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Analysis of the impact of the policy interest rate on colombian economic growth: evidence 2010 – 2022

Análisis del impacto de la tasa de referencia sobre el crecimiento económico colombiano: evidencia 2010 – 2022

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Abstract

In emerging economies such as Colombia, monetary policy is a fundamental tool, but its effectiveness in influencing short-term economic growth is uncertain. This study examines the impact of the Banco de la República's reference rate on economic growth in Colombia, with a specific emphasis on identifying and quantifying its main transmission channels. For this purpose, a Vector Autoregressive (VAR) model was implemented with quarterly data for the period 2010-2022, complemented with impulse-response function analysis. The results show that, although the reference rate has a statistically significant influence on intermediate variables such as consumption, which experiences a maximum contraction of -0.1% after a contractionary shock, its direct aggregate effect on GDP variation does not reach statistical significance over a horizon of up to eight quarters. It is concluded that monetary policy alone has limitations in promoting short-term growth, which requires greater coordination with fiscal policy and a strengthening of financing mechanisms. The main innovation of this paper lies in its empirical approach to analyzing transmission channels, which opens a critical research agenda on the real effectiveness of the Central Bank's decisions by quantifying the disconnection between channels and aggregate growth in Colombia.

Keywords: Monetary policy; GDP growth; transmission channels; econometric models; macroeconomic context.

Resumen

En economías emergentes como la colombiana, la política monetaria es una herramienta fundamental, pero su efectividad para incidir en el crecimiento económico a corto plazo es incierta. Este estudio examina el impacto de la tasa de referencia del Banco de la República sobre el crecimiento económico en Colombia, con un énfasis explícito en la identificación y cuantificación de sus principales canales de transmisión. Para ello, se implementó un modelo de Vector Autorregresivo (VAR) con datos trimestrales para el período 2010-2022, complementado con análisis de funciones impulso-respuesta. Los resultados evidencian que, si bien la tasa de referencia influye de manera estadísticamente significativa sobre variables intermedias como el consumo, que experimenta una contracción máxima de -0,1% tras un shock contractivo, su efecto directo agregado sobre la variación del PIB no alcanza significancia estadística en un horizonte de hasta ocho trimestres. Se concluye que la política monetaria, por sí sola, presenta limitaciones para fomentar el crecimiento a corto plazo, lo cual demanda una mayor articulación con la política fiscal y un fortalecimiento de los mecanismos de financiamiento. La principal innovación de este trabajo radica en su aproximación empírica al análisis de los canales de transmisión, abriendo una agenda de investigación crítica sobre la eficacia real de las decisiones del Banco Central al cuantificar la desconexión entre los canales y el crecimiento agregado en Colombia.

Palabras clave: Política monetaria; crecimiento del PIB; canales de transmisión; modelos econométricos; coyuntura macroeconómica.

INTRODUCTION

Economic growth is a fundamental pillar of development, and monetary policy is one of the primary tools of the State to guide its trajectory. In Colombia, the reference interest rate set by the Bank of the Republic is a key instrument that influences the costs of credit, investment, and consumption, with the ultimate goal of maintaining price stability. However, the effectiveness of this mechanism, especially in its ability to influence real economic activity in the short term, is the subject of intense and persistent debate.

The academic literature has demonstrated that the relationship between interest rates and economic growth is influenced by multiple structural factors and the level of financial system development (Fan et al., 2011; Okina & Shiratsuka, 2004; Chu et al., 2017). In emerging economies, such as China and Japan, for example, it has been found that the money supply can be more effective than changes in interest rates in stimulating growth (Fan et al., 2011; Okina & Shiratsuka, 2004). Similarly, non-linear relationships have been demonstrated, such as the inverted "U" shape between inflation and growth, suggesting the existence of an optimal inflation threshold to maximize development (Chu et al., 2017).

In the case of Colombia, the effects of monetary policy on economic activity are mixed. In fact, despite a consensus on the influence of the interest rate on certain financial variables, there is still no conclusive agreement on the magnitude and speed of its impact on aggregate GDP growth in time horizons relevant to business cycle stabilization. This uncertainty represents a significant gap in the literature, as effective policymaking requires a precise quantification of these relationships.

Therefore, this article seeks to answer the following research question: What is the magnitude and nature of the impact of the reference rate of the Bank of the Republic on Colombia's economic growth in the short term, and through which transmission channels does this impact operate?, for this, the central hypothesis was raised indicating that in the transmission of monetary policy to GDP growth it is statistically weak in its direct impact, but materializes through statistically significant indirect channels – such as consumption and exports – although with an insufficient magnitude to forcefully alter the aggregate trajectory of output in the short term.

To verify this hypothesis, an Autoregressive Vector (VAR) model is implemented with quarterly data for the period 2010-2022. The main contribution of this study lies in its empirical approach to decomposing and quantifying transmission channels in Colombia, providing evidence on the apparent disconnect between the activation of these channels and their final effect on GDP. The rest of the document is structured as follows: the second section presents the theoretical framework and the literature review; the third details the econometric methodology; the fourth presents and analyzes the empirical results; the fifth discusses them in the light of the literature and the limitations of the study; and, finally, the conclusions and policy implications are presented.

STATE OF THE ART

Monetary policy stands as a fundamental pillar in the macroeconomic management of modern nations. Its primary objective, consolidated over the last decades, is the maintenance of price stability as a necessary condition for sustained economic growth and the improvement of social welfare. To achieve this goal, central banks have shifted from controlling monetary aggregates to using a benchmark interest rate as their primary policy instrument (Mishkin, 1995).

However, the process by which decisions about this interest rate are propagated through the economy to affect inflation and real economic activity (known as the monetary policy transmission mechanism) is complex, multifaceted, and remains the subject of intense academic debate. This "transmission mechanism" is not a black box, but a set of interconnected channels whose effectiveness varies significantly according to the economic and institutional structure of each country.

The transmission mechanism: theoretical foundations and classical channels

Standard macroeconomic theory has identified several channels through which monetary policy operates. The interest rate channel is the most traditional and direct. An increase in the policy rate increases the interbank cost of funds, which is passed on to the cost of credit for firms and households, discouraging investment and consumption of durable goods, and consequently contracting aggregate demand and moderating inflationary pressures (Taylor, 1995). The empirical literature has extensively explored the nonlinearities in these reaction functions, encapsulated in the Taylor Rule, finding that central bank responses can be asymmetric, especially in emerging economies (Bui & Kiss, 2020).

Closely linked to the former, the credit channel posits that monetary policy not only affects the cost of credit but also its availability. This channel is subdivided into two strands: the bank lending channel, which argues that a contractionary policy reduces bank reserves and, therefore, the ability of banks to offer loans (Bernanke, & Gertler, 1995); and the balance sheet channel, which argues that higher interest rates deteriorate borrowers' financial position, increasing lenders' perceived risk and reducing access to credit. Studies for Colombia have empirically shown that the financial structure of banks is a determining factor in the power of this channel (Gomez-Gonzalez et al., 2021) and that the pass-through from the policy rate to retail rates can be heterogeneous and incomplete (Holmes et al., 2015).

For small and open economies such as Colombia's, the exchange rate channel is of vital importance. An increase in the domestic interest rate, relative to international rates, tends to attract capital flows, appreciating the local currency (Hsing, 2012). A stronger currency makes imports cheaper (reducing imported inflation) and makes exports more expensive, which can contract net demand for domestic goods and services.

However, empirical evidence for emerging economies suggests that this relationship is often unstable and subject to elements that work like puzzles, such as unexpected depreciation following a rate hike (Kim & Lim, 2022). Finally, the asset price channel, popularized by Tobin, suggests that monetary policy affects the value of financial assets (such as stocks and bonds) and real assets (such as real estate), influencing household wealth and, consequently, their consumption and investment decisions (Tobin, 1969).

Particularities of monetary transmission in emerging economies

Although theoretical channels are universal, their operation in emerging economies has particularities that often attenuate or distort their effectiveness. These economies are characterized by shallower financial markets, a higher prevalence of informal financing, weaker institutions, and greater vulnerability to external shocks, such as volatile commodity prices and capital flows (Schadler et al., 1993; Calvo et al., 1995).

The credibility of the central bank plays a crucial role in its effectiveness. In contexts of historically high inflation, anchoring inflation expectations is a significant challenge. Studies such as Ferreira de Mendonça (2018) and Osorio-Barreto et al. (2025) demonstrate that, in emerging economies, expectations often exhibit a strong backward-looking component, which complicates the task of monetary policy. Central bank communication thus becomes a critical tool for guiding expectations, as demonstrated by Arango et al. (2023) in their analysis of the Banco de la República's press releases and Anzoátegui-Zapata & Galvis-Ciro (2020) in their study on the role of the internet in forming consumer expectations.

In addition, financial frictions are more pronounced. The market power of banks can lead to an asymmetric and incomplete transmission of the policy rate to retail rates (Gomez-Gonzalez et al., 2023). Access to formal credit is limited for a large portion of the population and firms, which often resort to informal sources that are not responsive to monetary policy (Arango et al., 2021; Martinez & Rivera-Acevedo, 2018). The high exposure to external shocks, evidenced in the work of Coronado et al. (2020) and Azad & Serletis (2022) on the spillover effects of US policy, complicates monetary management, forcing central banks to consider multiple objectives beyond inflation (Ferreira Frascaroli & Lacerda Nobrega, 2019).

Empirical Evidence and Debates on Monetary Policy in Colombia

The Colombian case encompasses many of the complexities of emerging economies. After the adoption of an inflation-targeting regime in the late 90s, the Bank of the Republic has made notable progress in reducing and stabilizing inflation (Giraldo et al., 2012; González & Hamann, 2011). However, the effectiveness of their actions on short-term economic growth is a matter of ongoing debate.

Literature for Colombia has explored various facets of this debate. Torrejón-Flores & García-Solanes (2012) found that, although the adoption of inflation targeting in Latin America contributed to reducing inflation volatility, its net effects on the level of economic growth were unclear. This uncertainty fully justifies the focus of our study. More specific research has identified significant asymmetries in transmission; for example, Quintero Otero et al. (2024) and Galindo & Steiner (2022) find that interest rates on commercial and consumer loans respond differently to increases in the policy rate than to decreases in the policy rate. Zárate et al. (2013) confirm this asymmetry, showing that firms of different sizes react heterogeneously to currency shocks.

Interaction with fiscal policy is another determining factor. Studies such as those by Galvis Ciro & Ferreira de Mendonça (2017) and Lozano-Espitia & Arias-Rodríguez (2022) have shown how monetary credibility and fiscal discipline reinforce each other. An expansionary fiscal policy or a high level of public debt can limit the central bank's ability to control inflation without generating significant costs in terms of output (Chamorro-Narváez & Zapata-Quimbayo, 2024).

Despite this rich and growing literature, a gap persists in the comprehensive understanding of the short-term impact of monetary policy on aggregate economic activity in Colombia. Although many studies have focused on the response of financial variables or the dynamics of inflation, fewer have offered a systematic empirical quantification of how, and through what channels, a change in the reference rate of the Bank of the Republic affects GDP growth in a relevant time horizon for the stabilization of the economic cycle.

This study aims to contribute to closing this gap by employing an Autoregressive Vector model to decompose and quantify the impact of the monetary policy rate, not only directly on GDP, but also indirectly through its effects on key intermediate variables. In doing so, we hope to provide empirical evidence that will enrich the debate on the scope and limitations of monetary policy as a short-term macroeconomic management tool in the specific context of an emerging economy such as Colombia's (Yuzvovich et al., 2020).

METHODOLOGY

To analyze the impact of the Banco de la República reference rate on economic growth in Colombia, a quantitative time-series approach is implemented. The empirical strategy is designed to capture the complex dynamic interdependencies between monetary policy and key macroeconomic variables, without imposing the rigid theoretical constraints of structural models, which is appropriate for an exploratory analysis of transmission channels (Sims, 1980).

Methodological approach and research design

The core of this study is an Autoregressive Vector model, a standard econometric tool for macroeconomic policy analysis, popularized by Sims (1980). The choice of the VAR model is justified by its ability to treat all variables as endogenous, allowing their interrelationships to be manifested through the data. This approach is particularly suitable for investigating transmission mechanisms, which, as discussed in the theoretical framework, involve multiple variables that influence each other over time. (Stock & Watson, 2001)

The analysis is complemented by two techniques derived from the VAR model: 1. Granger Causality Tests, to formally determine whether the past values of one variable (e.g., the reference rate) contain helpful information to predict the future values of another (e.g., GDP). 2. Impulse-Response Function Analysis (IRF), which allows tracing the dynamic trajectory of one variable in response to a shock or unexpected innovation in another, quantifying the magnitude and persistence of the effect over several quarters.

Data and variable selection

The study utilizes data collected quarterly from the first quarter of 2009 to the fourth quarter of 2022 (2009Q1-2022Q4). The choice of this period is based on two criteria: first, it seeks to analyze the Colombian economy during a phase of relative maturity of the inflation-targeting regime, thus avoiding possible structural breakdowns associated with its initial implementation or the global financial crisis of 2008. Second, the availability of consistent data for all selected variables defines the time horizon.

The quarterly frequency represents an appropriate balance between capturing the dynamics of the business cycle and avoiding the noise inherent in higher-frequency data. All the series were obtained from official sources such as the Bank of the Republic (Banrep) and the National Administrative Department of Statistics (DANE). The variables included in the model, justified by the theoretical framework and previous empirical evidence, are:

Table 1. Abbreviations of variables

Indicator	Abbreviation	Variable Type
Gross Domestic Product	GDP	Continuous quantitative
Reference Rate		Continuous quantitative
Imports	Imp	Continuous quantitative
Exports	Exp	Continuous quantitative
Representative Market Rate	TRM	Continuous quantitative
Deflator	Def	Continuous quantitative
Consumer Price Index	CPI	Continuous quantitative
Producer Price Index	PPI	Continuous quantitative
Foreign Direct Investment	FDI	Continuous quantitative

Indicator	Abbreviation	Variable Type
Foreign Portfolio Investment	IEP	Continuous quantitative
Industrial Manufacturing Production	Indus	Continuous quantitative
Household Consumption	C	Continuous quantitative
Fiscal Expenditure	GF	Continuous quantitative
Tax Revenue	IF	Continuous quantitative
International Reserves	ResInt	Continuous quantitative
Balance of Payments	BP	Continuous quantitative
Unemployment Rate	TD	Continuous quantitative

Sources: Authors.

Econometric model: the VAR

The empirical analysis of dynamic interactions in macroeconomics faces the challenge of simultaneous endogeneity, where the distinction between causal and caused variables is theoretically ambiguous. To address this challenge, this study adopts the Autoregressive Vectors approach, proposed by Sims (1980). The choice of a VAR model is justified by its ability to treat all the variables of the system as endogenous, allowing their dynamic interdependencies to be determined by the data themselves, rather than by an a priori theory. This approach is particularly well-suited to exploring the transmission channels of monetary policy, an inherently dynamic and multifaceted phenomenon.

Formal mathematical specification

An order VAR modelρ, denoted as VAR(ρ), represents each of the η system's endogenous variables as a linear function of its own past values and of the past values of all other variables, up to an order lag.ρ In its compact matrix form, the model is expressed as:

$$Y_t = c + \sum_{i=1}^{p} A_i Y_{t-i} + \varepsilon_t$$

Where: is the vector () of the endogenous variables in the period Y_t $n\times 1\tau$:

$$Y_t = \begin{bmatrix} Y_{1,t} \\ Y_{2,t} \\ \vdots \\ Y_{n,t} \end{bmatrix}$$

$\boldsymbol{c}$ is a vector ($n\times 1$) of constant terms (intercepts). A_i is the matrix of coefficients ($n\times n$) for lag I. $\boldsymbol{p}$ it is the order of the model, that is, the maximum number of lags. $\boldsymbol{\varepsilon}_t$ is the vector ($n\times 1$) of reduced-form innovations (or forecast errors), which is assumed to be a vector of white noise with the following properties: 1. Zero mean:

$E(\varepsilon_t)=0$, 2, 2. Matrix of variances and constant covariances (homoskedasticity), 3. Absence of serial autocorrelation: $E(\varepsilon_t \varepsilon_s')=0$ for $t \neq s$

The Problem of Identification and Structural Shocks

The VAR model presented above is a "reduced form" model. Their residuals, ε_t, represent the innovations in the variables, but they are contemporaneously correlated with each other (i.e., the matrix Σ is not diagonal). This correlation prevents a direct economic interpretation; for example, an innovation in GDP may be correlated with an innovation in the interest rate over the same period, making it impossible to isolate a pure "monetary policy shock."

To perform policy analysis, such as impulse-response functions, it is necessary to transform these correlated innovations into a set of structural shocks that are orthogonal (i.e., uncorrelated with each other) and have a clear economic interpretation (e.g., a supply shock, a demand shock, or a monetary policy shock). The relationship between reduced-form residuals and structural shocks is established as:

$$\varepsilon_t = S u_t$$

Where u_t is the vector of structural shocks with $E(u_t u_t') = I$ (the identity matrix), and S is a matrix (nxn) that describes the contemporary impact of structural shocks on variables. The central problem, known as the identification problem, is to estimate the matrix S from the estimated matrix of covariances Σ, since the latter $\Sigma=SS'$ is not directly observable. This equation imposes $n(n+1)/2$ constraints, but the matrix S has n^2 elements that need to be estimated. Additional constraints are therefore needed, which $n^2-n(n+1)/2 = n(n-1)/2$ must come from economic theory.

Identification strategy: Cholesky decomposition

For this study, the most common identification strategy in the empirical macroeconomic literature is adopted: Cholesky decomposition. This method imposes $n(n-1)/2$ the necessary constraints, assuming that the matrix is lower triangular. This implies a recursive causal ordering between the variables in the contemporary impact of shocks.

The logic of this order is fundamental. In the context of monetary policy, it is commonly assumed that "slow" macroeconomic variables, such as GDP or consumption, do not react to a monetary policy shock within the same quarter due to rigidities in decision-making and implementation. On the contrary, monetary policy can react to information about these real variables within the same period. This justifies an ordering where the variables of economic activity precede the variable of monetary policy. The specific ordering used in this study is:

[GDP, Consumption, Exports, ..., Reference Rate]

Under this scheme, a structural shock in the reference rate does not have a contemporaneous effect on GDP, but a shock in GDP can affect the reference rate in the same quarter. The main criticism of this method is that the results of the impulse-response functions can be sensitive to the ordering of variables. However, for short-term analysis with quarterly data, this recursive assumption can be considered a reasonable approximation and a standard starting point in the literature.

Estimation and validation procedure

The empirical analysis is developed in four rigorous steps, designed to guarantee the statistical robustness of the model and its results:

1. Stationarity analysis: Since the estimation of standard VAR models requires time series to be stationary to avoid spurious regressions, the Augmented Dickey-Fuller Test (ADF) was performed for each variable (Dickey & Fuller, 1979). For variables that turned out to be non-stationary in levels (integrated of order 1,$I(1)$), the first difference was applied to induce stationarity. It is recognized that differentiating series can eliminate information about long-run equilibrium relationships (cointegration). However, since the focus of this study is explicitly on short-term impact (one year), estimating a VAR in differences is a standard and methodologically valid approach (Hamilton, 1995).

2. Determining the optimal lag length: Choosing the number of lags is crucial to avoid bias due to omission or loss of efficiency. The standard information criteria were used: Akaike Information Criterion (AIC), Schwarz Bayesian Information Criterion (BIC), and Hannan-Quinn Criterion (HQC). The lag length that minimized most of these criteria was selected, following the practice recommended in the econometric literature of time series (Lütkepohl, 2005).

3. Estimation and validation of the model: Once the number of lags was determined, the VAR model was estimated using Ordinary Least Squares (OLS). Subsequently, diagnostic tests were carried out to validate the correct specification of the model:

   a. Stability test: It was verified that all the inverse roots of the characteristic polynomial of the VAR were within the unit circle. This condition is critical to ensure that the model is stable and that the impulse-response functions converge.

   b. Autocorrelation tests in residuals: Portmanteau's multivariate test was used to confirm the absence of serial autocorrelation in residuals, ensuring that the model adequately captures the dynamics of the data.

   c. Normality tests in the residues: The multivariate Jarque-Bera test was applied to evaluate whether the residues follow a normal distribution.

4. Impulse-Response Analysis: Only after validating the statistical robustness of the model, economic analysis was carried out. Impulse-response functions (IRFs) were calculated using Cholesky decomposition to identify structural shocks. The justification for this recursive ordering follows the standard of the monetary policy literature (Christiano et al., 1999), as detailed above.

RESULTS

In this section, the study's empirical findings will be presented. It begins with the analysis of the time series properties and the selection of variables for the model. Subsequently, the results of the VAR model estimation are presented, including evidence from the Granger Causality tests. Finally, a quantitative analysis of the impulse-response functions is conducted to elucidate the dynamics of the monetary policy transmission channels.

Preliminary analysis and properties of the series

The first step of the empirical analysis involved verifying the unit root properties of all time series using the Augmented Dickey-Fuller test (ADF, 1979). As reported in Table 2, stationary variables were found at levels (I(0)), as well as variables that required one (I(1)) or two (I(2)) differences to reach stationarity.

Table 2. Stationarity of variables.

Variable	Mexico City	T-statistic	Prob
GDP	0	-3.076	0.0284
	2	-5.044	0.0000
Indus	1	-8.313	0.0000
Exp	1	-6.34	0.0000
Imp	1	-5.181	0.0000
ResInt	2	-7.591	0.0000
BP	1	-9.222	0.0000
TRM	1	-5.088	0.0000
C	1	-7.555	0.0000
FDI	1	-9.585	0.0000
IEP	0	-7.152	0.0000
Def	1	-20.218	0.0000
CPI	0	-6.208	0.0000
PPI	2	-10.868	0.0000
TD	1	-7.404	0.0000
IF	0	-5.797	0.0000
GF	1	-10.916	0.0000

Sources: Authors.

Subsequently, the endogenous variables for the main VAR model were selected, as detailed in the Methodology section. A crucial step in specifying VAR is determining the optimal lag length. An inappropriate choice can lead to bias by omission or a loss of efficiency. To this end, VAR models with up to 5 lags were estimated and the standard information criteria were calculated, the results of which are presented in Table 3.

Although the BIC criterion suggested a more parsimonious model with 2 lags, the AIC and HQC criteria, together with the diagnostic tests for residuals (absence of autocorrelation), favored a specification with four lags (p=4). This choice enables

a more comprehensive capture of the quarterly dynamics of the Colombian economy and was adopted for the final estimate.

Table 3. Criteria for selecting the length of VAR lags.

Lags	AIC	BIC	HQC
1	-25.1	-22.3	-24
2	-27.3	-23.1*	-25.8
3	-28.9	-23.3	-27.1
4	-29.5*	-22.5	-27.4*
5	-29.2	-21.8	-26.9

Sources: Authors.
Note: The asterisk (*) indicates the optimal lag selected by each criterion.

VAR model estimation and results

Based on the VAR specification (4), the model was estimated and satisfactorily passed the diagnostic tests of stability and non-autocorrelation in the residuals. Table 4 presents the detailed results for the Gross Domestic Product (GDP) equation, which is the main one of interest for this study.

It is important to analyze two results that, at first glance, might seem counterintuitive. First, the negative and significant export coefficient (Exp) suggests that an increase in exports is associated with lower GDP growth in subsequent quarters. This could reflect the composition of the Colombian export basket, concentrated in low-value-added raw materials, whose price volatility can generate "Dutch disease" effects that affect other productive sectors. Second, the positive coefficient of the Producer Price Index (PPI) indicates a positive correlation with growth. This is unlikely to represent direct causation (higher costs that drive growth). A more plausible interpretation is that the PPI is acting as a proxy for the strength of aggregate demand: in periods of economic boom (high GDP growth), demand puts upward pressure on input prices, generating a positive correlation that does not imply causality of the PPI to GDP

Table 4. Results of the estimation of the VAR model - GDP equation.

Variable	Coefficient	Standard Error	P-value
GDP (Q-1)	0.4717	0.1150	<0.01***
Exp (t-4)	-0.0691	0.0320	0.03**
C (t-3)	0.5496	0.1500	<0.01***
IEP (t-2)	0.0011	0.0005	0.03**
TD (t-1)	-0.1306	0.0550	0.02**
PPI (t-1)	0.4728	0.1800	0.01**
Constant	0.0171	0.0060	<0.01***

$p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Note: The coefficients of the variables with the most significant economic relevance are presented. The lags of other endogenous variables of the system (such as Imp, TRM, Gf) were included in the estimate but are omitted for brevity due to their low statistical significance in this particular equation.
Fit Stats: R-squared adjusted: 0.76; F-statistic: 11.85 (p-value < 0.001).

The results of the estimation indicate a good fit of the model, with an adjusted R^2 of 0.76, suggesting that a substantial portion of the variance in GDP growth is explained by the system's variables. It is confirmed that, although the past behavior of GDP and domestic demand variables, such as consumption, is a significant predictor, no lag in the reference rate has a directly statistically significant effect on GDP growth.

To analyze the transmission channels, Table 5 presents the key coefficients of the reference rate (i) in the equations of the other endogenous variables of the system. Thus, the reference rate does have a statistically significant impact on all key intermediate variables, validating the theoretical existence of transmission channels. These static results are the first piece of our empirical argument. Although the policy rate does not directly affect GDP (Table 4), it does affect the variables that should theoretically convey its effect (Table 5).

Table 5. Effect of the Reference Rate on Transmission Variables.

Equation (dependent variable)	Explanatory variable	Coefficient	Standard Error	P-value
Exports (Exp)	i(T-4)	-0.2499	0.110	0.03**
Consumption (C)	i(T-4)	0.0432	0.018	0.02**
Ext. Portfolio Investigation (IEP)	i(T-2)	-22.4382	5.850	<0.01***
Unemployment Rate (TD)	i(T-4)	0.1007	0.045	0.03**
PPI	i(T-1)	-0.0496	0.021	0.02**
Imports (Imp)	i(T-2)	0.1431	0.065	0.03**
TRM	i(T-4)	0.0203	0.009	0.03**
Tax Expenditure (GF)	i(T-1)	-0.1073	0.050	0.04**

$p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Only the coefficient of the most significant lag of the reference rate (i) is presented in each equation.

However, these coefficients represent partial correlations and do not capture the complete dynamics of the system. To understand the magnitude, persistence, and net effect of these channels over time, it is essential to resort to the analysis of impulse-response functions.

Analysis of Impulse-Response Functions (IRF)

Although the coefficient tables display the statistical relationships, the dynamic analysis through the IRFs enables the visualization of the magnitude and persistence of these effects over time. The figures below illustrate the response of the variables to a one-standard-deviation positive shock in the reference rate.

Fig 1 illustrates the dynamic impact of the monetary policy shock on transmission variables. Specifically, an unanticipated positive shock of one standard deviation in the reference rate (approximately 35 basis points) generates a contraction in Consumption (C) that peaks at approximately -0.1% in the second quarter following the shock. Although modest in magnitude, the effect is statistically significant

between the second and fourth quarters, confirming that the interest rate and credit channel operate as expected, albeit with limited power.

In Exports (Exp), it generates a more pronounced negative response, reaching a maximum drop of -0.5% in the fourth quarter. The effect is significant from the third quarter onwards, which is consistent with the lags in the exchange rate channel, where a higher interest rate (after the initial appreciation) can lead to a loss of competitiveness that impacts export volumes. On the other hand, in Foreign Portfolio Investment (IEP), the strongest and most immediate response, with a capital outflow that reaches a maximum of almost -50 units (on the scale in the graph) in the first quarter. This result, which shows capital outflows following an interest rate hike, is a well-documented phenomenon in emerging market literature, where global risk aversion can dominate over rate differentials, causing investors to withdraw funds at the slightest sign of monetary tightening.

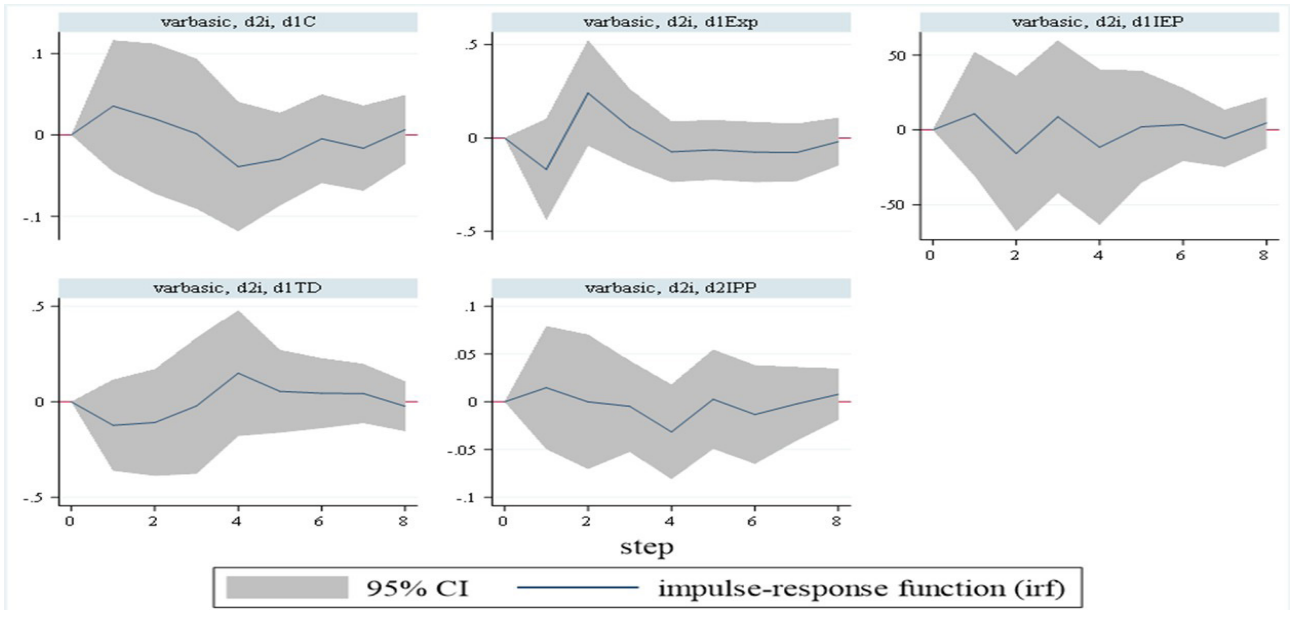

Fig 1. Variable impulse-response results in transmission variables
Sources: Authors.

Fig 2 shows the final result of these dynamics on GDP growth. Despite significant responses in transmission channels, the net effect on GDP is virtually nil. The central line, which represents the average GDP response to the shock, fluctuates very close to zero over the entire 8-quarter forecast horizon, with a maximum impact of just -0.1%. Crucially, the 95% confidence interval always contains the value zero.

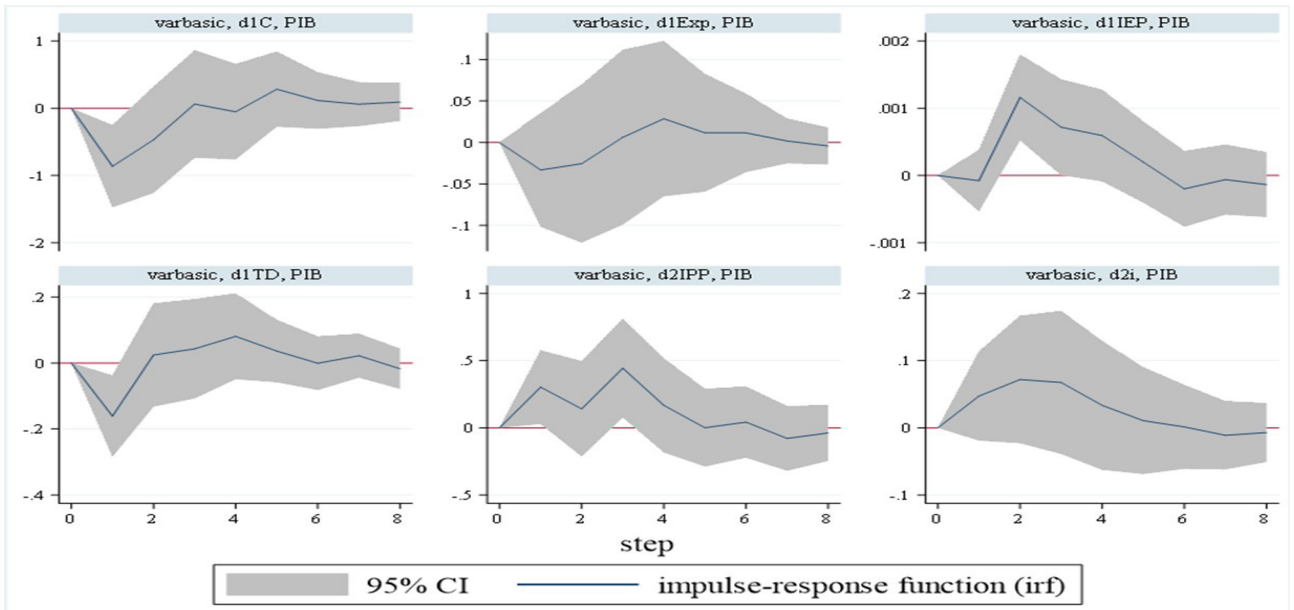

Fig 2. Impulse-response results of the transmission variables to GDP
Fuents: Authors.

This is the central and most important empirical finding of our study. During the period of analysis, a disconnect exists in the transmission of monetary policy in Colombia in the short term. The channels work, but their aggregate impact is too weak, too slow, or counteracted by other factors, so that the ultimate effect on GDP growth is statistically indistinguishable from zero.

DISCUSSION OF THE RESULTS

The empirical findings of this study reveal a complex reality about the transmission of monetary policy in Colombia. The central result – the absence of a statistically significant impact of the reference rate on GDP growth in the short term – is consistent with the general uncertainty noted in the literature for Latin America, where studies such as that of Torrejón-Flores and García-Solanes (2012) concluded that the net effect of inflation targets on growth was unclear. Then, the present analysis proceeds by decomposing this phenomenon, demonstrating that the transmission channels do operate, albeit with a modest magnitude that does not significantly impact the aggregate product.

A first explanation for this limited aggregate impact lies in the asymmetries documented for the Colombian economy, which can dilute the power of monetary policy. Evidence suggests that the response to shocks is heterogeneous: Zárate et al. (2013) found that firms of different sizes react differently, while Quintero Otero et al. (2024) and Galindo & Steiner (2022) found asymmetric responses in loan interest rates. Suppose important segments of the economy do not respond or respond weakly to the central bank's signals. In that case, it is likely that the aggregate effect on GDP will become statistically insignificant, as observed in this study.

A second set of factors is related to structural frictions that generate an apparent disconnection in transmission, since the Colombian economy is characterized by a high degree of informality, where, as Martinez & Rivera-Acevedo (2018) argue, a considerable portion of credit operates outside the formal banking system, being insensitive to the reference rate. In addition, household demand for credit can be highly inelastic to the interest rate, a point consistent with the findings of Arango et al. (2021), which further weakens the effectiveness of the credit channel in the formal sector.

It should be noted that the effectiveness of monetary policy cannot be assessed in isolation either, as its interaction with fiscal policy is crucial. According to Lozano-Espitia & Arias-Rodríguez (2022), a procyclical fiscal stance or high levels of public debt, such as those analyzed by Chamorro-Narváez & Zapata-Quimbayo (2024), can generate risk premiums that counteract movements in the policy rate. This overlapping of policies can neutralize the effect of monetary policy on aggregate demand, a factor that the present model does not explicitly endogenize.

On the other hand, it is essential to acknowledge the methodological limitations of the adopted approach. The analysis is based on a Cholesky decomposition, a standard in the empirical literature (Christiano et al., 1999), but whose results could be sensitive to a different ordering of the variables. The VAR model also assumes linear relationships, thereby ignoring any potential asymmetries. The finding of zero impact on GDP should therefore be interpreted as "null within a standard short-term linear VAR model", which opens up a research agenda to explore whether this result is maintained using more complex methodologies.

CONCLUSIONS

This study examined the impact of the reference rate on economic growth in Colombia using an Autoregressive Vector model for the period 2009-2022. The central and most important empirical finding is that the transmission of monetary policy to economic growth is limited and indirect in the short term. Specifically, it is found that the direct impact of the reference rate on the variation of GDP is not statistically distinguishable from zero over a horizon of up to eight quarters. However, statistically robust, albeit modest, effects are identified on key intermediate channels such as consumption, which experienced a maximum contraction of -0.1% after a contractionary currency shock.

This apparent disconnect between channel activation and the final effect on output is attributed to a confluence of structural factors. As argued in the discussion, the prevalence of informal financing, the low elasticity of credit demand for basic needs, and the documented asymmetries in the response of economic agents act as frictions that weaken and slow down the transmission mechanism. These structural elements prevent monetary policy momentum from spreading thoroughly and uniformly throughout the aggregate economy in the short term.

The primary policy outcome of these findings is that monetary policy, on its own, is a limited tool for managing the short-term business cycle in Colombia. Empirical evidence suggests that, while it is effective in influencing financial variables and anchoring inflation expectations, its ability to stimulate or contract real economic activity in a significant way is weak. This reinforces the need for fiscal policy to play a more active countercyclical role and underscores the importance of financial inclusion policies as a mechanism to strengthen long-term credit transmission channels.

Despite the above results, it is essential to acknowledge the limitations of this study, which pave the way for a valuable future research agenda. First, the analysis is based on a VAR model that assumes linear and symmetric relationships. Given that the literature for Colombia suggests the existence of important transmission asymmetries, future research could employ nonlinear methodologies, such as regime change (MS-VAR) or threshold (TVAR) models, to explore whether the impact of monetary policy varies in phases of expansion versus economic contraction.

Likewise, the shock identification strategy is based on a Cholesky decomposition, a standard method whose results can be sensitive to the ordering of the variables. It would be valuable to contrast these findings using more advanced identification schemes, such as sign constraints, which allow for more flexible theoretical assumptions.

The inclusion of proxy variables that capture the dynamics of informal credit or the use of microdata at the household and firm level could offer a more accurate view of the real scope of monetary policy in the country and quantify the magnitude of the frictions discussed.

RECOMMENDATIONS

It is recommended that monetary policy decisions acknowledge the limitations of the reference rate as a tool for managing the short-term business cycle. While its role in anchoring inflation expectations is indisputable, empirical evidence suggests that its ability to stimulate or contract real economic activity significantly is modest. Therefore, it is suggested that Banco de la República continue to strengthen its communication frameworks to manage expectations, while considering the indirect and asymmetric effects of its decisions on key channels, such as consumer credit and investment, and avoid overestimating their direct impact on output.

The evidence of weak monetary transmission reinforces the need for a more active and countercyclical role for fiscal policy, with a coordinated approach between the Bank of the Republic and the Ministry of Finance recommended for effective macroeconomic management. In phases of economic slowdown, targeted fiscal stimulus may be more effective than interest rate cuts. Likewise, financial inclusion policies and the deepening of the capital market should be a priority, as they reduce structural frictions and strengthen the transmission channels of monetary policy in the long term.

This study enables us to recommend that the academic sector investigate the causes of weak monetary transmission in Colombia. In this sense, the use of non-linear methodologies to capture asymmetries, the implementation of identification schemes more robust than Cholesky's decomposition, and the exploitation of microdata at the household and firm level to quantify the impact of financial informality are crucial to improve the understanding of the real effectiveness of monetary policy in the country.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

Juan Sebastian Benjumea: Data collection and processing, writing the methodology, writing the results, and conclusions. Julián David Olivares: Data collection, presentation, definition, and writing of the state of the art. Víctor David Jaramillo Mejía: Academic orientation, methodological orientation, and guidance in the interpretation of the results, review of the article.

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STATEMENT OF CONFLICTS OF INTEREST

The authors declare that the work embodied in this scientific production does not represent a conflict of interest between the authors, nor with the journal Económicas CUC and its editorial group, nor with any institution or entity.

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