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Is Money Demand Function Stable In Developing Economies? Evidence From Panel Data Study

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ABSTRACT

This study evaluates money demand in a sample of developing countries by analysing data from 1990-2023. This study employs a dynamic Panel ARDL model and a suite of stability and causality tests to explore the key issues surrounding the money demand function. The findings provide substantial empirical support for a statistically significant and enduring association within the specified function of demand for money. Moreover, the results indicate that the estimated values of all variables, except for the real interest rate, are both rational and consistent with the economic theory. Nevertheless, the inclusion of the real interest rate as a proxy variable for opportunity cost in a given sample of developing economies has been criticised as inadequate because of its failure to accurately capture prevailing financial market conditions. The application of the Dumitrescu and Hurlin (2012) test verifies the notion that money demand is influenced by income, interest rate, and inflation rate, in line with the theoretical framework of monetary transmission mechanisms.

Keywords Open economy, Money Demand, Developing economies, Panel ARDL.

JEL Codes: F41, E41, E50, E52

Introduction.

In light of the evolutionary dynamics characterising emerging economies and their integration into the globalised world economy, a comprehensive examination of the stability inherent in the money demand function (MDF) and its attendant monetary policy framework becomes imperative. The formulation of an efficacious monetary policy necessitates meticulous consideration of the foundational role of a robust money demand function within an economic system. Positioned as the cornerstone model within macroeconomic discourse, the progressive application of the MDF has garnered considerable scholarly attention as an invaluable tool for monetary policy formulation, particularly in the realm of empirical enquiry (Adil et al., 2020). As underscored by Goldfeld (1989), the interrelationship between money demand and its principal determinants assumes a seminal position within the annals of macroeconomic literature and assumes critical significance in the execution of monetary policy. Even within the purview of inflation targeting, the delineation of a well-

defined money demand function emerges as indispensable for the accurate tracking of both interest rates and money supply, as well as for the nuanced evaluation of the ramifications of monetary policy interventions on the broader economic landscape. As articulated by (Singh & Pandey, 2010), "The contours of monetary management, in terms of both framework and instruments, have undergone significant metamorphosis, mirroring the overarching transition of the economy from a regulated to a liberalized and deregulated paradigm." The stability of money demand perennially looms as a pivotal subject of enquiry in macroeconomic policy discourse. A monetary policy calibrated to align money supply with demand not only facilitates demand management but also significantly contributes to the pursuit of price stability. The rate of growth in money supply must correspond harmoniously with the desired output growth rate while concurrently curbing inflationary pressures to levels deemed acceptable. Stable demand for money not only portends a robust money multiplier but also renders prognostications regarding the impact of a given money supply on aggregate money income more tractable.

Under diverse economic circumstances, the populace's anticipated retention of money emerges as a fundamental prerequisite for devising a potent monetary strategy within an economic framework. This requisite stems from the fact that the requisition for money and its constituent elements furnishes indispensable perspectives on the character and magnitude of the interconnections between a nation's monetary realm and its tangible sectors. (Muralikrishna Bharadwaj & Pandit, 2010) posit, 'The coherence between the currency supply and economic benchmarks such as output, interest rates, and price levels must endure stability to serve the ends of policymaking. If such stability endures, policymakers can efficaciously pursue ultimate objectives such as price stability, capital accumulation, mitigation of unemployment, and economic expansion through the manipulation of intermediary factors like interest rates and financial liquidity.' The significance of preserving a steadfast Money Demand Function (MDF) is of paramount importance for the formulation and efficacious operation of monetary policy, as it exerts a direct influence on the pivotal macroeconomic variables that constitute the focal points of these policies (Laidler, 1977). A resilient MDF implies a consistent money multiplier, engendering predictability in gauging the impact of a specific currency supply on aggregate monetary revenue (Pradhan & Subramanian, 2003). Comprehending the causal relationship of a stable money demand function (MDF) can provide invaluable insights into monetary policy decisions. Conversely, the volatility of the MDF wields considerable sway in delineating financial liquidity preferences. A steadfast demand for currency denotes the effectiveness of monetary aggregates in the execution of monetary policy and the extent to which a currency can prognosticate inflationary trends (Albulescu & Pepin, 2018).

A considerable body of research has been conducted to empirically validate the stability inherent in money demand. However, a noteworthy constraint in the extant literature is the predominant focus on developed nations, which neglects the nuances of developing

countries[1]. Moreover, the existing literature[2] indicates a notable emphasis on country-specific time series analyses, with a conspicuous dearth of comprehensive studies encompassing developing countries in their entirety[3]. Consequently, we discern from the extant literature that studies of the Money Demand Function (MDF) have pursued two avenues: country-specific analyses and panel testing methodologies (Narayan et al., 2009). The latter approach remains in its infancy, with a predominant focus on regional blocs such as the South Asian Association for Regional Cooperation (SAARC), the Organisation of the Petroleum Exporting Countries (OPEC), and the Association of Southeast Asian Nations (ASEAN). Hence, escalating apprehension regarding the stability of MDF in contemporary times is of paramount significance. Against the backdrop of a transition towards more flexible exchange rate regimes, the integration of emerging and developing economies into the global economic milieu, and the heightened openness of these economies, the global community of central bankers, policymakers, and researchers grapple with the ramifications thereof. Consequently, in light of these emergent realities, the stability of the money demand function emerges as a pressing question warranting meticulous examination.

METHODOLOGY

Sources of Data

In the present study, we employed panel estimation to account for individual differences, unveil hidden traits, and provide reliable estimation details (Baltagi, 2005). The variables examined here align with those identified in recent literature (Asongu et al., 2019) and include real broad money M3, real gross domestic product (GDP), rate of inflation, real rate interest, and real effective exchange rate (REER). A comprehensive list of countries with country-specific codes specified by (International Financial Statistics) is provided in Table A2 in the Appendix. We used annual data from a sample of twenty-six developing nations from 1990 to 2019. The decision to focus on developing countries stems from considerations of data availability and the relevance of the sample period to the issues under investigation.

Econometric Approach

We employed the methodology introduced by (Hossain, 1993) which is in line with recent research on the stability of money demand functions. The specified money demand is as follows:

$$M/P = f(Y, IR, P, EX), \quad (1)$$

[1] Mehra (1997), Sriram (2001), Calza and Joao (2003) and (Bahmani-Oskooee et al., 2015) provide a review of empirical money demand studies.

[2] (Pradhan & Subramanian, 2003), (Royal et al., 2005), (Muralikrishna Bharadwaj & Pandit, 2010) (Adil et al., 2018) Mehra (1997), Sriram (2001), Calza and Joao (2003) and (Bahmani-Oskooee et al., 2015) provide a review of empirical money demand studies.

[3] (Arize, 1994), (Arrau et al., 1995), (Bahmani & Kutan, 2010), (Kumar, 2011), (Asiedu et al., 2020), (Benati et al., 2021) and (Azimi, 2023) provide empirical study on either regional or a group of developing countries.

In this context, M/P symbolises the actual money supply adjusted for inflation, while Y represents the real gross domestic product (GDP) adjusted for inflation and measured in 2015 US$. IR stands for the real interest rate, P signifies the inflation rate, and EX indicates the real effective exchange rate.

Representing Equation (1) in log form as

$$\ln (M/p)_t = \beta_0 + \beta_1 \ln\ y_t + \beta_2 IR_t + \beta_3 \ln P_t + \beta_4 \ln EX_t + \varepsilon_t \qquad (2)$$

where ln is the natural logarithm, βs are variable coefficients, ε is the error term, and the subscript t represents time. All variables except the real interest rate were log-transformed using their natural logarithms. Equation (2) represents the long-run function of money demand for a sample of developing countries. For the panel function of money demand, Equation (2) can be rewritten as

$$\ln (M/p)_{it} = \beta_0 + \beta_{i1} \ln y_{it} + \beta_{i2} IR_{it} + \beta_{i3} \ln P_{it} + \beta_{i4} \ln EX_{it} + \varepsilon_{it} \qquad (3)$$

where i and t denote the country and time subscripts, respectively, and $\varepsilon_{it} \sim N(0, \sigma)$ for all i and t. The study employs a procedure in a three-way perspective to investigate the predictors of MDF and its stability over the chosen sample period. The initial step entails examining whether there exists a long-term relationship between real money balances and their corresponding variables. The subsequent steps hinge on the outcome of the first step in determining long- and short-run elasticities.

Dynamic panel ARDL model

The subsequent procedure specifies a dynamic panel data methodology, which depends on the integration properties of the variables. If all variables exhibit stationarity, the estimation can proceed with fixed- or random-effects models. Alternatively, if all variables are non-stationary at the level but stationary at the first difference, the Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) methods are applied (Pedroni, 2001); (Mark & Sul, 2003). Considering the integration order of the variables, the Panel Autoregressive Distributed Lag model (ARDL) is employed. ARDL proves superior regardless of the integration order of the underlying regressors, whether I (0), I (1), or a combination of both. Incorporating panel ARDL with an appropriate number of lags can address serial autocorrelation simultaneously, thus mitigating endogeneity issues. In the panel ARDL frameworks proposed by (Pesaran & Smith, 1995) and (Pesaran & Shin, 1999) two estimators are utilised: the Mean Group (MG) and Pooled Mean Group (PMG). The Mean Group (MG) and Pooled Mean Group (PMG) estimators yield consistent estimates owing to the expansive dimensions of their cross-sections and time panels. The primary disparity between these methods lies in their treatment of long-run coefficients. While both allow intercepts, short-run coefficients, and error variances to vary across cross-sectional units, only PMG enforces the homogeneity of the long-run coefficients. Thus, under the assumption of long-run slope homogeneity, both PMG and MG remain consistent estimators, although PMG is deemed more efficient. Consequently, (Pesaran & Shin, 1999) recommend utilising a joint Hausman test statistic to test for long-run homogeneity. In our study, we employed

several estimators, including Mean Group (MG), Pooled Mean Group (PMG), and Dynamic Two-Way Fixed Effect (DFE) estimators, to evaluate the relationship between money demand and its determinants. The DFE estimator accommodates intercept heterogeneity while maintaining parameter heterogeneity across the sampled countries. In addition, the Hausman test assesses the comparative efficiency and consistency of these estimators.

The panel ARDL model of order (m, n) is formulated as follows:

$$y_{it} = \sum_{j=1}^{m} \lambda_{ij} P_{i,t-j} + \sum_{j=1}^{n} \delta_{ij} Q_{i,t-j} + \mu_i + \varepsilon_{i,t} \quad (4)$$

where $x_{i,t-j}$ and δ_{ij} denote the k×1 vector of independent variables and the coefficients of independent variables, respectively, and y_{it} denotes the dependent variable λ_{ij} is a vector of scalars, μ_i is the country-specific time-invariant fixed effect, and $\varepsilon_{i,t}$ are the residuals.

Reparametrizing Equation (4) yields the error-correction model:

$$\Delta P_{i,t} = \varphi_i\left(P_{i,t-1} - \theta_{a,i} - \theta_i x_{i,t}\right) + \sum_{j=1}^{m-1} \lambda^*_{i,j} \Delta y P_{i,t-j} + \sum_{j=1}^{n-1} \delta^*_{i,j} \Delta Q_{i,t-j} + \eta_i + \varepsilon_{i,t} \quad (5)$$

Where, $Q_{i,t-j}$ = Y, IR, P and EX as represented in Equation (4) above, $\varphi_i = -\left(1 - \sum_{j=1}^{m} \lambda_{i,j}\right)$, $\theta_i = -\frac{\sum_{j=0}^{n} \delta_{i,j}}{\varphi_i}$, $\lambda^*_{i,j} = -\sum_{x=j+1}^{m} \lambda_{i,x}$, $\delta^*_{i,j} = -\sum_{x=j+1}^{q} \delta_{i,x}$

Equation (5) can be rewritten as follows:

$$\Delta \ln BM_{it} = -\mu_i + \varphi_i(\ln BM_{it-1} - \lambda_1 \ln Y_{it-1} - \lambda_2 \ln P_{it-1} - \lambda_3 IR_{it-1} - \lambda_4 \ln EX_{it-1}) + \sum_{j-1}^{m-1} \gamma^i_j (\Delta \ln BM_i)_{t-j} + \sum_{j-0}^{n-1} \delta^i_{1j} \Delta \ln Y_{it-j} + \sum_{j-0}^{n-1} \delta^i_{2j} \Delta \ln P_{it-j} + \sum_{j-0}^{n-1} \delta^i_{3j} \Delta IR_{it-j} + \sum_{j-0}^{n-1} \delta^i_{4j} \Delta \ln EX_{it-j} + \varepsilon_{it} \quad (6)$$

The Equation (6) thus formulated captures the co-integrating relationship between money demand and its determinants, delineated by the term $\varphi_i\left(P_{i,t-1} - \theta_{a,i} - \theta_i x_{i,t}\right)$, where θ_t is the vector of the corresponding long-term coefficients. A fundamental characteristic of cointegration is the presence of temporary deviations from equilibrium that gradually diminish at a rate of φ_i towards the long-term equilibrium, presuming that the series is integrated at most to the first order I (1) or not integrated I (0). We anticipate φ_i to be both statistically significant and negative.

RESULTS AND DISCUSSION

Panel Unit Root Analysis

The initial phase of this study involves examining the integrating properties of the variables, essentially detecting unit roots within the underlying variables of the panel data. The results

are presented in Table 3, revealing a mixed order of integration properties among the variables. Specifically, broad money (lnBM) and the real rate of interest (IR) demonstrate stationarity at a level with a significance level of 1 per cent, while income (lnY), inflation rate (lnP), and real exchange rate (lnEX) exhibit stationarity at the first difference. However, inflation (lnP) is stationary at level, according to the LLC test. In addition, to ensure the robustness of the study, the unit root test proposed by (Im et al., 2003) was employed, as shown in Table 3. The results of the IPS test closely align with those of the ADF and PP tests, indicating a mixed order of integration, I (0) and I (1)) among the variables under scrutiny.

The results of the panel unit root tests led the study to use the dynamic panel autoregressive distributed lag (ARDL) model. The appropriateness of the dynamic panel ARDL model depends on the integration characteristics of the variables, namely, I (0) and I (1).

Dynamic Panel ARDL Model

In this section, we estimate Equation (6) using three different estimators: PMG, MG, and DFE, as presented in Table 4. Additionally, we conduct Hausman tests (Hausman, 1978) to compare an efficient model with a more efficient one, which yields consistent results. The results of the Hausman test indicate that the PMG estimator is suitable for the model because the null hypothesis of homogeneity in the long-run parameters is not rejected at the 5 per cent significance level (that is, Ho: difference in coefficients not systematic), given that the Hausman test statistic p-value is (Prob>chi2 = 0.385). Furthermore, the p-value of the test statistic for the Hausman test between PMG and DFE is (Prob>chi2 = 1.00), offering no supporting evidence to reject the null hypothesis that PMG is a consistent and efficient estimator. Hence, this study employs a PMG estimator.

Table 3: Panel unit root test

variables	LLC	IPS	ADF-Fisher X^2	PP-Fisher x^2
Level				
lnBM	-4.87***	1.73	44.84	51.34
lnY	11.82	15.14	4.59	2.56
lnP	6.63	12.16	21.25	12.76
IR	-9.77***	-11.96***	250.73***	313.005***
lnEX	-0.70	-1.64**	65.75**	101.68***

1st difference				
ΔlnBM	--	-16.63***	535.10***	535.10***
ΔlnY	-19.65***	-19.62***	640.46***	640.46***
ΔlnP	-11.78***	-12.86***	354.94***	354.94***
ΔIR	--	--	--	--
ΔlnEX	-16.80***	--	--	--

Notes: ***, **, and * indicate rejection of the null hypothesis at the 1%,5% and 10% levels of significance, respectively.

Table 4 demonstrates the outcomes of the Panel ARDL estimation, which incorporates PMG, MG, and DFE, where the dependent variable is money demand (lnBM). These findings suggest the presence of a co-integrated relationship, as validated by the Hausman test of PMG efficacy. The efficiency of the PMG estimator is affirmed at the 5 per cent significance level. Additionally, the ECT or adjustment coefficient (φ_i), observed to be consistently negative across all three cases (PMG, MG, and DFE), implies a converging long-term association between money demand, real income, the real interest rate, inflation, and the real exchange rate, while addressing short-term deviations. This enduring relationship underscores the significant influence of broad money, as a tool of monetary policy in developing nations, on the aforementioned determinants. Notably, Table 4 shows that the income elasticity (β1) is greater than one (β1>1) or 3.79, indicating a positive relationship between income and money demand.

Source: The authors

The results from the extensive panel, consisting of 24 developing nations, are not included here because of space brevity[4]. Nonetheless, the long-term findings indicate that all estimated coefficients for the variables under scrutiny, except for the interest rate, are reasonable and aligned with the economic theory. Specifically, the coefficient for lnY suggests that a 1 per cent rise in income (lnY) corresponds to a (3.79) per cent increase in money demand (lnBM) in the sample of developing nations. Consequently, during the specified timeframe, the velocity of money in these countries exhibited a decreasing trend. The model was further refined to include the determinants of inflation, reflecting the financial market conditions of these nations. These outcomes are consistent with the existing empirical literature, revealing an inverse correlation between money demand and inflation.

According to the macroeconomic theory, the estimate of λ_4 in Equation (6) may vary between positive and negative values. Given that EX, defined as a measure of domestic currency units against a weighted average of several foreign currencies, plays a crucial role

[4] The results may be available upon the request to authors.

in this estimation. An increase in the exchange rate or depreciation of the domestic currency could enhance the value of foreign assets in terms of domestic currency. If perceived as an increase in wealth, this rise would stimulate demand for domestic money, resulting in a positive estimate of λ_4. Conversely, if an increase in the exchange rate leads to expectations of further depreciation of the domestic currency, individuals may prefer holding less domestic and more foreign currencies. In this case, the estimate of λ_4 is anticipated to be negative. Remarkably, our results indicate a negative estimate of EX or λ_4, aligning with the latter scenario[5].

Regarding the real interest rate (IR), the results indicate a significant but very small positive impact that deviates from the theoretical expectations. As explained in the methodology section, we consider two opportunity cost variables for the sample of developing countries: inflation (P) and interest rate (IR). However, our findings suggest that using the interest rate as an opportunity cost variable in this sample set is inappropriate. This conclusion is supported by various factors, notably the less-developed financial markets prevalent in developing countries. Hence, the interest rate fails to adequately reflect the market conditions in these regions. This viewpoint resonates with the findings of (Bahmani-Oskooee & Gelan, 2009) and is consistent with the arguments presented by (Folarin & Asongu, 2019).

Panel Causality Test

The PMG ARDL results concerning the money demand function indicate that the underlying variables display statistical significance at the 1 per cent, 5 per cent, and 10 per cent levels, suggesting the existence of long-term relationships among them. However, in the short term, inflation shows statistical

Table 4: Panel ARDL estimation

	ARDL		
	(1)	(2)	(3)
	PMG	MG	DFE
Adjustment coefficients	-0.085***	-0.313***	-0.055***
	(0.00)	(0.00)	(0.00)
Long-term coefficients			
lnY	3.792***	-0.021	2.483***
	(0.00)	(0.996)	(0.001)
IR	0.048***	0.010	0.039**
	(0.00)	(0.463)	(0.015)
lnP	-1.364***	1.459	-2.456***
	(0.00)	(0.376)	(0.001)
lnEX	-0.769***	1.979	-1.606*
	(0.01)	(0.631)	(0.076)
Short-term coefficients			

[5] For more on the expected sign of d see (Arango & Nadiri, 1981) and (Bahmani-Oskooee & Pourheydarian, 1990)

lnY			
D1	-0.281	-0.797**	0.413
	(0.672)	(0.013)	(0.193)
IR	0.0012	0.0007	0.001***
D1.	(0.037)	(0.465)	(0.001)
lnP			
D1.	0.110***	0.037	0.068**
	(0.004)	(0.543)	(0.034)
lnEX			
D1.	0.292	0.211	0.087
	(0.078) *	(0.301)	(0.354)
Constant	1.03***	2.39***	1.13***
	(0.00)	(0.001)	(0.00)
	(0.849)		
Number of observations	696	696	696
Number of countries	24	24	24
Hausman test	(PMG vs. MG) [a]	(PMG vs. GFE) [b]	
Chi^2	4.15	0.00	
Prob.>Chi^2	0.385	1.00	

Source: The authors

(Notes):

(i) ***, **, and *, indicate the significance at 1%,5%, and 10% levels respectively. The estimated ARDL model has an order of (1 1 1 1 1), and the order variable consists of lnBM, lnY, IR, lnP, and lnEX.

(ii) The null hypothesis (H0) characterizes the efficiency of the PMG over MG [a].

(iii) The null hypothesis (H0): Efficiency of PMG over DFE [b]

significance at the 3 per cent level, suggesting a short-term causal relationship with the other variables. Conversely, variables that are insignificant in the short term do not have a causal impact on other variables. Furthermore, the ECT term is significant at the 1 per cent level, indicating long-term joint causality among the variables. Although the long-term equilibrium relationship does not determine the direction of causality, it is reasonable to conduct a causality test to examine the nature of the causal relationships among the co-integrated variables. The results reported in Table 5 reveal a feedback relationship (bi-directional relationship) between money demand and income, money demand and inflation, and inflation and exchange rates at the 1 per cent and 5 per cent levels of significance. Moreover, bidirectional causality is observed between the exchange rate and the real interest rate, significant at the 5 per cent and 10 per cent levels. Unidirectional relationships are evident between real interest rate and money demand, real interest rate and income, inflation rate and income, and exchange rate and income, as consistent with the findings of (Narayan et al., 2009). As evident from Table 5, there is no indication of Granger causality from money

demand to the real interest rate, money demand to the exchange rate, income to inflation, income to the exchange rate, and inflation to the interest rate.

A significant finding from the DH test indicates that demand for money is associated with income, interest rate, and inflation, as highlighted in the second row of Table 5. Consequently, the results align with theories of the monetary transmission mechanism. These findings are consistent with previous studies by (Friedman & Schwartz, 1963) ; (Laidler, 1980)

Parametric stability test

To ensure the reliability and consistency of the findings, it is imperative to assess the stability of the parameters. In this context, this study adopts the recursive estimation method of CUSUM and CUSUMSQ, as recommended by (Brown et al., 1975), given the likelihood of shocks experienced by the determinants of money demand (broad money, income, real interest rate, inflation, and exchange rate) over the sample period. The CUSUM and CUSUMSQ statistics reveal two aspects: first, countries that affirm the stability results of the tests, and second, countries that do not. These findings are illustrated in Figure 1 to 10 for the former case exclusively. Among the countries where the plots of the CUSUM and CUSUMSQ statistics fall within the critical bands of the 5 per cent confidence intervals are the Dominican Republic, Grenada, Indonesia, Nigeria, Lesotho, Pakistan, Papua New Guinea, Paraguay, Peru, Philippines, South Africa, and St. Lucia. Conversely, countries such as Algeria, Bangladesh, Belize, Bolivia, India, China, Colombia, Costa Rica, Dominica, Fiji, Malaysia, and Mexico have exhibited different results. It is revealed that out of the twenty-four sample developing countries, 12 demonstrate stability, while the remaining 12 do not support the stability of the MDF parameters. The affirmation of stability in the parameters of the 12 countries suggests a stable MDF.

Table 5: Dumitrescu and Hurlin (2012) panel causality test

	lnBM		lnY		IR		lnP		lnEX	
	W-stat	Z-stat	W-stat	Z-stat	w-stat	Z-stat	w-stat	Z-stat	w-stat	Z-stat
lnBM	---	---	9.48	14.83 (0.00)***	3.92	3.52 (0.00)***	9.75	15.83 (0.00)***	2.82	1.29 (0.19)
lnY	4.01	3.69 (0.00)***	---	---	3.83	3.84 (0.00)***	6.31	8.39*** (0.00)	3.87	3.42*** (0.00)
IR	4.50	4.70 (3.E-06)	4.98	5.68 (1.E-08)	---	---	5.33	6.39 (2.E-10)	3.17	1.99 (0.46)
lnP	6.50	8.77 (0.00)***	5.05	5.81 (6.E-09)	2.51	0.66 (0.50)	---	---	3.83	3.33*** (0.00)
lnEX	4.11	3.90 (9.E-05)	4.87	5.45 (5.E-08)	3.03	1.70* (0.08)	3.22	2.10** (0.03)	---	---

Note: The values in parenthesis are p-values of respective test statistics
***, ** and * denote statistical significance at the 1%,5% and 10% levels, respectively

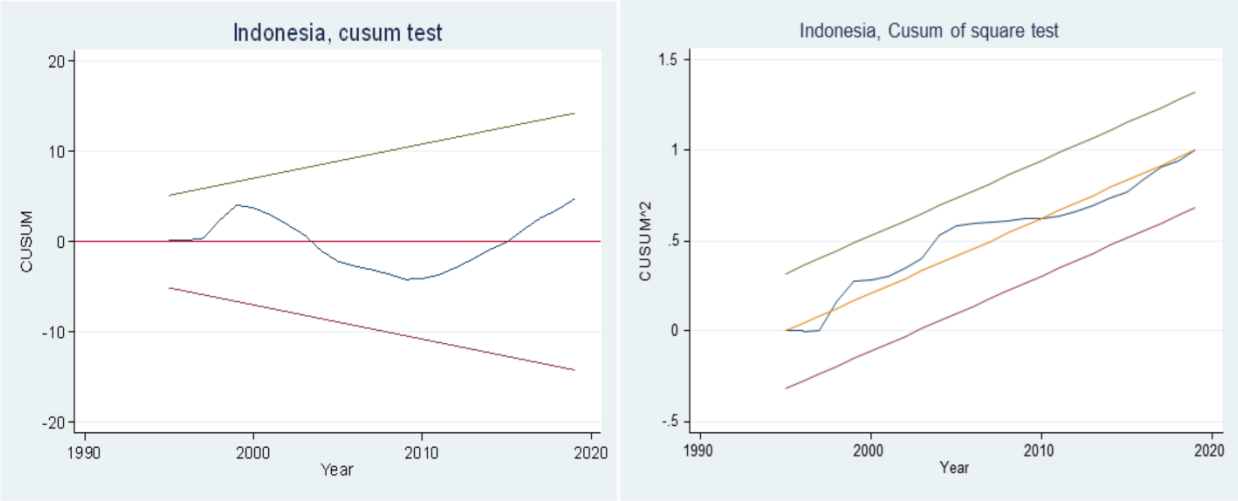

Figure 1: Indonesia, CUSUM and CUSUMQ test

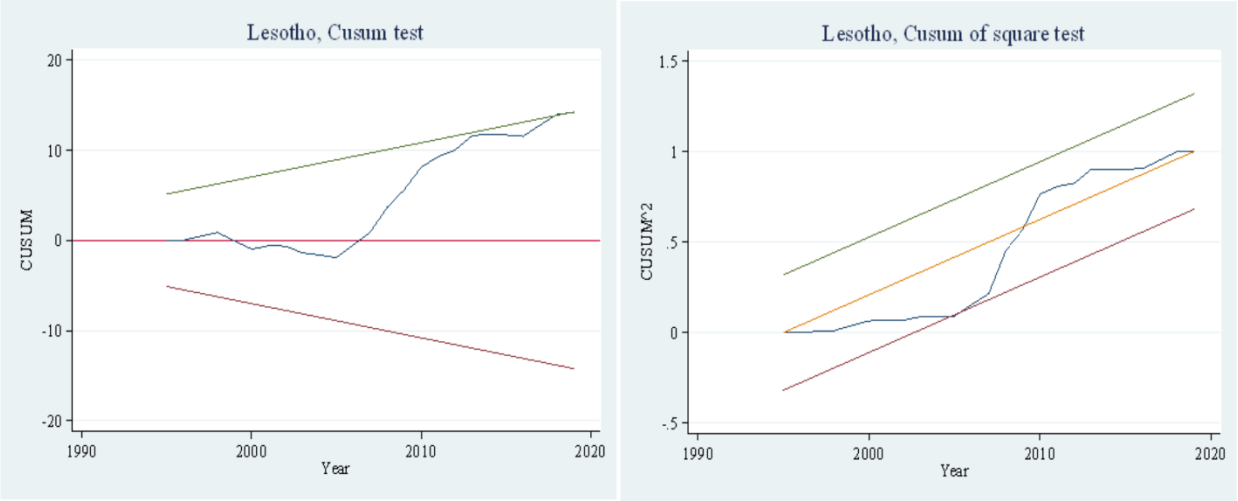

Figure 2:Lesotho, CUSUM and CUSUMQ test

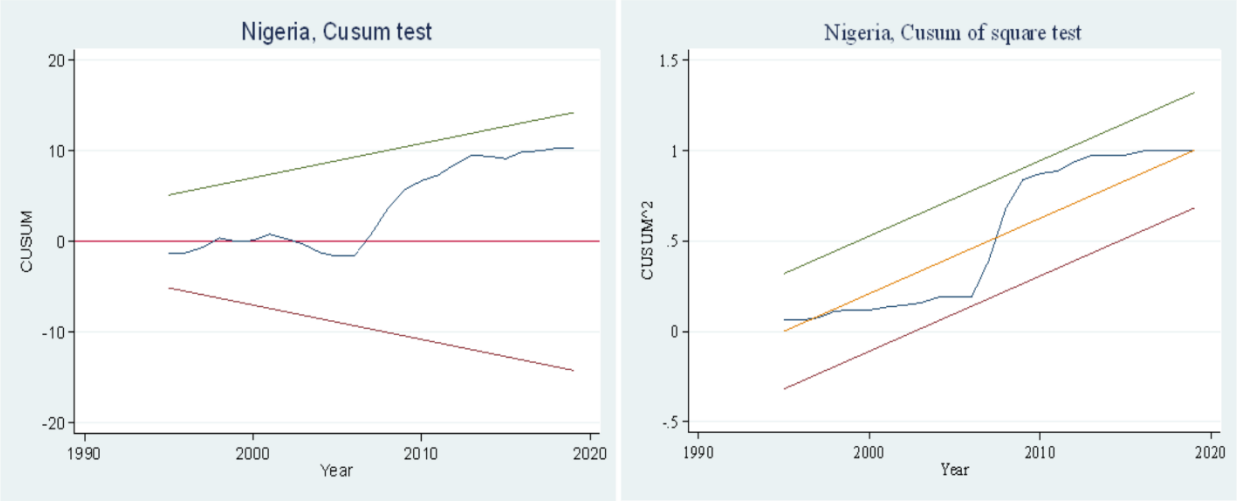

Figure 3: Nigeria, CUSUM and CUSUMQ test

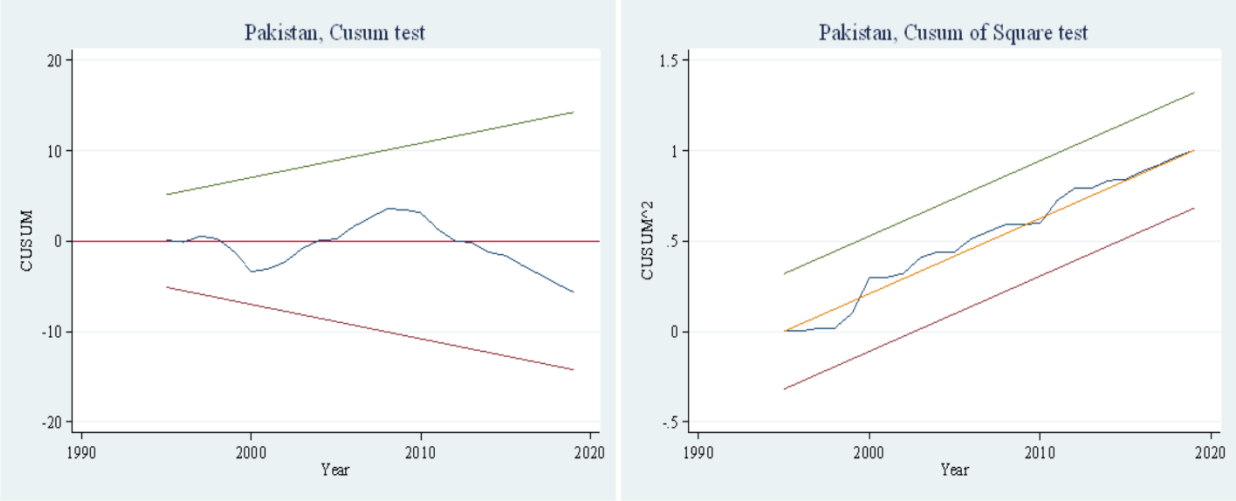

Figure 3: Pakistan, CUSUM and CUSUMQ test

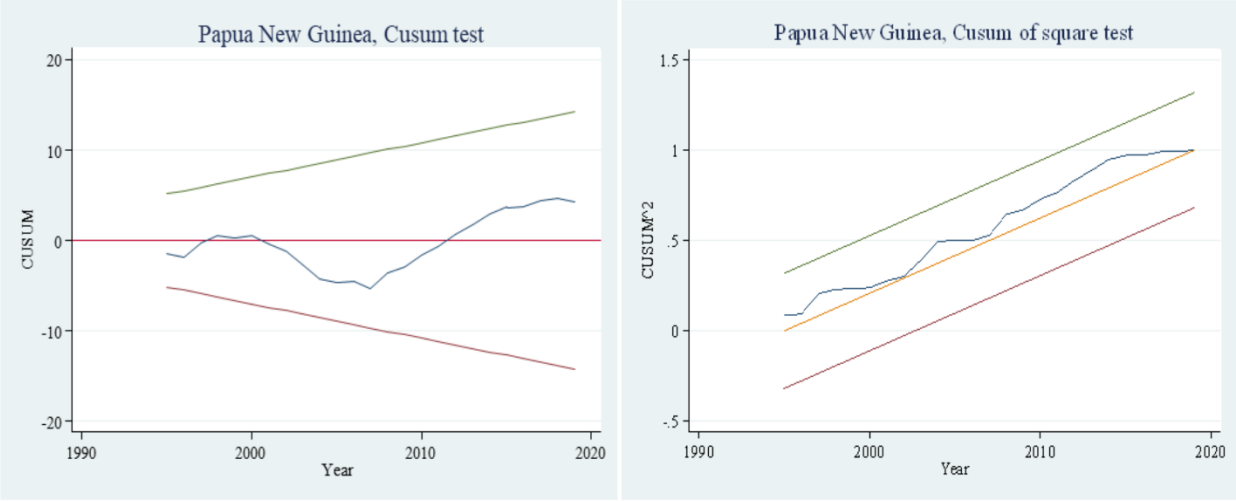

Figure 4: Papua New Guinea, CUSUM and CUSUMQ test

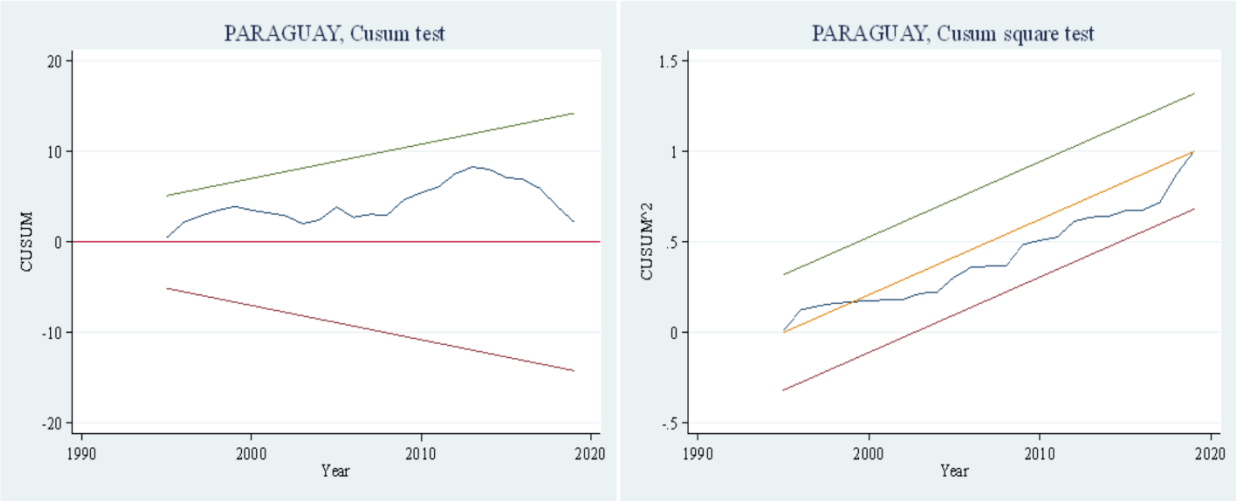

Figure 5: Paraguay, CUSUM and CUSUMQ test

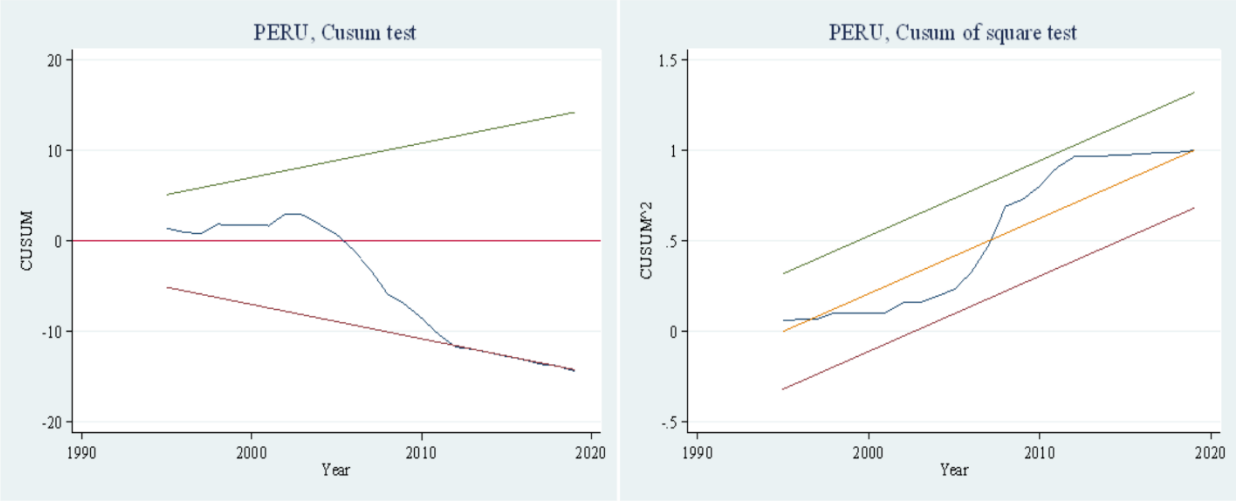

Figure 6: Peru, CUSUM and CUSUMQ test

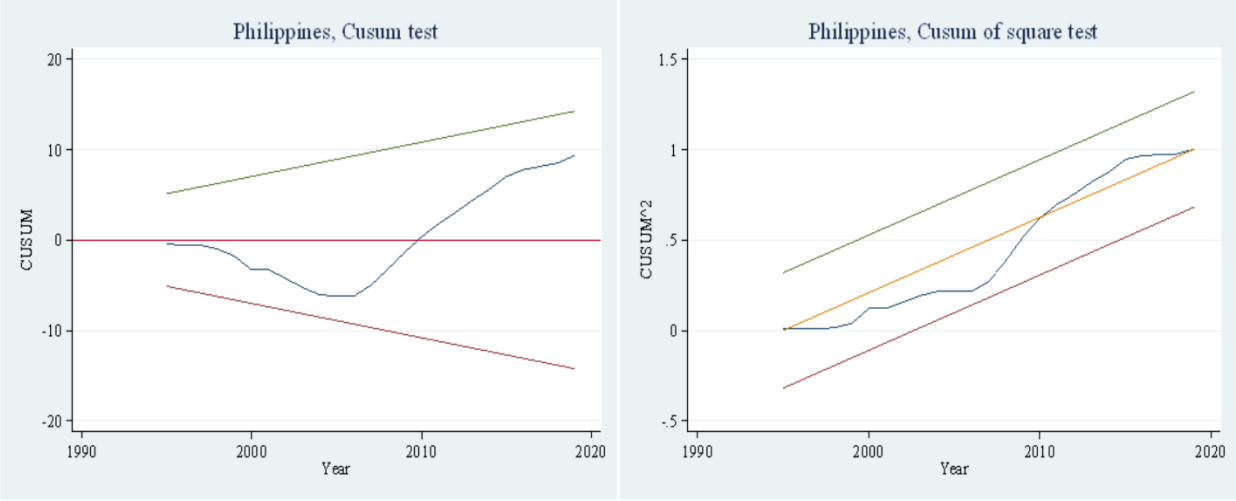

Figure 7: Philippines, CUSUM and CUSUMQ test

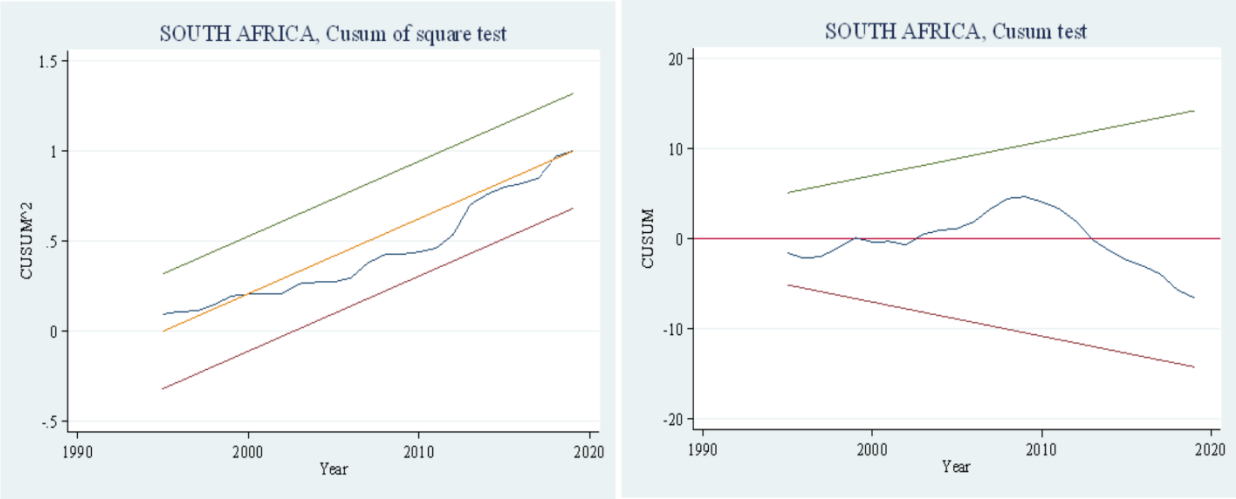

Figure 8: South Africa, CUSUM and CUSUMQ test

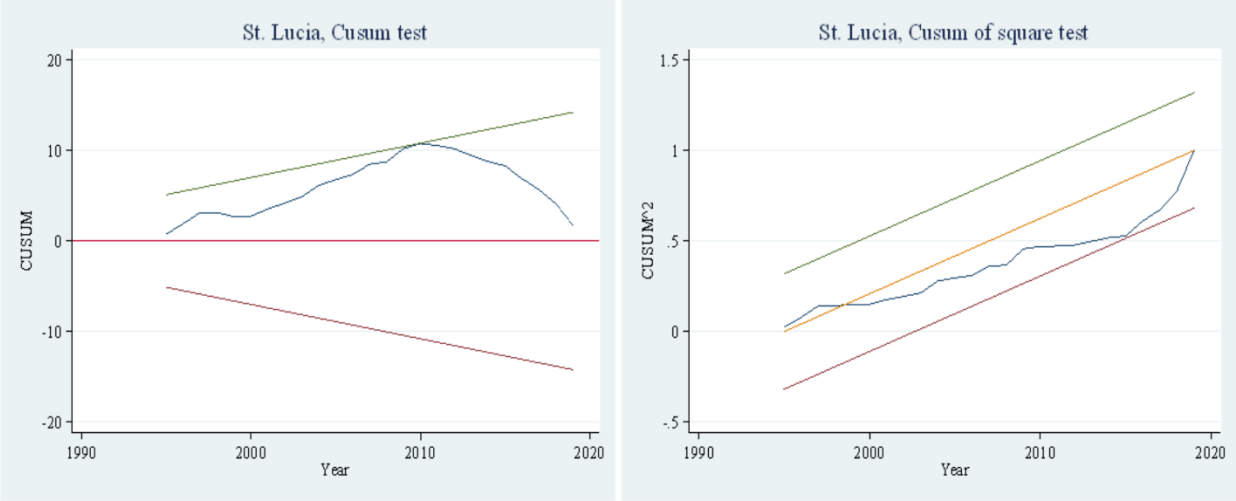

Figure 9: St. Lucia, CUSUM and CUSUMQ test

CONCLUSION

The correlation between money demand and its determinants, a fundamental aspect of macroeconomic discourse (Goldfeld, 1989), holds a significant sway in crafting optimal policy prescriptions for the underlying economies. A multitude of scholarly works have delved into the stability of money demand, focusing on steadfast intermediate MDF variables, such as monetary aggregates and interest rates. However, the modernised global economy and assimilation of developing economies have introduced constraints on the existing literature. Given these limitations, the current investigation endeavours to address the question of whether the money demand function maintains stability in the sampled developing economies and aims to ascertain the constancy of money demand in the sampled developing countries. To accomplish this, this study adopts panel analysis, a methodological framework that accommodates individual heterogeneity and enables researchers to manage time-varying factors while controlling for immutable individual attributes over time. Furthermore, this study empirically validates the money demand function concerning stability and co-integrating relationships using a sample of developing countries from 1990 to 2019.

In our study, we employ a dynamic panel ARDL model based on the specifications and attributes of its underlying determinants. The findings reveal substantial and statistically significant evidence of a long-term relationship between money demand and its determinants across all selected developing countries. However, the stability assessment indicated that only 12 out of 24 developing countries exhibited a stable money demand function[6]. Concerning the long-run elasticities of the money demand function (MDF), the

[6] These countries are: *Dominica Republic*, *Grenada*, *Indonesia*, *Nigeria*, *Lesotho*, *Pakistan*, *Papua New Guinea*, *Paraguay*, *Peru*, *Philippines*, *South Africa and St. Lucia*.

estimates of the coefficients of the variables under scrutiny, except for the interest rate, display coherence with economic theory and bore correct signs. Remarkably, the coefficient estimation for income surpassed unity and exhibited statistical significance, suggesting that a one per cent rise in income corresponds to a 3.79 per cent increase in money demand within the sampled developing countries. Nonetheless, this study identifies the unsuitability of utilising the interest rate as an opportunity cost variable within the given sample set for gauging market conditions. Consequently, this study advocates the utilisation of the interest rate as an opportunity cost variable. Furthermore, the investigation explored panel causality by employing the (Dumitrescu & Hurlin, 2012) test, revealing a linkage between money demand and income, interest rate, and inflation, which is consistent with theories on the monetary transmission mechanism.

The policy implications of the study can be succinctly summarised as follows: First, the central banks of countries including Dominica Republic, Grenada, Indonesia, Nigeria, Lesotho, Pakistan, Papua New Guinea, Paraguay, Peru, Philippines, South Africa, and St. Lucia have a viable option of targeting broad monetary aggregates within their monetary policy framework. Second, this study suggests that the inflation rate, rather than the interest rate, better reflects the financial market conditions of these countries and should be utilised as the opportunity cost for holding money balances. Third, in line with the insights of (Poole, 1970), the study findings endorse the prudent policy recommendation for the central banks of countries, demonstrating strong evidence of stability. This involves targeting monetary aggregates as the primary strategy for implementing monetary policy, thereby enabling central banking authorities to mitigate inflationary pressure and reduce the magnitude of output fluctuations. Utilising interest rates as a mechanism for monetary policy would only serve to exacerbate the inherent volatility in output dynamics.

Conflict of Interests

The authors declare no conflicts of interest regarding the authorship, research, and/or publication of this article.

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Appendix A

Table A1: Variables and variable definitions

Variables	Full name	Definition	Sources
BM	Broad money constant local currency units.	Broad money current local currency units divided by GDP deflator.	International Monetary Fund, International Financial Statistics and data files, World Bank
Y	GDP per capita (constant 2015 US$)	GDP per capita is gross domestic product divided by midyear population	International Monetary Fund, International Financial Statistics, World Bank
IR	Real interest rate (%)	The lending interest rate is adjusted for inflation as measured by the GDP deflator.	International Monetary Fund, International Financial Statistics., World Bank
P	Consumer price index (2010 = 100)	Changes in the cost to the average consumer of acquiring a basket of goods and services may be fixed or changed at specified intervals, such as yearly.	International Monetary Fund, International Financial Statistics, World Bank
EX	Real effective exchange rate index (2010 = 100)	The nominal effective exchange rate is divided by a price deflator or index of costs.	International Monetary Fund, International Financial Statistics, World Bank

Source: The authors

Table A2: Sample of developing countries

Country	Country Code	Country	Country Code
Algeria	DZA	Indonesia	IDN
Bangladesh	BGD	Lesotho	LSO
Belize	BLZ	Malaysia	MYS
Bolivia	BOL	Mexico	MEX
India	IND	Nigeria	NGA
China	CHN	Pakistan	PAK
Colombia	COL	Papua New Guinea	PNG
Costa-Rica	CRI	Paraguay	PRY

Dominica	DMA	Philippines	PHL
Dominica Republic	DOM	Peru	PER
Fiji	FJI	South Africa	ZAF
Grenada	GRD	St. Lucia	LCA

Source: International Monetary Fund and World Bank

Appendix B

Table 1B: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
lnBM	720	22.483	4.207	15.155	31.373
lnY	720	3.529	.343	2.693	4.103
IR	720	7.818	8.471	-33.357	61.186
lnP	720	1.205	.198	-.416	3.875
lnEX	720	1.961	.412	-.726	3.572

Source: The Authors

Fig 2B: Max Min