Asymmetric Exchange Rate Pass-Through Effects on Prices in the Persian Gulf Countries (NARDL Approach)

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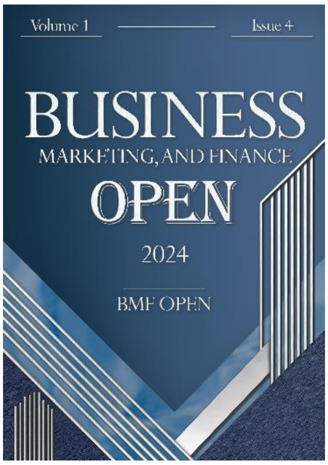

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Abstract: For decades, the exchange rate has held strategic significance in both microeconomic and macroeconomic dimensions of national economies. Exchange rate fluctuations have become a principal determinant in shaping the behavior of markets, governments, households, and firms, continuously directing macroeconomic variables—including inflation, liquidity, production, exports, imports, consumption, investment, aggregate demand, and aggregate supply—toward the formation of new equilibriums. These recurrent transitions toward new equilibriums, in turn, serve as a destabilizing force in the economy. The aim of this study is to conduct a comparative analysis of exchange rate pass-through effects on prices in the Persian Gulf Countries (including Iran, Iraq, Saudi Arabia, the United Arab Emirates, Bahrain, Kuwait, Qatar, and Oman) over the period from 1990 to 2022. Accordingly, to perform a cross-country comparative analysis, the study employs the nonlinear autoregressive distributed lag (NARDL) model. The findings indicate that a positive exchange rate shock (exchange rate appreciation) leads to an increase in prices, while a negative exchange rate shock (exchange rate depreciation) results in a decrease in prices across the Persian Gulf countries, both in the short run and the long run. Therefore, a direct and statistically significant relationship exists between exchange rate shocks and price levels in the the Persian Gulf countries in both time horizons. Furthermore, variables such as the import price index, money supply, and global oil prices exhibit a positive and significant impact on price levels in the the Persian Gulf region in both the short term and long term.

Keywords: exchange rate pass-through, prices, Persian Gulf Countries, NARDL approach.

1. Introduction

In the context of increasing globalization and deeper economic integration, exchange rate fluctuations have become a dominant macroeconomic variable influencing domestic price stability, inflation dynamics, and policy formulation, especially in open and semi-open economies. The degree to which exchange rate changes transmit to domestic prices, known as exchange rate pass-through (ERPT), is a critical component in evaluating the effectiveness of monetary and exchange rate policies. In particular, for oil-exporting and import-dependent economies like those in the Persian Gulf Countries, understanding the ERPT mechanism is essential, as these economies are inherently exposed to both global commodity price shocks and external exchange rate volatility [1, 2].

Exchange rate pass-through refers to the percentage change in domestic prices resulting from a one percent change in the nominal exchange rate. The literature differentiates between complete and incomplete pass-through: the former occurs when exchange rate changes are fully transmitted to domestic prices, while the latter implies only partial transmission [3, 4]. Numerous studies highlight that ERPT is typically incomplete due to pricing-to-market strategies, nominal rigidities, and monetary policy frameworks, especially in emerging and developing economies [5, 6].

A wide body of empirical research investigates the determinants of ERPT, including the degree of economic openness, inflation regimes, currency regimes, import content of consumption, and the credibility of monetary policy authorities [7, 8]. For instance, studies show that countries with low inflation targets and stable monetary environments experience lower pass-through rates due to anchored inflation expectations and policy credibility [2, 9]. On the other hand, in countries with high inflation volatility or limited monetary independence, exchange rate shocks often translate more directly and quickly into domestic price levels [10, 11].

The Persian Gulf countries, comprising Iran, Iraq, Saudi Arabia, the United Arab Emirates, Kuwait, Qatar, Oman, and Bahrain, provide a unique context for investigating ERPT effects. These nations are heavily reliant on imports for consumer and intermediate goods, while their export revenues are predominantly derived from hydrocarbons. This dual dependency creates a situation in which external exchange rate volatility has a magnified impact on domestic inflation and broader macroeconomic stability [12, 13]. Furthermore, given the fixed or quasi-fixed exchange rate regimes adopted by several the Persian Gulf Countries economies—particularly those pegged to the U.S. dollar—their ability to respond to global monetary shocks is often constrained, making the management of ERPT even more complex [4, 6].

Existing evidence points to substantial variation in ERPT across countries and over time. For instance, Balcilar et al. (2020) showed that the pass-through effect in BRICS countries is asymmetric and state-dependent, highlighting the importance of business cycle conditions and inflation environments in shaping the pass-through mechanism [14]. Their findings resonate with the conditions in the Persian Gulf Countries, where oil-price booms and busts can create vastly different macroeconomic environments. Moreover, studies using regime-switching models or variable parameter approaches further validate that ERPT is not constant over time and can be influenced by structural breaks, policy shifts, or external crises [1, 11].

The theoretical foundations of ERPT are rooted in the pricing behavior of exporters and importers. According to the "pricing-to-market" hypothesis, exporters may adjust their mark-ups in response to exchange rate changes rather than allowing prices to fully reflect currency fluctuations, particularly when facing competitive pressure or demand elasticities [3, 9]. Similarly, the "local currency pricing" model suggests that firms may prefer to maintain price stability in the buyer’s currency, which leads to sticky import prices despite currency volatility [4, 8]. In the Persian Gulf Countries markets, where a significant proportion of goods are imported under contracts denominated in foreign currencies, firms often have limited ability to shield domestic prices from currency shocks, making ERPT particularly relevant.

Moreover, the role of oil prices as a transmission channel in the Persian Gulf Countries cannot be overstated. As the primary source of export revenues and fiscal income, oil price fluctuations have a strong bearing on exchange rate policy, liquidity conditions, and inflationary pressures. Recent studies emphasize that global oil price volatility, when interacting with exchange rate movements, can amplify or dampen the overall ERPT depending on the structure of the economy and the responsiveness of monetary authorities [10, 15]. In this regard, understanding the simultaneous effects of exchange rate shocks, oil price changes, and money supply on domestic prices becomes critical for policymakers across the region.

The empirical literature on ERPT in Iran—a representative economy among the Persian Gulf Countries states—provides strong evidence of asymmetry in pass-through effects. Using nonlinear models, researchers have found that positive and negative exchange rate shocks affect domestic prices differently, with depreciation generally exerting a stronger impact than appreciation [11, 16]. This asymmetry is attributed to behavioral biases in consumer expectations, cost-push inflation mechanisms, and the dependence of production on imported intermediate goods. Furthermore, evidence from time-varying parameter models suggests that the pass-through in Iran has increased during periods of macroeconomic instability, sanctions, and monetary loosening [1].

In contrast, research from Turkey and other emerging markets indicates that inflation-targeting regimes can help dampen ERPT by anchoring expectations and enhancing policy credibility. For instance, BaŞ and Kara (2020) reported that Turkey's adoption of inflation targeting has significantly lowered the degree of pass-through from exchange rates to consumer prices, especially in the post-2002 period [5]. These findings hold valuable lessons for Persian Gulf Countries policymakers seeking to modernize their monetary frameworks and enhance the resilience of their economies against external shocks.

The present study aims to fill a significant gap in the literature by systematically comparing the short-term and long-term ERPT across eight the Persian Gulf countries using the Nonlinear Autoregressive Distributed Lag (NARDL) approach. This methodology allows for the differentiation between the effects of positive and negative exchange rate shocks on price levels while accounting for non-linear dynamics and asymmetric responses over time. Furthermore, the study incorporates key explanatory variables such as the Import Price Index (LIPI), broad money supply (LM2), and world oil prices (LWOP), each of which represents critical transmission channels of ERPT in oil-dependent, import-reliant economies.

Building on the empirical frameworks proposed by researchers such as Nasir et al. (2020), who emphasized the role of inflation expectations and policy credibility in moderating pass-through, this study situates the Persian Gulf Countries experience within a broader comparative context [2]. It also draws methodological insights from Lin and Wu (2012), who demonstrated the utility of cointegration-based models in identifying long-run equilibrium relationships in the presence of deflationary and inflationary forces [4].

In doing so, the paper contributes to a nuanced understanding of ERPT by offering empirical evidence on both symmetric and asymmetric transmission effects in the Persian Gulf Countries. It also provides policy-relevant recommendations for macroeconomic stabilization, inflation targeting, and exchange rate regime management. Given the evolving global financial landscape and the strategic economic transformations underway in several the Persian Gulf countries—including diversification plans under "Vision 2030" initiatives—rigorous empirical research on ERPT is both timely and essential.

2. Methodology

This study is applied in nature. The statistical population of this research consists of the Persian Gulf Countries: Iran, Iraq, Oman, Saudi Arabia, Kuwait, the United Arab Emirates, Qatar, and Bahrain. The time period of the study spans from 1990 to 2022. The statistical data were collected based on available records from the World Bank, the International Monetary Fund (IMF), and the Federal Reserve for each relevant variable during the target period. Additionally, documentary research using library methods (including reference books and scholarly articles) was employed. The main analytical tool used in this research is the econometrics software EViews 10.

This study utilizes the Nonlinear Autoregressive Distributed Lag (NARDL) technique. The model specification in this study follows Balsilar et al. (2020), and the econometric model is defined as follows:

$\Delta LCPI\_it = \beta_0 + \beta_1 \Delta LCPI\_it\text{-}k + \beta_2(+) \Delta EXR\_it\text{-}k(+) + \beta_3(-) \Delta EXR\_it\text{-}k(-) + \beta_4 \Delta LIPI\_it\text{-}k + \beta_5 LMS\_it\text{-}k + \beta_6 LWOP\_it\text{-}k + u\_it$

In this model, the symbol Δ indicates the first difference of variables. The term *k* represents the optimal lag length of the system. The coefficients β denote the short-term effects. The term *u_it* is the vector of disturbance error components. The positive sign (+) refers to positive exchange rate fluctuations, while the negative sign (–) refers to negative exchange rate fluctuations.

The variables used in this study include:

CPI (Consumer Price Index): Data for this variable were obtained from the World Bank and the International Monetary Fund. It is a measure of the average change in the prices of goods and services consumed by an average household. This index reflects the inflation experienced by consumers in their daily lives.

EXR (Exchange Rate): Data for this variable were sourced from the International Monetary Fund. The exchange rate is defined as the cost of exchanging one currency for another that an investor intends to purchase. Exchange rates fluctuate constantly due to the ongoing trading of currencies.

IPI (Import Price Index): Data for this variable were obtained from the World Bank. It reflects the price of goods and services entering a country over a specific period of time.

MS (Money Supply): Data for this variable were sourced from the World Bank. Money supply refers to the total amount of cash and cash equivalents, such as savings accounts, circulating in an economy at a given time.

WOP (World Oil Price): Data for this variable were retrieved from the Federal Reserve. The oil price generally refers to the spot trading price per barrel of crude oil based on crude oil benchmarks. In addition to production costs, oil prices are influenced by the type and quality of the crude oil (light or heavy), specific gravity, sulfur content, the location of production, and a variety of economic and political factors that collectively determine the final price.

In this study, the Import Price Index, Money Supply, and World Oil Price serve as long-term transmission channels for the impact of exchange rate shocks on price levels. All variables, except for the exchange rate, are considered in their logarithmic form.

3. Findings and Results

Before estimating the model, it is essential to examine the stationarity of the variables, as non-stationary variables can lead to spurious regression. A variable is considered stationary when its mean and variance are constant over time. In this study, the Augmented Dickey-Fuller (ADF) test is employed to assess stationarity. The results of this test are presented in Table (1).

Table 1. Unit Root Tests

Country	Variable	ADF Statistic (p-value)	Stationarity Level
Iran	LCPI	-2.52 (0.31)	Non-stationary at level
	D(LCPI)	-6.32 (0.00)	Stationary at first difference
	EXR	-0.77 (0.95)	Non-stationary at level
	D(EXR)	-3.58 (0.04)	Stationary at first difference
	LIPI	-1.41 (0.83)	Non-stationary at level
	D(LIPI)	-5.20 (0.00)	Stationary at first difference
	LM2	-1.59 (0.77)	Non-stationary at level

	D(LM2)	-6.04 (0.00)	Stationary at first difference
	LWOP	-2.04 (0.55)	Non-stationary at level
	D(LWOP)	-4.81 (0.00)	Stationary at first difference
Iraq	LCPI	-3.85 (0.02)	Stationary at level
	EXR	-0.75 (0.97)	Non-stationary at level
	D(EXR)	-3.98 (0.02)	Stationary at first difference
	LIPI	-2.97 (0.15)	Non-stationary at level
	D(LIPI)	-4.37 (0.00)	Stationary at first difference
	LM2	-2.05 (0.55)	Non-stationary at level
	D(LM2)	-4.68 (0.00)	Stationary at first difference
	LWOP	-2.04 (0.55)	Non-stationary at level
	D(LWOP)	-4.81 (0.00)	Stationary at first difference
Saudi Arabia	LCPI	-2.59 (0.28)	Non-stationary at level
	D(LCPI)	-4.44 (0.00)	Stationary at first difference
	EXR	-0.97 (0.93)	Non-stationary at level
	D(EXR)	-4.32 (0.00)	Stationary at first difference
	LIPI	-1.21 (0.88)	Non-stationary at level
	D(LIPI)	-4.34 (0.00)	Stationary at first difference
	LM2	-3.73 (0.03)	Stationary at level
	LWOP	-2.04 (0.55)	Non-stationary at level
	D(LWOP)	-4.81 (0.00)	Stationary at first difference
Bahrain	LCPI	-1.87 (0.64)	Non-stationary at level
	D(LCPI)	-4.54 (0.00)	Stationary at first difference
	EXR	-1.58 (0.77)	Non-stationary at level
	D(EXR)	-4.55 (0.00)	Stationary at first difference
	LIPI	-1.83 (0.66)	Non-stationary at level
	D(LIPI)	-5.94 (0.00)	Stationary at first difference
	LM2	-0.75 (0.96)	Non-stationary at level
	D(LM2)	-4.77 (0.00)	Stationary at first difference
	LWOP	-2.04 (0.55)	Non-stationary at level
	D(LWOP)	-4.81 (0.00)	Stationary at first difference
UAE	LCPI	-3.18 (0.10)	Non-stationary at level
	D(LCPI)	-6.81 (0.00)	Stationary at first difference
	EXR	-1.06 (0.91)	Non-stationary at level
	D(EXR)	-4.10 (0.01)	Stationary at first difference
	LIPI	-1.33 (0.86)	Non-stationary at level
	D(LIPI)	-5.73 (0.00)	Stationary at first difference
	LM2	-1.80 (0.67)	Non-stationary at level
	D(LM2)	-5.69 (0.00)	Stationary at first difference
	LWOP	-2.04 (0.55)	Non-stationary at level
	D(LWOP)	-4.81 (0.00)	Stationary at first difference
Kuwait	LCPI	-2.66 (0.25)	Non-stationary at level
	D(LCPI)	-4.73 (0.00)	Stationary at first difference
	EXR	-2.00 (0.57)	Non-stationary at level
	D(EXR)	-6.28 (0.00)	Stationary at first difference
	LIPI	-1.63 (0.75)	Non-stationary at level
	D(LIPI)	-4.94 (0.00)	Stationary at first difference
	LM2	-1.44 (0.82)	Non-stationary at level
	D(LM2)	-6.64 (0.00)	Stationary at first difference
	LWOP	-2.04 (0.55)	Non-stationary at level
	D(LWOP)	-4.81 (0.00)	Stationary at first difference
Oman	LCPI	-1.99 (0.58)	Non-stationary at level
	D(LCPI)	-4.45 (0.00)	Stationary at first difference

	EXR	-1.16 (0.90)	Non-stationary at level
	D(EXR)	-4.16 (0.01)	Stationary at first difference
	LIPI	-1.48 (0.81)	Non-stationary at level
	D(LIPI)	-5.13 (0.00)	Stationary at first difference
	LM2	-0.96 (0.95)	Non-stationary at level
	D(LM2)	-4.18 (0.01)	Stationary at first difference
	LWOP	-2.04 (0.55)	Non-stationary at level
	D(LWOP)	-4.81 (0.00)	Stationary at first difference
Qatar	LCPI	-2.55 (0.30)	Non-stationary at level
	D(LCPI)	-4.92 (0.00)	Stationary at first difference
	EXR	-1.52 (0.79)	Non-stationary at level
	D(EXR)	-3.79 (0.03)	Stationary at first difference
	LIPI	-1.10 (0.91)	Non-stationary at level
	D(LIPI)	-4.76 (0.00)	Stationary at first difference
	LM2	-0.81 (0.95)	Non-stationary at level
	D(LM2)	-4.28 (0.04)	Stationary at first difference
	LWOP	-2.04 (0.55)	Non-stationary at level
	D(LWOP)	-4.81 (0.00)	Stationary at first difference

Note: p-values are shown in parentheses. "D" indicates the first difference. All variables are in logarithmic form except EXR.

According to the results of the Augmented Dickey-Fuller unit root test, in the countries of Iran, Bahrain, the United Arab Emirates, Kuwait, and Qatar, all variables are non-stationary at level and become stationary after first differencing. In Iraq, all variables except the Consumer Price Index (CPI)—which is stationary at level—are non-stationary at level and become stationary at first difference. In Saudi Arabia, all variables except the money supply (which is stationary at level) are non-stationary at level and become stationary after first differencing.

Therefore, since the unit root test results show that in most the Persian Gulf Countries, the majority of the variables are non-stationary at level but become stationary after one differencing, it is necessary to conduct cointegration tests for all the Persian Gulf Countries to prevent the risk of spurious regression.

Following the stationarity analysis of variables for the Persian Gulf Countries, the short-term coefficients, cointegration test, and long-term coefficients were estimated sequentially for the model and for all the Persian Gulf Countries. The results of the short-term coefficient estimations are presented in Table 2.

Table 2. Short-Term Coefficient Estimations for All the Persian Gulf Countries

Country	Variable	Coefficient	t-statistic	p-value
Iran	LCPI(-1)	1.05	7.74	.000
	EXR_POS	0.23	4.00	.000
	EXR_POS(-1)	0.29	4.95	.000
	EXR_NEG	–0.15	–4.19	.000
	EXR_NEG(-1)	–0.12	–3.85	.000
	LIPI	0.11	4.12	.000
	LM2	0.17	4.25	.000
	LWOP	0.15	4.19	.000
	C	0.16	4.35	.000
	R^2	.99		
Iraq	LCPI(-1)	0.98	12.26	.000
	EXR_POS	0.25	4.37	.000
	EXR_POS(-1)	0.24	4.47	.000
	EXR_NEG	–0.23	–4.15	.000
	EXR_NEG(-1)	–0.20	–4.44	.000
	LIPI	0.09	4.01	.000

	LM2	0.15	4.19	.000
	LWOP	0.17	4.17	.000
	C	5.90	17.73	.000
	R^2	.99		
Saudi Arabia	LCPI(-1)	1.01	3.79	.000
	EXR_POS	0.23	3.74	.000
	EXR_POS(-1)	0.22	3.73	.000
	EXR_NEG	–0.22	–3.75	.000
	EXR_NEG(-1)	–0.20	–3.72	.000
	LIPI	0.10	3.74	.000
	LM2	0.17	3.65	.010
	LWOP	0.19	3.56	.000
	C	7.94	15.23	.000
	R^2	.99		
Bahrain	LCPI(-1)	2.24	4.68	.000
	EXR_POS	0.25	4.99	.000
	EXR_POS(-1)	0.24	4.73	.000
	EXR_NEG	–0.23	–4.40	.000
	EXR_NEG(-1)	–0.23	–4.61	.000
	LIPI	0.19	3.80	.010
	LM2	0.20	4.88	.000
	LWOP	0.16	4.12	.030
	C	2.64	4.88	.000
	R^2	.99		
UAE	LCPI(-1)	0.42	6.99	.000
	EXR_POS	0.24	4.32	.000
	EXR_POS(-1)	0.21	4.19	.000
	EXR_NEG	–0.23	–4.10	.000
	EXR_NEG(-1)	–0.22	–4.41	.000
	LIPI	0.16	3.69	.000
	LM2	0.28	4.99	.000
	LWOP	0.26	4.76	.000
	C	23.70	5.72	.000
	R^2	.93		
Kuwait	LCPI(-1)	0.67	6.91	.000
	EXR_POS	0.21	4.93	.000
	EXR_POS(-1)	0.27	4.41	.000
	EXR_NEG	–2.29	–4.71	.000
	EXR_NEG(-1)	–1.53	–4.79	.000
	LIPI	0.14	4.32	.000
	LM2	0.22	4.31	.000
	LWOP	0.16	4.53	.000
	C	4.43	4.18	.000
	R^2	.99		
Oman	LCPI(-1)	0.36	7.33	.000
	EXR_POS	0.25	4.01	.000
	EXR_POS(-1)	0.25	4.11	.000
	EXR_NEG	–0.23	–4.15	.000
	EXR_NEG(-1)	–0.21	–4.79	.000
	LIPI	0.20	4.31	.000
	LM2	0.20	4.84	.000
	LWOP	0.20	5.17	.000
	C	6.08	5.99	.000

	R^2	.99		
Qatar	LCPI(-1)	0.68	3.52	.000
	EXR_POS	0.20	3.97	.000
	EXR_POS(-1)	0.20	3.76	.000
	EXR_NEG	–0.20	–3.68	.000
	EXR_NEG(-1)	–0.20	–3.94	.000
	LIPI	0.16	3.68	.000
	LM2	0.15	3.64	.000
	LWOP	0.17	3.91	.000
	C	2.55	4.86	.000
	R^2	.99		

The above table indicates that a positive exchange rate shock (i.e., currency depreciation) leads to a rise in the Consumer Price Index (CPI) and overall domestic prices in Iraq and other the Persian Gulf countries in the short run. Conversely, a negative exchange rate shock (i.e., currency appreciation) results in a decrease in the CPI and general price levels in the same countries during the short term. Therefore, it can be concluded that there is a direct and statistically significant short-term relationship between exchange rate shocks and the CPI, which reflects the price dynamics in the Persian Gulf Countries.

Furthermore, the variables Import Price Index (LIPI), Money Supply (LM2), and World Oil Prices (LWOP) also exhibit positive and significant short-term effects on the CPI in Iraq and the other Persian Gulf Countries (Iran, Saudi Arabia, Bahrain, UAE, Kuwait, Oman, and Qatar).

The R-squared (R^2) values for the models in all the Persian Gulf Countries —except the UAE—are 0.99, indicating a high explanatory power. This suggests that the explanatory variables (positive and negative exchange rate shocks, import prices, money supply, and oil prices) account for 99% of the variance in the target variable, namely the CPI, which represents domestic price levels in these countries in the short run.

In the case of the UAE, the R^2 value is 0.93, which also indicates strong explanatory power. The model explains 93% of the changes in CPI, or domestic prices in the UAE, based on the selected explanatory variables.

Given that most variables in the unit root test for the Persian Gulf Countries were found to be non-stationary at level but became stationary after first differencing, it is necessary to perform a cointegration test to avoid spurious regression. In this study, the Bounds Test is applied to determine whether a long-run equilibrium relationship exists among the variables. If cointegration is established, it confirms the presence of a long-term equilibrium relationship between the variables under study.

In the NARDL model, after calculating the value of the F-statistic and extracting the relevant critical bounds for the model in the Bounds Test, one of the following three decisions is made regarding the presence or absence of cointegration among the variables:

1. If the value of the F-statistic falls between the lower and upper critical bounds, the test result is inconclusive.
2. If the value of the F-statistic is greater than the upper critical bound, the null hypothesis of no cointegration among the variables is rejected, and the alternative hypothesis suggesting the existence of a long-term relationship among the variables is accepted.
3. If the value of the F-statistic is less than the lower critical bound, the null hypothesis of no cointegration among the variables cannot be rejected.

The results of the Bounds Test for cointegration are presented in the following table:

Table 3a. Bounds Test for Cointegration

Country	F-statistic
Iran	5.40
Iraq	5.64
Saudi Arabia	6.23
Bahrain	6.61
UAE	5.20
Kuwait	7.99
Oman	6.07
Qatar	6.05

Table 3b. Critical Values for Bounds Test

Significance Level	Lower Bound	Upper Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

According to the results in the table above, since the F-statistics in all countries exceed the upper bound critical values, the existence of a long-term relationship among the variables is confirmed for all the Persian Gulf Countries.

Following the examination of stationarity and cointegration among the variables for the Persian Gulf Countries, long-term coefficients for the model were estimated for each of these countries. The results of the long-term estimations are presented in the table below:

Table 4. Long-Term Coefficient Estimates for the Persian Gulf Countries

Country	Variable	Coefficient	t-statistic	p-value
Iran	EXR_POS	1.23	6.22	.000
	EXR_NEG	-1.21	-6.00	.000
	LIPI	0.95	3.95	.000
	LM2	0.96	4.09	.000
	LWOP	1.07	4.33	.000
Iraq	EXR_POS	1.39	6.12	.000
	EXR_NEG	-1.24	-5.92	.000
	LIPI	1.17	4.12	.000
	LM2	1.23	4.12	.000
	LWOP	1.42	5.12	.000
Saudi Arabia	EXR_POS	1.02	5.09	.000
	EXR_NEG	-1.00	-4.11	.000
	LIPI	1.50	4.30	.000
	LM2	1.27	3.93	.000
	LWOP	2.31	7.37	.000
Bahrain	EXR_POS	1.60	4.06	.000
	EXR_NEG	-1.61	-4.06	.000
	LIPI	1.27	3.81	.000
	LM2	1.21	3.92	.000
	LWOP	2.43	5.14	.000
UAE	EXR_POS	1.21	6.13	.000
	EXR_NEG	-1.20	-3.28	.000
	LIPI	1.19	3.35	.030
	LM2	1.37	5.36	.000
	LWOP	1.13	3.75	.000
Kuwait	EXR_POS	1.23	4.10	.000
	EXR_NEG	-1.15	-3.96	.020

	LIPI	1.24	4.55	.000
	LM2	1.24	3.72	.000
	LWOP	2.00	4.28	.000
Oman	EXR_POS	1.21	3.65	.020
	EXR_NEG	-1.24	-3.94	.010
	LIPI	1.20	3.91	.000
	LM2	1.21	3.93	.000
	LWOP	2.44	4.50	.000
Qatar	EXR_POS	1.22	4.91	.000
	EXR_NEG	-1.20	-4.11	.000
	LIPI	1.20	5.35	.000
	LM2	1.23	4.18	.000
	LWOP	2.20	4.17	.000

Based on the results in the table above, it can be concluded that positive exchange rate shocks (i.e., currency depreciation) lead to a long-term increase in prices across the Persian Gulf Countries. Likewise, negative exchange rate shocks (i.e., currency appreciation) cause a long-term decrease in prices. Therefore, a direct and statistically significant long-term relationship exists between exchange rate shocks and the Consumer Price Index (CPI), which serves as an indicator of domestic price levels in these countries.

If, due to economic policy interventions or other factors, the exchange rate increases, the resulting currency depreciation influences prices through various channels. Since a significant share of imports includes consumer goods, capital goods, and raw materials needed by factories, both wholesale and retail prices rise. This leads to increased prices of imported consumer goods and higher production costs for domestic products.

On the other hand, an appreciation of the domestic currency (i.e., a decrease in the exchange rate) makes domestic goods more expensive for local buyers. This shift results in increased imports and reduced aggregate demand. Consequently, a decline in domestic demand contributes to a reduction in domestic price levels.

The Import Price Index (LIPI) has a positive and statistically significant long-term impact on price levels in the Persian Gulf Countries. When domestic retailers import final consumer goods, an increase in the exchange rate first raises the prices of these imported goods and the import price index. Eventually, this effect is transmitted to the consumer level, raising domestic prices and the CPI. If domestic producers use imported intermediate goods, the same chain of effects occurs—initially raising the import price index and production costs, which then elevates consumer prices.

The Money Supply Index (LM2) also has a positive and significant long-term impact on prices in the Persian Gulf Countries. An increase in the exchange rate leads to a nominal rise in asset values, which stimulates higher demand for money. To meet this demand, banks may increase the money supply, often through overdrafts from central banks. As a result, the CPI and inflation increase. Rising inflation, in turn, fuels market anxiety and prompts asset conversion—especially into durable goods like gold and foreign currency. This behavior reinforces the exchange rate–inflation feedback loop, which becomes a self-reinforcing cycle unless effectively managed through appropriate policy measures. Exchange rate changes also raise money demand among production firms, and their liquidity needs compel the monetary system to expand money supply—whether through direct banking mechanisms or indirectly via rising interest rates in open markets. This creates pressure to convert quasi-money to money, influencing the money-to-liquidity ratio and introducing instability unless tightly controlled.

Lastly, global oil prices (LWOP) show a positive and significant long-term correlation with price levels in the Persian Gulf Countries. From a macroeconomic perspective, higher oil prices increase the costs borne by firms for producing and transporting goods and services. Indirectly, this raises production, distribution, and operational costs. Firms often transfer these increased costs to consumers, leading to broader inflation. Additionally, rising oil prices elevate the cost of petroleum-based products (e.g., plastics) and transportation, contributing to higher consumer prices across sectors.

After examining the stationarity of variables and estimating the coefficients, several diagnostic tests were conducted to verify the accuracy of coefficient estimations and the validity of classical regression assumptions. The Portmanteau and Breusch-Godfrey LM tests were used to detect autocorrelation, the Jarque–Bera test to assess normality, and the ARCH test to detect heteroskedasticity of residual error terms. The results of these tests for each model are presented in Table 5.

Table 5. Diagnostic Test Results for the Persian Gulf Countries

Country	Test	Test Statistic	p-value
Iran	ARCH	0.10	.75
	Jarque–Bera	2.10	.34
	LM	0.25	.61
	Portmanteau	0.27	.60
Iraq	ARCH	0.23	.63
	Jarque–Bera	2.45	.29
	LM	1.17	.21
	Portmanteau	3.09	.07
Saudi Arabia	ARCH	0.13	.71
	Jarque–Bera	1.90	.38
	LM	2.14	.19
	Portmanteau	5.81	.11
Bahrain	ARCH	0.05	.81
	Jarque–Bera	1.51	.46
	LM	0.61	.48
	Portmanteau	1.86	.71
UAE	ARCH	0.32	.57
	Jarque–Bera	0.62	.73
	LM	0.90	.36
	Portmanteau	1.14	.28
Kuwait	ARCH	0.04	.83
	Jarque–Bera	0.27	.87
	LM	4.43	.06
	Portmanteau	4.78	.51
Oman	ARCH	0.44	.50
	Jarque–Bera	0.88	.64
	LM	1.19	.29
	Portmanteau	1.67	.19
Qatar	ARCH	0.02	.87
	Jarque–Bera	0.90	.63
	LM	3.01	.11
	Portmanteau	4.20	.14

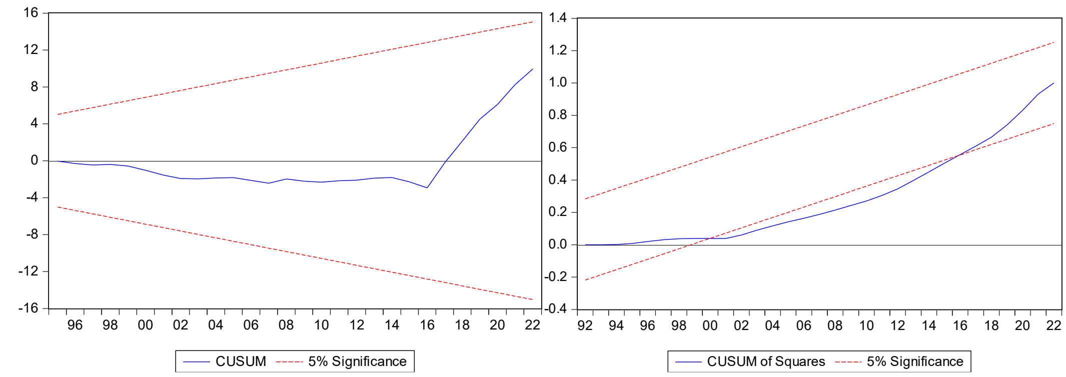
The Portmanteau test was used to detect autocorrelation. The Breusch–Godfrey LM test was also used for autocorrelation detection. The Jarque–Bera test was applied to test for normality of residuals. The ARCH test was used to detect heteroskedasticity in the residual terms.

According to the results in Table 5, the diagnostic tests for all the Persian Gulf Countries indicate no evidence of autocorrelation or heteroskedasticity, as the p-values of the Portmanteau, LM, and ARCH tests are greater than 0.05, leading to non-rejection of the null hypotheses. The Jarque–Bera test also shows that the residuals in all countries are normally distributed, as the corresponding p-values are above 0.05, confirming no violation of the normality assumption.

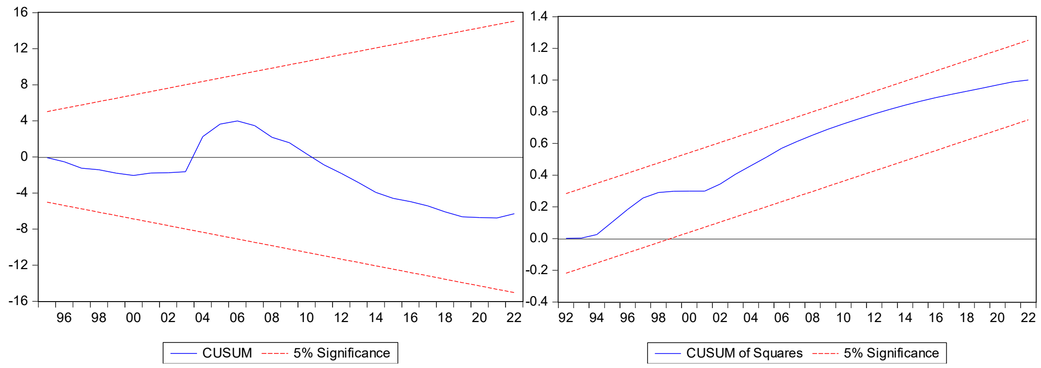
In regression model estimation, it is implicitly assumed that parameters remain constant over the entire sample period. However, if a significant event—such as a war—occurs during the study period, it may cause structural breaks in the data, altering the slope, intercept, or both. The implicit assumption that the slope and intercept are the same before and after a break point can be statistically tested using parameter stability tests.

The results of the CUSUM and CUSUMSQ tests for checking the parameter stability over time for all the Persian Gulf Countries are presented in Figure 1.

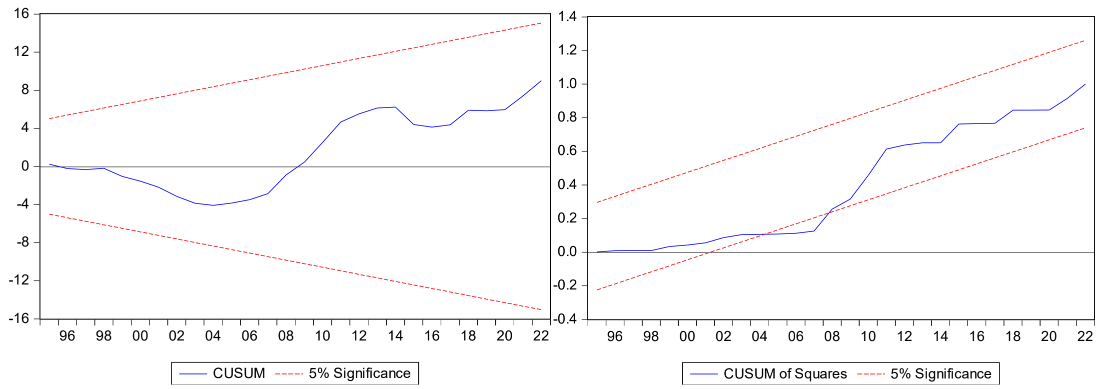
Iran



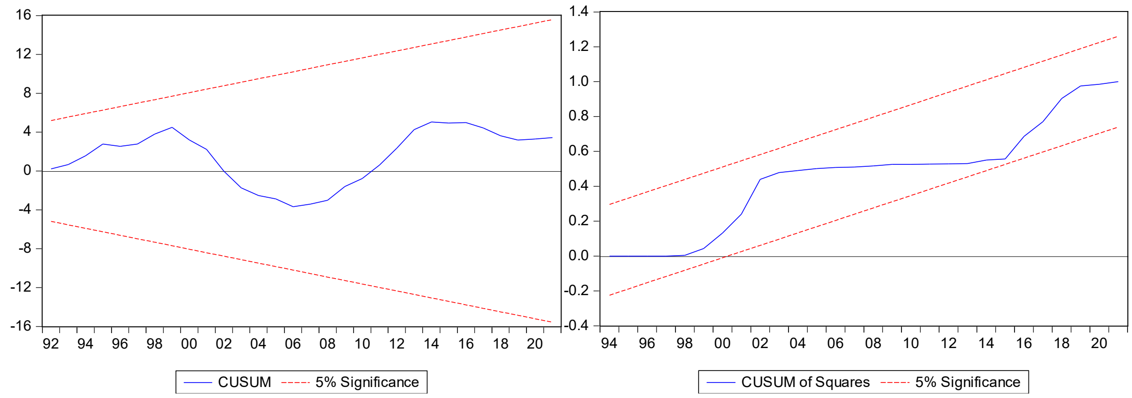
Iraq



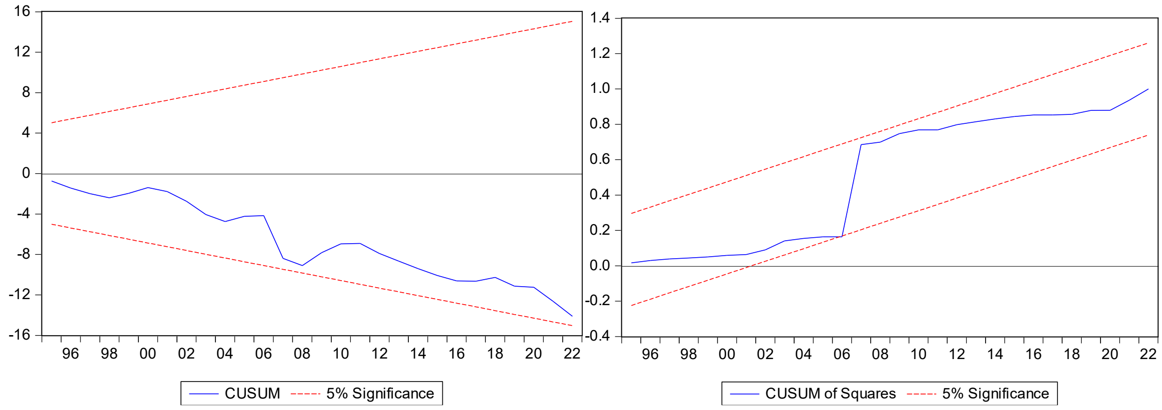
Saudi Arabia



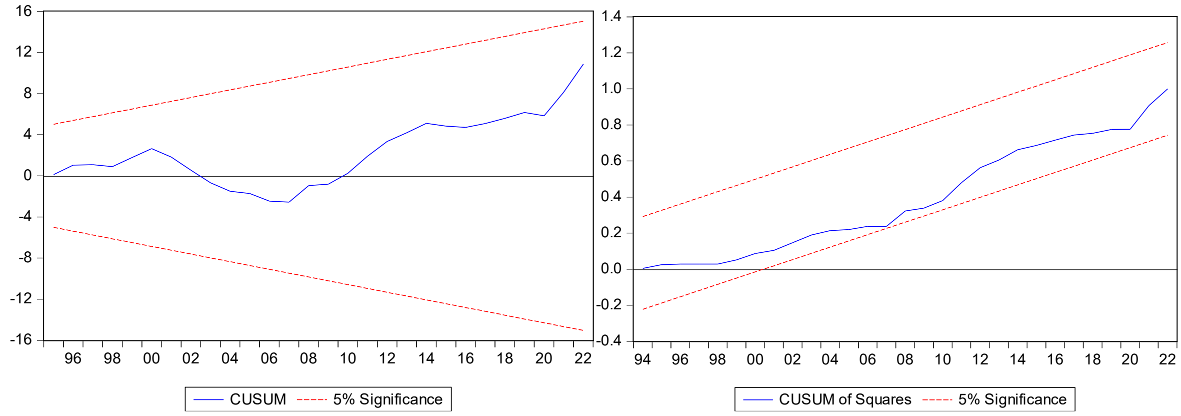
Bahrain



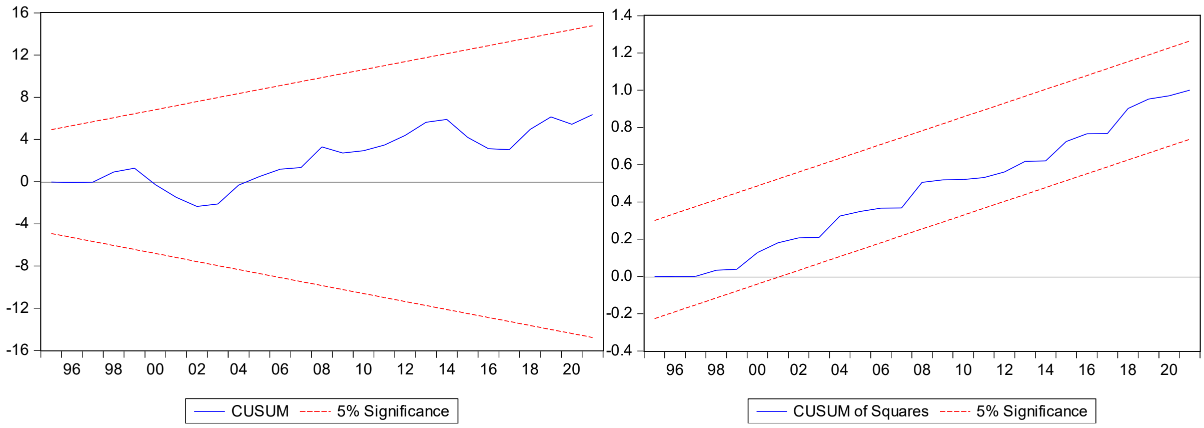
UAE



Kuwait



Oman



Qatar

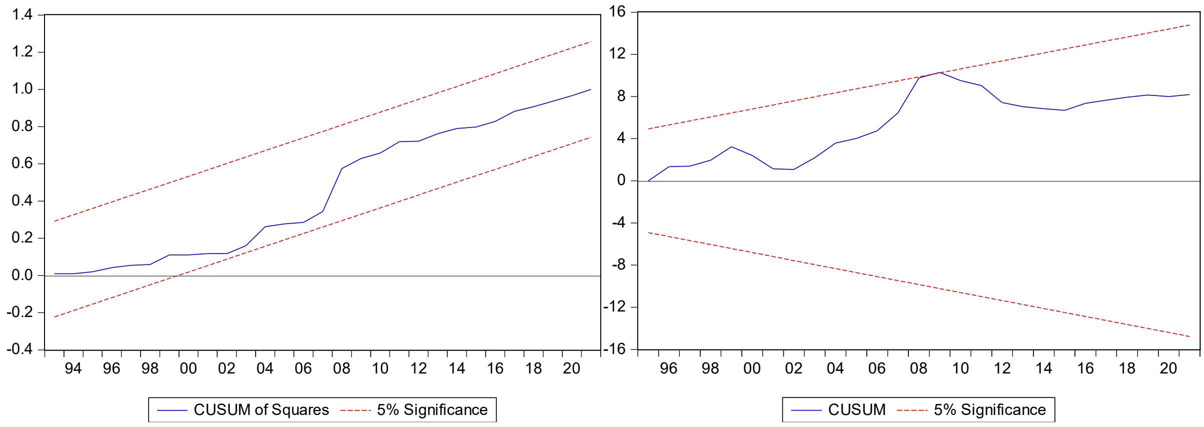


Figure 1. **CUSUM and CUSUMQ Stability Tests for the Persian Gulf Countries**

In the CUSUM test, for all countries, the parameters remained within the 95% confidence bounds, meaning the null hypothesis of parameter stability is accepted. Thus, the estimation results are reliable and valid at the 5% significance level, confirming stable coefficient estimates and the absence of structural breaks.

In the CUSUMSQ test, parameters for some countries—such as Saudi Arabia and Iran—briefly exceeded the 5% threshold, but later returned within the 10% confidence level and ultimately converged toward the 5% line in the long run, indicating an overall confidence level of approximately 90%. Therefore, it can be concluded that the model and estimated coefficients exhibit sufficient stability across all the Persian Gulf Countries.

4. Discussion and Conclusion

The results of this study offer comprehensive insights into the short-term and long-term asymmetric effects of exchange rate pass-through (ERPT) on consumer prices across eight the Persian Gulf Countries, using the Nonlinear Autoregressive Distributed Lag (NARDL) approach. In the short term, the findings demonstrate a significant and positive relationship between exchange rate depreciations and consumer prices in all the Persian Gulf Countries. Conversely, appreciations in the exchange rate exhibit a smaller and less intense effect in reducing prices, confirming the presence of asymmetric ERPT in the region. These findings are consistent with empirical studies in other emerging markets, such as those reported for Iran, where asymmetric responses to positive and negative exchange rate shocks have been found to be statistically significant and economically relevant [11, 16].

The long-run estimations reaffirm the positive and statistically significant effect of exchange rate depreciations on domestic prices in the Persian Gulf Countries. This sustained effect indicates that in economies characterized by high import dependency, depreciations in the domestic currency exert continued upward pressure on prices through increased import costs, production expenses, and consumer prices. This result aligns with the findings of Pham (2019), who documented strong long-term ERPT in the Vietnamese economy, especially during periods of persistent depreciation and external vulnerability [6]. Similarly, in the Iranian context, long-term ERPT has been found to be robust and persistent, particularly under regimes of monetary expansion and currency instability [1].

Importantly, the asymmetry in the ERPT is evident in the fact that exchange rate appreciations—despite being statistically significant—yield a relatively smaller impact in reducing consumer prices. This confirms prior theoretical and empirical assertions regarding downward price rigidities and the tendency of firms to adjust upward more rapidly than downward in response to cost changes [3, 9]. The pricing-to-market behavior and monopolistic competition among importers may further explain this phenomenon, where firms are reluctant to pass on cost savings to consumers even when the exchange rate improves.

The inclusion of the Import Price Index (LIPI), broad money supply (LM2), and world oil prices (LWOP) as control variables in the model sheds light on important transmission channels of ERPT. Across all countries, the LIPI exhibited a significant and positive impact on domestic prices, reaffirming that the imported inflation component is substantial in economies reliant on foreign intermediate and consumer goods. These findings are in line with those of Çulha et al. (2019), who emphasized the role of import prices in shaping Turkey's inflation dynamics through external price pressures [7]. In the Persian Gulf Countries context, this relationship is particularly acute given the limited diversification of domestic production and the reliance on imported goods for both consumption and industrial input.

Likewise, the money supply (LM2) showed a strong and positive correlation with the Consumer Price Index (CPI) in both the short and long term, indicating that monetary expansion contributes to inflationary pressures in the Persian Gulf Countries economies. This finding echoes the results of Nasir et al. (2020), who concluded that monetary policy credibility and inflation expectations play a significant role in determining the magnitude of ERPT in small open economies with inflation-targeting frameworks [2]. In countries where monetary policy is less responsive to inflationary trends, or where fiscal dominance undermines the autonomy of central banks, money supply growth tends to reinforce the inflationary effects of currency depreciation.

The effect of global oil prices (LWOP) on consumer prices was also found to be positive and statistically significant, which is intuitive in the Persian Gulf Countries setting where oil revenues significantly affect fiscal space, public expenditure, and liquidity. Higher oil prices may contribute to increased domestic demand, relaxed monetary conditions, and cost-push inflation via fuel and transportation costs. These findings support the theoretical propositions made by Rady et al. (2024) on the dual influence of commodity price shocks and exchange rate volatility on domestic markets, especially in resource-rich nations [15].

Furthermore, the Bounds cointegration test confirmed the existence of a long-term equilibrium relationship among the variables for all countries, indicating the robustness of the model and the consistency of the variables' interactions over time. The significance of the CUSUM and CUSUMQ tests for structural stability in the estimated coefficients validates the assumption that, despite short-term volatilities or regional shocks, the long-term parameters governing ERPT in the Persian Gulf Countries remain stable and reliable. However, slight deviations observed in the CUSUMQ graphs for Iran and Saudi Arabia hint at the potential influence of structural events such as sanctions or geopolitical conflicts, which could merit deeper investigation.

From a comparative perspective, the magnitude of ERPT observed in the Persian Gulf Countries mirrors those reported for other oil-exporting nations and developing economies. For instance, Balcilar et al. (2020) reported strong state-dependent pass-through effects in BRICS countries, where macroeconomic conditions such as inflationary regimes and GDP gaps modulate the extent of ERPT [14]. Similarly, BaŞ and Kara (2020) found that Turkey's ERPT was substantially higher in periods of exchange rate volatility and economic instability, reaffirming the relevance of macroeconomic environment in shaping price dynamics [5].

In contrast, economies with more advanced monetary institutions and credible inflation-targeting regimes have experienced more moderate pass-through effects. Lin and Wu (2012) noted that Taiwan's experience with ERPT was notably subdued during deflationary periods, underscoring the buffering role of central bank communication and anchored expectations [4]. This contrast provides policy lessons for the Persian Gulf Countries, particularly as several member states are reforming their fiscal and monetary frameworks under diversification plans like Saudi Arabia's Vision 2030.

The present findings hold several important implications. First, the strong and asymmetric ERPT in the Persian Gulf Countries suggests that exchange rate management and import dependence jointly determine inflation sensitivity. Policymakers aiming to stabilize domestic prices must consider the trade-offs between currency devaluation (as a tool to boost competitiveness) and its inflationary consequences. Second, the significant role of money supply and oil prices in inflation transmission calls for coordinated monetary-fiscal frameworks that can dampen external shocks while maintaining liquidity discipline. Third, given the asymmetric nature of ERPT, supply-side policies aimed at increasing domestic production capacity and reducing dependency on imports could structurally mitigate the pass-through intensity over time.

This study, while comprehensive in its scope and methodology, is subject to several limitations. First, the use of aggregate national-level data may obscure sector-specific variations in exchange rate sensitivity. For instance, tradable goods may exhibit stronger ERPT than services or regulated sectors, but such disaggregation was beyond the scope of this analysis. Second, the assumption of structural stability—though supported by diagnostic tests—may not fully capture abrupt regime shifts, such as policy overhauls, war, or sanctions, that may influence both exchange rate behavior and inflation transmission mechanisms. Third, although the NARDL model effectively captures asymmetry and nonlinearity, it does not fully account for potential threshold effects or nonlinear interactions among explanatory variables, which could be better addressed using more advanced machine learning or structural VAR models.

Future research could benefit from several extensions. One promising direction involves applying the NARDL model at a more disaggregated level—across sectors or commodities—to better understand heterogeneous ERPT effects within each the Persian Gulf Countries economy. Another avenue is to incorporate additional macroeconomic variables such as interest rates, fiscal balances, or exchange rate regimes to assess their interaction effects. Additionally, future work could explore the role of expectations and credibility—perhaps through survey-based inflation expectations—to evaluate how forward-looking behavior alters pass-through dynamics. Comparative studies between the Persian Gulf Countries and other oil-exporting regions such as Sub-Saharan Africa or Latin America could also enhance the external validity of findings.

Policymakers in the Persian Gulf Countries should consider implementing inflation-targeting frameworks that incorporate ERPT monitoring as a core diagnostic tool. Strengthening central bank independence and transparency can also improve credibility, thereby anchoring inflation expectations and reducing pass-through intensity. Investment in domestic production capabilities—particularly in strategic industries such as food processing, pharmaceuticals, and construction materials—can reduce reliance on imports and enhance resilience to exchange rate shocks. Finally, financial instruments such as forward contracts or currency hedging strategies could be promoted among firms to mitigate the direct impact of exchange rate volatility on input costs and final prices.

Authors' Contributions

Authors equally contributed to this article.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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