SCIENTIFIC CULTURE
www.sci-cult.com

SCIENTIFIC CULTURE, Vol. 11, No. 2, (2025), pp. 182-196
Open Access. Online & Print

DOI: 10.5281/zenodo.17218208

THE IMPACT OF SOME ECONOMIC FACTORS ON THE INFLATION RATE IN EGYPT

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Received: 23/05/2025
Accepted: 04/09/2025

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ABSTRACT

This study investigates the primary economic determinants of inflation in Egypt from 1990–2023. The analysis determines how inflation relates to key economic factors by examining Egyptian inflation patterns. The research implements the ARDL framework to evaluate the direct as well as indirect relationships linking exchange rates with GDP and importing values with real interest rate variables. Research results show that increasing exchange rates and imports together generate 0.25 and 0.34 units of inflation increase, respectively. Conversely, a one-unit increase in both the interest rate and GDP leads to a decline in the inflation rate of about 1.04 and 0.08 units, respectively, consistent with established economic theory. A stronger GDP leads to more social products, thus lowering general market prices in economic systems. The research data implies establishing new economic guidelines to direct public funds toward profitable economic market segments. The policy would promote home manufacturing together with developing international market capacities while reducing imported goods. This investigation should be expanded with additional variables because institutional and international economic elements show new implications for inflation.

***Keywords**: Inflation Rate, GDP, Exchange Rate, Real Interest Rate, ARDL, ADF Test.*

1. INTRODUCTION

Economies throughout the world face inflation as one of their fundamental macroeconomic obstacles. The economic phenomenon creates broad-ranging consequences for the distribution of income together with resource management and growth rates as well as monetary stability. Financial experts and those responsible for policy creation continuously express their need to properly recognize and understand main inflation-causing factors because they lead to effective policy stabilization approaches (Maher, 2023). The process of economic development is influenced by inflation because nations experience changes in their internal markets while their global marketplace competitiveness faces impacts. Emerging and developing economies encounter enduring inflationary forces, which require precise empirical research about their driving factors (Abdelraouf et al., 2021; Pritchett et al., 2010). The institutional protection that advanced economies utilize to reduce inflation volatility does not exist in developing nations whose inflation stems from fundamental structural issues (Oikawa & Ueda, 2018).

Inflation in these situations transcends monetary causes since it arises from the dynamic relationship between fiscal policies and monetary policies and external sector variables. The repeated inflationary patterns in Egypt create an excellent opportunity to study which economic variables affect inflation rate dynamics, according to Ibrahim Abdu (2022). The Egyptian economy faced high inflation episodes during recent times because of domestic disturbances alongside worldwide crises and modifications in official policies. In 2016, the International Monetary Fund (IMF)-backed economic reform program brought major structural changes to Egypt when it combined currency devaluation with subsidy reforms and fiscal policy adjustments (Albagoury, 2024). The implemented reforms strengthened macroeconomic resilience, but their implementation triggered inflationary waves that reduced household buying power together with total economic value. The combination of external factors that include worldwide commodity price changes and disruptions in currency income has contributed to Egyptian price instability (Boshra Ghaly, 2023).

The combination of population growth and growing demand for basic essentials and limited infrastructure has worsened inflation rates in the economy. Research on these elements becomes fundamental because it helps Egypt meet its development targets and support sustainable expansion (Abonazel & Elnabawy, 2020). An investigation of this nature serves as a crucial tool that helps develop policies to regulate inflation without damaging economic strength (Azam & Khan, 2022). Multiple empirical studies have studied inflation determinants in emerging markets by focusing on both structural factors and policy-related components. A research paper, by El Araby et al. (2024), has confirmed the impact of monetary aggregates and exchange rate changes and fiscal deficits on inflation rates. The responses of inflation to exchange rate changes and fiscal deficits in many developing countries display asymmetry when institutions face significant weakness (Kamal, 2022). Studies have shown that supply-side limitations, especially energy expenses and varied agricultural outputs, directly impact price movements (Salah et al., 2023).

Research studies in the Egyptian economy demonstrate that budget deficits alongside import dependencies and exchange rate liberalization lead to inflation, according to Omran and Bilan (2021). Inflation rates rise after devaluations of the exchange rate because currency fluctuations directly affect the economy's price stability. Research has confirmed food price increases as the primary elemental cause of inflation because food absorbs significant proportions of household expenses. Available literature continues to utilize limited analytical methods that omit the comprehensive analysis of connected economic forces in the Egyptian economy (Abd El-Aal, 2023; Azam & Khan, 2022). Current research lacks thorough research on systematic multi-factor assessments that integrate demand-side and supply-side economic factors for inflation determination in the Egyptian market. Studies examining monetary and fiscal influences exist separately from each other but leave a gap in understanding how monetary and fiscal factors interact in relation to inflation in Egypt's unique economic structure.

Most empirical examination techniques in current research studies face two major shortcomings: a short analysis period together with a weak ability to detect complex sequential associations between economic variables. A lack of comprehensive perspectives blocks the creation of precise policy recommendations that can find and resolve inflation's base factors. This research addresses the knowledge gap by conducting an extended-time analysis of how economic factors such as exchange rates combine with government spending levels and monetary supply along with interest rates to impact inflation rates in Egypt. The main purpose of this research is to measure single-factor and multi-factor influences of these variables alongside determining which factors drive inflation the most. The investigation enhances knowledge about inflation in developing countries through practical recommendations to national authorities. The systematic consolidation of theory through empirical

methodology increases both academic and policy applications of this study.

1.1. Statement of the Problem

The macroeconomic challenge of inflation continues to be a major enduring issue throughout Egypt because it directly impacts the well-being of households and the economic stability of the country. The rate of inflation rose substantially in recent times and reached more than 33% during 2023. Rapid inflation has reduced the buying power of the public population, with special vulnerability among less wealthy people, while damaging overall economic belief. The Egyptian economy faces three main inflation factors, including internal production problems and currency value fluctuations, together with worldwide economic turbulence, particularly during major events like the COVID-19 crisis. Available research demonstrates how supply chain disruptions and higher import costs drive Egyptian inflation since they intensify existing structural economic deficiencies alongside external dependency (Salah et al., 2023; Suleiman, 2023).

Inadequate control of inflation in Egypt represents the primary research problem because various economic factors, such as exchange rate changes, changes in real interest rates, increasing imports, and limited GDP expansion, have different causes. Multiple economic variables together generate inflationary effects by applying cost-push and demand-pull factors into the economy. Inflation represents persistent price rises throughout the consumer market, while the exchange rate shows pound-to-foreign currency ratios, and real interest rates account for economic inflation rates, and imports total all foreign purchases, and GDP represents the national production data. Various economic studies show that real GDP growth has a negative link with inflation rates, while both import dependency and exchange rate devaluation generate positive inflation effects (Ahmed et al., 2024; Kamal, 2022). The behavior of fiscal deficits together with inadequate monetary interventions contributes fundamentally to rising prices, according to recent economic research (Ibrahim Abdu, 2022).

Many policy interventions have failed to reduce the gap in understanding how variables interact in Egypt's inflationary conditions. Research studies on this topic lack either solid methodological frameworks or time span evaluation, which fails to display structural chronologies and economic disturbances. The recent research indicates that policymakers should develop frameworks that unite solutions for supply-side constraints with demand-side pressure management (Alghamdi et al., 2024; Kamal, 2022). This analytical research implements the ARDL method over 33 years (1990–2023) to study both short-term and long-term causal effects. Research at this time becomes essential since evidence-based policy solutions are needed to stabilize inflation alongside promoting sustainable growth. The resolution of this problem remains essential for economic theoreticians and policymakers, and social-economy defenders need it to ensure sustainable economic equity during global uncertainties.

The research focuses on determining the impact of exchange rates along with real interest rates and import values and gross domestic product on Egypt's inflation rate within 1990–2023.

1.2. Objectives

1. To investigate how exchange rates together with real interest rates, GDP, and imports influence inflation rates in Egypt starting from 1990 through 2023 to analyze their specific impact on price instability during this timeframe.
2. To estimate the short- and long-term effects of these indicators on inflation using the ARDL model, which allows for analyzing dynamic relationships and equilibrium adjustments between inflation and its determinants over time.
3. To evaluate the capability of monetary methods together with fiscal measures to regulate inflation through detailed study of how government outlays and interest policies and exchange rate reforms influence price changes and achieve economic stability.

2. LITERATURE REVIEW

The review analyzes current experimental and conceptual studies that investigate the origins and active mechanisms along with inflationary outcomes throughout Egypt. The review categorizes the research chronologically while assessing research methods and points out the major knowledge gaps that guide the present study. The analysis contains six parts ordered as follows:

2.1. Comprehensive Overview

The analysis reviews fourteen peer-reviewed research articles spanning 2015 to 2024 that focus on studying Egypt's macroeconomic and structural elements affecting inflation rates. The authors use different research approaches that include machine learning models (Abd El-Aal, 2023) and vector autoregression, threshold regressions (Maher, 2023), and structural equation modeling to study the causal links connecting inflation with exchange rates and government expenditure, money supply, capital formation, and GDP growth. The research adopts two

main approaches: comparing data (Alghamdi et al., 2024) and analyzing through policy-oriented analysis (Omar & Yousri, 2024) to investigate inflation relations with institutional and global and social frameworks. The target populations analyzed in research include national economic totals as well as specialized sectors. Multiple monetarist, structuralist, and institutional theoretical approaches exist in literature to explain inflation because it shows itself differently based on context.

2.2. Thematic Analysis

The literature shows three main thematic aspects. The initial step focuses on stressing and prioritizing inflationary factors. The research by Abd El-Aal (2023), coupled with Ibrahim and ElSharkawy (2023) demonstrates that exchange rate volatilities together with high government spending both play disruptive roles in inflation. Developing economies maintain high inflation rates because they face fiscal weaknesses and unstable capital movements. The researchers verified expansionary monetary policy and external price shocks as inflation acceleration factors through their ARDL and cointegration models. Maher (2023) establishes that an inflation threshold exists at 9.32%, causing GDP reduction, literature demonstrates how different policy frameworks and institutional abilities affect the inflation-growth relationship. The third theme explores how inflation generates adverse effects across multiple social groups and institutional domains and economic sectors, according to analyses by Omar and Yousri (2024).

2.3. Comparative and Critical Analysis

The reviewed studies strongly demonstrate that currency exchange rate variations and government spending play key roles in defining Egypt's inflation patterns. Both quantitative studies (e.g., Abd El-Aal, 2023) and policy-oriented ones (Omar & Yousri, 2024) affirm this trend. Studies by Maher (2023) agree that the effects of inflation are non-linear and obtain special meaning through two components: structural breaks in systems and governance standards. The research approaches diverge with respect to both interpretation methods and analytical coverage. A prior study uses theoretical comparative analysis for BRICS economies, but Alghamdi et al. (2024) examine how national institutions and cross-national factors influence the study field. The scholarly discourse includes studies that urge strict inflation-targeting regimes and others that support inclusive reform-sensitive policy design. The diverse research approaches indicate how complex and spread-out academic discussion has become regarding this subject matter.

2.4. Research Gap Identification

The present research, covering many topics, shows several research gaps that continue to exist. The research on how inflation affects households and enterprises at the microeconomic level presents many uninvestigated areas. Most researchers utilize macroeconomic aggregate data to analyze inflation effects in their reports (Omar & Yousri, 2024). This research shows a clear hole in relating behavioral economics with political economics to understand how governance quality and trust levels transfer policy effectiveness. Multiple research papers acknowledge structural changes (Maher, 2023), yet researchers have only included limited analysis of pandemic-related dynamics and worldwide inflation effects. Only a small number of research papers use mixed-method triangulation methods and fail to evaluate the normative assumptions operational within inflation models. Research on inflation needs to target these gaps because they ensure both theoretical advancement and policy-relevant actions.

2.5. How the Current Study Benefits from Previous Studies

The study develops an integrated policy-relevant inflation model in Egypt by synthesizing experimental evidence from various literature on this diverse topic. Previous scholarly work successfully identified core macroeconomic variables, including exchange rates together with government expenditure, GDP growth, and monetary expansion, but these elements typically received limited analysis of joint associations. The research utilizes the Autoregressive Distributed Lag (ARDL) method to examine the short- and long-run causal relations, including breaks in the system since 2020. This paper builds upon previous scholarly work in two ways by incorporating social policy variables, institutional capacity indicators, and region-specific data to address how equity, governance, and resilience gaps have been excluded. This research investigation connects with existing literature by developing the predictive and explanatory capabilities regarding inflation patterns in Egypt.

2.6. Advanced Integration

The examined research papers demonstrate the development of inflation research, which has progressed from traditional macroeconomic models to framework methods that integrate contextual awareness. The initial scholarly work demonstrated quantitative precision while neglecting institutional factors and political societal elements. The literary domain contains different sections that share overlapping areas between monetary policy research,

structural reform studies, and social impact evaluations, yet each section provides limited understanding of systemic relationships. This study provides advancement by developing a model that blends econometric accuracy with structural and institutional analysis according to current demands for methodological pluralism and policy-sensitive research models in economic sciences. Research with this integrated structure both improves academic understanding and makes research more practical to shape inclusive inflation control strategies.

The examined academic literature delivers both extensive and fragmented knowledge about inflation mechanisms in Egypt and their observed patterns as well as monetary policy reactions. The empirical contributions are significant, but several theoretical and methodological limitations appear in this research. The current research expands current knowledge bases to create a unified, policy-oriented analysis of inflation patterns.

2.7. Key Concepts and Definition of Model Variables

This study investigates the determinants of inflation in Egypt over the period 1990 to 2023, using the inflation rate (Inf) as the dependent variable and several key macroeconomic indicators as independent variables. The exchange rate (Excha) plays a central role through the exchange-rate pass-through (ERPT) effect, where currency depreciation raises the cost of imported goods, thereby increasing overall price levels (Suleiman, 2023). The real interest rate influences inflation via the monetary transmission mechanism, as lower real rates typically stimulate consumption and investment demand, which in turn exert upward pressure on prices (Ibrahim Abdu, 2022). Government expenditure (GovExp) is considered a driver of fiscal inflation, particularly when expansionary spending is financed by borrowing or monetary expansion, which can increase aggregate demand beyond supply capacity (El Araby et al., 2024). Total imports (Imp) contribute to inflation by transmitting external price changes into the domestic economy, especially when global prices rise or when the domestic currency weakens (Suleiman, 2023). These variables collectively provide a comprehensive framework for assessing the internal and external forces driving inflation in Egypt.

3. METHODOLOGY

The researcher utilized the ARDL model bounds testing approach for assessing the existence of cointegrating relationships, defined as long-term associations between the dependent variable inflation and macroeconomic indicators exchange rate, GDP, imports, and real interest rate, according to Duasa (2007). According to Pesaran et al. (2001), the examination of long-term connections between variables together with short-term analysis of their effects on inflation was achieved with the ARDL framework.

The choice of using bound's testing procedure was supported by several technical advantages that separated it from alternative cointegration methods. By contrast to Johansen cointegration, the bounds testing approach accepts parameters that are either I (0) or I (1), so researchers enjoy broader practical use in economic empirical projects. The method suits studies containing variables at different orders of integration because of its design.

Small-sample analyses benefit from the bound approach since it provides an effective solution for such research. The ARDL-bounds methodology proves trustworthy when analyzing short datasets even though other cointegration techniques need extensive sample sizes due to its alignment with this study's time frame of 1990 to 2023. The method delivers valuable outcomes specifically for developing country macroeconomic investigations because limited available time-series data makes it particularly appropriate.

The ARDL model permits researchers to evaluate time-dependent relationships by measuring both short-term behavioral patterns and extended elasticity for validation of economic principles between inflation rates and macro variables. The model enables researchers to verify if relationships between variables meet established economic theory, which strengthens its interpretive worth (Pesaran & Pesaran, 1997; Pesaran et al., 2001).

An F-test within the bounds-testing framework helped verify the presence of equilibrium relationships between variables in the long run. The F-test evaluated whether no cointegration existed between the selected variables against the alternative hypothesis of establishing a stable long-run relationship (Fig. 1 shows the results).

The researchers presented the null hypothesis for the absence of cointegration between inflation and the exchange rate and GDP and imports and the real interest rate in the following form:

$$H_0 = \varphi_1 = \varphi_2 = \varphi_3 = \varphi_4$$

While the alternative hypothesis indicates:

$$H_1 \neq \varphi_1 \neq \varphi_2 \neq \varphi_3 \neq \varphi_4$$

The F-test has a non-standard distribution irrespective of whether the variables are I(0) or I(1)

(Pesaran et al., 2001). It offers two sets of critical values that establish the upper and lower boundaries for inference at four significance levels: 1%, 5%, and 10%. One set posits that all the variables are I (0), whereas the other posits that they are all I (1). If the calculated F-statistic surpasses the upper critical value, the null hypothesis of no cointegration is rejected. If the F-statistic is below the lower threshold, then the null hypothesis cannot be rejected. If the F-statistic lies between the upper and lower boundaries, then the outcome is inconclusive.

The ideal lag periods for the ARDL model were established based on the Akaike Information Criterion (AIC). The correlation between inflation and the exchange rate, GDP, imports, and real interest rate is expressed as follows:

$$Y = f(X_1, X_2, X_3, X_4) \quad (1)$$

According to Pesaran et al. (2001), the ARDL model in Equation (1) is defined as follows:

Y: Represents the inflation rate (%).
X_1: Represents the exchange rate of the Egyptian pound to the US dollar (EGP per USD).
X_2: GDP value (billion USD).
X_3: Represents the value of imports (billion USD).
X_4: Represents the real interest rate (%).

The Unrestricted Error Correction Model (UECM) was used to test the cointegration among the studied variables:

$$\Delta LNY_t = \varphi_0 + \sum_{n=1}^{p} \varphi_1 \Delta LNY_{t-1} + \sum_{n=0}^{p} \varphi_2 \Delta LNX_{1t-1} + \sum_{n=0}^{p} \varphi_3 \Delta LNX_{2t-1} + \sum_{n=0}^{p} \varphi_4 \Delta LNX_{3t-1} \sum_{n=0}^{p} \varphi_5 \Delta LNX_{4t-1} + \beta_1 LNY_{t-1} + \beta_2 LNX_{1t-1} + \beta_3 LNX_{2t-1} + \beta_4 LNX_{3t-1} + \beta_5 LNX_{4t-1} + \mu_t \quad (2)$$

Upon identifying cointegration, the long-term relationship is evaluated using the designated ARDL model, as delineated in Equation (3):

$$\Delta LNY_t = \varphi_0 + \beta_1 LNY_{t-1} + \beta_2 LNX_{1t-1} + \beta_3 LNX_{2t-1} + \beta_4 LNX_{3t-1} + \beta_5 LNX_{4t-1} + \mu_t \quad (3)$$

The dynamic short-run relationship is estimated using the Error Correction Model (ECM), as shown in equation (4):

$$\Delta LNY_t = \varphi_0 + \sum_{n=1}^{p} \varphi_1 \Delta LNY_{t-1} + \sum_{n=0}^{p} \varphi_2 \Delta LNX_{1t-1} + \sum_{n=0}^{p} \varphi_3 \Delta LNX_{2t-1} + \sum_{n=0}^{p} \varphi_4 \Delta LNX_{3t-1} \sum_{n=0}^{p} \varphi_5 \Delta LNX_{4t-1} + \delta ecm_{t-1} + \mu_t \quad (4)$$

where Y denotes the inflation rate.

X_1: Represents the exchange rate.
X_2: GDP value.
X_3: Represents the import value.
X_4: Represents the real interest rate.
ϕ_0: Represents a constant term.
μ_t: Represents white noise.
$\phi_1 - \phi_5$: Represent the short-run elasticities (coefficients of the first-differenced explanatory variables).
$\beta_1 - \beta_5$: Represent the long-run elasticities (coefficients of the explanatory variables).

$ecmt_{-1}$: Represents the error correction term lagged by one period.
δ: Represents the adjustment speed.
Δ: Represents the first-difference operator.
ln: Represents the natural logarithm.
p: Represents the lag length, and data analysis was conducted using EViews 12 software.

The data in this study are based on a time series (1990–2023) of published data from the Central Agency for Public Mobilization and Statistics, the Central Bank of Egypt, and the World Bank database.

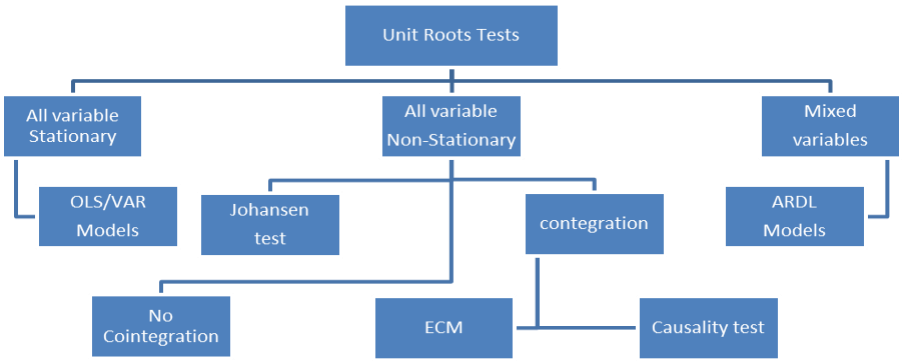

Figure 1: Method Selection for Time Series Data.
Source: Prepared by the authors.

4. RESULTS

4.1. Time Series Stationary Study

This section concentrates on evaluating the results through fundamental econometric methodologies, including data stationarity, the ARDL model, and bound testing processes. The research utilized the Augmented Dickey-Fuller (ADF) test to assess the stationarity of the economic variables analyzed, aiming to ascertain the order of integration for each variable investigated. The investigation is initiated by employing the ADF test to ascertain the integration order of the variables and determine whether they are in levels or first differences. This phase is essential for assessing the stationarity of the time series to ascertain whether the variables are integrated of order zero I (0), first order I (1), or second order I (2).

Table 1 presents the results of the Augmented Dickey-Fuller (ADF) test, which shows the stationarity of the study variables, a critical aspect for ensuring the consistency of the data, especially in the context of inflation and its determinants. The ADF test results indicate that inflation, exchange rates, GDP, and imports are all non-stationary at level but become stationary after taking the first difference, suggesting that they are I (1) series. In contrast, the real interest rate is I (0), meaning that it is stationary at level. These results highlight the importance of differencing in modeling the relationships between these variables, particularly when studying the factors affecting inflation, as non-stationary variables could lead to spurious regression results if not properly transformed.

Table 1: Augmented Dickey Fuller test (ADF).

Variables			Level I (0)			1st Difference I (1)		
			Intercept	Intercept and Trend	None	Intercept	Intercept and Trend	None
$\hat{Y}_t$	INF	I (1)	1.92-	2.65-	-0.29	*5.06-	*5.27-	*5.14-
X_{1t}	EX-CHANGE	I (1)	0.896	-1.567	2.26	-3.178*	-3.389	-4.57*
X_{2t}	GDP	I (1)	-1.68	-2.58	1.66	-2.98**	-2.89	-2.88*
X_{3t}	IMP	I (1)	-0.68	-1.86	2.69	-4.08*	-3..98*	-3.49*
X_{4t}	REAL INTER	I (0)	-2.95*	-4.1*	-2.45*	-4.73*	-4.66*	-4.78*

Source: Collected and calculated from the data in Table 1 in the Appendix using (E-views 12). *Significant at the 1% level, **Significant at the 5% level, ***Significant at the 10% level.

4.2. Vector Autoregressive Lag Order Selection Criteria

By using the five macroeconomic variables from 1990 to 2023, the study conducted VAR Lag Order Selection Criteria to identify the right lag length for the VAR model. The selection process utilized standard statistical indicators, namely Akaike Information Criterion (AIC), along with Final Prediction Error (FPE) and Hannan-Quinn (HQ). The three criteria showed that an optimal lag length exists at four, so researchers chose this length because predictive accuracy was their main priority. The Schwarz Criterion together with the Likelihood Ratio test selected shorter lag periods, but these tests preferred more simplified models compared to other criteria. Research used the forecasting capability of the model to confirm the adopted lag structure of 4 due to better performance in AIC, FPE, and HQ calculations in Table 2.

Table 2: VAR Lag Order Selection Criteria.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-849.5612	NA	3.80e+18	56.97074	57.20428	57.04545
1	-713.7365	217.3194*	2.41e+15	49.58243	50.98363*	50.03069
2	-684.9898	36.41255	2.19e+15	49.33265	51.90151	50.15445
3	-646.7219	35.71664	1.40e+15	48.44813	52.18466	49.64348
4	-592.2938	32.65687	5.66e+14*	46.48625*	51.39045	48.05515*

Source: Results of analysis of study data using (E-views 12).

- LR: Sequential modified likelihood ratio (LR) test statistic (each test at the 5% level).
- FPE: Final Prediction Error,
- AIC: Akaike Information Criterion,
- SC: Schwarz Information Criterion,
- HQ: Hannan-Quinn Information Criterion.

4.3. F-Bounds Test

Upon validating the stationarity of the data through the ADF test to ascertain the integration orders for each of the five study variables, the study advanced to estimate the F-statistic utilizing F-bounds, as illustrated in Table 3 below. When

inflation is treated as the dependent variable and exchange rate, GDP, imports, and real interest rate as independent variables, the null hypothesis test reveals no long-term relationship, whereas the alternative hypothesis indicates that a cointegrating relationship exists. The F-statistic was 8.67, exceeding all upper bounds at significance levels of 1%, 2.5%, 5%, and 10%. Consequently, the null hypothesis, which posits the absence of a long-term relationship, is rejected, while the alternative hypothesis is accepted, thereby affirming the existence of a long-term relationship between the four independent variables (exchange rate, GDP, imports, and real interest rate) and inflation (dependent variable).

Table 3: F-Bounds Test.

Test Statistic	Value	Sig.	I(0)	I(1)
F-statistic	8.674646	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37
Source: Author's computation using E-views 12. where k denotes the number of regressors.				

The estimation of the ARDL (1, 1, 0, 0, 4) model proceeded by using the Bayesian Schwarz Criterion after validating the relationship. The data in table 4 demonstrates that exchange rate changes produce a statistically significant and instantaneous increase in inflation by 2.29 points according to the results and P-value measurement below 1%. The real interest rate exhibits significant positive effects through its lagged terms at lags 1 to 3, even though the present level remains nonsignificant (p = 0.167).

A negative and significant coefficient at 1% represents the error correction term (CointEq-1), which has a value of -1.057. A statistics value of -1.057 demonstrates a stable long-run relationship while showing that 106% of temporary deviations from equilibrium points get resolved during one year, indicating quick equilibrium adjustments.

The diagnostic test results indicate that the model fits well together. Nearly 90% of inflation variation can be accounted for through the model because its R-squared value stands at 0.8979. The residuals show no significant autocorrelation since the Durbin-Watson statistic measures 2.08. The data from this study validates that the ARDL model performs well in detecting both short-term effects and long-term relationships among the research variables.

Table 4: ARDL Error Correction Model Results – ARDL (1, 1, 0, 0, 4).

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXCHANGE_RATE)	2.294039	0.226153	10.14375	0.000
D(REAL_INTEREST_RATE)	-0.180908	0.125914	-1.436757	0.167
D(REAL_INTEREST_RATE(-1))	0.782172	0.140014	5.58638	0.000
D(REAL_INTEREST_RATE(-2))	0.666692	0.133086	5.009484	0.000
D(REAL_INTEREST_RATE(-3))	0.391867	0.11025	3.554346	0.002
Coint Eq(-1)*	-1.057061	0.130368	-8.10831	0.000
R-squared	0.897913	Mean dependent var		0.726333
Adjusted R-squared	0.876645	S.D. dependent var		6.911492
S.E. of regression	2.427454	Akaike info criterion		4.788419
Sum squared resid	141.4207	Schwarz criterion		5.068659
Log likelihood	-65.82629	Hannan-Quinn critter.		4.87807
Durbin-Watson stat	2.084246			
Source: Author's computation using (E-views 12).				

Table 5 offers long-run coefficient results from the ARDL model analysis showing the financial relations between inflation and key macroeconomic elements. Analysis findings indicate that exchange rates and imports create positive inflationary pressure, which produces statistically important impacts. Research indicates that currency depreciation by one unit increases inflation by 0.34 units, and each one-unit import rise generates a 0.26-unit inflation increase (p = 0.0821 and p = 0.0325). Research evidence supports the higher costs that result from currency depreciation and growing imports in the Egyptian economy, which drive up inflation rates.

Conversely, the GDP and real interest rate both exhibit significant negative effects on inflation. The level of GDP increases at a rate of 0.08 units for every one-unit increase in economic growth (p = 0.0014), thus showing its deflationary capacity through better supply and production systems. The real interest rate shows a significant inverse relationship with inflation when it grows by one unit because inflation falls by 1.05 units (p = 0.0028). This finding verifies how higher interest rates decrease consumer demand and lower overall prices.

The constant element (C = 13.035) shows individual price inflation levels while managing other factors in the analysis. The long-term ARDL model effectively captures the economic relationships between external exchange rates and internal GDP and interest rate factors, which drive inflation patterns in Egypt, according to the research results.

Table 5: Long-term Relationship.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXCHANGE_RATE	0.341244	0.185901	1.83562	0.0821
GDP	-0.08122	0.021698	-3.74333	0.0014
IMPORTS	0.256295	0.111072	2.307471	0.0325
REAL_INTEREST_RATE	-1.04986	0.305394	-3.43771	0.0028
C	13.03545	3.245903	4.015971	0.0007
EC = INFLATION - (0.3412*EXCHANGE_RATE -0.0812*GDP + 0.2563				
*IMPORTS -1.0499*REAL_INTEREST_RATE + 13.0355)				
Source: Collected and calculated from the data in Table (1) in the Appendix using (E-views 12).				

4.4. Diagnostics Tests

A set of tests was used to judge the suitability of the applied model to measure the estimated elasticities in the long run to ensure that the model does not include errors and problems in the measurement, as it uses the normal distribution test, the non-stationary variance test, and the autocorrelation test between errors.

4.5. Residual Normality Test

An evaluation of the estimated ARDL model's validity and robustness required performing three diagnostic tests, which checked normal residual distribution together with heteroskedasticity and serial correlation. Residual normality distribution was tested through the Jarque-Bera test. The results from the test produced a 0.385 statistic together with a 0.824 p-value exceeding standard levels of significance. The testing criterion established that normality could not be proved invalid. A negative skew coefficient together with kurtosis exceeding 3 indicates a skewed left distribution that is leptokurtic in nature. Fig. 2 shows that even though the residuals of the model show deviations from normality, the results indicate no significant difference from normality, which warrants its acceptance for distributional assumptions.

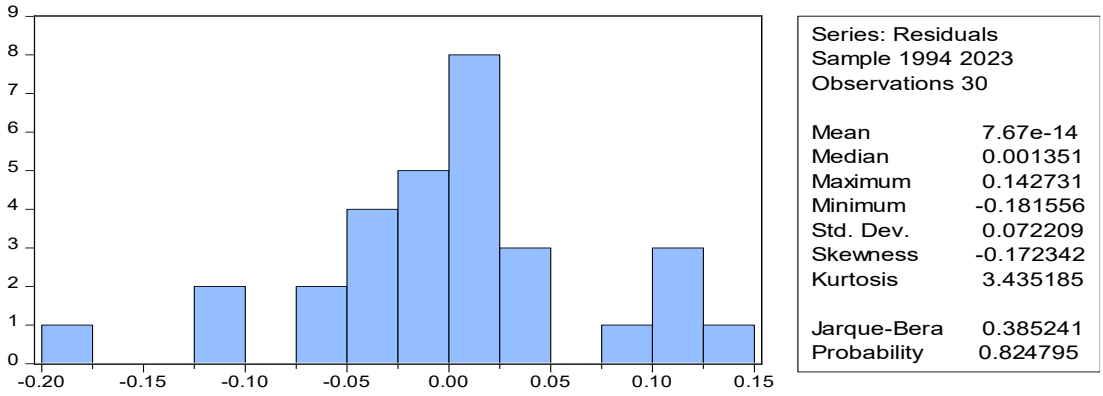

Figure 2: Residual Normality Test.

Source: Collected and calculated from the data in Table 1 in the appendix, using (E-views 12).

4.6. Serial Correlation LM test

The statistical investigation aimed to check if estimated model residuals displayed serial correlation. The F-statistic value in Table 6 indicates 0.49 with a p-value of 0.62, exceeding the significant level of 0.05. Approval of the null hypothesis of no serial correlation takes place. The model demonstrates independent residual distribution, which proves that autocorrelation issues do not exist.

Table 6: Results of Diagnostics Tests.

Test	Value	Prop.
Jarque- Bera Test	0.385	0.824
Serial Correlation LM test	0.49	0.62
ARCH Test	0.69	0.379
Ramsey Reset Test	1.39	0.279
Source: Collected and calculated from the data in Table (1) in the Appendix using (E-views 12).		

4.7. Heteroskedasticity test (ARCH)

The researchers conducted the ARCH test to verify heteroskedasticity cases that produce non-constant variance in the residuals. As per Table 6 data, the F-statistic value stands at 0.69, with 0.379 as the p-value exceeding a significance level of 0.05. The absence of rejection of the null hypothesis proves that the residuals maintain consistent variance levels. The study results reveal that the model can be considered statistically sound because it does not display heteroskedasticity issues.

4.8. Ramsey Reset Test

The Ramsey Regression Equation Specification Error (RESET) test determined whether the current model specification is appropriate and free from possible relevant omitted variables and forms. Table 6 shows an F-statistic value of 1.39, while the p-value reaches 0.279, above the established 0.05 significance threshold. The examiners accept the null hypothesis, which states that the model maintains correct specification. The specification error test shows no evidence of incorrect model specification because the functional relationships used in the model prove fit for purpose.

4.9. CUSUM Test

A CUSUM (cumulative sum of recursive residuals) test evaluated the estimations' time-series structural stability for the obtained ARDL model results. The CUSUM line plotted in Figure 3 stays within the indicated 5% critical boundaries from beginning to end during the sample period. The model demonstrates structural stability because its parameters show no indications of instability and avoid significant structural changes. The research results from both short-run and long-run estimations prove suitable for economic and statistical analysis.

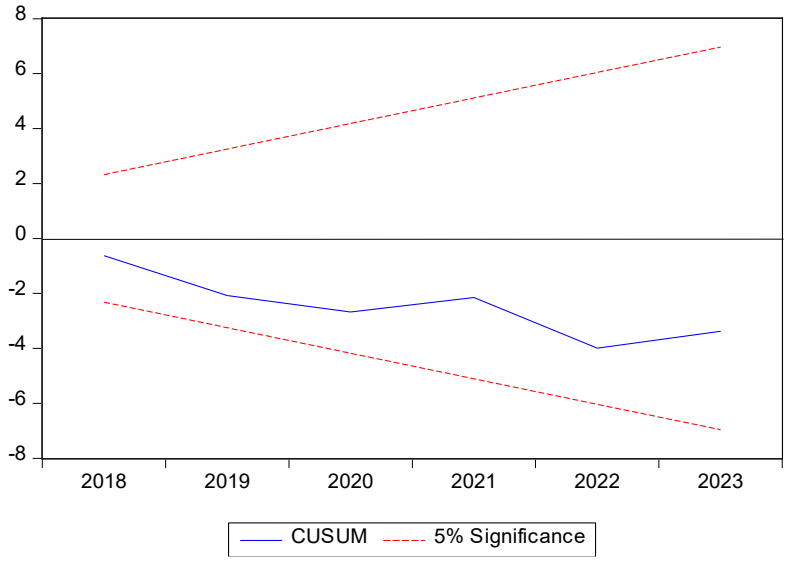

Figure 3: CUSUM Test.

Source: Collected and calculated from the data in (Table1)in the Appendix using (E-views 12).

This study proves the high methodological coherence and consistency between all econometric empirical evidence through the ADF test, which revealed that all variables began as non-stationary at level but stabilized at first difference, confirming their I(1) characters. The real interest rate maintained stationary properties when in level form, thus indicating an I(0) process. The integration orders of these variables support the application of the ARDL bounds testing approach because this method handles different levels of integration. The order of integration required determination for the purpose of avoiding spurious regression and securing reliable inference outcomes. The initial integration assessment provided crucial statistical validity for all upcoming model calculations.

All three tests (AIC, FPE, and HQ) indicated the best lag length should be set at four. This selection steered the ARDL model design and improved its prediction abilities. The F-Bounds test verified the existence of a long-term relationship between inflation and its chief elements because the F-statistic surpassed all acceptable threshold values. In the short period, exchange rate changes generated important and immediate inflationary patterns. The real interest rate showed important impacts through lagged time periods, indicating monetary transmission continues over time. After short-run disturbances, the negative and significant value of the error correction term demonstrated that the

system moved toward its long-run equilibrium.

Analysis of long-term data patterns established inflation as well as exchange rate fluctuations and international imports to drive inflation patterns in Egypt. Internal production together with monetary tools demonstrated substantial negative effects, while GDP and real interest rates presented substantial negative effects. Economic theories and Egypt's import-dependent market structure match the study results. The model passed tests demonstrating normal distribution together with consistent variances and showing no autocorrelation and no misspecification. The CUSUM test proved that the model maintained constant structural relationships through time, which confirmed the solid foundation of estimated relationships between variables. The ARDL model successfully examines inflation dynamics through its documented reliability to explain short-term and long-term effects in both cases.

5. DISCUSSION

The study results line up with previous research about inflation determinants in Egypt, particularly showing GDP as an inverse indicator to inflation (Abonazel & Elnabawy, 2020). The data confirms the established belief that increased industrial output acts as a force to reduce inflation pressure. The current study deviates from previous research by showing exchange rate movements and import dependence to be the key elements along with money supply and fiscal policy (Abdelraouf et al., 2021). Growing external factors now significantly influence the inflation patterns observed in Egypt as a result of its open market strategy. The study, along with related research, applied the ARDL approach for analyzing long-term economic relationships, and this strengthens the validity of the method, as noted by Ponziani (2023). The researchers applied similar research methods, which enhance theoretical strength and enable cross-country findings (Ali, 2023).

The literature demonstrates that domestic fiscal imbalances together with government policy errors act as primary drivers of inflation (Bouyacoub, 2022; El Araby et al., 2024). The relationship between inflation and both loose monetary policy and budget execution inefficiencies has been established by various researchers. The present study's focus on currency depreciation and rising import costs receives support from different analytical perspectives, which do not create contradiction with the current analysis. The field of inflation analysis requires diverse explanatory variables since the economic phenomenon absorbs domestic conditions together with international economic influences. To achieve successful inflation management, one must simultaneously examine external vulnerabilities together with internal policy reform measures. The combination of internal policies and external monitoring becomes crucial when applied to countries with constrained financial options together with high import dependence status.

The extended time span from 1990 to 2023 in the present study extends its value to existing literature by tracking major economic transformations. This research differentiates itself from studies with brief durations because it investigates multiple cycles of devaluations along with inflationary spikes and policy reforms, which result in expansive empirical evidence. The model successfully depicts both temporary global financial crises impacts and long-term domestic reform consequences. The study's extended historical research period increases the reliability of extended findings to strengthen policy evaluation. The economic system in Egypt has continuously transformed due to both national policy transformations and international economic disturbances. The combination of these conditions emphasizes why we should evaluate inflation from a historic perspective.

The ARDL bounds testing technique applied its technique after confirming the stationary nature of the chosen variables. The combination of I(0) along with I(1) variables made ARDL the appropriate method for analyzing both immediate and lasting effects on inflation dynamics (Abonazel & Elnabawy, 2020). The F-statistic surpassed all upper critical values during the testing, which demonstrated a durable equilibrium in the long run. The exchange rate acted rapidly on inflation patterns in the short run, whereas real interest rate effects became noticeable with time lag (Mohamed Youssef et al., 2022). Throughout the long period of analysis, inflation showed a positive relationship with both the exchange rate and imports but a negative correlation with GDP and real interest rate values. Both theoretical predictions and external and internal market forces confirm the findings displayed in these results.

Research findings receive backing through empirical studies that validate the importance of currency fluctuations along with monetary elements and international trading connections. Research demonstrates that foreign exchange remittances result in lasting price increases, which emphasizes why capital flows matter to economic stability (Sharaf El-Din, 2024). Current literature shows that independent central banks and stable fiscal policies lead to lower inflation rates, according to ElHodaiby and Elsamman (2021). According to Emam (2024)

and Elmoghany (2024), inflation affects how people save money and how financial assets perform, as well as how consumers conduct themselves in the marketplace. The present study agrees with previous observations that demonstrate that inflation functions as a macroeconomic variable that depends on various connecting sectors. Multiple dimensions of inflation can be studied by analyzing the diverse set of financial, structural, and external variables.

The research builds on past studies about Egyptian inflation determinants by combining external factors with internal macroeconomic instruments as outlined in Abonazel and Elnabawy (2020) and Bouyacoub (2022). Detailed empirical evidence shows that inflation depends on currency depreciation together with import dependency and output growth and interest rate variations. The ARDL approach functions as a dependable tool for studying interrelated time-based models (Ponziani, 2023). Recent studies within the framework verify how these research findings are applicable to current economic conditions. An effective inflation management strategy in Egypt should combine policies to address structural inefficiencies with strategies to reduce global price volatility. The obtained results provide essential direction to researchers and policymakers who develop sustainable inflation-control methods.

6. CONCLUSION

The research employed the ARDL bounds testing approach to analyze economic determinants of inflation in Egypt throughout the 1990-2023 period. Research findings demonstrated that exchange rates and imports caused significant inflationary pressure in the economy, yet GDP and real interest rates acted as negative influencing factors on inflation rates. Currency movement creates immediate price increases, whereas real interest rate effects appear with a delay in the short run. Diagnostic tests verified the accuracy of the model structure, and parameter stability examination was performed through the CUSUM test. The cointegration tests demonstrated that the variables continued their long-term relationships. The research outcomes validate the ability of the ARDL model to detect short-term and long-term drivers that affect inflation.

This research makes valuable contributions through its extensive time frame together with robust methodology, and it incorporates external along with internal macroeconomic variables. The authors deepen existing literature that usually conducts research in shorter time spans or with limited indicators through their extensive application of ARDL modeling across three decades. The research findings demonstrate that global price shocks, along with increased reliance on imports, are increasingly shaping the inflation trends in Egypt. The analysis brings forward crucial guidelines for economic planners, which prove beneficial to import-based developing economies. The study provides deeper insights into the numerous causes of inflation that exist between fiscal policy interventions and monetary controls and external economic pressures. The research findings yield implications that influence trade sectors together with financial and social developments.

Multiple restrictive research constraints exist for ARDL methodologies, which affect their capability to process many variables and complex structural elements. Some extreme circumstances might reduce the capacity of the model to explain its results because political shocks and global economic factors are not included. The improvement of inflation forecasting reliability will come from the use of standardized benchmarks alongside dynamic simulation tools. Future inflation research needs to include institutional structures alongside behavioral events with geopolitical variables in order to build adaptable, complete inflation prediction models. Economic modeling powered by AI will experience advancements through prompt engineering coupled with sophisticated econometric tools for policy simulation improvements. Interdisciplinary teamwork between humans and AI systems will shape responsive inflation control strategies for advanced economic frameworks during future operations.

6.1. Recommendation

The analysis of this study advises policymakers to implement specialized monetary policies aimed at stabilizing exchange rates while increasing fiscal and monetary coordination because it helps control external price inflation. The reduction of import dependence requires incentives for local essential goods production through tax benefits together with private-public coordination of supply chain development programs and industrial development programs. Higher interest rates generate substantial deflation, yet the central bank should make interest rate adjustments following real sector data with clear messaging about market expectations. The long-term fight against inflation requires that economic growth work as a control method by implementing resilience plans across national development frameworks, which includes developing productive sectors while training the workforce and expanding infrastructure to achieve supply stabilization. The proposed

recommendations draw their basis from study outcomes to establish macroeconomic stability by implementing multi-sectoral policies, which entail institutional changes across government entities and financial institutions.

6.2. Study Implications and Future Directions

In this research, both theoretical and practical knowledge about inflation in Egypt is advanced through empirically validating that exchange rates, together with imports, GDP, and real interest rates, impact long-run inflation patterns in the country. The analysis demonstrates why fiscal-monetarist coordination demands import substitution strategies for controlling inflation levels. The research results help organizations design economic plans and direct central bank operations to achieve price stability through institutional reforms. Research in the forthcoming years must examine unique sector-level inflation causes and monitor both macroeconomic instability factors and governmental and institutional control fluctuations in their effects on price volatility. Extended research following crisis developments will enhance the comprehension of long-term inflationary frameworks.

6.3. Study Limitations

The study presents strong methodological elements along with a long observation period, yet it contains various constraints that need attention. The research evaluated macroeconomic data while omitting analysis of other possible important metrics, including fiscal deficits, global commodity price shocks, and money supply. The model lacked crucial elements that would explain variations in inflation dynamics because it did not assess structural breaks or political instability that occurred during the thirty years of research. The ARDL approach successfully identifies long-term relationships but lacks features that explain inflation behavior during different economic situations through nonlinear patterns or asymmetric effects.

FUNDING: This work was supported and funded by the Deanship of Scientific Research at Imam Mohammad ibn Saud Islamic University (IMSIU) (Grant Number: IMSIU-DDRSP2504).

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APPENDIX

Table 1: Some Economic Factors in Egypt During the Period (1990-2023).

Years	Inflation	Real Interest Rate	Exchange Rate	GDP	Imports
	%		Egyptian Pound/US dollar	Billion US Dollars	
1990	16.76	1.067535	1.55	43.00	14.00
1991	19.75	3.204639	3.14	37.40	13.20
1992	13.64	1.670925	3.32	41.90	12.90
1993	12.09	9.101241	3.35	46.60	14.00
1994	8.15	7.435419	3.39	51.90	14.60
1995	15.74	4.552158	3.39	60.20	16.70
1996	7.19	7.91322	3.39	67.60	17.70
1997	4.63	3.563453	3.39	78.40	19.50
1998	3.87	10.3919	3.39	84.80	21.80
1999	3.08	11.93582	3.4	90.70	21.10
2000	2.68	8.919601	3.47	99.80	22.80
2001	2.27	11.21451	3.97	96.70	21.60
2002	2.74	10.30003	4.5	85.10	19.30
2003	4.51	6.327026	5.85	80.30	19.60
2004	11.27	1.526903	6.2	78.80	23.30
2005	4.87	6.523641	5.78	89.60	29.20
2006	7.64	4.880797	5.73	107.00	33.90
2007	9.32	-0.07763	5.64	130.00	45.40
2008	18.32	0.107853	5.43	163.00	62.90
2009	11.76	0.710036	5.54	189.00	59.80
2010	11.27	0.818722	5.62	219.00	58.20
2011	10.06	-0.56388	5.93	236.00	58.30
2012	7.11	-6.26272	6.06	279.00	67.90
2013	9.47	3.292157	6.87	288.00	67.40
2014	10.07	0.414129	7.08	306.00	69.30
2015	10.37	1.541068	7.69	329.00	71.30
2016	13.81	6.922011	10.03	332.00	66.20
2017	29.51	-8.75819	17.78	248.00	69.10
2018	14.4	-2.3587	17.77	263.00	73.30
2019	9.15	2.199096	16.77	319.00	78.00
2020	5.04	4.887815	15.76	384.00	75.40
2021	5.21	4.366207	15.64	425.00	81.90
2022	13.9	0.14267	19.16	477.00	104.00
2023	33.88	-5.66131	30.63	396.00	84.50