Empirical Analysis of Money Demand: Inflation Targeting Effects and Heterogeneous Behavior in Pacific Alliance Countries (PAC)[**]

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ABSTRACT

This study aims to estimate a microfounded money demand for Pacific Alliance Countries (PAC) and evaluate whether the elasticities of income, interest rates, inflation expectations, exchange rate, and U.S. rates have changed after the adoption of inflation targeting (IT). As a consequence, we study the role the interest rate has played in these emerging economies under the complementary hypothesis of McKinnon (1973). Furthermore, we analyze the heteregeneous behavior of the demand for money during the IT period using a quantile regression approach. This study suggests that there is statistical evidence that the elasticities of the demand for money have changed after the adoption of IT. Also, the findings indicate that the demand for money has exhibited heterogeneous behavior for all the PAC during the IT period. Generally, interest rate elasticity tends to be smaller in magnitude when real balances are high, while income elasticity demonstrates heterogeneous behavior across countries.

Keywords: Money demand, Quantile regression, Inflation targeting, Monetary policy, McKinnon Hypothesis.

JEL: C2, E12, E41, E52

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INTRODUCTION

A significant number of central banks worldwide have adopted inflation targeting (IT) as a monetary policy framework. Substantial progress has been made in studying the effects of IT on inflation and inflation expectations. Numerous studies indicate that adopting inflation targets has led to better control of inflation, anchored inflation expectations, and reduced inflation volatility (Orphanides and Williams, 2003; Levin et al., 2004; Vega and Winkelried, 2005; Ardakani et al., 2018; Achiyaale et al., 2022). Conversely, little attention has been paid to studying the effects of adopting IT on money demand. Based on Lucas (1972), we hypothesize that there may be an indirect effect of IT on changes in the income and interest rate elasticities of money demand, as these parameters represent the preferences of economic agents (e.g., preferences for transactions, speculative demand, etc.).

Thus, the objective of this research is to estimate the effects of IT on the money market, specifically focusing on providing a preliminary assessment of whether the elasticities have changed after the introduction of IT. Moreover, given the growing recognition of nonlinearities in money demand functions, we aim to explore potential heterogeneity in money demand within the Pacific Alliance Countries (Peru, Chile, Mexico and Colombia). Building upon insights from McKinnon's (1973) complementarity hypothesis, our investigation extends to analyzing the significance of interest rate elasticities and their controversial role in money demand in emerging economies.

The rest of the study is organized as follows. Section 2 details the IT adoption by each country. Section 3 presents the literature review. Section 4 shows the model and methodology, and Section 5 details the data and results. Section 6 provides the study's conclusions, and Section 7 shows the discussion.

1. PRE-CONDITIONS AND INFLATION TARGETING ADOPTION IN PACIFIC ALLIANCE COUNTRIES

The Pacific Alliance (PA), established in 2011 by Chile, Colombia, Mexico, and Peru, represents a regional economic bloc aimed at fostering trade liberalization, financial

integration, and macroeconomic cooperation. These countries share several economic characteristics, including a high degree of trade openness, well-developed financial markets, and a historical reliance on commodity exports (De la Torre and Ize, 2019). Additionally, they have all experienced episodes of high and persistent inflation, primarily driven by inadequate monetary policy frameworks during the late 20th century (Mishkin and Savastano, 2000).

Understanding the evolution of monetary policy in these economies is crucial for managing hyperinflation, exchange rate volatility, and fiscal imbalances. During the late 20th century, some of these countries operated under fixed exchange rate regimes while progressively reducing capital controls. However, fiscal imbalances (often financed through central bank credit) led to excess money supply and inflationary pressures, putting pressure on international reserves and limiting the ability of monetary authorities to respond effectively (Petursson, 2005).

The IS-LM-BP framework provides a useful lens to analyze these dynamics. Under a fixed exchange rate regime with increasing capital mobility, an expansionary fiscal stance shifts the IS curve to the right, worsening the external balance (BP curve). To maintain the peg, monetary authorities must contract the money supply, shifting the LM curve to the left, which in turn raises domestic interest rates and crowds out private investment. However, if inflation expectations remain unanchored and fiscal deficits persist, speculative attacks can force authorities to abandon the peg, leading to sharp devaluations, inflationary spirals, and financial instability.

Thus, these countries, sharing a similar historical background, constitute a valuable sample for studying how improvements in monetary policy management (particularly the transition toward credible monetary frameworks and fiscal discipline) have contributed to greater macroeconomic stability, control of inflation expectations, and reduced exchange rate volatility. Furthermore, this research provides insight into how these policies influenced the money market, particularly through their impact on money demand dynamics in economies where monetary and fiscal credibility were historically weak.

The countries in our sample share the characteristic of having adopted the inflation targeting regime as a framework over the past 30 years. According to Hammond (2012), the explicit inflation targeting regime is not a rigid set of rules but rather a framework with the following characteristics: i) price stability is explicitly recognized as the primary objective of monetary policy, ii) there is a public announcement of a quantitative target, iii) monetary policy is based on a broad set of relevant information, including forecasts, iv) transparency, and v) mechanisms for accountability. As can be inferred, much of this regime is linked to interaction with economic agents, as transparency and explicit objectives would play a fundamental role in the expectations of economic agents (King, 2005).

Generally, the adoption of this framework is mostly due to the failure of previous regimes. In general, this implementation was caused as part of the stabilization process (Petursson, 2005). For example, before the implementation of IT, nominal or exchange rate anchors were used to conduct monetary policy, and even earlier, the well-known Friedman rule. However, the results were not as expected.

In Peru, the full adoption of IT occurred in January 2002 (Pérez, 2017). Prior to this, the Peruvian economy had experienced hyperinflationary periods in the 1980s and 1990s, primarily due to poor management of monetary policy. Starting in 1993, significant institutional and structural changes were made, including granting autonomy to the central bank, which prevented it from financing the central government as it had in previous years. Additionally, many institutional safeguards were incorporated into fiscal policy, such as debt limits and fiscal rules (Montoro and Moreno, 2008).

Between 1994 and 2001, the growth rate of base money followed a downward trend, aligning with the policy of gradually reducing inflation through preannounced targets; the central bank first announced its inflation target in 1994 (Petursson, 2005). This period was characterized by a considerable convergence of inflation, reaching single-digit levels by 1997. However, given the past hyperinflationary experience and a high level of economic dollarization, approximately 77%, the central bank required a framework to restore confidence in the currency among economic agents. From 2002

onwards, with the new monetary policy regime in place, the observed target measure became the headline Consumer Price Index (CPI), with a target set at 2% plus a tolerance range of 1%. The horizon of the objectives is long term (Petursson, 2005).

In Colombia, the full adoption of the inflation targeting regime occurred in October 1999, after allowing the currency to float (Pineda et al., 2002). Although Colombia did not have a hyperinflationary past, between 1972 and 1992, inflation rates varied within a range of 18.0% to 32.0%. One of the distortions in the economy was the complex mechanisms of price indexation, which perpetuated the level of inflation. Additionally, Colombia maintained an excessively volatile balance of payments, exacerbating the situation. Thus, Colombia's monetary policy framework, already complex, was further challenged by fiscal pressures that contributed to rising inflation (Junguito and Rincón-Castro, 2004).

Prior to 1999, the Central Bank of Colombia managed its monetary policy primarily using monetary aggregates as the main policy instrument and using exchange rates as nominal anchor. The adoption of a new framework was driven by dissatisfaction with the previous framework and the need to establish a new anchor within the International Monetary Fund program (Petursson, 2005). Once the regime was adopted, the target variable became headline inflation, with the target established as a range of 2%-4% over a medium-term horizon.

In the case of Chile, the adoption of the explicit inflation targeting regime took place in September 1999. Cooper and Truman (2004) identify September 1990 as the starting point, when the Central Bank of Chile first announced its IT. However, Schaechter et al. (2000) argue that it was not until 1999 that the crawling exchange rate peg was eliminated and the inflation targeting regime was fully implemented. Before the adoption of inflation targets, the initial conditions were not favorable, as Chile faced double-digit inflation, close to 21.2% by 1991. During that period, the Chilean economy was highly indexed, with backward indexation mechanisms in many markets, including non-tradable goods, labor, and financial markets. However, an economic advantage was that public finances were solid, along with a healthy financial system.

Prior to the implementation of IT, Chile conducted its monetary policy using the exchange rate as a nominal anchor (Petursson, 2005). Although the Chilean economy experienced various exchange rate regimes (flexible, fixed, and crawling pegs), in 1999, a flexible exchange rate was maintained in the context of adopting IT. After 1999, the target variable became the headline CPI, with a point target of 3% plus a tolerance range of 1%, and a target horizon of around 2 years. Inflation convergence was gradual, reaching single-digit levels in 2001 (3.5%).

Mexico embraced fully IT in 2001 (Hammond, 2012). However, Central Bank of Mexico made its first inflation target announcement in 1995 (Petursson, 2005). Preceding this adoption were periods marked by significant financial crises. Throughout the 1980s, average inflation fluctuated between 20% and 30%. This high inflation was primarily attributable to external sector shocks and inadequate economic policy management. The situation exacerbated during the 1994-1995 Mexican peso crisis, precipitated by the abrupt devaluation of the peso against the US dollar, triggering a financial crisis and impacting inflation.

Mexico experimented with various monetary and exchange rate regimes. Before 1994, it operated under a fixed exchange rate system with a floating band; however, complete inflation stabilization remained elusive. Post the peso crisis, Mexico shifted to a monetary targets approach. Since 2001, the central bank has monitored the headline CPI, setting a target point of 3% with a tolerance range of 1%. The target horizon extends to the medium term (Hammond, 2012).

2. BRIEF LITERATURE REVIEW

This research falls within the literature that examines the effects of IT on macroeconomic aggregates and the literature on money demand. However, it represents a first attempt to evaluate the effects of IT on money demand, as most of the existing literature focuses on the relationship between IT and inflation levels, inflation volatility, interest rates, monetary policy credibility, among other aspects.

The theoretical foundation of our analysis builds on the rational expectations framework introduced by Lucas (1972). His seminal work on expectations and the

neutrality of money posits that economic agents adjust their behavior based on anticipated policy changes, implying that shifts in monetary regimes, such as the adoption of IT, can alter economic decisions, including money demand. Specifically, if IT enhances credibility and reduces inflation uncertainty, it could lead to changes in the elasticity of money demand as agents adjust their liquidity preferences in response to a more stable macroeconomic environment. Therefore, for this relationship between IT and money demand to exist as an intermediate effect, there must be a link between IT and strong macroeconomic performance that leads to stable economic conditions.

Regarding the literature that examines the relationship between IT and macroeconomic performance, a vast body of empirical research has addressed this issue. Recent studies support the notion that the adoption of IT has had a positive impact on the economy, fostering an environment of stability, credibility, and confidence (Bordo and Siklos, 2014). In order to achieve this, part of the literature suggests that after the adoption of inflation targets, macroeconomic aggregates have performed better.

For instance, in developed countries, Ardakani et al. (2018) examines the causal effects of IT adoption on macroeconomic performance using a semiparametric index model. Under this methodology, the author accounts for model misspecification often observed in parametric propensity scores. The findings indicate that the sacrifice ratio and interest rate volatility have decreased in developed countries with inflation targets. Additionally, the results suggest improvements in fiscal terms, particularly showing that IT adoption has enhanced the debt-to-GDP ratio in both advanced and emerging economies.

Similarly, using a VAR approach, Berument and Froyen (2015) study the experience of IT in New Zealand and Australia, two countries with historically longer experience under this regime. They find that IT has strongly anchored expectations, indicating that even during times of crisis, the credibility of IT has not weakened. Furthermore, their model suggests that long-term interest rates have become less sensitive to economic shocks, including monetary policy shocks. These results are consistent with those found by Levin et al. (2004). However, this evidence based on

Impulse Response Functions (IRF) is highly sensitive to the identification strategy. To address this issue, using an alternative method to evaluate whether IT has successfully anchored expectations, Szyszko and Tura-Gawron (2021) examine the dependence of consumer inflation expectations on the inflation projections of the European Central Bank for Austria, Belgium, Finland, and Germany. They find that within the context of IT, inflation expectations are primarily guided by the European Central Bank. This result aligns with the findings of Nedeljković et al. (2017), who indicate that in Central and Eastern European countries, inflation expectations have remained anchored following the implementation of IT.

For emerging countries, empirical studies show that, similar to advanced economies, the effects of IT have been favorable. For example, Adaletey et al. (2022) provided a comprehensive study on the effect of inflation target announcements on inflation and its volatility. Employing a GARCH model to characterize inflation volatility, the authors find that IT has not only reduced the level of inflation but also its volatility. However, although their proposed model does not control for potential self-selection issues, the results are consistent with those provided by Lin and Ye (2008), who use causal inference techniques, employing propensity score matching methods to address self-selection problems.

In Latin American economies, the literature supports the positive effects of IT. Corbo et al. (2001) indicate that macroeconomic performance, in terms of industrial output sacrifice and volatility, improved in countries that adopted IT. They also find that IT has contributed to reducing inflation inertia. However, their results are subject to the sample size and the fact that they analyze countries before fully adopting IT. Mariscal et al. (2018) studied IT's impact on expectation anchoring and credibility with an expanded sample size. The authors show that inflation expectations have not remained fully anchored throughout the sample period and that the credibility of monetary policy has increased. It is clear that these episodes of de-anchored expectations may have responded to periods of major financial crises, such as the 2009 crisis.

Although most of the literature supports the favorable effects of IT adoption, some studies, particularly in advanced economies, are skeptical. For example, Ball and Sheridan (2005) argue that there is no evidence that IT adoption has led to better economic performance. Instead, they suggest that targeter countries had poorer monetary management compared to non-targeters. Thus, when controlling for this factor, the evidence suggests that IT has not improved macroeconomic performance, and any improvements observed may simply reflect mean reversion. Along the same lines, Lin and Ye (2007) found IT has no significant effects on inflation or its variability in industrial countries, using propensity score matching models. However, when the study includes both advanced and emerging economies, the results favor IT. For instance, Lanzafame and Nogueira (2013) evaluate whether IT has contributed to reducing interest rates. Using a broad sample of 52 countries, both advanced and emerging, and a panel data model controlling for parameter heterogeneity and cross-sectional dependence, they find that IT has played an important role in reducing nominal interest rates, primarily in emerging economies.

Thus, the evidence from both advanced and emerging economies suggests that IT may have contributed to reducing inflation, interest rates, and the volatility of both variables. Therefore, with this shift in the policy framework, which established a more stable macroeconomic environment, it is plausible to hypothesize that the preferences and decisions of economic agents may have been affected. An indication of this is the weakening of long-term theoretical relationships; for example, Ryczkowski (2021) provides recent empirical evidence showing the weakening of the relationship between money supply and inflation after the adoption of IT, a trend also observed by Sargent and Surico (2011).

Regarding the effects on economic agents' preferences, Sahin (2013) studies the role of inflation uncertainty in money demand using a Smooth Transition Regression (STR) model and suggests that individuals' preferences change depending on the level of inflation uncertainty (volatility). Thus, with a reduction in inflation volatility, the precautionary motive for money demand decreases, leading to a reduction in precautionary savings. Addressing other potential effects on changes in

economic agents' behavior, Fouejieu (2016) examines whether emerging economies with IT are financially more vulnerable than those without such a framework. To estimate causal effects, they employ a panel data model using the propensity score matching method. The findings suggest that countries adopting IT exhibit greater sensitivity to financial risks. This finding is significant because increased risks may lead individuals to protect themselves, potentially reducing their sensitivity to changes in interest rates and altering their liquidity preferences.

3.1 The non-linearity in macroeconomics and money demand

In recent years, studies in the field of macroeconomics have shown great interest in nonlinear phenomena and models in economics and finance, concurrently with the development of nonlinear econometric methodologies. Nonlinearity is present in many economic relationships, including theoretical ones. The importance of studying nonlinear models is due to several reasons. First, linear models may not capture the complexity and dynamics observed in the data (Orlando et al., 2021). Second, nonlinearities can be essential for understanding and predicting economic behavior in response to large disturbances or shocks (Leahy, 2013). Finally, nonlinear techniques allow for a deeper and more nuanced understanding of issues highly relevant to macroeconomic policy (Constancio, 2014).

One of the nonlinear methodologies that allows for the study of asymmetric and heterogeneous behaviors is quantile regression, proposed by Koenker and Gilbert (1978). In macroeconomics, there are numerous studies utilizing this methodology to examine theoretical economic relationships in international macroeconomics and finance (Lloyd et al., 2024), fiscal policy and economic growth (Ostrihoň et al., 2023), and as a test for structural breaks (Chang et al., 2024).

Concerning money demand, it is noteworthy that most of the literature mentioned above employs linear models to study the effects of IT, with the exception of Sahin (2013). This approach limits the ability to capture potential heterogeneous effects and asymmetries.

Empirical evidence consistently supports the presence of nonlinearity and possible asymmetries in money demand. Austin et al. (2007) and Jawadi and Sousa

(2013) employ Smooth Transitions Models (STM) to analyze possible nonlinearities in both advanced and emerging countries, providing evidence of nonlinear behavior in money demand through time series analysis. Similarly, Chen and Wu (2005) utilize a nonlinear cointegration model to reach the same conclusion regarding advanced economies. The rejection of the linearity hypothesis is precisely attributed to the presence of transaction costs. This idea falls within the inventory-theoretic models of money demand, such as Miller and Orr (1966). Since adjusting money balances incurs transaction costs, agents delay adjustments until the benefits outweigh these costs. This creates an "inaction band" where small deviations persist, but once a threshold is crossed, rapid adjustments occur, leading to non-linear money demand behavior.

Using an alternative approach, Lee and Yang (2012) investigate whether conditional forecasts of GDP growth can be enhanced by considering different quantiles of the money growth distribution. Through the use of quantile regression and Granger causality analysis, they demonstrate that the relationship between income and money supply is nonlinear. Their findings reveal that forecasts incorporating information on the distribution of money supply exhibit improved performance, particularly at the tails of the conditional GDP distribution.

Furthermore, the literature not only suggests the presence of nonlinearity but also potential asymmetries in money demand. Several studies utilize nonlinear autoregressive distributed lag (ARDL) models to assess asymmetry and suggest that money demand demonstrates asymmetric behavior in emerging economies. This phenomenon may be attributed to factors such as external shocks, the openness of the economy, real exchange rates, and oil prices (Alsamara et al., 2016; Adil et al., 2020; Zehra et al., 2020).

Based on the empirical evidence presented above, a significant research gap emerges regarding the effects of IT on money demand. Moreover, the evidence suggests that macroeconomic stability may indeed influence preferences and decisions, leading to plausible changes in the elasticities of money demand under the IT regime (e.g., precautionary savings, transaction preferences, speculative demand, etc.).

Furthermore, the nonlinear methodologies predominantly employed in the literature often overlook the state of the economy. Since our objective is to address heterogeneity rather than asymmetries, we propose quantile regression as an appropriate methodology. This approach allows us to gain insights into the economic situation or regime by considering the distribution of real balances.

3. MODEL AND METODOLOGY

4.1 Money in Utility Model (MIU)

The general equilibrium model with rational expectations depicted below is drawn from Atta-Mensah (2004), Choi and Oh (2003), and Romer (1990). This model is a variation of the MIU model proposed by Sidrauski (1967). The economy is composed of 4 sectors: households, a continuum of producers of intermediate goods, the producer of the final good, and the monetary authority; and two market structures. Economic relationships maintain the following characteristics: final goods are sold to households and producers of intermediate goods in a competitive market. Then, intermediate goods are differentiated goods, therefore, they are sold to producers of final goods in a monopolistically competitive market. As a result, producers of final goods have a certain mark-up. Household preferences are represented by the following utility function:

$$U(c_1, c_2 \ldots.) = E_t \sum_{t=0}^{\infty} \beta^t \left\{ \frac{\gamma}{1-\gamma} \ln \left[c_t^{\frac{\gamma}{1-\gamma}} + \left(\frac{M_t}{P_t} \right)^{\frac{\gamma}{1-\gamma}} \right] + \sigma \log(1 - l_t) \right\} \qquad (1)$$

Where $0 < \beta < 1$ is the intertemporal discount factor, reflecting households' valuation of present consumption; $0 < \gamma < 1$ represents risk aversion, and σ is the elasticity of labor. Real balances are represented by $\frac{M_t}{P_t}$, the level of consumption by c_t and hours of work by l_t. Note that higher levels of consumption, real balances, and leisure $(1 - l_t)$ result in higher levels of utility.

Furthermore, households face a resource constraint, which is depicted as follows

$$c_t + I_t + \frac{M_t}{p_t} + \frac{B_t}{p_t R_t} \leq \frac{R_t^k k_t + w_t h_t + M_{t-1} + B_{t-1} + D_t}{p_t} \quad (2)$$

$$k_{t+1} = I_t + (1-\delta)k_t \quad (3)$$

Where $M_t, B_t \; y \; D_t$ represent the nominal amount of money, government bonds, and dividends, respectively. Households receive income from capital rent (leased to firms) and their wages. Additionally, there exists a stock of money held over from the previous period (M_{t-1}). Furthermore, they accumulate financial assets in the form of bonds; thus, there is a certain quantity of bonds from the previous period that generates interest. Moreover, firms own the companies and therefore receive dividends. Households allocate a portion of their income to consumption, investment, the accumulation of real balances, and financial assets. The capital stock evolves as shown in equation (3).

Once all the characteristics of this economy have been described, we establish that households seek to maximize their intertemporal utility level, subject to their resource constraint, where they will choose the levels of consumption, hours of work, future capital, financial assets, and real balances. The first-order conditions are as follows (The first-order conditions for consumption, government bonds, and real balances are displayed. For the complete derivation, refer to Atta-Mensah, (2004)):

$$\frac{c_t^{-\frac{1}{\gamma}}}{c_t^{-\frac{1}{\gamma}} + \left(\frac{M_t}{P_t}\right)^{\frac{\gamma}{1-\gamma}}} = \lambda_t \quad (4)$$

$$\frac{\left(\frac{M}{P_t}\right)^{-\frac{1}{\gamma}}}{c_t^{-\frac{1}{\gamma}} + \left(\frac{M_t}{P_t}\right)^{\frac{\gamma}{1-\gamma}}} = \lambda_t - \beta E_t\left(\frac{p_t \lambda_{t+1}}{p_{t+1}}\right) \quad (5)$$

$$\frac{\lambda_t}{p_t R_t} = \beta E_t\left(\frac{\lambda_{t+1}}{p_{t+1}}\right) \quad (6)$$

Where Equation 4 represents the Euler equation, depicting the optimal consumption trajectory in each period. Equation 5 is the first-order condition with respect to real balances, and Equation 6 is the first-order condition for government bonds. Equation (6) can be rearranged (Multiplying by p_t we obtain the following expression $\frac{\lambda_t}{R_t} = \beta E_t\left(\frac{p_t\lambda_{t+1}}{p_{t+1}}\right)$) to substitute it into Equation (5) to obtain the following expression.

$$\frac{(\frac{M}{P_t})^{-\frac{1}{\gamma}}}{c_t^{-\frac{1}{\gamma}}+\left(\frac{M_t}{P_t}\right)^{\frac{\gamma}{1-\gamma}}} = \lambda_t\left(1-\frac{1}{R_t}\right) \tag{7}$$

Substituting equation (4) into equation (7), we obtain the following expression.

$$\left(\frac{c_t}{\frac{M_t}{p_t}}\right)^{\frac{1}{\gamma}} = \left(1-\frac{1}{R_t}\right) \tag{8}$$

Applying the natural logarithm to both sides of the expression and assuming that $\log\left(\frac{R_t-1}{R_t}\right) \approx \log(1+r_t)$, where r_t is the net nominal interest rate, we obtain the money demand:

$$\text{Log}\left(\frac{M_t}{p_t}\right) = \log(c_t) - \gamma\log(1+r_t) \tag{9}$$

Where consumption is a fraction of income, $c_t = \exp({y_t}^{C_0})$ and γ is the elasticity of the interest rate on real balances. According to Laidler (1969), the primary difficulties stem from accurately measuring income and wealth, as well as identifying suitable metrics for the opportunity cost of holding money. To address this issue, much of the empirical literature relies on scaling variables to approximate production volume; consequently, real GDP serves as a proxy for production volume or transaction levels (Laidler, 1969).

The money demand derived from the microfoundations of general equilibrium shares the same characteristics as Keynesian money demand. The final equation to be estimated using an econometric model is as follows:

$$\text{Log}\left(\frac{M_t}{p_t}\right) = c_0\log(y_t) - \gamma\log(1+r_t) + e_t; \quad e_t \sim N(0,\eta^2) \tag{10}$$

Where e_t represents uncorrelated shocks and η^2 is the variance of the error.

4.2 OLS Regression with Dummies

Although the money demand function is derived from a microfunded model for closed economies, the countries analyzed are small open economies, implying significant interactions with global markets. In particular, exchange rate fluctuations, inflation expectations, and U.S. interest rates influence domestic monetary equilibrium (Arango and Nadiri, 1981). Empirical evidence suggests that in such economies, money demand is sensitive to external factors due to capital flows, trade openness, and monetary policy spillovers (Bahmani and Kutan, 2009). Therefore, incorporating these additional variables provides a more comprehensive framework to capture the determinants of money demand in these economies while also mitigating potential bias from omitted variables.

Since the objective of this study is to analyze the change in elasticities of the demand for money, we integrate a linear functional form into the analysis as follows:

$$\text{Log}\left(\frac{M_t^d}{P_t}\right) = \alpha_1 + \alpha_1 \log(Y_t) + \alpha_2 r_t + \alpha_3 ER_t + \alpha_4 IE_t + \alpha_5 r_t^* + \alpha_6 D_t \log(Y_t) + \alpha_7 D_t r_t + \alpha_8 D_t ER_t + \alpha_9 D_t IE_t + \alpha_{10} D_t r_t^* + e_t; \quad e_t \sim iid\ N(0, \sigma_e^2) \tag{11}$$

Where $\frac{M_t^d}{P_t}$ is the demand for real balances, P_t is the GDP deflator , Y_t denotes real output, r_t indicates the domestic nominal interest rates, ER_t is the nominal exchange rate; r_t^* is the foreing nominal interest rate and D_t is the dummy variable that equals 1 under IT regime and 0 otherwise. We include interaction dummies to assess changes in elasticities resulting from regime changes

$$\log\left(\frac{M_t^d}{P_t}\right) = \alpha_1 + \alpha_1 \log(Y_t) + \alpha_2 r_t + \alpha_3 ER_t + \alpha_4 IE_t + \alpha_5 r_t^* + e_t; \text{ Before IT}$$

$$\log\left(\frac{M_t^d}{P_t}\right) = \alpha_1 + (\alpha_1 + \alpha_6)\, log(Y_t) + (\alpha_2 + \alpha_7) r_t + (\alpha_3 + \alpha_8) ER_t + (\alpha_4 + \alpha_9) IE_t + (\alpha_5 + \alpha_{10}) r_t^* + e_t; \text{ After IT}$$

The equations specify the demand for real balances before and after the adoption of the inflation targeting regime. Before IT, the demand is modeled as a function of real output, domestic nominal interest rates, the nominal exchange rate, expected inflation, and the foreign nominal interest rate. After IT, interaction terms with the

regime dummy (D_t) are introduced to capture changes in the elasticities of these variables. The coefficients $\alpha_6, \alpha_7, \alpha_8, \alpha_9, \alpha_{10},$ quantify the adjustments in parameter estimates following the regime shift, allowing for an assessment of how IT affects money demand.

We run individual regressions for each country in our sample. To estimate model (11), we use an Ordinary Least Square estimator (OLS) and Generalized Moment Method (GMM) to address potential endogeneity problems. Additionally, precautions for serial correlation was taken and heteroskedasticity and autocorrelation consistent (HAC) standard errors proposed by Newey and West (1987) were used to adjust standard errors estimates. Before conducting GMM and OLS estimations, we first perform unit root tests to determine the integration order. Then, to evaluate long-run equilibrium, we apply the Johansen–Juselious cointegration test for each country.

4.3 Quantile Regression Approach

The quantile function of a single-valued random variable Y essentially represents the inverse of its distribution function. Like the distribution function, the quantile function offers a detailed portrayal of the statistical characteristics intrinsic to the random variable. Additionally, as described by Xiao (2012), the conditional quantile function for Y given X acts as the inverse of the corresponding conditional distribution function.

$$Q_y(\tau|X) = F_y^{-1}(\tau|X) = \inf\{y: F_y(y|X) \geq \tau\}$$

Where $F_y(y|X) = P(Y \leq y|X)$. The conditional quantile function of Y, given X, provides a comprehensive depiction of the relationship between Y and X. Thus, we introduce the following classical linear model:

$$Y_t = \theta' X_t + u_t, \quad t = 1, \dots, n, \tag{12}$$

Where X_t are the vectors of regressors including a constant, and u_t are i.i.d. The regression (12) can be carried out based on the following optimization problem:

$$\hat{\theta} = \min_{\theta} \sum_{t=1}^{n} \rho(Y_t - \theta' X_t)$$

Where $\rho(.)$ is a loss function. Quantile regression proposed by Koenker and Bassett (1978) utilizes an asymetric loss function $\rho(u) = \rho_\tau(u) = u\big(\tau - I(u < 0)\big)$,

where $\tau \in (0,1), and\ I(.)$ is the indicator function. By Solving $\theta_\tau^* = \min_\theta E\rho_\tau(Y - \theta' X)$, we obtain $X'\theta_\tau^* = Q_y(\tau|X)$, where quantile regression gives an estimate of the (τh) conditional quantile of Y. The criterion function $\rho_\tau(.)$ is called the "check function" (Koenker and Bassett, 1978) and the solutions:

$$\hat{\theta}(\tau) = \min_\theta \sum_t \rho_\tau(Y_t - \theta' X_t)$$

are referred to as the regression quantiles. Given $\hat{\theta}(\tau)$, the conditional quantile function of Y_t given X_t can be estimated by:

$$\hat{Q}_{y_t}(\tau|X_t) = \hat{\theta'}(\tau)X_t$$

4. EMPIRICAL RESULTS

5.1 Data

In our analysis, we collected the following variables: the monetary aggregate M1, representing the nominal money supply measured in the local currency but subsequently converted into the real money supply in billions of local currency and adjusted for the Gross Domestic Product (GDP) deflator; real GDP, denoting income measured in billions of constant local currency; the nominal short-term continuous capitalization rate (passive interest rates); IE, representing 12-month inflation expectations derived from central bank surveys; ER, the nominal exchange rate, expressed in terms of domestic currency per U.S. dollar; and U.S. rates, referring to yields on U.S. Treasury bonds with maturities of less than one year.

All data are sourced from the websites of the respective central banks and the Federal Reserve Economic Data at Saint Louis (FRED). The definitions of variables associated with each country, as well as the methodology used to construct each series, are detailed in the Appendix.

Table 1. *Main Characteristics of the Selected Countries*

	GDP (B. US$)	Per-Capita GDP (US$)	GDP growth (%)	Inflation (%)	Trade (%)	Banking (%)	Fiscal debt (%)	Country risk (%)
Perú	223.2	12,966	4.37	2.94	58.4	57	34.3	1.94
Chile	281.5	24,747	3.64	3.61	75.0	87	38.0	1.40

Colombia	355.7	15,854	3.79	5.05	48.6	60	60.4	3.69
México	1,243.8	19,943	1.79	4.72	89.5	67.8	54.1	3.86

Note: This table presents key macroeconomic indicators for the selected countries. GDP values are expressed in billions of U.S. dollars at constant 2010 prices for 2022. Per capita GDP is reported in U.S. dollars, adjusted for purchasing power parity (PPP 2017) for the year 2022. The GDP growth and inflation rates represent annual averages from 2000 to 2022. Country risk is measured as the spread between a country's treasury bond yield and U.S. Treasury bonds, expressed as a percentage as of the end of 2022. Trade openness is calculated as the sum of exports and imports as a percentage of GDP for 2021. The fiscal debt refers to gross public debt as a percentage of GDP for 2022. Banking penetration is measured as the proportion of adults using financial products in 2021. Source: WEO October 2023, World Bank, Global Findex Database (2021), JP Morgan, Datos Macro and Statista.

The selected sample period for the analysis is constrained by data availability, leading to variations in the time span across the countries analyzed. Specifically, data for Peru, Chile, Colombia, and Mexico are available for the periods 1995Q1–2024Q3, 1996Q1–2024Q3, 1994Q1–2024Q1, and 1996Q2–2023Q3, respectively.

Table 1 provides a comparative view of the main economic characteristics of the selected countries.

It is highlighted that all of them exhibit a robust economic foundation with a stable economic growth during the last 22 years. Regarding inflation, it is observed to remain at moderate levels in all countries, ranging from 2.94% to 5.05% in average. This relatively narrow range suggests effective management of monetary policies in all cases. Moreover, all countries show a high proportion of international trade relative to their GDP, with percentages ranging from 48.6% to 89.5%.

In regard to banking penetration, limited access to financial services is evident across all countries, with rates spanning from 57% to 87% of the adult population. This underscores the ongoing challenge of achieving comprehensive financial inclusion throughout the region. Lastly, country risk, measured as the difference in yields between national government bonds and U.S. Treasury bonds, is relatively low in all cases, with levels ranging from 1.40% to 3.86%. In summary, despite differences in economic size and structure, the selected countries share similarities in terms of their macroeconomic stability, trade integration, and access to financial services.

5.1.1 Unit Root Tests

As is common in time series analysis, Tables 9–12 in Appendix B present the results of three types of unit root tests: ADF, PP, and KPSS. These tests are analyzed for various reasons. The first two tests (ADF and PP) are sensitive when the autoregressive parameter is close to one, whereas the KPSS test overcomes this issue and is more robust to structural breaks. Additionally, while the null hypothesis of the ADF and PP tests assumes the presence of a unit root, the KPSS test assumes stationarity, providing a more comprehensive contrast. Although these tests still have certain limitations, they serve as an initial approach to examining the behavior of the data. The results suggest that most variables are non-stationary in levels but become stationary in first differences across all countries analyzed. This indicates the presence of unit roots in levels, suggesting that the series are integrated of order one, I(1). These findings justify the use of cointegration techniques to assess both short- and long-term relationships in the analysis of money demand. However, if cointegration is not confirmed, estimating a regression with I(1) variables may lead to spurious results, rendering the interpretation of the coefficients unreliable.

5.2 Results

5.2.1 Results on cointegration Johansen tests:

Having established that the variables are I(1), this section applies the Johansen–Juselius maximum-likelihood procedure to estimate the Trace and Maximum Eigenvalue tests. To implement this approach, it is necessary to determine the optimal lag order of the VAR model, which was selected using the Akaike Information Criterion (AIC).

Table 2: *Johansen Cointegration Tests for Peru*

Panel A: Max Eigenvalue and Trace tests							
Null	Alternative	Max Eigen statistic	95% critical value	P-value	Trace statistic	95% critical value	P value
r = 0	r = 1	46.88	40.08	0.00	121.13	95.75	0.00
r ≤ 1	r = 2	29.42	33.88	0.16	74.25	69.82	0.02
r ≤ 2	r = 3	21.48	27.58	0.25	44.83	47.86	0.09
Panel B: Estimate of cointegrating vector							
Ln Real M1	Ln GDP	Domestic rate	ER	IE	U.S rate	Log -Likelihood	

1	-2.14	0.25	-0.08	-0.24	-0.02	
	(0.08)	(0.05)	(0.06)	(0.04)	(0.02)	
1	0	4.20	0.67	4.15	-0.96	518.90
		(1.31)	(2.04)	(1.20)	(0.56)	
0	1	1.85	0.35	2.05	-0.44	
		(0.62)	(0.96)	(0.57)	(0.26)	

Note: The significance levels are as follows: (*) at 90%, (**) at 95%, and (***) at 99%. The critical values are based on MacKinnon, Haug, and Michelis (1999). The cointegrating relationship includes a constant. The number of lags is set to 2. The estimation is conducted using the maximum likelihood method. The sample period spans from 1995Q1 to 2024Q3. The number of cointegrating vectors is denoted by r. According to the Trace test, there are 2 cointegrating vectors at the 0.05 significance level, while the Max Eigenvalue test identifies only 1. The first column of Panel B corresponds to the first cointegrating vector evaluated by the Max Eigenvalue test, while the last column corresponds to the cointegrating vector identified by the Trace test.

Table 3: *Johansen Cointegration Tests for Chile*

Panel A: Max Eigenvalue and Trace tests

Null	Alternative	Max Eigen statistic	95% critical value	P-value	Trace statistic	95% critical value	P value
r = 0	r = 1	71.91	40.08	0.00	124.24	95.75	0.00
r ≤ 1	r = 2	19.77	33.88	0.77	52.33	69.82	0.53
r ≤ 2	r = 3	12.62	27.58	0.90	32.56	47.86	0.58

Panel B: Estimate of cointegrating vector

Ln Real M1	Ln GDP	Domestic rate	ER	IE	U.S rate	Log -Likelihood
1	-2.20	0.00	-0.00	-0.40	0.02	-62.80
	(0.11)	(0.02)	(0.00)	(0.06)	(0.02)	

Note: The significance levels are as follows: (*) at 90%, (**) at 95%, and (***) at 99%. The critical values are based on MacKinnon, Haug, and Michelis (1999). The cointegrating relationship includes a constant. The number of lags is set to 2. The estimation is conducted using the maximum likelihood method. The sample period spans from 1996Q1 to 2024Q3. The number of cointegrating vectors is denoted by r. There are 1 cointegrating vectors at the 0.05 level.

Table 4: *Johansen Cointegration Tests for Colombia*

Panel A: Max Eigenvalue and Trace tests							
Null	Alternative	Max Eigen statistic	95% critical value	P-value	Trace statistic	95% critical value	P value
r = 0	r = 1	40.11	40.07	0.04	94.08	95.75	0.06
r ≤ 1	r = 2	19.84	33.88	0.77	53.97	69.82	0.46
r ≤ 2	r = 3	12.76	27.58	0.90	34.13	47.86	0.49
Panel B: Estimate of cointegrating vector							
Ln Real M1	Ln GDP	Domestic rate	ER	IE	U.S rate	Log -Likelihood	
1	-0.80 (0.15)	-0.10 (0.02)	-0.00 (0.00)	0.17 (0.06)	0.09 (0.01)	-132.2	

Note: The significance levels are as follows: (*) at 90%, (**) at 95%, and (***) at 99%. The critical values are based on MacKinnon, Haug, and Michelis (1999). The cointegrating relationship includes a constant. The number of lags is set to 2. The estimation is conducted using the maximum likelihood method. The sample period spans from 1994Q1 to 2024Q1. The number of cointegrating vectors is denoted by r. There are 1 cointegrating vectors at the 0.05 level according max Eigenvalue test.

The exact number of lags used in each estimation is specified in the notes accompanying each table. Table 2 presents the results for Peru. Panel A shows that both the Trace test and the Maximum Eigenvalue test reject the null hypothesis of no cointegration, as the test statistics exceed their respective critical values. However, in the Maximum Eigenvalue test, the null hypothesis of a single cointegrating vector cannot be rejected at the 95% confidence level.

Meanwhile, the Trace test provides evidence of the existence of two cointegrating vectors. Panel B displays the estimated cointegration vectors, confirming the presence of a long-run equilibrium relationship. For Chile (Table 3) and Colombia (Table 4), both the Trace and Maximum Eigenvalue tests indicate the presence of a single cointegrating vector at the 95% confidence level. In the case of Mexico (Table 5), both tests reject the null hypothesis of no cointegration but do not reject the null hypothesis of two cointegrating vectors.

Table 5: *Johansen Cointegration Tests for Mexico*

Panel A: Max Eigenvalue and Trace tests							
Null	Alternative	Max Eigen statistic	95% critical value	P-value	Trace statistic	95% critical value	P value
r = 0	r = 1	58.14	40.08	0.00	134.35	95.75	0.00
r ≤ 1	r = 2	37.50	33.88	0.01	76.21	69.82	0.01
r ≤ 2	r = 3	22.21	27.58	0.21	38.71	47.86	0.27

Panel B: Estimate of cointegrating vector						
Ln Real M1	Ln GDP	Domestic rate	ER	IE	U.S rate	Log -Likelihood
1	0	0.41	-0.14	-0.27	-0.29	404.21
		(0.07)	(0.01)	(0.10)	(0.06)	
0	1	0.15	-0.04	-0.05	-0.10	
		(0.03)	(0.00)	(0.05)	(0.03)	

Note: The significance levels are as follows: (*) at 90%, (**) at 95%, and (***) at 99%. The critical values are based on MacKinnon, Haug, and Michelis (1999). The cointegrating relationship includes a constant. The number of lags is set to 2. The estimation is conducted using the maximum likelihood method. The sample period spans from 1996Q2 to 2023Q3. The number of cointegrating vectors is denoted by r. (there are 2 cointegrating vectors at the 0.05 level)

Overall, the results from applying both tests across the countries in our sample indicate that at least one cointegrating vector exists in the long run. This finding suggests two key implications: (i) the incorporated series share at least one common stochastic trend, meaning that a long-run equilibrium relationship exists, and (ii) the estimated coefficients obtained from regressions (such as OLS or GMM) are superconsistent (Hamilton, 1994).

5.2.2 Results on the change in elasticities of money demand

Table 6 presents the estimation results for money demand across countries. Overall, all regressions exhibit a strong fit, as indicated by the coefficient of determination, which ranges from 0.98 to 0.99. This robustness is further reinforced by the cointegration analysis. To address potential simultaneity bias, we employ generalized method of moments (GMM) estimations, which outperform instrumental variables (IV) estimation due to model overidentification. Under asymptotic theory, with a larger sample size, the distributions converge to normality, and GMM

estimators, when overidentified, remain consistent, asymptotically normal, and asymptotically efficient (Greene, 2010). The validity of statistical tests in GMM relies on its asymptotic properties. As sample size increases, the estimator's asymptotic normality ensures that test statistics, such as the Hansen J-test, follow their expected chi-square distribution under the null hypothesis. This allows for proper inference on overidentification and instrument validity. Similarly, consistency guarantees that coefficient estimates converge to their true values, while efficiency minimizes variance, enhancing the power of hypothesis tests.

The J-test in all GMM regressions fails to reject the null hypothesis at the 95% confidence level, confirming the validity of the instruments and strengthening the reliability of our estimates. Furthermore, in the ordinary least squares (OLS) estimations, the F-test supports a strong overall model fit.

The results reveal significant shifts in money demand dynamics following the adoption of IT in Peru, Chile, Colombia, and Mexico. A key component of the analysis is the comparison of estimates across different sample periods, particularly with the inclusion of data from the pandemic. The models estimated using both OLS and GMM highlight notable changes in the determinants of money demand, underscoring the importance of addressing endogeneity concerns. The GMM estimates, which correct for potential simultaneity bias, generally yield lower intercept values than OLS, suggesting that failing to account for endogeneity may lead to overestimated baseline money demand. The inclusion of pandemic-era data introduces further complexities, revealing shifts in elasticities and the influence of macroeconomic variables in the post-COVID period.

The GDP coefficient remains positive and statistically significant across all countries, confirming the expected relationship between money demand and economic activity. However, the interaction term between GDP and IT adoption suggests a decline in GDP elasticity pre-IT (except in Peru), a pattern that becomes even more pronounced when the pandemic period is included (except in Chile). This decline is particularly substantial in Chile and Mexico, where financial markets are more developed, suggesting that financial deepening may have reduced the need for money

holdings as a function of GDP. Specifically, Chile exhibits a reduction of 0.55 in the pre-pandemic period, whereas Mexico experiences declines of 0.11% and 0.20% in the pre- and post-pandemic periods, respectively. In contrast, Peru and Colombia show smaller reductions in GDP elasticity after IT (0.02 and 0.01 post-COVID, respectively) suggesting that transaction motives for holding money remain relatively strong in these economies. Notably, GDP elasticities exceed 1, consistent with evidence supporting the continued presence of the wealth effect in emerging markets (Sousa, 2010).

The coefficient on domestic interest rates exhibits minimal differences between OLS and GMM estimates. In some cases, OLS and GMM results even suggest a weak or counterintuitive positive relationship. The interaction term for IT adoption indicates that money demand has become more responsive to interest rate fluctuations post-IT, particularly in Peru. However, when the pandemic period is included, interest rates lose statistical significance, likely due to the extraordinary monetary easing policies implemented during the crisis. The insignificance of interest rate elasticity during the pandemic suggests that, under extreme economic conditions, money demand becomes less responsive to conventional monetary policy instruments.

The exchange rate effect is consistently negative pre-COVID and before IT (except in Colombia), where it remains positive, indicating that a depreciation of the domestic currency reduces local money demand as economic agents seek alternative stores of value. This effect is strongest in Mexico and Chile, where financial integration is deeper, while it is weaker in Peru (see Table 7). In Colombia, however, the pre-COVID and pre-IT elasticity is positive and statistically significant, whereas when the sample is extended to include the pandemic period, the sign changes, suggesting either a parameter bias induced by the pandemic shock or that the Colombian economy is structurally more sensitive to exchange rate fluctuations. The interaction term for IT adoption suggests that, post-IT, money demand has become less responsive to exchange rate movements, and in some cases, the parameter is no longer significant. A lower exchange rate elasticity may indicate greater confidence in the domestic currency or reduced sensitivity to external uncertainty. During the pandemic

period, exchange rate elasticity remains significant in Colombia, while in Peru, Chile, and Mexico, it loses significance post-IT.

Inflation expectations exhibit a weak or negative relationship with money demand in Peru and Chile before IT and pre-COVID, in line with theoretical predictions that rising inflation expectations erode the real value of money holdings. Interestingly, post-IT, the elasticity of inflation expectations becomes statistically insignificant, suggesting that the IT regime may have successfully anchored expectations, thereby mitigating the role of expected inflation as an opportunity cost in these countries. In the extended sample, this effect persists even after IT adoption.

External interest rates, represented by U.S. interest rates as a proxy for global financial conditions, remain mostly insignificant across all countries, indicating that domestic money demand is primarily influenced by internal macroeconomic factors. However, it is worth noting that the role of external interest rates in money demand could become more pronounced under financial stress conditions or when capital flow volatility increases. In this sense, while foreign interest rates may not directly impact money demand under stable conditions, they could still play a critical role in shaping broader liquidity dynamics and financial stability in emerging economies.

The results can be summarized as follows: Across countries, the elasticity of money demand with respect to GDP declined after the adoption of IT in the pre-COVID and pre-IT period, except in Peru, where it increased by 0.02% (see Table 7). When extending the sample to include the post-COVID period, money demand elasticity post-IT also declines, except in Chile, where it rises by 0.13%. In general, this decline in elasticity is likely linked to lower inflation and inflation expectations post-IT, as extensively documented in the literature, which reduces the opportunity cost of holding liquidity. However, a counteracting effect exists: financial market development tends to decrease GDP elasticity while increasing interest rate elasticity. In Peru, interest rate elasticity rises after IT, both in pre- and post-COVID data, whereas in the other countries, it loses statistical significance.

The loss of significance in the interest rate coefficient post-IT may reflect greater macroeconomic stability and increased credibility in monetary policy, reducing

money demand sensitivity. Additionally, financial development and lower inflation volatility may have diminished the reliance on liquid money. If this trend intensifies during the pandemic, it suggests that global monetary expansion and abundant liquidity further weakened the role of interest rates in money demand. Regarding inflation expectations, they generally lack statistical significance, which could indicate that the IT regime has successfully anchored expectations, thereby reducing their influence on money demand. This could also reflect greater financial development or, in the post-pandemic period, heightened uncertainty and shifts in liquidity preferences.

Finally, concerning external variables such as the exchange rate and foreign interest rates, the latter does not appear to play a significant role in these economies. Meanwhile, the exchange rate loses significance post-IT, both in the pre- and post-COVID periods, or maintains its magnitude, suggesting that the credibility of the IT regime has reduced exchange rate risk perceptions. Moreover, during the pandemic, other factors such as global uncertainty or extraordinary monetary policy measures may have diluted the exchange rate's impact on money demand. Overall, our findings support the notion that the credibility and anchoring of expectations following IT adoption have significantly reshaped money demand dynamics.

Table 6. *GMM and OLS Estimations of Money Demand for PAC – Real Balances of M1 as Dependent Variable*

	Peru				Chile				Colombia				Mexico			
	OLS		GMM		OLS		GMM		OLS		GMM		OLS		GMM	
	1995Q1-2019Q4	1995Q1 - 2024Q3	1995Q1 - 2019Q4	1995Q1 - 2024Q3	1996Q3 - 2019Q4	1996Q3-2024Q3	1996Q3-2019Q4	1996Q3 - 2024Q3	1994Q1 - 2019Q4	1994Q1 – 2024Q1	1994Q1-2019Q4	1994Q1 - 2024Q1	1995Q4 - 2019Q4	1996Q4 - 2023Q4	1996Q4 - 2019Q4	1996Q4 - 2023Q4
c	-18.93*	-20.27***	-18.84***	-20.34***	-13.98***	-15.84***	3.18	-23.21***	-6.20***	-4.33***	-5.81***	-5.20***	-11.70***	-7.88	-15.04***	-8.61***
	(0.29)	(0.59)	(0.32)	(0.71)	(2.99)	(6.00)	(9.46)	(7.62)	(0.70)	(1.45)	(0.70)	(0.84)	(2.87)	(5.38)	(2.19)	(2.97)
GDP	2.16***	2.28***	2.19***	2.31***	2.14***	2.17***	2.65***	1.97***	1.25***	1.13***	1.20***	1.18***	2.33***	2.08***	2.61***	2.26***
	(0.03)	(0.07)	(0.03)	(0.07)	(0.10)	(0.13)	(0.23)	(0.16)	(0.06)	(0.09)	(0.05)	(0.08)	(0.19)	(0.36)	(0.15)	(0.23)
rate	0.02***	0.02	0.02***	0.03***	-0.008**	-0.007*	-0.05**	0.02	-0.003**	-0.002**	-0.004**	-0.005**	0.01***	0.01***	0.03*	0.06
	(0.00)	(0.02)	(0.00)	(0.00)	(0.003)	(0.004)	(0.02)	(0.03)	(0.001)	(0.001)	(0.002)	(0.003)	(0.002)	(0.00)	(0.02)	(0.03)
I.E	-0.006	-0.007	-0.02***	-0.02**	0.004	0.01	-0.08	0.07	-0.0003	-0.003	-0.001	-0.0005	-0.01***	-0.01***	-0.03	-0.07
	(0.00)	(0.02)	(0.00)	(0.00)	(0.02)	(0.03)	(0.10)	(0.15)	(0.002)	(0.004)	(0.004)	(0.005)	(0.003)	(0.003)	(0.02)	(0.04)
E.R	-0.10***	-0.11	-0.23***	-0.21***	-0.50	-0.26	-3.74**	1.12	-0.35***	-0.40***	0.32***	-0.38***	-0.09***	-0.08***	-0.19**	-0.32*
	(0.05)	(0.13)	(0.05)	(0.05)	(0.58)	(1.03)	(1.72)	(1.29)	(0.06)	(0.08)	(0.06)	(0.06)	(0.01)	(0.02)	(0.08)	(0.18)
U.S rate	-0.002	-0.003	-0.01	-0.02	-0.02	-0.008	-0.31	0.05	-0.01	-0.02**	0.004	-0.01	0.001	0.002	0.01	0.02
	(0.01)	(0.03)	(0.01)	(0.01)	(0.04)	(0.06)	(0.23)	(0.31)	(0.01)	(0.008)	(0.01)	(0.02)	(0.006)	(0.004)	(0.01)	(0.03)
D*GDP	0.05***	0.002	0.02	-0.02	-0.07	-0.07	-0.55**	0.13	-0.01	-0.01	-0.004	-0.01	-0.05***	-0.07***	-0.11*	-0.20**
	(0.02)	(0.04)	(0.02)	(0.02)	(0.07)	(0.11)	(0.24)	(0.18)	(0.008)	(0.009)	(0.01)	(0.01)	(0.008)	(0.01)	(0.04)	(0.10)
D*rate	-0.04***	-0.12***	-0.07***	-0.14***	-0.0003	-0.03*	0.05*	-0.02	-0.003	-0.009*	-0.003	-0.009*	-0.02***	-0.03**	-0.04**	-0.08**
	(0.01)	(0.03)	(0.02)	(0.03)	(0.008)	(0.02)	(0.02)	(0.04)	(0.004)	(0.006)	(0.003)	(0.005)	(0.008)	(0.01)	(0.02)	(0.04)
D*I.E	0.02*	0.005	0.04***	0.04	-0.01	0.06*	0.07	-0.06	-0.01	-0.02	-0.01*	-0.01	-0.0001	0.05**	0.02	0.10*
	(0.01)	(0.03)	(0.01)	(0.02)	(0.02)	(0.03)	(0.10)	(0.15)	(0.007)	(0.02)	(0.007)	(0.01)	(0.01)	(0.02)	(0.02)	(0.06)
D*E.R	-0.12**	0.14	0.02	0.20***	0.001	0.001	0.007**	-0.001	0.0002***	0.0003***	0.0002***	0.0003***	0.13***	0.14***	0.22***	0.38**
	(0.05)	(0.13)	(0.05)	(0.07)	(0.001)	(0.002)	(0.00)	(0.002)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.08)	(0.18)
D*U.S rate	0.006	-0.002	0.01	0.02	0.007	0.01	0.30	-0.08	-0.003	-0.003	-0.01	-0.01	-0.02**	-0.0001	-0.03*	-0.02
	(0.01)	(0.03)	(0.01)	(0.02)	(0.04)	(0.07)	(0.23)	(0.31)	(0.01)	(0.009)	(0.01)	(0.02)	(0.008)	(0.00)	(0.02)	(0.02)
R^2	0.99	0.98	0.99	0.98	0.99	0.98	0.98	0.96	0.99	0.99	0.99	0.98	0.99	0.98	0.99	0.98
J-statistic	-	-	0.32	0.73	-	-	0.61	0.33	-	-	0.16	0.22	-	-	0.48	0.63
F-Test	0.00	0.00	-	-	0.00	0.00	-	-	0.00	0.00	-	-	0.00	0.00	-	-

Note: The significance levels are as follows: (*) at 90%, (**) at 95%, and (***) at 99%. The endogenous variables considered are real GDP, the domestic interest rate, inflation expectations, and the exchange rate, while the exogenous variables include the U.S. interest rate and interactive dummies. The chosen instruments comprise the two lags of each endogenous variable along with the exogenous variables. The weighting matrix was estimated using the HAC (Newey-West) method, and its update was performed through a two-step iterative procedure. The results of the Hansen overidentification test (J-statistic) and F test are presented. The reported values of tests correspond to the p-values.

Table 7. *Elasticities Before and After IT Adoption Under GMM Estimations*

	Peru				Chile				Colombia				Mexico			
	1995Q1-2019Q4		1995Q1 -2024Q3		1996Q3-2019Q4		1996Q3 -2024Q3		1994Q3-2019Q4		1995Q1 -2024Q1		1995Q1-2019Q4		1995Q1 -2024Q3	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
GDP	2.19***	2.21***	2.31***	2.29***	2.65***	2.10***	1.97***	2.10***	1.20***	1.20***	1.18***	1.17***	2.61***	2.50***	2.26***	2.06***
	(0.03)	(0.04)	(0.07)	(0.07)	(0.23)	(0.33)	(0.16)	(0.23)	(0.05)	(0.05)	(0.08)	(0.06)	(0.15)	(0.16)	(0.23)	(0.25)
D. rate	0.02***	-0.05**	0.03***	-0.11***	-0.05**	0.00	0.02	0.00	-0.00**	-0.01	-0.00**	-0.01	0.03*	-0.01	0.06	-0.02
	(0.00)	(0.02)	(0.00)	(0.03)	(0.02)	(0.03)	(0.03)	(0.05)	(0.00)	(0.00)	(0.00)	(0.01)	(0.02)	(0.02)	(0.03)	(0.05)
IE	-0.02***	0.02	-0.02**	0.02	-0.08	-0.01	0.07	0.01	-0.00	-0.01	-0.00	-0.01	-0.03	-0.01	-0.07	0.03
	(0.00)	(0.02)	(0.00)	(0.03)	(0.10)	(0.15)	(0.15)	(0.22)	(0.00)	(0.01)	(0.00)	(0.01)	(0.02)	(0.03)	(0.04)	(0.07)
ER	-0.23***	-0.21***	-0.21***	-0.01	-3.74**	-3.73**	1.12	1.12	0.32***	0.32***	-0.38***	-0.38***	-0.19**	0.03	-0.32*	0.06
	(0.05)	(0.07)	(0.05)	(0.09)	(1.72)	(1.72)	(1.29)	(1.29)	(0.06)	(0.06)	(0.06)	(0.06)	(0.08)	(0.11)	(0.18)	(0.25)
U.S rate	-0.01	0.00	-0.02	0.00	-0.31	-0.01	0.05	-0.03	0.00	-0.01	-0.01	-0.02	0.01	-0.02	0.02	0.00
	(0.01)	(0.01)	(0.01)	(0.02)	(0.23)	(0.32)	(0.31)	(0.43)	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.03)	(0.04)

Note: The significance levels are as follows: (*) at 90%, (**) at 95%, and (***) at 99%. The weighting matrix was estimated using the HAC (Newey-West) method, and its update was performed through a two-step iterative procedure.

5.2.3 On the McKinnon's complementarity hypothesis

The results presented above (Table 7) also enable an assessment of whether McKinnon's complementarity hypothesis remains valid after more than 50 years since its proposition. In his seminal work, McKinnon contended that the demand for money is complementary to the demand for physical capital, suggesting that financial assets do not serve as substitutes for money in emerging countries. This premise stems from limited access to international and domestic credit in these nations due to their classification as highly risky, with high risk premiums acting as liquidity constraints. Consequently, individuals primarily rely on their own resources for investment. Thus, an increase in interest rates, tied to real returns, presents economic agents with an opportunity to invest in physical capital, thereby increasing their demand for money (Thornton and Poudyal, 1990).

A significant body of literature has examined McKinnon's hypothesis, particularly in Asian and African emerging economies; however, the evidence remains inconclusive (Thornton and Poudyal, 1990; Khan and Hasan, 1998; Odhiambo, 2004; Moore, 2010; etc.). Notably, there are no studies focusing on Latin American emerging economies. Therefore, our research aims to fill this gap with the results presented herein.

We utilize the money demand estimates provided in the first row of Table 8, where the OLS estimation of money demand after the adoption of IT is presented, and assess whether the interest rate elasticities exhibit positive and significant signs. Notably, our findings reveal that in Peru, the elasticity of money demand with respect to the domestic interest rate remains statistically insignificant. Likewise, in the other countries in our sample, the estimated coefficients are negative, indicating that the interest rate primarily plays the role of an opportunity cost or a speculative factor.

One possible explanation for the statistically insignificant interest rate elasticity in Peru is the presence of structural financial constraints or a relatively underdeveloped capital market, which could limit the transmission of interest rate changes to money demand. In this context, McKinnon's hypothesis might not hold due to persistent credit frictions, preventing economic agents from directly linking higher interest rates to

increased investment in physical capital. Alternatively, a Keynesian interpretation suggests that liquidity preference remains strong, with economic agents holding money for precautionary or transactional motives, irrespective of interest rate fluctuations.

In contrast, the negative interest rate elasticities observed in Colombia, Mexico, and Chile indicate that the cost of holding money outweighs its potential complementarity with investment. This suggests that in these economies, interest rates act primarily as an opportunity cost rather than as a channel for capital accumulation. Moreover, financial market development could play a crucial role, as more sophisticated financial instruments provide viable alternatives to holding money, reinforcing the negative relationship between interest rates and money demand.

5.2.4 Heterogeneous behavior of money demand

In this section, we present the results of the quantile regression estimations and discuss the main findings. Table 8 and Figure 1 displays the estimated elasticities of money demand (income and interest rates) using both the OLS and quantile regression approaches for the Pacific Alliance (PA) countries.

In quantile regression, the term τ represents the specific quantile of the conditional distribution of the dependent variable. A quantile τ (where $0< \tau <1$) partitions the distribution such that a proportion τ of the observations falls below the estimated quantile regression line, while $1- \tau$ lies above it. For instance, τ =0.5 corresponds to the median, capturing the central tendency, whereas lower and upper quantiles (e.g., τ =0.1 or τ =0.9) allow for an assessment of effects at the tails of the distribution.

Quantile regression provides a more comprehensive analysis of the conditional distribution of a dependent variable by estimating relationships at different points in the distribution, rather than focusing solely on the mean as in OLS. Unlike OLS, which minimizes the sum of squared residuals and is sensitive to outliers, quantile regression minimizes weighted absolute deviations, making it more robust to heteroskedasticity and non-normal errors. This method is particularly useful when the impact of explanatory variables varies across different quantiles, revealing distributional heterogeneity that mean-based approaches may overlook.

Overall, the equality of slope test, proposed by Khmaladze (1982) and Koenker and Xiao (2002), indicates statistical evidence of heterogeneous joint elasticities of income and interest rates across different quantiles of the distribution for all countries in our sample.

Examining Peru, the OLS estimate shows the expected sign for income elasticity with statistical significance, but lacks significance for interest rates. Similarly, the OLS estimate aligns with the 0.5 and 0.6 quantiles, indicating consistent results across different segments of the distribution. Notably, income elasticity exhibits higher values from the 0.5 to 0.8 quantiles, suggesting a moderate level of heterogeneity in its behavior. On the other hand, interest rate elasticity demonstrates greater magnitude in the left tail of the distribution. However, statistical significance is absent from the 0.7 to 0.9 quantiles.

The elasticities estimated for Chile exhibit a similar pattern. Although the OLS estimate for income elasticity aligns with the 0.6 quantile, there is evidence suggesting that it inadequately captures heterogeneous behavior. This is evident as income sensitivity is more pronounced in the lower quantiles of the money demand distribution, reaching its peak at the 0.1 quantile. Notably, from the 0.5 to 0.9 quantile, coefficients show minimal variation. Conversely, OLS estimates for interest rate elasticity align with Keynesian theory, featuring a small magnitude, statistical significance, and a negative slope. Quantile regression reveals that interest rate elasticity increases in magnitude for higher quantiles. On the other hand, elasticity estimates for Colombia indicate that income elasticity is higher for the upper tail of the distribution, peaking at the 0.8 quantile. Inversely, it is lower for the lower tail of the distribution. Regarding interest rates, elasticity diminishes in magnitude for higher quantiles of the real balances distribution. Consequently, interest rate elasticity increases for lower quantiles of the distribution. Importantly, both elasticities' signs and magnitudes align with theoretical expectations and exhibit statistical significance.

In the case of Mexico, OLS estimates closely align with the 0.6 quantile for income elasticity and the 0.8 quantile for interest rate elasticity. However, quantile regression suggests that the OLS model might not adequately capture elasticities for

extreme variations in real balances. Specifically, income elasticity increases for higher quantiles, whereas interest rate elasticity diminishes in magnitude for higher quantiles of the real balances distribution. Regarding the expected signs, both OLS and quantile regression demonstrate the appropriate signs with statistical significance.

According to the results presented above, similar characteristics are observed in the PA countries. Firstly, interest rate elasticity tends to decrease in magnitude as real balances increase. Regarding income elasticity, heterogeneous behavior is noted across countries. In Colombia and Mexico, income elasticity is higher in the right tail of the distribution, while in Chile, it tends to be higher for lower quantiles. In Peru, the income elasticity tends to be slightly higher in the right tail of the distribution.

What are the macroeconomic implications? The effects are solely related to the equilibrium in the money market. If interest rates become less responsive (inelastic) in the highest quantiles of the real balances distribution (indicative of an expansionary monetary policy by the central bank), an increase in income would lead to increased demand for money. To restore equilibrium, interest rates must rise; however, the increase needs to be proportionately greater due to the lower elasticity. Conversely, if income elasticity rises as real balances increase, income shocks would result in a more pronounced increase in the demand for money. Additionally, in the event of an exogenous demand shock and the economy facing near-zero interest rates, restoring equilibrium would necessitate a substantial increase in interest rates.

Furthermore, these results provide some evidence related to the economic cycle. As the economy experiences a boom (right tail of the real balances distribution), money demand increases in countries such as Colombia and Mexico. This suggests that the preference for liquidity in such contexts leads to a procyclical behavior of money demand. However, this claim would require more robust empirical validation.

In contrast, the opposite pattern is observed in Chile, suggesting that precautionary demand for money plays a significant role during periods of uncertainty, such as recessions (left tail of the real balances distribution). In these scenarios, economic agents increase their liquidity holdings to safeguard against potential financial distress. This effect may be further amplified by Chile's highly developed

financial and banking sector, where economic booms encourage the use of banking products rather than cash, reducing the need for precautionary money holdings.

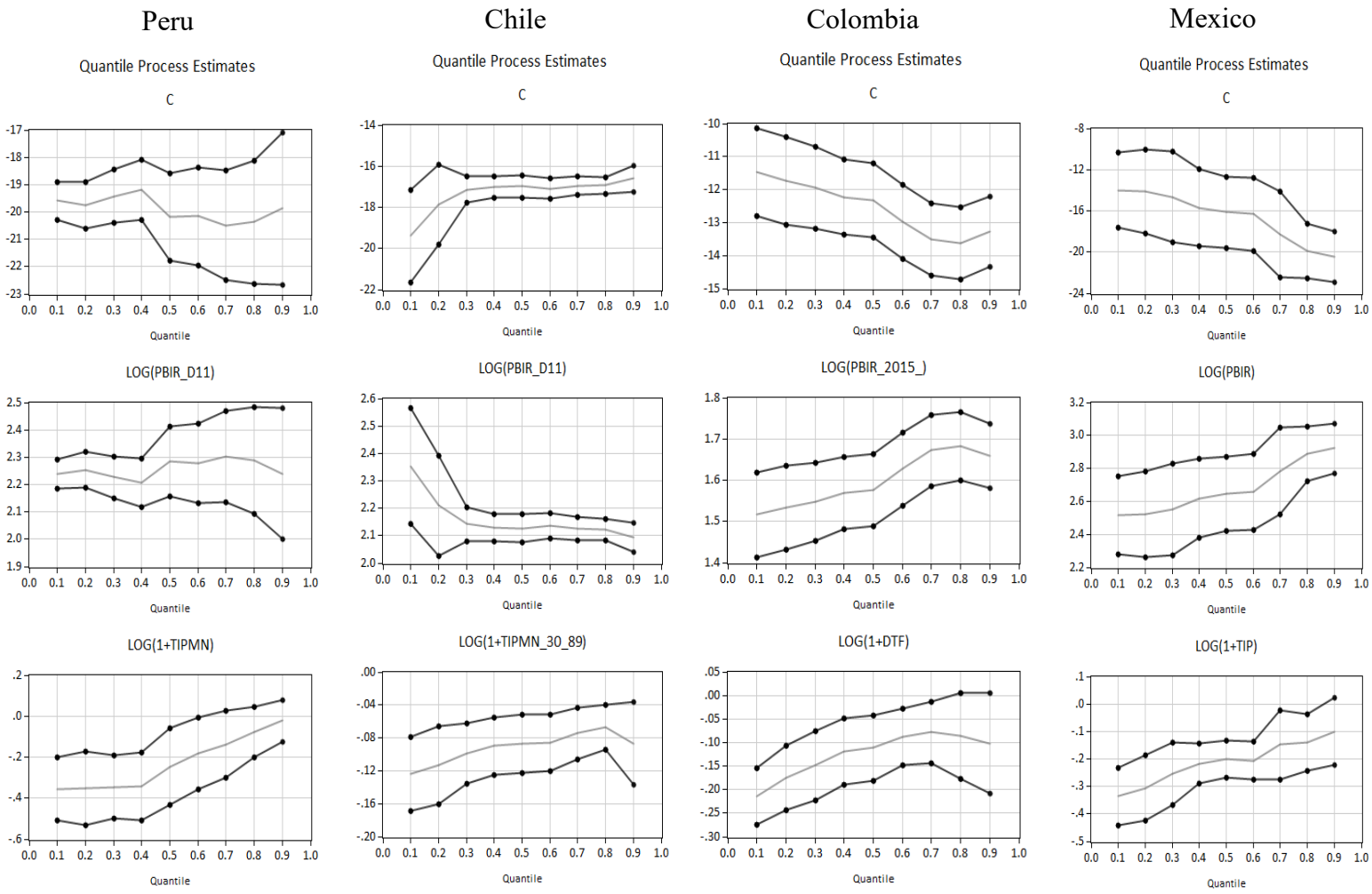
For Peru, the evidence is less conclusive, suggesting that both transactional and precautionary demand for money may offset each other. During economic expansions, there is an increased demand for money due to higher transaction volumes. However, at the same time, the need for excessive liquidity diminishes, as economic stability reduces perceived financial risks.

Table 8. Quantile Regression for Pacific Alliance Countries After IT Adoption and Before the COVID-19 Crisis – M1 as the Dependent Variable

	Peru 2002Q1:2019Q4		Chile 1999Q4:2019Q4		Colombia 1999Q4:2019Q4		Mexico 2001Q1:2019Q4	
	Log(y)	Log(r)	Log(y)	Log(r)	Log(y)	Log(r)	Log(y)	Log(r)
OLS	2.27***	-0.18	2.14***	-0.10***	1.61***	-0.13***	2.67***	-0.21***
	(0.03)	(0.10)	(0.03)	(0.02)	(0.05)	(0.04)	(0.15)	(0.04)
$\tau = 0.1$	2.23***	-0.35***	2.35***	-0.12***	1.52***	-0.21***	2.52***	-0.34***
	(0.03)	(0.08)	(0.11)	(0.02)	(0.05)	(0.03)	(0.12)	(0.05)
$\tau = 0.2$	2.25***	-0.35***	2.21***	-0.11***	1.53***	-0.18***	2.52***	-0.31***
	(0.03)	(0.09)	(0.09)	(0.02)	(0.05)	(0.03)	(0.13)	(0.06)
$\tau = 0.3$	2.23***	-0.35***	2.14***	-0.09***	1.55***	-0.15***	2.55***	-0.25***
	(0.04)	(0.08)	(0.03)	(0.02)	(0.05)	(0.04)	(0.14)	(0.06)
$\tau = 0.4$	2.20***	-0.34***	2.13***	-0.09***	1.57***	-0.12***	2.62***	-0.22***
	(0.04)	(0.08)	(0.03)	(0.02)	(0.04)	(0.04)	(0.12)	(0.04)
$\tau = 0.5$	2.28***	-0.25**	2.12***	-0.08***	1.58***	-0.11***	2.65***	-0.20***
	(-0.25)	(0.09)	(0.03)	(0.02)	(0.04)	(0.04)	(0.11)	(0.03)
$\tau = 0.6$	2.28***	-0.18**	2.14***	-0.09***	1.63***	-0.09***	2.66***	-0.21***
	(0.07)	(0.09)	(0.03)	(0.02)	(0.05)	(0.03)	(0.11)	(0.04)
$\tau = 0.7$	2.30***	-0.14	2.12***	-0.07***	1.67***	-0.08**	2.78***	-0.15***
	(0.09)	(0.08)	(0.02)	(0.02)	(0.04)	(0.03)	(0.13)	(0.06)
$\tau = 0.8$	2.29***	-0.08	2.12***	-0.07***	1.68***	-0.09*	2.89***	-0.14**
	(0.09)	(0.09)	(0.02)	(0.01)	(0.04)	(0.05)	(0.08)	(0.05)
$\tau = 0.9$	2.24***	-0.02	2.09***	-0.09***	1.66***	-0.10***	2.92***	-0.10
	(0.12)	(0.05)	(0.03)	(0.03)	(0.04)	(0.05)	(0.08)	(0.06)
Slope Equality Test	0.03**		0.07*		0.00***		0.03**	
Obs.	72		81		81		65	

Note: Standard errors are in parentheses. The asterisks denote statistical significance at the 1 (***), 5 (**), and 10 (*) per cent levels. The standard error was calculated with Huber Sandwich method for quantile regressions and HAC robust estimator (Newey and West, 1992) for OLS. The sparsity method: Hall-Sheater. The Slope equality test (SET) is provided by Khmaladze (1982) and Koenker and Xiao (2002). For Chile, Colombia and Mexico, the SET is calculated based on quantiles 0.10, 0.25, 0.50 and 0.75. For Peru, the SET is based on quantiles 0.25, 0.30, 0.50 and 0.75. The p value of wald test is showed for SET. Source: own elaboration.

Figure 1. *Dynamics of the Quantile Regression Coefficients – M1 as a Dependent Variable*



Note: This graph shows the dynamics of the coefficients according to the quantiles (see Table 6). The confidence intervals are estimated at 95%. Source: own elaboration.

5. CONCLUSION

Understanding the behavior of money demand is crucial for the effectiveness of monetary policy, particularly in emerging countries, which are not only exposed to domestic shocks but also to foreign ones. In this paper, we provide an initial approach regarding the potential effects of IT on money demand. To do so, we estimate a microfounded money demand and assess the behavior of elasticities before and after the adoption of IT.

The results indicate the following: Using a pre-COVID sample, we find that after the adoption of IT, the GDP elasticity declined in Mexico and Chile, remained unchanged in Colombia, and increased slightly in Peru. The elasticity of domestic interest rates rose, particularly in Peru, while exchange rate elasticities declined in Peru and Chile but remained stable in Colombia.

Expanding the sample to include post-COVID data, the findings reveal that following IT adoption, GDP elasticity decreased in Mexico, Peru, and Colombia, whereas it increased slightly in Chile. Additionally, the elasticity of domestic interest rates continued to rise in Peru, while the exchange rate elasticity in Colombia remained unchanged. For the other countries, the lack of statistical significance prevents a meaningful comparison before and after IT adoption.

On the other hand, there is a growing literature arguing for possible non-linearities in money demand. Given its importance for the execution and effectiveness of monetary policy, we estimate a quantile regression model to evaluate heterogeneous behaviors.

The findings indicate that money demand has exhibited heterogeneous behavior for all the PA countries during the inflation targeting period. Generally, interest rate elasticity tends to be smaller in magnitude when real balances are high, while income elasticity demonstrates heterogeneous behavior across countries. For Colombia and Mexico, income elasticity is higher in the right tail of the distribution, while for Chile, it tends to be higher for lower quantiles. For Peru, income elasticity tends to be slightly higher in the right tail of the distribution.

According to McKinnon's (1973) complementarity hypothesis, our evidence suggests that after more than 50 years, money no longer serves as a savings vehicle, nor is the demand for money complementary to the demand for physical capital. Therefore, McKinnon's hypothesis has lost validity in emerging Latin American countries, largely due to the region's greater development and financial integration.

6. DISCUSSION

We present an approximation of the potential effects of IT on money demand in some Latin American countries. It remains on the agenda for future research to use causal models to more rigorously identify the effects of IT on money demand for emerging countries. Furthermore, exploring the dynamic effects of IT on money demand over longer time horizons could provide insights into the sustainability of such regimes. Additionally, investigating the impact of financial innovation, globalization, and behavioral economics on money demand dynamics in the context of IT can offer valuable perspectives on the evolving nature of monetary dynamics. Furthermore, assessing the relationship between IT regimes and financial stability, as well as conducting cross-country comparisons and policy evaluations, can inform policymakers about the broader macroeconomic implications of adopting such frameworks.

Given the evidence of heterogeneous behavior in money demand across all PA countries, policymakers should adopt a nuanced and adaptive approach to monetary policy that accounts for the diverse economic conditions and structural characteristics of each member nation. Firstly, it is imperative to recognize the varying sensitivities of money demand to key economic variables such as income and interest rates across different quantiles of the distribution. Policymakers should leverage this understanding to tailor monetary policy interventions to specific segments of the economy, ensuring that policy measures are effective in addressing the needs and challenges faced by different economic agents.

Furthermore, policymakers should prioritize the development of robust econometric models and empirical methodologies to monitor and analyze changes in money demand dynamics over time. By continuously assessing the drivers of money demand and their interactions with inflation targeting policies, policymakers can make informed decisions regarding the calibration and implementation of monetary policy measures. Additionally, fostering collaboration and knowledge-sharing among central banks and research institutions within the PA countries can facilitate the exchange of best practices and insights into monetary policy design and implementation.

In light of the findings suggesting a diminishing role of money as a savings vehicle and the evolving relationship between money demand and physical capital, policymakers should also explore alternative policy instruments and frameworks to complement inflation targeting regimes. This may include measures to enhance financial inclusion, promote the development of alternative payment systems, and harness the potential of financial technology to improve the efficiency and effectiveness of monetary policy transmission mechanisms.

Moreover, given the interconnectedness of global financial markets and the susceptibility of emerging economies to external shocks, policymakers should remain vigilant to developments in the global economy and their potential impact on domestic money demand dynamics. Strengthening macroeconomic surveillance and coordination efforts at the regional and international levels can help mitigate the spillover effects of external shocks and enhance the resilience of domestic monetary policy frameworks.

Overall, adopting a flexible, data-driven, and adaptive approach to monetary policy, informed by a comprehensive understanding of the heterogeneous nature of money demand, is essential for promoting economic stability, growth, and financial inclusion across the PA countries. By embracing innovation, collaboration, and evidence-based policymaking, policymakers can navigate the complexities of monetary policy in an increasingly dynamic and interconnected global economic landscape.

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APPENDIX

Appendix A: Data processing

Data and Sources

1. Peru

1.1 Real GDP

The real GDP series (at 2007 prices) was obtained for the period from 1995Q1–2024Q3 and was seasonally adjusted using Census X-13. Source: Central Bank of Peru.

1.2 Real balances

The nominal monetary aggregate used was M1, which includes currency in circulation and demand deposits at the end of the period. Initially, the series was obtained at a monthly frequency, then converted into a quarterly series and adjusted for the GDP deflator. The series starts from 1995Q1 to 2024Q3. Source: Central Bank of Peru.

1.3 Interest rate

The series corresponds to the average active and passive interest rates of banking companies in the national currency (annual effective terms). Initially, the series was

compiled at a monthly frequency and subsequently transformed into quarterly frequency for the period 1995Q1–2024Q3. Source: Central Bank of Peru.

1.4 Inflation expectations

The series corresponds to 12-month inflation expectations derived from macroeconomic surveys. Initially obtained at a monthly frequency, it was converted to a quarterly frequency using quarterly averages for the period 1995Q1–2024Q3. In the case of Peru, since the series began in 2002, for the preceding years, current inflation was used with a 12-month lead. Source: Central Bank of Peru.

1.5 Exchange rate

The nominal exchange rate corresponds to the average interbank exchange rate for the period, reflecting how many soles are equivalent to one dollar. The original series was at a monthly frequency and was converted to a quarterly frequency using averages for the period 1995Q1–2024Q3. Source: Central Bank of Peru.

2 Chile

2.4 Real GDP

The real GDP series at 2018 prices (chained) was obtained for the period from 1996Q1–2024Q3 and was seasonally adjusted using Census X-13. Source: Central Bank of Chile.

2.5 Real balances

The nominal monetary aggregate used was M1, at the average of the period. Initially, the series was obtained at a monthly frequency, then converted into a quarterly series and adjusted for the GDP deflator. The series starts from 1996Q1 to 2024Q3. Source: Central Bank of Chile.

2.6 Interest rate

The series corresponds to the average passive interest rate of the financial system (deposits from 30 to 89 days). Initially, the data were collected monthly and later transformed into quarterly frequency for the period 1996Q1–2024Q3. Source: Central Bank of Chile.

2.7 Inflation expectations

The series corresponds to 12-month inflation expectations based on macroeconomic surveys. The data were originally obtained at a monthly frequency and were converted

to a quarterly frequency using simple averages for the period 1996Q1–2024Q3. Since inflation expectations data have been published only since 2004, forecasted inflation data from the OECD were used for earlier periods. Source: Central Bank of Chile.

2.8 Exchange rates

The series corresponds to the nominal exchange rate of the observed dollar in pesos per dollar. The data were obtained at a quarterly frequency for the period 1996Q1–2024Q3. Source: Central Bank of Chile.

3 Colombia

3.4 Real GDP

Two series of real GDP with different base years were collected and then spliced together to obtain a complete GDP series with the maximum amount of data possible. The first series was real GDP at constant 1994 prices, available from 1994Q1–2007Q4. The second series corresponds to GDP at 2015 prices, available from 2005Q1–2024Q1. Thus, using the mixing splicing technique, a complete series of real GDP from 1994Q1–2024Q1 at 2015 prices was obtained. The data obtained was already seasonally adjusted. Source: Departamento Administrativo Nacional de Estadística de Colombia (DANE).

3.5 Real balances

The nominal monetary aggregate used was M1, which includes cash and current account deposits at the average of the period. Initially, the series was obtained at a monthly frequency, then converted into a quarterly series and adjusted for the GDP deflator. The series starts from 1994Q1 to 2024Q1. Source: Central Bank of Colombia.

3.6 Interest rate

The series corresponds to the average deposit rate. The average monthly Fixed-term deposit (DTF) rate refers to the weighted average by amount of the daily 90-day Time Deposit Certificate (CDT) rate for banks, financial corporations, and financing companies on business days of the respective month. Initially, the data were collected monthly and later transformed into quarterly frequency for the period 1994Q1–2024Q1. Source: Central Bank of Colombia.

3.7 Inflation expectation

The series corresponds to 12-month inflation expectations (mean). The data were initially collected at a monthly frequency and later converted to a quarterly frequency using averages for the period 1994Q1–2024Q1. Since inflation expectations data began in 2003, forecasted inflation data from the OECD were used for earlier periods. Source: Central Bank of Colombia.

3.8 Exchange rate

The series corresponds to the nominal exchange rate in pesos per dollar, averaged over the period. The data were initially obtained at a monthly frequency and converted to a quarterly frequency using quarterly averages for the period 1994Q1–2024Q1. Source: Central Bank of Colombia.

4 Mexico

4.4 Real GDP

The real GDP series at 2008 prices was obtained for the period from 1996Q2–2019Q4 and was already seasonally adjusted. Source: Federal Reserve Bank of St. Louis (FRED).

4.5 Real balances

The nominal monetary aggregate used was M1, wich includes cash and current account deposits at the average of the period. Initially, the series was obtained at a monthly frequency, then converted into a quarterly series and adjusted for the GDP deflator. The series starts from 1996Q2 to 2023Q3. Source: Federal Reserve Bank of St. Louis (FRED).

4.6 Interest rate

The series corresponds to the cost of term liabilities funding in national currency of the Multiple Banking System. Initially, the data were collected monthly and later transformed into quarterly frequency for the period 1994Q1–2023Q3. Source: Central Bank of Mexico.

4.7 Inflation expectations

The series corresponds to 12-month inflation expectations derived from expectation surveys (mean value). The data were collected at a monthly frequency and later converted to a quarterly frequency using averages for the period 1994Q1–2023Q3.

Inflation expectations were first published in 1999; for earlier periods, forecasted inflation data from the OECD were used. Source: Central Bank of Mexico.

4.8 Exchange rate

The series corresponds to the nominal exchange rate in pesos per dollar, averaged over the period. It was initially collected at a monthly frequency and converted to a quarterly frequency using averages for the period 1994Q1–2023Q3. Source: Central Bank of Mexico.

4.8 U.S. rate

This series corresponds to the market yield on U.S. Treasury securities with a 1-year constant maturity, quoted on an investment basis (percent, quarterly, not seasonally adjusted). The Census X-13 filter was applied to remove seasonality. The data were obtained at a quarterly frequency. Source: Federal Reserve Bank of St. Louis (FRED).

Appendix B: Tables and Figures

Table 9. *Unit Root and Stationarity Tests for Peru*

		Augmented Dickey Fuller Test (ADF)			**Phillips and Perron Test (PP)**			**KPSS Test**	
		None	Intercept	Trend and Intercept	None	Intercept	Trend and Intercept	Intercept	Trend and Intercept
Real log M1		1.15	-0.64	-3.76**	1.62	0.61	-2.56	1.18	0.06***
Δ Real log M1		-3.57***	-3.99***	-3.96**	-6.11***	-6.62***	-6.58***	0.06***	0.06***
Log GDP		2.91	1.62	-1.83	4.19	-2.19	-2.19	1.18	0.30
Δ Log GDP		-11.91***	-12.77***	-12.85***	-11.91***	-15.23***	-19.06***	0.38***	0.10***
Domestic rate		-1.20	-3.64***	-4.17***	-1.20	-3.11**	-3.03	0.33***	0.07***
Δ Domestic rate		-5.16***	-5.14***	-5.14***	-5.00***	-4.96***	-4.82***	0.08***	0.03***
I. expectation		-0.91	-4.34***	-4.46***	-0.67	-3.14**	-3.16*	0.22***	0.07***
Δ I. expectation		-5.20***	-5.17***	-5.16***	-5.28***	-5.25***	-5.24***	0.04***	0.03***
Exchange rate		0.13	-0.79	-1.71	0.24	-0.86	-1.44	0.44**	0.28
Δ Exchange rate		-7.40***	-7.36***	-7.77***	-6.31***	-6.27***	-6.23***	0.33***	0.07***
U.S. rate		-2.42**	-3.89***	-3.94**	-1.03	-1.78	-1.71	0.17***	0.17
Δ U.S rate		-4.34***	-4.31***	-4.30***	-4.42***	-4.40***	-4.40***	0.12***	0.05***
	1%	-2.59	-3.51	-4.07	-2.59	-3.50	-4.06	0.74	0.22
	5%	-1.94	-2.89	-3.46	-1.94	-2.89	-3.46	0.46	0.15
	10%	-1.61	-2.58	-3.16	-1.61	-2.58	-3.16	0.35	0.12

Note: The significance levels are as follows: (*) at 90%, (**) at 95%, and (***) at 99%. The null hypothesis of the unit root tests states the presence of a unit root. For the stationarity test (KPSS), the null hypothesis indicates that the series is stationary. The data are in quarterly frequency and cover the period from 1995Q1 to 2024Q3. The optimal lag length for the ADF test was determined using the Schwarz Information Criterion (max. 14). For the PP and KPSS tests, the Barlett Kernel spectral estimation method and Newey-West Bandwidth selection were applied.

Table 10. *Unit Root and Stationarity Tests for Chile*

		Augmented Dickey Fuller Test (ADF)			**Phillips and Perron Test (PP)**			**KPSS Test**	
		None	Intercept	Trend and Intercept	None	Intercept	Trend and Intercept	Intercept	Trend and Intercept
Real log M1		0.62	-1.00	-2.26	0.23	-1.29	-2.34	1.09	0.09***
Δ Real log M1		-5.14***	-5.30***	-5.29***	-4.15***	-4.19***	-4.19***	0.07***	0.06***
Log GDP		3.76	-1.89	-1.96	3.76	-1.92	-1.96	1.21	0.28
Δ Log GDP		-8.46***	-9.69***	-9.88***	-8.62***	-9.69***	-9.88***	0.25***	0.03***
Domestic rate		-1.91*	-4.20***	-4.22***	-1.50	-2.86*	-2.94	0.10***	0.08***
Δ Domestic rate		-4.34***	-4.31***	-4.27***	-4.45***	-4.43***	-4.39***	0.05***	0.03***
I. expectation		-0.68	-3.94***	-4.24***	-0.74	-3.22**	-3.49**	0.26***	0.09***
Δ I.expectation		-6.77***	-6.73***	-6.69***	-6.75***	-6.71***	-6.67***	0.04***	0.03***
Exchange rate		0.86	-0.00	-1.51	0.82	-0.05	-1.42	0.71	0.29
Δ Exchange rate		-7.62***	-7.66***	-8.03***	-6.92***	-6.93***	-9.53***	0.47	0.07***
U.S. rate		-2.42**	-3.92***	-3.96**	-1.02	-1.78	-1.71	0.17***	0.17**
Δ U.S rate		-3.28***	-2.27**	-3.17*	-4.45***	-4.43***	-4.43***	0.12***	0.05***
	1%	-2.59	-3.51	-4.07	-2.59	-3.50	-4.06	0.74	0.22
	5%	-1.94	-2.89	-3.46	-1.94	-2.89	-3.46	0.46	0.15
	10%	-1.61	-2.58	-3.16	-1.61	-2.58	-3.16	0.35	0.12

Note: The significance levels are as follows: (*) at 90%, (**) at 95%, and (***) at 99%. The null hypothesis of the unit root tests states the presence of a unit root. For the stationarity test (KPSS), the null hypothesis indicates that the series is stationary. The data are in quarterly frequency and cover the period from 1996Q1 to 2024Q3. The optimal lag length for the ADF test was determined using the Schwarz Information Criterion (max. 14). For the PP and KPSS tests, the Barlett Kernel spectral estimation method and Newey-West Bandwidth selection were applied.

Table 11. *Unit Root and Stationarity Tests for Colombia*

		Augmented Dickey Fuller Test (ADF)			**Phillips and Perron Test (PP)**			**KPSS Test**	
		None	Intercept	Trend and Intercept	None	Intercept	Trend and Intercept	Intercept	Trend and Intercept
Real log M1		2.26	-1.14	-2.97	2.32	1.20	-1.76	1.07	0.10***
Δ Real log M1		-6.17***	-6.75***	-6.79***	-6.56***	-7.00***	-7.03***	0.13***	0.07***
Log GDP		3.04	-1.30	-2.82	5.12	-1.71	-2.69	1.24	0.24
Δ Log GDP		-8.88***	-9.93***	-9.95***	-8.88***	-10.88	-11.87***	0.24***	0.09***
Domestic rate		-1.27	-3.61	-3.56**	-0.77	-2.27	-2.15	0.15***	0.14**
Δ Domestic rate		-3.84***	-3.82***	-5.11***	-4.07***	-4.05***	-4.06***	0.10***	0.04***
I. expectation		-1.02	-3.22**	-3.19*	-0.83	-2.46	-2.31	0.22**	0.20
Δ I. expectation		-4.35***	-4.33***	-4.26***	-4.41***	-4.39***	-4.32***	0.12***	0.03***
Exchange rate		0.34	-0.82	-2.51	0.47	-0.50	-2.41	0.90	0.29
Δ Exchange rate		-6.28***	-6.29***	-6.34***	-6.00***	-5.96***	-5.92***	0.29***	0.08***
U.S. rate		-2.24**	-3.44**	-3.37*	-0.78	-1.58	-1.44	0.21***	0.20
Δ U.S rate		-3.99***	-3.98***	-3.97**	-3.96***	-4.05***	-3.94**	0.14***	0.08***
	1%	-2.59	-3.51	-4.07	-2.59	-3.50	-4.06	0.74	0.22
	5%	-1.94	-2.89	-3.46	-1.94	-2.89	-3.46	0.46	0.15
	10%	-1.61	-2.58	-3.16	-1.61	-2.58	-3.16	0.35	0.12

Note: The significance levels are as follows: (*) at 90%, (**) at 95%, and (***) at 99%. The null hypothesis of the unit root tests states the presence of a unit root. For the stationarity test (KPSS), the null hypothesis indicates that the series is stationary. The data are in quarterly frequency and cover the period from 1994Q1 to 2024Q1. The optimal lag length for the ADF test was determined using the Schwarz Information Criterion (max. 14). For the PP and KPSS tests, the Barlett Kernel spectral estimation method and Newey-West Bandwidth selection were applied.

Table 12. *Unit Root and Stationarity Tests for Mexico*

		Augmented Dickey Fuller Test (ADF)			**Phillips and Perron Test (PP)**			**KPSS Test**	
		None	Intercept	Trend and Intercept	None	Intercept	Trend and Intercept	Intercept	Trend and Intercept
Real log M1		9.73	1.41	-2.36	8.39	-1.28	-2.12	1.34	0.09***
Δ Real log M1		-3.39***	-7.77***	-7.83***	-4.73***	-7.77***	-7.83***	0.15***	0.07***
Log GDP		1.75	-1.35	-4.24***	2.74	-1.05	-4.17***	1.30	0.11***
Δ Log GDP		11.91***	-12.17***	-12.11***	-12.34***	-13.89***	-13.82***	0.07***	0.06***
Domestic rate		-0.29	-2.06	-1.79	-4.20***	-6.79***	-5.73***	0.54	0.26
Δ Domestic rate		-4.44***	-4.20***	-4.25***	-9.96***	-9.89***	-10.40***	0.73	0.16*
I. expectation		-2.45**	-5.94***	-5.69***	-4.14***	-11.35***	-11.16***	0.53	0.20
Δ I. expectation		-4.79***	-4.85***	-4.98***	-4.64***	-4.70***	-4.81***	0.66	0.22***
Exchange rate		0.68	-1.02	-2.07	0.66	-1.04	-2.07	1.20	0.18
Δ Exchange rate		-8.79***	-8.84***	-8.81***	-8.75***	-8.79***	-8.76***	0.11***	0.11***
U.S. rate		-1.53	-3.92***	-3.64**	-1.30	-1.98	-1.37	0.45	0.17
Δ U.S rate		-2.83***	-2.81*	-4.73***	-4.59***	-4.57***	-4.75***	0.21***	0.06***
	1%	-2.59	-3.51	-4.07	-2.59	-3.50	-4.06	0.74	0.22
	5%	-1.94	-2.89	-3.46	-1.94	-2.89	-3.46	0.46	0.15
	10%	-1.61	-2.58	-3.16	-1.61	-2.58	-3.16	0.35	0.12

Note: The significance levels are as follows: (*) at 90%, (**) at 95%, and (***) at 99%. The null hypothesis of the unit root tests states the presence of a unit root. For the stationarity test (KPSS), the null hypothesis indicates that the series is stationary. The data are in quarterly frequency and cover the period from 1996Q1 to 2023Q3. The optimal lag length for the ADF test was determined using the Schwarz Information Criterion (max. 14). For the PP and KPSS tests, the Barlett Kernel spectral estimation method and Newey-West Bandwidth selection were applied.