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Remittances and Economic Growth in the Turkic Republics and Tajikistan: A Panel Data Analysis

Sedef Oluklulu[a]*, Hatice Altınok[a]

[a]*Anadolu University, Faculty of Economics and Administrative Sciences, 26470, Eskişehir, Türkiye*

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ABSTRACT

Migrant remittances are an important source of external financing for developing economies, but their impact on economic growth remains ambiguous. This study aims to examine the long-run effects of remittances, foreign direct investment (FDI), trade openness, and tax revenues on real GDP and to identify causal relationships among these variables in five Turkic Republics (Azerbaijan, Kazakhstan, Kyrgyzstan, Türkiye, and Uzbekistan) and Tajikistan over the period 2005–2023. The analysis employed tests of cross-country dependence and coefficient homogeneity, panel unit root tests, the Durbin–Hausman cointegration test, FMOLS and DOLS estimates, as well as the Dumitrescu–Hurlin panel causality test. The results showed a positive long-term relationship between remittances and real GDP: the coefficient was 10.7917 for FMOLS ($p = 0.0137$) and 3.8556 for DOLS ($p = 0.023$). Trade openness also has a positive and statistically significant long-term relationship with real GDP: the corresponding coefficients were 1.1260 and 1.2183 ($p = 0.000$ in both cases). At the same time, the coefficients for foreign direct investment turned out to be negative: −1.7361 for FMOLS ($p = 0.051$) and −2.2875 for DOLS ($p = 0.088$). The results obtained confirm the significant role of remittances in the economic dynamics of the countries under study and indicate the feasibility of improving the mechanisms for attracting them into the formal financial sector and for their productive use. The findings underscore the need to develop formal financial channels, improve the efficiency of using money transfers, and direct external financial flows toward productive investments and sustainable economic growth.

KEYWORDS: Economy, Economic Growth, Trade Openness, Financial Integration, External Financing, Intercountry Dependence, Turkic Republic, Tajikistan

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*** Corresponding author: Oluklulu S.** – PhD, Assistant Professor, Anadolu University, Faculty of Economics and Administrative Sciences, 26470, Eskişehir, Türkiye, email: sedefcelik@anadolu.edu.tr

Денежные переводы и экономический рост в тюркских республиках и Таджикистане: панельный анализ

Олуклулу С.[a]*, Алтынок Х.[a]

[a]*Университет Анадолу, факультет экономики и административных наук, 26470, Эскишехир, Турция*

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АННОТАЦИЯ

Денежные переводы мигрантов являются важным источником внешнего финансирования для развивающихся экономик, однако их влияние на экономический рост остается неоднозначным. Цель исследования заключается в оценке долгосрочного влияния денежных переводов, прямых иностранных инвестиций, открытости торговли и налоговых доходов на реальный ВВП, а также в выявлении причинно-следственных связей между этими переменными в пяти тюркских республиках (Азербайджане, Казахстане, Кыргызстане, Турции и Узбекистане) и Таджикистане за период 2005–2023 гг. Для анализа применены тесты межстрановой зависимости и однородности коэффициентов, панельные тесты единичного корня, тест коинтеграции Дурбина–Хаусмана, оценки FMOLS и DOLS, а также тест панельной причинности Думитреску–Хёрлина. Результаты показали положительную долгосрочную связь денежных переводов с реальным ВВП: коэффициент составил 10,7917 по FMOLS (p = 0,0137) и 3,8556 по DOLS (p = 0,023). Открытость торговли также имеет положительную и статистически значимую долгосрочную связь с реальным ВВП: соответствующие коэффициенты составили 1,1260 и 1,2183 (p = 0,000 в обоих случаях). В то же время коэффициенты прямых иностранных инвестиций оказались отрицательными: −1,7361 по FMOLS (p = 0,051) и −2,2875 по DOLS (p = 0,088). Полученные результаты подтверждают значимую роль денежных переводов в экономической динамике исследуемых стран и указывают на целесообразность совершенствования механизмов их привлечения в формальный финансовый сектор и направления продуктивного использования. Результаты подчеркивают необходимость развития формальных финансовых каналов, повышения эффективности использования денежных переводов и ориентации внешних финансовых потоков на производительные инвестиции и устойчивый экономический рост.

КЛЮЧЕВЫЕ СЛОВА: экономика, экономический рост, торговая открытость, финансовая интеграция, внешнее финансирование, межстрановая зависимость, тюркская республика, Таджикистан

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*** Корреспондирующий автор: Олуклулу С.** – PhD, доцент, Университет Анадолу, факультет экономики и административных наук, 26470, Эскишехир, Турция, email: sedefcelik@anadolu.edu.tr

INTRODUCTION

In 2024, the approximate number of international migrants is 304 million individuals. Despite the rise in foreign migrants, this proportion has remained consistently at 3.7% of the global population for many years. In other words, almost 4 out of every 100 individuals who reside are international migrants. According to the World Economic Forum's Global Risks Report, involuntary migration or relocation is among the top 10 short-term challenges (WEF, 2025). The primary solutions offered for mitigating this risk factor are augmenting development funding and establishing international agreements (WEF, 2025).

Remittances from migrants departing their homes to pursue economic opportunities are crucial for both households and the broader economies of developing nations. Remittances enhance population resilience, facilitating the attainment of Sustainable Development Goals 11, 13, and 16, despite financial or social upheaval in the home country (Ullah et al., 2025). Analysis of the influence of migrants on the public finances of their host nations reveals that migrants contribute more to the public budget through taxation than they receive from social security, healthcare, and educational expenses (OECD, 2021). Immigrants' contributions to the public budget are indispensable; once they reach a certain threshold, they can finance all congestible public goods. Furthermore, they substantially support the funding of all public goods, including public debt and national defense, thereby enhancing the public finances of their host countries (OECD, 2021).

In 2023 and 2024, remittances to low- and middle-income nations surpassed the combined total of foreign direct investment and official development assistance, reaching 636 billion and 699.9 billion dollars, respectively. Due to the robust economies of nations employing migrants, remittances have consistently increased throughout pandemics and worldwide financial crises (Ratha et al., 2024; UN, 2026). Research indicates that the economic and political circumstances of the country do not significantly influence the remittances provided by workers (Ambrosius et al., 2021). Despite an unparalleled worldwide recession during the COVID-19 pandemic, remittances continued to rise. The current consensus is that travel limitations have shifted remittances from informal to formal routes (Kpodar et al., 2023). The use of unofficial channels for transmitting worker remittances to the home country complicates the assessment of their economic impact, while alternative transfer systems, such as “hawala”, which operate without legal regulation, raise concerns about money laundering and terrorist financing (Kholmatova, 2024). The World Bank's strategy to promote worker remittances in accordance with the SDGs is to increase remittance volumes by lowering transfer costs. The World Bank has introduced an online tool to compare global remittance costs and promote transparency in international money transfers. Reducing remittance transfer costs to less than 3% by 2030, in line with SDG 10, could encourage the use of formal remittance channels (Mohammed, 2025; Thakur et al., 2026).

The correlation between remittances and real GDP is affected by financial sector development, economic openness, the purpose of remittances (investment or consumption), their share of GDP, and the country's income level (low, middle, or high) (Radic et al., 2023). In middle-income countries with a relatively strong financial system, remittances have a positive effect on growth (Aggarwal et al., 2011). However, this effect is not seen in low-income countries with a weak financial system. This circumstance suggests that the crucial factor in the influence of remittances on economic growth is the efficient operation of the financial system, channeling cash from official sources to productive investments (Sholehah & Samputra, 2025). Recent studies contend that substantial remittance inflows, contingent upon their utilization (investment versus consumption), may induce a production shift toward sectors with inherently weaker long-term development potential, a phenomenon referred to as “Dutch disease” (Manato, 2025; Behzadan & Chisik, 2025).

For the past two decades, the proportion of worker remittances to GDP in Kyrgyzstan and Tajikistan has consistently been above 20%, with Tajikistan ranking among the highest globally in this regard, almost reaching 50% (World Bank, 2025). Due to the elevated rate of labour migration from the Turkic republics and Tajikistan, substantial sums of foreign cash are remitted to these nations (Sugözü & Talantbekova, 2024).

Alongside conventional macro- and

microeconomic determinants of economic growth, scholars increasingly focus on the strategic significance of FDI and remittances in fostering sustainable development in Türkiye, the Turkic republics, and Tajikistan. Remittances substantially influence the stability of domestic demand in Tajikistan (UN, 2026). This study aims to examine the long-run effects of remittances, foreign direct investment (FDI), trade openness, and tax revenues on real GDP and to identify causal relationships among these variables in five Turkic Republics (Azerbaijan, Kazakhstan, Kyrgyzstan, Türkiye, and Uzbekistan) and Tajikistan over the period 2005–2023. The study seeks to elucidate the long-term cointegration relationship and the direction of causation among the variables, accounting for cross-sectional dependence and slope heterogeneity within a complex framework characterised by varying degrees of integration among the series. Thus, despite the large literature on remittances and economic growth, empirical evidence for the Turkic Republics and Tajikistan is scarce, especially when accounting simultaneously for cross-sectional dependence, country heterogeneity, fiscal variables and multiple external sources of financing. Using second-generation panel econometric techniques that account for cross-sectional dependence and heterogeneity across countries, the study fills these gaps by analyzing the joint effect of worker remittances, foreign direct investment, trade openness, and tax revenues on economic growth. It does so by providing stronger empirical evidence on the impact of external finance inflows and fiscal considerations in enabling sustainable economic growth in the selected economies.

LITERATURE REVIEW

The empirical research on the macro-financial effects of international capital flows shows considerable disagreement over the growth-enhancing capacity of migrant remittances and foreign investments. The scholarly discussion is not offering consensus but, rather, is divided into subject clusters based on operational channels, the structural maturity of recipient economies, and possible crowding-out issues. The consensus view in the empirical research is that remittance inflows are an important external source of finance that reduces credit limits and promotes long-run economic growth, especially in areas with financial friction. The basic mechanism of this optimism is that migrant remittances operate as a parallel credit link financing household spending, accumulation of domestic savings, and micro-entrepreneurship when formal banking institutions are inadequate.

Giuliano and Ruiz-Arranz (2009) have shown in a broad panel setting of 100 developing countries that remittances are very efficient in boosting economic performance exactly where the formal banking sector is not well developed, acting as an institutional substitute for credit markets. For example, Aggarwal et al. (2011) present robust evidence in favour of this financial deepening view, using a GMM framework across 109 developing countries and confirming a positive relationship between remittance receipts and banking sector development variables, such as domestic deposit and loan ratios.

The analysis of transition and post-Soviet regions reveals positive growth paths that align perfectly with the geographic focus of this study. For example, Abduvaliev and Bustillo (2020) assessed 10 post-Soviet states. They proved that a 1% increase in remittance inflows leads to a 0.25% growth in GDP per capita, while concurrently reaching a 2% decrease in poverty measures. Similarly, Kumar et al. (2018) applied ARDL bounds testing for Kyrgyzstan and Macedonia and found remittances to be a consistent catalyst for long-term real production growth. Recent studies by Khan (2025) and Pal et al. (2022) have noted that these inflows have persistent positive effects on aggregate social welfare, reduce income inequality, and strengthen economic development provided that the funds are directed to human capital formation, e.g., education and healthcare infrastructure.

The second group of literature presents a more complex perspective. It argues that the growth dividend from external capital is neither automatic nor unconditional. Instead, it is fully contingent upon the institutional environment, financial literacy, and the overall absorptive capacity of the home country. This body of research highlights the importance of formal financial inclusion as a crucial intermediary or regulatory channel that transforms raw foreign currency liquidity into productive local assets.

In this context, Edafe et al. (2024) investigated the relationship between remittance channels

and formal banking infrastructure in Nigeria, revealing that the effectiveness of formal payment systems and specialised remittance-related banking products is crucial for fostering inclusive growth. Khan et al. (2025) further develop this analysis across 79 developing countries, illustrating that in environments characterized by high financial inclusion, incoming remittances are more likely to be invested in entrepreneurial activities rather than used solely for immediate consumption.

Moreover, the structural link of these inflows with public finance is an important but understudied issue. Bangaké et al. (2025) studied the endogeneity of migrant transfers and public budgets for 83 developing nations. Their dynamic panel threshold regressions found that the tax revenue-raising potential of remittances is very sensitive to institutional threshold factors, such as control of corruption and contraction of the informal economy. In a country-specific context, Özyakışır et al. (2024) verified that concerning Türkiye, remittance inflows impact domestic financial development asymmetrically, supporting the policy mandate of preserving robust pension and social security linkages for the diaspora to retain foreign exchange within the formal banking architecture.

On the other hand, the third group of literature warns against over-reliance on inflows of external capital and paints a more negative macroeconomic narrative, characterised by structural bottlenecks, substitution of labour and the phenomenon of 'Dutch disease'. The pessimistic approach asserts that uncoordinated and large foreign cash windfalls can result in actual exchange rate distortions, decrease the international competitiveness of manufacturing sectors, and unwittingly breed political complacency.

Barajas et al. (2009) made a comprehensive methodological critique of traditional growth models based on fixed-effects analysis across 84 countries, finding no statistically significant positive economic benefits of remittances. In their study of Kazakhstan, Kaliyeva et al. (2026) found a short-term positive relationship between income and migration attractiveness ($p < 0.001$), but no long-term stable cointegration. Institutional conditions and infrastructure are the determining factors. The growth-neutral or even negative effect was expressly ascribed to behavioural changes, such as the substitution of labour for leisure, and the structural camouflage that remittance buffers provide to short-sighted governments. This structural disconnection is very apparent in resource-dependent environments. Gachino (2025) used Augmented Mean Group (hereinafter – AMG) and panel VAR estimators for the leading economies in Africa and found an uncoordinated dichotomy. FDI directly financed capital accumulation, while remittances had a persistent negative association with long-term growth because of their severe consumption-driven orientation.

Table 1 demonstrates that the international literature conceptualizes external financial inflows and migrant transfers along three primary theoretical axes: a direct liquidity-enhancing growth mechanism, an institutional/financial mediation requirement, and the risk of Dutch Disease distortions.

Table 1. Literature review matrix

Thematic axis/channel	Author(s)/year	Main findings
The Liquidity-Enhancing and Financial Inclusion Channel	Giuliano & Ruiz-Arranz (2009), Aggarwal et al. (2011), Kumar et al. (2018), Abduvaliev & Bustillo (2020), Sugözü & Talantbekova (2024), Khan (2025)	Remittances positively affect growth.
Absorptive Capacity, Institutional Quality and Complementarity Channel	Özyakışır et al. (2024), Edafe et al. (2024), Bangaké et al. (2025), Khan et al. (2025), Kaliyeva et al. (2026)	Remittances moderately or conditionally affect growth.
Crowding-out risks and “Dutch Disease” Dynamics	Barajas et al. (2009), Gachino (2025), Manato (2025), Behzadan & Chisik (2025), Gajurel & Chindengwike (2025)	Remittances negatively or neutrally affect growth.

Note: compiled by the authors

This empirical matrix provides a comprehensive theoretical baseline to rationalize the econometric findings obtained for the selected 5 Turkic Republics and Tajikistan. When all the studies are synthesized, the empirical literature indicates that the growth effects of remittances are extremely situation-specific rather than generally positive or negative. The benefits of remittance inflows through investment and human capital accumulation are generally associated with countries with developed financial systems and stronger institutions, but the growth effects can be limited, or even Dutch disease dynamics may be at play for economies with poor institutional quality or excessive consumption-oriented use of remittances. The divergence in results suggests that institutional capacity is an important determinant of the ability to convert external financial flows into sustained economic growth.

Modern macroeconomic models, both empirically and theoretically, confirm the risk of unbalanced, consumption-led growth, popularly known as "remittance-induced Dutch disease". Massive, non-intermediated cash injections by migrants result in a harmful reallocation of local production factors towards non-tradable sectors with fundamentally weak long-term productivity and low technological diffusion, as confirmed by investigations by Manato (2025) and Behzadan and Chisik (2025). Gajurel and Chindengwike (2025) similarly warn that ignoring domestic industrial productivity and passively relying on external currency inflows instead upsets the economic balance and requires the creation of institutional "remittance banks" to direct incoming liquidity into physical capital formation artificially.

The prior studies generally show ambiguous growth benefits of remittances and foreign direct investment. These disparities appear mainly to be due to differences in institutional quality, financial development, nation characteristics, and estimating methodology. Therefore, the literature increasingly points out that the efficiency of foreign financial inflows is a function of the economic structure and policy environment of receiving nations, rather than a universal growth mechanism. This result suggests that additional research in comparatively understudied countries such as the Turkic Republics and Tajikistan is warranted.

Previous studies have either analysed individual countries (Abdulai, 2023; Edafe et al., 2024; Özyakışır et al., 2024), focused on groups of developing countries (Khan et al., 2025; Barajas et al., 2009; Aggarwal et al., 2011), or examined a limited subset of Central Asian countries (Sugözü & Talantbekova, 2024; Koc et al., 2024). However, relatively few studies have jointly examined the Turkic Republics and Tajikistan as a distinct group of economies. Moreover, many previous studies employ first-generation methods (Siddique et al., 2012; Pal et al., 2022) that do not account for cross-sectional dependence arising from common policy patterns or global shocks, or for structural heterogeneity across countries. This analysis addresses the literature gap by applying second-generation panel unit root tests (CADF and CIPS), long-run estimators (FMOLS and DOLS), and the Dumitrescu–Hurlin panel causality test. This study is an innovative research endeavor that integrates worker remittances, foreign direct investment, trade openness, and tax revenues into a singular dynamic model tailored for the Turkic Republics and Tajikistan. It addresses econometric issues stemming from differing levels of series integration by employing second-generation methodologies. It empirically illustrates the impact of remittances on GDP, both directly and indirectly through fiscal policies.

RESEARCH DESIGN

This section provides a systematic summary of the empirical methodologies employed and explains how the hypothesis concerning the impact of remittances on real GDP in the chosen countries is tested. This section explicitly clarifies the properties of the data employed, the time span of the search, the variable composition, and the motivation for using econometric methodologies. To study the relation between real gross domestic product, remittances, trade openness, tax revenues, and FDI in the case of 5 Turkic Republics (Azerbaijan, Kazakhstan, Kyrgyzstan, Türkiye, and Uzbekistan) and Tajikistan, we have analyzed a panel model for the period between 2005 and 2023. Due to data limitations during the specified period, Turkmenistan could not be included in the study. Table 2 presents the variables employed in the model specification.

Table 2. Description of variables

Variable	Symbol	Description	Source
Real GDP	RGDP	Real gross domestic product (constant 2015 US$)	World Bank and IMF
Remittances	REMIT	Personal remittances comprise personal transfers and employee compensation.	World Development Indicators
Trade openness	TRADE	As the ratio of imports plus exports	World Bank and IMF
Foreign direct investment	FDI	FDI refers to direct investment equity flows in the reporting economy.	World Bank and IMF
Tax revenues	TAX	Tax revenues	World Bank and IMF

Note: compiled by the authors based on the World Bank (2025) and IMF (2025)

Based on the theoretical and empirical literature, real GDP is assumed to depend on remittances, foreign direct investment, trade openness, and tax revenues. The model used for the current study, for the variables, is as follows in equation (1):

$$RGDP_{it} = \alpha_0 + \beta_1 REMIT_{it} + \\ + \beta_3 FDI_{it} + \beta_4 TAX_{it} + \varepsilon_{it} \quad (1)$$

where:

$t = 1, 2, \ldots, T$ – time-series index;

$i = 1, \ldots, N$ – cross-sectional units;

$\beta_1, \beta_2, \beta_3, \beta_4$ – estimated coefficients of the explanatory variables;

α_0 – intercept;

ε_{it} – stochastic error term;

$RGDP_{it}$ – denotes the real gross domestic product;

$REMIT_{it}$ – the personal remittances comprise personal transfers and employee compensation;

$TRADE_{it}$ – as the ratio of imports plus exports;

FDI_{it} – refers to direct investment equity flows in the reporting economy;

TAX_{it} – the government tax revenues.

To construct the panel data model, information for Azerbaijan, Kazakhstan, Kyrgyzstan, Türkiye, Uzbekistan, and Tajikistan was collected from World Bank and IMF databases. Also, panel data sets are data structures that contain time-series and cross-sectional records. This combination allows for observing changes over time while also registering differences among units. The panel data method improves prediction accuracy, increases degrees of freedom, and helps address multicollinearity by using a larger number of observations and variation. In addition, it allows for controlling for effects specific to different units of analysis. It also enables the modeling of changing behaviors, which increases the explanatory power of empirical studies.

The empirical methodology employed in this study is illustrated in Figure 1.

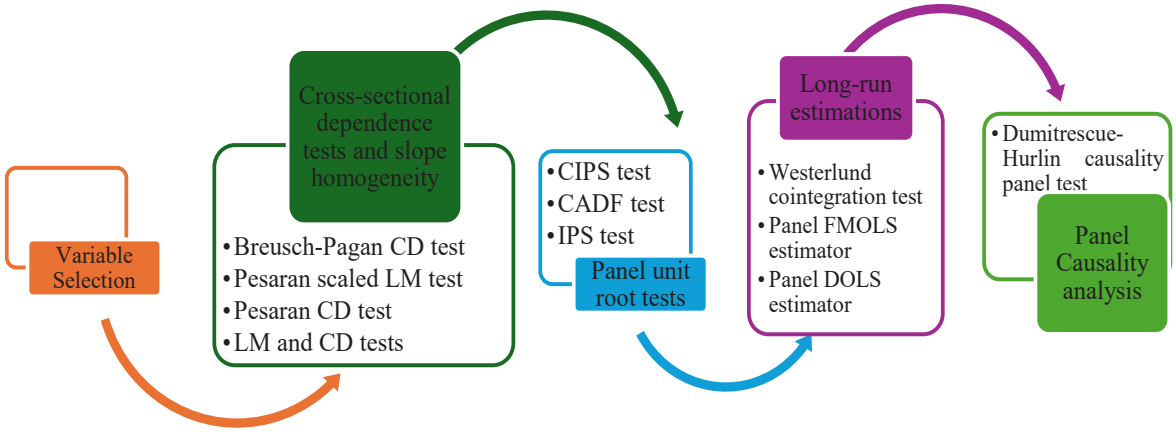


Figure 1. Methodology structure of the study

In econometric analyses of country-level panel data, cross-sectional dependence and heterogeneity may pose important methodological concerns. Hence, it is crucial to carefully assess these issues before determining the appropriate estimation strategy. The presence of common factors influencing the results, along with cross-sectional dependence and unit heterogeneity, may lead to biased estimates and weaken the robustness of empirical findings. Therefore, when these problems are present, the application of second-generation econometric methods becomes necessary.

The analysis initially investigates the presence of interdependence among panel units, which may stem from similar policy practices, external shocks, or unobserved common factors. To detect cross-sectional dependence, the Pesaran CD, Breusch–Pagan LM, Pesaran-scaled LM, and bias-corrected LM tests are employed. Using several complementary tests provides a more robust assessment of cross-sectional dependence. Identifying cross-sectional dependence is important because it guides the selection of appropriate panel unit root tests in the subsequent analysis. Cross-sectional dependence refers to the condition in which the error terms of the estimated models for each unit in the panel dataset are correlated, indicating a relationship among error terms from different units within the dataset (Kumari & Singh, 2025; Yerdelen Tatoğlu, 2017).

Following the identification of cross-sectional dependence, it is essential to assess the slope homogeneity of the dataset to determine which unit root test to use. Ensuring the reliability of estimation results requires addressing slope heterogeneity. In panel data analysis, slope heterogeneity refers to different responses among the units under investigation (such as countries, companies, individuals, etc.), both among themselves and over time, indicating distinct dynamics (Pesaran & Yamagata, 2008).

Two critical factors for selecting methods in panel data analysis are cross-sectional dependence and heterogeneity. The existence of cross-sectional dependency, indicating the correlation of error terms among units in the panel data set, dictates the appropriate unit root test to employ. First-generation unit root tests are recommended in the absence of cross-sectional dependence among the units, but second-generation unit root tests are employed when such dependence is present (Kumari & Singh, 2025). This study employed second-generation unit root testing, specifically CADF, CIPS, and IPS. Spurious regression may arise while analyzing series that have a unit root (Alatrash et al., 2025). Therefore, it is important to determine the existence of a unit root.

The condition of heterogeneity, indicating that variable coefficients in the model differ between units or time, is crucial, as it dictates the selection of the estimate method employed. The simultaneous presence of cross-sectional dependency and heterogeneity plays an important role in selecting which causality tests to use. In addition, to determine the appropriate causality test for the study, it is essential first to identify the cross-sectional dependence of the panel dataset (Dritsaki & Dritsaki, 2020).

After unit root testing, the study examined variable cointegration. The Durbin–Hausman panel cointegration test, established by Westerlund (2008), is used to assess the presence of a long-term cointegration relationship in panel data models where the variables exhibit varying integration orders. The test is crucial in literature, particularly for yielding accurate findings in mixed integration frameworks where certain series are I(0) and others are I(1). The methodology employs the Durbin–Hausman approach within the error correction model, yielding two distinct test statistics: the panel statistic and the group statistic. The null hypothesis posits the absence of a cointegration relationship. In this regard, the test is sometimes favored as an alternative to conventional panel cointegration tests because of its comparatively flexible framework concerning cross-sectional dependence and its accommodation of varying integration orders. Following the cointegration analysis, long-term coefficients were estimated by the FMOLS and DOLS estimators.

In the presence of the situations mentioned above (the existence of cross-sectional dependence and heterogeneity), the Dumitrescu-Hurlin panel causality test in heterogeneous panels developed by Dumitrescu and Hurlin (2012) can be used.

The regression proposed by Dumitrescu and Hurlin (2012) for identifying causality in panel data is as follows in equation (2):

$$y_{i,t} = \alpha_i + \sum_{k=1}^{K} \gamma_i \, y_{i,t-k} + \sum_{k=1}^{K} \beta_i \, x_{i,t-k} + \\ + \varepsilon_{i,t} \; with \; i = 1, \ldots, N \; and \; t = 1, \ldots, T \quad (2)$$

where:

$y_{i,t}$ and $x_{i,t-k}$ – two stationary variables for every individual country in periods;

β_i – estimated coefficients of the explanatory variables;

α_i – intercept;

ε_{it} – stochastic error term.

The null hypothesis of the test in equation (2) is that there is no causal relationship in the panel dataset for which the variable *x* Granger causes *y*. The Dumitrescu and Hurlin test presumes that causality may exist for some units, but not necessarily for all. The Dumitrescu-Hurlin (2012) panel causality test is a strong alternative in panel data analysis because of its considerable advantages. The main advantage of this test is that it can give good results even with unbalanced panels. It also yields stronger inferences by accounting for cross-sectional dependence and correlation across units. Furthermore, it allows the model to flexibly adjust to the data structure by identifying the ideal lag length for each variable independently in autoregressive processes.

RESULTS

This study explores the causality between real GDP, remittances, trade openness, foreign direct investment, and tax revenues by using the Dumitrescu-Hurlin (2012) panel causality test. The test starts by determining the existence of cross-sectional dependence through four widely utilized tests: the Breusch-Pagan LM test, the Pesaran scaled LM test, the Bias-corrected scaled LM test, and the Pesaran CD test. The presence of cross-sectional dependence is critical for identifying which tests to use in the study. This means there is a correlation between the error terms obtained from each unit in the panel dataset. Additionally, a shock in any country in the panel will clearly affect the others. The results of all these tests, as shown in Table 3, consistently indicate significant evidence against the null hypothesis of cross-sectional independence at the 1% level.

Table 3. Cross-sectional dependence test results for every variable

Test/Variables	RGDP	REMIT	TRADE	FDI	TAX
Breusch-Pagan LM	206.4691* (0.0000)	124.5082* (0.0000)	198.6532* (0.0000)	54.09779* (0.0000)	161.9215* (0.0000)
Pesaran scaled LM	34.95732* (0.0000)	19.99337* (0.0000)	33.53034* (0.0000)	7.138246* (0.0000)	26.82407* (0.0000)
Bias-corrected scaled LM	34.79065* (0.000)	19.82670* (0.000)	33.36367* (0.000)	6.971580* (0.0000)	26.65740* (0.000)
Pesaran CD	14.30439* (0.0000)	4.826467* (0.0000)	14.02616* (0.0000)	2.694330* (0.0071)	12.37112* (0.0000)
The values enclosed in parentheses within the table denote probability values. *Denotes significance at the 1% level of significance.					

Note: compiled by the authors

Before applying the causality analysis, it is essential to perform both cross-sectional dependence and heterogeneity analysis of the model. The model in equation (1) is displayed in Table 4 as the result of slope homogeneity.

Table 4. Slope homogeneity test result for the model

Method	Test stat. (P-value)
$\tilde{\Delta}$ test	2.957* (0.003)
$\tilde{\Delta}_{adj}$ test	3.575* (0.000)
* is significant at the 1% significance level.	

Note: compiled by the authors

Given the complexity of economic relationships, the likelihood of variables affecting the econometric results of stationarity increases. Therefore, it is necessary to determine the stationarity of the variables that will be used in the analysis. Subsequently, as all variables exhibit cross-sectional dependence across countries and are heterogeneous, we employ second-generation panel stationarity tests, including CIPS, CAD, and IPS, to assess the stationarity of the obtained panel data. The findings indicate that the examined variables, except FDI (I(0)), were non-stationary at their initial levels but attained stationarity following the application of the first difference, signifying they are integrated of order one (I(1)). The results in Table 5 indicate that all variables are I(1), signifying they are integrated of order one.

Table 5. Second-generation unit root test results

Variables/	CIPS		CAD		IPS	
Tests	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
RGDP	-1.249	-3.297*	1.414	-2.151**	0.7121	-3.276*
REMIT	-1.063	-3.755*	1.504	-1.955**	-0.0048	-6.868*
TRADE	-0.692	-3.267*	1.105	-1.769**	0.6683	-4.775
FDI	-3.189*	-4.996*	-1.604***	-3.750*	-3.1274*	-8.710*
TAX	-1.895	-4.256*	0.620	-2.014**	-1.1289	-8.377*
*, ** and *** are significant at 1%, 5% and 10% significance levels.						

Note: compiled by the authors

To determine the appropriate panel causality test, cross-sectional dependence in the model is also examined. The p-values of the LM, adjusted LM, and LM CD tests are below the 1% significance level. Therefore, the null hypothesis of cross-sectional independence is rejected, indicating the presence of cross-sectional dependence in the model, as shown in Table 6.

Table 6. Cross-sectional dependence test results for the model

Test	Stat. value	p-value
LM	72.520*	0.000
LM adj	10.501*	0.000
LM CD	5.901*	0.000
The values in parentheses in the table represent probability values. *Indicates statistical significance at the 1% level.		

Note: compiled by the authors

The existence of a long-run relationship between variables can be examined using conventional cointegration tests when the variables are integrated of the same order, typically I(1). However, when some variables are I(0) and others are I(1), many conventional panel cointegration tests may not be appropriate. In such cases, alternative approaches are required. The Durbin–Hausman panel cointegration test proposed by Westerlund (2008) provides a framework for examining cointegration when the variables have different orders of integration. The unit root test results in Table 5 indicate that foreign direct investment is stationary at I(0), whereas the remaining variables are integrated at I(1). Therefore, the Westerlund (2008) Durbin–Hausman panel cointegration test was employed to examine the long-run relationship among the variables in equation (1). The results are presented in Table 7.

Table 7. Durbin–Hausman panel cointegration test results

Cointegration Test Statistics	t-stat.	p-value
DH_g	-1.924	0.973
DH_p	1.289***	0.099
*** Indicates statistical significance at the %10 level.		

Note: compiled by the authors

The DH_g statistic does not reject the null hypothesis of no cointegration, whereas the DH_p statistic provides weak evidence of cointegration at the 10% significance level. Table 7 indicates that there is no cointegrated relationship between the variables, as shown by the DH_g test results. According to the results of the DH_p test, a cointegration connection exists between the variables at the 10% significance level. The difference corresponds with the cross-section dependence heterogeneity shown for the model. The cointegration relationship is not generally applicable across all cross-sections, it exists only in certain instances, which may result in a statistically meaningful, though weak, panel statistic. Therefore, the results should not be interpreted as contradictory but as an indication of the heterogeneous structure of the panel dataset. Consequently, it can be inferred that there is statistically supported evidence of a long-term relationship among remittances, economic growth, trade openness, foreign direct investment, and tax revenues.

After determining the existence of a long-term cointegration relationship between the variables, the long-term coefficients of the variables in the model are estimated. Table 8 shows the results of the FMOLS and DOLS estimators, indicating the long-term relationship between the variables.

Table 8. FMOLS and DOLS results

Variable	Panel FMOLS		Panel DOLS	
	Coefficient	p-value	Coefficient	p-value
TRADE	1.1260*	0.000	1.2183*	0.000
FDI	-1.7361***	0.051	-2.2875***	0.088
REMIT	10.7917**	0.0137	3.8556**	0.023
TAX	-0.0073**	0.01872	-0.0027	0.399
*, **, and *** indicate statistical significance at the 1%, 5%, and 10% levels				

Note: compiled by the authors

According to Table 8, remittances have a positive and statistically significant coefficient at the 5% level in both the FMOLS and DOLS models. The estimated coefficients range from 3.8556 to 10.7917, indicating a positive long-run association between remittances and real GDP, although the magnitude differs across the two estimation methods. This difference suggests some sensitivity of the estimated effect to the econometric specification. The findings are consistent with previous studies suggesting that remittances may support economic performance through household consumption, savings, and investment channels (Eggoh et al., 2019; Kumar et al., 2018).

Upon evaluating the results of FMOLS and DOLS collectively, it is evident that the trade openness variable exerts a positive and statistically significant influence on real GDP. Thus, a 1-unit increase in trade openness is associated with an increase in real GDP ranging between 1.1260 and 1.2183. The positive and statistically significant coefficients at the 1% level in both estimation methods demonstrate that the rise in trade volume fosters long-term growth in Azerbaijan, Kazakhstan, Kyrgyzstan, Türkiye, Uzbekistan and Tajikistan. Also, trade openness seems to be associated with positive effects on economic performance through greater integration into global markets, where export-oriented structures and access to imported intermediate inputs might result in higher productivity (Melitz, 2003; Dollar & Kraay, 2004; Amiti & Konings, 2007). In addition to this, while the FMOLS estimates suggest a statistically significant relationship between tax revenues and real GDP, the DOLS estimates show that the coefficient becomes statistically insignificant. This indicates that tax revenues may be sensitive to the estimation method employed.

On the contrary, the negative effect of foreign direct investment implies that capital inflows do not necessarily lead to stronger real GDP in the selected countries. In the selected countries, the concentration of foreign investments in sectors primarily involving natural resources, energy, or limited technology diffusion may not have contributed to growth as expected due to profit transfers and weak technological spillover effects (Alfaro et al., 2004; Asiedu, 2002; Poelhekke & van der Ploeg, 2013). Additionally, this outcome is consistent with the Dutch disease approach, which

suggests that foreign capital inflows can exert pressure on the real exchange rate, reducing the competitiveness of productive and tradeable sectors (Lartey et al., 2012; Combes et al., 2012).

The Dumitrescu-Hurlin panel causality test, formulated by Dumitrescu and Hurlin (2012), is employed in heterogeneous panel data models, as indicated by the results in Tables 3, 4, 5, and 6. Table 9 presents the outcomes of this examination. The null hypothesis of the Dumitrescu-Hurlin causality test for panel data assumes that there is no causal relationship among the variables in the panel dataset. The alternative hypothesis states that a causal relationship exists among the variables of at least one unit. Upon analyzing Table 9, it was determined that certain variables exhibit unidirectional causation, while others demonstrate bidirectional causality and no causality.

Table 9. Dumitrescu-Hurlin panel causality test results

H_1 hypothesis	W-stat	Z-bar statistics	P-value	Causality direction
RGDP→REMIT	1.44358	0.38552	0.6999	REMIT→RGDP
REMIT→RGDP	2.47046	1.75188***	0.0798	
RGDP→TAX	0.87343	-0.37313	0.7091	No causality
TAX→RGDP	1.31331	0.21218	0.8320	
RGDP→FDI	0.98398	-0.22602	0.8212	No causality
FDI→RGDP	0.92324	-0.30684	0.7590	
REMIT→TAX	2.63382	1.96925**	0.0489	REMIT↔TAX
TAX→REMIT	4.06146	3.86885*	0.0001	
FDI→REMIT	2.61509	1.94431***	0.0519	
REMIT→FDI	2.75102	2.12518**	0.0336	REMIT↔FDI
FDI→TAX	1.57193	0.55630	0.5780	No causality
TAX→FDI	2.27267	1.48870	0.1366	
TRADE→REMIT	2.16443	1.34467	0.1787	
REMIT→TRADE	0.90201	-0.33509	0.7376	No causality
RGDP→TRADE	0.88732	-0.35464	0.7229	TRADE→RGDP
TRADE→RGDP	2.69259	2.04745**	0.0406	
TRADE→TAX	1.69638	0.72189	0.4704	No causality
TAX→TRADE	0.39660	-1.00759	0.3137	
FDI→TRADE	2.63859	1.97559**	0.0482	FDI→TRADE
TRADE→FDI	1.59095	0.58161	0.5608	
*, **, and *** indicate statistical significance at the 1%, 5%, and 10% levels				

Note: compiled by the authors

The results in Table 9 indicate a unidirectional Granger causal relationship from remittances to real GDP, from trade openness to real GDP, and from foreign direct investment to trade openness. In contrast, bidirectional Granger causal relationships are found between remittances and tax revenues and between remittances and foreign direct investment. Consistent with these findings, several studies report a predictive relationship between migrant remittances and the economic performance of recipient countries (Eggoh et al., 2019; Sobiech, 2019; Islam, 2022; Benhamou & Cassin, 2021; Kumar et al., 2018). However, other studies find no significant effect of remittances on economic growth (Dujava & Kalovec, 2020; Yadeta & Hunegnaw, 2022), while some report negative effects (Karadag et al., 2019; Bird & Choi, 2020). The bidirectional Granger causal relationship between remittances and foreign direct investment suggests a feedback mechanism in which each variable contains predictive information about the other.

The Dumitrescu-Hurlin causality test revealed no Granger causal relationship between variables. Table 9 indicates the variables for which no Granger Causal Relationship was identified. Accordingly, no predictive relationships were found between real GDP and tax revenues, between FDI and real GDP, between foreign direct investment and tax revenues, between trade openness and real GDP, and between trade openness and remittances.

CONCLUSION

This study analysed the correlation among remittances, trade openness, FDI, tax revenues, and real GDP utilising data from 2005 to 2023, encompassing five Turkic Republics (Azerbaijan, Kazakhstan, Kyrgyzstan, Türkiye, and Uzbekistan) and Tajikistan. Due to the identification of cross-sectional dependence and heterogeneity among the variables, second-generation econometric tests were employed in the analyses. The Durbin-Hausman test results by Westerlund (2008) have validated the existence of a long-term cointegration relationship among the variables.

The long-term coefficients derived from the FMOLS and DOLS estimators indicate that remittances and trade openness exert a statistically significant and positive influence on real GDP. Conversely, it has been established that FDI exert a substantial yet adverse effect on real GDP. Besides, the long-term coefficients derived from the FMOLS estimator are statistically significant, but the long-term coefficients derived from the DOLS estimator are statistically insignificant.

The FMOLS and DOLS estimates indicate that remittances and trade openness are positively and statistically significantly associated with real GDP in the long run. Remittances are significant at the 5% level in both models, while trade openness is significant at the 1% level. In contrast, FDI has a negative coefficient in both FMOLS and DOLS estimates, although the relationship is statistically significant only at the 10% level. The effect of tax revenues is less robust, as the coefficient is statistically significant in the FMOLS model but insignificant in the DOLS model.

The Dumitrescu–Hurlin panel causality results provide evidence of a one-way Granger causal relationship from remittances to real GDP at the 10% significance level. This finding suggests that remittances contain predictive information about future economic growth in the selected economies and is consistent with previous studies (Kumar et al., 2018; Abduvaliev & Bustillo, 2020). The positive long-run association between remittances and real GDP also highlights the potential role of migrant transfers in supporting domestic consumption, savings, and investment. Accordingly, policies aimed at reducing remittance transfer costs and expanding the use of formal financial channels may strengthen the contribution of remittances to economic activity and financial inclusion, in line with SDG 10. Moreover, directing remittance resources toward education, healthcare, entrepreneurship, and productive investment may enhance their long-run contribution to economic development (Khan, 2025; Pal et al., 2022).

The results also show a negative long-run association between FDI and real GDP in the selected economies. This finding suggests that the contribution of foreign investment depends not only on its volume but also on its sectoral composition and quality. In resource-rich economies such as Azerbaijan and Kazakhstan, a substantial share of foreign investment has been concentrated in extractive industries rather than manufacturing, innovation, and research and development. Such a structure may generate relatively limited employment and technological spillovers, while weak linkages with domestic firms and the repatriation of profits may reduce the long-run growth benefits of FDI. These factors may help explain the negative FDI coefficients obtained from both the FMOLS and DOLS estimations. Therefore, policies should place greater emphasis on attracting FDI that promotes knowledge transfer, innovation, productivity growth, and stronger linkages with domestic enterprises.

The Dumitrescu–Hurlin results further indicate bidirectional Granger causality between remittances and tax revenues and between remittances and FDI. These findings suggest important interactions between migrant transfers, foreign investment, and fiscal processes. From a policy perspective, strengthening institutional quality, tax administration, financial transparency, and the formalisation of remittance-related economic activity may help broaden the tax base and improve the productive use of external financial inflows (Bangaké et al., 2025). Overall, the findings underline the importance of policies that not only attract external financial resources but also improve the institutional and financial conditions required to transform them into sustainable long-run economic growth.

AUTHOR CONTRIBUTIONS

Conceptualization and theory: SO and HA; research design: SO; data collection: HA; analysis and interpretation: SO and HA; writing draft preparation: SO

and HA; supervision: SO and HA; correction of article: SO and HA; proofread and final approval of article: SO and HA. All authors have read and agreed to the published version of the manuscript.

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Information about the authors

***Sedef Oluklulu** – PhD, Assistant Professor, Anadolu University, Faculty of Economics and Administrative Sciences, Eskişehir, Türkiye, email: sedefcelik@anadolu.edu.tr, ORCID ID: https://orcid.org/0000-0002-1335-7880

Hatice Altınok – PhD, Assistant Professor, Anadolu University, Faculty of Economics and Administrative Sciences, Eskişehir, Türkiye, email: haltinok@anadolu.edu.tr, ORCID ID: https://orcid.org/0000-0002-1093-403X

Авторлар туралы мәліметтер

***Олуклулу С.** – PhD, доцент, Анадолу Университеті, экономика және әкімшілік ғылымдар факультеті, Эскишехир, Түркия, email: sedefcelik@anadolu.edu.tr, ORCID ID: https://orcid.org/0000-0002-1335-7880

Алтынок Х. – PhD, доцент, Анадолу Университеті, экономика және әкімшілік ғылымдар факультеті, Эскишехир, Түркия, email: haltinok@anadolu.edu.tr, ORCID ID: https://orcid.org/0000-0002-1093-403X

Сведения об авторах

***Олуклулу С.** – PhD, доцент, Университет Анадолу, факультет экономики и административных наук, Эскишехир, Турция, email: sedefcelik@anadolu.edu.tr, ORCID ID: https://orcid.org/0000-0002-1335-7880

Алтынок Х. – PhD, доцент, Университет Анадолу, факультет экономики и административных наук, Эскишехир, email: haltinok@anadolu.edu.tr, ORCID ID: https://orcid.org/0000-0002-1093-403X