 9 % of the variance in collection, indicating that its influence is significant but not dominant (it does not exceed 10 % of the explained variability). The effect remains stable over time without abrupt decay, suggesting that policies that adjust tax rates can have lasting impacts on collection, though their capacity to boost collection is limited. This conclusion is consistent with studies such as Castro *et al.* (2024), which caution that increasing fiscal progressivity (e.g., raising rates for higher-income sectors) could reduce economic growth in the medium term, thereby limiting its effectiveness in generating sustained revenue.

On the other hand, the monetary policy rate also has a considerable impact. In the initial period, its contribution is high, ranging from 5 % to 9 %, similar to the tax rate. This suggests that monetary policy directly influences tax collection, likely through its effects on investment and consumption. Regarding the inflation rate, its contribution to tax collection is notably low, fluctuating between 1 % and 1.5 % across all periods. While inflation affects the nominal tax base, its impact in this case is relatively small. This implies that price shocks are not a significant determinant of tax collection compared to tax rates and monetary policies. Finally, when analyzing the contributions of all variables, it becomes evident that shocks to fiscal and monetary policies have a significant influence. However, internal shocks in real tax collection play the most critical role over time. The VAR model shows that tax collection responds primarily to its own lags, though it is also sensitive to fiscal and monetary decisions. This dynamic interaction underscores the importance of coordinating

fiscal and monetary policies to maximize tax collections, while acknowledging that internal shocks—such as past collection performance—remain a key determinant of long-term fiscal behavior.

Figure 4.

Variance Decomposition of Income Tax Collection



Note. Variance decomposition for periods 1, 8, and 10 from the VAR model forecast horizon: 10 months.

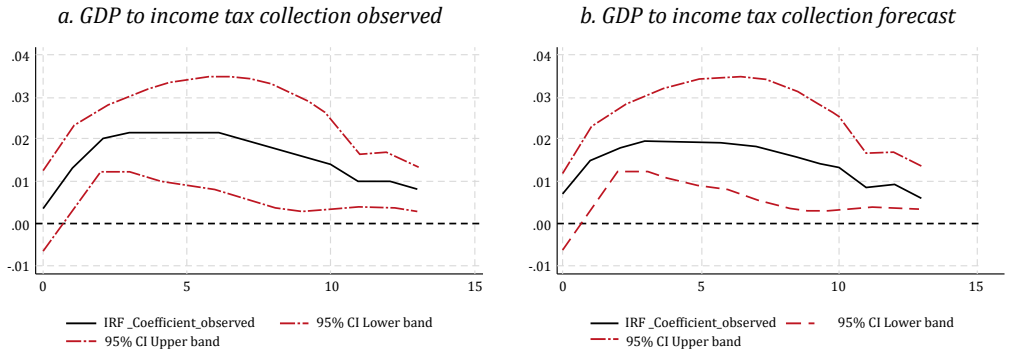
Source: Own elaboration based on VAR estimation

Robustness Test: Impulse Responses by Local Projections (LIRFs)

Based on the forecast evaluation results, the VAR model demonstrated strong predictive performance for income tax revenue. This is supported by a low mean absolute percentage error (MAPE) and a Theil's *U* coefficient close to zero, suggesting that the variables included in the model, such as sectoral GDP, interest rates, inflation, and exchange rates, adequately capture the underlying dynamics of tax behavior during the study period (see Appendix C). To evaluate the model's consistency and robustness, IRFs generated using local projections were compared across two scenarios: forecasted income tax revenue as a proportion of real GDP and observed income tax revenue as a proportion of real GDP. A hypothesis test was conducted, with the null hypothesis (H_0) that there is no significant difference in the mean IRF coefficients between the two scenarios (diff = 0). The resulting two-sided *p*-value of 0.5764, well above the 5 % significance threshold ($\alpha = 0.05$), indicates that we fail to reject the null hypothesis. Therefore, there is no statistical evidence of significant differences between the projected and observed responses, confirming that the VAR model is consistent, stable, and robust for predicting tax revenue behavior relative to real GDP. Figure 5 below shows the LIRFs.

Figure 5.

Local Impulse Response Functions



Note. The figure on the left shows the impulse response coefficients based on the actual, observed income tax collection data. The dashed red lines represent the 95 % confidence bands.

Source: Own elaboration by local projections estimations

In contrast, Figure 5(b) displays the VAR-model-forecasted coefficients for the income tax collection series. Shock induced a 1 percentage point. The robustness test using local projections following Jordà and Taylor (2025), comparing observed versus projected revenue, did not show statistically significant differences (*p* = 0.5764), indicating that, despite the number of variables, the VAR model estimated adequately captures the underlying dynamics with no evidence of over-parameterization. Table 5 below presents the coefficients of the local projections of the estimated LIRFs, while Table 6 presents the mean *t*-test with equal variances to check robustness.

DISCUSSION

This section places our findings within the existing literature, interpreting the dynamics of corporate income tax collection in Colombia in light of current debates. Our aim is to position our contribution by identifying contextual, empirical, and outcome-related gaps that this analysis helps to close.

First, our work has identified a gap in context and approach for multisector analysis in an emerging economy. The literature on taxation in developing countries often focuses on why these countries collect less than advanced economies, highlighting factors such as state capacity, informality, and economic structure (Besley & Persson, 2014). While those studies explain the "why" of low collection levels, our work advances toward the "how" by modeling the dynamic response of tax collection to macroeconomic and sectoral shocks in a specific emerging economy.

Second, we have identified a clear empirical gap. Econometric research on tax revenues has begun to explore the persistence, or inertia, in collection. Our findings, which reveal a strong inertial component in which past shocks to collection explain around 35 % of its short-term variability and stabilize at 25 %, are consistent with recent evidence for OECD countries (Caporale *et al.*, 2024).

Table 5.

Local Projection IRFs

Local projection IRFs response of real GDP to forecast income collection						
Time horizon	**IRF coefficient**	**95 % *CI* lower**	**95 % *CI* upper**	**Std. error**	***t*-statistic**	***p*-value**
0	0.0069**	0.0001	0.0138	0.0031	2.24	0.046
1	0.0146***	0.0085	0.0208	0.0028	5.25	0.000
2	0.0178***	0.0115	0.0241	0.0028	6.26	0.000
3	0.0195***	0.0123	0.0268	0.0033	5.91	0.000
4	0.0194***	0.0095	0.0292	0.0045	4.32	0.001
5	0.0194***	0.0082	0.0305	0.0051	3.83	0.003
6	0.0191***	0.0071	0.0310	0.0054	3.51	0.005
7	0.0184***	0.0059	0.0309	0.0057	3.23	0.008
8	0.0165**	0.0038	0.0292	0.0058	2.85	0.016
9	0.0145**	0.0027	0.0263	0.0054	2.71	0.020
10	0.0131**	0.0035	0.0226	0.0043	3.01	0.012
11	0.0087***	0.0031	0.0143	0.0026	3.39	0.006
12	0.0092***	0.0035	0.0149	0.0026	3.57	0.004
13	0.0061**	0.0008	0.0114	0.0024	2.54	0.027
Local projection IRFs response of real GDP to observed income collection						
Time horizon	**IRF coefficient**	**95 % *CI* lower**	**95 % *CI* upper**	**Std. error**	***t*-statistic**	***p*-value**
0	0.0037*	-0.0064	0.0117	0.0041	0.65	0.053
1	0.0131***	0.0036	0.0225	0.0043	3.04	0.011
2	0.0197***	0.0125	0.0270	0.0033	5.98	0.000
3	0.0213***	0.0126	0.0300	0.0039	5.40	0.000
4	0.0214***	0.0102	0.0327	0.0051	4.21	0.001
5	0.0215***	0.0090	0.0341	0.0057	3.77	0.003
6	0.0215***	0.0082	0.0347	0.0060	3.56	0.004
7	0.0201***	0.0057	0.0344	0.0065	3.08	0.010
8	0.0183**	0.0039	0.0326	0.0065	2.81	0.017
9	0.0162**	0.0030	0.0294	0.0060	2.69	0.021
10	0.0142**	0.0033	0.0251	0.0050	2.87	0.015
11	0.0100***	0.0039	0.0161	0.0028	3.61	0.004
12	0.0101***	0.0037	0.0166	0.0029	3.46	0.005
13	0.0083***	0.0033	0.0133	0.0023	3.67	0.004

Note. * significant at the 10 % significance level; ** significant at the 5 % significance level or less; *** significant at the 1 % significance level or less.

Source: Own elaboration

Table 6.

Two-Sample Mean t-Test with Equal Variances

Hypothesis	Group	Mean	Std. err.	Std. dev.	[95 % CI]	
H0: diff = 0, Ha: diff < 0, Ha: diff = 0, Ha: diff > 0	IRF of forecast income collection	0.01451	0.0013	0.0049	0.0116	0.0173
Pr(T < t) = 0.2882	IRF of observed income collection	0.01567	0.0015	0.0058	0.0122	0.0190
Pr(|T| > |t|) = 0.5764	Combined	0.01509	0.0010	0.0053	0.0122	0.0171
Pr(T > t) = 0.7118	diff	-0.0011	0.0020		0.0122	0.0030
diff = mean(1) - mean(2) t = -0.5657						

Source: Own elaboration

However, our model goes a step further and addresses a key empirical question: What explains the remaining variance after controlling for inertia? While studies such as Caporale *et al.*'s (2024) focus on the stochastic properties of aggregate collection, our variance decomposition attributes this variability to specific factors. We show that the tax rate and the monetary policy interest rate each account for approximately 9 % of collection dynamics, and that a set of key sectors (arts, public administration, professional activities, construction, and industry) together account for approximately 35 %. Additionally, much of the fiscal-policy literature has focused on the effect of taxation on investment (Perret & Brys, 2015) or on the effectiveness of administrative enforcement tools (Cui *et al.*, 2024; Fiorio & Santoro, 2023). Our study complements and extends this perspective by analyzing causality in the opposite direction: how shocks to economic activity and monetary policy affect fiscal revenue outcomes. This approach is important in contexts such as Colombia's, where economic volatility can affect fiscal sustainability.

Finally, we have identified an outcomes gap due to sectoral heterogeneity. One of the most significant contributions of this work is the revelation of heterogeneity in the collection response, a finding that goes beyond analyses based on aggregate GDP.

One notable result is the absence of a statistically significant effect of shocks in the financial and real-estate sectors on corporate income tax collection (an aspect that should be examined with much deeper sectoral scrutiny). This gap between results and theoretical expectations (where highly profitable sectors like finance would be expected to be major contributors) can be explained by several factors

not explicitly modeled but present in the Colombian context, such as special tax schemes or aggressive tax-planning strategies that decouple accounting profits from the taxable base.

This finding contrasts markedly with the positive, significant, rapid, and sustained impact of the industrial, commercial, and professional services sectors on corporate income tax collection. Moreover, our results offer a nuanced view of the Laffer curve. The collection response to an increase in the tax rate is positive and significant, but it shows a downward correction after the initial period. This suggests that, while rate increases are effective in the short term, their effects may not be linear and could erode if a higher tax burden disincentivizes economic activity, in line with theory. Finally, the negative and significant effect of the monetary policy interest rate on collection highlights a fundamental tension between monetary policy objectives (inflation control) and fiscal policy goals (revenue sustainability). This empirical finding underscores the critical need for macroeconomic coordination, which is rarely modeled at this level of sectoral detail in the literature on emerging economies.

Our findings have direct implications for policy design in emerging economies. First, the evidence that the monetary policy interest rate has a significant negative effect on tax revenue (Figure 3) underscores the need for explicit coordination between fiscal and monetary authorities. In contexts of economic slowdown, when the central bank might raise rates to control inflationary pressures (as occurred in Colombia in 2022–2023), this contractionary effect could exacerbate fiscal constraints, creating a trade-off that requires a more coordinated dialogue among policymakers.

Second, the observed sectoral heterogeneity offers a roadmap for the design of differentiated tax incentives. The results suggest that sectors such as manufacturing, commerce, and professional services respond quickly and positively to positive shocks in their activity; this indicates that policies aimed at stimulating their productivity (e.g., investment in technology, labor formalization) could translate into higher tax revenues in the short and medium term. Conversely, the absence of significant effects in sectors such as finance and real estate raises questions about the effectiveness of special tax schemes and the need to review potential tax avoidance practices that decouple sectoral value-added from the income tax base. A modern fiscal policy agenda should not be limited to adjusting tax rates but should also involve a permanent evaluation of the consistency between sectors' real performance and their effective fiscal contribution.

Limitations

This research is subject to several limitations that we must consider when interpreting its results. First, the use of annual data, although necessary due to the availability of sectoral GDP information, may mask short-term dynamics and the immediate effects of policy shocks that occur within a fiscal year. Second, the VAR methodology, while robust for capturing interdependencies, relies on historical correlations and does not establish strict structural causality. Finally, the findings are specific to Colombia's institutional and economic structure. Future research could address these limitations by incorporating higher-frequency data, firm-level information, and cross-country comparative analyses.

CONCLUSIONS

This study analyzed the impact of various economic, policy, and labor-market variables on corporate income tax collections in Colombia between 1995 and 2023. To achieve this, a VAR econometric model was estimated to assess the effects of the corporate income tax rate, inflation rate, monetary policy interest rate, GDP by economic sector, employment rate, and unemployment rate on tax collection. Using annual data from 1995 to 2023, IRFs were calculated, and a variance decomposition analysis was conducted to identify dynamic relationships among the model's variables.

The VAR model results demonstrate that corporate income tax collection in Colombia responds dynamically to macroeconomic and policy factors, with heterogeneous effects conditioned by the inherent uncertainty of posterior distributions. The tax rate and monetary policy rate show significant positive short-term impacts, with coefficients of 0.3963 and 0.1688, respectively, suggesting that increases in these variables transiently boost collection. However, these effects must be interpreted in light of the Laffer curve's nonlinearity and monetary policy transmission lags (6–12 months), as high rates may discourage economic activity. Inflation has a marginal positive effect (coefficient: 0.1060) on nominal adjustments to the taxable base, while the employment rate exhibits a volatile, less predictable influence, reflecting labor-market complexity and its dependence on unobservable factors.

The sectoral GDP analysis reveals that sectors such as mining and manufacturing significantly affect tax collection, whereas financial and artistic activities have coefficients that are statistically insignificant. Additionally, the persistence of tax

collection (autoregressive coefficient: 0.1384) underscores the importance of inertial factors and prior fiscal policies. These findings highlight the need for differentiated fiscal policy approaches: while monetary policy requires timely coordination to avoid adverse fiscal effects, stability in tax rates and support for key production sectors emerge as priority strategies.

The IRF analysis shows heterogeneous responses of corporate income tax collection to shocks in sectoral and macroeconomic variables. The corporate income tax rate has an immediate positive effect on tax collections, but a negative correctional impact that stabilizes after four periods, reinforcing the Laffer curve hypothesis and the need for periodic adjustments to maintain the tax system's progressivity.

Our analysis of the IRFs on income tax revenue reveals a complex and contrasting set of dynamics. Tax take does not respond uniformly to all economic shocks; rather, it is affected differently by fiscal, macroeconomic, and sectoral factors. An increase in the tax rate proved to be the most potent factor in boosting short-term revenue, albeit with non-linear behavior that could align with the Laffer curve. In contrast, a rise in interest rates and an increase in unemployment had a detrimental effect, highlighting the vulnerability of revenue to shocks that slow down the economy. Inflation and the exchange rate showed a statistically insignificant impact. Furthermore, revenue is particularly sensitive to positive shocks in the industrial, retail, professional, and public administration sectors, which generated significant and sustained responses. On the other hand, sectors such as agriculture, the arts, and mining, while contributing positively, do so with more limited or transitory effects, reflecting their smaller economic weight or capital-intensive nature. Surprisingly, shocks in the financial, real estate, and energy sectors had no significant effect on revenue. Additionally, the communications sector showed a negative response that requires further investigation to understand its causes.

The variance decomposition of the VAR model indicates that tax collection in Colombia is predominantly influenced by its own historical shocks: these explain 35 % of its initial variability and stabilize at 25 % after the tenth period. This pattern, consistent with prior studies, suggests that external factors, such as business profitability and the economic cycle, become more relevant in the long term, while collection inertia gradually diminishes. Fiscal and monetary policies show differentiated effects: the tax rate contributes a steady 7 % to 9 %, confirming that tariff adjustments have lasting but non-dominant impacts. Meanwhile, the monetary policy

rate fluctuates between 5% and 9%, reflecting its dual role in collecting through channels such as investment and consumption.

In conclusion, the behavior of income tax revenue is intrinsically linked to the performance of key sectors that generate high productivity and large volumes of economic activity. Fiscal policy, through the tax rate, has direct power, but its effect is mediated by general economic activity, which, in turn, is sensitive to monetary policy. This analysis underscores that to optimize tax take, it is crucial not only to adjust the tax rate but also to foster robust growth in high-impact sectors, which are the true engines of tax revenues.

Our findings make a significant contribution to the analysis of tax collection in Colombia by applying a VAR model to capture the dynamic relationships among economic and tax variables, offering a more robust perspective on the determinants of tax collection. The main innovation lies in identifying differentiated effects across production sectors and evaluating the persistence of collection. In terms of policy design, the results underscore the importance of effective coordination between fiscal and monetary policies to avoid counterproductive effects on collection. Additionally, they highlight the need to design differentiated tax strategies tailored to economic sectors, avoiding disproportionate increases in the tax burden that could discourage investment and business formalization. In this sense, tax rate stability and the promotion of strategic sectors emerge as key elements to improve the efficiency and effectiveness of corporate income tax collection in Colombia.

Furthermore, this work opens two avenues for future research: first, investigating how the implementation of specific fiscal policies aimed at boosting productivity across different economic sectors could optimize corporate income tax collection, considering the unique characteristics and needs of each sector; second, exploring how improved coordination between fiscal and monetary policies might influence the stability and efficiency of income tax collection, both for legal entities and individuals.

DECLARATION OF CONFLICTS OF INTEREST

The authors declare that they have no financial or non-financial conflicts of interest that may have influenced the work presented in this manuscript.

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AI USAGE

The authors used artificial intelligence tools only for English editing tasks (grammar and spelling review and standardization to American English). They were not used to generate ideas, analyze data, or interpret results. All substantive aspects of the work—research design, methodology, econometric analysis, and interpretation of results—were carried out entirely by the authors, who assume full responsibility for the final content of the manuscript.

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APPENDIX A

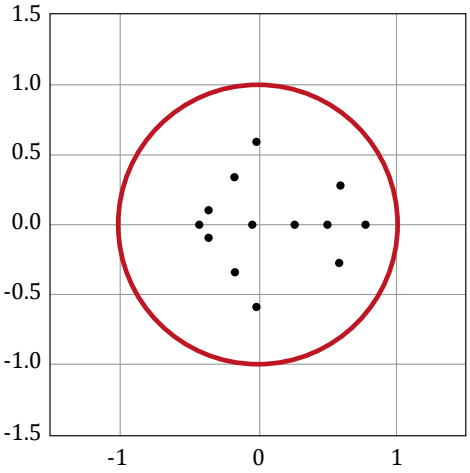
VAR Residual Serial Correlation LM Tests

Lag	Stat	df	Rao *F*-stat	*P*-value
1	**57.463**	**49.000**	**1.201**	**0.277**
2	62.215	49.000	1.358	0.160
3	42.070	49.000	0.767	0.813
4	62.564	49.000	1.370	0.154
5	41.143	49.000	0.744	0.839

Source: Own elaboration

APPENDIX B

Inverse Roots of AR Characteristic Polynomial



Source: Own elaboration based on VAR estimates

APPENDIX C

Forecast Evaluation

Variable	Inc. obs.	MAPE	Theil
Inflation	28	15.9766	0.0809
Real GDP of arts, entertainment, and recreation	28	13.8622	0.0732
Real GDP of finance and insurance	28	10.2615	0.0610
Real GDP of real estate	28	1.3212	0.0090
Real GDP of professional, scientific, and technical activities	28	9.0011	0.0057
Real GDP of the public sector and defense	28	20.6717	0.0109
Real GDP of agriculture and related sectors	28	2.2794	0.0153
Real GDP of wholesale and retail trade	28	9.2491	0.0057
Real GDP of construction	28	6.4933	0.0046
Real GDP of mining and quarrying	28	5.4093	0.0034
Real GDP of manufacturing	28	16.0752	0.0099
Real GDP of information and communications technology	28	6.2959	0.0039
Real GDP of energy supply	28	8.1422	0.0060
Tax rate	28	3.9212	0.0031
Income tax collection	28	8.3087	0.0060
Monetary policy interest rate	28	13.4257	0.0061
Unemployment rate	28	6.4271	0.0044
Exchange rate	28	3.7052	0.0029

Note. MAPE: mean absolute percentage error; Theil: Theil inequality coefficient.

Source: Own elaboration based on VAR estimation