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Suggested Citation: Kwizera, Placide Aime (2024) : Monetary policy reaction function in emerging economies: an empirical analysis, Cogent Economics & Finance, ISSN 2332-2039, Taylor & Francis, Abingdon, Vol. 12, Iss. 1, pp. 1-18, https://doi.org/10.1080/23322039.2024.2411768

This Version is available at:
https://hdl.handle.net/10419/321626

Cogent Economics & Finance

ISSN: 2332-2039 (Online) Journal homepage: www.tandfonline.com/journals/oaef20

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To cite this article: Placide Aime Kwizera (2024) Monetary policy reaction function in emerging economies: an empirical analysis, Cogent Economics & Finance, 12:1, 2411768, DOI: 10.1080/23322039.2024.2411768

To link to this article: https://doi.org/10.1080/23322039.2024.2411768

Published online: 20 Oct 2024.

COGENT ECONOMICS & FINANCE
2024, VOL. 12, NO. 1, 2411768
https://doi.org/10.1080/23322039.2024.2411768

GENERAL & APPLIED ECONOMICS | RESEARCH ARTICLE
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Monetary policy reaction function in emerging economies: an empirical analysis

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ABSTRACT
This article presents the results of a comprehensive cross-country analysis of central banks' reaction functions in eighteen emerging economies from 2000Q1 to 2017Q4. Utilizing quarterly panel data, the study employs the generalized method of moments (GMM) alongside pooled OLS and fixed-effects estimators to investigate central banks' interest rate-setting behavior. The focus extends beyond conventional variables, incorporating external conditions into the analysis. The findings demonstrate that central banks in emerging markets adhere to an expanded Taylor rule, considering not only inflation and the output gap but also external financial conditions and commodity prices. The article concludes by suggesting policy implications derived from the empirical results, emphasizing the need for enhanced effectiveness and adaptability of monetary policy in emerging countries, accounting for both domestic and external factors. The study also proposes avenues for future research, encouraging exploration into extended forms of central bank reaction functions, including interactions with central bank independence.

IMPACT STATEMENT
This research analyzes the reaction functions of central banks in eighteen emerging economies from 2000 to 2017. It reveals that these banks follow an expanded Taylor rule, considering not just inflation and output gaps, but also external financial conditions and commodity prices. The findings emphasize the need for adaptable monetary policies that respond to both domestic and global influences. This work has significant implications for policymakers in formulating interest rate-setting policies and suggests further research into the interaction between central bank independence and reaction functions.

ARTICLE HISTORY
Received 21 May 2024
Revised 16 September 2024
Accepted 19 September 2024

KEYWORDS
Central bank; reaction function; dynamic panel data

SUBJECTS
Econometrics; Macroeconomics; International Economics; Monetary policy; Interest rate

JEL CLASSIFICATION NUMBERS
C25; E42; E52; E58

1. Introduction

Central banks in emerging markets are currently focusing on maintaining price stability and determining optimal responses to fundamental economic developments (Mehrotra & Sánchez-Fung, 2011). These banks use monetary policy instruments to stabilize the economy, targeting inflation and output levels. The nominal interest rate has become the primary tool for many central banks, with low inflation in advanced countries often attributed to policy rules and central bank independence (Taylor, 1993). Interest rate rules support inflation stabilization by mitigating time inconsistency (Kydland & Prescott, 1977) and promoting transparency (Svensson, 2000). Clarida et al. (2000) extended these ideas to New Keynesian models.

Despite extensive research on how central banks respond to economic changes, a gap remains in the literature. Most studies focus on conventional response functions using single-country time series analysis, overlooking the broader context of extended central bank reaction functions. This gap is particularly pronounced in emerging markets, where the influence of global factors and the unique challenges faced by these economies are not fully understood.

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To address this gap, we investigate the interest rate-setting behavior of central banks in emerging economies using panel data models. This approach provides additional evidence on the nature and effectiveness of alternative interest rate settings. Our study explores whether monetary policy in these countries responds solely to traditional variables like inflation and output or also considers additional factors such as the international environment and central bank independence.

We employ the generalized method of moments (GMM) to estimate our models, addressing potential endogeneity issues (Arellano & Bond, 1991; Arellano & Bover, 1995). For comparison, we also report results from pooled OLS and fixed-effects estimators. Our analysis includes both a basic interest rate rule with regressors such as inflation and output gap and extended versions incorporating the exchange rate and other international factors.

This research advances the understanding of central bank reaction functions in emerging economies, offering a comprehensive view of the factors influencing monetary policy. Our findings provide valuable insights into the optimal design of monetary policy frameworks in these regions, contributing significantly to the existing literature and addressing the previously identified gap.

The rest of the article is organized as follows: In Section 2 we provide the related literature. Section 3 explains the methodology and data. Section 4 reports the model results and Section 5 concludes.

2. Literature review

The current section provides a comprehensive review of relevant literature in the field of central bank interest rate setting, group classification, and country-specific estimates of the central bank reaction function, which serve as valuable benchmarks for our analysis.

The seminal work in understanding central bank behavior and their reaction functions can be traced back to Taylor's influential paper (Taylor, 1993). Over the years, numerous studies have delved into central bank reaction functions in industrialized economies, with notable contributions from scholars like Cukierman and Muscatelli (2008), Neuenkirch and Tillmann (2014), and Qin and Enders (2008).

These studies have primarily focused on investigating how central banks in advanced economies respond to various factors, including inflation, output, and exchange rates. They employ diverse methodological approaches, ranging from time series and panel data analyses to various empirical methodologies. We then proceed to explore a series of country-specific studies that have concentrated on developed nations such as the United States, the United Kingdom, the Eurozone, and Japan. Historically, cross-country comparisons have been relatively scarce. However, recent research in the field of monetary policy norms has seen a growing trend of pooling data from multiple countries.

US: In the context of the United States, Taylor (1999) has proposed an equation to represent the monetary policy of the US Federal Reserve. This equation relates the policy rate, denoted as i_t, to key variables, including the equilibrium interest rate ($\bar{i}$), inflation (π_t), the inflation target ($\bar{\pi}$), and the output gap (X_t). The parameters φ_π and φ_X govern the responsiveness of the policy rate to inflation and the output gap, respectively. Empirical analyses reveal that φ_π and φ_X exhibit variations across different periods, highlighting the adaptability of US monetary policy. Alexandre et al. (2008) has explored Taylor-type rules and optimal policy in a Markov-switching economic framework, concluding that a specific, straightforward rule aligns well with effective monetary policy. These findings are consistent with those of other scholars, such as Reis (2009), Rivolta (2018), and Taylor (1993). Benchimol and Fourçans (2019) evaluated the central bank's loss functions, NGDP level targeting rules are frequently shown to be superior, though Taylor-type rules yield almost similar results. Nonetheless, the analysis suggests that different empirical rules, whether NGDP-based or Taylor-type, are better suited to meet the central bank's goals across different periods (stable, crisis, recovery). Additionally, Aguiar-Conraria et al. (2018) has examined the Taylor Rule in the time-frequency domain, identifying lead-lag relationships between policy rates, inflation, and the output gap. Judd & Rudebusch (1998) has emphasized changes in the Federal Reserve's reaction function over time, potentially influenced by shifts in the Federal Open Market Committee's membership. The estimates of φ_π indicate consistency with the Taylor principle in the post-1979 period but not before.

Clarida et al. (1999) has estimated forward-looking monetary policy reaction functions for the postwar United States economy, revealing significant differences across different time periods. The Volcker-

Greenspan era, in particular, exhibited higher sensitivity to inflation fluctuations. In summary, the empirical estimates of φ_π and φ_X in this period align with Taylor's work. In contrast, Orphanides (2003) has presented an alternative perspective, asserting that monetary policy adhered to the Taylor principle even before the Volcker era, despite estimates surpassing 1 for φ_π during the 1966–1979 period. The misleading nature of real-time data during policy decisions is considered as a factor contributing to these findings.

Coibion and Gorodnichenko (2012) have reported results that are more in line with existing literature, demonstrating changes in the responsiveness of policy rates to inflation and output growth during different time periods. Additionally, Coibion has emphasized the role of interest smoothing, highlighting short-term responses of policy rates to various factors.

European Union (EU): Studies focusing on the European Union, conducted by Gerlach and Schnabel (2000) and Ullrich (2003) indicate that interest rates in the Economic and Monetary Union (EMU) countries exhibit behavior consistent with the Taylor rule, responding to both the output gap and inflation. Notably, estimates of φ_π fall within a range of 0.98 to 1.62, supporting the Taylor principle, while φ_X estimates are generally smaller. Furthermore Benchimol and Fourçans (2012) highlighted the role of output, inflation, money, interest rate, flexible-price output, and flexible-price real money balance dynamics.

Germany: Bernanke and Mihov (1997) has investigated the behavior of the Bundesbank, highlighting that variations in expected money growth have limited impact on the monetary policy of Germany. This has led to the conclusion that the Bundesbank is more focused on targeting money supply than inflation. Clausen et al. (2003) used real-time data for Germany's GDP to estimate Taylor-type reaction functions. The results demonstrate the compatibility of reaction coefficients with Taylor's work, especially when using real-time measures of the output gap. However, discrepancies emerge when ex-post output gap data is incorporated, emphasizing the importance of timely data.

UK: Kim et al. (2003) has examined the utility of a Taylor rule in predicting changes in UK monetary policy during the 1992–2000 period. The study found that while the Taylor rule is a valuable reference for monetary planning, information derived from inflation and the output gap alone is insufficient to predict the direction of policy changes. Nelson (2003) has estimated simple interest rate reaction functions for different UK monetary policy regimes, with results suggesting that the inflation coefficient exceeded one only after the adoption of inflation targeting in 1992. The Taylor rule estimates suggest that the inflation coefficient was greater than one only after 1992, when inflation-targeting was adopted.

Other countries: Clarida et al. (1999) has provided insights into reaction functions for two sets of countries: the G3 (Germany, Japan, and the US) and the E3 (UK, France, and Italy). The G3 central banks have fully embraced inflation targeting since 1979 and tend to be proactive, responding to anticipated rather than lagged inflation. For instance, in Germany, the inflation coefficient is estimated to range between 1.10 and 1.37, while the output gap coefficient ranges between 0.25 and 0.35. Japan's inflation coefficient falls between 1.89 and 2.04, with an output gap coefficient ranging from 0.03 to 0.10.

Emerging economies: In the case of emerging economies, there is limited empirical research on monetary policy rules and central bank reaction functions. Taylor (2000), has argued that market dynamics in emerging market economies may necessitate different policy guidelines due to unique market dynamics and less developed financial markets. The response of policy rates to inflation in emerging economies varies, with coefficients falling within the range of 0.9 to 2.75 (Hofmann & Bogdanova, 2012). Research on emerging markets, such as the Central Bank of Brazil's reaction to inflation expectations (Minella et al. 2003), indicates that external economic and financial conditions play a significant role in shaping central bank policies in emerging economies. In addition, the study by Benchimol (2024) indicated when central banks consider objectives, shock uncertainty, and limited information, NGDP targeting rules may have been more desirable over the past three decades compared to inflation targeting (IT) rules. However, according to Benchimol and Bounader (2023), optimal monetary policy can be evaluated within a consistently microfounded New Keynesian framework, showing that the first-best solution depends on the type of myopia affecting economic agents. In some cases of myopia, price-level targeting (PLT) is optimal, while in others, inflation targeting (IT) proves to be more appropriate. Their modified Phillips curve captures the microeconomic and aggregate dynamics of myopia, which arise from the transition from subjective to objective expectations, ultimately giving rise to inflation myopia.

In summary, existing literature highlights the diversity of monetary policy reaction functions across countries and time periods. Moreover, it underscores the influence of external economic and financial conditions on central bank policies in emerging economies.

3. Methodology and data

3.1. Data

The sample selection for this research is driven by the need to comprehensively represent emerging economies with a diverse set of characteristics. It includes eighteen countries – Brazil, Chile, China, Colombia, Czech Republic, Egypt, Hungary, India, Korea, Malaysia, Mexico, Pakistan, Peru, Philippines, Qatar, Russia, South Africa, and Thailand – covering the period from 2000 to 2017. These countries were chosen based on their significant economic size, geographic diversity across continents, varying levels of development within the emerging market category, and the availability of reliable quarterly data.

The selection of variables in our study was informed by the discussions presented in the existing literature, including works by authors such as Taylor (1993), Clarida et al. (1999), and Alexandre et al. (2008), among others. As previously mentioned, central banks primarily set policy interest rates based on deviations of inflation and output from their targets. In accordance with the approach outlined by Clarida et al. (1999) and Aizenman et al. (2011), we utilize an extended Taylor rule. This expanded rule incorporates additional factors, such as the real exchange rate, 10-year US government bond yields, and commodity prices, in addition to inflation and the output gap (which represents the percentage deviation of output from its potential level).

The significance of the exchange rate in interest rate determination has been emphasized in studies like Mohanty and Klau (2005). Moreover, various external economic and financial conditions play a pivotal role in shaping monetary policy within emerging countries. To account for this, we introduce additional variables into our model, specifically the change in the 10-year U.S. government bond yield and total foreign reserves, which serve as indicators of global financial liquidity. When global liquidity is abundant, it tends to manifest in lower U.S. interest rates, as demonstrated in the research by Güney (2016) and Caputo and Herrera (2017). A distinctive aspect of our study is the incorporation of the measure of central bank independence(ECBI)[1] (Kwizera 2022). Some features of this index build upon the existing literature, particularly its time-varying nature, as discussed by Romelli (2022) and Garriga (2016). This new central bank independence index captures specific dimensions that influence monetary policy decisions in emerging countries, which were not included in most previous studies. These dimensions reflect critical considerations in monetary policymaking, particularly in the context of emerging economies, as emphasized by Aizenman et al. (2011).

Our primary data sources include the World Economic Outlook (WEO), the World Bank's World Development Indicators (WDI), and the Federal Reserve Bank of St. Louis website (FRED).

3.2. Methodology

We start by organizing the regressors for all countries *i* and time periods *t* into one large matrix *X*. This matrix contains the constant term *c* along with vectors representing inflation (π), output (*y*), exchange rate (*er*), US bond (*us*), total reserve (*tr*), energy price (*en*), food price (*fp*), and central bank independence index (*ecbi*). Each of these vectors spans across all time periods *T* for each country, resulting in a matrix *X* of dimensions $NT \times 8$.

The initial step involves organizing all variables into a matrix format, facilitating subsequent analysis. We also conduct the Hausman test (Hausman, 1978) is an important diagnostic tool used to determine whether to use a fixed effects or a random effects model when dealing with panel data.

Assuming the Fixed Effects (FE) method, we estimate the equation:

$$I = I_{-1}\phi + X\beta + \varepsilon \tag{1}$$

where ϕ represents the estimator for the lagged interest rate, β is a vector containing the estimators of the remaining regressors, and ε is the vector of estimation residuals.

FE estimation accounts for unobserved country-specific effects, providing more robust parameter estimates.

Next, we apply GMM estimation techniques, which require rearranging Equation (1) into first differences form, following (Arellano & Bond, 1991; Arellano & Bover, 1995). This results in (T – 1) equations for each country i, where the equation becomes:

$$\Delta I = \Delta I_{-1}\phi + \Delta\tilde{X}\beta + \Delta\varepsilon \tag{2}$$

Here, the constant is omitted due to the initial differences in X, leading to the creation of a new matrix $\Delta\tilde{X}$ that includes the instruments in the first differences.

GMM estimation is applied to address potential endogeneity issues and improve efficiency by using differenced variables.

To obtain appropriate instruments in I_{-1i} for every country i, we select all lagged variables i_{ij} for time period i ($j < t$) and add them to the appropriate place in W_i, which consists of stacked lagged interest rate variables for each country.

Lagged variables are included as instruments to control for potential endogeneity and improve the identification of causal relationships.

We then merge W with the matrix of instruments ΔX to form Z, with dimensions $N(T-1) \times (7 + T - 1)$. Following Arellano and Bond (1991), certain moment conditions must be met for GMM estimation to apply.

The moment conditions ensure that the instrumental variables used in estimation are valid and satisfy orthogonality conditions required for consistent estimation.

For system GMM estimation, Equation (3) is used, and the following moment condition is imposed:

$$E\left[P_i'(I_i - \phi I_{-1i} - \beta\tilde{X})\right] = 0 \tag{3}$$

This condition implies the initial observation restrictions of Arellano and Bond (1991) and Arellano and Bover (1995), along with the homoskedasticity condition of Schmidt et al. (1992). The constant is not included as a regressor due to the elimination of redundant moment conditions. The use of GMM estimation is crucial for addressing endogeneity concerns common in panel data analysis, such as reverse causality and omitted variable bias. System GMM extends GMM to dynamic panel data models, improving efficiency and addressing biases from unobserved heterogeneity and endogeneity.

Finally, we derive the initial estimator for system GMM as:

$$\hat{\gamma}_{init} = \left[S_{P\tilde{X}}'\left(\sum_{p}\right)^{-1} S_{P\tilde{X}}\right]^{-1} S_{P\tilde{X}}'\left(\sum_{P}\right)^{-1} S_{PI}$$

where $\sum_P$ is replaced with $D_{\hat{u}}$, and $\hat{u}_i$ represents the residuals obtained from the initial IV estimation. The system GMM estimator is then calculated as:

$$\hat{\gamma} = \left[S_{P\tilde{X}}'(D_{\hat{u}})^{-1} S_{P\tilde{X}}\right]^{-1} S_{P\tilde{X}}'(D_{\hat{u}})^{-1} S_{PI} \tag{4}$$

These equations outline the process of obtaining the system GMM estimator, which involves iteratively refining the estimates using moment conditions and instrumental variables to achieve consistent and efficient parameter estimates.

Coming to the empirical model, we begin by estimating the simplified version of the Taylor rule, which describes the monetary policy decision in accordance with the framework proposed by Taylor (1993). Subsequently, we proceed to estimate extended versions of the model, considering additional factors that influence the interest rate decision, as discussed in Clarida et al. (1999) and Alexandre et al. (2008). This extension is of particular significance since the literature underscores the substantial role played by the international environment in shaping monetary policymaking, as highlighted in Güney (2016) and Caputo and Herrera (2017) in the following general specification:

$$i_{it} = \phi i_{it-1} + \alpha\pi_{it} + \beta\hat{y}_{it} + \delta er_{it} + \theta us_{it} + \lambda tr_{it} + \gamma en_{it} + \psi fp_{it} + \omega ecbi_{it} + \mu_i + \varepsilon_{it} \tag{5}$$

where i and t denote country and time, respectively, i_{it} is the nominal interest rate, π_{it} represents the quarterly inflation rate, $\hat{y}_{it}$ is the output gap calculated as a percentage deviation from its potential level using the Hodrick Prescott (HP) filter,[2] er_{it} is the log level of the effective exchange rate, us_{it} is the 10-year US government bond yield, tr_{it} is total reserves, en_{it} is the energy price index, fp_{it} is a food price index, $ecbi_{it}$ is the extended central bank independence index, and μ_i is the unobserved time-invariant country-specific effect. Finally, ε_{it} is the error term, assumed to be independently and identically distributed (IID).

As previously demonstrated, the Generalized Method of Moments (GMM) estimator is particularly attractive because it can handle situations where the lagged dependent variable is included in the set of explanatory variables, which is pertinent when estimating Equation (5). In our analysis, we will utilize both the difference-GMM (DGMM) and system-GMM (SGMM) estimators.

However, it's worth noting that the GMM estimator can exhibit substantial finite-sample biases if the instruments are weak. An excessive number of instruments can also lead to estimation challenges, thereby necessitating careful selection of the instrument set. To address this issue, we will employ the technique suggested by Roodman (2007) to reduce the number of instruments. We will subject our modeling and estimation choices to two tests: one for detecting autocorrelation in residuals and the other for evaluating over-identifying restrictions. Additionally, apart from the GMM estimates, we will provide results for a static version of the Taylor rule, estimated using pooled Ordinary Least Squares (OLS) and fixed-effects (FE) estimators.

4. Empirical results

The descriptive analysis Table 1 presents summary statistics for various key variables in the dataset, covering 18 emerging countries during the period 2000–2017.

Notably, variables such as 'Ninter' exhibit significant variability, with a right-skewed distribution and heavy tails. In contrast, the 'USB' variable shows a relatively symmetric distribution with moderately heavy tails. The 'ECBI' variable is slightly left-skewed with moderately heavy tails. 'Infl' exhibits a right-skewed distribution with heavy tails. Variables related to exchange rates and commodities show varying degrees of skewness and tail weight, with 'DLREER' having very heavy tails. 'GDPg' demonstrates moderately heavy tails with a slightly right-skewed distribution. These statistics provide essential insights into the characteristics and distributional properties of the dataset, which are valuable for subsequent econometric analysis.

4.1. Baseline estimations

The baseline models are static and dynamic Taylor rules of the general form given in Equation (5). The estimates are presented in Table 2. The empirical results presented in this study reveal intriguing dynamics in the monetary policy of emerging economies. We first conducted the Hausman test to choose between the random effects and fixed effects models, and we obtained a p-value of 0.0001. Since this p-value is much smaller than typical significance levels (0.05 or 0.01), we reject the null hypothesis. This indicates that the difference between the coefficients from the two models is systematic and not due to random variation. Therefore, our analysis will focus on the fixed effects model in our static analysis.

Table 1. Summary statistics.

Variables	N	Mean	SD	Min	Max	Skewness	Kurtosis
Ninter	1,296	11.58	10.27	1.293	72.40	3.081	13.48
USB	1,296	3.532	1.240	1.563	6.480	0.208	2.065
ECBI	1,296	0.463	0.204	0	1	−0.0953	2.796
Infl	1,296	4.819	3.863	−7.478	24.37	1.573	7.004
DLREER	1,278	0.000911	0.0298	−0.258	0.312	−0.285	21.97
DLFood	1,278	0.00763	0.0565	−0.248	0.111	−1.201	7.176
DLEner	1,278	0.0106	0.129	−0.568	0.224	−1.578	7.366
DLTres	1,278	0.0270	0.0848	−0.501	0.542	0.647	11.60
GDPg	1,296	−0.00786	1.483	−6.037	6.930	0.106	4.523

Table 2. Baseline specifications of the reaction function.

	Static models						Dynamic models					
	OLS	OLS	OLS	FE	FE	FE	DGMM	DGMM	DGMM	SGMM	SGMM	SGMM
Ninter(-1)							0.659***	0.712***	0.555***	0.987***	0.986***	0.987***
							(0.036)	(0.016)	(0.018)	(0.005)	(0.005)	(0.005)
Infl	0.014*	0.014*	0.014*	0.047***	0.047***	0.046***	0.459***	0.116***	0.145***	0.008	0.006	−0.001
	(0.007)	(0.007)	(0.007)	(0.010)	(0.010)	(0.010)	(0.119)	(0.019)	(0.019)	(0.010)	(0.015)	(0.010)
GDPg	0.112***	0.112***	0.111***	0.087***	0.087***	0.080***	0.719***	0.150***	−0.000	0.079**	0.080**	0.096***
	(0.019)	(0.019)	(0.020)	(0.019)	(0.019)	(0.020)	(0.096)	(0.027)	(0.028)	(0.034)	(0.031)	(0.026)
DLREER		−1.163	−0.847		−0.940	−0.925		−2.846***	−2.372**		−0.057	1.277
		(0.925)	(0.936)		(0.917)	(0.926)		(1.011)	(1.003)		(2.263)	(1.794)
ECBI			−0.238*			−0.097			0.306			−0.274*
			(0.139)			(0.147)			(0.349)			(0.139)
USB			0.024			0.084***			0.937***			−0.032
			(0.032)			(0.032)			(0.057)			(0.023)
DLTres			−0.403			−0.384			0.179			−0.766*
			(0.333)			(0.329)			(0.308)			(0.432)
DLEner			−0.330			−0.395			−1.676***			−0.252
			(0.305)			(0.300)			(0.225)			(0.230)
DLFood			−1.139*			−1.118*			0.118			−0.671**
			(0.661)			(0.649)			(0.475)			(0.291)
N	1278	1278	1278	1278	1278	1278	1260	1260	1260	1278	1278	1278
Groups				18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000
sarganp							0.000	0.000	0.000	0.059	0.054	0.065
hansenp										0.232	0.249	0.423
j							13.000	13.000	18.000	8.000	9.000	14.000
ar1p							0.359	0.000	0.000	0.047	0.045	0.042
ar2p							0.735	0.006	0.036	0.325	0.324	0.367

Source: Author's computation.
Dependent variable: Nominal interest rate.
Note. (i) respectively, the sign *, **, and *** describe the significance level of 10%, 5% and 1%; (ii) standard errors are reported in brackets.

Initially, static models suggest relatively modest coefficients for inflation and the output gap compared to earlier literature. However, the adoption of dynamic models employing GMM estimators, as detailed in Table 2, uncovers a strikingly high and statistically significant coefficient for the lagged interest rate. This finding underscores a pronounced interest rate smoothing behavior, with a first-order autoregressive term exceeding 0.9 in SGMM-estimated models.

This implies that approximately 10% of the adjustment to deviations from the target interest rate occurs within the same period of the change, highlighting a persistent policy stance. Furthermore, the policy rate responds significantly to both inflation and the output gap, echoing established research findings. The positive and statistically significant coefficient on inflation suggests a prevalent anti-inflationary monetary policy stance among central banks in emerging economies, characterized by rate hikes in response to inflationary pressures. However, these inflation coefficients do not strictly adhere to the Taylor principle.

In examining additional variables, the results across different model specifications and estimators are inconclusive. Nonetheless, indications point to nuanced reactions to movements in exchange rates, reserves, energy, and food prices. Notably, central banks in these economies appear sensitive to changes in US interest rates, reflecting interconnected global financial dynamics. Moreover, greater central bank independence seems to correlate with lower interest rates in emerging markets, though conclusive support for these relationships is lacking.

The use of the SGMM estimator is validated by Hansen and autocorrelation diagnostic tests, affirming the model's specification and the validity of its over-identifying restrictions. These tests indicate no evidence of second-order residual serial correlation, further solidifying the robustness of the findings.

4.2. Robustness checks: alternative specifications

Table 3 highlights how central bank independence, as measured by different indices, influences monetary policy decisions. The lagged interest rate consistently shows high significance across all models, indicating strong inertia in the central bank's interest rate decisions, suggesting that past rates heavily influence current policy. GDP growth is also a key driver, with positive and significant effects, showing that the central bank tightens policy as the economy expands. In terms of central bank independence, the Extended Central Bank Independence Index (ECBI) is mostly insignificant, except in the dynamic panel models where it is negative, implying that higher autonomy may allow for more accommodative policy. Garriga's Index shows a strong negative relationship with interest rates in dynamic models,

Table 3. Central bank reaction function with alternative indexes.

	Static models						Dynamic models					
	OLS	OLS	OLS	FE	FE	FE	DGMM	DGMM	DGMM	SGMM	SGMM	SGMM
L.Ninter							0.316**	0.444***	0.556***	0.900***	0.932***	1.097**
							(0.137)	(0.062)	(0.085)	(0.283)	(0.283)	(0.386)
Infl	0.002		−0.007	0.041***		0.024*	0.525		−0.212	−0.018		0.024
	(0.009)		(0.009)	(0.013)		(0.013)	(0.618)		(0.177)	(0.236)		(0.313)
GDPg		0.130***	0.131***		0.127***	0.117***		0.439***	0.656**		0.107	0.164
		(0.021)	(0.021)		(0.021)	(0.022)		(0.110)	(0.268)		(0.179)	(0.262)
DLREER			1.868			1.582			2.222			−8.460
			(1.200)			(1.213)			(4.863)			(21.236)
ECBI	0.019	0.010	0.016	0.018	0.013	0.009	−2.388**	−1.578***	−0.446	−0.681	−0.742*	−0.726
	(0.037)	(0.035)	(0.036)	(0.040)	(0.040)	(0.040)	(1.114)	(0.589)	(0.317)	(0.564)	(0.393)	(0.474)
Garriga	−0.004	−0.006	−0.006	0.027	0.018	0.025	−0.602	−6.449***	−8.261***	0.326	0.802	2.469
	(0.011)	(0.011)	(0.011)	(0.029)	(0.029)	(0.029)	(2.934)	(1.064)	(2.277)	(3.072)	(2.879)	(4.610)
CWN	−0.002	0.002	0.001	−0.009	0.001	0.001	−4.354	3.665***	6.714**	−0.576	−0.794	−1.267
	(0.011)	(0.011)	(0.011)	(0.023)	(0.023)	(0.023)	(3.716)	(1.174)	(2.977)	(2.418)	(2.110)	(2.932)
N	918	918	918	918	918	918	900	900	900	918	918	918
Groups				18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000
sarganp							0.325	0.445	0.706	0.622	0.691	0.952
hansenp										0.492	0.522	0.958
j							13.000	13.000	18.000	7.000	7.000	9.000
ar1p							0.622	0.840	0.982	0.304	0.256	0.351
ar2p							0.974	0.715	0.853	0.617	0.605	0.678

Source: Author's computation.
Dependent variable: Nominal interest rate.
Note. (i) respectively, the sign *, **, and *** describe the significance level of 10%, 5% and 1%; (ii) standard errors are reported in brackets.

suggesting that greater independence allows the central bank to pursue more flexible and potentially looser policies. In contrast, Cukierman, Webb & Neyapti's (CWNI) Index presents a positive relationship with interest rates, indicating tighter policy under greater independence, perhaps reflecting a stricter focus on inflation control.

This result is not surprising, as ECBI includes external components of central bank independence, unlike the other two indices, which focus more on internal or institutional aspects. This external component may contribute to its different impact on interest rates, highlighting the nuanced role of central bank autonomy in shaping monetary policy decisions.

To further validate our previous findings, we conducted additional robustness checks by estimating alternative specifications based on Equation (5). In Table 4, we present estimates for three models. These models, aside from the lagged interest rate in the case of dynamic models, incorporate a limited set of variables: one includes inflation alone, the second includes solely the output gap, and the third encompasses inflation, the output gap, and, from the set of additional variables considered previously, only the exchange rate. In comparison to the results outlined in Table 3, the changes in these new estimates are generally minor.

In the second set of alternative specifications, we introduced interactions between the extended central bank independence index and both inflation and the output gap into the models that were estimated in Table 4. The outcomes of these models are presented in Table 5.

The introduction of interaction terms seems to have an unusual impact on the DGMM estimates, which now assign a negative coefficient to the inflation variable. The estimated coefficients for the interaction with inflation are generally negative (except when DGMM is used) and typically statistically significant (except when SGMM is used). In sum, these results do not readily yield clear conclusions. Nevertheless, the frequent statistical significance of the interaction terms suggests that further research on their role may be warranted.

We further estimate models with explanatory variables lagged by one period. The rationale behind this specification is that policymakers' decisions may be influenced by past information rather than current values due to information lags. The results for the baseline specifications can be found in Table 6.

Once again, the differences in relation to the baseline estimations presented in Table 2 are not substantial. In the case of Table 7, the results appear to more clearly indicate a statistically significant negative coefficient for total reserves. Table 6 displays the results for the restricted models discussed in Table 4, and similar to the previous comparisons, these results do not seem to vary significantly.

For the sake of completeness, Table 8 presents the results associated with incorporating information lags into the models with interactions outlined in Table 5. Once again, the inclusion of information lags does not substantially alter the results.

4.3. Other-robustness check

Another crucial aspect to consider is whether the behavior of interest rate setting varies across countries. Central banks' reaction functions may differ based on various factors, including a country's economic structure, level of financial integration, and historical macroeconomic conditions.

Table 9 provides country-specific results that offer valuable insights into the interest rate-setting behavior of central banks in emerging economies, which is essential for informed decision-making. The findings reveal that all countries in the sample exhibit a high degree of persistence in their policy interest rates. Inflation is consistently the most influential variable in determining interest rates across most countries, aligning with the results of cross-country regressions. Notably, energy prices hold significant importance, particularly for central banks in China and Russia.

Examining why interest rate-setting practices vary among countries is a pertinent question. Various factors, such as a country's economic structure, can lead to differences in central banks' reaction functions. For instance, if a central bank's primary objective is price stability, and there is a stringent inflation targeting framework in place, the coefficient of inflation in the Taylor rule equation tends to be higher.

The findings also highlight that central bank behavior is impacted by fluctuations in energy and food prices, as well as external financial conditions. This suggests that central banks respond not only to country-specific variables like the real exchange rate, inflation, and output gap but also to international

Table 4. Restricted specifications of the reaction function.

	Static models						Dynamic models					
	OLS	OLS	OLS	FE	FE	FE	DGMM	DGMM	DGMM	SGMM	SGMM	SGMM
Ninter(-1)							0.484***	0.756***	0.713***	0.985***	0.988***	0.986***
							(0.032)	(0.014)	(0.016)	(0.005)	(0.005)	(0.005)
Infl	0.019**		0.014*	0.055***		0.047***	1.040***		0.115***	0.011		0.006
	(0.007)		(0.007)	(0.010)		(0.010)	(0.104)		(0.019)	(0.010)		(0.015)
GDPg		0.116***	0.112***		0.104***	0.087***		0.198***	0.138***		0.084**	0.080**
		(0.019)	(0.019)		(0.019)	(0.019)		(0.027)	(0.027)		(0.035)	(0.031)
DLREER			−1.163			−0.940			−2.892***			−0.057
			(0.925)			(0.917)			(1.011)			(2.263)
N	1278	1278	1278	1278	1278	1278	1260	1260	1260	1278	1278	1278
Groups				18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000
sarganp							0.000	0.000	0.000	0.050	0.090	0.054
hansenp										0.177	0.276	0.249
j							13.000	13.000	18.000	7.000	7.000	9.000
ar1p							0.000	0.000	0.000	0.048	0.047	0.045
ar2p							0.157	0.007	0.006	0.327	0.327	0.324

Source: Author's computation.
Dependent variable: Nominal interest rate.
Note. (i) respectively, the sign *, **, and *** describe the significance level of 10%, 5% and 1%; (ii) standard errors are reported in brackets.

Table 5. Reaction functions with interactions.

	Static models						Dynamic models					
	OLS	OLS	OLS	FE	FE	FE	DGMM	DGMM	DGMM	SGMM	SGMM	SGMM
Ninter(-1)							0.920***	0.690***	0.534***	0.987***	0.986***	0.991***
							(0.141)	(0.016)	(0.019)	(0.010)	(0.011)	(0.015)
Infl	0.046***	0.045***	0.057***	0.066***	0.066***	0.073***	−4.668***	−0.046	−0.083**	0.039	0.035	0.079
	(0.013)	(0.013)	(0.018)	(0.014)	(0.014)	(0.018)	(0.985)	(0.031)	(0.038)	(0.149)	(0.184)	(0.319)
GDPg	0.085*	0.086*	0.079	0.065	0.066	0.060	2.226	0.114*	−0.025	0.537	0.499	−1.129
	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)	(2.709)	(0.060)	(0.060)	(0.682)	(0.680)	(1.993)
DLREER		−1.026	−0.825		−0.864	−0.922		−2.536**	−1.873*		0.124	0.843
		(0.924)	(0.935)		(0.917)	(0.927)		(1.010)	(1.006)		(1.870)	(2.248)
ECBI			0.212			0.191			−2.069***			−0.083
			(0.219)			(0.222)			(0.481)			(2.668)
USB			0.026			0.085***			0.888***			−0.076
			(0.032)			(0.032)			(0.058)			(0.084)
DLTres			−0.473			−0.440			0.227			−1.110
			(0.333)			(0.330)			(0.307)			(1.113)
DLEner			−0.356			−0.412			−1.679***			−0.304
			(0.305)			(0.300)			(0.224)			(0.771)
DLFood			−1.107*			−1.097*			0.147			−0.545
			(0.660)			(0.649)			(0.474)			(0.944)
Infl × ECBI	−0.066***	−0.065***	−0.091***	−0.045*	−0.044*	−0.062*	5.807***	0.362***	0.492***	−0.075	−0.066	−0.136
	(0.021)	(0.021)	(0.034)	(0.023)	(0.023)	(0.035)	(1.144)	(0.054)	(0.073)	(0.305)	(0.379)	(0.654)
GDPg × ECBI	0.058	0.055	0.067	0.048	0.046	0.044	−2.848	0.031	0.004	−0.928	−0.851	2.398
	(0.089)	(0.089)	(0.089)	(0.089)	(0.089)	(0.089)	(4.735)	(0.115)	(0.114)	(1.354)	(1.367)	(4.154)
N	1278	1278	1278	1278	1278	1278	1260	1260	1260	1278	1278	1278
Groups				18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000
sarganp							0.153	0.000	0.000	0.014	0.013	0.329
hansenp										0.252	0.266	0.288
j							15.000	15.000	18.000	8.000	9.000	14.000
ar1p							0.001	0.000	0.000	0.056	0.054	0.133
ar2p							0.009	0.013	0.058	0.343	0.338	0.430

Source: Author's computation.
Dependent variable: Nominal interest rate.
Note. (i) respectively, the sign *, **, and *** describe the significance level of 10%, 5% and 1%; (ii) standard errors are reported in brackets.

Table 6. Reaction functions with information lags.

	Static models						Dynamic models					
	OLS	OLS	OLS	FE	FE	FE	DGMM	DGMM	DGMM	SGMM	SGMM	SGMM
Ninter(-1)							0.899***	0.651***	0.523***	0.987***	0.990***	0.991***
							(0.053)	(0.015)	(0.018)	(0.004)	(0.003)	(0.003)
Infl(-1)	−0.001	0.002	0.004	0.020**	0.020**	0.021**	0.237	0.044**	0.094***	−0.011	−0.008	−0.003
	(0.007)	(0.007)	(0.007)	(0.010)	(0.010)	(0.010)	(0.163)	(0.020)	(0.020)	(0.011)	(0.011)	(0.005)
GDPg(-1)	0.133***	0.134***	0.133***	0.119***	0.122***	0.117***	−0.425***	0.235***	0.094***	0.089***	0.102***	0.098***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.162)	(0.026)	(0.028)	(0.030)	(0.035)	(0.029)
DLREER(-1)		−1.387	−1.489		−1.205	−1.576*		−1.782*	−0.679		−0.032	0.356
		(0.940)	(0.952)		(0.942)	(0.954)		(1.006)	(1.034)		(1.562)	(1.075)
ECBI(-1)			−0.267*			−0.182			−0.182			−0.341
			(0.140)			(0.149)			(0.359)			(0.207)
USB(-1)			−0.004			0.051			0.990***			−0.038
			(0.031)			(0.032)			(0.055)			(0.028)
DLTres(-1)			−0.569*			−0.593*			−0.237			−0.993***
			(0.329)			(0.328)			(0.316)			(0.339)
DLEner(-1)			0.761**			0.695**			−0.595**			0.438
			(0.312)			(0.309)			(0.236)			(0.331)
DLFood(-1)			0.061			−0.022			0.780			0.125
			(0.663)			(0.657)			(0.485)			(0.525)
N	1278	1260	1260	1278	1260	1260	1260	1242	1242	1278	1260	1260
Groups				18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000
sarganp							0.000	0.000	0.000	0.027	0.011	0.009
hansenp										0.282	0.242	0.298
j							11.000	14.000	18.000	8.000	9.000	14.000
ar1p							0.007	0.000	0.004	0.049	0.040	0.036
ar2p							0.028	0.005	0.066	0.329	0.256	0.244

Source: Author's computation.
Dependent variable: Nominal interest rate.
Note. (i) respectively, the sign *, **, and *** describe the significance level of 10%, 5% and 1%; (ii) standard errors are reported in brackets.

Table 7. Restricted reaction functions with information lags.

	Static models						Dynamic models					
	OLS	OLS	OLS	FE	FE	FE	DGMM	DGMM	DGMM	SGMM	SGMM	SGMM
Ninter(-1)							0.682***	0.732***	0.649***	0.990***	0.991***	0.993***
							(0.029)	(0.014)	(0.015)	(0.004)	(0.006)	(0.004)
Infl(-1)	0.004		0.002	0.031***		0.020**	0.166*		0.047**	−0.002		−0.010
	(0.007)		(0.007)	(0.010)		(0.010)	(0.097)		(0.020)	(0.008)		(0.013)
GDPg(-1)		0.133***	0.134***		0.126***	0.122***		0.269***	0.239***		0.087**	0.103***
		(0.019)	(0.019)		(0.019)	(0.019)		(0.025)	(0.026)		(0.035)	(0.035)
DLREER(-1)			−1.387			−1.205			−1.869*			−0.038
			(0.940)			(0.942)			(1.008)			(1.660)
N	1278	1278	1260	1278	1278	1260	1260	1260	1242	1278	1278	1260
Groups				18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000
sarganp							0.000	0.000	0.000	0.062	0.017	0.009
hansenp										0.216	0.195	0.214
j							13.000	11.000	13.000	7.000	7.000	9.000
ar1p							0.000	0.000	0.000	0.049	0.047	0.040
ar2p							0.004	0.015	0.005	0.328	0.329	0.255

Source: Author's computation.
Dependent variable: Nominal interest rate.
Note. (i) respectively, the sign *, **, and *** describe the significance level of 10%, 5% and 1%; (ii) standard errors are reported in brackets.

Table 8. Reaction functions with interactions and information lags.

	Static models						Dynamic models					
	OLS	OLS	OLS	FE	FE	FE	DGMM	DGMM	DGMM	SGMM	SGMM	SGMM
Ninter(-1)							0.682***	0.625***	0.498***	0.990***	0.992***	0.989***
							(0.108)	(0.016)	(0.018)	(0.009)	(0.009)	(0.009)
Infl(-1)	0.035***	0.032**	0.037**	0.047***	0.044***	0.047**	−4.424***	−0.113***	−0.167***	0.032	0.047	−0.038
	(0.013)	(0.013)	(0.018)	(0.015)	(0.015)	(0.019)	(0.802)	(0.031)	(0.040)	(0.131)	(0.149)	(0.151)
GDPg(-1)	0.101**	0.088*	0.084*	0.083*	0.073	0.071	−0.914	0.167***	0.058	0.954**	0.952**	0.145
	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)	(2.591)	(0.059)	(0.061)	(0.421)	(0.442)	(1.185)
DLREER(-1)		−1.214	−1.432		−1.071	−1.540		−1.495	0.028		−0.425	−0.436
		(0.939)	(0.952)		(0.942)	(0.954)		(1.013)	(1.039)		(1.523)	(1.344)
ECBI(-1)			0.066			0.083			−2.881***			−0.650
			(0.222)			(0.227)			(0.492)			(1.351)
USB(-1)			−0.004			0.049			0.944***			−0.025
			(0.031)			(0.032)			(0.057)			(0.048)
DLTres(-1)			−0.631*			−0.656**			−0.180			−0.357
			(0.330)			(0.330)			(0.315)			(1.309)
DLEner(-1)			0.756**			0.691**			−0.695***			0.700
			(0.311)			(0.309)			(0.236)			(1.715)
DLFood(-1)			0.068			−0.014			0.836*			−0.183
			(0.662)			(0.656)			(0.485)			(5.414)
Infl × ECBI(-1)	−0.073***	−0.061***	−0.069**	−0.062***	−0.054**	−0.059	6.687***	0.362***	0.567***	−0.066	−0.092	0.072
	(0.022)	(0.022)	(0.035)	(0.024)	(0.024)	(0.036)	(1.220)	(0.054)	(0.075)	(0.261)	(0.305)	(0.289)
GDPg × ECBI(-1)	0.068	0.096	0.101	0.078	0.104	0.097	1.520	0.116	0.027	−1.812*	−1.809*	−0.079
	(0.088)	(0.088)	(0.088)	(0.089)	(0.089)	(0.089)	(4.661)	(0.114)	(0.117)	(0.875)	(0.923)	(2.454)
N	1278	1260	1260	1278	1260	1260	1260	1242	1242	1278	1260	1260
Groups				18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000	18.000
sarganp							0.288	0.000	0.000	0.032	0.014	0.002
hansenp										0.407	0.360	0.147
j							15.000	15.000	18.000	8.000	9.000	14.000
ar1p							0.001	0.000	0.006	0.100	0.090	0.038
ar2p							0.057	0.013	0.088	0.415	0.334	0.253

Source: Author's computation.
Dependent variable: Nominal interest rate.
Note. (i) respectively, the sign *, **, and *** describe the significance level of 10%, 5% and 1%; (ii) standard errors are reported in brackets.

commodity prices and external financial conditions, in line with the insights obtained from panel data analysis.

The finding from Table 10 is consistent with traditional central bank reaction variables maintaining their significance. Notably, central banks in countries characterized by a high level of trade openness and financial integration with the global economy tend to exhibit a more pronounced responsiveness to changes in external financial conditions.

Table 9. Country-specific extended Taylor-type reaction functions for emerging markets.

	BRICS						Latin America			
	Panel	Brasil	Russia	India	China	S_Africa	Chile	Colombia	Mexico	Peru
Ninter(-1)	0.933***	0.972***	0.836***	0.637***	0.923***	0.933***	0.718***	0.916***	0.841***	0.912***
	(0.009)	(0.058)	(0.049)	(0.112)	(0.058)	(0.053)	(0.106)	(0.073)	(0.095)	(0.061)
Infl	0.441**	−1.441	−0.513	−1.235**	0.600	−0.550	−0.625	0.304	−1.947	−1.671
	(0.175)	(3.552)	(0.568)	(0.485)	(0.590)	(1.008)	(2.521)	(1.531)	(2.157)	(2.229)
GDPg	0.000**	0.003	0.000	0.000***	−0.000	0.000	−0.000*	−0.000	0.000**	−0.000
	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DLREER	−1.043	−7.364	0.145	0.920	1.694	−6.264**	6.139	−4.218	2.083	3.321
	(0.938)	(14.428)	(2.717)	(1.416)	(1.757)	(2.933)	(12.459)	(3.684)	(4.700)	(5.256)
ECBI	−0.156	−2.504	−0.110	2.165***	0.117	−0.849*	2.779**	0.019	0.393	−1.103*
	(0.147)	(1.946)	(0.763)	(0.567)	(0.649)	(0.447)	(1.294)	(0.580)	(0.573)	(0.652)
USB	0.182***	−0.127	0.103	0.250***	0.060	0.122	0.407	0.200	−0.058	−0.185
	(0.043)	(0.789)	(0.153)	(0.092)	(0.062)	(0.128)	(0.252)	(0.204)	(0.254)	(0.182)
DLTres	−0.307	−0.204	−4.849***	0.233	1.351	−1.720	2.491	3.700	1.678	1.569
	(0.336)	(3.853)	(1.557)	(0.931)	(0.812)	(1.632)	(1.938)	(2.375)	(2.681)	(2.447)
DLEner	−0.485	−4.315	−3.764***	0.356	0.755*	0.923	−1.724	0.189	1.886	−0.209
	(0.304)	(3.335)	(1.345)	(0.382)	(0.432)	(0.653)	(2.106)	(1.044)	(1.379)	(0.983)
DLFood	−1.146*	−0.861	2.371	−2.989*	1.509*	−2.131	−6.267	−1.352	−6.619**	1.547
	(0.657)	(6.550)	(1.929)	(1.688)	(0.800)	(1.862)	(5.037)	(2.458)	(2.807)	(2.246)

Source: Author's computation.
Dependent variable: Nominal interest rate.
Standard errors in parentheses.
$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 10. Country specific extended Taylor-type reaction functions for other emerging markets.

	Other emerging economies									
	Panel	Czech	Egypt	Hungary	Korea	Malaysia	Pakistan	Philippines	Qatar	Thailand
Ninter(-1)	0.933***	0.947***	1.078***	0.846***	0.885***	0.864***	1.003***	0.722***	0.829***	0.810***
	(0.009)	(0.044)	(0.060)	(0.063)	(0.066)	(0.042)	(0.021)	(0.106)	(0.084)	(0.093)
Infl	0.441**	0.774**	0.374**	−0.941	0.459	0.092	0.084	−2.320**	−0.411	0.581
	(0.175)	(0.333)	(0.162)	(1.601)	(0.677)	(0.237)	(0.165)	(0.930)	(0.554)	(0.737)
GDPg	0.000**	−0.000*	−0.000*	0.000*	−0.000**	0.000*	0.000***	−0.000**	0.000**	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DLREER	−1.043	0.950	−1.765*	1.546	−0.681	0.124	−0.407	−3.460	−2.979**	6.830
	(0.938)	(0.852)	(0.938)	(4.631)	(0.735)	(0.356)	(1.405)	(2.953)	(1.392)	(4.599)
ECBI	−0.156	0.321*	0.007	3.210***	0.444	0.306*	−0.246	0.158	0.208	0.385
	(0.147)	(0.176)	(0.339)	(0.748)	(0.344)	(0.173)	(0.596)	(0.511)	(0.329)	(0.334)
USB	0.182***	0.099***	−0.029	0.024	0.232***	0.138***	0.228***	0.126	0.167*	0.221**
	(0.043)	(0.023)	(0.060)	(0.209)	(0.067)	(0.042)	(0.069)	(0.147)	(0.099)	(0.090)
DLTres	−0.307	−0.003	0.183	−1.215	−2.231*	−0.117	−0.317	2.303	0.872**	−0.724
	(0.336)	(0.136)	(0.509)	(1.945)	(1.123)	(0.202)	(0.346)	(1.690)	(0.386)	(0.577)
DLEner	−0.485	−0.316	0.319	−2.035**	0.626*	−0.002	−0.349	−0.829	−0.693	−1.016*
	(0.304)	(0.193)	(0.363)	(0.974)	(0.337)	(0.124)	(0.481)	(0.638)	(0.493)	(0.511)
DLFood	−1.146*	0.312	−0.553	0.135	0.096	−0.164	−1.730	−2.371**	0.176	1.031
	(0.657)	(0.377)	(0.799)	(1.756)	(0.551)	(0.344)	(1.229)	(1.088)	(1.106)	(0.734)

Source: Author's computation.
Dependent variable: Nominal interest rate.
Standard errors in parentheses.
$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Across all countries, the exchange rate plays a dominant role in shaping interest rate decisions, with energy and food prices also contributing significantly. It is noteworthy that inflation and the output gap continue to exert the expected influence on interest rates in emerging economies, reflecting conventional coefficients associated with the traditional Taylor rule. In other words, central bank reactions align with the Taylor principle, implying that monetary policy is effective in maintaining inflation and output consistently in line with findings from previous studies (e.g. Klose, 2019).

The empirical findings from Table 11 suggests that an extended Taylor rule provides a more accurate representation of monetary policy decisions in emerging countries compared to the simpler version. Notably, the responses of monetary authorities to deviations in inflation or the output gap exhibit variations in magnitude and statistical significance across all countries. In light of recent shifts in monetary policy, the inclusion of additional variables enhances the precision of central banks' interest rate determinations.

Table 11. Country specific Restricted Taylor-type reaction functions for entire for emerging markets.

	Panel	Brasil	China	India	Russia	S_Africa	Chile	Colombia	Mexico	Peru
Ninter(-1)	0.933***	0.972***	0.923***	0.637***	0.836***	0.933***	0.718***	0.916***	0.841***	0.912***
	(0.009)	(0.058)	(0.058)	(0.112)	(0.049)	(0.053)	(0.106)	(0.073)	(0.095)	(0.061)
Infl	0.441**	−1.441	0.600	−1.235**	−0.513	−0.550	−0.625	0.304	−1.947	−1.671
	(0.175)	(3.552)	(0.590)	(0.485)	(0.568)	(1.008)	(2.521)	(1.531)	(2.157)	(2.229)
GDPg	0.000**	0.003	−0.000	0.000***	0.000	0.000	−0.000*	−0.000	0.000**	−0.000
	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DLREER	−1.043	−7.364	1.694	0.920	0.145	−6.264**	6.139	−4.218	2.083	3.321
	(0.938)	(14.428)	(1.757)	(1.416)	(2.717)	(2.933)	(12.459)	(3.684)	(4.700)	(5.256)

	Panel	Czech	Egypt	Hungary	Korea	Malaysia	Pakistan	Philippines	Qatar	Thailand
Ninter(-1)	0.933***	0.947***	1.078***	0.846***	0.885***	0.864***	1.003***	0.722***	0.829***	0.810***
	(0.009)	(0.044)	(0.060)	(0.063)	(0.066)	(0.042)	(0.021)	(0.106)	(0.084)	(0.093)
Infl	0.441**	0.774**	0.374**	−0.941	0.459	0.092	0.084	−2.320**	−0.411	0.581
	(0.175)	(0.333)	(0.162)	(1.601)	(0.677)	(0.237)	(0.165)	(0.930)	(0.554)	(0.737)
GDPg	0.000**	−0.000*	−0.000*	0.000*	−0.000**	0.000*	0.000***	−0.000**	0.000**	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DLREER	−1.043	0.950	−1.765*	1.546	−0.681	0.124	−0.407	−3.460	−2.979**	6.830
	(0.938)	(0.852)	(0.938)	(4.631)	(0.735)	(0.356)	(1.405)	(2.953)	(1.392)	(4.599)

Source: Author's computation.
Dependent variable: Nominal interest rate.
Standard errors in parentheses.
$^{*}p < 0.1$, $^{**}p < 0.05$, $^{**}p < 0.01$.

Both cross-country and country-specific analyses consistently reveal that the coefficients for inflation in the interest rate rule are statistically greater than those for the output gap. These results remain robust across alternative estimation methods and real interest rates. Therefore, it is evident that a shift toward a stricter anti-inflation interest rate rule has occurred during the study period.

5. Conclusions and policy implications

This article provides empirical insights into the interest rate-setting behavior of central banks in eighteen emerging economies from 2000Q1 to 2017Q4, utilizing a quarterly panel dataset. By estimating panel data models with the generalized method of moments (GMM), as well as presenting results from pooled OLS and fixed-effects estimators, we address endogeneity concerns and compare estimation methods.

Our analysis reveals that central banks in emerging markets follow an expanded Taylor rule, incorporating not only inflation and the output gap but also external financial conditions and commodity prices. The statistical significance of the inflation coefficient indicates a consistent responsiveness to inflation, aiming to keep it within target ranges. Additionally, the robustness of our findings across alternative specifications, including interaction terms and lagged information, reinforces the reliability of these conclusions. These results provide actionable recommendations for policymakers, emphasizing the need for a more comprehensive approach to monetary policy that considers both domestic and external factors. Emerging economies can enhance the effectiveness and adaptability of their monetary policies by integrating factors such as economic development goals, export dependencies, and sensitivity to global commodity prices. This holistic approach can help central banks in emerging markets better navigate the complexities of the global economy and achieve their macroeconomic objectives.

The findings also highlight the importance of external financial conditions and commodity prices in shaping monetary policy decisions in emerging economies. As these economies are often more susceptible to global market fluctuations, central banks need to be particularly vigilant in monitoring and responding to these external influences. This underscores the necessity for a flexible and dynamic monetary policy framework that can adapt to changing global economic conditions. Moreover, our study contributes to the broader literature on monetary policy by extending the traditional Taylor rule to better capture the realities faced by central banks in emerging markets. This extended Taylor rule can serve as a valuable tool for policymakers in these economies, offering a more accurate and practical guide for setting interest rates in response to both domestic and international economic variables.

Future research in this domain can build upon the reaction functions of central banks in emerging countries, particularly in their extended forms, including interactions with central bank independence. Investigating the role of institutional factors, such as the degree of central bank independence, political stability, and governance quality, can provide deeper insights into the effectiveness of monetary policy in different emerging market contexts. Additionally, exploring the impact of technological advancements and financial innovation on central bank policies in emerging economies could yield valuable insights. As financial markets become increasingly interconnected and technology-driven, understanding how these developments influence monetary policy will be crucial for maintaining economic stability.

Disclosure statement

No potential conflict of interest was reported by the author.

Notes

1. A new index developed by the author integrates two components – external and domestic factors – of central bank independence into a unified framework. These components are not considered in existing indices such as those by Cukierman et al. (1992), Garriga (2016), and Aizenman et al. (2011), among others. By design, the proposed index involves coding the legal aspects of central banks into five groups, comprising twenty-four variables registered in from the IMF's Central Bank Legislation Database (CBLD) Adrian et al. (2024) that represent domestic aspects of central bank independence, and three variables that capture the external component, totaling twenty-seven variables. The characteristics of this new index were then compared to those of existing indices.
2. In the HP filter, the smoothing parameter was set as 1600, the standard value for quarterly data.

Funding

There is no fund received by the author.

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Data availability statement

Data is available on request from the author.

References

Adrian, T., Khan, A., & Menand, L. (2024). A new measure of central bank independence. IMF Working Paper.

Aguiar-Conraria, L., Martins, M. M., & Soares, M. J. (2018). Estimating the Taylor rule in the time-frequency domain. *Journal of Macroeconomics*, *57*, 122–137. https://doi.org/10.1016/j.jmacro.2018.05.008

Aizenman, J., Chinn, M. D., & Ito, H. (2011). Surfing the waves of globalization: Asia and financial globalization in the context of the trilemma. *Journal of the Japanese and International Economies*, *25*(3), 290–320. https://doi.org/10.1016/j.jjie.2011.06.003

Alexandre, F., Gabriel, V. J., & Bação, P. (2008). Taylor-type rules versus optimal policy in a markov-switching economy [Universidade do Minho. Núcleo de Investigação em Políticas Económicas (NIPE)].

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte carlo evidence and an application to employment equations. *The Review of Economic Studies*, *58*(2), 277–297. https://doi.org/10.2307/2297968

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, *68*(1), 29–51. https://doi.org/10.1016/0304-4076(94)01642-D

Benchimol, J. (2024). Central bank objectives, monetary policy rules, and limited information. *Journal of Macroeconomics*, *80*, 103604. https://doi.org/10.1016/j.jmacro.2024.103604

Benchimol, J., & Bounader, L. (2023). Optimal monetary policy under bounded rationality. *Journal of Financial Stability*, *67*, 101151. https://doi.org/10.1016/j.jfs.2023.101151

Benchimol, J., & Fourçans, A. (2012). Money and risk in a DSGE framework: A Bayesian application to the Eurozone. *Journal of Macroeconomics*, *34*(1), 95–111. https://doi.org/10.1016/j.jmacro.2011.10.003

Benchimol, J., & Fourçans, A. (2019). Central bank losses and monetary policy rules: A DSGE investigation. *International Review of Economics & Finance*, *61*, 289–303. https://doi.org/10.1016/j.iref.2019.01.010

Bernanke, B. S., & Mihov, I. (1997). What does the Bundesbank target? *European Economic Review*, *41*(6), 1025–1053. https://doi.org/10.1016/S0014-2921(96)00056-6

Caputo, R., & Herrera, L. O. (2017). Following the leader? The relevance of the fed funds rate for inflation targeting countries. *Journal of International Money and Finance*, *71*, 25–52. https://doi.org/10.1016/j.jimonfin.2016.10.006

Clarida, R., Galí, J., & Gertler, M. (1999). The science of monetary policy: A new Keynesian perspective. *Journal of Economic Literature*, *37*(4), 1661–1707. https://doi.org/10.1257/jel.37.4.1661

Clarida, R., Gali, J., & Gertler, M. (2000). Monetary policy rules and macroeconomic stability: Evidence and some theory. *Quarterly Journal of Economics*, *115*(1), 147–180. https://doi.org/10.1162/003355300554692

Clausen, J. R., Meier, C.-P., et al. (2003). *Did the Bundesbank follow a Taylor rule? An analysis based on real-time data* (Tech. Rep.). Kiel Working Paper.

Coibion, O., & Gorodnichenko, Y. (2012). Why are target interest rate changes so persistent? *American Economic Journal: Macroeconomics*, *4*(4), 126–162. https://doi.org/10.1257/mac.4.4.126

Cukierman, A., & Muscatelli, A. (2008). Nonlinear Taylor rules and asymmetric preferences in central banking: Evidence from the United Kingdom and the United States. *The B.E. Journal of Macroeconomics*, *8*(1). https://doi.org/10.2202/1935-1690.1488

Cukierman, A., Web, S. B., & Neyapti, B. (1992). Measuring the independence of central banks and its effect on policy outcomes. *The World Bank Economic Review*, *6*(3), 353–398. https://doi.org/10.1093/wber/6.3.353

Garriga, A. C. (2016). Central bank independence in the world: A new data set. *International Interactions*, *42*(5), 849–868. https://doi.org/10.1080/03050629.2016.1188813

Gerlach, S., & Schnabel, G. (2000). The Taylor rule and interest rates in the emu area. *Economics Letters*, *67*(2), 165–171. https://doi.org/10.1016/S0165-1765(99)00263-3

Güney, P. Ö. (2016). Does the central bank directly respond to output and inflation uncertainties in turkey? *Central Bank Review*, *16*(2), 53–57. https://doi.org/10.1016/j.cbrev.2016.05.001

Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica*, *46*(6), 1251–1271. https://doi.org/10.2307/1913827

Hofmann, B., & Bogdanova, B. (2012). Taylor rules and monetary policy: A global'great deviation'? *BIS Quarterly Review September*.

Judd, J. P., & Rudebusch, G. D. (1998). Taylor's rule and the fed: 1970–1997. *Economic Review-Federal Reserve Bank of San Francisco*, 3–16.

Kim, T.-H., Chevapatrakul, T., & Mizen, P. (2003 Predicting changes in the interest rate: The performance of Taylor rules versus alternatives for the United Kingdom. In *Royal Economic Society Annual Conference 2003*.

Klose, J. (2019). Are eastern European Taylor reaction functions asymmetric in inflation or output? Empirical evidence for four countries. *Eastern European Economics*, *57*(1), 31–49. https://doi.org/10.1080/00128775.2018.1517600

Kwizera, P. A. (2022). *Monetary policy in emerging countries: An empirical analysis* (Unpublished doctoral dissertation). Universidade Do Minho (Portugal).

Kydland, F. E., & Prescott, E. C. (1977). Rules rather than discretion: The inconsistency of optimal plans. *Journal of Political Economy*, *85*(3), 473–491. https://doi.org/10.1086/260580

Mehrotra, A., & Sánchez-Fung, J. R. (2011). Assessing Mccallum and Taylor rules in a cross-section of emerging market economies. *Journal of International Financial Markets, Institutions and Money*, *21*(2), 207–228. https://doi.org/10.1016/j.intfin.2010.10.004

Minella, A., De Freitas, P. S., Goldfajn, I., & Muinhos, M. K. (2003). Inflation targeting in Brazil: Constructing credibility under exchange rate volatility. *Journal of International Money and Finance*, *22*(7), 1015–1040. https://doi.org/10.1016/j.jimonfin.2003.09.008

Mohanty, M. S., & Klau, M. (2005). Monetary policy rules in emerging market economies: Issues and evidence. In *Monetary policy and macroeconomic stabilization in Latin America* (pp. 205–245). Springer.

Nelson, E. (2003). UK monetary policy 1972–97: A guide using Taylor rules. *Central Banking, Monetary Theory and Practice: Essays in Honour of Charles Goodhart*, *1*, 195–216.

Neuenkirch, M., & Tillmann, P. (2014). Inflation targeting, credibility, and non-linear Taylor rules. *Journal of International Money and Finance*, *41*, 30–45. https://doi.org/10.1016/j.jimonfin.2013.10.006

Orphanides, A. (2003). Historical monetary policy analysis and the Taylor rule. *Journal of Monetary Economics*, *50*(5), 983–1022. https://doi.org/10.1016/S0304-3932(03)00065-5

Qin, T., & Enders, W. (2008). In-sample and out-of-sample properties of linear and nonlinear Taylor rules. *Journal of Macroeconomics*, *30*(1), 428–443. https://doi.org/10.1016/j.jmacro.2006.10.001

Reis, R. (2009). Optimal monetary policy rules in an estimated sticky-information model. *American Economic Journal: Macroeconomics*, *1*(2), 1–28. https://doi.org/10.1257/mac.1.2.1

Rivolta, G. (2018). Potential ECB reaction functions with time-varying parameters: An assessment. *Empirical Economics*, *55*(4), 1425–1473. https://doi.org/10.1007/s00181-017-1337-z

Romelli, D. (2022). The political economy of reforms in central bank design: Evidence from a new dataset. *Economic Policy*, *37*(112), 641–688. https://doi.org/10.1093/epolic/eiac011

Roodman, D. (2007). A short note on the theme of too many instruments. *Center for Global Development Working Paper*, *125*(10.2139). Citeseer.
Schmidt, P., Ahn, S. C., & Wyhowski, D. (1992). [On the estimation of panel-data models with serial correlation when instruments are not strictly exogenous]: Comment. *Journal of Business & Economic Statistics*, *10*(1), 10–14. https://doi.org/10.2307/1391796
Svensson, L. E. (2000). Open-economy inflation targeting. *Journal of International Economics*, *50*(1), 155–183. https://doi.org/10.1016/S0022-1996(98)00078-6
Taylor, J. B. (1993). Discretion versus policy rules in practice. *In Carnegie-Rochester Conference Series on Public Policy*, *39*, 195–214. https://doi.org/10.1016/0167-2231(93)90009-L
Taylor, J. B. (1999). A historical analysis of monetary policy rules. In *Monetary policy rules* (pp. 319–348). University of Chicago Press.
Taylor, J. B. (2000). Using monetary policy rules in emerging market economies. In 75th Anniversary Conference "Stabilization and Monetary Policy: The International Experience", Bank of Mexico.
Ullrich, K. (2003). A comparison between the fed and the ECB: Taylor rules. ZEW discussion paper.