Remittances and Economic Growth in North Africa: A Panel Cointegration Analysis

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Abstract: This article explores the short-term and long-term impacts of remittance inflows on economic growth in five North African countries (NAC): Egypt, Algeria, Tunisia, Morocco, and Sudan. Using annual panel data from 2000–2020 and employing the Panel Autoregressive Distributed Lagged (ARDL) model proposed by Pesaran et al. (1999), the research finds that remittance inflows have both significant long-term and short-term positive effects on economic growth. Specifically, a 1% increase in remittance inflows results in a 0.025% increase in economic growth. Additionally, other macroeconomic variables, such as capital formation and labor force participation, also contribute significantly to economic growth. The study reveals that in the long term, remittances promote investment activities, while in the short term, remittances primarily boost private consumption. The findings emphasize the need for policymakers to develop economic policies that encourage remittance inflows and direct them towards productive investment in the real economy. Recommendations include improving financial systems, reducing transaction costs, and implementing policies that stimulate remittance inflows for sustainable development.

JEL classification : C30, C33, F24, F43, O55
Keywords: Remittance inflows, economic growth, migration, panel data, North African countries

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العلاقة بين التحويلات والنمو الاقتصادي في دول شمال إفريقيا: تحليل قياسي باستخدام منهجية التكامل المشترك للبيانات المدمجة

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المستخلص: يهدف هذا البحث إلى دراسة تأثيرات تدفقات الحوالات الخارجية على النمو الاقتصادي في خمس دول مختارة من دول شمال أفريقيا وهي كلا من مصر، والجزائر، وتونس، والمغرب، والسودان. استخدمت الدراسة للوصول إلى نتائجها البيانات المتاحة عن متغيرات الدراسة خلال الفترة من عام 2000 إلى 2020. لقد أظهرت نتائج الدراسة باستخدام نموذج الانحدار الذاتي الموزع ذو الفجوات الزمنية الموزعة المعروف في الأدبيات بـ (Panel Autoregressive Distributed Lagged (ARDL) model) أن الحوالات الخارجية لها تأثيرات إيجابية ومهمة على النمو الاقتصادي في البلدان المشمولة بالدراسة على المدى القصير والمدى الطويل. وبرغم أن الحوالات الخارجية توجهت بشكل رئيسي لتغطية النفقات الاستهلاك في المدى القصير، إلا أن نتائج الدراسة أوضحت أن تلك الحوالات تساهم في المدى الطويل في الأنشطة الاستثمارية التي تعزز الإنتاجية في اقتصاديات تلك الدول. لقد كشفت نتائج هذه الدراسة أن زيادة بنسبة 1% في الحوالات تؤدي إلى زيادة قدرها 0.025% في الناتج المحلي الإجمالي. من هنا توصي الدراسة لتعزيز هذه النتائج واستدامتها إلى ضرورة قيام صانعي السياسة في تلك الدول بتحسين وتعزيز الأنظمة المالية، تشجيع استخدام المنصات المالية الرقمية لخفض تكاليف المعاملات وزيادة الشفافية في تدفقات الحوالات وتقليل تكاليفها والحد من الآثار السيئة لقنوات الحوالات غير الرسمية، وتعزيز الشراكات بين القطاعين العام والخاص بما يسهم في توجيه الحوالات إلى الاستثمار في البنية التحتية والمشاريع الاقتصادية المنتجة. وضرورة مواءمة استراتيجيات التنمية الوطنية مع تلك الحوالات لتعظيم الفوائد الاقتصادية والاجتماعية منها.

الكلمات المفتاحية: الحوالات الخارجية، النمو الاقتصادي، دول شمال أفريقيا، الانحدار الذاتي ذو الفجوات الزمنية الموزعة.

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I. Introduction

The World Bank (2017) defined remittances as personal transfers either in cash or kind, workers' compensations, income from abroad, and short-term work. International remittances (IR) have grown in importance over the past decade and have taken the lead as the most prominent and vital external financial inflows to developing countries. The total volume of IR reached USD 773 billion in 2021. In 2020, the distribution of IR flows received by each region was as follows: 21.5% East Asia and Pacific, 20.85% South Asia, 14.76% Latin America, 12.55% Eastern Europe and Central Asia, 9.03% Middle East and North Africa, and 6.01% Sub-Saharan Africa (World Bank data, 2021a). Additionally, international remittance inflows represent a significant portion of international capital flows to labor-exporting countries, surpassing other types of flows, such as foreign direct investment, exports, and foreign aid, in terms of size and contribution to the economy (Jumiu & Husam, 2021; Ishaq Saidu1 & Ali Salisu, 2020; Mathew et al., 2022; Héla & Habib, 2020; Jumiu & Husam, 2021).

The importance of remittances is well documented in the economic literature. In the last few decades, remittance inflows have gained significant attention in labor-exporting countries due to their potential impacts on major macro and microeconomic variables (Moukpè & Essossinam, 2022; Adjei et al., 2020; Lawal et al., 2022; Al-Abdulrazag, 2018). Recent applied research revealed the role of remittance in affecting significant macroeconomic variables; for example, remittance inflows raise national income (Al-Abdulrazag & Abdel-Rahman, 2016), increase private consumption, promote investment activities (Azizi, 2018), increase production, increase employment opportunity (Al-Abdulrazag & Amani, 2014), and hence indirectly increase families' income, leading to a reduction in poverty level, among others (Prasiddha & George, 2021; Nyasha & Odhiambo, 2021; Al-Abdulrazag & Wahban, 2013). Specifically, the bulk of the applied research has focused on the remittance-economic growth nexus of recipient countries (Ishaq Saidu & Ali Salisu, 2020; Belesity, 2022; Héla & Habib, 2020; Mathew et al., 2022; Oluwasheyi, 2020; Jamiu & Husam, 2019). Kumar et al. (2018) argued that despite the importance of remittances as a vital source of income for migrants' families, it is often exposed to exchange risk and transaction costs (Jamiu & Husam, 2019). Therefore, the final impacts of remittance on EG could be ambiguous and depend on the final use by recipients for consumption or investment activities.

There is disagreement on the role of remittance inflows on the economic growth of the recipient countries. Some applied research reported a positive impact, others revealed a negative, and the rest found a neutral effect. The strand of empirical research that concluded that remittance inflows promote and enhance economic growth provided empirical evidence on the positive impacts of remittance inflows on economic growth (Ishaq Saidu & Ali Salisu, 2020; Jamiu & Husam, 2019; Mathew et al., 2022; Moukpè & Essossinam, 2022; Adjei et al., 2020; Héla & Habib, 2020; Oluwasheyi, 2020; Sutradhar, 2020; Kumar et al., 2018). They argued that remittances directly or indirectly affect economic growth by stimulating key significant macroeconomic variables (for example, private consumption, domestic investment, domestic saving, human capital, and trade), contributing to raising financing needed for sustainable development and economic activities. On the other hand, another stream of applied research concluded that remittance inflows could directly or indirectly negatively affect economic growth (Belesity, 2022; Nyasha & Odhiambo, 2021; Prasiddha & George, 2021; Jouini, 2015). Belesity (2022) argued that the direct negative impact of remittances on economic growth could be due to several reasons: (1) Remittances are considered an increase in recipient families' income without contribution, which hence leads to more leisure and less participation in the labor market; (2) the moral hazard problem arises due to the misuse of remittances from productive to unproductive uses. Another group of researchers indicated a neutral or insignificant nexus between remittances and economic growth (Mulatu, 2020).

This study intends to experimentally assess and explore the short- and long-term effects of remittances from foreign migrants on economic growth, along with some chosen macroeconomic

variables, in five chosen North African countries[c] including Egypt, Algeria, Tunisia, Morocco and Sudan utilizing the panel autoregressive distributed lag (ARDL) model introduced by Pesaran et al. (2001). Assessing the long- and short-term nexus between remittances and economic growth in those nations will also be aided by the Panel Cointegration Approach. We restrict our analyses to these five nations for two reasons: first, data availability; and second, because the nations we chose account between 52 and 73 percent of all the personal remittances that North African nations received during the study period, which ranged from roughly $11.6 billion in 2000 to $65.8 billion in 2020.

Figure (a) shows the relative share of the selected countries in the total personal remittances flowing into North African countries. Egypt obtained the most significant percentage among the selected countries, with a percentage ranging from 22% to approximately 50% during the entire period, followed by Morocco, which maintained its share of personal transfers at a rate that ranged around 18%, followed by Tunisia with a rate of not less than 3%, and then Sudan, at a rate that ranged from 6% as a maximum to 1.5% as a minimum during the entire period. Algeria also obtained varying percentages over time, ranging from 11% at its highest level to 3% at its lowest level.

Figure (a): Personal remittances flow into the selected North African countries, 2000–2022 (% of total personal remittances received by MENA countries)
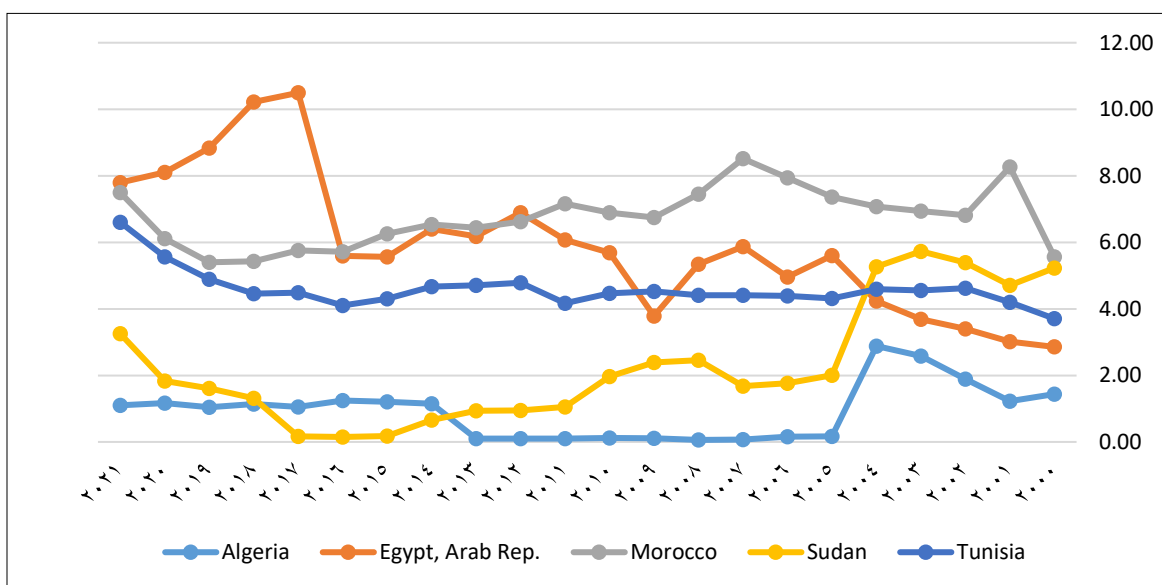

Source: World Bank database (https://data.worldbank.org/indicator/BX.TRF.PWKR.CD.DT).
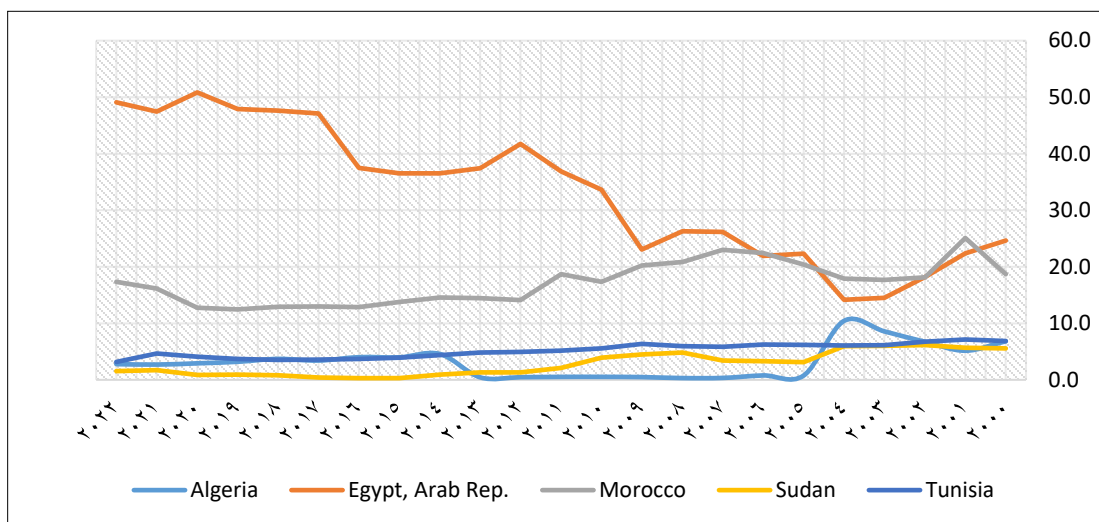
More importantly, Figure (b) indicates the flow of personal remittances (PR) contribution to GDP in NAC. It can be observed that the PR contribution to the GDP in Egypt has been rising over the years and is equal to, on average, 7%. An argument has been raised by some economists, such as Ratha (2019), who believe that remittances will become the most significant external source of finance for developing countries. The same conclusion can be stated for the cases of Morocco

and Tunisia. While PR contribution to the GDP in Algeria was only less than 2% from 2005 to 2021, PR contribution to the GDP in Sudan ranged from 5.7% in 2003 to approximately less than 1% in 2015 and returned to more than 3% in 2021. The formal one is that Algeria is an oil-producing country, so there are fewer migrants. However, Sudan has been feasibly under global economic sanctions since 2006, so the PR went down all over the period.

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[c] *The North African countries are Egypt, Sudan, Libya, Tunisia, Algeria, Morocco, Mauritania, and the Western Sahara.*

Figure (b): Personal remittances flow into the selected North African countries, 2000–2022 (% of GDP).

Source: World Bank database (https://data.worldbank.org/indicator/BX.TRF.PWKR.CD.DT).

Given the significant increase in remittance inflows to those countries, the literature on international migration and subsequent development effects in North African countries has increased. However, the results of the many applied studies are inconclusive or, at the very least, mixed. Consequently, the study was motivated by these conflicting empirical findings in the literature on the remittance-growth nexus in North African countries. In addition, the study was also motivated by the need to provide evidence on the vital role of remittances in economic growth. Moreover, there is still room for further investigation of the remittance-growth nexus.

The main empirical findings show that remittance inflows have significant long-run and short-run impacts on the economic growth of North African countries; moreover, the other macroeconomic variables have significant positive impacts. The estimation results revealed that a 1% increase in remittance inflows into NAC causes a 0.025% increase in economic growth.

The study contributes to the existing literature in many ways. Firstly, it focuses on five NAC from 2000–2020. In particular, the study investigates the direct impact of remittances on the economic growth of North African countries. This makes some economic sense because these countries possess similar characteristics.

Secondly, the study employed the system GMM estimator due to its practical advantage for the dynamic data set. Thirdly, the study contributes to the empirical literature on the macroeconomic implications of remittances in North African countries and, by extension, developing countries.

This paper is structured as follows: Section two presents the trends in remittance inflows to North African countries. Section three discusses literature reviews and the theoretical framework. Section four presents the methodology. Section five reports the results and discussion. Finally, section six presents the conclusion and recommendations.

2. Review of Literature

This section discusses the theoretical and empirical literature on remittance inflows' potential impacts on significant macroeconomic variables, concentrating on economic growth in selected North African countries.

2.1 Theoretical background

There has been a growing concern about the role of remittance inflows as a critical source of

external finance and their potential impact on significant macroeconomic variables in the receiving countries. In economic literature, two significant motives or factors cause labor movement across borders: the push and pull factors. Push factors are related to countries of origin (sending countries), while pull factors are associated with destination (labor-receiving) countries. Both factors almost share the same factors: economic, political, and cultural, among others. These factors include the income gap, employment opportunities, inequality, injustices, demographic imbalances, etc. Moreover, social exclusion, discrimination, political victims, corruption, a lack of education, health care, social security, and marriage opportunities

Over the last few decades, there has been a growing interest in the determinants of economic growth and significant macroeconomic variables (Vensa, 2020). Among these factors, as researchers, policymakers, and the public believed, remittances were an essential factor affecting economic growth, specifically in developing countries. Remittances impact economic growth through three channels. First, by improving the rate of capital accumulation, remittances increase the physical and human capital accumulation rate and lower the cost of capital in the recipient country. This may stabilize the economy and reduce volatility. The second impact is related to the subsequent change in labor force participation as remittance income is substituted for labor income. Third, remittances affect investment efficiency by impacting total factor productivity growth (Vensa, 2022; Jumiu & Husam, 2021; Oluwasheyi, 2020). In this regard, three competing theories were introduced in the economic literature to explain the impact of remittances on economic growth. First, the developmental-optimistic school This theory regards remittances as one of the significant factors in reducing poverty levels among recipient families and being used to finance trade, thereby affecting economic growth. Second, the pessimistic developmental school believes that the increased volume of remittances would increase the dependency level of the recipient countries on remittance inflows and, hence, negatively affect economic growth, leading to income inequality among the population. Third, the remittance

development pluralists' theory argues that there is no strict optimistic or pessimistic view on the impact of remittances on economic growth. There needs to be a consensus or clear-cut consensus among researchers on the effect of remittances on economic growth. Therefore, it is the task of empirical work to clarify and solve the controversy among economists.

2.2 Empirical literature

A substantial amount of applied research has investigated the influence of remittances on economic growth in recent decades. Similar to the proposed theories outlined previously, applied research shows conflicting evidence on the influence of remittances and their long-term consequences in the origin countries, resulting in mixed empirical evidence. While some applied research supports the idea that remittances play a vital role in economic growth in recipient countries, specifically developing countries, others highlight negative findings, contrasting perspectives, and identify gaps for future research.

Here are some empirical studies indicating that remittances have a favorable impact on economic growth. Moukpè and Essossinam (2022) examined the effect of remittance on EG in ESCAWS countries over the period 1980–2017 by applying the seemingly unrelated regression method. The findings indicated a significant positive impact of remittances on economic growth in these countries.

Ishaq Saidu1 & Ali Salisu (2020) investigated the nexus between remittance inflows and economic growth in some selected sub-Saharan African countries using panel data from 1980-2018. Their empirical findings revealed a positive impact of remittances in connection with FDI, trade openness, and domestic investment on economic growth.

Using dynamic panel data techniques, Adjei et al. (2020) investigated the causality between remittances and EG in West Africa (Burkina Faso, Ghana, Guinea, Guinea-Bissau, Mali, Nigeria, and Togo). The empirical evidence revealed that remittances have a significant positive impact on the economy of West Africa.

Using panel regression, Vesna (2022) investigated the remittance-economic growth nexus in the South East European (SEE) countries

using quarterly data from 2008–2020. His findings revealed a significant positive impact of remittances on economic growth, thereby providing evidence of the validity of the remittances-growth hypothesis for SEE countries.

Mathew et al. (2022) examined the nexus between international remittances and per capita economic growth in Nigeria by employing annual time series data from 1980 to 2020 and adopting the ARDL bounds estimating model. The empirical findings revealed a significant positive impact of remittances on economic growth in both the long and short run.

Oluwasheyi (2020) examined the long-run and short-run impacts of remittances on Nigeria's economic growth, using quarterly data from 1970 to 2017, by applying the Johansen cointegration and the VECM approaches. The findings showed that remittances positively and significantly affect Nigeria's economic growth.

Sutradhar (2020) investigated the impact of workers' remittances on economic growth in four South Asian emerging countries using balanced panel data from 1977 to 2016. The results of the study revealed that remittances have a positive impact on economic growth in India.

Jamiu and Husam (2019) examined the long-run and short-run nexus between remittance and EG in MINT countries (Mexico, Indonesia, Nigeria, and Turkey) from 1990-2017 by employing the ARDL bounds test to cointegration. They concluded that remittance has a long-run positive impact on EG of MINT countries, except for Nigeria was negative.

Kumar et al. (2018) examined the nexus between remittances and economic growth in Kyrgyzstan and Macedonia from 1990 to 2015 by applying the ARDL. Their empirical findings revealed the positive impact of remittances on economic growth both in the long run and the short run. Moreover, the non-granger causality test provides evidence for the remittance-led growth hypothesis for Kyrgyzstan, supporting the EG-led remittances for Macedonia. In the long run, both financial development and remittances exerted a negative effect on per capita income. However, the latter was not statistically significant, and there was a negative correlation between remittances and financial development.

In contrast, some of the empirical researches demonstrating negative impact of remittances on

economic growth. Belesity (2022) examines the impact of remittance inflows on the economic growth of 26 Sub-Saharan African countries, along with financial sector development, institutional quality, economic freedom, and others from 2010-2019. The empirical findings using the two-step system GMM revealed that remittance inflows negatively impact economic growth.

Lawal et al. (2022) explored the intricate relationship between economic growth and various factors such as exchange rates, remittances, trade, and agricultural output, utilizing data collected from 1980 to 2018 across ten selected African economies. Results from the time-domain test suggests no significant relationship between economic growth and both remittances and agricultural output and the causality only exists between economic growth and both exchange rate and trade.

Nyasha and Odhiambo (2021) examined the impact of remittances on the EG of South Africa from 1970 to 2019 by applying the autoregressive distributed lag (ARDL) bounds testing approach. Their findings showed a significant negative impact of remittances on economic growth in both the long and short run.

Prasiddha & George (2021) examined the impact of remittance on the economic growth of Nepal over the period 1976-2019 by applying the J-J cointegration and VECM methods. The main finding is that remittance significantly negatively impacts the EG of Nepal.

On the other hand, Mulatu (2020) among others found mixed results when he studied the short-run and long-run nexus between remittance inflows of international migration and economic growth in three selected economies, Ethiopia, Kenya, and Uganda, for the period 1990–2017 by applying the pooled modified least squares (FMOLS) estimation approach. The results of the study provide significant evidence for the remittance-led growth hypothesis, but the results showed an insignificant long-run positive impact of remittance inflows on economic growth.

These contradictory results could be due to several factors, such as whether the study was applied to a single or multi-country context, research methodology, data type (time series or panel), the covered period, whether the countries are developed or developing, income

classification, and the effectiveness of government policies used to redirect those remittances. In fact, the impact of remittances on growth is often conditional on factors like how the funds are used, government policies, and the overall economic context (Chami et al., 2008). Research suggests that remittances can positively influence economic growth by stimulating consumption, fostering investment, and promoting entrepreneurship (Ratha, 2020). However, over-reliance on remittances can lead to Dutch disease, a phenomenon where currency appreciation hinders export competitiveness and industrial development (Aizenman, 2009).

The impact of remittances on economic growth in North African countries has been a subject of ongoing research and debate. Recent literature explores the multifaceted nature of this relationship. Here's a summary of key findings from recent available literature:

1. For the significance of remittances: Studies consistently highlight the high dependence of North African economies on remittances, with countries like Morocco, Algeria, and Egypt receiving significant portions of their GDP from these inflows. (World Bank, 2022). Remittances remain a crucial source of income for many households, contributing to consumption, poverty reduction, and overall economic well-being (Ratha, 2020).

2. For the impact on economic growth: A few empirical studies analyze the impact of remittances on the economic growth of each of the selected North African countries, and the findings can be summarized as follows: In Algeria, Research on the relationship between remittances and GDP growth in Algeria provides mixed evidence. For example, Abdelkader and Benhabib (2014) found a positive and statistically significant correlation between remittances and GDP growth, suggesting that remittances contribute positively to Algeria's economic expansion. But Bouarfa and Meziani (2018) argued that the relationship is complex and depends on factors such as the sector of the economy and the recipient's characteristics. In another recent study, Khediri and Aït-Sahalia (2017) highlighted the need to consider other macroeconomic factors alongside

remittances, such as government policies and oil prices.

- In Egypt, several studies suggest a positive correlation between remittances and GDP growth in Egypt. For example, El-Sakka et al. (2017) found that remittances contribute significantly to Egypt's economic growth, with a 1% increase in remittances leading to a 0.2% increase in GDP. Another study by Mahmoud and El-Ashry (2019) concluded that remittances are a vital driver of economic growth, particularly in non-oil sectors.

- In Morocco, the impact of remittances on GDP growth in Morocco has been studied extensively, with mixed results. Whereas, Benhima and El-Attar (2013) found a positive and significant correlation between remittances and GDP growth, suggesting that remittances contribute positively to Morocco's economic expansion. And Rachid and Chakir (2017) also highlighted the importance of considering the impact of remittances on other macroeconomic indicators like inflation and unemployment. Alaoui and Benhima (2018), however, argued that the relationship is less straightforward and depends on various factors, such as the sector of the economy and the recipient's characteristics.

- In Sudan, while some studies suggest a positive relationship between remittances and GDP growth in Sudan, evidence is not conclusive. For example, Ahmed and El-Hassan (2016) found a positive and statistically significant impact of remittances on GDP growth, concluding that remittances contribute significantly to Sudan's economic growth. However, Al-Amin and El-Tom (2018), argued that the impact of remittances on GDP growth is less pronounced due to structural constraints in the Sudanese economy, including limited access to financial services and a weak institutional framework.

- In Tunisia, Studies on the impact of remittances on GDP growth in Tunisia have yielded mixed results. For example, Ben Youssef and El-Hani (2014) found a positive and statistically significant correlation between remittances and GDP growth,

suggesting that remittances contribute positively to Tunisia's economic expansion. Also, Sellami and Boujelbene (2017) emphasized the importance of considering the impact of remittances on other macroeconomic indicators alongside GDP, such as inflation and unemployment. While, a recent study by Ayadi and Ben Ameur (2018), found that the relationship is complex and depends on various factors, such as the sector of the economy, the recipient's characteristics, and government policies.

Another stream of studies considering more than one of the selected north African countries found mixed results. For example, Jouini et al. (2021) applied the cointegration approach to data from 1970–2009 to examine the remittances-economic growth nexus of two North African countries, Algeria and Morocco. The empirical findings conflicted in the short-run and long run for Algeria, where the nexus was negative in the long run. However, in the short run, remittances affect EG through human capital and financial development. On the other hand, for Morocco, only in the long run was their evidence for the remittance-growth hypothesis, and no causal link was found in the short run. Héla, M. and Habib, O. (2020) investigated the role of the financial sector as a channel through which migrants' remittances could affect EG in some selected MENA regions, namely Algeria, Egypt, Iran, Jordan, Lebanon, Morocco, Sudan, Tunisia and Turkey, during the period 1990-2018 by applying the GMM estimation approach. Their empirical findings revealed the positive impact of remittances on EG in those selected MENA countries.

The study contributes to the existing literature in many ways. Firstly, it focuses on five North African countries from 2000–2020. In particular, the study investigates the direct impact of remittances on the economic growth of North African countries. This makes some economic sense because these countries possess similar characteristics and account for more than 52% of the total amount of IR received by the North African countries. Secondly, the study employed the system GMM estimator due to its practical advantage for the dynamic data set. Thirdly, the

study contributes to the empirical literature on the macroeconomic implications of remittances in North African countries and, by extension, developing countries.

3. Methodology and data
3.1 The Theorical Model and data

This study explores the impact of remittance outflows and foreign direct investment (hereafter FDI) on economic growth in selected North African countries by using an extended production function where remittances and FDI are included as macroeconomic factors. The primary economic growth model can be written as follows:

$$GDP_{it} = f(K_{it}, L_{it}, REM_{it}, FDI_{it}) \quad (1)$$

As each variable is expressed in its natural logarithmic form, and after adding a random error term, the empirical model takes the following form:

$$LGDP_{it} = \beta_0 + \beta_1 LK_{it} + \beta_2 LL_{it} + \beta_3 LREM_{it} + \beta_4 FDI_{it} + \varepsilon_{it} \quad (2)$$

Where GDP_{it} is the real gross domestic product (measured in milliards of constant 2015 US dollars), K_{it} is the gross fixed capital formation (measured in millions of constant 2015 US dollars), L_{it} is the labor force (measured in millions), FDI_{it} is the stock of FDI (measured in millions of constant 2015 US dollars). Moreover, REM_{it} is the remittance inflows (measured as a percentage of GDP), ε_{it} is the stochastic error term, I refer to the country, and t refers to the period for each country. All variables are converted into natural logarithms, so the estimated coefficients represent the elasticities of real GDP with respect to the dependent variable. Finally, the panel cointegration techniques are used to investigate the long-run dynamic effects between economic growth, remittance outflows, and FDI in a cointegration relationship between variables.

The data set used in the study is annual and extends from[d] 2000 to 2020 for the selected five North African countries: Algeria, Egypt, Morocco, Sudan, and Tunis. Data are collected

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[d] *The period is chosen according to data availability for all selected countries; therefore, the panel is balanced.*

from the World Development Indicators (WDI) and United Nations Conference on Trade and Development (UNCTAD).

3.2 The Econometric Model

The study employs the Pooled Mean Group (PMG) estimation approach[e] Pesaran et al. (1999) estimate the dynamic heterogeneous panel model, which includes the short-run and long-run causal linkages between economic growth and foreign direct investment and remittance outflows. The estimated model takes the form of the Autoregressive Distributed Lag (ARDL) model, which allows for estimating the short-run and long-run relationship. The model takes the following specification:

$$\Delta L y_{it} = \phi_i \left(y_{i,t-1} - \gamma_i' X_{i,t-1} \right) + \sum_{j=1}^{p-1} \beta_{ij}' \Delta L y_{i,t-j} + \sum_{j=0}^{q-1} \Delta X_{i,t-j} \delta_{ij}' + \mu_i + \varepsilon_{it} \quad \textbf{(3)}$$

Where L and Δ stands for the natural logarithm and the first difference operator, respectively. $\Delta L y_{it}$ and ΔX_{it} are, respectively, the first differenced real GDP and the set of dependent variables (capital, labor, foreign direct investment, and remittances), $\emptyset_i$ is the term of error-correcting speed of adjustment. The vector of coefficients γ contains coefficients of the long-run relationship between variables which are assumed to be identical across countries, the vector of coefficients β captures the short-run past own effects of real GDP, the vectors of coefficients δ measure the short-run impacts of the dependent and α_i are the individual specific effects. The optimal lag orders P and q are selected using the Schwarz Bayesian information criterion (SBC).

We should at this point clarify that the reason behind our selection of the Panel ARDL approach over alternative models, such as fully modified OLS or dynamic panel models was driven by several key considerations specific to our study's objectives and data characteristics. First of all, the primary focus of the analysis is to explore both the short-term and long-term impacts of remittance inflows on economic growth. The ARDL model excels in this regard, as it can estimate both short- and long-run relationships simultaneously. Other FMOLS methods focus on

long-run dynamics and may not capture short-run effects as effectively. Second, the presence of cross-sectional dependency across the countries studied was confirmed through diagnostic tests. The Pooled Mean Group (PMG) estimator within the ARDL framework is designed to handle this dependency, ensuring more accurate and unbiased results. Other estimation techniques, such as FMOLS, may lead to biased estimates when cross-sectional dependency is present. Third, the ARDL model allows to capture the dynamic relationships between variables over time, and it ensures the robustness of our estimates. Finally, as for robustness tests, we conducted panel unit root and cointegration tests to validate the appropriateness of the model, and we ensured that the selection of lag lengths was done systematically to avoid overfitting. Cross-sectional dependence tests were also carried out to confirm the presence of dependencies, further justifying the use of the ARDL approach. Also, according to Pesaran et al. (1999), the PMG estimation methods provides robust estimation results of the long-run relationship under the homogeneity assumption and overcomes endogeneity and serial correlation.

4. Empirical results and findings

The initial step in the empirical study is to examine the stationarity properties to determine the order of integration of the used variables. Next, the panel cointegration tests are employed to check for long-run relationships among variables. The integration properties of the variables and cointegration tests allow for determining the appropriate econometric methods to be used in the empirical analysis. Finally, if a long-run cointegration relationship is found, the cointegrated panel estimation methods are applied to investigate the linkages between the variables.

4.1 Data and summary statistics

The study uses annual data for real GDP, capital, labor, foreign direct investment, and remittance outflows for a panel of five North African countries from 2000-2020. Table 1 summarizes the descriptive statistics for each variable.

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[e] *Pesaran et al. (1999) indicate that the PMG estimation technique provides a consistent and efficient estimated*   *coefficient of the long-run relationship under the homogeneity assumption.*
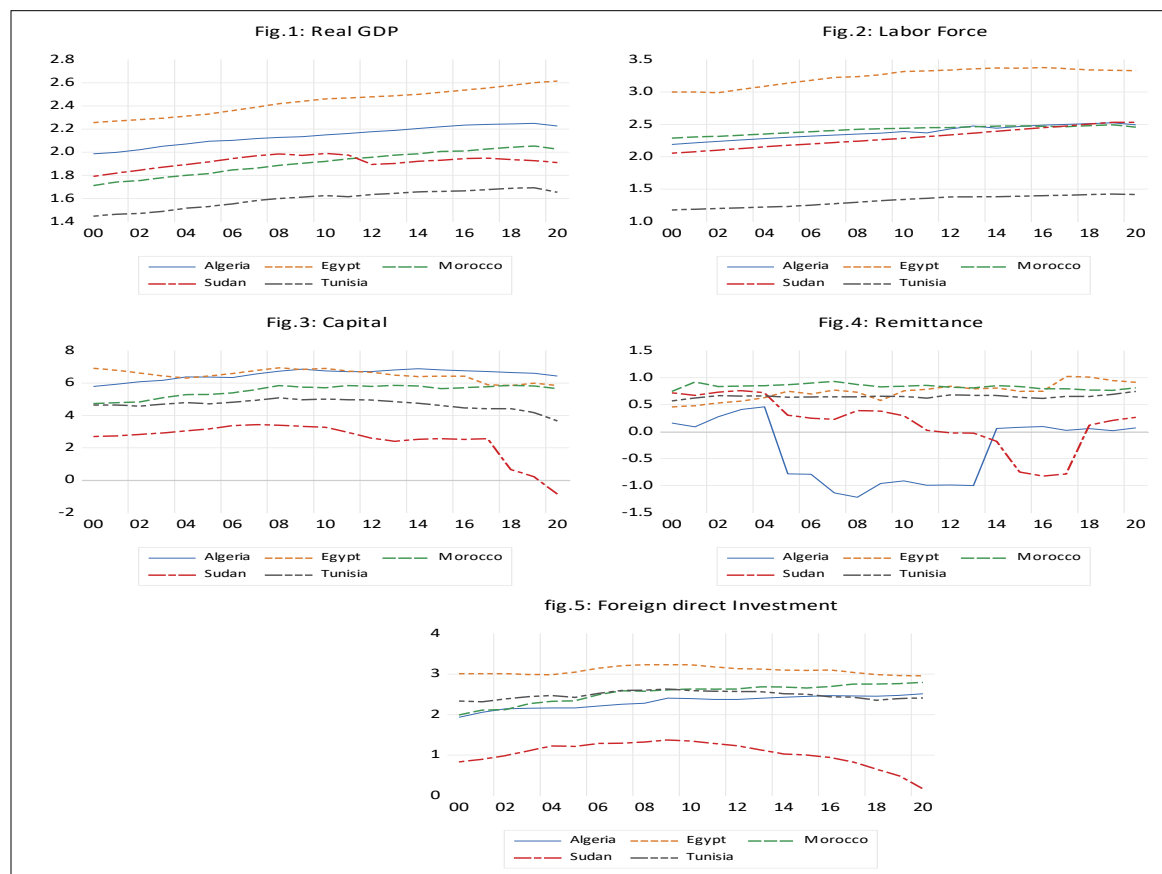
The log levels of the real gross domestic product (GDP), the gross fixed capital formation (K), the labor force (L), foreign direct investment (FDI), and remittance outflows (REM) are plotted in Figs. 1–5, respectively. We observe a common trending behavior, indicating some relationship between the variables. Furthermore, the figures show that all variables have increased over time for all countries. Egypt has the highest real GDP, labor force, and FDI, Tunisia has the lowest real GDP and labor force, and Sudan has the lowest FDI.

Table 1: Summary statistics

Variables	Mean	Max	Min	Std.
GDP	125.65	412.246	27.97	91.555
Capital	12.303	29.254	3.245	7.456
Labor	359.04	1033.94	0.426	320.575
FDI	4.074	10.494	0.061	2.600
Remittanc	432.15	1701.69	1.444	448.973

Figs. 3 and 4 reveals that the highest remittance value (capital) inflows are in Morocco (Algeria), while the lowest capital and remittance inflows are observed in Sudan. The drop in Sudanese remittances from 2004–2012 is attributed to the world economic sanctions led by the USA from 1988–2007 and the global financial crises (Atif & Abdalla, 2018). This action affected the Sudanese's economic activities, such as the agricultural, industrial, and financial sectors. Due to the sanctions on international financial activities and the gap between the formal exchange rate and the informal (black market) exchange rate, the formal flow of remittances has declined, which has led to the flourishing of informal channels (Ishag, 2023; Cohen et al., 2012).

Fig.1: Real GDP

Fig.2: Labor Force

Fig.3: Capital

Fig.4: Remittance

fig.5: Foreign direct Investment

4.2 The panel unit root tests

The variables' non-stationarity analysis and integration properties are a priority for conducting empirical studies, which allows for determining the appropriate estimation method. For panel data, a wide range of panel unit tests (Maddala & Wu, 1999; Breitung, 2000; Hadri, 2000; Levin, Lin, and Chu, 2002; Pesaran & Shin, 2003) are developed to examine variables' integration order. However, these unit root tests deal with the issues of homogeneity and heterogeneity among pooled cross-sectional data. Therefore, in the presence of significant contemporaneous correlation among cross-sections, the panel unit root tests cited previously can have low power and lead to misleading results. Within this context, the cross-section dependence (CD) test has been developed by Pesaran (2004), which allows for verifying the existence of such dependence for cross-section panel data. The CD test is constructed to test independence under the null hypothesis against dependence under the alternative hypothesis. In addition, Pesaran (2007) proposes a second generation of panel unit root tests incorporating cross-sectional dependency. The panel unit-root test of Pesaran (2007), referred to as the CIPS test, is constructed under the null hypothesis of a unit root against no unit root under the alternative hypothesis.

The results of the CD test and CIPS unit root test are reported in Table 2. The CD test results strongly reject the null hypothesis of cross-sectional independence at the 1% level. Furthermore, according to the CIPS test, each variable contains a unit root but no unit root at the first difference, I(1).

Table 2: CD test and CIPS unit root test results

Variables	CD test	CIPS test	
	CD statistics	Level	First differences
GDP	11.503* (0.000)	-1.036 (0.952)	-5.427* (0.000)
K	13.761* (0.000)	-2.525 (0.303)	-3.561* (0.002)
L	4.437* (0.000)	-1.544 (0.967)	-3.093** (0.036)
FDI	14.807* (0.000)	-2.288 (0.509)	-3.510** (0.000)
REM	5.351* (0.000)	-2.326 (0.484)	-2.604** (0.024)

*Notes: *, **, and ***denote the rejection of the null hypothesis at the 1%, 5%, and 10% significance levels, respectively. The values in parentheses are the P-Values. The critical value of the CIPS is provided in Pesaran (2007), Section 4, Table II(b) and II(c), pages 280-281. The lag order p is selected based on the AIC with a maximum delay order equal to 4. The "xtcdf" and "pescadf "stata commands are used to perform CD and CIPS tests.*

4.3 Panel cointegration analysis

The panel unit root test results indicate that all variables are integrated in order one. Consequently, the panel cointegration tests explore the long-run relationships between economic growth, foreign direct investment, and remittance outflows. Many panel cointegration tests have been developed and used to test for cointegration in panel data. For example, Kao (1999) proposes ADF-type tests for cointegration under the assumption of endogeneity between variables, while Pedroni (1999, 2004) proposes several tests for cointegration, allowing for heterogeneity.[f] [1]. However, using the classic panel cointegration test, the first-generation cointegration test can produce misleading results in cross-sectional dependency. Hence, the second-generation panel cointegration tests deal with cross-sectional dependency and provide evidence about cointegration relationships among variables. In this context, the panel cointegration test developed by Westerlund (2007) is conducted to explore

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[f] *The results of the panel cointegration tests of Kao (1999) and Pedroni (2004) strongly reject the null hypothesis of no*

cointegration. Unfortunately, the obtained results are not reported but are available upon the authors' request.

evidence of cointegration between variables. The obtained results of the panel cointegration test are reported in Table 3 and reveal that the null hypothesis is firmly rejected at the 5% significance level, implying evidence of a long-run relationship between variables.

Table 3: Results of panel cointegration test

Tests	Statistic	Z. Values	P. Values
Gt	-18.082	1.364	0.000*
Ga	-16.036	1.081	0.000*
Pt	-5.360	-2.457	0.007*
Pa	-6.485	-1.819	0.035**

*Notes: The Stata commends "twist" is used to perform Westerlund's (2007) cointegration test. The panel cointegration test of Westerlund (2007) is constructed under the null hypothesis of no cointegration. The optimal lag and lead lengths for each series are selected using AIC, * and ** * and ** denote significance at 1% and 5% significance levels, respectively. The cointegration test is conducted with both constant and trend terms.*

4.4 Estimation results and findings

The above results of panel unit root and cointegration tests reveal that all variables are integrated of order one and are cointegrated; hence, the cointegrated panel estimation techniques are employed to estimate the short- and long-run linkages between economic growth, foreign direct investment, and remittance outflows. However, the OLS estimation method for the cointegrated panels leads to spurious regression. In addition, the DOLS method proposed by Kao and Chiang (1997) and the FMOLS estimation techniques developed by Pedroni (2001, 2004) are not appropriate to estimate the long-run cointegration relationship between the model's variables under cross-sectional dependency. Thus, the PMG estimation procedure is implemented to estimate the short-run and long-run relationships since it is the appropriate estimation technique under cross-sectional dependency (see, among others, Pesaran et al., 1999).

4.5 The results of the Long-run dynamics

The estimated results of the long-run relationship between economic growth, foreign direct investment, and remittance outflows using PMG are displayed in Table 4. The results reveal a positive and significant impact of capital on economic growth. In addition, we find that FDI and remittance inflows exert a significant and positive long-run effect on economic growth. The results indicate that a 1% increase in FDI leads to an increase of 0.128% in economic growth, and an increase of 1% in remittance inflows leads to an increase in real GDP of 0.025%.

Table 4: The PMG long-run estimate results

Variables	Coef.	T-statistics
L	0.016	0.178
K	0.181	4.095*
REM	0.025	3.548*
FDI	0.128	3.503*

*Notes: * and ** denote significance at 1% and 5% significance levels, respectively.*

4.6 Short-run dynamics and error correction mechanism

The estimated results of the long-run relationship between economic growth, FDI, and remittance inflows indicate that FDI and remittance significantly impact economic growth. Therefore, the study sought to explore the short-run linkages among variables and the adjustment speed toward long-run equilibrium. The estimated results of the short-run interactions are reported in Table 5. The results reveal that the factors of production (labor and capital) with one lag are positive and statistically significant. Furthermore, the estimated results of the short-run dynamic indicate that remittance inflows have a positive and insignificant effect on real GDP.

Table 5: The short-run estimates results and error correction

Variables	Coef.	t-statistics
DLGDP(-1)	0.011	2.343**
DLL	-1.784	-0.045
DLL(-1)	0.312	2.795*
DLK	-0.208	-0.835
DLK (-1)	0.061	2.283**
DLREM	0.013	4.162*
DLREM(-1)	0.004	2.267**
DLFDI	-0.087	-1.090
DLFDI(-1)	-0.024	-0.924
Adj. speed	-0.318	-1.779***

*Notes: "DL" indicates the first log difference, and "Adj. speed" is the error correction speed of adjustment. *; ** and *** denote significance at 1%; 5% and 10% significance levels respectively.*

In contrast, FDI has a non-significant impact on GDP. The short-run, insignificant impact of remittance inflows indicates that foreign

workers take some time to remit their income to their homeland. Moreover, the estimated result reveals a higher speed of adjustment, where the estimated error correction term is about 0.32 and is significant at the 5% level. This finding indicates that we need about three years to restore long-run equilibrium.

4.7 Discussion of the Estimated Results

The empirical results reveal important insights into the relationship between remittance inflows and economic growth in North African countries, both in the short run and the long run. This section will break down these findings more explicitly and highlight their policy implications.

Short-Run Results

In the short run, the analysis shows that remittances have a **positive but insignificant impact** on real GDP. This suggests that remittance inflows in the short term are primarily directed toward immediate consumption needs, such as household expenses and personal consumption. These findings are consistent with earlier studies (Mathew et al., 2022; Sutradhar, 2020) which indicate that remittances in developing countries initially stimulate consumption rather than investment activities.

The insignificant short-term impact of remittances on GDP can be explained by the time lag in the remittance process. Many migrant workers take time to remit their income back to their home countries, which delays the economic effects. Furthermore, the short-run dynamics show a positive effect of labor and capital on GDP, reinforcing the idea that these production factors play a more immediate role in driving short-term economic growth.

Long-Run Results

In contrast, remittances have a **significant and positive impact** on economic growth in the long run. The long-run elasticity of remittance inflows indicates that in the long run, a 1% increase in remittances corresponds to a 0.025% rise in real GDP. This suggests that over time, remittance inflows contribute to **investment activities** that enhance productive capacity. Migrants' remittances are increasingly directed towards more sustainable uses such as business

ventures, real estate, and education, which positively influence total factor productivity.

This long-run positive effect aligns with previous studies (Ishaq Saidu & Ali Salisu, 2020; Jamiu & Husam, 2019) and reflects the shift from consumption to more productive uses over time. The findings highlight the potential of remittances as a long-term growth factor when properly channeled into investment and human capital development.

Finaly, both short-term and long-term impacts highlights the importance of remittances as a key driver of economic growth in North African countries. While their immediate effect may be limited to consumption, the long-run benefits through increased investment and productivity are significant. By implementing effective policies that promote the productive use of remittances we recommended in the conclusion, North African countries can better harness these funds for sustainable economic growth and poverty reduction.

5. Conclusion and policy implication

According to the results of the long-run cointegrating parameter estimations, an increase in remittances had a favorable and significant long- and short-term impact on the economic growth of the selected North African nations. This finding suggests that remittances are spent for productive purposes rather than personal consumption, such as genuine investment activities and the degree of human capital investment. Thus, we advise the North African nation under consideration to strengthen its domestic financial system and macroeconomic policies to foster an environment that attracts private and public investors and increase investment prospects in their economies. As the results indicate, a 1% increase in FDI leads to an increase of 0.128% in economic growth, and an increase of 1% in remittance inflows leads to an increase in real GDP of 0.025%. Furthermore, more remittances should be directed to the formal financial system rather than informal channels to achieve comprehensive growth. In other words, go from cash to digital and from unofficial to official routes to increase the benefits the chosen countries receive from their skilled and unskilled migration streams and anticipate stable economic conditions

in both the most advanced and the Gulf countries. Here are some significant policy implications for North African countries may leverage remittances for sustainable economic growth:

1. Strengthening the Formal Financial Systems: The study reveals that remittances have a significant impact on economic growth, especially when directed toward productive activities such as investment rather than consumption. Also, given the delay in short-run effects and the importance of formal financial channels in the long run, governments should strengthen financial systems to facilitate faster and more secure remittance transfers. Such that governance policy that enhances formal financial channels for remittances would increase the positive impact of these inflows. Governments could:

- Improve access to banking and financial services, particularly in rural and underserved areas, to make it easier for remittance recipients to invest funds productively.
- Encourage the use of digital financial platforms to reduce transaction costs and increase transparency in remittance flows.

2. Incentivizing Productive Use of Remittances: Policymakers could implement incentive programs to encourage recipients to invest remittances in productive sectors, such as entrepreneurship, real estate, and local business ventures. This could include:

- Offering tax incentives or matching funds for remittance recipients who invest in certain sectors.
- Promoting financial literacy programs to educate remittance recipients about investment opportunities and the long-term benefits of saving and investing.

3. Fostering Public-Private Partnerships: The positive impact of remittances on economic growth could be maximized through public-private partnerships (PPPs) aimed at channeling remittances into infrastructure and social projects. Governments could:

- Partner with financial institutions and private firms to create specialized remittance investment funds or bonds that direct remittances toward infrastructure development or other public goods.
- Collaborate with diaspora organizations to mobilize remittances for specific national development goals, such as affordable housing or sustainable agriculture.

4. Aligning National Development Strategies with Remittances: Remittances play a vital role in the economies of North African countries, yet their potential remains underutilized. Policymakers should align remittance-related policies with broader national development strategies by:

- Incorporating remittance flows into macroeconomic planning and poverty reduction strategies.
- Establishing clear regulatory frameworks to manage remittance inflows efficiently and ensure they contribute to long-term national goals such as education, healthcare, and infrastructure development.

5. Addressing Informal Remittance Channels: The study highlights the use of informal remittance channels in some countries, which reduces the potential benefits of these funds for the formal economy. A governance policy could focus on:

- Creating more attractive and efficient formal channels by reducing fees, enhancing accessibility, and providing faster services.
- Collaborating with international organizations to curb the use of informal remittance systems and increase the overall security of money transfers.

By implementing these governance policies, North African countries can more effectively harness remittances to boost economic growth, reduce poverty, and promote sustainable development.

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