Print ISSN: 2288-4637 / Online ISSN 2288-4645
doi:10.13106/jafeb.2023.vol10.no1.0079

Asymmetric Relationship between Inflation and Remittance Outflows in Saudi Arabia: A NARDL Approach*

Musa FOUDEH[1], Bashier AL-ABDULRAZAG[2]

Received: October 10, 2022 Revised: January 06, 2023 Accepted: January 15, 2023

Abstract

The paper aims to investigate the asymmetric long-run and short-run relationships between inflation and remittance outflows in the Kingdom of Saudi Arabia (hereafter KSA) over the period 1971−2019 by using the Nonlinear Autoregressive Distributed Lag (NARDL) model. The statistical tests have supported the validity and stability of the model. The Wald *F*-test statistics confirm the existence of a long-run equilibrium relationship among the model variables; remittance outflows, positive (negative) shocks in inflation rates, investment, real GDP, and trade openness. Moreover, the empirical results confirm the existence of an asymmetric effect of the inflation rate on remittance outflows. The response of foreign workers to an increase in inflation rates differs from their response to a decrease in inflation rates. However, this asymmetric relationship between the increases/decreases in inflation and remittance outflows is significantly weak. The weakness of this relationship is due to the high marginal remittance propensity of migrant workers, which is explained by the low consumption propensity of foreign workers and their ability to adjust to the high cost of living due to inflation and the imposition of accompanying fees. Finally, the change in the inflation rate is not among the main factors influencing foreign remittance decisions in Saudi Arabia.

Keywords: Saudi Arabia, Asymmetric Relationship, NARDL, Inflation, Remittances

JEL Classification Code: O53, O40, C21, C23, G53

1. Introduction

Remittances are considered a leakage of financial resources from labor-receiving countries to sending countries. Recently, a strand of thinking focused on ways that might reduce this leakage, such as encouraging expatriates to increase their spending in domestic markets and participate in financial markets, among others. The inflation rate in remitting countries has always been considered one of the most important factors influencing the economic decisions of migrant workers. In addition, it is to be noted that all previous studies concerning receiving economies or remitting ones dealt with the relationship between remittances and inflation from the point of view of receiving countries, which is the effect of remittances on the inflation rate. Examining the previously reviewed literature on the remitting countries, especially in GCC and Saudi Arabia case, we can notice that it focuses on the influence of remittances on inflation (Narayan et al., 2011; Taghavi, 2012; Termos et al., 2013; Al-Kaabi, 2016; Haddad & Choukir, 2017). Yet, the reverse influence has not received much of the researchers' attention; that is, the influence of inflation on the remittance outflows was not explicitly investigated. There is a growing controversial issue of whether the increase in the cost of living due to the

***Acknowledgments:**
The authors extend their appreciation to the Deanship of Scientific Research, Imam Mohammad Ibn Saud Islamic University (IMSIU), Saudi Arabia, for funding this research work through Grant No. (221411008).

[1]First Author and Corresponding Author. Associate Professor, Department of Economics, Imam Mohammad Ibn Saud Islamic University, Saudi Arabia. ORCID ID: 0000-0002-5418-5341. [Postal Address: Imam Mohammad Ibn Saud Islamic University, P.O. Box 5701, Riyadh 11432, Saudi Arabia] Email: musa_foudeh@hotmail.com
[2]Professor, Economic Department of Economics, College of Business Administration, King Saud University, Saudi Arabia. ORCID ID: 0000-0003-4553-7795. Email: basheerf@yahoo.com

price increase would reduce remittance outflows from Saudi Arabia. Al-Abdulrazag and Foudeh (2022) were among the pioneers to bridge the research gap on remittance outflows in Saudi Arabia. They examined the impact of inflation in KSA on remittance outflows. They. They employed the ARDL cointegration model using annual data over the period (from 1971−2019). Although their empirical study revealed the existence of a negative short-run and long-run relationship between inflation rates and remittance outflows, it didn't explain the nature of this relationship.

The inflation rate in remitting countries has always been among the important factors affecting the economic decisions of migrant workers. Recently, the GCC countries in general, and Saudi Arabia in particular, have become aware of the great importance of reducing remittance outflows to their economies. This study examines the long-term and short-term asymmetric relationships between remittance outflows and inflation rates. It is worth noting that most of the economic literature focuses on studying the asymmetric effect of oil prices on remittance inflows in receiving countries (Makhlouf & Kasmaoui, 2018; Akçay & Karasoy, 2019; Abbas, 2020). Few have attempted to investigate the nature of the relationship between oil prices and remittances in sending countries (De et al., 2019; Akçay, 2019; Akçay, 2021; Abbas, 2020) and receiving countries (Akçay & Karasoy, 2019; Zahran, 2019). However, none of them has examined the asymmetric effect of inflation on remittance outflows in remitting countries in general and in Saudi Arabia in particular. Based on the main result of Al-Abdulrazag and Foudeh (2022) and Javid and Hasanov (2022) who found that inflation in Saudi Arabia reduced remittance outflows, this study examines the long-run and short-run asymmetric impact of inflation rates on remittance outflows in Saudi Arabia for the period 1970−2019, specifically, the effect of positive (negative) changes in inflation on remittance outflows. This procedure is in the context of testing for the symmetric/asymmetric relationship between inflation and remittance outflows. The main hypothesis of this study is that there is an asymmetric relationship between inflation and remittance outflows in Saudi Arabia. That is to say, the effect of a positive shock on the inflation rate differs from that of a negative shock. For this purpose, the study employs the (NARDL) approach to test for the hypothesized asymmetric relation between the two variables over the period (1971−2019).

This paper contributes to the existing economic literature in various aspects. First, to the best knowledge of the researchers, it is the first attempt that investigates the symmetric/ asymmetric relationship between inflation and remittance outflows in KSA by applying the NARDL approach. Second, it might help Saudi policymakers predict the behavior of remittance outflows in response to positive or negative innovations in the general price level. Third, it is hoped that this study opens the door for future research that can use different advanced estimation techniques to confirm the results obtained by our study.

The construction of the study is as follows: the introduction, section 2 reviews the most relevant empirical studies addressing the nature of the relationship between remittance outflows and inflation. The NARDL model, the econometric method of estimation, and the model's variables are presented and described in section 3. This is followed by the results in section 4. Finally, the discussion of the results and conclusion are presented in section 5.

2. Literature Review

There is a huge body of literature related to inflation, such as its relation with major macroeconomic factors, for example, unemployment (Wulandari et al., 2019), price fluctuations (Echchabi1 & Azouzi, 2017), economic growth (Ngoc, 2020; Dinh, 2020), oil price (Liaqat et al., 2022), Remittances inflows/outflows (Zahran, 2019; Al-Abdulrazag & Foudeh, 2022). However, the major of applied literature reviews concerning remittance outflows from GCC countries in general and Saudi Arabia, in particular, focused on the effect of oil prices rather than the effect of inflation rates due to the important share of oil revenues in these oil-producing countries. They depend heavily on oil, and hence, oil prices play a major role in determining all other major macroeconomic factors. Akçay (2021) was a pioneer study to examine the symmetric/asymmetric effect of oil prices on remittance outflows in Saudi Arabia over the period (1980−2018). Employing the NARDL model, he concluded that: (i) There is an asymmetric long-run relationship between oil prices and remittance outflows; and (ii) positive shocks in oil prices significantly influence remittance outflows, whereas negative shocks have an insignificant impact. However, this study was not the first regarding the GCC countries, as the same researcher Akçay (2019) had conducted a study two years earlier to answer the main question: Does oil price asymmetrically impact remittance outflows in Oman over the period (1975−2015)?

The estimated NARDL model revealed the presence of an asymmetric association between oil prices and remittance outflows in the long and short term. Namely, positive innovations in oil prices promoted remittance outflows, while negative shocks didn't show any significant impact. These results align with De et Al. (2019), who found that remittance outflows from GCC countries toward Mashreq, Pakistan, and Yemen were modestly affected by large oil price declines, but they recovered quickly after oil price increases. Abbas (2020) employed the advanced non-linear panel Pooled Mean Group (PMG) model, to study the relationship between oil prices and remittances from GCC countries to Pakistan over the period 1980−2018. His results were similar to other researchers as there was an

asymmetric association between oil prices and remittances. Moreover, in the context of receiving countries, Akçay and Karasoy (2019) found an asymmetric association between oil prices and India's remittance inflows in both the short and long run using the NARDL model over the period 1975−2017. Zahran (2019) applied a VAR model to study the dynamic response of remittance inflows in Egypt to different oil price shocks for the period 1960−2016. His results revealed that remittance inflows respond asymmetrically to changes in oil prices. The empirical findings indicate that oil price increases are less influential than oil price decreases.

It can be noted that all previous recent studies agree that there is a non-linear relationship between remittances and oil price variations, whether for receiving or sending countries. In this regard, it is interesting to mention that an asymmetric relationship has been found also between oil prices and food price inflation in Malaysia by Ibrahim (2015), who applied the NARDL model. A significant long-run relation between oil price increases and food prices was found. In the meantime, there was no significant long-run relation between oil price decreases and the food price.

Based on the foregoing, our study will be the first to examine the hypothesis of the existence of an asymmetric relationship between inflation and remittance outflows of foreign worker rates in Saudi Arabia.

3. Econometric Model and Methodology

The paper utilizes the recent Non-linear Autoregressive Distributed Lag Model (NARDL) introduced by Shin et al. (2014) to investigate the symmetric/asymmetric relation between inflation and remittance outflows over the long run as well as the short run in Saudi Arabia. It is an asymmetric extension of the linear (ARDL) cointegration model, which does not consider the possibility that negative and positive variations of independent variables can affect differently the explicative variable. In addition, The NARDL model allows the detection of the asymmetric effects and permits testing for cointegration in a single equation framework. Moreover, this model presents some advantages, which have been previously explained, over other cointegration techniques used frequently (Carlos, 2017).

The remittance outflows-inflation nexus relationships are usually investigated by employing various estimation methods; cointegration, Error-correction model ECM, VCEM, Granger-Causality, and ARDL among others. In general, one common feature of these estimation techniques is that they carry on the estimation on the assumption of symmetric relation between the model variables, in our case remittance outflows and inflation among others (Ibrahim, 2015). However, one drawback of such estimation techniques is that they cannot capture the potential asymmetries in the remittance outflows dynamics due to among others the presence of inflation.

The NARDL methodology has some advantages over the traditional econometric approaches modeling used in economic applied research, (for example, the Error Correction Model (ECM), and the threshold (ECM)) (Shawkat et al., 2014). In addition, the NARDL model does not require that the time series must be stationary from the same order. Additionally, it performs better when testing for cointegration in small samples and permits to identification precisely between the presence of cointegration, linear cointegration, and non-linear cointegration (Katrakilidis & Trachanas, 2012). Moreover, it is suitable for testing for cointegration in small samples (Romilly et al., 2001).

Since the objective of the study is to examine the nature of the relationship between remittance outflows and inflation rate, relying on the previously applied research of Al-Abdulraza and Foudeh (2022) and following Shin et al. (2014), a specification of an asymmetric long run model describing the relation between inflation and remittance outflows is constructed in the following algorithmic form:

$$\mathrm{LREM}_t = \alpha_0 + \alpha_1 \mathrm{LZ}_t + \alpha_2 \mathrm{INF}_t^+ + \alpha_3 \mathrm{INF}_t^- + \varepsilon_t \quad (1)$$

Where, INF_t, is the inflation rate, Rem_t is the remittance outflow, Z_t is a ($k \times 1$) vector of control variables, and $\alpha = (\alpha_0 + \alpha_1 + \alpha_2 + \alpha_3)$ is a cointegrating (a vector of long-run parameters to be estimated). In addition, INF_t^+ (INF_t^-) is the positive (negative) effect of inflation on remittance outflows, and INF_t^+ (INF_t^-) is the partial sums process that accumulates positive (negative) changes. ε_t is the normally distributed error term.

According to Shin et al. (2014), the NARDL model is built around the following asymmetric long-run equilibrium relationship, where the effect of INF_t is decomposed into these effects:

$$\mathrm{INF}_t = x_o + \mathrm{INF}_t^+ + \mathrm{INF}_t^- \quad (2)$$

x_o is a random initial variable,

$$\mathrm{INF}_t^+ = \sum_{i=1}^{t} \Delta \mathrm{INF}_j^+ = \sum_{t=1}^{t} \max(\Delta \mathrm{INF}_j, 0) \quad (3)$$

$$\mathrm{INF}_t^- = \sum_{i=1}^{t} \Delta \mathrm{INF}_j^- = \sum_{t=1}^{t} \min(\Delta \mathrm{INF}_j, 0) \quad (4)$$

The NARDL setting is a cointegration test that employs positive and negative partial sum decompositions, enabling the detection of the long-run and short-run asymmetric effects. It allows for a joint investigation of nonstationary and nonlinearity in the setting of an unrestricted error correction model. From Equation (1), $\alpha_2 > 0$ captures the long-run relation between inflation increases and remittance outflows. Meanwhile, $\alpha_3 < 0$ captures the long-run relation

between remittance outflows and inflation decreases. It is posited that the inflation increases will result in higher long-run changes in remittance outflows as compared to the impact of inflation decreases of the same magnitude, i.e. $\alpha_2 > \alpha_3$. Thus, the long-run association presented by Equation (1) indicates asymmetric long-run inflation pass through to remittance outflows.

Following the general form of the NARDL model introduced by Shin et al. (2014), equation (1) can be formulated as:

$$\begin{aligned}\Delta \mathrm{REM}_t = {} & \beta_0 + \beta_1 \mathrm{REM}_{t-i} + \beta_2 X_{t-1} + \beta_3 \mathrm{INF}^+_{t-1} + \beta_4 \mathrm{INF}^-_{t-1} \\ & + \sum_{i=1}^{p} \gamma_i \Delta \mathrm{REM}_{t-i} + \sum_{i=1}^{K} \theta_i \Delta x_{t-i} + \sum_{i=0}^{q} (\varphi_i^+ \Delta \mathrm{INF}^+_{t-1} \quad (5) \\ & + \varphi_i^- \Delta \mathrm{INF}^-_{t-1}) + \lambda \mathrm{ECT}_{t-1} + \varepsilon_t\end{aligned}$$

Where all variables are described in equation (5), *K*, *p* and *q* are lags order. The long-run parameters coefficients $(\beta_3 = -\varphi_i^+ / \beta_1, \beta_4 = -\varphi_i^- / \beta_1)$ are the long-run effects of inflation increases and decreases on remittance outflows respectively. $\sum_{i=0}^{q} \varphi_i^+$ captures the short-run effect of increases in inflation on remittance outflows, where as $\sum_{i=0}^{q} \varphi_i^-$ captures the short-run effect of decreases in inflation on remittance outflows. $\gamma_i, \theta_i, \varphi_i^+$ and φ_i^- are the estimated parameters that represent the error correction dynamics in the short run. The model specification of Equation (5) indicates the asymmetric short-run impact as well as the asymmetric long-run effects of inflation on remittance outflows.

ECT is the error correction term. It is OLS residuals obtained from the long-run estimated cointegration model. While λ is the speed of adjustment indicating how quickly variables parameters return to equilibrium in long term (λ is expected to be negative and significant). It is ideal if it lies between 0 and −1. The more it is to −1 stronger the equilibrium is but its significance is a must (Foudeh, 2022).

In carrying out the process of estimating the equation (5), there are a certain number of steps needed to be followed. The first step involves testing for the order of integration of variables by using the well-known and widespread technique of the Augmented Dicky-Fuller (ADF) proposed by Dicky and Fuller (1981) to ensure none of the variables is I(2) since its presence causes the invalidity of cointegration. The second step involves estimating equation (5) by implementing the NARDL method. In the third step, we test the possible existence of long-run equilibrium relationships between variables using the bounds-testing approach of Pesaran et al. (2001). This can be done by using the Wald *F*-statistic test of the null hypothesis of no cointegration $H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$, as opposed to the alternative $H_0 : \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$.

The *F*-test considers the stationarity properties of the variables. Specifically, the test follows the same procedures as in the case of ARDL using Pesaran et al. (2001) to compute bounds for the critical values at any significance level. In short, if the *F* statistic is higher (lower) than the upper (lower) bound critical value, the null hypothesis of no cointegration is rejected (accepted) at the significance level we are considering the bounds values. However, if the *F* statistic falls between the two bounds, the inference remains inconclusive (Mahmoudinia et al., 2013), and other cointegration tests like Johansen must be used (Carlos, 2017).

The final step involves testing for the presence of long-run and short-run asymmetry between inflation and remittance outflows by using the Wald test. In particular, the null hypothesis of long-run no asymmetry $H_0 : \beta_3 = \beta_4$ against the alternative hypothesis $H_1 : \beta_3 \neq \beta_4$. On the other hand, the short-run adjustment to positive and negative shocks of inflation affecting the remittance outflows can be examined by the null hypothesis of no asymmetry $H_0 : \varphi_i^+ = \varphi_i^-$ against the alternative hypothesis of asymmetry $H_1 : \varphi_i^+ \neq \varphi_i^-$.

4. Results and Discussion

4.1. The Set of Study Variables

Following Al-Abdulrazag and Foudeh (2022), we will use the same dependent and independent variables for the period (1971−2019). These variables are presented as follows:

- LREM_t: Log of remittance outflows / GDP at the time (t), is the dependent variable.
- LREM_{t-1}: The Log of lags dependent variable (explicative variable).
- INF_t^+: Partial sums process, which accumulates positive changes in inflation rates (The main independent variable).
- INF_t^-: Partial sums process, which accumulates negative changes in inflation rates (the main independent variable).
- X_t: Other explicative variables (control variables) at the time (t):
- LGDPC: Log of gross domestic product at constant prices.
- LGF Log of gross fixed capital formation.
- LOPEN: Log of Exportation + Importation / GDP (The degree of economy openness).
- Dum1: Is the breakpoint of remittance outflows in 2015

4.2. Descriptive Analysis

Figure 1 shows that the movement of remittance outflows (REMIT) with positive changes in inflation rates is different from its movement with negative changes in inflation rates. We can remark that the (INF^-) move over time in the opposite direction of the movement of remittances, widening the gap

between the two curves, while the (INF^+) move almost in the same direction, narrowing the gap between them. This gives us a preliminary indication of a non-linear long-run relationship between inflation rates and remittance outflows in KSA. This figure is elaborated by the authors based on the World Bank dataset. To make the comparison possible, the inflation rates (positive and negative) were multiplied by 1000.

4.3 Unit Root Test

The outputs of Phillips-Perron (1988) and Augmented Dickey-Fuller (1979) tests reported in Table 1 indicate the integration of order I(0) or I(1) for all the variables. The ADF breakpoint unit root test (not reported) was run and it suggested similar results. The two conditions to apply the ARDL model are respected (Pesaran et al., 2001):

1. The dependent variable must be integrated from the first difference I(1).
2. None of the variables are I(2). The ADF breakpoint unit root test (not reported) was run, and it suggested similar results.

4.4 NARDL Estimation Results

To check if the negative and positive variations of the inflation rate have a different effect on the remittance outflows in KSA, the NARDL approach will be applied. We let Eviews9 automatically select the optimal model using the Akaike info criterion method by fixing the maximum number of lags at 4 lags for the dynamic dependent and independent variables of the study. The dummy variable and the constant are fixed regressors.

Table 2 shows the relative fit of the goodness of the estimated model through the highest adjusted R^2 (0.975). It means that the model explains 97% of the variation in the remittance outflows. The high significance of the *F*-statistic (85.46) completely negates any existence of a spurious

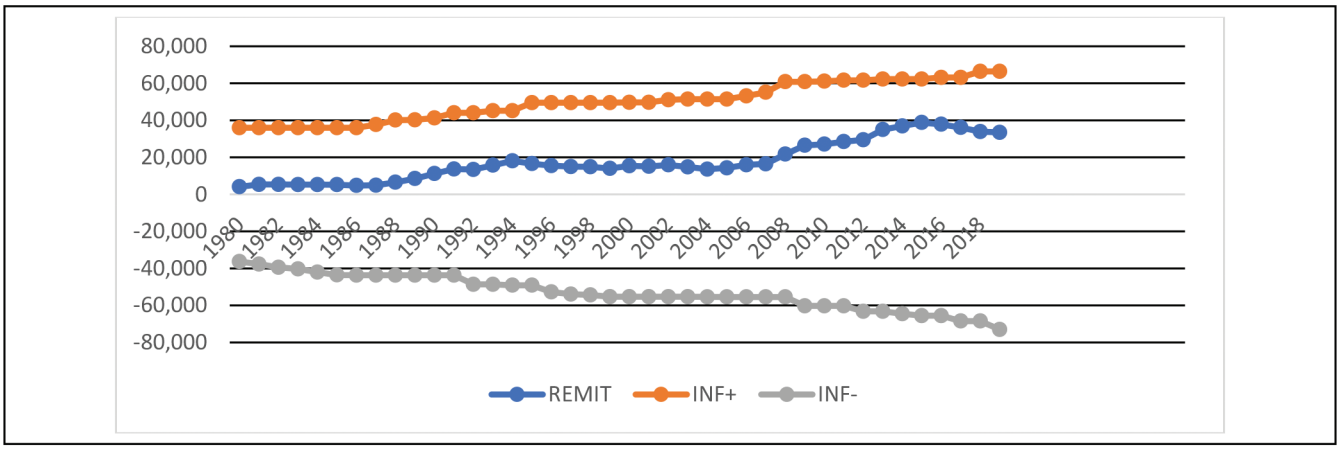

Figure 1: The Evolution of Remittance Outflows with Positive Increases and Negative Decreases of Inflation Rates in the KSA (1980–2019)

Table 1: Unit Root Tests (Model with Constant and Linear Trend)

Null hypothesis: The Series has a Unit Root (Not Stationary)						
	Phillips-Perron			ADF		
Variables	**Level**	**1st Diff.**	**Integration**	**Level**	**1st Diff.**	**Integration**
LREMITGDP	–1.256	–5.09***	I(1)	–1.550	–5.278***	I(1)
INF	–2.704	–4.925***	Q11111111111111	–2.506	–4.952***	I(1)
LCPI	–3.499*	–5.677***	I(1)	–4.55***		I(0)
LGDPC	–2.843	–5.595***	I(1)	–2.961	–3.742**	I(1)
LOPEN	–2.924	–9.520***	I(1)	–2.035	–7.033***	I(1)
LGF	–3.54**		I(0)	–4.566***		I(0)

***, **, & *Significant at 1%, 5%, and 10% respectively. ADF-Fischer Chi-square & PP-Fischer Chi-square are left-hand side rejection areas.

Table 2: Optimal Model Lags (1971−2019)

Dependent Variable: LREMIT/GDP			**Method: ARDL**	
Selected Model: ARDL(3, 3, 3, 4, 2, 0)				
Variables	**Coefficient**	**Std. Error**	***t*-statistic**	**Prob.***
LREMIT(−1)	0.614612	0.117913	5.212412	0.0000
LREMIT(−2)	0.089465	0.147912	0.604858	0.0007
LREMIT(−3)	−0.439417	0.141299	−3.109843	0.0049
INF_POS	0.005812	0.004449	1.306279	0.2044
INF_POS(−1)	0.001839	0.006319	0.290989	0.7737
INF_POS(−2)	−0.011389	0.005312	−2.143898	0.0428
INF_POS(−3)	0.012388	0.004459	2.778203	0.0107
INF_NEG	−0.010029	0.003882	−2.583639	0.0166
INF_NEG(−1)	−0.002374	0.004787	−0.495957	0.6246
INF_NEG(−2)	0.012771	0.004612	2.769199	0.0109
INF_NEG(−3)	−0.014851	0.003233	−4.593464	0.0001
LGDPC	0.180529	0.282495	0.639054	0.5291
LGDPC(−1)	0.108873	0.327489	0.332447	0.7426
LGDPC(−2)	0.096350	0.312037	0.308778	0.7603
LGDPC(−3)	0.264857	0.310728	0.852375	0.4028
LGDPC(−4)	−1.032736	0.270124	−3.823191	0.0009
LOPEN	−1.384954	0.228634	−6.057519	0.0000
LOPEN(−1)	1.167950	0.281981	4.141946	0.0004
GF	−0.643934	0.216017	−2.980948	0.0067
DUM1	−0.118851	0.057080	−2.082197	0.0486
C	10.58564	2.481522	4.265785	0.0003
R-squared	0.987348	Mean dependent var		0.729365
Adjusted *R*-squared	0.975795	S.D. dependent var		0.231154
S.E. of regression	0.035963	Akaike info criterion		−3.506067
Sum squared resid.	0.029746	Schwarz criterion		−2.622810
Log-likelihood	100.8865	Hannan-Quinn criterion.		−3.176797
F-statistic	85.46817	Durbin-Watson stat		2.067182
Prob(*F*-statistic)	0.000000			

*p-values and any subsequent tests do not account for model selection.

relationship between the study variables. Durbin-Watson statistic, which is very near to two (2.06) indicates no possible autocorrelation between the residuals.

4.4.1. NARDL Bounds Test to Cointegration

Table 3 reports the cointegration test for NARDL specification. The computed *F*-statistics (9.01) is beyond the upper bounds at 1% and 5% critical values, indicating the existence of a long-run equilibrium relationship between the set of underlying variables.

4.4.2. NARDL Long Run and Short Run Estimation Results

First of all, Table 4 shows that the error correction term λ equals (−0.735) and it is significant at a 1% level, enhancing the result obtained from the NARDL Bounds Test for the

Table 3: NARDL Bounds Test for Cointegration**:** H_0**:** No Long-Run Relationship

Test Statistic	**Value**	***k***	**Included Observations**
F-statistic	9.015	5	45
Critical Value Bounds	Significance	I_0 Bound	I_1 Bound
	5%	2.62	3.79
	1%	3.41	4.68

Table 4: The Estimation of the Short and Long-Run NARDL

Dependent Variable: LREMIT/GDP				
Selected Model: ARDL(2, 3, 3, 0, 3, 3, 2) Sample: 1971−2019				
Included observations: 45				
Cointegrating Form				
Variable	**Coefficient**	**Std. Error**	***t*-statistic**	**Prob.**
D(LREMIT(−1))	0.349952	0.146566	2.387677	0.0256
D(LREMIT(−2))	0.439417	0.141299	3.109843	0.0049
D(INF_POS)	0.005812	0.004449	1.306273	0.2044
D(INF_POS(−1))	0.011389	0.005312	2.143898	0.0428
D(INF_POS(−2))	−0.012388	0.004459	−2.778203	0.0107
D(INF_NEG)	−0.010029	0.003882	−2.583639	0.0166
D(INF_NEG(−1))	−0.012771	0.004612	−2.769199	0.0109
D(INF_NEG(−2))	0.014851	0.003233	4.593464	0.0001
D(LGDPC)	0.180529	0.282495	0.639054	0.5291
D(LGDPC (−1))	−0.096350	0.312037	−0.308778	0.7603
D(LGDPC (−2))	−0.264857	0.310728	−0.852375	0.4028
D(LGDPC (−3))	1.032736	0.270124	3.823191	0.0009
D(LOPEN)	−1.384954	0.228634	−6.057519	0.0000
D(LOPEN(−1))	−0.280431	0.214408	−1.307931	0.2038
D(GF)	−0.643934	0.216017	−2.980948	0.0067
D(DUM1)	−0.118851	0.057080	−2.082197	0.0486
CointEq(−1)	−0.735340	0.165028	−4.455845	0.0002
Cointeq = LREMITGDP − (0.0118 * INF_POS − 0.0197 * INF_NEG − 0.5197 *LGDPC + 0.0863 * LOPEN − 0.8757 * GF − 0.1616 * DUM1 + 14.3956)				
Long Run Coefficients				
Variables	**Coefficient**	**Std. Error**	***t*-statistic**	**Prob.**
INF_POS	0.011764	0.005641	2.0085359	0.0483
INF_NEG	−0.019696	0.003993	−4.933239	0.0001
LGDPC	−0.519660	0.372845	−1.393772	0.1767
LOPEN	0.086254	0.230563	0.374104	0.7118
GF	−0.875697	0.136307	−6.424451	0.0000
DUM1	−0.161627	0.076518	−2.112273	0.0457
C	14.395579	3.292474	4.372268	0.0002

existence of a long-run relationship among variables. This implies that 74% of any movements into disequilibrium are corrected within one period.

Second, the long-run coefficients in Table 4 reveal that the coefficient of positive increases (INF+) has a positive sign (0.011) and it is significant at a 5% level, while the parameter of negative decreases (INF−) has a significant negative sign (−0.019). The opposite signs of the long-run coefficients concerning the effects of inflation increases and inflation decrease on remittance outflows in KSA lead us to reject the null hypothesis underlying the existence of the asymmetric relationship. In addition, the results obtained from the Wald tests in Table 6 reject the null hypothesis of the equality of the positive innovation and negative innovation coefficients in the long term only, confirming the non-linear relationship between INF and REMT.

Third, the diagnostic tests for Heteroscedasticity, Autocorrelation, Normality, and Stability in Table 5 assure the validity and stability of the estimated model. The Breusch-Pagan-Godfrey test indicates that the null hypothesis of homoscedasticity can't be rejected for all the lagged models. The Lagrange Multiplier test shows the absence of an autocorrelation problem between residuals. Jarque-Bera test indicates that errors are normally distributed, while the Ramsey RESET test confirms that the model is well specified. In addition, the plot of the Cumulative sum of Recursive Residuals and the plot of CUSUM of Squared Residuals that the coefficients of the regression are not changing systematically or suddenly. Thus, we can't reject the null hypothesis of no problem of functional form misspecification, indicating the stability of the estimated parameters.

5. Discussion

The NARDL long-run estimated parameter associated with the positive changes in inflation rates INF_t^+ has a significant positive sign, while the negative changes in inflation rates INF_t^+ has a significant negative sign. The results obtained from the Wald test reject the null hypothesis of the equality of the positive innovation coefficients and negative innovation coefficients in long term only which is in line with the results obtained by Akçay (2019), who also found an asymmetric relationship between oil prices and remittance outflows but only in the long-run. The study confirms the existence of an asymmetric relationship between general price increases/decreases and remittance outflows. In other words, the effect of a positive shock to the inflation rate in Saudi Arabia differs from that of a negative shock to inflation, confirming the results obtained by the descriptive analysis in Figure 1 showing that (INF^+) curve moves over time in the same direction as the remittance outflows curve, while negative changes in inflation rates (INF^-) move in the opposite direction of the movement of the remittances curve.

Table 5: Residuals and Diagnostic Tests for the NARDL Model

A: Heteroscedasticity	B: Autocorrelation	C: Normality	D: Ramsey RESET	E: Stability
***F*-statistic Prob. ( )**	***F*-statistic Prob. ( )**	**Jarque-Bera Prob. ( )**	***F*-statistic Prob. ( )**	**Stability**
1.697 (0.109)	1.474 (0.251)	0.406 (0.816)	1.765 (0.197)	CUSUM of RR CUSUM of SR

***Significant at 1%; **Significant at 5%.

A: Breusch-Pagan-Godfrey test regresses the squared residuals on the original regressors;
H_0: No heteroscedasticity

B: Lagrange multiplier test of residual serial correlation.
H_0: No autocorrelation between residuals.

C: Jarque-Bera value based on a test of Skewness and Kurtosis of residuals.
H_0: Normal distribution of residuals.

D: Ramsey RESET test;
H_0: The model is correctly specified.

E: Structural stability test for the NARDL model.
H_0: Parameters are stable.

Table 6: Results of Asymmetric Short Run and Long Run Tests

Wald Test	*F*-statistic	Prob.	*t*-statistic	Prob.
Short run	1.52	0.2294	−1.23	0.229
Long run	13.37***	0.0003	3.66***	0.0013

*** Significant at 1%; ** Significant at 5%; * Significant at 10%.

Moreover, the existence of the asymmetric relationship between inflation increases/decreases and remittance outflows agrees with several previous studies that showed a non-linear relationship between oil prices and remittance outflows/inflows in both remitting countries and receiving countries (Akçay, 2021, 2019; Abbas, 2020; De et Al., 2019; Akçay & Karasoy, 2019; Zahran, 2019).

The empirical results show a weak positive significant parameter associated with the positive changes in INF, implying that an increase in inflation rates by 10 percentage points will increase remittance outflows by only 0.1% in the long term. However, the weak negative significant parameter associated with the negative changes in INF implies that a 10% decrease in INF will lead to a 0.19% increase in remittance outflows in the long term. These results are consistent with the main result obtained by Al-Abdulrazag and Foudeh (2022) and Javid and Hasanov (2022), who found that an increase in inflation rate by 10% would decrease remittance outflows by only 3.2%. Although they found this weak relationship between the inflation rate and remittances using the ARDL model, they did not provide a full economic explanation for the real cause of this weak relationship. In other words, why were foreign workers in Saudi Arabia always able to adjust their consumption patterns to rising prices over time? Thus, the price level increase in the host country (KSA) had a limited effect on the level of foreign labor remittances to their home countries. According to the theoretical analysis of Al-Abdulrazag and Foudeh (2022), consumption is the most important component of the demand side through which remittance outflows are influenced. The consumption Bill of foreign workers accounts for most of the migrants' overall spending. Accordingly, the marginal propensity to consume for foreigners in Saudi Arabia is much less than the long-run marginal propensity to consume among Saudi citizens which was estimated by Al-Gahtani et al. (2019) at (0.95). They indicated that the long-run MPC might vary from 0.5 to 0.9, depending on the economy and the type of consumers.

Since the marginal propensity to consume (b) for migrants who live in KSA is small compared to Saudis Javid and Hasanov (2022), this necessarily means that their marginal propensity to save (1-b) is large, which helps them transfer a large portion of their income to their home countries. This implies that the marginal propensity to remit is high as there is a positive relationship between the marginal propensity to save and the marginal propensity to remit. Our analysis is in line with the conclusion made by IMF Country Report No. 12/272 (Sep 2012) "The marginal propensity to remit in Saudi Arabia is high for both skilled and unskilled migrants. Unskilled migrants are normally associated with a higher propensity to remit, as they are financially constrained and typically leave their families back home" page 27. Docquier et al. (2012) found that immigration policies in the GCC caused skilled migrants in these countries to remit more than they would in other countries.

However, since July 2017, the Saudi government has begun applying a gradually accompanying final objective fee of 4,800 riyals annually for each family member related to migrant workers who reside in Saudi Arabia. This governmental measure constituted a huge burden on skilled foreign workers, forcing many of them to return to their families homes. According to study analysis, these new fees reduced the marginal propensity to consume for foreigners leading to a decrease in their consumption bills. Therefore, skilled workers have increased their tendency to send more money abroad weakness furthermore the negative relationship between inflation and outward remittances over time. The study analysis goes against what Javid and Hasanov (2022) indicated in their discussion section: "Migrant workers cannot send more money back and their home countries if the cost of living increases in the Kingdom".

On the contrary, foreign workers have proven their ability to adapt to the high cost of living and the imposition of high accompanying fees because a large part of them succeeded in getting rid of these fees by sending their families back to their countries.

The decrease in the value of remittances is due to reasons other than the rise in general prices, such as the decrease in the number of foreign workers in Saudi Arabia. It should be emphasized that between the end of 2016 and the end of the year 2019, about one million foreigners left the workforce in Saudi Arabia (World Bank, 2020). This is in line with the government's new policy to replace foreign workers with Saudi workers who suffer from unemployment.

6. Conclusion

This study is considered a pioneer in examining the nature symmetric and asymmetric relationship between inflation and remittance outflows in KSA over the period 1971 to 2019 by employing the NARDL estimation approach. This model enabled us to capture responses of the remittance outflows in KSA to positive INF_t^+ and negative INF_t^- shocks in inflation as the independent variables along a set of other control supposed to influence the remittance outflows. The results of Phillips-Perron and Augmented Ducky-Fuller tests show that all the variables of the study are either stationary from the level or the first difference. None is integrated from the second difference.

The existence of a long-run equilibrium relationship among the variables of this study is proven by the significant calculated *F*-statistics which is beyond the upper bounds concerning the NARDL Bounds Test for Cointegration and confirmed also by the negative significant error correction terms (λ).

The main finding in this study of weak responses of foreigners' remittances to any changes in general price levels in Saudi Arabia implies that the inflation rates (positive changes or negative changes) aren't considered among the major factors that influence foreign remittance decisions. Despite the weak responses, the results show that the behavior of foreign workers in response to an increase in inflation rates differs from their behavior to a decrease in inflation rates concerning their remittances abroad. Therefore, the monetary policymakers in Saudi Arabia should take this finding into their consideration, especially when they take measures to reduce foreign remittances abroad.

References

Abbas, S. (2020). Impact of oil prices on remittances to Pakistan from GCC countries: Evidence from panel asymmetric analysis. *OPEC Energy Review*, *44*(2), 205−223. https://doi.org/10.1111/opec.12180

Akçay, S. (2019). Does oil price asymmetrically impact remittance outflows? The case of Oman. *Review of Middle East Economics and Finance*, *15*(2), 1−9. https://doi.org/10.1515/rmeef-2019−0012

Akçay, S., & Karasoy, A. (2019). The Asymmetric impact of oil prices on remittances: Evidence from India. *OPEC Energy Review*, *43*(3), 362−382. https://doi.org/10.1111/opec.12162

Akçay, S. (2021). Are oil prices and remittance outflows asymmetric? Evidence from Saudi Arabia. *Energy Research Letters*, *2*(1), 948. https://doi.org/10.46557/001c.18948

Al-Abdulrazag, B., & Foudeh, M. (2022). Does inflation reduce remittance outflows in Saudi Arabia? *Cogent Economics and Finance*, *10*(1), 1−23. https://doi.org/10.1080/23322039.2022.2141424

Al Gahtani, G., Bollino, C. A., Bigerna, S., & Pierru, A. (2020). Estimating the household consumption function in Saudi Arabia: An error correction approach. *Applied Economics*, *52*(11), 1259−1271. https://doi.org/10.1080/00036846.2019.1659933

Kaabi, F. A. (2016). The nexus between remittance outflows and GCC growth and inflation. *Journal of International Business and Economics*, *4*(1), 76−85. https://doi.org/10.15640/jibe.v4n1a7

Carlos, L. R. (2017). *Linear and non-linear relationships between interest rate changes and stock return International evidence* [Unpublished Master thesis]. Banca y Finanzas Cuantitativas. https://www.uv.es/bfc/TFM2017/16%20Carlos%20Lopez%20Rocher.pdf

De, S., Quayyum, S., Schuettler, K., & Yousefi, S. R. (2019). Oil prices, growth, and remittance outflows from the Gulf Cooperation Council. *Economic Notes*, *48*(3), e12144. https://doi.org/10.1111/ecno.12144

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, *74*(366a), 427−431. https://doi.org/10.1080/01621459.1979.10482531

Dinh, D. V. (2020). Optimal inflation threshold and economic growth: Ordinal regression model analysis. *Journal of Asian Finance, Economics, and Business*, *7*(5), 091−002. https://doi.org/10.13106/jafeb.2020.vol7.no5.091

Docquier, F., Rapoport, H., & Salomone, S. (2012). Remittances, migrants' education, and immigration policy: Theory and evidence from bilateral data. *Regional Science and Urban Economics*, *42*(5), 817−828. https://doi.org/10.1016/j.regsciurbeco.2011.10.005

Echchabi, A., & Azouzi, D. (2017). Oil price fluctuations and stock market movements: An application in Oman. *Journal of Asian Finance, Economics, and Business*, *4*(2), 19−86. https://doi.org/10.13106/jafeb.2017.vol4.no2.1

Foudeh, M. (2022). The long run effects of oil prices on economic growth: The case of Saudi Arabia. *International Journal of Energy Economics and Policy*, *7*(6), 171−192.

Haddad, H. B., & Choukir, J. (2017). Short- and long-run effects of remittance outflow shock on the Saudi Arabian economy. *International Journal of Economics and Business Research*, *14*(2), 194−213. https://doi.org/10.1504/IJEBR.2017.086708

Ibrahim, M. H. (2015). Oil and food prices in Malaysia: A non-linear ARDL analysis. *Agricultural and Food Economics*, *3*(1), 1−14. https://doi.org/10.1186/s40100-014-0020-3

Javid, M., & Hasanov, F. J. (2022). *Determinants of remittance outflows: The case of Saudi Arabia.* SA: King Abdullah Petroleum Studies and Research Center.

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration with applications to the demand for money. *Oxford Bulletin of Economics and Statistics*, *52*(2), 169−210. https://doi.org/10.1111/j.1468-0084.1990.mp52002003.x

Katrakilidis, C., & Trachanas, E. (2012). What drives housing price dynamics in Greece: New evidence from asymmetric ARDL cointegration. *Economic Modelling*, *29*(4), 1064−1069. https://doi.org/10.1016/j.econmod.2012.03.029

Liaqat, M., Ayesha, A., Shoaib, N., & Aisha, K. (2022). The impact of oil price inflation on the economic growth of oil importing economies: Empirical evidence from Pakistan. *Journal of Asian Finance, Economics, and Business*, *9*(1), 167−176. https://doi.org/10.13106/jafeb.2022.vol9.no1.0167

Mahmoudinia, D., Amroabadi, B. S., Pourshahabi, F., & Jafari, S. (2013). Oil products consumption, electricity consumption economic growth nexus in the economy of Iran: A bounds testing co-integration approach. *International Journal of Academic Research in Business and Social Sciences*, *3*(1), 353−367.

Makhlouf, F., & Kasmaoui, K. (2018). The impact of oil price on remittances: The case of morocco. *Journal of Energy and Development*, *43*(1&2), 239−310.

Narayan, P. K., Narayan, S., & Mishra, S. (2011). Do remittances induce inflation? Fresh evidence from developing countries. *Southern Economic Journal*, *77*(4), 914−933. https://doi.org/10.4284/0038-4038-77.4.914

Ngoc, B. H. (2020). The asymmetric effect of inflation on economic growth in Vietnam: Evidence by non-linear ARDL approach.

Journal of Asian Finance, Economics, and Business, *7*(2), 143−149. https://doi.org/10.13106/jafeb.2020.vol7.no2.143

Phillips, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, *75*(2), 335−346. http://doi.org/10.1093/biomet/75.2.335

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, *16*(3), 289−326. https://doi.org/10.1002/jae.616

Romilly, P., Song, H., & Liu, X. (2001). Car ownership and use in Britain: A comparison of the empirical results of alternative cointegration estimation methods and forecasts. *Applied Economics*, *33*(14), 1803−1818. https://doi.org/10.1080/00036840011021708

Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modeling asymmetric cointegration and dynamic multiplier in a non-linear ARDL framework. In J. Sickles & W. C. Horrace (Eds.), *Festschrift in honor of Peter Schmidt: Econometric methods and applications* (pp. 281−314). Cham: Springer.

Shawkat, H., Amine, L., Duc, K. N., & Ricardo, M. S. (2014). *Asymmetric and non-linear pass-through of energy prices to CO2 emission allowance prices* (NIPE Working Paper No. 05/204). Portugal: NIPE - Universidade do Minho. http://repositorium.sdum.uminho.pt/handle/1822/28105

Taghavi, M. (2012). *The impact of workers' remittances on macro indicators: The case of the Gulf Cooperation Council.* SA: Middle East Economic Association and Loyola University Chicago.

Termos, A., Naufal, G., & Ismail, G. I. (2013). Remittance outflows and inflation: The case of the GCC countries. *Economics Letters*, *120*, 5−9.

Wulandari, D., Utomo, S. H., Narmaditya, B. S., & Kamaludin, M. (2019). Nexus between inflation and unemployment: Evidence from Indonesia. *Journal of Asian Finance, Economics, and Business*, *6*(2), 269−275. https://doi.org/10.13106/jafeb.2019.vol6.no2.269

Zahran, M. S. A. (2019). The response of remittances inflows to asymmetric oil price shocks in Egypt. *Review of Economics and Political Science*, *5*, 1−20. https://doi.org/10.1108/REPS-01-2019-0009