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The Asymmetric Effect of Remittances on Financial Development in Jordan: A Nonlinear ARDL Analysis

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Abstract

Globally, the inflows of migrant workers' remittances have surged dramatically over the last few decades. Furthermore, remittances' inflows have influences on various economic and social aspects. In this context, this study utilizes data on Jordan from 1980 to 2019 to analyze the asymmetric short-run and long-run impacts of remittances on financial development in the country by applying the linear and nonlinear Autoregressive Distributed Lag (ARDL) model. The estimation results revealed the existence of an asymmetric long–run equilibrium relationship, where positive (negative) short-run shocks in remittances exert positive (negative) impacts on financial development. Understanding the nature of such a relationship may help policymakers in Jordan to realize the importance of the role remittances play in developing the financial sector, and hence, the role of international migration of domestic labor in that context. Hence, encouraging remittance inflows through formal channels, promoting the financial literacy and education, reducing the cost of transferring remittances through formal channels, and encouraging the use of formal financial institutions' services may induce a greater influence of remittances on the financial sector of Jordan.

Keyword: Remittances, Financial Development, ARDL, Cointegration, Jordan. Journal classification: F24, F41, F63, F68

Introduction

The globalization movement in the last three decades led to a significant surge in the number of migrants who are working outside their homelands, which amounted to about 250 million people. Consequently, the remittance volume in recipient countries registered a maximum level of $549 billion in 2019 (Chuc et al., 2020; Sami et al., 2020). Furthermore, remittance inflows come second to Foreign Direct Investment (FDI) flows as the largest significant and stable source of external finance for developing countries (World Bank, 2016; Aggarwal et al., 2006).

For that reason, the issue of workers' remittances inflows has continued to attract the attention of policymakers and researchers in both labor-recipient and labor-sending countries.

As a result, a substantial body of applied studies examined the various dimensions related to macro and microeconomic impacts of remittance inflows. For example, these dimensions included economic growth (Falade et al., 2021; Waqas, 2017; Al-Abdulrazag, 2017), consumption (Waqas, 2017; Hadeel & Omet, 2021; Vincent & Florian, 2018), and human and physical investment (Waqas, 2017), among others. Yet, the question of whether or not remittances promote financial development (FD) remains open and testable (Orozco & Fedewa, 2005; Paola et al., 2005). Moreover, remittances are considered a substitute for financial credit by easing the liquidity constraint facing households. In this context, remittances provide an alternative way of financing investment expenditures on human and physical capital for households that are excluded from obtaining loans from the financial system (Md., 2021; Vincent & Florian, 2018). However, this ambiguous and undetermined effect stems from the

conflicting theoretical perspectives on the role of remittances in financial development (Vincent & Florian, 2018). Moreover, remittances act as an insurance against any sudden local shocks to their income, since they are not affected by these shocks (Vincent & Florian, 2018).

In conclusion, remittances could reduce demand for credit and hence have a dampening effect on credit markets where several applied papers provide support for this view (Azizi, 2020;

Thompson & Temidayo, 2021; Bhattacharya et al., 2018; Donou et al., 2020). Furthermore, remittances are viewed as a stimulus for FD for both the recipient and non-recipient individuals. For example, on the demand-side, recipients become more willing to apply for loans due to improvements in financial literacy and/or banks' having more trust in recipients. However, due to the consistent source of revenue, banks have become more eager to offer loans to remittance recipients (Vincent & Florian, 2018). As for non-recipients, credit could increase because remittances increase the loanable funds available for banks as recipients' savings increase, and banks will offer more financial products or create new branches to attract more recipients, which in turn will benefit the population.

This study examines whether or not remittance inflows affect financial development in Jordan. The question is relevant since some argue that remittance recipients will help in developing the financial sector (Aggarwal et al., 2006). Contrary to the previous research in Jordan, which assumed a linear relationship, the present study contributes to the existing literature on the remittance-financial development nexus in Jordan by examining the short-run and long-run asymmetric relationships utilizing the Nonlinear ARDL (NARDL) model framework proposed by Shin et al. (2014) in order to show the positive and negative effects of short-run shocks in remittance inflows. Furthermore, the Kruse's (2011) nonlinear unit root tests and the nonlinearity test are used by performing the Brock et al. (1987) (BDS) test.

The study's findings indicate the existence of a long–run asymmetric equilibrium relationship where remittance inflows have a nonlinear effect on financial development; that is, the positive and negative shocks in remittance have adverse impacts. These results provide evidence of the important role of remittance inflows in developing and promoting financial development in Jordan. The results suggest that policymakers could harvest the potential gains from remittances' inflows on the financial sector development by various ways, such as promoting financial literacy and education; reducing the cost of transferring remittances through formal channels; and encouraging the use of formal financial institutions' services and labor migration, which may induce a greater influence on remittances on the financial sector.

The paper is structured as follows: following the introduction, Section 2 demonstrates the development of remittance inflows and financial development in Jordan. Section 3 surveys the existing literature. Section 4 presents the research methodology and data sources. Section 5 presents the empirical results, while Section 6 presents the results discussions. Finally, this paper ends with a conclusion and some suggested policy recommendations.

2. Remittances and Financial Development: Review of Prior Literature

2.1 Theoretical Background

The current literature has not provided a consistent theoretical framework for establishing the causal link between remittances and financial development. Orozco and Fedew (2005) argued that remittances might affect financial development, particularly in a developing country setting, based on the encouragement efforts of financial intermediaries to remittances' recipients, enticing them to deposit received remittances in the financial system while helping them reach out for other financial products and services. Consequently, financial intermediaries would put more effort into expanding their loanable funds to recipients, positively impacting credit market growth. Conversely, due to a lack of trust in the banking system, there are various ways in which remittance inflows could deter banks' ability to promote loanable funds and,

hence, might have a negative effect on financial development. For example, directing remittances to consumption activities rather than being deposited in the banking system, acting as a substitute for financial credit would discourage recipients from reaching the financial system, and if banks' lending preference is in favor of the public sector rather than the private sector, remittances hike may not increase loanable funds to the latter.

2.2 Empirical Literature

The applied work on remittances flows into macroeconomic and microeconomic streams. For instance, the microeconomic stream concentrates on the impact of remittances on education, health, poverty, household consumption using household data, and motivation to remit, among others. The macroeconomic stream focuses on investment in productive assets, imports, aggregate consumption, income, inflation, and FDI, among others. The early literature has identified a significant positive impact of remittances on various economic factors (Aggarwal et al., 2006). Focusing on financial variables allows investigating their expected important role in enhancing financial sector, especially in many developing countries where remittance flows constitute the major external financial resource for their economies.

An extensive body of empirical literature investigating the remittances-financial development nexus relationship reveals conflicting results. A stream of research studies on the contribution of remittances according to the level of income (low, middle, and high) found that the positive impact of remittance is stronger in developed countries with advanced financial development than in developing countries (Vincent & Florian, 2018; Azizi, 2020).

On the regional level, several studies found a positive relation between remittances and financial development: for instance, Issahaku (2019) for some selected developing countries; Aggarwal et al. (2006) for 99 developing countries; Thompson and Temidayo (2021) in four African countries; Witness et al. (2019) in 14 Southern African Development Community countries (SADC); Bhattacharya et al. (2018) in the 57 highest remittance recipient economies; Donou et al. (2020) in Sub-Saharan countries; Al Manaseer and Ahmad (2015) in eight Arab countries. On the other hand, several studies found a negative relation; for example, Keho (2020) in African western countries and Karikari et al. (2016) in Africa. Other studies found mixed impacts, for example, Bayar and Sezgin (2016) in Central and Eastern European countries, Taiwo et al. (2012) in Sub-Saharan African countries. In addition, Naceur et al. (2020) reported a non-linear U-shaped relationship in 124 countries.

On the countries-specific level, several studies found mixed results, where the positive impact indicates that remittances act as a substitute for credit; for example, Hadeel and Omet (2021) in Jordan; Falade et al. (2021), Omobolanle et al. (2019), Godwin et al. (2013), Babatunde et al. (2011) in Nigeria; Muhammad et al. (2019), Janesh (2013), Prakash (2009) in Fiji; Riaqa et al. (2016), Waqas Javaid (2017), and Faheem et al. (2019) in Pakistan; Ahmad and Selliah (2020) in Siri Lanka; Misati et al. (2019) in Kenya; and Al-Abdulrazag and Abdel-Rahman (2016) for Saudi Arabia. On the other hand, other studies found a negative impact, indicating the complementarity relation existing between remittances and total credit; for example, Karikari et al. (2016) and Md. (2021) in Bangladesh.

Regarding the research methodologies used, various estimation techniques were applied. Hadeel and Omet (2021), Falade et al. (2021), Karikari et al. (2016), Janesh (2013), and Omobolanle et al. (2019) applied the cointegration and VECM approach. Furthermore,

Muhammad et al. (2019), Mehta et al. (2021), Md. (2021), Ahmad and Selliah (2020), Faheem et al. (2019), Misati et al. (2019), Godwin et al. (2013), Janish (2013), Taiwo et al. (2012), and Prakash (2009) applied either the ARDL or NARDL estimation approach. Moreover, Waqas Javaid (2017) applied linear regression, Bayar and Sezgin (2016) applied the LM bootstrap cointegration technique, Vincent and Florian (2018) applied the ARDL PMG, Thompson and Temidayo (2021) applied the Toda-Yamamoto causality approach to Panel data, Aziz (2020) relied on the instrumental variable-fixed effect approach, Donou et al. (2020) used the Panel Cointegration approach; and Al-Manaseer, Ahmad (2015), Naceur et al. (2020), Issahaku (2019), Witness et al. (2019), Bhattacharya et al. (2018), Babatunde et al. (2011) all applied dynamic panel Generalized Method of Moments (GMM) regressions.

As for Jordan, few applied studies have examined the remittance-financial development nexus. Alaaeddin (2016), Hadeel and Omett (2021), Al-Manaseer (2015), and Al-Shraideh (2015), for example. Exploring these studies, one can tell that they used shorter periods, except for Hadeel and Omett (2021). Furthermore, they used different estimation methods, for example, the TAR approach (Alaaeddin, 2016), VECM (Hadeel & Omett, 2021), Panel data (Al-Manaseer, 2015), and ARDL (Al-Shradideh, 2015). In addition, some of these studies neglected to include some control variables, such as FDI, inflation, and trade openness, among others. Using the ratio of credit to the private sector by banks to GDP, the results were mixed where most of them found a direct linkage, except for Hadeel and Omett (2021), who found an inverse one. The justification of the positive association is that remittances are mainly directed towards consumption activities, while the negative association may indicate the substitution relation of remittances. However, this existing research assumed a linear relationship between remittances and financial development, which could lead to some estimation problems. Therefore, this flaw in their work provided a motivation for this study to investigate the existence of a nonlinear relationship nexus in Jordan, that is, to examine the effects of positive and negative short-run shocks in remittances on financial development.

In conclusion, the above surveyed empirical literature has shown some conclusive evidence and adverse outcomes. The contradicting outcomes may be due to the different data composition, the existence of country-specific and regional-specific factors, the application of various estimation techniques, and variable measurement.

3. Econometric Methodology and Data Source

3.1 The Econometric Model

This paper uses the NARDL model to capture the asymmetric effects of positive and negative short-run shocks in remittances on FD in Jordan over the 1980-2019 period. The sources of the necessary data required were the Central Bank of Jordan (CBJ) and the World Development Indicators (WDI). To establish the linkage between remittances and financial development, a multivariate model is constructed as follows:

$$FD_t = f(REM_t, GDP_t, \mathbf{Z_t}) \qquad (1)$$

Where FD_t is the financial development indicator, REM_t is remittances inflows, and $\mathbf{Z_t}$ is a vector of control variables. Following Cameron's (1994) suggestion that a log-linear form

is more suitable than a linear form (cited by Babatunde et al. 2011), equation 1 is expressed in a logarithmic form that transforms the variables' parameters into elasticities as follows:

$$LFDt = a_0 + \lambda_1 LREM + \lambda_2 LGDP + \lambda_3 LZ_t + e_t \quad (2)$$

Where λ_1, λ_2, and λ_3 are the model parameters, and e_t is white noise. In addition, all data are current at 2010 prices.

Variable Definition

Following previous literature by Hadeel and Omet (2021), Vincent and Leon (2018), Falade et al. (2021), Bayar and Sezgin (2016), Karikari et al. (2016), Omobolanle et al. (2019), Alaadeen (2016), Al-Manaseer (2015), Mehta et al. (2021), Faheem et al. (2020), Keho (2020), Aziz (2020), Misati and Kamau (2019), and Anwar et al. (2013), this study employs the ratio of credit to the private sector by banks (CBP) to GDP as a proxy for the financial development variable. This measure indicates the quantity and quality of investment financed by the banking sector. In addition, the financial systems that funnel large loanable funds to the private sector are more deeply involved in performing the five functions of the financial system than other systems that simply channel credit to the public sector (Babatunde et al., 2011). Remittances ($LREM$) is the ratio of current private transfers from migrant workers in the host countries to recipients in their home countries (to GDP), and it was used by Falade et al. (2021), Omobolanle et al. (2019), Hadeel and Omett (2021), Mehta et al. (2021), Faheem et al. (2020), Keho (2020), Aziz (2020), and Misati and Kamau (2019), among others. Per capita GDP is used as a proxy for economic growth as specified in various studies such as Hadeel and Omett (2021), Mehta et al. (2021), Faheem et al. (2020), Keho (2020), Aziz (2020), and Misati and Kamau (2019), among others. The vector variables LZ_t refers to the control variables that are expected to have an effect on financial development and are introduced to avoid the problem of omitted variables bias in the model. They include trade openness ($LOPEN$) measured as the trade share of GDP (Hadeel and Omet (2021), Alaadeen, (2016), Al-Manaseer (2015), Mehta et al. (2021), Keho (2020), Aziz (2020); the Consumer Price Index ($LCPI$, $2010 = 100$) proxies, and the inflation rate (Hadeel & Omet (2021), Alaadeen (2016), Manseer (2015), Mehta et al. (2021), Keho (2020), and Aziz (2020)), whereas e_t is the error term, and L refers to the natural logarithm. It is expected that remittances positively affect financial development, where ($\lambda_1 > 0$).

Table 1: Descriptive statistics

	LBCP	LREM	LOPEN	LYC	LCPI
Mean	4.209	7.525	4.758	8.072	4.136
Maximum	4.517	8.759	5.007	8.256	4.834
Minimum	3.839	6.105	4.405	7.833	3.162
Std. Dev.	0.152	0.706	0.159	0.122	0.511
Skewness	-0.344	-0.057	-0.491	-0.330	-0.405
Kurtosis	3.344	1.987	2.515	1.879	1.998
Jarque-Bera	0.984	1.733	2.004	2.819	2.766

3.2 The Estimation Approach

To achieve its goal, this study employs the Linear and Nonlinear (ARDL) methodologies to establish the possible asymmetric long-run and short-run relationships between financial development and remittances in Jordan. The ARDL model has various advantages over other existing estimation approaches. For instance, the bound test for cointegration can be performed regardless of the order of integration of the variables - but not I(2) - as required by the Johansen and Juselius (1988, 1990) test and the Engle-Granger test (1987). In addition, the ARDL is a more statistically significant approach for determining the co-integrating relationships in small samples (Ghatak & Siddiki, 2001), while the Johansen co-integration technique requires the use of large data samples (for more details, see Taiwo and Sylvanus, 2012; Narayan, 2005). Furthermore, Pesaran and Smith (1999) argued that an appropriate modification of the ARDL order is sufficient to correct for the problem of serial correlation and endogeneity simultaneously (Md., 2021; Janish, 2013). Following Pesaran et al. (2001), equation 2 can be written as an unrestricted error correction model (UECM) as follows:

$$\Delta LFD_t = \beta_0 + \beta_1 LFD_{t-1} + \beta_2 LREM_{t-1} + \beta_3 LGDP_{t-1} + \beta_i LZ_{t-1} + \sum_{i=1}^{p_1} \theta_1 \Delta LFD_{t-1} + \sum_{i=0}^{q} \theta_2 \Delta LREM_{t-1} + \sum_{i=0}^{r} \theta_3 \Delta LGDP_{t-1} + \sum_{i=0}^{s} \theta_4 \Delta LZ_{t-i} + \varepsilon_t \quad (3)$$

Where Δ indicates the first difference of the variable, β_0 is the constant, β_1, β_2, β_3, and β_i (θ_1, θ_2, θ_4, and θ_4) are the long-run (short-run) elasticities. Moreover, equation (3) can be viewed as an ARDL of order (p, q, r, s), and it indicates that financial development tends to be influenced and explained by its past values plus the lagged values of the control variables. The structural lags are established by using the minimum Akaike's information criteria (AIC). In addition, the Wald test (F-statistic) was applied to test for the long-run equilibrium among variables, which is sensitive to the model lag length (Shahbaz et al., 2012). The null hypothesis of no cointegration is $H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ versus the alternative hypothesis $H_a: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$. Thus**,** the calculated F-statistic compared with the tabulated values determines the acceptance (rejection) of H_0. Accordingly, if the calculated F-statistic is less than the lower bound critical value, then H_0 cannot be rejected; otherwise, there is a long-run level relationship (Davoud et al., 2013). However, if the computed F-statistic falls between the two boundaries, then the results are inconclusive.

Once co-integration is established, then the conditional ARDL (p, q, s, r) long-run model for LFD_t becomes as follows:

$$LFD_t = \beta_0 + \sum_{i=1}^{p} \beta_1 \Delta LFD_{t-i} + \sum_{i=0}^{q} \beta_2 LREM_{t-i} + \sum_{i=0}^{r} \beta_3 LGDP_{t-i} + \sum_{i=0}^{s} \beta_4 L\boldsymbol{Z}_{t-i} + \varepsilon_t \quad (4)$$

Subsequently, determining the lag order of the VAR involves selecting the ARDL (p, q, r, s) model order in the four variables by implementing the AIC criteria.

Next, the short-run dynamic parameters are obtained by estimating an Error Correction Model (ECM) as follows:

$$\Delta LFD_t = \beta_0 + \sum_{i=1}^{p} \gamma_i \, \Delta LFD_{t-i} + \sum_{j=0}^{q} \nu_i \, \Delta LREM_{t-j} + \sum_{k=0}^{r} \sigma_i \, \Delta LGDP_{t-k} + \sum_{m=0}^{s} \delta_i \, \Delta LZ_{t-m} + \lambda_1 ECT_{t-1} + \varepsilon_t \quad (5)$$

Where, $\sigma, \nu, \gamma, and\ \delta_i$ are the short-run dynamic model's parameters measuring convergence to equilibrium, and λ_1 is the speed of adjustment to the equilibrium parameter, which is expected to be negative, hence, indicating the existence of a long-run causality running from remittances to financial development. Further, the short-run causality from remittances to FD is investigated by testing the hypothesis:

$$H_0 = \nu_1 = \cdots \ldots \ldots \ldots = \nu_i = 0$$

The rejection of H_0 indicates a unidirectional causality running from remittances to financial development.

3.3 Nardl Model

One flaw of the linear ARDL approach proposed by Pesaran et al. (2001) is that it does not consider the asymmetric (nonlinear) long-run relationship among the variables, whereas the NARDL proposed by Shin et al. (2014) does. Furthermore, the NARDL model has some advantages over other cointegration techniques (for more details see Carlos, 2017). Following Shin et al. (2014), the specification of an asymmetric long-run model describing the financial development-remittances nexus is as follows:

$$LFD_t = \theta_0 + \theta_1 x_t + \ \theta_2 LREM_t^+ + \ \theta_3 LREM_t^- + \mu_t \quad (6)$$

Where LFD_t is the financial development variable, $LREM_t^+$ and $LREM_t^-$ are the partial sum processes which accumulate positive and negative changes in remittances, x_t is a $(k \times 1)$ vector of control variables, and $\theta = (\theta_0, \theta_1, \theta_2, \theta_3)$ are the long-run parameters to be estimated.

According to Shin et al. (2014), the NARDL model is constructed around the decomposition of the asymmetric long-run equilibrium relationship of the $LREM_t$ effect as:

$$LREM_t = \ x_0 + \ LREM_t^+ + LREM_t^- \quad (7)$$

Where x_0 is a random initial variable:

$$LREM_t^+ = \sum_{i=1}^{t} \Delta LREM_j^+ = \sum_{t=1}^{t} max\left(\Delta LREM_j, 0\right) \quad (8)$$

$$LREM_t^- = \sum_{i=1}^{t} \Delta LREM_j^- = \sum_{t=1}^{t} min\left(\Delta LREM_j, 0\right) \quad (9)$$

From Equation (6), the expected positive (negative) long-run relation between LFD and $LREM_t^+$ $(LREM_t^-)$ is captured by θ_2 (θ_3). It is posited that remittances increases will result in

higher long-run changes in FD as compared to the impact of remittances decreases of the same magnitude, i.e., $\theta_2 > \theta_3$.

Following Shin et al. (2014), equation (1) can be rewritten in the context of an ARDL as:

$$\Delta LFD_t = \beta_0 + +\beta_1 LFD_{t-1} + \beta_2 Z_{t-1} + \beta_3 LREM^+_{t-1} + \beta_4 LREM^-_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta LFD_{t-i} + \sum_{i=1}^{K} \delta_i \Delta Z_{t-i} + \sum_{i=0}^{q} (\delta_i^+ \Delta LREM^+_{t-1} + \delta_i^- \Delta LREM^-_{t-1}) + \lambda ECT_{t-1} + \varepsilon_t \quad (10)$$

Equation (10) represents the long-run and the short-run asymmetric effects of remittance inflows on LFD. Where $Kk, p, and\ q$ are lag orders, ($\beta_3 = -\delta_i^+/\beta_1$, $\beta_4 = -\delta_i^-/\beta_1$) are the long run effects of $LREM^+_{t-1}$ and $LREM^-_{t-1}$ on FD. The $\sum_{i=0}^{q} \delta_i^+$ captures the short run effect of increases in LREM on LFD, whereas $\sum_{i=0}^{q} \delta_i^+$ captures the short run effect of decreases in LREM on LFD. The bounds testing approach was applied by performing the Wald F-statistic test to the null hypothesis of no cointegration ($H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$) as opposed to the alternative ($H_a: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$). Further, the Wald F-statistic is performed to test for the long-run (short-run) asymmetric effect on the null hypothesis $H_0: \beta_3 = \beta_4$ ($H_0: \delta_i^+ = \delta_i^-$) against the alternative hypothesis of the asymmetric effect $H_0: \beta_3 \neq \beta_4$ ($H_1: \delta_i^+ \neq \delta_i^-$). Moreover, the asymmetric cumulative dynamic multiplier effects of a one percent change in $LREM^+_{t-1}$ and $LREM^-_{t-1}$ are as:

$$m_k^+ =, \sum_{j=0}^{k} \frac{\partial REM_{t+j}}{\partial REM^+_{t-1}} \qquad m_k^- = \sum_{j=0}^{k} \frac{\partial REM_{t+j}}{\partial REM^-_{t-1}}, \quad k = 0,1,2 \ldots \ldots \quad (11)$$

Note that as $k \to \infty$, $m_k^+ \to \beta^+ \; and \; m_k^+ \to \beta^-$

4. ARDL Model Estimation Results

4.1 The Unit Root Test

Table 2 reports the standard (ADF) unit root test of the model variables with the AIC lag selection criteria. It was discovered that all series are integrated by I(0) or I(1) but not by I(2).

Table 2: ADF (constant and linear trend)

Variable	Level	1st Diff.	integration
LREMIT	-3.11	-4.702***	I(1)
LY	-0.561	-3.129**	I(1)
LCPI	-1.984	-3.956*	I(1)
LOPEN	-1.359	-4.913*	I(1)
LBCP	-1.006	-4.480*	I(1)

"*", "**", and "***" indicate the significant level at 1%, 5%, and 10% respectively

4.2 Estimation Results

4.2.1 Nonlinearity Test

The results of nonlinearity with the Jarque-Bera test on the residuals recovered from Eq. (1), of 1.063014, were insignificant, and hence, the null of normality is overwhelmingly rejected at the highest levels of significance. Furthermore, Brock et al. (1996) BDS test applied to these residuals rejects the null hypothesis of serial dependence at all possible dimensions and at all levels of significance, thus providing strong evidence that the remittance inflows financial development relationship in Jordan is nonlinear as shown in table (3). The BDS results revealed that an increment to a data series is independent and identically distributed (*iid*).

Table 3: BDS Test for RESID03

Dimension	BDS Statistic	Std. Error	z-Statistic	Prob.
2	0.106405	0.007341	14.49389	0.0000
3	0.166749	0.011840	14.08293	0.0000
4	0.193152	0.014305	13.50214	0.0000
5	0.196687	0.015129	13.00073	0.0000
6	0.179331	0.014807	12.11106	0.0000

4.2.2 The Nonlinear Unit Root Test

The nonlinear unit root test is performed by applying Kruse (2011) procedures. Table 4 shows the rejection of H_0 of linearity at a 1% significance level. Hence, the model variables follow the nonlinear process of becoming stationary.

Table 4: nonlinear unit root test

Series	Level Series	Demeaned Series
LBCP	8.524432***	10.28688
LCPI	7.856688	3.162972
LDCP	8.492803	10.37295
LOPEN	6.91623	8.766914
LREM	1.281076	6.870145
LY	8.996009	2.383386
Asymptotic Critical t-Value	Case 1	Case2
1%	13.15	13.75
5%	.53	10.17
10%	7.83	8.62

It can be inferred from the ARDL model results shown in table 5 that all variables are significant at 1% or 10% level at their respective levels.

Table 5: ARDL (3, 1, 0, 0, 3): Dependent Variable: LBCP

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LBCP(-1)	0.854932	0.164737	5.189667	0.0000
LBCP(-2)	-0.107893	0.223350	-0.483068	0.6333
LBCP(-3)	-0.272330	0.158693	-1.716074	0.0985
LREM	-0.242435	0.060414	-4.012891	0.0005
LREM(-1)	0.105177	0.046473	2.263178	0.0326
LOPEN	0.243838	0.062016	3.931884	0.0006
LYC	0.339040	0.147883	2.292623	0.0306
LCPI	-0.497419	0.199604	-2.492028	0.0197
LCPI(-1)	0.084143	0.318146	0.264480	0.7936

LCPI(-2)	0.136705	0.315786	0.432904	0.6688
LCPI(-3)	0.514808	0.194926	2.641040	0.0140
C	-1.547235	0.857759	-1.803811	0.0833
R^2	0.934498	Prob(F-statistic)		0.000000

The results of the bounds test for cointegration in table 6 provide evidence of the existence of a long-run equilibrium relationship among model variables as seen from the F-bound test (7.76), which is greater than the critical value of the upper level (4.37) at 1% level of significance.

Table 6: bounds test results

F-Bounds Test		**H_o: No levels relationship**		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	7.715	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

4.2.3 Diagnostic and Stability Tests

Table 7 presents the results of the diagnostic tests that revealed the model validity. Furthermore, there is no evidence of Heteroskedasticity. The Jarque–Bera statistic shows that the error term is normally distributed, the BG-LM test indicates that the model is free of serial correlation problems, and the Ramsey RESET test indicates that the model is correctly specified. In addition, the model is free of the structural break problem as indicated by the (CUSUM) and (CUSUMSQ) tests proposed by Borenstein et al. (1995).

Table 7: Diagnostic and stability tests results

Diagnostic Test	**F-statistic**	**Prob.**
Heteroskedasticity BPG Test:	0.625	0.782
Breusch-Godfrey LM Test	0.997	0.384
Jarque-Bera normality test	0.054	0.974
Ramsey RESET Test	1.852	0.186
Recursive Stability test	CUSUM and CUSUMSQ	Stable

4.3 The Estimation Results

4.3.1 The Short-Run Estimation Results

The short-run estimation results presented in table 8 reveal that all the differenced variables are having significant negative impacts on the financial development indicator (LBCP) except for the first and second lagged dependent variables. Moreover, the error correction term (-0.529) is negative and significant; thus, the model variables are moving toward a long-run equilibrium relationship, and it requires about two years for the model to reach the long-run equilibrium relationship after a short-run sudden shock.

Table 8: Short-run ARDL (3, 1, 0, 0, 3) Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LBCP(-1))	0.380223	0.115691	3.286532	0.0030
D(LBCP(-2))	0.272330	0.125520	2.169619	0.0397
D(LREM)	-0.242435	0.041663	-5.818990	0.0000
D(LCPI)	-0.497419	0.154490	-3.219759	0.0035
D(LCPI(-1))	-0.651514	0.192608	-3.382582	0.0024
D(LCPI(-2))	-0.514808	0.164929	-3.121395	0.0045
CointEq(-1)*	-0.525291	0.070483	-7.452708	0.0000

4.3.2 Long-Run Estimation Results

The long-run estimation results reported in table 9 reveal that remittance inflows (LREM) negatively impact the financial development indicator (LBCP). A 10% increase in the remittance inflows results in a 1.1% decrease in the domestic credit provided by banks; thus, remittance inflows act as a substitute for domestic credit provided by banks. Contrary to remittance inflows, control variables are having positive impacts on the FD indicator, where a 10% increase in LYC, LOPEN, and LCPI increases financial development by 6.45%, 4.64, and 4.53%, respectively.

Table 9: Long-Run estimation: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LREM	-0.261298	0.095484	-2.736551	0.0113
LOPEN	0.464197	0.125349	3.703238	0.0011
LYC	0.645433	0.235743	2.737864	0.0112
LCPI	0.453534	0.104954	4.321259	0.0002
C	-2.945480	1.524617	-1.931948	0.0648

4.3.3 NARDL Empirical Results

Based on the results of the F-bound-test of cointegration presented in table 10, which assumed a value of 7.65, the null hypothesis can be rejected, and hence, there is a long-run relationship.

Table 10: bounds test results

F-Bounds Test		**H_o: No levels relationship**		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	**7.65**	10%	2.08	3
		5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15

As table 11 shows, the diagnostic statistical tests provide evidence of the reliability of the estimated results. It shows that the residuals are normally distributed, the model is free of the autocorrelation problem, the variance of the error term is homoscedastic, and there is no model misspecification problem. Moreover, the CUMS and CUSMUSQ tests indicate that the estimated parameters are free of any structural breaks.

Table 11 Diagnostic and stability tests results (NARDL

Diagnostic Test	F-statistic	Prob.
Heteroskedasticity BPG Test:	0.794	0.659
Breusch-Godfrey LM Test	0.319	0.730
Jarque-Bera normality test	0.291	0.865
Ramsey Test	1.907	0.070
CUMS and CUSMUSQ	Stable	

4.3.4 The Long-Run NARDL Results

The effects of long-run positive and negative shocks in LREM on LFD are shown in table 12. The LREM_POS shock has a direct effect on LFD, where a 1% increase in LREM causes a 0.199% increase in LFD. In contrast, LREM_NEG has an inverse impact, where a 1% decrease in LREM leads to a 0.33% increase in LFD.

Table 12: Long-Run NARDL Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LREM_POS	0.199859	0.058954	3.390112	0.0026
LREM_NEG	-0.334030	0.066252	-5.041799	0.0000
LOPEN	0.237300	0.095953	2.473079	0.0216
LYC	0.399949	0.139957	2.857661	0.0092
LCPI	-0.497274	0.131045	-3.794687	0.0010
C	1.259707	1.086796	1.159102	0.2588

4.3.5 The Short-Run Results

The short-run estimation results shown in table 13 indicate that all lagged positive and negative shocks in LREM are having negative impacts on LFD except for D(LREM_POS(-1)).

Table 13: Short-Run: ARDL (3, 3, 0, 1, 0, 0) Results: DEPN VAR D(LBCP)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LBCP(-1))	0.604056	0.112472	5.370730	0.0000
D(LBCP(-2))	0.196495	0.106878	1.838497	0.0795
D(LREM_POS)	-0.097028	0.038961	-2.490383	0.0208
D(LREM_POS(-1))	-0.014878	0.049199	-0.302408	0.7652
D(LREM_POS(-2))	-0.134935	0.049049	-2.751028	0.0117
D(LOPEN)	0.085546	0.057973	1.475614	0.1542
DUM	-0.082817	0.016902	-4.899799	0.0001
CointEq(-1)*	-0.908040	0.110031	-8.252595	0.0000
R^2	0.788918	Hannan-Quinn criterion		-3.894409

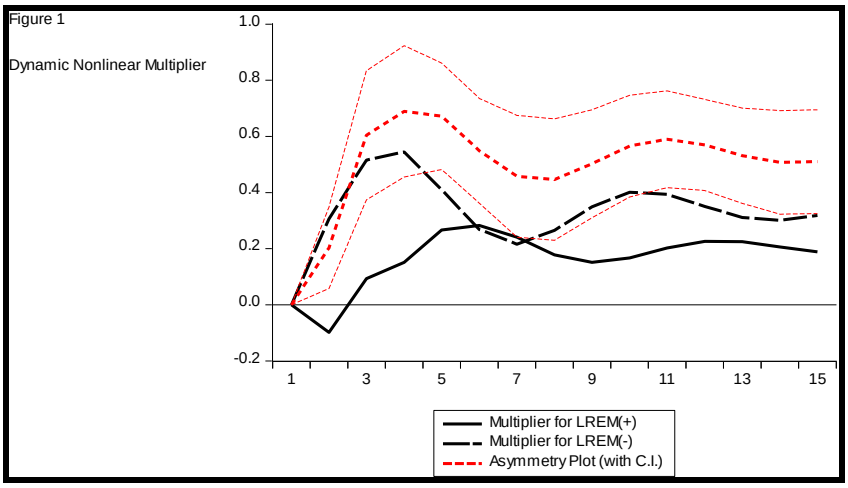
As for short-run results, only the LREM_POS has an effect on LFD, thus we can test the joint hypothesis. The Wald F-statistic test result (0.009) shows that the null hypothesis can be rejected. This points out the notion that there is short-run causality running from LREM_POS to LFD. Furthermore, table 14 presents the Wald-test statistics of the asymmetric short-run and long-run impacts. Accordingly, the LREM_POS and LREM_NEG shocks have different impacts on LFD only in the long-run, and hence, indicate an asymmetric long-run relationship.

Table (14): Results of short-run and long-run Asymmetry tests

Statistical test	F-stat	Prob	H_0
Long-run	17.19	0.000	reject
Short-run	*	*	*

4.3.6 The Dynamic Nonlinear Multiplier (CDM) Results

The dynamic multipliers analysis proposed by Shin et al. (2014) was utilized to demonstrate the cumulative dynamic nonlinear multiplier results for up to 15 years to indicate the reaction of financial development on the positive and negative changes in remittance outflows LREM. As shown in the figure, the zero line falls outside of the boundary of the asymmetric plot within a 95% confidence interval (Md. Fouad & Mohd, 2022). Hence, the CDM graph supports the asymmetric long-run relationship suggested by the Wald F-Statistic test in table 12.



Furthermore, the CDM graphs show that, initially, the difference between the negative changes in LREM is larger than the positive changes. However, this pattern changes between the 6th and 7th year, then it returns to its initial pattern after the 8th year. It takes about 13 years for both changes to become stable.

5. Discussion of the Results

The long-run estimation results of the linear ARDL in table 9 are significant; however, they have adverse impacts on the financial development indicator. They revealed the negative impact of remittances on the LFD indicator, where a 10% increase in remittances decreases the LFD indicator by 2.61%. This result implies that remittances act as a substitute for financial inclusion. The result is consistent with those of Karikari et al., 2016; and Md., 2021, in Bangladish; Keho (2020) in West-African countries; and Karikari et al., 2016 for the rest of Africa. The level of income positively affects LFD, where a 10% increase in income leads to a 6.4% increase in the indicator. This result is supported by Vincent and Florian (2018); Hadeel and Omet (2021) in Jordan; and Falade et al., 2021; but is contrary to Karikari et al. (2016), who found a negative effect of GDP. Regarding the positive effect of inflation, this shows that people, in the event of rising prices and the subsequent decline in their purchasing power, increase their demand for loans. This result contradicts Vincent and Florian (2018); and Karikari et al. (2016), who reported a negative impact. Finally, the trade openness positive impact reflects that trade helps expand business activities by allowing them to participate in

the international arena and that financial institutions are not isolated. This result is in line with the findings of Md. (2021), Muhammad et al. (2019), and Falade et al. (2021), who found a positive effect. However, it contradicts Karikari et al. (2016), Omobolanle et al. (2019), Md. (2021) findings, who found a negative effect, whereas Bayar and Sezgin (2016) found a mixed effect.

Conclusion

The present study explores the asymmetric long-run and short-run relationship between remittance inflows and financial development in Jordan over the period 1980-2019 by applying both the ARDL and ARDL models. The financial development was proxied by the ratio of the credit by banks to private sector to GDP (CBP/GDP). The estimation results of the ARDL and NARDL bounds tests confirm that variables are cointegrated. According to the ARDL estimation results, the significant and negative ECM term with a magnitude (-0.525) confirms the long-run causality running from variables jointly to financial development, further, it takes about two years to converge to equilibrium as consequence of a sudden short-run shock. Moreover, the NARDL estimation results revealed an asymmetric long–run equilibrium relationship, where positive (negative) shocks in remittances exert positive (negative) impact on financial development.

This study recommends that policymakers in Jordan could harvest the potential gains from remittances' inflows on the financial sector development by various ways, such as promoting financial education, reducing the cost of transferring remittances through formal channels, and encouraging the use of formal financial institutions' services which may induce a greater influence on remittances on financial sector.

The study can be enhanced by various ways. The quality, the true volume, and the coverage of remittances' inflows can be considered as a crucial issue. The use of informal channels through which remittance can be sent by unregulated firms and families remain unaccounted. This would underestimate the true remittances' inflows volume; hence, having better data could improve the estimation results. Moreover, the different natures of different recipient countries income groups and the use of these remittances' channels could explore the relationship between remittance inflows and financial development indicators. Finally, the use of different financial development indicators (combined indicators) could provide more understanding of the relationship.

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