Humanities & Social Sciences Communications

ARTICLE

https://doi.org/10.1057/s41599-023-01607-z OPEN

Do personal remittance outflows impede economic growth in Saudi Arabia? The role of trade, labor force, human, and physical capital

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Saudi Arabia is the leading economy in the Arabian Gulf region; it accounts for a significant amount of remittance outflow (RMO) to the rest of the world. The objective of the study is to investigate the impact of remittance outflow on the economic growth (EG) of Saudi Arabia by utilizing time-series data from 1985 to 2019 controlling trade, labor force, human capital, and physical capital. It employs the non-linear autoregressive distributive lag (NARDL) model, cointegrating regressions, and vector error correction (VEC) Granger causality check to accomplish the study. The outcomes of the NARDL exercise confirm a cointegrating association among variables and reveal that RMO has mixed but negative resultant impacts on the EG in the short run, while in the long run, EC growth is augmented if remittance outflows decline. Both trade and labor force positively contribute to EG, while neither human nor physical capital significantly influences the latter. The cointegrating regression outcomes precisely authenticate the NARDL findings and acknowledge their robustness. Moreover, the VEC Granger causality test also supports the NARDL outcomes. The outcome suggests that the policymakers may allure the expatriates through pragmatic labor laws, policies, and smart incentives to direct their savings to domestic consumption and investments. Moreover, the quality of education in general and tertiary education, in particular, needs to be upgraded in the real sense to develop the practical skills and efficiency of the Saudi labor force so that they can replace the expatriates. This will eventually reduce outbound remittances.

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Introduction

Studies on remittances have overwhelmingly grown, however, the attention has mainly been on remittance inflows. This is because inbound personal remittances have emerged as an important source of finance for economic expansion in many countries. After all, they are riskless and involve no refund. Many studies such as Martin et al. (2002), Adams and Page (2005), Yang and Choi (2007), Islam et al. (2012), Islam and Imran (2013), Yoshino et al. (2017), Jushi et al. (2021), and Islam (2022a) have examined the various kinds of the positive contribution of inbound remittances to the economic growth (EG) of remittance-receiving countries. On the other hand, studies on remittance outflow (RMO) are a relatively new phenomenon, and empirical pieces of evidence are few and confined to GCC countries. Empirical investigations into the impact of RMO on economic growth (EG) have received less attention perhaps because the size of RMO relative to sending economies' GDP is relatively small.

The current trend of research on the RMO-growth nexus has witnessed very limited pieces of studies. Relative to a large volume of research on the remittance inflow-growth nexus, there are only a few studies focused on the domain of RMO-growth relationship including Alkhathlan (2013), Kaabi (2016), Hathroubi and Aloui (2016), Rahmouni and Debbiche (2017), Khan et al. (2019), and Alsamara (2022). These studies are limited to the economies of Saudi Arabia, Qatar, and the GCC only, due to the insignificant share of RMO relative to the GDP of sending economies in other parts of the globe.

Generally, RMO occurs from rich economies to developing economies implying that the national income of the remittance-sending economy is usually big. The general perception about RMO is that it weakens the EG of the sending country, because, theoretically, it is likely to impede the economic expansion of a country, which sends remittances to other countries. RMO is a fraction of the income of the expatriates, which is a kind of import and an outbound flow of income from the economy. Therefore, based on the national income identity economists usually conceive that RMO may cause a decline in the EG of remittance-paying country. However, there is another side of the story that the expatriates also add to the GDP of the host country and thereby accelerate its EG, which is generally overlooked. Saudi Arabia is a host of millions of expatriates, who comprised 78% of the working population and 30% of its population during the last quarter of 2016 (Industry Brief, 2017). Accordingly, the Kingdom provides a significant volume of outbound remittances across the world. For example, in 2020, the volume of outbound remittances amounted to 3.5 billion US dollars which comprised 4.9% of its GDP (World Bank, 2021). This phenomenon needs to be investigated using the latest data and employing recent econometric exercises.

Figure 1 provides the nominal value of the RMO of the Kingdom in millions of US dollars during the study period and exhibits a steady rise. The highest value of RMO amounted to 3.88 billion US dollars in 2015 and then it slightly declined consecutively until 2019, and then again moved upward in 2020.

However, the volume of goods and services in the economy has also increased many folds over the same time, and as a result, RMO as a fraction of GDP has declined over the period. Figure 2, describes RMO as a percentage of the Kingdom's GDP. The magnitude of RMO as a ratio to GDP was the highest at 13.37% in 1994, and since then it steadily declined to ever lowest at 3.93% in 2019.

The per capita income (PCI) of Saudi Arabia at 2015 prices is depicted in Fig. 3. In 1985, the PCI was only 15248.76 US dollars, which rose over the years at a low pace. The highest value of PCI was 20,627.93 US dollars in 2015, and in 2019, it was 19801.87 US

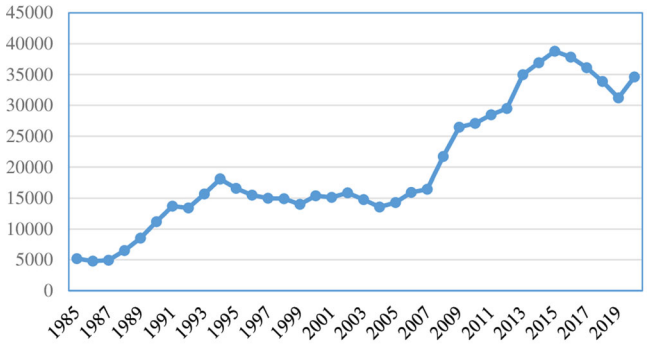

Fig. 1 RMO in million US dollars. Source: Word Bank (2021).

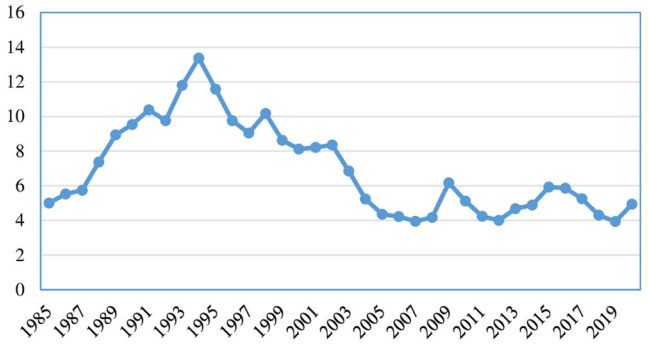

Fig. 2 RMO as a percentage of GDP. Source: Word Bank (2021).

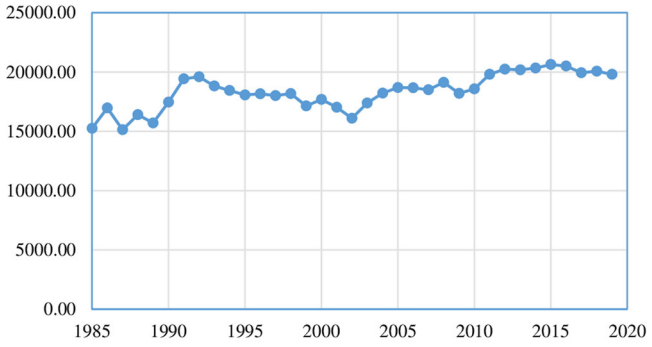

Fig. 3 Per capita GDP at 2015 US$. Source: Word Bank (2022).

dollars. If we consider Figs. 1–3 together, they indicate that despite an increasing trend in RMO in a nominal term, in terms of a ratio of GDP, it has been in a continuous declining trend, while PCI has increased slowly over the same period. Thus, it gives a complex relationship between RMO and PCI, which may not be retrieved by simple linear regression analysis.

Under the circumstances, it seems to be interesting to check the significance of RMO in shaping the performance per capita GDP of Saudi Arabia. Hence, we formulate the research hypotheses to help general readers understand as follows:

Null hypothesis: Remittance outflows impede economic growth in the Kingdom of Saudi Arabia

Alternative hypothesis: Remittance outflows don't impede economic growth in the Kingdom of Saudi Arabia.

Consequently, this study aims to investigate the impact of outbound remittances on Saudi Arabia's EG (per capita GDP) controlling trade openness, physical capital, human capital, and labor force, using the recently developed non-linear ARDL model, cointegrating regression technique, and the vector error correction (VEC) Granger causality test. The remainder of the research

is structured as follows: A review of the literature is covered in section "Literature review", data and methods are discussed in section "Data and methods", the results are exhibited in section "Outcomes and findings", and the study is concluded in section "Conclusion".

Literature review

Studies on RMO are relatively new phenomena, and observed pieces of evidence are limited to GCC nations. It is believed that RMO weakens the EG of sending countries in the short run, but it does not impede the long-run EG of the sending country. Many studies have investigated the influence of remittance inflows on the economic growth of remittance-receiving nations. By contrast, the influence of remittance outflows on the economic expansion of remittance-paying countries is examined by relatively very few studies. Available pertinent studies are reviewed and portrayed here.

Alkhathlan (2013) utilized yearly data from 1970 to 2010, employed the ARDL procedure, and examined the impact of the outflow of remittances on EG in Saudi Arabia along with government expenditure, exports, and inflation as control variables. The study though reported a negative impact of outbound remittances on EG in the short run, it revealed no significant impact of remittance outflows on the latter in the long run. The study did not consider any causality check. Kaabi (2016) examined the impact of RMO on GCC countries' EG and inflation using panel data for 2004–2014, and the panel least square (PLS) method, and showed that RMO affected EG negatively only in Saudi Arabia, while in other GCC economies, it had no significant effects.

In a time-frequency framework, Hathroubi and Aloui (2016) investigated the lead/lag interactions between employees' RMO and macroeconomic factors in Saudi Arabia from 1980 to 2013. They carried out wavelet experiments, which demonstrated a substantial positive association between RMO and short-term real GDP growth in Saudi Arabia. This outcome might be explained by the fact that non-Saudi employees send their wages back home right away. Rahmouni and Debbiche (2017) considered a simple ARDL model, used yearly data from 1970 to 2014, and estimated the influence of remittance outflows on the EG of Saudi Arabia. They specified per capita income dependent on RMO, government consumption expenditure, gross fixed capital formation, trade openness, and human capital [tertiary enrollment ratio of the total population], and reported insignificant impacts of RMO on EG of the Kingdom in the short run as well as the long run. The study did not consider any further studies such as causality checks.

Khan et al. (2019) used annual data from 1996 to 2017, applied the bootstrap panel causality method, and tested the relationship between outbound remittances and EG in GCC countries. The study revealed that outbound remittances had an important impact on the per capita output of Oman, Bahrain, and Saudi Arabia suggested by the bootstrap panel causality test, while per capita income caused remittance outflows in Bahrain, Kuwait, Qatar, and Saudi Arabia suggested by causality test. Thus, the study failed to provide a unique and consistent outcome.

Alsamara (2022) utilized quarterly data [2000: Q1 to 2019: Q4] on the Qatar economy, employed the non-linear autoregressive distributive lag (NARDL) approach to cointegration, explored the impact of remittance outflows on EG of the Qatar economy, and documented a negative influence of outbound remittances on EG. Alongside, the study also investigated the same using a simple ARDL model, which could not discover any impact of RMO on the EG. Moreover, the study did not report any direction of causality among variables.

Theoretically, remittance outflow is likely to impede the economic expansion of a country. Such impact of RMO also may not be traced by employing an ARDL estimation exercise, because, the behavior of remittance remains always asymmetric and volatile. Therefore, the use of a NARDL model is the best option to estimate the asymmetric impact of remittance outflow on EG. Saudi Arabia has a big economy, its's outbound remittances account for 4.9% of its GDP, an investigation of its impact on EG using the latest data and recent econometric tools seems to be an interesting option. Available researches particularly for Saudi Arabia are a few only and based on less suitable estimation methods.

Summary of the literature surveyed

Study	Econometric method	Period/ Country	Findings
Alkhathlan (2013)	ARDL	1970 to 2010, Saudi Arabia	Insignificant impact of RMO on EG in the long run.
Kaabi (2016)	PLS	2004–2014, GGC countries	RMO affected EG negatively only in Saudi Arabia.
Hathroubi and Aloui (2016)	Wavelet experiment	1980 to 2013, Saudi Arabia	RMO influenced real GDP growth in the short run.
Rahmouni and Debbiche (2017)	ARDL	1970 to 2014, Saudi Arabia	Insignificant effects of RMO on EG.
Khan et al. (2019)	Bootstrap panel causality	1996 to 2017, GGC countries	Provided dissimilar outcomes across the GCC counties.
Alsamara (2022)	NARDL	2000: Q1 to 2019: Q4, Qatar	RMO influenced EG negatively.

The volume of trade (TR) is used as an explanatory variable in the growth function in many studies. For example, Alkhathlan (2013) showed that exports significantly contributed to EG in Saudi Arabia, while Rahmouni and Debbiche (2017) reported an insignificant impact of trade on EG. Similarly, Yaya (2017) reported a positive role of trade on EG in Cote d'Ivoire, while Islam (2021a) discovered a significant affirmative effect of readymade garments exports on EG in Bangladesh, and Islam (2021b), and Islam et al. (2022) exhibited an augmenting impact of trade on the latter in Saudi Arabia, while Islam (2022c) demonstrated readymade garment exports' positive and asymmetric contribution to EG in Bangladesh.

The impact of capital formation on EG is also investigated in literature by many studies. Yaya (2017) documented capital formation's positive contribution to EG Cote d'Ivoire, while Rahmouni and Debbiche (2017) demonstrated a positive effect of physical capital on EG in Saudi Arabia. Islam (2021a) showed an insignificant effect of gross fixed capital formation (GFCF) on EG in Bangladesh, Islam (2021b) revealed an insignificant impact of

GFCF on EG in Saudi Arabia, while, Alsamara (2022) exhibited a positive role of physical human capital on EG in Qatar.

Several studies have used the school enrollment ratio as an explanatory variable in the RMO-growth nexus. Of them, Rahmouni and Debbiche (2017) demonstrated an insignificant yet negative effect of the tertiary enrollment ratio on EG in Saudi Arabia, Maneejuk and Yamaka (2021) revealed a positive contribution of enrollment ratio on EG in five ASEAN countries. Besides, Alsamara (2022) exhibited the secondary enrollment ratio's positive contribution to EG in Qatar.

Numerous, research has looked into the relationship between the labor force and EG, but the findings are not uniform. Tumwebaze and Ijjo (2015), and Bucci (2015) found that population growth ensured positive impacts on per capita income, while Banerjee (2012), and Yao et al. (2013), and found current growth of the labor force exhibited an adverse influence on EG. Similarly, Yaya (2017) revealed a negative contribution labor force to EG, and Islam (2021a) showed that LF contributed positively to EG in Bangladesh. Islam (2021b) and Islam et al. (2022) revealed a significantly positive impact of LF on EG in Saudi Arabia, while, Alsamara (2022) exhibited a positive role of the labor force on EG in Qatar. The above-cited studies considered mainly symmetric ARDL modeling except for Alsamara (2022), who used asymmetric ARDL modeling. The remittance-growth association is always complex and cannot be captured by simple ARDL modeling, and in that case, the asymmetric relationship for Saudi Arabia is yet to be examined. Moreover, none of the above studies considered any causality analysis. Therefore, this study is the first effort to discover the remittance-growth nexus using NARDL modeling to enrich this gray area and cast new insight into the existing body of literature. Hence our effort differs from previous studies in several ways. ① None of the studies from the Saudi Arabian perspective so far considered an asymmetric association between RMO and EG, while we consider an asymmetric impact of RMO on EG from the Saudi Arabian perspective. ② We use canonical cointegrating regression (CCR) and fully modified ordinary least square (FMOLS) approaches to test the reliability of the NARDL results. This is a novel approach to the RMO-growth nexus. ③ Previous studies did not consider any causality assessment alongside the main econometric analysis, we also consider the VEC Granger causality check to determine the direction of causality among variables.

Data and methods

Data is collected from two sources of the Word Bank, World Development Indicators (World Bank, 2022) and Migration and Remittances Data (World Bank, 2021). The data period covers 1985 to 2019, based on availability [although a larger data span is available for some variables] for all variables.

Based on the empirical literature, a multivariate function is specified in Eq. 1. We use per capita income (GDPC) to measure EG over time and express it as a function of remittance outflow (RMO). Besides, several studies have used the volume of trade (TR) is used as an explanatory variable [consistent with Alkhathlan (2013), Rahmouni and Debbiche (2017), Islam (2021b), and Islam et al. (2022)] in modeling economic growth, while we use gross capital formation (GCF) as a proxy for capital formation (CF), and utilize tertiary enrollment ratio (TEN) for human capital (HC). Labor force (LF) is also used as an independent variable. The inclusion of these three variables (CF, HC & LF) is consistent with Rahmouni and Debbiche (2017), Khan et al. (2019), and Alsamara (2022). Besides, many studies in the literature have used LF as an explanatory variable to compute EG [Islam, 2021a; Islam et al., 2022].

$$\mathrm{GDPC} = f(\mathrm{RMO},\ \mathrm{TR},\ \mathrm{CF},\ \mathrm{HC},\ \mathrm{LF}) \ldots \ldots \ldots \quad (1)$$

We take the natural log on both sides of the equation for ease of calculations and specify it in Eq. 2.

$$\mathrm{LnGDPC} = f(\mathrm{LnRMO},\ \mathrm{LnTR},\ \mathrm{LnCF},\ \mathrm{LnHC},\ \mathrm{LnLF}) \ldots \ldots \ldots \quad (2)$$

We use gross capital formation (GCF) as a proxy for CF, and detail the variables in Table 1 with their descriptive statistics.

We aim to uncover the asymmetric influence of RMO on per capita income, because the outflow of remittance is not uniform, rather it follows a non-linear path based on the complex macroeconomic performance of the sending economy. Therefore, we extract the negative and positive shocks of LnRMO [i.e., LnRMO_N & LnRMO_P] based on the partial sum procedure, which is outlined in Eqs. 3–4.

$$\mathrm{LnRMO\_}N_t = \sum_{i=1}^{t} \Delta\mathrm{LnRMO\_}N_t = \sum_{i}^{t} \min\left(\Delta\mathrm{LnRMO}_i,\ 0\right) \ldots \ldots \ldots \quad (3)$$

$$\mathrm{LnRMO\_}P_t = \sum_{i=1}^{t} \Delta\mathrm{LnRMO\_}P_t = \sum_{i}^{t} \max\left(\Delta\mathrm{LnRMO}_i,\ 0\right) \ldots \ldots \ldots \quad (4)$$

We combine Eqs. 2–4, and the proposed growth function is reformulated as follows.

$$\begin{aligned}\mathrm{LnGDPC}_t = {} & \alpha_1 + \alpha_2 \mathrm{LnRMO\_}N_t + \alpha_3 \mathrm{LnRMO\_}P_t \\ & + \alpha_4 \mathrm{LnTR}_t + \alpha_5 \mathrm{LnGCF}_t + \alpha_6 \mathrm{LnTEN}_t \\ & + \alpha_7 \mathrm{LnLF}_t + u_t \ldots \ldots \ldots\end{aligned} \quad (5)$$

We employ yearly data from 1985 to 2019 sourced from the World Bank. Conventional stationary tests are applied to check desired properties of the variables. Once the variables meet their anticipated properties, further econometric tests are applied.

Usually, Johansen-Juselius (1990) and ARDL method (Pesaran, 1995; Pesaran et al., 2001) are used to estimate time-series data. However, they cannot estimate any non-linear relationship, and the NARDL model (Shin et al., 2013) is suitable to determine such asymmetric association. This model is suitable to examine any dynamic variations in the explanatory variable(s) caused by

Table 1 Variable specifications.

Var.	Description	Mean	Max	Min	Std. dev.	Obs.
LnGDPC	Natural log of GDP per capita in 2015 US dollars	9.81	9.93	9.62	0.08	35
LnRMO	Natural log of remittance outflow in 2015 US dollars	24.00	24.53	23.03	0.34	35
LnTR	Natural log of total trade in 2015 US dollars	26.39	26.95	25.62	0.42	35
LnGCF	Natural log of gross capital formation in 2015 US dollars	25.29	26.17	24.42	0.52	35
LnLF	Natural log of the labor force	15.75	16.48	14.60	0.52	35
LnTEN	Natural log of tertiary enrollment ratio	3.18	4.26	2.17	0.68	35

positive or negative deviations. It is an advanced version of the usual ARDL model and equally applicable to a different order of integration, and also suitable for both large and small sample cases (Nkoro and Uko, 2016). The long-run formula of the NARDL model is outlined in Eq. 6.

$$\begin{aligned}\mathrm{LnGDPC}_t = {} & \alpha_{01} + \sum_{1}^{l} \alpha_{1i}\mathrm{LnGDPC}_{t-1} \\ & + \sum_{0}^{m} \alpha_{2i}\mathrm{LnRMO\_N}_{t-1} + \sum_{0}^{n} \alpha_{3i}\mathrm{LnRMO\_P}_{t-1} \\ & + \sum_{0}^{o} \alpha_{4i}\mathrm{LnTR}_{t-1} + \sum_{0}^{q} \alpha_{5i}\mathrm{LnGCF}_{t-1} + \sum_{0}^{r} \alpha_{6i}\mathrm{LnTEN}_{t-1} \\ & + \sum_{0}^{s} \alpha_{7i}\mathrm{LnLF}_{t-1} + e_{1t} \ldots \ldots .\end{aligned} \tag{6}$$

where, l to s, each denotes the optimum lag length of the relevant variable following the Akaike info criterion (AIC). We conduct the bounds test of the same model to validate the long-run association among the above variables. Since our sample size is finite and small, we compare the bound F-statistic value with Narayan's (2005) critical values instead of Pesaran et al. (2001) critical values. If the estimated F-statistic is greater than Narayan's (2005) critical values, a long-run relationship is established. Then we demonstrate the long-run relationship at levels among variables.

The short-term form of the NARDL model is obtained through an error correction model (ECM), described in Eq. 7.

$$\begin{aligned}\Delta\mathrm{LnGDPC}_t = {} & \alpha_{01} + \sum_{1}^{l} \alpha_{1i}\Delta\mathrm{LnGDPC}_{t-1} \\ & + \sum_{0}^{m} \alpha_{2i}\Delta\mathrm{LnRMO\_N}_{t-1} + \sum_{0}^{n} \alpha_{3i}\Delta\mathrm{LnRMO\_P}_{t-1} \\ & + \sum_{0}^{o} \alpha_{4i}\Delta\mathrm{LnTR}_{t-1} + \sum_{0}^{q} \alpha_{5i}\Delta\mathrm{LnGCF}_{t-1} + \sum_{0}^{r} \alpha_{6i}\Delta\mathrm{LnTEN}_{t-1} \\ & + \sum_{0}^{s} \alpha_{7i}\Delta\mathrm{LnLF}_{t-1} + \gamma\mathrm{ECT}_{t-1} + e_{2t} \ldots \ldots .\end{aligned} \tag{7}$$

Equation 7 is a differenced form of Eq. 6, with an added error correction term (ECT), which is one-period lag residuals of Eq. 6 and provides the promptness of correction to the long equilibrium relationship from any short-term deviations. Moreover, ECT integrates each short-term statistic with long-term parameters without losing any info. If $\gamma < 0$, and significant, a long-term affiliation is settled, while the short-run relationship is recognized by the significant coefficient values of the regressors.

Finally, we employ cointegrating regression namely the FMOLS and CCR techniques to check the robustness of the NARDL outcomes. We further apply the vector error correction (VEC) Granger causality test to explore the causal links among variables. Generally, the VEC causality test is considered to be better than the Granger causality test.

Outcomes and findings

Stationarity check outcomes. The outcomes of the stationarity check demonstrated in Table 2, show that the series is stationary at different orders, and the dependent variable [LnGDPC] is particularly I(1). This makes us comfortable utilizing the NARDL bounds test. The lag specification of the model is selected based on the AIC.

Long-run estimates. The selected model is NARDL (1, 0, 2, 0, 1, 0, 1) based on Eq. 6 is run utilizing the asymmetric components of remittance outflows. The outcomes of the bound test are portrayed in Table 3 to ascertain the existence of a long-run association among the variables. The underlying null hypothesis behind the bounds check is that there exists no level relationship among the variables. The estimated F-statistic value (10.54) is much greater than the reported critical values following Narayan (2005), and thus, it rejects the null hypothesis and confirms the cointegration, i.e., a long-run association among variables.

Based on the bound check outcomes, we provide the long-run level relationship among the variables of the estimated NARDL (1, 0, 2, 0, 1, 1, 0) model in Table 4. The long-run level relationship is presented following case 3, unrestricted constant and no trend.

The level relationship shows that positive components of outbound remittance do not bring any change in the EG. However, negative shocks of it spur EG. It implies that when outbound remittances decline, EG performance improves. Hence, we may conclude that maintaining remittance outflow at a lower level is beneficial for the EG of the Kingdom. The outcome is consistent with Alsamara (2022), partially in line with Alkhathlan (2013), and opposite to Rahmouni and Debbiche (2017). The finding has strong implications for policymakers to transmit the expatriates' savings (remittance outflows) to domestic consumption or investments by creating expatriate-friendly labor policies and rules, and offering them judicious incentives. Providing them permanent residentship to skilled expatriates may be an option. The recent move of the Kindom granting citizenship to exceptional expatriates may be also popularized to allure potential expatriates.

The positive coefficient of LnTR indicates that the volume of trade improves the EG. Saudi Arabia has historically been a trade-dependent economy, and its economy has been largely trade-reliant. The geographical location and ownership of resources make it easy for the Kingdom to involve in

Table 2 Unit root tests outcomes.

Var	ADF	ERS	PP
LnGDPC	-2.4498	-1.4611	-2.4275
LnRMO	-2.7142*	-1.3356	-3.1028**
LnTR	1.6689	-0.4210	-1.6399
LnCF	-0.7656	-0.0138	-0.6193
LnLF	-2.2091	0.1041	-2.4601
LnTEN	0.2814	-0.3663	0.281395
D(LnGDPC)	-7.5304***	-1.8951	-7.4304***
D(LnRMO)	-4.3976***	-3.7707***	-4.3976***
D(LnTR)	-2.70*	-2.5958**	-4.2028***
D(LnCF)	-5.5444***	-5.561***	-5.7279***
D(LnLF)	-4.8268***	-4.7473***	-4.8386***
D(LnTEN)	-4.3385***	-4.4075***	-4.3749***

Note: ***, **, * indicate significance at 1%, 5% & 10% levels, respectively.

Table 3 Bounds test outcomes.

Test statistic	Value	Significance	I(0)	I(1)
Asymptotic: $n = 1000$				
F-statistic	10.5402	10%	2.12	3.23
k	6	5%	2.45	3.61
		1%	3.15	4.43
Actual sample size	32	Finite sample: $n = 35$		
		10%	2.387	3.671
		5%	2.864	4.324
		1%	4.016	5.797
Finite sample: $n = 30$				
		10%	2.457	3.797
		5%	2.97	4.499
		1%	4.27	6.211

Table 4 Long-run level relationship.

Variable	Coefficient	Std. error	*t*-Statistic	Prob.
LnRMO_P	0.055773	0.055316	1.008274	0.3254
LnRMO_N	0.363735	0.068423	5.315995	0.0000***
LnTR	0.229293	0.055040	4.165896	0.0005***
LnGCF	-0.016010	0.073588	-0.217561	0.8300
LnTEN	0.016400	0.066734	0.245751	0.8084
LnLF	0.359207	0.116640	3.079614	0.0059***

Note: *** indicates significance at 1% level.

Table 5 Long-run relationship with lag variable.

Variable	Coefficient	Std. error	*t*-statistic	Probability
LnGDPC(-1)	0.1901	0.1336	1.4220	0.1704
LnRMO_N	0.1536	0.0779	1.9712	0.0627*
LnRMO_N(-1)	-0.1379	0.1141	-1.2091	0.2407
LnRMO_N(-2)	0.2789	0.0802	3.4767	0.0024***
LnRMO_P	0.0452	0.0448	1.0074	0.3258
LnTR	0.1857	0.0416	4.4666	0.0002***
LnGCF	0.0824	0.0533	1.5454	0.1379
LnGCF(-1)	-0.0953	0.0418	-2.2784	0.0338**
LnTEN	0.1348	0.0894	1.5069	0.1475
LnTEN(-1)	-0.1215	0.0837	-1.4504	0.1625
LnLF	0.2909	0.0775	3.7550	0.0012***
C	-1.170634	1.248929	-0.9373	0.3598
R-squared	0.934464	*F*-statistic		25.925***
Adjusted *R*-squared	0.898419	Durbin-Watson stat		2.1851
Long-run asymmetry check outcome				
Test statistic	**Value**	**df**		**Probability**
F-statistic	2.4140	(3, 20)		0.0967*
Chi-square	7.2419	3		0.0646*
H_0: $C(1) = C(2) = C(3) = C(4)$; H_A: $C(1) \neq C(2) \neq C(3) \neq C(4)$				

Note: ***, **, * refer to significance at 1%, 5% & 10% levels, respectively.

Table 6 Diagnostic check outcomes.

Test name	Coefficient	Statistic	Prob.
Normality	Jarque-Bera	2.1971	0.3333
Heteroskedasticity	Obs[a]*R*-squared	16.31123	0.1300
Serial correlation	Obs[a]*R*-squared	2.012699	0.3656
Ramsey RESET	Likelihood ratio	0.631273	0.4269
CUSUM[a]	Stable		
CUSUM of Sq.[a]	Stable		

[a]CUSUM and CUSUM of sq. graphs (Fig. 4).

international trade with world communities. The finding is in line with Yaya (2017), Islam (2021a), Islam (2021b), and Islam et al. (2022), who reported a positive role of trade on EG, while it contradicts Rahmouni and Debbiche (2017), who conveyed an insignificant impact of trade on EG. Thus, participation in trade is useful for its economy, and it implies for the policymakers engage more in international trade and benefit therefrom.

The affirmative coefficient of LnLF also recognizes the fact that the Saudi Arabian labor force has been effective in contributing to EG. This finding is widely endorsed by many previous studies. For example, Islam (2021b) for Saudi Arabia, Islam (2022b) for South Asian economies, and Islam et (2022) for Saudi Arabia have deliberately spelled out the positive contribution of LF to economic expansion. However, the labor force data contain the expatriates and Saudis together, no separate data Saudi labor force is available. Generally, the private sector is widely unrepresented by the Saudis, who are mainly occupied in the public sector (Islam, 2021b). The observed perception of the low representation of Saudis in the private sector reflects their low skills and relatively less efficiency at jobs compared to the expatriates. It suggests that the Saudi government and policymakers must resort to enhancing the skill and efficiency of its workers by increasing their human capital through effective training and education.

Neither physical nor human capital shows any significant contribution to EG. It is appealing that the skill of the local labor force needs to be upgraded through effective training and education to ensure their positive contribution to EG. Moreover, the insignificant (yet negative) impact of physical capital also indicates the relatively ineffective role of the labor force, which is responsible to operate and manage the physical capital. The outcome suggests that the quality of education in general and tertiary education, in particular, needs to be upgraded in the real sense to develop the practical skills and efficiency of the Saudi labor force so that they can replace the expatriates. This will eventually reduce outbound remittances.

The long-run outcomes with lag variables show that the negative shocks of RMO have a significant impact while positive shocks do not influence EG. Out of the three variants, LnROM_N, and LnROM_N(-2) influence EG, while LnROM_N(–1) remains insignificant. It implies that negative shocks spur per capita GDP, and positive shocks do not. Moreover, there is an asymmetry in the behavior of different lag variables of RMO, acknowledged by the long-run asymmetry check outcome (Table 5), which reveals that the coefficients of the four formats of RMO are not equal. Thus, the non-linear asymmetric association between per capita GDP and RMO is justified.

Trade openness exerts a positive impact on EG as usual. Out of two variants of physical capital (LnGCF & LnGCF(–1)), one is significant with a negative impact, while the other is insignificant. However, the log-run resultant impact is insignificant as shown by the level relationship. Both the variants of human capital (LnTEN & LnTEN(–1)) remain insignificant, and their resultant impact is as well. The coefficient of LnLF exercises a significant positive effect on EG similar to the level relationship as shown in Table 4.

Diagnostic check outcomes. The long-run NARDL model outcomes require that its residuals must follow a normal distribution, be serially uncorrelated, homoscedastic, and stable, and should not miss any appropriate variable. The required diagnostic and stability checks are conducted and their outcomes are reported in Table 6 to validate the requirements. The estimated diagnostic outcomes corroborate the suitability of the model.

In two plots, the CUSUM and CUSUM of the squares, the blue lines are extending within the two bounds of red lines, meaning that the estimated long-run model is stable.

Short-run outcomes. The short-run model based on Eq. 7 is carried out and the outcomes are demonstrated in Table 7. The positive components of RMO do not influence EG, while its negative shocks show a mixed impact on per capita GDP. However, the resulting impact of two different mixed impacts is likely to be negative as suggested by their magnitudes. In that case, the negative shocks of remittance outflows may cause EG negatively.

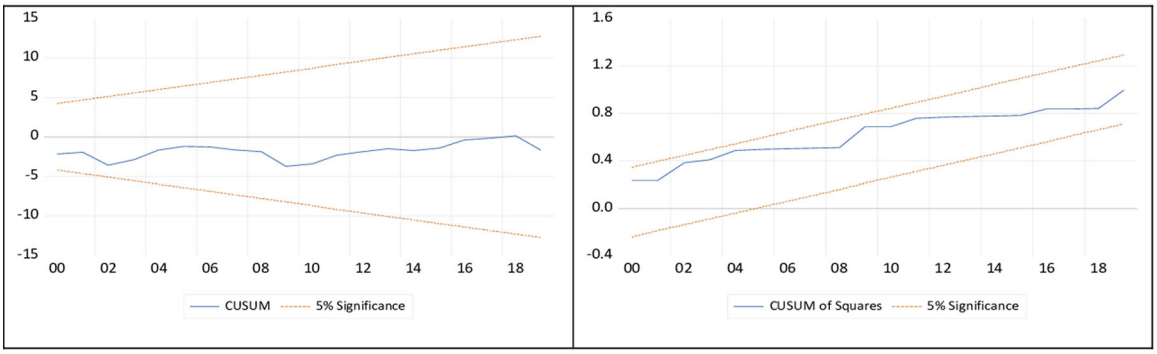

Fig. 4 CUSUM and CUSUM of sq. graphs.

Table 7 ECM regression, ARDL (1, 0, 2, 0, 1, 1, 0) model.

Variable	Coefficient	Std. error	*t*-statistic	Prob.
C	-1.170634	0.118559	-9.873833	0.0000***
D(LnRMO_N)	0.153556	0.061286	2.505563	0.0210**
D(LnRMO_N(-1))	-0.278960	0.059883	-4.658445	0.0002***
D(LnGCF)	0.082368	0.030186	2.728673	0.0129**
D(LnTEN)	0.134755	0.063251	2.130486	0.0457**
ECT(-1)	-0.809952	0.082702	-9.793670	0.0000***
R-squared	0.822941	*F*-statistic		24.1687***
Adj. *R*-squared	0.788891	D-W stat		2.1851

Note: *** and ** indicate significance at 1% & 5% levels, respectively.

Both capital formation and tertiary enrollment ratio enhance short-term EG. The coefficient of ECT is negative and highly significant, authenticating the bounds test findings. It indicates that any short-term deviation in the model is likely to arrive at long-run equilibrium at the rate of 80.99% per year.

Robustness check

Cointegrating regression outcomes. The outcomes of cointegrating regressions along with the NARDL findings are reported in Table 8. The CCR and FMOLS outcomes are similar to those demonstrated in NARDL long-run level relationship. Thus, outcomes of both the CCR and FMOLS techniques precisely acknowledge the outcomes of the NARDL approach and confirm the latter's robustness.

VEC Granger causality check results. The VEC Granger causality test is applied using a maximum of 2 lags. Its outcomes are presented in Table 9. The positive shock of remittance outflow does not cause EG, while there happens to be one-way causation from EG to the negative shock of RMO. Unidirectional causality runs from the volume of trade to EG, while bidirectional causation exists between the labor force and EG. Thus, both the volume of trade and labor forces positively influence economic expansion.

Moreover, both EG and volume of trade reinforce the level of tertiary education. Two-way causations exist between the negative component of RMO and labor force, and trade and labor force.

Positive components of RMO, physical capital, and human capital, all-cause labor force unidirectionally. These three variables, though not influencing economic expansion directly, may be impacting the latter indirectly through the labor force channel. Thus, the causality test outcomes also are mostly in line with the NARDL, CCR, and FMOLS outcomes.

Conclusion

The study has investigated the impact of remittance outflows on Saudi Arabia's EG keeping trade openness, physical capital, human capital, and labor force as controlled variables, utilizing NARDL regression and causality checks. The NARDL bounds test outcomes have authenticated a long-run association among the variables. The long-run level relationship demonstrates that the positive components of outbound remittance do not influence the EG, while its negative shocks enhance the latter, indicating a lower level of emittance outflow is favorable to the EG of the Kingdom. The long-run results with lag variables further acknowledge the asymmetric behavior of remittance outflow and justify the non-linear asymmetric relationship between per capita GDP and remittance outflow.

The Kingdom's locational advantage and ownership of resources make it easy to involve in international trade, and consequently, the size of trade improves its EG. The labor force effectively contributes to EG, while neither physical nor human capital spurs any significant influence on EG. It is observed that the local labor force is not skilled enough, they have been quite inefficient relative to expatriates. Moreover, the insignificant (yet negative) impact of physical capital also raises apprehension about the role of the Saudi labor forces who are responsible to operate and manage the physical capital. The outcome suggests that the quality of education in general and tertiary education, in particular, needs to be upgraded in the real sense to develop the practical skills and efficiency of the Saudi labor force so that they can replace the expatriates. This will eventually reduce outbound remittances.

Based on the findings, the policymakers need to attract the savings (outbound remittances) of expatriates into consumption or investments within the Kingdom by creating expatriate-friendly labor laws and offering reasonable incentives such as allure and retain a skilled and qualified workforce and offering them permanent residentship. The recent move of the Kingdom to grant citizenship to exceptional expatriates may be expanded to allure potential expatriates. Above all, the quality of education in general and tertiary education, in particular, need to upgrade in the real sense to develop the practical skills of the Saudi labor force so that they can replace the expatriates. This will eventually take care of outbound remittances.

Limitations and future research track. The study used total labor force data including expatriate labor force as distinct Saudi labor force data is not available. If separate Saudi labor force data is available, any future study may utilize it to investigate its distinct impact on EG separately. Similar studies may be replicated in other GCC countries as well.

Table 8 Cointegrating regression outcomes.

Variable	CCR		FMOLS		NARDL level	
	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
LnRMO_P	0.0250	0.3791	0.0249	0.4952	0.055773	0.3254
LnRMO_N	0.2632	0.0001***	0.2788	0.0000***	0.363735	0.0000***
LnTR	0.1500	0.0100**	0.1739	0.0004***	0.229293	0.0005***
LnGCF	0.0646	0.3245	0.0482	0.3380	-0.016010	0.8300
LnTEN	0.0333	0.5457	0.0439	0.4471	0.016400	0.8084
LnLF	0.2265	0.0229**	0.2254	0.0135**	0.359207	0.0059***
C	0.6797	0.5805	0.4565	0.7020		
R-squared	0.8372		0.8452		0.934464	
Adj *R*-squared	0.7997		0.8094		0.898419	

** & *** show significance at 5% and 1% levels, respectively.

Table 9 VEC Granger causality test outcomes.

	Hypothesis	Chi-sq	Prob.	Direction causality
1	LnRMO_N does not cause LnGDPC	1.5986	0.4497	LnGDPC →LnRMO_N
	LnGDPC does not cause LnRMO_N	5.1644	0.0756*	
2	LnTR does not cause LnGDPC	5.4622	0.0651*	LnTR → LnGDPC
	LnGDPC does not cause LnTR	0.4316	0.8059	
3	LnLF does not cause LnGDPC	7.9495	0.0188**	LnLF ↔ LnGDPC
	LnGDPC does not cause LnLF	20.8757	0.0000***	
4	LnTEN does not cause LnGDPC	0.7604	0.6837	LnGDPC →LnTEN
	LnGDPC does not cause LnTEN	5.9589	0.0508*	
5	LnTEN does not cause LnTR	2.3144	0.3144	LnTR→ LnTEN
	LnTR does not cause LnTEN	4.9524	0.0841*	
6	LnLF does not cause LnTR	7.5807	0.0226**	LnTR ↔LnLF
	LnTR does not cause LnLF	5.7025	0.0578*	
7	LnLF does not cause LnRMO_N	5.4812	0.0645*	LnRMO_N ↔ LnLF
	LnRMO_N does not cause LnLF	16.097	0.0003***	
8	LnLF does not cause LnRMO_P	3.3483	0.1875	LnRMO_P → LnLF
	LnRMO_P does not cause LnLF	20.484	0.0000***	
9	LnLF does not cause LnGCF	2.4570	0.2927	LnGCF→ LnLF
	LnGCF does not cause LnLF	5.6835	0.0583*	
10	LnLF does not cause LnTEN	4.2652	0.1185	LnTEN→LnLF
	LnTEN does not cause LnLF	9.8555	0.0072***	

***, **, & * indicate significance at 1%, 5% and 10% levels, respectively.

Data availability

Data underpinning the study were obtained from: https://databank.worldbank.org/source/world-development-indicators# https://www.worldbank.org/en/topic/migrationremittancesdiasporaissues/brief/migration-remittances-data.

Received: 16 November 2022; Accepted: 28 February 2023;
Published online: 18 March 2023

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Competing interests
The authors declare no competing interests.

Ethics approval
Ethical approval is not required as the study does not include human participants.

Informed consent
Informed consent is not required as the study does not include human participants.

Additional information
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