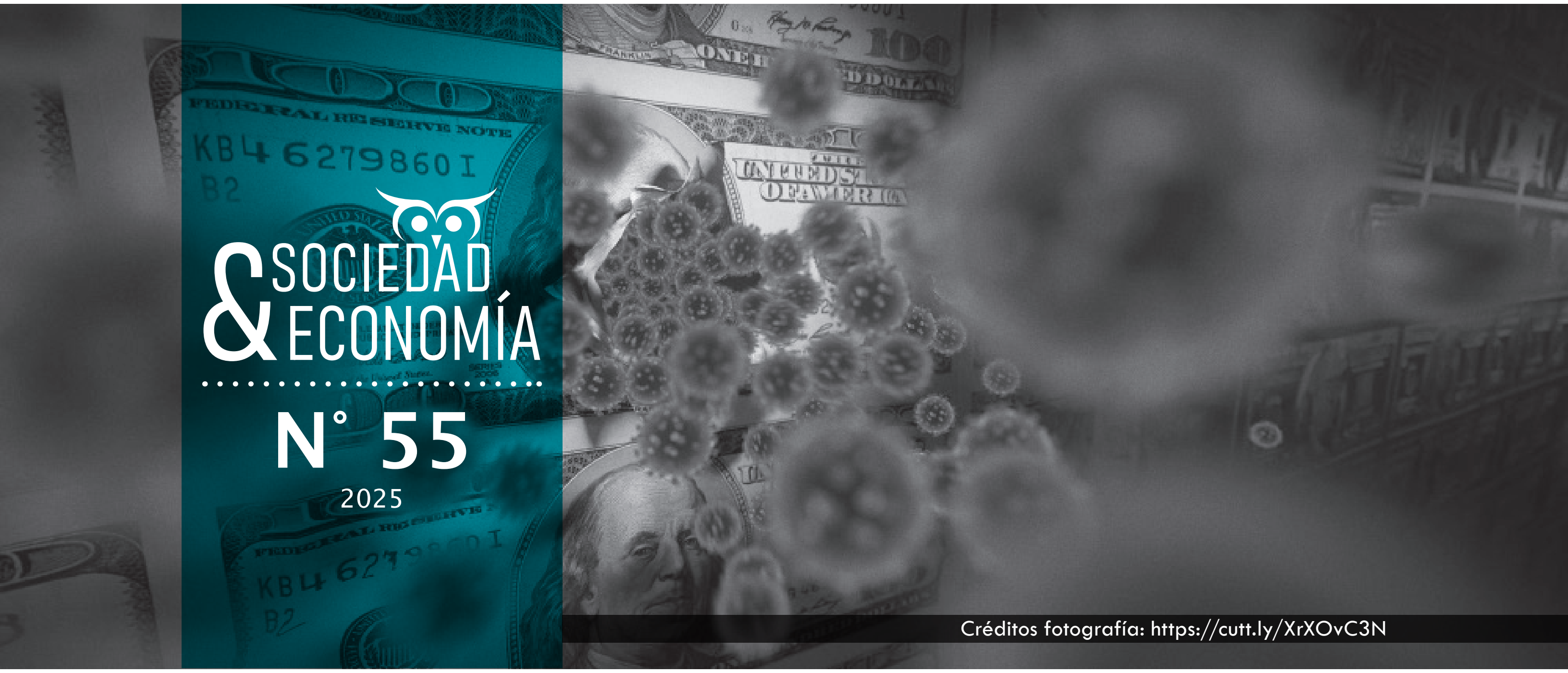

COVID-19, Macroeconomic Performance, and Monetary Efficiency in Latin American Countries with Inflation Targeting: 2017-2022

COVID-19, desempeño macroeconómico y eficiencia monetaria en países latinoamericanos con metas de inflación: 2017-2022

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Abstract

Introduction

The COVID-19 pandemic triggered a severe adverse supply shock, leading to recessions and rising inflation across Latin American economies.

Objective

This study evaluates the impact of the pandemic on macroeconomic performance and the efficiency of monetary policy in ten Latin American countries operating under Inflation Targeting (IT).

Methodology

We apply the output–inflation variability efficiency frontier method to decompose changes in macroeconomic performance into two components: those caused by supply shock variability and those attributable to monetary policy efficiency. The analysis compares the pre-pandemic (2017–2019) and pandemic (2020–2022) periods using quarterly data on GDP, inflation, and interest rates.

Results

The findings show a universal decline in macroeconomic performance across the region during the pandemic. In most cases, adverse supply shocks were amplified by reduced monetary policy efficiency. However, the Dominican Republic and Mexico partially mitigated the negative impacts through more cautious monetary expansion.

Conclusions

The results highlight the critical importance of efficient monetary policy in stabilizing economies during crises. Our contribution lies in providing a systematic assessment of IT regimes in Latin America under the extraordinary circumstances of the COVID-19 pandemic, offering new empirical evidence to the debate on the resilience of monetary frameworks.

Keywords:

COVID-19; inflation; monetary policy; macroeconomic performance; supply shock; inflation targeting; Latin America; efficiency frontier; output gap; central banks; economic crises; stabilization policies.

JEL Classification:

B41; E00; E31; E32; E42; E52; E58.

Resumen

Introducción

La pandemia de COVID-19 provocó un fuerte shock adverso de oferta, generando recesiones y aumento de la inflación en las economías latinoamericanas.

Objetivo

Este estudio evalúa el impacto de la pandemia en el desempeño macroeconómico y en la eficiencia de la política monetaria en diez países latinoamericanos bajo metas de inflación (MI).

Metodología

Se utiliza el método de frontera de eficiencia de variabilidad producto-inflación para descomponer los cambios en el desempeño macroeconómico entre aquellos causados por la variabilidad del shock de oferta y los atribuibles a la eficiencia de la política monetaria. El análisis compara el período pre-pandemia (2017–2019) con el de pandemia (2020–2022), empleando datos trimestrales de PIB, inflación y tasas de interés.

Resultados

Los hallazgos muestran una disminución generalizada del desempeño macroeconómico en la región durante la pandemia. En la mayoría de los casos, los shocks de oferta adversos se vieron amplificados por una menor eficiencia de la política monetaria. Sin embargo, República Dominicana y México lograron mitigar parcialmente los impactos negativos gracias a una expansión monetaria más cautelosa.

Conclusiones

Los resultados subrayan la importancia crítica de una política monetaria eficiente para estabilizar las economías en contextos de crisis. La contribución principal de este trabajo es ofrecer una evaluación sistemática de los regímenes de MI en América Latina bajo las circunstancias extraordinarias de la pandemia, aportando nueva evidencia empírica al debate sobre la resiliencia de estos marcos.

Palabras clave:

COVID-19; inflación; política monetaria; desempeño macroeconómico; shock de oferta; metas de inflación; América Latina; frontera de eficiencia; brecha del producto; bancos centrales; crisis económicas; políticas de estabilización.

Clasificación JEL:

B41; E00; E31; E32; E42; E52; E58.

1. Introduction

This study evaluates the impact of the COVID-19 pandemic on macroeconomic performance and the effectiveness of monetary policy in Latin American countries operating under Inflation Targeting (IT) frameworks between 2017 and 2022. The analysis covers ten countries—Brazil, Chile, Colombia, Costa Rica, Guatemala, Mexico, Paraguay, Peru, the Dominican Republic, and Uruguay—which together account for 75.97% of the region's population and 81.10% of its GDP (World Bank, 2021), underscoring the broader relevance of the findings.

Focusing on IT regimes is essential, as this monetary policy provides the foundation for applying the efficiency frontier methodology. The efficiency frontier illustrates the trade-off between inflation and output variability and is employed here to measure the efficiency of monetary policy across different periods. Building on Cecchetti *et al.* (2006) this approach enables us to attribute changes in macroeconomic performance either to supply-side shocks or to shifts in policy efficiency.

By comparing the pre-pandemic (2017-2019) with the pandemic period (2020-2022), we assess the extent to which the COVID-19 affected macroeconomic outcomes and the effectiveness of monetary interventions. The results indicate a widespread decline in macroeconomic performance across all sampled countries, primarily driven by the adverse supply shocks triggered by the pandemic. Notably, the central banks of the Dominican Republic and Mexico showed relative effectiveness in partially mitigating these impacts through their monetary policies.

The paper is organized into five sections. Section 2 presents the theoretical foundations of the efficiency frontier methodology within the canonical New-Keynesian (NK) framework, as described by Galí (2015), and discusses the key equations used to measure monetary policy efficiency. Section 3 outlines the methodology for estimating the efficiency frontier, allowing us to distinguish between variations in macroeconomic performance caused by supply shocks and those resulting from changes in monetary policy efficiency. Section 4 applies this methodology to evaluate the specific impact of the COVID-19 pandemic on ten Latin American countries under IT. Finally, Section 5 provides concluding remarks and policy implications.

This analysis contributes to the literature by filling an important gap. While previous studies have employed the efficiency frontier methodology to evaluate monetary policy across advanced and emerging economies (Cecchetti et al., 2006; Mishkin & Schmidt-Hebbel, 2007; Aguir & Smida, 2015), to the best of our knowledge no study has applied this approach to Latin American countries under Inflation Targeting during the COVID-19 pandemic. By doing so, our paper provides the first systematic assessment of whether monetary policy in the region was conducted efficiently under such extraordinary circumstances, thereby complementing existing work that has focused primarily on descriptive outcomes or Taylor-rule estimations. Furthermore, it enhances our understanding of how IT regimes in Latin America responded to the unprecedented economic challenges of the COVID-19 pandemic and offers insights into the role of monetary policy in stabilizing macroeconomic performance during crises.

2. Foundations of monetary economics: the new-keynesian model

This section presents the theoretical framework underlying contemporary monetary policy, particularly the NK model, as described by Galí (2015). The focus is on deriving key relationships that assess the effectiveness of monetary policy in achieving social welfare, the central aim of this study. Rooted in microeconomic foundations, the NK model has become a cornerstone of monetary policy strategies among major global central banks, especially those adopting IT, such as the Central Bank of Brazil, the Bank of Canada, the Bank of England, and the Bank of Japan, as noted by Costa Junior (2016).

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Building on the traditional Ramsey-Cass-Koopmans model, the NK framework assumes that economic agents are rational and optimize their behavior intertemporally. The model simplifies the economy by considering a representative agent with an infinite lifespan and a continuum of firms that employ identical technology and face isoelastic demand.

Thus, households face an intertemporal optimization problem in which they seek to maximize the expected utility of consumption over an infinite horizon. This problem is subject to a set of budget constraints, yielding a key relationship in which current consumption depends positively on expected future consumption, adjusted for real interest rates and preference parameters.

In turn, firms in the NK model operate under a Cobb-Douglas production function and face identical isoelastic demand[3]. Given price rigidities, they adjust prices according to current and expected future marginal costs. Firms set prices to achieve a desired markup over costs, resulting in forward-looking price setting that shapes inflation dynamics.

The core equations of the NK model include the New-Keynesian Phillips Curve (NKPC) and the dynamic IS equation. The NKPC links current inflation to expected future inflation and the output gap, while the IS equation relates the output gap to the real interest rate and expected future output. Together with the natural interest rate equilibrium, these equations constitute the foundation of the NK model, as noted by Galí (2015).

In this framework, optimal monetary policy seeks to stabilize firms' marginal costs, leading to a zero output gap and stable inflation. The Taylor Rule plays a central role in this context, prescribing how the nominal interest rate should adjust to deviations of inflation and output from their targets.

Finally, following the pioneering work of Rotemberg and Woodford (1999), the performance of monetary policy rules is often evaluated using social welfare criteria, particularly through second-order approximations of utility losses arising from inefficient allocations. This theoretical framework underpins methodologies for assessing monetary policy efficiency, which are further explored in the next section on the efficiency monetary policy frontier.

3. Efficiency monetary policy frontier

Building on the theoretical foundations of the NK model discussed in the previous section—which guide the actions of major global central banks, particularly those operating under IT—it is possible to estimate the degree of efficiency in conducting monetary policy using quantitative social welfare criteria. This section presents the theoretical aspects and methodology underlying the efficiency monetary policy frontier estimation, namely the trade-off between inflation and output variability.

As noted, this estimate makes it possible to measure the macroeconomic performance and the efficiency of a country's monetary policy (or a sample of countries). According to Svensson (2009), estimating the efficiency monetary policy frontier has been one of the most widely used methodologies to evaluate monetary policy over time, both *ex-ante*[4] and *ex-post*[5].

The efficiency monetary policy frontier provides an estimate of variations in macroeconomic performance that can be attributed to aggregate supply shocks and the effectiveness of monetary policy. Cecchetti and Krause (2002), Cecchetti *et al.* (2006), Mishkin and Schmidt-Hebbel (2007), and Aguir and Smida (2015) explain the intuition behind this concept. According to these authors, economies experience two types of shocks: aggregate demand shocks

3 In the production function, the capital stock is treated as fixed, and the economy's short-term investment is given as zero, following the proposition made by McCallum and Nelson (1999).

4 By making use of inflation expectations.

5 When using effective inflation.

and supply shocks. Aggregate demand shocks[6] and monetary policy move output and inflation in the same direction, enabling the central bank to offset their effects. In contrast, aggregate supply shocks[7] impose a trade-off between inflation and output variability, giving rise to the efficiency monetary policy frontier, which minimizes both. If monetary policy is suboptimal, the economy will lie at a point above and to the right of the efficiency frontier, resulting in higher levels of inflation and output variability.

This trade-off allows for the construction of a efficiency monetary policy frontier where inflation and output variability are minimized, meaning that monetary policy is optimal (efficient), as illustrated in Figure 1. If monetary policy is suboptimal, the economy will not lie on the efficiency frontier but will instead be represented by a performance point located above and to the right of it. In this case, inflation and output variability exceed optimal levels, as shown in Figure 1.

The position of the efficiency monetary policy frontier depends on the variability of supply shocks. When the variability of these shocks is low, the efficiency frontier lies closer to the origin. Conversely, when the variability of supply shocks is high, the frontier shifts farther from the origin. The slope of the efficiency monetary policy frontier is determined by the structural conditions of aggregate demand and supply in the economy, which in turn depend on the model parameters.

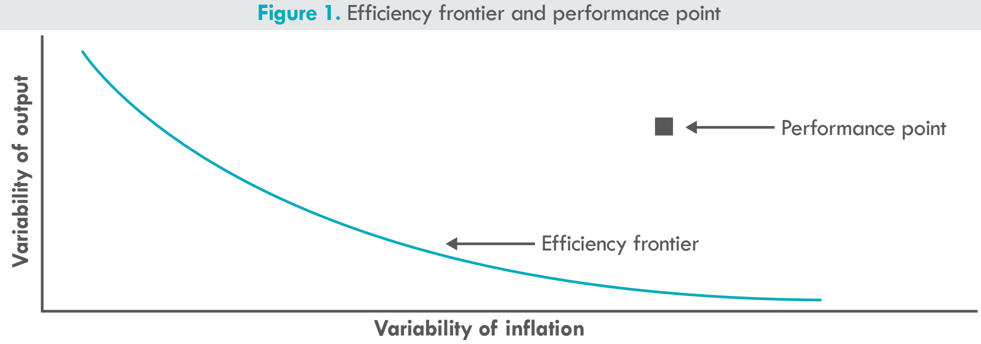
It is assumed that the objective of central bank monetary policy is to minimize a weighted sum of inflation and output variability. The following quadratic social welfare loss function can represent this:

$$L = \lambda(\pi_t - \pi_t^m)^2 + (1 - \lambda)(y_t - y_t^p)^2 \quad [1]$$

Where $(\pi_t - \pi_t^m)^2$ is the quadratic deviation of current inflation (π_t) in relation to the inflation target (π_t^m), and $(y_t - y_t^p)^2$ represents the quadratic deviation of current output (y_t) in relation to the potential output (y_t^p). λ is the central bank's preference parameter[8], being $\lambda \in [0,1]$ and assumed to be constant. Although strong, this assumption is essential, as it makes it possible to compare macroeconomic performance over time (Cecchetti et al., 2006). All other equations presented in this section are derived from this social welfare loss function.

The parameter λ can be measured using the efficiency monetary policy frontier methodology, as in by Cecchetti and Ehrmann (2000) and

Figure 1. Efficiency frontier and performance point



Source: adapted from Cecchetti et al. (2006).

6 Aggregate demand shocks have different causes, from changes in consumer preferences to changes in economic policy (monetary and fiscal), which impact the size of the employment/output gap.

7 Aggregate supply shocks affect production costs. The main aggregate supply shocks are the oil crises of 1973 and 1979 and the COVID-19 pandemic in 2020.

8 Cecchetti and Ehrmann (2000) refer to this parameter as the central bank inflation variability aversion index.

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Krause (2007), or through alternative approaches such as those employed by Favero and Rovelli (2003) and Dennis (2004). Another option is to assign a plausible value for this parameter based on the literature, as done by Cecchetti et al. (2006). Following Cecchetti and Ehrmann (2000) estimations, the value of the central bank preference parameter adopted for the empirical estimations is approximately 0.8, based on a sample of developed countries.

Macroeconomic performance (P_t) in period t ($t = 1{,}2$) can be computed as the weighted average of observed inflation and output variability, that is, the social welfare loss function:

$$P_t = \lambda(\pi_t - \pi_t^m)^2 + (1-\lambda)(y_t - y_t^p)^2 \qquad [2]$$

Changes in macroeconomic performance, represented as the variation in P between one period and the subsequent period, $\Delta P = P_1 - P_2$, constitute an important indicator. A positive ΔP signifies an improvement in macroeconomic performance, whereas a negative ΔP indicates a deterioration. This equation, together with Figure 1, defines the performance point.

As emphasized by Cecchetti et al. (2006), shifts in the efficiency monetary policy frontier over time are driven solely by the variability of supply shocks (S_t). These shifts can be measured through changes in the weighted sum of the optimal variability of inflation and output, expressed as:

$$s_t = \lambda(\pi_t - \pi_t^*)^2 + (1-\lambda)(y_t - y_t^*)^2 \qquad [3]$$

In which $(\pi_t - \pi_t^*)^2$ is the quadratic deviation of current inflation (π_t) in relation to the optimal inflation rate (π_t^*), under the optimal monetary policy, and $(y_t - y_t^*)^2$ is the quadratic deviation of the current output (y_t) in relation to the optimal output (y_t^*), under the optimal monetary policy. The efficiency monetary policy frontier is projected using this equation, as shown in Figure 1.

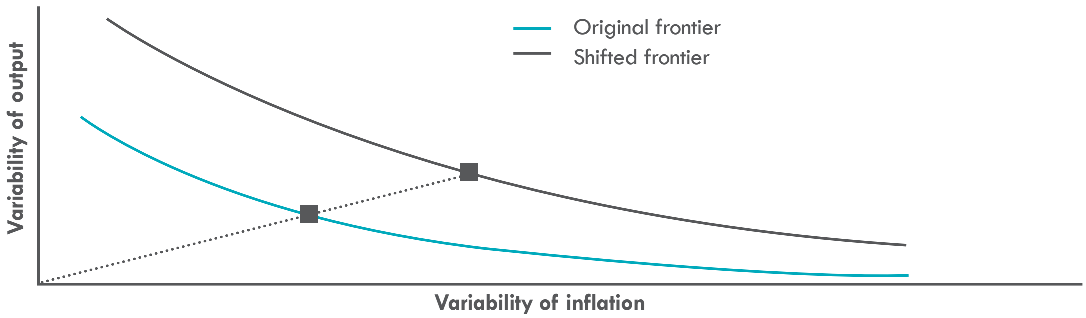
Changes in the variability of supply shocks can be represented as the difference in S between a period and the immediately preceding one, that is, $\Delta S = S_2 - S_1$. A positive ΔS indicates that the supply shocks affecting the economy were larger in absolute magnitude. Conversely, a negative ΔS implies smaller shocks, bringing the efficiency monetary policy frontier closer to the origin. Svensson (2009) provides an example of such displacement over time, showing that in the Swedish economy the efficiency frontier moved progressively farther from the origin due to the effects of the 2007-2008 Financial Crisis. Figure 2 illustrates the shift in the efficiency monetary policy frontier following an adverse supply shock.

Monetary policy efficiency is assessed by observing how close (or far) current policy performance is to the optimal benchmark. Accordingly, monetary policy inefficiency (E_t) in period can be measured using the following equation:

$$E_t = \lambda[(\pi_t - \pi_t^m)^2 - (\pi_t - \pi_t^*)^2] + (1-\lambda)\left[(y_t - y_t^p)^2 - (y_t - y_t^*)^2\right] \qquad [4]$$

Equation 4 estimates the distance between the performance point and the efficiency monetary policy frontier. Ideally, the values of E_t should be as small as possible (close to 0), indicating that current monetary policy is near the optimal. Changes in the inefficiency of monetary policy can be interpreted as variations in E between one period and the next one, that is, $\Delta E = E_1 - E_2$. A positive ΔE implies an improvement in monetary policy efficiency, whereas a negative ΔE reflects a deterioration, meaning the economy moves farther away from the efficiency monetary policy frontier.

Figure 2. Effects of a supply shock on the efficiency frontier



Source: adapted from Cecchetti et al. (2006).

Finally, the contribution of monetary policy efficiency to variations in macroeconomic performance can be computed as the ratio between the two performance components, that is:

$$Q = \frac{\Delta E}{|\Delta P|} \qquad [5]$$

Because the denominator of the ratio contains the absolute value of the change in macroeconomic performance ($|\Delta P|$), positive values of Q indicate greater monetary policy efficiency, whereas negative Q values signal a decline in efficiency. Following Cecchetti et al. (2006), when an economy experiences gains in macroeconomic performance ($\Delta P>0$), simultaneous improvements in monetary policy efficiency ($\Delta E>0$) and a reduction in the variability of supply shocks ($\Delta S<0$) imply that Q lies between 0 and 1, indicating the extent to which more efficient monetary policy contributed to the improvement in macroeconomic performance.

Estimating the efficiency monetary policy frontier has become one of the most widely used approaches to evaluate monetary policy over time. For instance, Cecchetti and Krause (2002) examine the relationships among central bank independence, credibility, transparency, and accountability of the monetary authority and estimate changes in macroeconomic performance and monetary policy efficiency using the efficiency frontier for a sample of 24 countries between 1991 and 1998. Cecchetti et al. (2006) extend the analysis period of this last sample (1983-1998) and assess the share of macroeconomic performance variation attributable to monetary policy.

Mishkin and Schmidt-Hebbel (2007) analyze macroeconomic performance and the efficiency of monetary policy, using the efficiency frontier, for a sample of 34 industrialized and emerging countries that adopted IT before and after the shock of the fall in oil prices from 1997 to 1998. Svensson (2009) surveys the main methods for evaluating monetary policy and highlights the efficiency-frontier approach, both ex-ante (using inflation expectations) and ex-post (using realized inflation). Aguir and Smida (2015) estimate the effects of adopting IT through the efficiency monetary policy frontier, comparing 16 adopters with 11 emerging economies using alternative monetary frameworks.

4. Impacts of the COVID-19 pandemic on macroeconomic performance and the efficiency of monetary policy in Latin American economies under it

At the onset of the COVID-19 pandemic in 2020, ten of the twenty Latin American countries had adopted IT as their monetary policy framework. These countries—Brazil, Chile, Colombia, Costa Rica, Guatemala, Mexico, Paraguay, Peru, Dominican Republic, and Uruguay—constitute the sample of this study. Together, they account for 75.97% of the region's population and 81.10% of its GDP (The World Bank, 2021), underscoring the relevance of the sample.

As noted in the introduction, the analysis covers the period from 2017 to 2022, with the main objective of comparing macroeconomic performance and the effectiveness of monetary policy between the pre-pandemic period (2017-2019, i.e., $t = 1$) and the pandemic years (2020-2022, that is, $t = 2$), with particular emphasis on the latter.

The primary objective is to estimate macroeconomic performance (ΔP), the variability of supply shocks (ΔS), and the efficiency of monetary policy (ΔE) for the countries in the sample, in order to infer the variations in efficiency (or inefficiency) of the monetary policy, which is represented by the Q quotient, during the COVID-19 pandemic. To achieve this, it is first necessary to estimate the conditions of aggregate demand (inflation) and aggregate supply (output). Quarterly data on seasonally adjusted real GDP in log form, current inflation, and the nominal interest rate are employed, with the latter two expressed as accumulated values over the previous 12 months[9]. Real GDP is seasonally adjusted using the U.S. Census Bureau's X13-ARIMA-SEATS software. Potential output is estimated with the Hodrick-Prescott (1997) filter (HP filter), which, despite criticisms, remains a widely used and reliable statistical tool (Drehmann & Yetman, 2018). The primary data source is the International Monetary Fund's International Financial Statistics (IMF, 2024).

Furthermore, the econometric model used to estimate the efficiency monetary policy frontier—necessary for computing the variables described in the previous section—is presented below. Based on these estimates, it is then possible to construct the efficiency monetary policy frontier and establish a rule for determining the nominal interest rate that guides monetary policy over time. This procedure helps to identify the level of macroeconomic performance and the efficiency of monetary policy in each of the sample countries over the period 2017-2022.

4.1 Econometric methodology

Building on the theoretical model of Svensson (1997) and the empirical model of Rudebusch and Svensson (1998), several studies have developed vector autoregressive (VAR) models. These models, based on a system of two linear equations, have been widely used to estimate an economy's structural demand and supply conditions. Notable contributions in this area include Cecchetti and Krause (2002), Cecchetti et al. (2006), and Mishkin and Schmidt-Hebbel (2007). With the development of more robust and sophisticated econometric methods, however, part of the literature has shifted toward panel data regression models for such estimations. A prominent example is Aguir and Smida (2015), who employ a pooled Ordinary Least Squares (OLS) regression to estimate demand and supply conditions for 27 countries. Following this evolution, the present article also estimates structural conditions using a fixed effects model.

As done by Aguir and Smida (2015) and following Cecchetti et al. (2006), the aggregate demand curve for period t can be estimated as:

In which real GDP (y) seasonally adjusted in log is explained by two of its lags[10], two lags of the nominal interest rate (i), and two lags of inflation (π). The error term (ε_1) assumes zero mean and constant variance and represents an exogenous structural shock to aggregate demand.

$$y_t = \alpha_1 i_{t-1} + \alpha_2 i_{t-2} + \alpha_3 y_{t-1} + \alpha_4 y_{t-2} + \alpha_5 \pi_{t-1} + \alpha_6 \pi_{t-2} + \varepsilon_{1t} \qquad [6]$$

9 Descriptive statistics are available upon request.

10 In line with previous studies employing the efficiency frontier methodology (Cecchetti et al., 2006; Aguir & Smida, 2015), we considered up to two lags of the variables in Equations 6 and 7. We verified lag selection using the Schwarz Information Criterion (BIC), and the results remain robust.

Likewise, as shown by Cecchetti et al. (2006), the aggregate supply curve (Phillips curve) in period t can be estimated as:

$$\pi_t = \beta_1 y_{t-1} + \beta_2 y_{t-2} + \beta_3 \pi_{t-1} + \beta_4 \pi_{t-2} + \varepsilon_{2t} \quad [7]$$

In which the deviations of current inflation (π) from its inflation target are explained by two of its lags (representing inflation expectations) and two log seasonally adjusted GDP lags. The error term (ε_2) assumes zero mean and constant variance and denotes an exogenous structural shock to aggregate supply.

Equations 6 and 7, according to Aguir and Smida (2015), can also be represented in matrix form, as:

$$X_t = AX_{t-1} + Bi_{t-1} + v_t \quad [8]$$

Where X_t represents the vector of endogenous variables of the model, A denotes the matrix of model parameters, B symbolizes the vector of constants, and v_t represents the vector of random disturbances not correlated with each other contemporaneously or temporally (Bueno, 2011).

Equations 7 and 8 are estimated separately with quarterly data using a fixed effects model. This comprehensive approach enhances the robustness of the results. To complete the model, a rule for determining the nominal interest rate must be specified, allowing the estimation of the efficiency monetary policy frontier for each country in the sample for the period 2017-2022. This exercise is presented in the following subsection.

4.2 Construction of the efficiency monetary policy frontier

As discussed in section 3, central bank monetary policy is assumed to minimize a quadratic social welfare loss function. This requires determining the nominal interest rate path that minimizes a weighted average of the squared deviations of inflation and output from their target levels. Following Cecchetti et al. (2006), the social welfare loss function (Equation 2) can be expressed as:

$$E(P) = E\left[\lambda(\pi_t - \pi_t^m)^2 + (1-\lambda)(y_t - y_t^p)^2\right] \quad [9]$$

The monetary authority is also considered to follow a simple rule: the nominal interest rate (i_t) will be determined based on the evolution of the model's endogenous variables (X_t). This rule takes the following form.

$$i_t = f(X_t) \quad [10]$$

In this way, it is supposed that the central bank aims to solve the following optimization (minimization) problem:

$$\sum_{t=0}^{\infty} \delta^\tau (X'_{t+\tau} Q X_{t+\tau} + 2X'_{t+\tau} U i_{t+\tau} + i'_{t+\tau} R i_{t+\tau}) \quad [11]$$

Subject to restrictions:

$$\{ X_t = AX_{t-1} + Bi_{t-1} + v_t \, i_t = f(X_t) \quad [12]$$

This optimization problem involves a series of sequential decisions over time. The optimal strategy for this process is determined using the dynamic programming technique. The solution to this problem can be found through:

$$s = (R + \delta B' \, VB) \, (U' + \delta B' \, VA) \qquad [13]$$

Where:

$$V = Q + Us + 2(s' \, U') + s' \, Rs + \delta(A + Bs)' \, V(A+Bs) \qquad [14]$$

Econometric software is required to obtain the numerical solution of Equation 13. Optimal inflation and output variabilities can be determined after solving Equation 10, assuming the central bank seeks to stabilize inflation and output variabilities at a given value of λ. This procedure allows us for plotting a point on the efficiency monetary policy frontier. By adjusting the values of λ, the complete efficiency monetary policy frontier can be mapped. Once the efficiency monetary policy frontier has been estimated, changes in ΔP, ΔS, and ΔE can be measured for the period from 2017 to 2022 across the ten Latin American countries operating under IT. This enables an assessment of monetary policy's efficiency (or inefficiency) through the Q quotient between the two periods analyzed. All these estimates are presented in the subsections that follow.

4.3 Inflation targeting in Latin America: 2017-2022

As explained by Bernanke et al. (1999), IT is a monetary framework in which the monetary authority, the central bank, announces to the public a numerical target for inflation, generally considering the accumulated inflation over 12 months. Within this framework, the central bank and authorities are committed to delivering current inflation close to this pre-established target.

Based on the arguments presented by Bernanke and Mishkin (1997), Bernanke et al. (1999), Mishkin (2000) and Svensson (2010), IT is a monetary policy strategy that can be characterized by having six main elements: (i) the public announcement of a numerical target for inflation for the medium term; (ii) an institutional commitment to price stability as the primary objective of monetary policy, so that other objectives are subordinate; (iii) a strategy that uses all available information to decide the definition of policy instruments; (iv) greater transparency of the monetary policy strategy through communication to the public and markets regarding the monetary authority's plans, objectives and decisions; (v) holding the central bank accountable for its actions and results concerning its inflation objectives; and (vi) a central role of projections of inflation expectations for monetary policy decisions, which has been called forecast targeting in the literature (Svensson, 1997; 2010; Woodford, 2003).

In short, IT main characteristic, which gives its name to this monetary framework, is a numerical target for inflation. The numerical target for inflation then becomes the nominal reference anchor for agents about the future behavior of the general price level. As pointed out in the introduction to this work, according to the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (IMF, 2023), among the organization's 193 member countries, IT is the most popular monetary regime, having been adopted by 45 economies. This pattern is also observed in Latin America. Of its 20 countries, ten adopted IT as their monetary framework.

Table 1 reports the respective numerical targets for inflation assumed by the sample countries throughout the analysis of this work (2017-2022). Peru has had the lowest numerical inflation target throughout the period, with a central target of 2% and a tolerance margin of 1 percentage point up and down, without changing it over time. Until the 2017-2018 biennium, Brazil was the second country with the highest inflation target, with a central target of 4.5% and a tolerance margin of 1.5 percentage points up and down. From the following year onwards, the central target and tolerance limits will be reduced by 0.25 p.p. to the end of 2022, with a central target of 3.5%, an upper limit of 5% and a lower limit of less than 2%. In this con-

Table 1. Inflation targets in Latin America, 2017-2022

		2017	2018	2019	2020	2021	2022
Brazil	Upper Limit	6.00	6.00	5.75	5.50	5.25	5.00
	Central Target	4.50	4.50	4.25	4.00	3.75	3.50
	Lower Limit	3.00	3.00	2.75	2.50	2.25	2.00
Chile	Upper Limit	4.00	4.00	4.00	4.00	4.00	4.00
	Central Target	3.00	3.00	3.00	3.00	3.00	3.00
	Lower Limit	2.00	2.00	2.00	2.00	2.00	2.00
Colombia	Upper Limit	4.00	4.00	4.00	4.00	4.00	4.00
	Central Target	3.00	3.00	3.00	3.00	3.00	3.00
	Lower Limit	2.00	2.00	2.00	2.00	2.00	2.00
Costa Rica	Upper Limit		4.00	4.00	4.00	4.00	4.00
	Central Target		3.00	3.00	3.00	3.00	3.00
	Lower Limit		2.00	2.00	2.00	2.00	2.00
Dominican Republic	Upper Limit	5.00	5.00	5.00	5.00	5.00	5.00
	Central Target	4.00	4.00	4.00	4.00	4.00	4.00
	Lower Limit	3.00	3.00	3.00	3.00	3.00	3.00
Guatemala	Upper Limit	5.00	5.00	5.00	5.00	5.00	5.00
	Central Target	4.00	4.00	4.00	4.00	4.00	4.00
	Lower Limit	3.00	3.00	3.00	3.00	3.00	3.00
Mexico	Upper Limit	4.00	4.00	4.00	4.00	4.00	4.00
	Central Target	3.00	3.00	3.00	3.00	3.00	3.00
	Lower Limit	2.00	2.00	2.00	2.00	2.00	2.00
Paraguay	Upper Limit	6.00	6.00	6.00	6.00	6.00	6.00
	Central Target	4.00	4.00	4.00	4.00	4.00	4.00
	Lower Limit	2.00	2.00	2.00	2.00	2.00	2.00
Peru	Upper Limit	3.00	3.00	3.00	3.00	3.00	3.00
	Central Target	2.00	2.00	2.00	2.00	2.00	2.00
	Lower Limit	1.00	1.00	1.00	1.00	1.00	1.00
Uruguay	Upper Limit	7.00	7.00	7.00	7.00	7.00	6.00
	Lower Limit	3.00	3.00	3.00	3.00	3.00	3.00

Source: own elaboration based on Annual Inflation Target Reports from the Central Banks of Latin America (2017-2022).

text, Paraguay becomes the second country with the highest inflation target, with a central target of 4% and a tolerance interval of 2 percentage points up and down. Guatemala and the Dominican Republic have the same inflation target: a central target of 4% and a tolerance interval of 1 percentage point up and down. Chile, Colombia, Costa Rica, and Mexico also share the same inflation target: a central target of 3% and a tolerance margin of 1 percentage point up and down. Uruguay is the country in the sample with the highest inflation target: a band with an upper limit of 6% and a lower limit of 3%.

It is also noteworthy that only Brazil and Uruguay reduced their inflation targets throughout the period analyzed by this work (2017-2022), with the latter reducing the upper limit from 7% to 6% in September 2022. Finally, it is noticeable that the numerical inflation target of 3% is the only point in common among all countries in the sample in all years of analysis. Therefore, it is assumed that the inflation target used to carry out the theoretical estimates in section 3 of this work is 3% per year. Although strong, this assumption is essential, as it makes it possible to make comparisons of macroeconomic performance between the countries in the sample over time, following Cecchetti et al. (2006).

The impact of COVID-19 on inflation in Latin American countries under IT is stark. Table 2 illustrates the changes in average inflation rates and volatility during the pre-pandemic (2017-2019) and pandemic (2020-2022) periods. A noticeable increase in both the average accumulated inflation rate over the last 12 months and annual inflation volatility (in %, calculated from the standard deviation) is observed for all countries in the sample. This surge is attributed to the adverse supply shock caused by the pandemic.

Uruguay stands out as the country with the highest average inflation rate, recording 7.24% p.a. between 2017-2019 and 8.87% p.a. between 2020-2022, marking a 1.63 p.p. increase (+22.51%). However, its inflation volatility remained relatively stable, increasing from 3.47% p.a. to 3.78% p.a. (+8.93%). This suggests that Uruguay may have been the least affected by the COVID-19 impact on inflation, a unique position compared to other countries that experienced significant jumps in average inflation and volatility during 2020-2022.

Chile was the country where there was the most significant average increase in inflation: it jumped from 2.29% p.a. between the years 2017-2019 to 6.38% p.a. between the years 2020-2022, which represents an increase of 4.09 p.p. (+178.60%). Brazil was also one of the countries with the most significant jump in inflation, going from an average of 3.62% p.a. between the years 2017-2019 to 6.95% p.a. between the years 2020-2022, representing a rise of 3.33 p.p. (+91.99%). In this sense, Costa Rica also stood out, with a jump in inflation of 2.16% p.a. to 3.57% p.a., an increase of 1.41 p.p. (+65.28%), Paraguay, with inflation rising from 3.44% to 5.44%, an addition of 2.00 p.p. (+58.14%), and Colombia, with inflation hovering around 3.69% p.a. to 5.39% p.a., representing an increase of 1.70 p.p. (+46.07%). For the pre-pandemic period (2017-2019), it was observed that average inflation was outside the inflation targets for Mexico, the Dominican Republic, and Uruguay. During the COVID-19 pandemic (2020-2022), only Costa Rica, Guatemala, and Paraguay managed to maintain average inflation within the inflation targets.

The preliminary descriptive analysis reveals markedly different characteristics and outcomes among Latin American countries with inflation targets from 2017 to 2022. To draw reliable inferences and compare experiences across the period of analysis, and following the methodology outlined in section 3, the next subsection

Table 2. Inflation of Latin American countries with inflation targets, 2017-2022

Countries	2017-2019		2020-2022	
	Average 12m (%)	Volatility (%)	Average 12m (%)	Volatility (%)
Brazil	3.62	2.90	6.95	11.48
Chile	2.29	1.48	6.38	14.17
Colombia	3.69	2.09	5.39	12.93
Costa Rica	2.16	1.32	3.57	13.01
Dominican Republic	2.89	3.92	6.95	8.89
Guatemala	3.96	2.93	4.78	8.33
Mexico	4.86	3.92	5.66	7.01
Paraguay	3.44	2.81	5.44	12.65
Peru	2.09	2.92	4.55	9.51
Uruguay	7.24	3.47	8.87	3.78
Average	3.62	2.78	5.85	10.18

Source: own elaboration based on data from the IMF's International Financial Statistics (IMF, 2023).

presents an empirical analysis of the results, detailing the macroeconomic performance and the efficiency of monetary policy in Latin American countries over 2017-2022.

4.4 Inflation targeting results in Latin America, 2017-2022

The main objective of this subsection is to present the empirical results of the efficiency monetary policy frontier estimations. First, the results of the econometric methodology are reported, which make it possible to evaluate the structural conditions (demand and supply) necessary for estimating the efficiency monetary policy frontier. Table 3 shows the regression results of Equation 6, which estimates the aggregate demand conditions of the economies.

The columns show the results of the fixed effects model. The difference between the two columns is the use of the dummy variable for IT since Costa Rica only adopted the monetary framework in 2018, one year after the start of the time series of interest. The F test compares the pooled model and the fixed effects model, indicating which one best fits the data. The result was significant at a p-value of 1%, demonstrating that the fixed effects model fits the data better than the pooled model, which justifies the choice of the fixed effects model. In this model, the statistical significance of the following variables is constant: second-time lag of real GDP in log, second-time lag of the interest rate, first-time lag of the inflation rate, and the dummy variable for IT.

The second time lag of real GDP in log and the first time lag of the inflation rate positively impact aggregate demand. As for the positive impact of the inflation rate on aggregate demand, this may indicate that all countries suffer from a process of demand inflation. Furthermore, the dummy variable for IT suggests that the monetary framework had a positive impact (more significant than not operating under IT) on aggregate demand. Finally, the second lag in the nominal interest rate has an adverse effect on aggregate demand, which aligns with the literature that finds the impact of the time lag in the interest rate on the output.

Table 3. Results of the fixed effects model for estimating aggregate demand

Variables	(1)	(2)
	logpib	logpib
laglogpib	-0.00377	-0.00371
	(0.00243)	(0.00243)
lag2logpib	0.00549**	0.00531**
	(0.00221)	(0.00226)
lagtxjur	0.331	0.328
	(0.267)	(0.268)
lag2txjur	-0.644**	-0.641**
	(0.234)	(0.237)
lagtxinf	0.353***	0.346**
	(0.107)	(0.109)
lag2txinf	0.315	0.323
	(0.293)	(0.290)
it		0.959*
		(0.441)
Constant	711.0***	710.1***
	(0.992)	(0.651)
Observations	240	240
R-squared	0.330	0.331
Prob > F	0.000***	0.000***
Number of id	10	10

Note: *** p<0,01; ** p<0,05; * p<0,1; standard error in parentheses.

Source: own elaboration.

Likewise, Table 4 presents the results of the regression of Equation 7, which estimates the aggregate supply conditions of the economies. Similarly to the previous table, the columns show the results of the fixed effects model. The difference between the two columns is the use of the dummy variable for Costa Rica's IT.

Again, the F test showed a significant result at a p-value of 1%, which indicates that the fixed effects model fits the data better than the pooled model, which justifies the choice of the fixed effects model. The model has statistical significance for all variables except the dummy variable for IT. The first-time lag of real GDP in log and the second-time lag of the inflation rate have a negative impact on aggrega-

Sociedad y Economía N° 55 (2025) / e-ISSN: 2389-9050 / e10814442
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te supply. On the other hand, the second time lag of real GDP in log and the first-time lag of the inflation rate positively impact aggregate supply.

Having obtained the results of the regressions referring to Equations 6 and 7 and following the methodology presented in subsection 4.2, the optimal inflation rate and optimal output values are estimated, determining the efficiency monetary policy frontier. From these estimates, it is possible to calculate all social welfare loss functions seen in Section 3.

Before presenting the estimates of social welfare loss functions, following Cecchetti et al. (2006), a simulation method is used to make the estimated measures more robust. We use the parametric recursive bootstrap method from Freedman and Peters (1984) to obtain samples for each country's social welfare loss functions. One thousand samples are obtained via bootstrap for each social welfare loss function from each country to obtain a better median of the estimated measures. The corrected median ($\hat{\beta}MC$) aims to obtain more robust estimates of the central tendency parameter, being estimated as:

$$\hat{\beta}_{MC} = 2\hat{\beta} - \hat{\beta}^{*}_{median} \qquad [15]$$

Where $\hat{\beta}$ represents the original median of the estimates of each social welfare loss function, and ($\hat{\beta}_{median}$) is the median estimated via bootstrap[11]. Thus, the estimated corrected median represents the value of the social welfare loss function of interest for each period t ($t = 1,2$).

The model and the efficiency monetary policy frontier are estimated for each country in the sample for the two periods of interest, 2017-2019 ($t = 1$) and 2020-2022 ($t = 2$). To this end, the common inflation target of 3% p.a. is considered for all countries in the sample, and the value of the central bank preference parameter of 0.8[12], which makes it possible to carry out analyses over time and between countries in the sample, as argued by Cecchetti *et al.* (2006). In this sense, Table 5 summarizes the macroeconomic performance estimates (P_t) results, including the social welfare loss function and its variation between the two analysis periods.

In Section 3, we highlighted that if ΔP is positive, there is a gain in macroeconomic performance; consequently, if ΔP is negative, this reveals a loss in macroeconomic performance. It is observed that the adverse supply shock caused by the COVID-19 pandemic led all countries in the sample to present a loss of macroeconomic performance between the two periods. It is noteworthy that seven of the ten countries in the sample noticed a worsening of their macroeconomic performance by more than -85% with the arrival of the effects of the pandemic on their economies, with only Mexico, Guatemala, and Uruguay showing

Table 4. Results of the fixed effects model for estimating aggregate supply

Variables	(1)	(2)
	txinf	txinf
laglogpib	-0.00648***	-0.00648***
	(0.00112)	(0.00112)
lag2logpib	0.00224***	0.00222***
	(0.000593)	(0.000605)
lagtxinf	1.140***	1.138***
	(0.0881)	(0.0891)
lag2txinf	-0.241**	-0.239**
	(0.0763)	(0.0772)
it		0.143
		(0.155)
Constant	3.694***	3.564***
	(0.540)	(0.448)
Observations	240	240
R-squared	0.802	0.802
Prob > F	0.000***	0.000***
Number of id	10	10

Note: *** p<0,01; ** p<0,05; * p<0,1; standard error in parentheses.

Source: own elaboration.

11 It is the median of the 1000 samples.

12 We also estimated with the values of 0.65 and 0.95 for the central bank preference parameter, and the conclusions remained unchanged. Results available upon request.

Table 5. Loss value and change in macroeconomic performance

Countries	2017-2019 (t=1)	2020-2022 (t=2)	Variation (ΔP=P1−P2)	Performance variation (Δ%)
Brazil	0.347	10.889	-10.542	-96.81%
Chile	0.484	7.447	-6.963	-93.50%
Colombia	0.330	5.672	-5.342	-94.18%
Costa Rica	0.731	6.358	-5.627	-88.50%
Dominican Republic	0.725	23.272	-22.547	-96.88%
Guatemala	1.126	3.324	-2.198	-66.13%
Mexico	2.980	12.961	-9.981	-77.01%
Paraguay	0.331	10.503	-10.172	-96.85%
Peru	0.874	8.618	-7.744	-89.86%
Uruguay	16.750	31.060	-14.310	-46.07%

Note: measurement estimates were obtained by taking the corrected median.

Source: own elaboration.

more minor variations. The latter was also the country in the sample with the lowest variation, at -46.07%. The country that recorded the worst performance was the Dominican Republic, with a variation of -96.88 % between the periods, closely followed by Paraguay and Brazil.

Once the variations in macroeconomic performance (ΔP) are estimated, Table 6 explains the variability of supply shocks (S_t), which determines the position of the efficiency monetary policy frontier. If ΔS is positive, this denotes that the supply shocks that hit the economy were more significant in absolute value. In turn, if ΔS is negative, the supply shocks that hit the economy were more minor, and the efficiency monetary policy frontier approached the origin.

These estimates highlight the impact of the adverse supply shock on the economy's supply conditions, as they represent the weighted average (by the central bank's preference parameter) of the quadratic deviation of current inflation (π_t) in relation to the optimal inflation rate (π_t^*), under the optimal monetary policy, and the quadratic deviation of the current output (y_t) concerning the optimal output (y_t^*), under the optimal monetary policy. There is a worsening of supply conditions in practically all countries in the sample, except Uruguay, which showed a reasonable improvement. This is because the volatility of its inflation has changed little, as shown in Table 1 of subsection 4.3, compared to other countries. Furthermore, its high inflation rate over time, with smaller peaks than in different countries, discounting the optimal inflation rate (higher than the inflation target of 3% p.a.), also helps explain this result of improvement in supply conditions, compared to other countries in the sample that showed a worsening.

From the estimates of variation in macroeconomic performance (P_t), and the variability of supply shocks (S_t), we obtain the variations in monetary policy inefficiency (E_t), observed in Table 7. As emphasized in section 3, this equation shows us the distance between the performance point and the efficiency monetary policy frontier. The values E_t should be as small as possible (close to 0), which indicates that the current monetary policy is close to the optimal monetary policy. If ΔE is positive, this means that there has been an increase in the efficiency of monetary policy. If ΔE is negative, this reveals that there has been a worsening in the efficiency of monetary policy, and the economy has moved away from the efficiency monetary policy frontier.

The analysis indicates that the monetary policies implemented by the central banks of all the countries in the study have become less effective due to the adverse supply shock caused by the COVID-19 pandemic. This suggests that the economies have deviated from the optimal path

Sociedad y Economía N° 55 (2025) / e-ISSN: 2389-9050 / e10814442
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Table 6. Loss value and change in supply conditions

Countries	2017-2019 (t=1)	2020-2022 (t=2)	Variation (ΔS=S2–S1)	Supply Variation (Δ%)
Brazil	0.747	6.055	5.308	-87.66%
Chile	1.715	9.604	7.889	-82.14%
Colombia	0.509	13.924	13.415	-96.34%
Costa Rica	2.268	14.405	12.137	-84.26%
Dominican Republic	0.597	7.706	7.109	-92.25%
Guatemala	0.498	3.029	2.531	-83.56%
Mexico	1.364	5.348	3.984	-74.50%
Paraguay	0.751	9.967	9.216	-92.47%
Peru	2.270	8.638	6.368	-73.72%
Uruguay	12.427	10.416	-2.011	19.31%

Note: measurement estimates were obtained by taking the corrected median.

Source: own elaboration.

Table 7. Loss value and change in monetary policy inefficiency

Countries	2017-2019 (t=1)	2020-2022 (t=2)	Variation (ΔE=E1–E2)	Inefficiency variation (Δ%)
Brazil	0.917	11.850	-10.933	-92.26%
Chile	1.301	8.788	-7.487	-85.20%
Colombia	0.424	12.853	-12.429	-96.70%
Costa Rica	1.520	15.314	-13.794	-90.07%
Dominican Republic	0.949	15.969	-15.020	-94.06%
Guatemala	0.987	5.779	-4.792	-82.92%
Mexico	1.626	7.153	-5.527	-77.27%
Paraguay	1.225	11.406	-10.181	-89.26%
Peru	1.524	11.111	-9.587	-86.28%
Uruguay	4.251	20.066	-15.815	-78.81%

Note: measurement estimates were obtained by taking the corrected median.

Source: own elaboration.

of monetary policy. Eight out of the ten countries evaluated experienced a significant deterioration in the effectiveness of their monetary policy, with Uruguay and Mexico being the only exceptions, although they also observed slight variations. With these findings in mind, we can deduce the extent to which monetary policy's efficiency (or inefficiency) (Q) contributes to the variations in macroeconomic performance, as shown in Table 8.

As the denominator of the ratio contains the absolute value of the change in macroeconomic performance ($|\Delta P|$), this implies that positive Q values indicate greater efficiency of monetary policy. In contrast, negative Q values show that monetary policy has become less efficient. If an economy observes gains in macroeconomic performance ($\Delta P > 0$) and at the same time, monetary policy becomes more efficient ($\Delta E > 0$) and the variability of supply shocks is smaller ($\Delta S < 0$), Q will be a number between 0 and 1. This quotient indicates the contribution of the most efficient monetary policy to the gain in macroeconomic performance.

However, as observed in the results of previous estimates explained in Table 5, Table 6, and Table 7, the analysis scenario is the opposite. The conclusion must differ from that formalized by Cecchetti et al. (2006), that is, if an economy experiences a loss of macroeconomic perfor-

Table 8. Loss and gain value of monetary policy efficiency

Countries	Variation ($\Delta E=E1-E2$)	Variation ($\Delta P=P1-P2$)	Absolute value ($\|P\|$)	Efficiency gain (Q)
Brazil	-10.933	-10.542	10.542	-1.037
Chile	-7.487	-6.963	6.963	-1.075
Colombia	-12.429	-5.342	5.342	-2.327
Costa Rica	-13.794	-5.627	5.627	-2.451
Dominican Republic	-15.020	-22.547	22.547	-0.666
Guatemala	-4.792	-2.198	2.198	-2.180
Mexico	-5.527	-9.981	9.981	-0.554
Paraguay	-10.181	-10.172	10.172	-1.001
Peru	-9.587	-7.744	7.744	-1.238
Uruguay	-15.815	-14.310	14.310	-1.105

Note: measurement estimates were obtained by taking the corrected median.
Source: own elaboration.

mance and, simultaneously, monetary policy becomes more inefficient and the variability of supply shocks is greater, a Q value between -1 and 0 indicates that monetary policy has cushioned part of the adverse supply shock. A value lower than -1 attests that monetary policy potentiated the adverse supply shock. In this sense, it is observed that eight of the ten countries in the sample noticed their monetary policy intensifying the effects of the adverse supply shock caused by the COVID-19 pandemic, with only the monetary policy conducted by the central banks of the Dominican Republic and Mexico cushioning the impacts of COVID-19.

5. Final considerations

This study evaluated the impact of the COVID-19 pandemic on economic performance and monetary policy effectiveness in Latin American countries operating under IT. Using the efficiency monetary policy frontier methodology, we distinguished the effects of aggregate supply shocks from variations in monetary policy efficiency. While not the sole approach available, the efficiency frontier constitutes a valid and analytically consistent framework to assess the effectiveness of monetary policy in the face of shocks. The analysis covered ten Latin American countries under IT as of early 2020 and compared their economic performance and monetary policy efficiency before (2017-2019) and during the pandemic (2020-2022), with particular emphasis on the latter period.

The findings reveal a significant decline in economic performance across all sample countries during the pandemic. Seven of the ten experienced a deterioration in macroeconomic performance exceeding 85%, while Mexico, Guatemala, and Uruguay showed comparatively smaller declines. Uruguay, in particular, registered the least impact on average inflation levels and volatility and was the only country to show a slight improvement in supply conditions. By contrast, most other countries faced worsening supply conditions and reduced monetary policy effectiveness. Notably, the monetary policies of the Dominican Republic and Mexico were the only ones that partially mitigated the adverse effects of the COVID-19 supply shock.

The IT remains the prevailing and effective monetary arrangement in the post-COVID-19 pandemic period in different countries, proving capable of anchoring inflationary expectations and managing major shocks in advanced and emerging economies, including those in Latin America, due to its flexibility in incorporating multiple factors. However, as shown in this article, central banks must act proactively and credibly to ensure price stability.

In conclusion, the results indicate that the less efficient conduct of monetary policy in most Latin American countries under IT exacerbated the adverse supply shocks caused by the COVID-19 pandemic, leading to heightened inflation levels. This underscores the critical importance of efficient monetary policies in stabilizing economies during crises. The implications are significant, as they suggest that the increased variability of aggregate supply shocks during the 2020-2022 period compelled central banks to prioritize output stabilization over inflation control.

Author's contributions

Mayson Miranda Pereira dos Santos: conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, software, validation, visualization, writing (original draft), and writing (review & editing).

Marcos Roberto Vasconcelos: conceptualization, formal analysis, investigation, methodology, project administration, supervision, validation, writing (original draft), and writing (review & editing).

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Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article. We confirm that we have no financial, personal, or professional affiliations that could be perceived as having influenced the research, findings, or conclusions presented in this manuscript.

Ethical implications

The authors have no ethical implications that need to be declared in the writing and publication of this article.

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