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The Impact of Remittances on Real Exchange Rates in Afghanistan: ARDL approach

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Abstract

Remittances play a crucial role in Afghanistan's economy, providing a substantial portion of the national income each year. This phenomenon remains unexplored in the context of Afghanistan. Utilizing seasonal data from 2007 to 2021 and using Autoregressive distributed lag (ARDL) developed by Pesaran et al. (2001) and Augmented-Dickey-Fuller (ADF) unit root tests, and looking at short-term and long-term co-integrations, this research attempts to find how remittances effect on real exchange rate (RER) in Afghanistan. Results reveal that remittances and real exchange rates have a negative but statistically significant relationship in the long run, leading to currency appreciation. While the empirical results demonstrate a positive and statistically significant relationship between the world interest rate (WIR) and real exchange rate (RER) nexus in the long-run, leading to depreciation in the Afghan currency. The relationship between GDP growth rate and RER nexus is negative but statistically significant, indicating that higher GDP growth strengthens the value of the Afghan currency in the long-run.

Highlights

- This research investigates the connection between remittances and real exchange rate in Afghanistan over a specified period.
- Higher world interest rates (WIR) cause a depreciation of Afghanistan's currency (RER) in the long term.
- Increased GDP growth strengthens the Afghan currency (negative relationship with RER), suggesting economic expansion enhances exchange rate stability.
- The study employs ARDL co-integration and ADF tests on 2007–2021 data, and looking at short- and long-term co-integrations.

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1. Introduction

Migrants' remittances are typically determined as the portion of personal income that migrant workers send back to their homeland of origin from the country in which they are employed. As noted by the International Monetary Fund (IMF), workers' remittances refer to monetary transfers sent by individuals living abroad for more than one year to their home country. These transfers are recorded under various components of the balance of payments. Workers' remittances have become an important and reliable source of household income, external funding, and capital accumulation in developing countries, and are considered a stable income source (Sutradhar, 2020). In 1925, the Afghan rupee was replaced with the original Afghani– the national currency of the Islamic Republic of Afghanistan– which was then reformed in 2002 and issued for circulation as the AFN in 2003. The former Afghan currency system operated under a fixed exchange rate regime, whereas the current Afghani (AFN) follows a managed flexible exchange rate system (Khatir & Güvenek, 2021).

The growing significance of migrants' remittances as a key pillar of Afghanistan's economy has sparked concern regarding their multifaceted effects, particularly on the exchange rate and export performance. In 2020 alone, Afghanistan received an estimated USD 788.9 million in remittances, representing approximately 4.1 percent of its GDP. This placed the country as the fifth highest remittance recipient in Southern Asia relative to GDP share (Ratha et al., 2021a). Remittances play a crucial role in boosting national savings, easing foreign exchange constraints, improving the balance of payments, and supporting the development budget. According to neoclassical migration theory, labor migration is driven by wage differentials between countries, with workers relocating from low-wage to high-wage economies (Kurekova, 2011). When migrants send earnings back home, remittances serve as a tool for poverty alleviation and economic development. This phenomenon may impede economic development when it leads to the emigration of highly qualified professionals, a process known as human capital flight (Sutradhar, 2020). Both migration and remittance inflows can have significant implications for a country's exchange rate dynamics.

The interplay between remittance flows, exchange rate dynamics, and Dutch disease phenomena has been extensively examined in the economic literature. Dutch disease refers to the reduction in competitiveness of the tradable sector excluding natural resources caused by an exchange rate appreciation following a significant inflow of foreign income, such as workers' remittances, in the context of this study. This study examines the impact of remittance inflows on real exchange rate dynamics in the context of Afghanistan's economy. Given the increasing importance of remittances in Afghanistan, it is essential to examine the linkage between workers' remittances inflow and the determinants of the RER. In general, the volume of workers' remittances is influenced by a combination of migrants' and their families' socio-demographic characteristics, as well as broader macroeconomic and political factors (Pant & Bahadur Budha, 2016).

Figure 1 illustrates the seasonal growth of the exchange rate from 2008 to 2021. Blue and green lines show nominal exchange rate (NER[1]) and real exchange rate (RER[2]), respectively. The sustained appreciation of both nominal and real exchange rates reflects a progressive depreciation of the Afghan afghani relative to the US dollar.

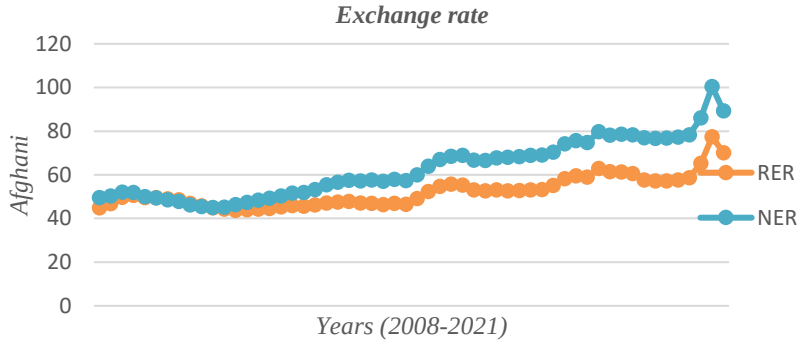

Figure 1. Real exchange rate in Afghanistan from 2008 to 2021.
Source: *Author's compilation using Da Afghanistan Bank database*

Figure 2 shows an upward trend in seasonal remittance inflows to Afghanistan from 2008 to 2021, indicating a consistent annual increase in Aggregate remittance receipts. This might be due to the rise in migration, and/or the ease of money transfers.

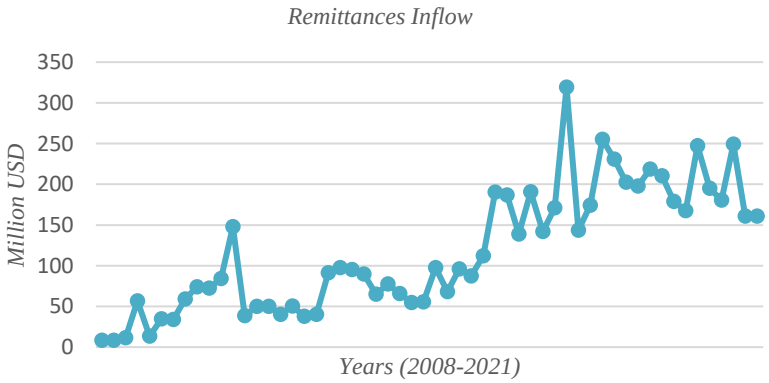

Figure 2. Remittances inflow to Afghanistan from 2008 to 2021
Source: *Author's compilation using Da Afghanistan Bank database*

Existing literature supports the conventional view that higher workers' remittances inflow lead to a rise in the long-run equilibrium real exchange rate,

[1] Nominal Exchange Rate
[2] Real Exchange Rate

but the findings are not universally consistent. This lack of consensus may, in part, be due to Unit Root Test (URT) results, which suggest that the RER is non-stationary in most developing countries studied (Essayyad et al., 2018). Afghanistan–a country with a poor economy, low income per capita, weak infrastructure, high population growth, high poverty rate, insecurity, and an unstable political system– ranks among the least developed countries in the world. i.e., Afghanistan ranks 162 out of 167 member countries (SDGs report, 2024), due to which most of the country's labor force decides to migrate for employment purposes, with a significant portion of their earnings being sent back as remittances to support their families. As a result, Afghanistan receives substantial remittance inflows each year, which impact key macroeconomic variables, including the RER. This research examines the impact of REMs[1] on the RER– a subject that has not yet been empirically investigated in the context of Afghanistan.

This research investigates to address the question of How does REM affect the RER in Afghanistan, particularly the long-term effect. We hypothesize that the workers' REMs and RER nexus are negatively related, and remittances causes the exchange rate to strengthen in Afghanistan in the long-run. We find that the workers' REMs harm the RER in the long-term; that is to say, a higher remittance will push down the RER, which increases imports and reduces exports. Due to prolonged conflicts and civil war in Afghanistan, many scientific questions across all sectors**,** particularly economics, remained unexplored. Therefore, this research examines the impact of workers' remittances on Afghanistan's RER, economic growth, and other macroeconomic and microeconomic variables and constitutes a novel and innovative contribution to the literature.

The paper's structure follows conventional research organization: subsequent sections address theoretical foundations (2), research design and datasets (3), empirical analysis and interpretation (4), before concluding with policy-oriented insights and practical applications (5).

2. Literature Review

2.1 Theoretical considerations

Workers' remittances can potentially impact on the real exchange rate through three main channels:

First; workers' REMs can influence the external balance of the economy by improving the net international investment position. An economy reaches external equilibrium when its current account deficit (or surplus) is financed through non-speculative, sustainable capital account flows that do not jeopardize future economic stability (Michael Mussa, 1984; Frenkel & Mussa, 1985; Alberola & Lopez, 2001). The sustainability threshold for capital inflows is fundamentally determined by a nation's net international investment position, implying that variations in net foreign assets exert direct pressure on the long-term equilibrium

[1] Remittances

RER. Unlike other international financial flows, workers' remittances being unilateral transfers with no repayment obligations— exert a direct causal effect and a favorable effect on the nation's external financial position vis-à-vis global counterparts. Conversely, alternative capital flows - including debt instruments and foreign direct investment - exhibit markedly divergent economic impacts. Distinct capital flow modalities differentially impact net foreign assets (NFA): (1) Debt instruments create liabilities whose NFA contribution equals the present value difference between disbursements and future repayment obligations - only exhibiting positive NFA effects when incorporating concessional elements. (2) Foreign direct investment, while expanding productive capacity, simultaneously increases external liabilities, thereby exerting downward pressure on the host nation's NFA position (Lopez et al., 2007).

Let's consider the case where net foreign assets position improves. For example, if Afghan migrant workers remit $100 million monthly to their home country, these funds are directly recorded as new foreign assets (without any corresponding liabilities). Then there will be several different scenarios:

This contrasts with:

- A $100 million IMF loan that requires interest payments
- Foreign direct investment where profits belong to foreign investors

Remittance Scenario:

- A family receives $10,000 in remittances → Entire amount recorded as net national asset
- This asset increase strengthens the national currency (e.g., exchange rate moves from 1 USD = 80 AFN to 1 USD = 75 AFN)

Bank Loan Scenario:

- Government borrows 10,000 at 510,000 at 512,000
- Net asset calculation: 10,000−10,000−12,000 = ($2,000) net liability

Effect on RER:

According to Alberola & Lopez (2001) model:

- Each 10% increase in net foreign assets can lead to 1.5% appreciation of real exchange rate

Afghanistan Case Projection:

If annual remittances grow from 2 to 3 billion:

- 50% increase in foreign assets → Predicted 7.5% real exchange rate appreciation.

Second, workers' REMs can also influence the internal equilibrium of the economy, which refers to the efficient utilization of interior capital and labor. As noted earlier, if remittance inflows stimulate increased demand for services, particularly in non-tradable sectors, this can lead to higher inflation in those areas. Since non-tradable sectors are generally insulated from international competition, such inflationary pressures contribute to RER appreciation, consistent with the Balassa-Samuelson effect. Additionally, structural rigidities in the labor and capital markets may further exacerbate productivity differentials across sectors (Lopez et al., 2007). Internal balance refers to a state in which production

factors—capital and labor—are fully employed, inflation remains at stable and optimal levels, and productive capacities are efficiently utilized. Remittance inflows can potentially disrupt this equilibrium by influencing each of these variables. For example, let's consider in the specification where remittances impact RER through the internal balance, then we would have the following cases:

1. Inflationary Effect in the Non-Tradable Sector: When Afghan households receive remittances, they tend to allocate a significant portion of this income to non-tradable goods and services such as housing (rent or purchase), education, healthcare, restaurants, and entertainment. These sectors are generally shielded from international competition and often exhibit inelastic supply in the short term. As a result, increased demand driven by remittance inflows leads to upward pressure on prices in these sectors, contributing to inflation.

2. Balassa-Samuelson Effect: According to this theory, rising relative prices of non-tradables increase general price levels (inflation) and consequently appreciate the real value of domestic currency (i.e., real exchange rate decreases).

3. Labor Market Impacts: Reservation wage increase: Remittances raise household incomes, causing workers to reject low-wage jobs.

Tertiary transmission channel through which remittances influence the real exchange rate (RER) operates via growth effects, whereby capital inflows stimulate economic expansion that subsequently alters relative price levels. (Acosta et al., 2008; Lopez et al., 2007), although the direction of this effect is uncertain. On one hand, faster growth can reduce the net foreign asset position as a share of GDP, which may lead to a depreciation of the real exchange rate, like the effect of increased external liabilities. On the other hand, if a country already has a negative net foreign asset position, higher growth can help reduce the debt-to-GDP ratio, potentially causing the RER to be appreciated (Lopez et al., 2007). Remittances can stimulate economic growth through: Household investment in education/small businesses → boosts productivity, financial deepening via increased deposits → improves credit access and stabilization of consumption → reduces macroeconomic volatility.

The net impact on the RER remains theoretically indeterminate, contingent upon (i) the economy's pre-existing net international investment position and (ii) Inter-sectoral distribution of growth —particularly the relative expansion of tradable versus non-tradable sectors.

2.2 Background of research

Previous studies have explored the impact of workers' REMs on the RER across various countries using a range of methodologies, including panel data analysis, ARDL models, and other econometric techniques. This research examines this relationship in the context of Afghanistan, employing a methodological approach similar to that of Lopez et al. (2007) However, there are limited but growing empirical studies that have used time series data to find the nexus between remittances and real exchange rates. This may be attributed to the steady rise in remittance inflows, which has drawn increasing attention from

researchers, policymakers, academics, and economists alike. The prevailing view suggests that higher remittance inflows tend o induce currency depreciation, assuming all other factors remain constant. Existing literature has extensively investigated the remittance-exchange rate (REM-RER) nexus across both individual and grouped developing economies (Essayyad et al., 2018, inter alia). However, scholarly inquiry has overlooked Afghanistan's unique context—a gap this study addresses. Essayyad et al. (2018) analyzed Nepal's remittance-driven exchange rate dynamics using Pesaran et al.'s (2001) ARDL framework and ADF stationarity tests. Their findings reveal short-run depreciation and long-run appreciation of the Nepalese rupee, though statistical significance was confined to short-term effects.

Complementing this, Chami et al., 2010 conducted an IMF multi-country study spanning Cape Verde to Guatemala. Their panel and country-specific analyses yielded heterogeneous results: while remittance inflows generally correlate with real exchange rate appreciation (consistent with theoretical expectations), the evidence lacks uniformity, underscoring context-dependent outcomes. This inconclusiveness highlights the need for further localized research, particularly in understudied economies like Afghanistan. Similarly, Amuedo-Dorantes & Pozo (2004) empirically assessed the effects of migrant REMs on RER dynamics across a panel of 13 Latin American and Caribbean economies. Their study provided early systematic evidence of remittance-induced Dutch disease phenomena in developing regions. Their findings echo concerns raised in Dutch Disease and Resource Boom models, the findings indicate that increased remittance inflows may generate appreciation pressures on the real exchange rate, subsequently inducing intersectoral resource shifts from export-oriented activities toward domestic-focused production. Azizi (2021) This investigation analyzed the effects of migrant remittance flows on both real exchange rate dynamics and export competitiveness across a panel of 101 developing economies during the 1990-2015 period. The results indicate that REMs inflow lead to an appreciation of the RER and a decline in net exports in recipient countries. Similarly, Hien et al. (2020) implemented a System GMM estimator on dynamic panel data from 32 countries (2006-2016), identifying a 0.103% real effective exchange rate (REER) appreciation per 1% rise in per capita remittances. This competitiveness erosion validates Dutch Disease transmission in low-remittance economies (1% or less of GDP), while revealing an inverse REER relationship in high-remittance contexts—suggesting threshold-dependent effects.

In another study, Ratha & Moghaddam (2020) Employing a random effects estimation approach, the study examined the linkage between remittance inflows and Dutch disease manifestations. The results indicate that a decadal rise in the remittance-GDP ratio induces a 0.009-unit real exchange rate appreciation, with this estimate demonstrating robustness when validated through bound test co-integration analysis. Likewise, Lopez et al., (2007) explored Empirical analysis reveals that rising remittance flows cause measurable appreciation of the real

exchange rate. Their study also discusses potential policy measures to mitigate this effect.

Singer (2010) distinguishes remittances from conventional capital flows by demonstrating their dual stabilizing role: (1) counter-cyclical behavior that buffers economic shocks, and (2) partial substitution for diminished monetary sovereignty through implicit international risk-sharing. Building on this theoretical foundation, Singer (2010) posits that remittances' stabilizing properties incentivize fixed exchange rate regimes in developing economies. Empirical studying of de facto ER classifications and a novel remittance dataset (74 countries, 1982–2006) corroborates this hypothesis, with results robust to controls for political-economic confounders and instrumental variable approaches.

Contrasting evidence emerges from Barrett (2015), whose IS-MP model analysis of Jamaica (1995–2010) reveals remittance-driven real exchange rate depreciation—a finding anomalous to prevailing literature. Meanwhile, Mawutor et al., (2023) employ an ARDL framework to demonstrate cointegration between remittances, FDI, exchange rates, and growth in Ghana. Their results show remittances consistently spur economic growth, whereas FDI, exchange rate movements, and imports exhibit growth-inhibiting effects across time horizons. Lawal et al. (2022) investigated growth-macroeconomic linkages across ten African economies (1980-2018), analyzing exchange rates, remittances, trade, and agricultural output. Their methodological approach innovatively combined time-domain (Dumitrescu-Hurlin) and frequency-domain (Croux-Reusens) Granger causality tests to assess both short-term and long-term dynamics. The analysis reveals bidirectional Granger causality with both transitory and enduring components between GDP growth and all explanatory variables (including remittance flows), suggesting complex feedback mechanisms operating across multiple time horizons. In another study titled REMs and Exchange Rate Linkages: Experiences of Nepal, Pant & Bahadur Budha (2016) investigated the connection between remittance inflows and exchange rate dynamics. Employing OLS regression analysis, the study revealed two key findings: First, Nepalese rupee depreciation exhibits a positive and statistically significant association with increased remittance inflows. Second, remittance flows demonstrate notable sensitivity to Indian economic conditions - a pattern attributed to Nepal's substantial migrant labor ties with India. Furthermore, the cyclical variation in remittances responds systematically to: (i) NER fluctuations, and (ii) Economic Performance in India, Gulf Cooperation Council countries, and advanced economies.

Table 1. Summary of literature review

Author and Year	The main concept of research	Methodology	Remittances and Real exchange rate nexuses
Musa Essayyad (2018)	REMs and RER in south Asia: the case of Nepal	ARDL	In short- term (+) and long- term (-)
Seyed Soroosh Azizi (2021)	Impacts of REMs on ER[1] and net export	Panel	Impact of rem on REL (+), Impact on NX (-)
Nguyen Phuc Hien (2021)	REMs, RER and the D-D in Asian developing countries	(S-GMM) Panel	Impact of rem on RER (+)
Segun Subair Awode (2021)	The effect of REMs and volatility in REMs on macro-economic performance in Africa: Any lessons for COVID-19?	Panel	Impact of REMs volatility on ER (-)
Artatrana Ratha (2020)	Workers' REM and the D-D phenomenon: evidence from the bounds error correction modelling and a panel space	bounds error correction modelling and a panel space	Impact of rem on RER (+)
Humberto Lopez et al. (2007)	REM and RER	Panel	Impact of rem on RER (+)
Kemeisha Barrett (2015)	The effect of REMs on the RER: The case of Jamaica	OLS	Impact of REMs on RER (-)

Source: *Summarized by the author based on various empirical studies.*

Our results for Afghanistan are consistent with existent literature and show that REMs have a negative impact on the RER in the long-term.

3. Methodology

3.1 Data collection method

We used the World Development Indicator (WDI) dataset on remittances (REM), foreign direct investment (FDI), Real exchange rate (RER), official development assistance (ODA), and GDP. Data on export, goods and services (XGS) was sourced from the Asia Development Bank (ADB) dataset, and we used the USA fiscal data on world interest rate (WIR). The dataset was used for 15 years, from 2007 to 2021, and 60 seasons because the data was mostly available for selected variables only for this period of time. Data is converted from year to season level using EViews 10. A list of variables with their statistical description is provided in Table 8 in the Appendix section.

[1] Exchange rate

3.1.1 Data analysis techniques

The data was analyzed using EViews 10. This study utilizes an ARDL bounds testing framework to analyze the dynamic effects of remittance inflows (RM), foreign direct investment (FDI), official development assistance (ODA), world interest rates (WIR), export growth (XGS), and GDP expansion on Afghanistan's real exchange rate. Stationarity properties were verified through complementary unit root tests (ADF and PP), with all variables confirmed as I(0) or I(1) at α=0.05.

3.2 Econometric approach

Following Musa Essayyad (2018), Our empirical strategy employs the ARDL cointegration approach, selected for its dual capacity to: (i) accommodate variables with differing integration orders [I(0)/I(1)], and (ii) simultaneously estimate short-run dynamics and long-run equilibrium relationships—a critical advantage given Afghanistan's mixed-frequency macroeconomic data. Musa Essayyad (2018) investigated the impact of REMs and other controls variables on the RER for Nepal. However, our study can be differentiated from his work not only in terms of the context of the study, in addition, we employed the ARDL co-integration approach and ADF stationarity tests to examine both short-term dynamics and long-term equilibrium connections. Following Romer (2011), The real effective exchange rate (REER), our key dependent variable, is calculated as:

$$RER_t = \frac{NER_t * CPI_{US,t}}{CPI_{Afg,t}} \quad (1)$$

Where, RER_t is the Real Exchange Rate for Afghanistan, contingent upon the Nominal Exchange Rate (NER_t) at time t multiplied by the ratio of the U.S. ($CPI_{US,t}$) and Afghanistan ($CPI_{Afg,t}$).Consumer Price Indexes.

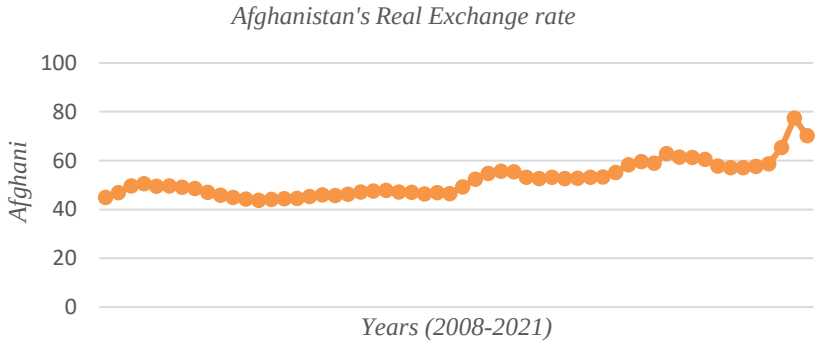

Figure 3. demonstrates the evolution of the computed Afghanistan's RER.
Source: *research finding by using Afghanistan central bank data*

Following standard practice in exchange rate analysis, we convert nominal

to real exchange rates and apply natural logarithmic transformations to all variables except the world interest rate (WIR) and annual GDP growth. This standardization enables direct interpretation of coefficients as long-run elasticities. Consistent with established empirical approaches to remittance-exchange rate dynamics, we specify the following long-run equilibrium model:

$$RER_t = f\left(REM_t, X_t\right) \tag{2}$$

Equation (2) can be written as:

$$RER_t = \beta_0 + \beta_1 REM_t + \beta_2 X_t' + \varepsilon_t \tag{3}$$

And equation (3) can be written with details as follows:

$$LRER_t = \beta_0 + \beta_1 LREM_t + \beta_2 LFDI_t + \beta_3 LODA_t + \beta_4 LXGS_t + \beta_5 GDP_t + \beta_6 WIR_t + \beta_7 dum_t + \varepsilon_t \tag{4}$$

Equation (4) specifies that the RER is a function of inward REMs as a percentage of GDP (REM), along with other key determinants of the RER, including FDI, ODA, Exports of Goods and Services (XGS), GDP, a dummy variable, and the world interest rate (WIR). The final term represents the idiosyncratic error. The dummy variable captures periods of political crisis, the COVID pandemic, and the intensification of civil conflict in Afghanistan, taking the value of 1 during critical periods and 0 otherwise. While data limitations prevent the inclusion of all possible RER determinants, this model aligns with the standard approach in the literature. As noted by Chami et al. (2010), individual country studies commonly incorporate remittance flows into the set of fundamentals used in a cointegration equation for the real exchange rate, alongside other relevant macroeconomic variables. In this study, five specific control variables are included:

- GDP annual growth (%) reflects a country's economic performance. A negative nexuse is expected between gross domestic products growth and the real exchange rate (RER), meaning that as an economy expands, the RER tends to decline.
  - Its currency may appreciate due to increased demand for its goods and services, leading to higher prices compared to foreign markets.
  - When a currency gains strength, it can lead to higher export prices and lower import costs, potentially hurting the trade balance.
- Goods and services sold to foreign markets (XGS, in current US$) reflect Afghanistan's global trade competitiveness. An increase in XGS is likely to negatively affect the real exchange rate (RER), as higher export earnings can lead to currency appreciation, making domestic goods more expensive in foreign markets.
  - If Afghanistan's currency appreciates (meaning the RER decreases), it makes Afghan exports more expensive for foreign buyers. Higher prices can reduce demand, leading to a decrease in export volumes (XGS).
- The World Interest Rate (WIR) is proxied by annual averages of U.S. Treasury bill rates. According to interest rate parity theory, Consistent with

interest parity conditions, the prevailing theoretical consensus suggests that WIR increases induce RER appreciation via two primary mechanisms: (i) heightened foreign investment inflows attracted by yield differentials, and (ii) consequent balance-of-payments effects that strengthen the currency's purchasing power.

- Interest Rate Differentials: According to the interest rate parity theory, differences in interest rates between countries can influence exchange rates. When WIR rises, it often leads to higher domestic interest rates in other countries to maintain competitiveness.
- Capital Inflows: When global interest rates rise, investments flow into countries offering higher returns, including Afghanistan, assuming it adjusts its interest rates accordingly. This inflow bolsters demand for the Afghan currency, leading to an appreciation in the RER. Consequently, an increase in WIR encourages foreign capital investments, which can strengthen the national currency as demand grows.
- Inflation Expectations: Higher interest rates can also signal expectations of rising inflation. In response, investors may favor assets in countries with stronger currencies, reinforcing the positive correlation between WIR and RER.

- Foreign Direct Investment (FDI, current US$) is anticipated to exhibit an inverse relationship with the Real Exchange Rate (RER). This expected negative correlation suggests that increased FDI inflows may contribute to domestic currency appreciation, thereby reducing the RER. Foreign direct investment (FDI) can cause the domestic currency to strengthen as rising demand for local currency supports investment inflows. This appreciation may raise export costs while lowering import prices, potentially worsening the trade balance. Consequently, as the domestic currency strengthens (an appreciation of the RER), it may negatively affect the nation's international competitiveness, which could lead to lower FDI inflows in subsequent periods if foreign businesses find it more expensive to operate.
- Official Development Assistance (ODA, current US$) is projected to demonstrate an inverse correlation with the Real Exchange Rate (RER). This anticipated relationship stems from the potential for aid inflows to induce currency appreciation, thereby decreasing the RER through increased foreign exchange supply. If ODA leads to increased domestic consumption without corresponding economic growth, it can create inflationary pressures. Rising prices can result in the devaluation of the local currency (a decrease in RER). In the long term, as aid levels fluctuate, currency depreciation may become expected, leading investors and traders to reassess the value of the local currency negatively.

The selection of model variables in this study is guided by existing research literature. Prior studies investigating the impact of REMs on RER in various countries have employed similar control variables. For example, Essayyad et al. (2018), in his analysis of Nepal, included explanatory variables such as the world interest rate, export volume, GDP, and government expenditures. Drawing on this framework, the present study adopts a comparable model to examine the case of Afghanistan.

This study utilizes the Autoregressive Distributed Lag (ARDL) bounds testing methodology (Pesaran et al., 2001) to examine the short-term and long-term dynamic impacts of remittances on the real exchange rate. The ARDL framework presents distinct methodological advantages, particularly its flexibility in handling variables with different integration orders - whether I(0), I(1), or a mix of both - thereby obviating strict pre-testing requirements for unit roots. However, to ensure methodological rigor and robustness, we have conducted and present (ADF) URT in Table 2. These tests verify that all time series variables maintain consistent integration orders, supporting the validity of our ARDL approach.

Table 2. Unit-Root Test (URT) results

Variables	ADF Stat	Significance level	Mackinnon-p-value	Model specification
		Level (Intercept)		
FDI	-2.739821		0.0736	Trend
XDP	-1.122174		0.7015	Trend
ODA	-1.121335		0.7018	Trend
RER	-0.7010		0.8382	Trend
EGS	-1.5361		0.5085	Trend
REM (%GDP)	-1.6624		0.4449	Trend
WIR	-4.396062	***	0.0008	Constant
		1st. difference (Intercept)		
FDI	-5.210408	***	0.0001	Constant
GDP	-7.610047	***	0.0000	Constant
ODA	-7.484094	***	0.0000	Constant
RER	-7.5081	***	0.0000	Constant
REM (%GDP)	-7.5260	***	0.0000	Constant
XGS	-7.484231	***	0.0000	Constant

Source: *research findings*

Note: Statistical significance is indicated by asterisks (***p<0.01, **p<0.05). The ADF test's lag structure was optimized via Schwarz Information Criterion (SIC) to prevent over-differencing while maintaining white noise residuals.

A key benefit of the ARDL methodology is its ability to estimate long-term and short-term dynamics jointly within a single equation, unlike traditional cointegration approaches that often necessitate a system of equations. Moreover, the ARDL framework performs robustly with limited data, making it advantageous for small-sample analyses. (Essayyad et al., 2018). This is especially relevant in the case of Afghanistan, where only 14 years of quarterly data are available. To evaluate both long-run equilibrium relationships and short-term adjustment processes, we employ the unrestricted error correction mechanism (UECM) within an ARDL framework, specified as follows:

$$\Delta RER_t = \gamma_0 + \gamma_1 T + \sum_{i=1}^{k} b_i \Delta RER_{t-1} + \sum_{i=1}^{p1} c_i \Delta REM_{t-1} + \sum_{i=1}^{p2} d_i \Delta GDP_{t-1} + \sum_{i=1}^{p3} e_i \Delta WIR_{t-1}$$
$$+ \sum_{i=1}^{p4} f_i \Delta ODA_{t-1} + \sum_{i=1}^{p5} g_i \Delta FDI_{t-1} + \sum_{i=1}^{p6} h_i \Delta XGS_{t-1} + \lambda_1 REM_{t-1} + \lambda_2 GDP_{t-1} + \lambda_3 WIR_{t-1} \quad (5)$$
$$+ \lambda_4 ODA_{t-1} + \lambda_5 FDI_{t-1} + \lambda_6 XGS_{t-1} + \mu_i$$

In equation 5 p and k denote lags, Δ is the difference in operator and μ_i is the white-noise error term. The optimal lag is chosen based on either (AIC) or the (SIC).

4. Empirical results and discussion

4.1 Residual Diagnostic tests

To assess the reliability of the estimated coefficients, a series of diagnostic tests were conducted. These tests serve to validate the robustness of the model's results. As noted by Shrestha & Bhatta (2018), key diagnostic checks include lag structure analysis, coefficient diagnostics, and residual diagnostics. Among these, residual diagnostics are particularly crucial in economic modeling, as they evaluate whether the model's error terms meet the assumption of being independently and identically distributed. This is essential because a well-specified regression model aims to minimize error-related distortions. In this study, several diagnostic tools were applied to test for serial correlation (using the LM test), heteroscedasticity, normality, and model stability. These tests help confirm the consistency and reliability of the estimated coefficients and are discussed in the sections that follow.

4.1.1 Auto-correlation test

Auto-correlation arises when the current value of the residuals is correlated with past values, thereby violating the Ordinary Least Squares (OLS) assumption of no autocorrelation. When this assumption is breached, standard errors become distorted, making the t-statistics unreliable. To assess autocorrelation in this study, the Lagrange Multiplier (LM) approach was employed, this approach streamlines the estimation of the restricted model while facilitating an assessment of the model specification's robustness (Shrestha & Bhatta, 2018). The Breusch-Godfrey Lagrange Multiplier (LM) test for serial correlation was implemented, yielding a test statistic with p=0.5744 (Table 3). As this exceeds the conventional α=0.05 significance threshold, we fail to reject the null hypothesis of no autocorrelation, confirming the model's error term satisfies the white noise assumption.

Table 3. Breusch-Godfrey Serial Correlation (LM) Test

F-Stat	0.56407	Probability. F(2,32)	0.5744
Obs *R^2	1.90702	Probability. Chi-Square(2)	0.3854

Source: *research findings*

4.1.2 Heteroscedasticity test

To assess the presence of heteroscedasticity, we employed the Autoregressive Conditional Heteroscedasticity (ARCH) test. This approach is favored for its straightforward implementation and reliability in identifying heteroscedasticity within linear regression frameworks, provided the error terms follow a normal distribution. The test outcomes, detailed in Table 4, reveal no evidence of heteroscedasticity, as the p-value surpasses the conventional 0.05 significance level.

Table 4. Heteroscedasticity Test (ARCH)

F-Stat	1.41161	Probability. F(1,53)	0.2401
Obs *R^2	1.42688	Probability. Chi-Square (1)	0.2323

Source: *research findings*

4.1.3 Model Stability Test (MST)

Stability testing is performed to assess the temporal consistency of estimated model parameters, a critical step in validating model reliability for policy applications. In this analysis, we implement the recursive residual-based CUSUM and CUSUMSQ tests (Singh & Pradhan, 2023). The results, presented in Appendix Figures B1-B2, demonstrate that both test statistics remain within their 5% critical bounds throughout the sample period, confirming parameter stability.

4.1.4 Bounds Test for Co-integration

To understand the long-run relationship, we use the bounds testing approach. The null hypothesis for the bounds test is that there is no co-integration (e.g. $H_0 : \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = \lambda_6 = 0$), and the alternative hypothesis is that the variables are co-integrated (e.g. $H_1 : \lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq \lambda_5 \neq \lambda_6 \neq 0$). Our diagnostic tests employ the F-statistic (reported in Table 5), which exceeds the upper critical bounds at both 5% and 1% significance levels. This leads to rejection of the null hypothesis of no co-integration, confirming a stable long-run equilibrium relationship between remittances, their determinants, and the exchange rate.

Table 5: Bounds Test for co-integration

		Critical Value bounds (5%)		Critical Value bounds (1%)	
	Test	I(0)	I(1)	I(0)	I(1)
F-Stat	8.947619***	2.87	4.00	3.6	4.9

Source: *research findings*

Our empirical approach employs automatic lag selection (up to 4 lags) with the following variables: remittances (REM), world interest rate (WIR), GDP, (ODA), (FDI), and exports (XGS). The bounds test results do not reject the null hypothesis of no co-integration, indicating absence of level relationships. Upon confirming cointegration among the variables, we proceed to estimate both long-run (Equation 6) and short-run (Equation 7) relationships.

$$RER_t = a + \sum_{i=1}^{k} \beta_i RER_{t-i} + \sum_{i=1}^{p1} \gamma_i REM_{t-i} + \sum_{i=1}^{p2} \delta_i GDP_{t-i} + \sum_{i=1}^{p3} \eta_i WIR_{t-i} + \sum_{i=1}^{p4} \kappa_i ODA_{t-i} + \sum_{i=1}^{p5} \theta_i FDI_{t-i} + \xi_i \quad (6)$$

$$\Delta RER_t = a + \sum_{i=1}^{k} \phi_i \Delta RER_{t-i} + \sum_{i=1}^{p1} c_i \Delta REM_{t-i} + \sum_{i=1}^{p2} d_i \Delta GDP_{t-i} + \sum_{i=1}^{p3} g_i \Delta WIR_{t-i} + \sum_{i=1}^{p4} e_i \Delta ODA_{t-i} + \sum_{i=1}^{p5} h_i \Delta FDI_{t-i} + \psi ECT_{t-1} \quad (7)$$

The coefficient ψ represents the error-correction term in Equation 6, quantifying the speed of adjustment toward long-run equilibrium. Consistent with theoretical expectations, this coefficient must be both: (1) negative (ensuring convergence to equilibrium), and (2) statistically significant (indicating meaningful adjustment dynamics).

Although ARDL model specifications (k, p_1-p_6) conventionally determine optimal lag length through information criteria (e.g., AIC, SIC), we consistently apply a maximum lag order of 4 across all estimations. This study investigates the effect of REMs inflows on RER dynamics—a relationship that remains theoretically ambiguous, requiring empirical clarification. Remittance inflows influence exchange rates indirectly**,** primarily through their effects on household income in recipient families and the subsequent spending or investment behavior. The macroeconomic effects of remittance flows exhibit dual potential - they may induce currency appreciation when directed toward investment activities, or contribute to depreciation when predominantly allocated to consumption expenditures.

4.2 Results of estimated long-run coefficients

Table 6 presents the long-run coefficient estimates from Equations (6) and (7), revealing a statistically significant negative relationship between REMs inflows and the RER. This finding contrasts with earlier research, including Essayyad et al. (2018), who reported differing results. The long-run coefficient estimate of -0.081 ($p<0.01$) suggests a statistically significant inverse relationship between remittance inflows and real exchange rate stability, where each percentage point increase in remittances induces an 0.081% depreciation of Afghanistan's equilibrium real exchange rate. The analysis confirms a statistically significant negative relationship between ODA and the real exchange rate (β=-0.06, $p<0.05$), indicating that a 1% increase in development assistance depreciates Afghanistan's RER by 0.06% ceteris paribus. While FDI (β=-0.01) and export growth (β=-0.0009) exhibit theoretically consistent negative coefficients, both fail to achieve statistical significance at conventional levels ($p>0.10$), suggesting limited systematic influence on currency valuation.

Another key finding is the negative and statistically significant relationship between GDP growth and the real exchange rate. The estimated coefficient for

GDP (-0.0037, t = -2.185) suggests a 1% increase in economic output reduces the real exchange rate by 0.0037%, aligning with theoretical predictions. Conversely, the world interest rate (WIR) shows a positive and significant effect (0.037), indicating that a 1% rise in global rates corresponds to a 0.037% appreciation of Afghanistan's exchange rate. Overall, the findings provide strong evidence that increased remittance inflows contribute to long-run currency appreciation in Afghanistan. This relationship is statistically significant and aligns with the theoretical expectation that remittances, by increasing household income and demand for non-tradable, exert appreciation pressure on the domestic currency.

Table 6. Results of estimated long-run coefficients

Variable	V-Coefficient	Standard. Error	T-Statistic	Probb.
REM	-0.081	0.02494	-3.2497	0.0026
ODA	-0.066	0.09724	-0.6782	0.5022
GDP	-0.0037	0.00168	-2.1851	0.0359
FDI	-0.011	0.01536	-0.7144	0.4799
XGS	-0.0009	0.03804	-0.0225	0.9822
WIR	0.03758	0.01155	3.25297	0.0026

Source: *research findings*

To control for structural instability, we incorporate a binary dummy variable distinguishing crisis periods (1) from normal economic conditions (0). Crisis years are defined by exceptional circumstances including armed conflict escalation, pandemic shocks, and substantial declines in foreign assistance. The statistically significant coefficient on this dummy confirms parameter instability across regime periods, suggesting distinct exchange rate dynamics during crises.

4.3 Result of estimated ECM coefficients

Table 7 presents the error correction results, revealing a statistically significant (1% level) negative coefficient of -0.69 for the ECM term. The significant negative error correction coefficient (-0.69, $p<0.01$) confirms a stable long-run co-integrating relationship among the variables. The estimated adjustment speed implies 69% of short-run RER deviations from equilibrium are corrected within one year, demonstrating rapid convergence to the steady-state path.

Table 7. Result of the estimated short-run Coefficient

Variable	V-Coefficient	Std. Error	T-Statistic	Probb.
C	3.68431	0.43431	8.48322	0.0000
@TREND	0.00544	0.00064	8.52933	0.0000
D(REM)	0.05172	0.01469	3.52058	0.0012
D(REM(-1))	0.10341	0.01784	5.79531	0.0000
D(REM(-2))	0.09853	0.01782	5.52961	0.0000
D(REM(-3))	0.09536	0.01779	5.3615	0.0000
D(ODA)	0.22947	0.07455	3.07814	0.0041

D(ODA(-1))	0.39138	0.07176	5.45417	0.0000
D(ODA(-2))	0.37192	0.07306	5.09078	0.0000
D(ODA(-3))	0.36806	0.07409	4.96753	0.0000
D(WIR)	0.06575	0.01754	3.74865	0.0007
D(WIR(-1))	-0.012	0.01954	-0.616	0.5420
D(WIR(-2))	0.03846	0.02002	1.92084	0.0632
D(WIR(-3))	-0.0757	0.01749	-4.3272	0.0001
WAR	-0.0014	0.01828	-0.0756	0.9402
CointEq(-1)*	-0.6953	0.081	-8.5841	0.0000
R^2	0.79549	Akaike info criterion		-4.4969
Adjusted R^2	0.7188	Schwarz criterion		-3.9182
F-Stat	10.3725	Akaike info criterion		-4.4969
Probb (F-statistic)	0.0000	Durbin-Watson stat		1.74544

Source: *research findings*

Our results diverge from Pant & Bahadur Budha's (2016) findings, which identified only weak and inconsistent effects of REMs on equilibrium RER. In contrast, our results for Afghanistan demonstrate a robust and statistically significant long-run relationship between remittances and the real exchange rate. Consistent with Pant and Budha's (Year) theoretical proposition that remittance inflows induce currency appreciation—especially in economies with limited trade and financial integration—our empirical results confirm this relationship for Afghanistan. The long-run estimates demonstrate statistically significant appreciative pressure on the Afghan afghani from sustained remittance flows, validating the hypothesized transmission channel in low-openness contexts. Table 7 displays the ARDL estimation results, revealing short-run dynamics consistent with Essayyad et al.'s (2018) findings for Nepal, where remittances demonstrated a statistically significant negative impact on the RER. Our analysis extends this observation by establishing a significant long-term relationship between REM inflows and ER movements in the Afghan context. Specifically, as remittances increase, the exchange rate tends to decline over time, suggesting currency appreciation. Consistent with the currency supply hypothesis (Lopez et al., 2020), remittance inflows expand the domestic foreign exchange supply, creating excess USD liquidity that appreciates the local currency through standard market mechanisms, when demand remains constant.

Regarding the other explanatory variables, the results indicate that the (WIR) has a positive and statistically significant long-run effect on the RER, implying that an increase in WIR contributes to depreciation of the Afghani. In contrast, GDP growth shows a negative and significant relationship with the real exchange rate, suggesting that stronger economic growth supports currency appreciation. Although foreign direct investment (FDI), official development assistance (ODA), and exports of goods and services (XGS) demonstrate theoretically consistent negative associations with the real exchange rate, these relationships lack statistical significance. The coefficient signs nevertheless correspond with both economic theory and established empirical patterns. This investigation elucidates two primary transmission mechanisms through which remittance flows

affect Afghanistan's real exchange rate dynamics:

1. External Balance Channel (Net Foreign Asset Position**):** Remittances contribute directly to improving the country's net foreign asset position, as they represent financial inflows that do not create offsetting liabilities.
2. Internal Balance Channel (Non-Tradable Inflation): Remittances can lead to currency appreciation through increased domestic demand, particularly in the non-tradable sector. Recipient households often allocate a significant portion of remittance income toward services such as housing, healthcare, and education, thereby driving up prices in these sectors.

5. Conclusion and Policy Recommendations

Remittance flows play a critical role in Afghanistan's economy, making it necessary to assess their impact on currency valuation and key economic outcomes. However, this relationship remains unexplored in existing work. Building on cross-country evidence from developing economies, this study addresses a critical research gap by examining how macroeconomic determinants—including GDP growth, export performance (XGS), ODA, FDI, WIR, and remittance inflows—collectively influence Afghanistan's exchange rate dynamics. Afghanistan's reliance on remittances from its overseas workforce has increased significantly over the past 45 years, largely driven by prolonged civil conflict, political instability, and widespread poverty. In 2020, the country received an estimated $788.9 million in remittances, making it the fifth-highest recipient among South Asian nations. These remittances inflow represented approximately 4.1% of Afghanistan's gross domestic product that year. This research examines the impact of REMs on the RER in Afghanistan.

Adopting Pesaran et al.'s (2001) methodology, we implement ARDL co-integration analysis and ADF stationarity tests to examine both short-run dynamics and long-run equilibrium relationships. The results demonstrate significant remittance-RER linkages across time horizons, with long-term effects operating through indirect channels. These effects may result from excessive foreign currency inflows into Afghanistan's market. Our findings also show a statistically significant positive short-run and long-run relationship between WIR and the RER. As predicted, higher WIR leads to depreciation of Afghanistan's currency. "Our results show a statistically significant negative relationship between GDP growth and RER, indicating economic growth strengthens Afghanistan's currency long-term. However, FDI, ODA, and XGS exhibit insignificant negative long-run associations with RER as anticipated. This study advances the literature by providing robust longitudinal evidence of remittance-exchange rate dynamics in Afghanistan, establishing distinct short-run adjustment pathways (ECT=-0.69) and long-run equilibrium relationships (β=-0.081) that refine existing theoretical models for conflict-affected economies.

Comprehending remittance-driven effects on (1) M2 money supply, (2) interest rate fluctuations, (3) inflationary pressures, and (4) export price elasticities remains critical for Afghanistan's central banking operations.

Policymakers must monitor net remittance inflows carefully to ensure they support, rather than undermine, sustainable economic growth.

The findings of this research suggest that REMs exert downward pressure on the RER in the long-term, increase the value of the Afghan currency. However, in the short-term, remittances may contribute to currency depreciation, primarily because they are largely spent on consumption rather than investment. This consumption-driven demand can increase inflation, particularly in the non-tradable sector, ultimately weakening the currency in the short-term.

The study identifies two primary transmission channels through which REMs affect the RER, namely the External Balance Channel by improving the country's net foreign asset position without incurring liabilities, and the Domestic Demand Channel, where increased spending on non-tradables contributes to inflation and currency pressures. In the long-run, however, the effect stabilizes and leads to currency appreciation. More importantly, based on our findings, three key monetary and economic policy recommendations are proposed for Afghanistan:

1. Exchange Rate Management & Monetary Policy Interventions: To mitigate excessive appreciation of the Afghan currency driven by remittance inflows, the central bank of Afghanistan could adopt a managed floating exchange rate regime combined with sterilization policies. This would involve intervening in the foreign exchange market by purchasing incoming U.S. dollars and accumulating reserves, thereby easing upward pressure on the local currency.

2. Enhancing Trade Balance and Export Competitiveness: To counter potential Dutch Disease effects and preserve export competitiveness, several targeted strategies are recommended:

- Export Subsidies/Tax Incentives: Provide tax incentives, subsidies, or improved access to credit for export-oriented sectors such as agriculture and textiles to encourage production and external trade.
- Import Substitution Policies: Implement selective tariffs or quotas on non-essential imports to help narrow the trade deficit. However, these measures must be carefully designed to avoid unintended consequences such as trade retaliation or increased smuggling.
- Long-Term Productivity Investments: Allocate remittance-driven revenues toward improving infrastructure and education, thereby enhancing productivity and competitiveness in the tradable goods sector over the long run.

These policy interventions are proposed to address Afghanistan's structural economic challenges while taking into account the country's ongoing fragility and dependence on external financial flows.

Author Contributions

Conceptualization, all authors; methodology all authors; formal analysis, all authors; resources, all authors; writing—original draft preparation, all authors; writing—review and editing, all authors. All authors have read and agreed to the published version of the manuscript.

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The authors declare no conflict of interest.

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Appendixes

Table 8. The list of variables and their statistical description

	RER	RM	ODA	GDP	FDI	XGS	WIR
Mean	3.94317	0.62079	20.9106	4.22518	16.4597	19.9377	0.94254
Median	3.92379	0.52576	20.8729	2.72454	16.4524	19.8963	0.25067
Maximum	4.18538	1.47772	21.2459	21.3905	18.0482	20.8278	5.11067
Minimum	3.76425	-0.185	20.67	-20.739	14.2403	19.4492	0.05033
Std. Dev.	0.1197	0.6274	0.18862	9.28196	0.86264	0.38095	1.30877
Observations	60	60	60	60	60	60	60
Sources	ACB[1]	WB[2]	WB	WB	WB	ADB[3]	US FD[4]

Source: *research finding*

[1] Afghanistan central Bank
[2] World Bank
[3] Asian Development Bank
[4] United State Financial database

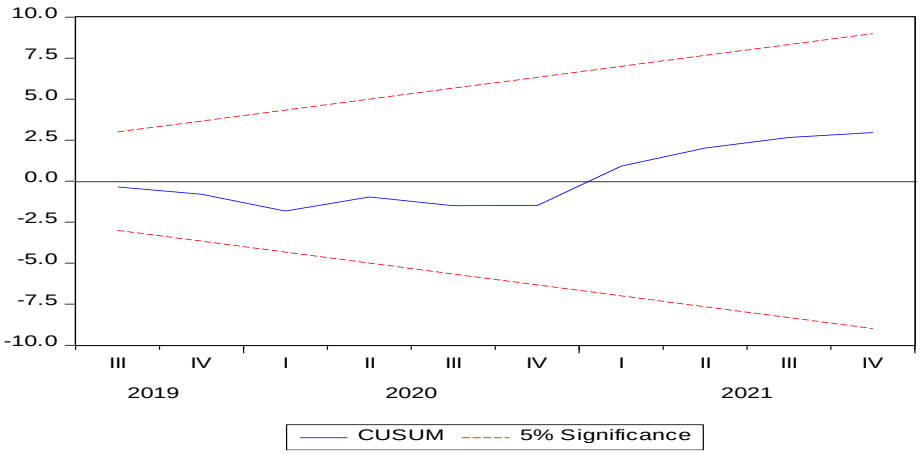

Figure B1. CUSUM Test
Source: *research findings*

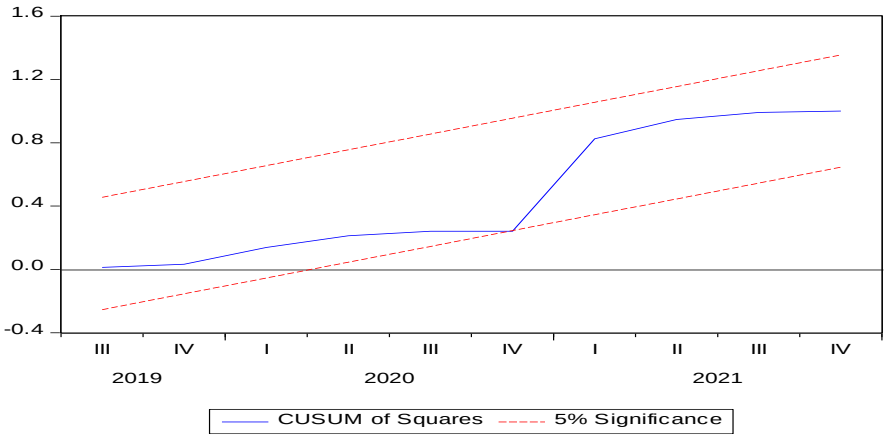

Figure B2. CUSUMQ Test
Source: *research findings*