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Impact of remittances, foreign direct investment and gross capital formation on economic growth in Timor-Leste: Strategies for sustainable development

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ABSTRACT

Timor-Leste is highly dependent on oil, and diversification of productive sectors is essential for attracting foreign direct investment (FDI) and remittances as contributions to GDP. This study analyzes the impact of remittances, FDI, and gross capital formation (GCF) on economic growth in Timor-Leste, with a focus on sustainable development strategies. Using an autoregressive distributed lag (ARDL) model, the analysis investigates short- and long-term dynamics among these critical economic indicators: remittances, FDI, GCF, and GDP growth from 2006 to 2023. The findings indicate that while FDI exerts a negative long-term impact on GDP, it plays a positive role in the short term. In contrast, GCF significantly increases economic growth in the long term. However, remittances do not have a significant impact on GDP in either the short or long term. Furthermore, Granger causality tests confirm that FDI significantly predicts GDP growth, emphasizing its crucial role in the economic development of Timor-Leste. Based on these insights, this study outlines strategic policy recommendations to enhance the effectiveness of FDI and capital formation in driving sustainable economic growth. These suggestions include targeted policies to boost FDI inflows and strengthen GCF, such as improving infrastructure, strengthening institutional frameworks, and promoting diversification of key sectors. By aligning investment strategies with the Sustainable Development Goals, Timor-Leste can reduce its reliance on oil and achieve more robust economic growth. These insights provide valuable guidance to policymakers and decision-makers seeking to leverage FDI and capital formation for long-term prosperity.

Contribution/ Originality: This paper analyzes the impact of FDI, GCF, and remittances on Timor-Leste's economic growth. Both short-term and long-term dynamics are studied using ARDL modeling (2006–2023). The results show that FDI promotes short-term growth but has a negative effect on long-term GDP. In the long run, growth is boosted by GCF, while remittances have little impact. Foreign direct investment is significant as it predicts GDP growth. The report contains policy proposals for the sustainable development of Timor-Leste.

1. INTRODUCTION

The United Nations 2030 Plan emphasizes migrant workers' remittances as vital for poverty reduction and for contributing to the achievement of the 17 Sustainable Development Goals, with indicator 17.3.2 explicitly aiming to increase the share of GDP from migrants (Kratou, Pillai, & Sharif, 2024). Remittances from migrant workers can

sustain the process of stable and changing financial flows to support household economic activities such as consumption and investment in education, health, and infrastructure, ultimately leading to more rational economic development. Therefore, the United Nations aims to increase GDP per capita in developing countries to achieve Sustainable Development Goal 8, which emphasizes inclusive and sustainable economic growth (Raza, Yan, Abbas, & Ilahi, 2024). The primary efforts are to create decent employment opportunities for all job seekers, increase productivity, and strengthen fair and equitable labor rights (Yerrabati, 2025). Increasing remittances contribute significantly to formulating national development strategies to accelerate SDG targets. This approach can help reduce social inequalities such as poverty, lack of decent employment, and economic disparity. All of this promotes sustainable economic growth in various contexts of economic development.

In many developing countries, remittances are crucial for economic growth and development as they support national investment, financial stability, economic growth, and poverty reduction (Ekanayake & Moslares, 2020; Ibrahim & Acquah, 2021; Shah & Wani, 2024). Remittances from migrant workers contribute significantly to the host country's economy. These financial inflows increase households' additional income for consumption and better access to goods and services, which can boost the local economy (Makina, 2024; Song, Paramati, Ummalla, Zakari, & Kummitha, 2021; Zurita Moreano, González Bautista, Vallejo Mata, & Ayaviri-Nina, 2024). In addition, remittances are also very useful for promoting investment in education and health, as recipient households can use the funds to start or expand businesses, and remittances contribute to family savings (Dash, 2020; Mulugeta, 2024; Su, Sun, Ahmad, & Mirza, 2021). The contribution of remittances to financial development is a crucial indicator for improving living standards, alleviating poverty, and enhancing educational attainment (Alshubiri & Jamil, 2025). In terms of economic growth, remittances can support the development of the financial sector by increasing demand for banking services and encouraging the utilization of domestic savings and credit, as well as the accumulation of international reserves. Remittances reduce poverty but do not address inequality. Therefore, policymakers should focus on inequality to prevent long-term economic decline (Anwar, Mang, & Plaza, 2024). In addition, poverty alleviation is becoming increasingly important for economic recovery (Shah & Wani, 2024).

FDI in the era of globalization increases productivity and drives economic growth by providing initial capital, modern technology, superior management skills, and creating employment opportunities (Fazaalloh, 2024; Mwakabungu & Kauangal, 2023; Sahu, 2021). In addition, capital inflows stimulate the economy by establishing new local production units and acquiring existing units (Malik & Sah, 2023). In addition, FDI in developing countries can transfer knowledge, increase market competition, and motivate local companies to innovate in production processes and product characteristics to maintain competitiveness against foreign subsidiaries of multinational enterprises (MNEs) and provide liquidity. In a recessionary economic situation, it is, therefore, possible for companies to engage in mergers and acquisitions (M&A) (Ghazalian, 2023; Wang, Xu, Liu, & Sun, 2023). For this reason, foreign direct investment (FDI) can improve the host country's economy through management skills and new capital, thus reducing poverty. Moreover, it can support environmental sustainability and offer access to healthcare and education (Hossain & Hossain, 2023). In addition, FDI significantly increases economic growth by facilitating decision-making, labor training, and global market integration (Bergougui & Murshed, 2023) and market networks that lead to worldwide production and distribution efficiency promote human resource growth (Banday, Murugan, & Maryam, 2021; Sarker & Khan, 2020). Similarly, foreign direct investment can increase productivity through new production methods to compete in a competitive business environment (Halliru, Loganathan, & Hassan, 2021).

Gross capital formation can occur through investment in fixed assets by promoting financial development through infrastructure and technology. This study increased economic growth and productivity (Li & Gong, 2023). With the help of innovative technology, gross capital formation can increase the production of goods and services (Azam, Ateeq, Shafique, Rafiq, & Yuan, 2023). Similarly, gross domestic expenditure on R&D leads to gross fixed capital formation (Cama & Emara, 2022). Gross capital formation (GCF) can potentially increase economic growth and employment rates (Soava, Mehedintu, Sterpu, & Raduteanu, 2020). In addition, innovation impacts trade

openness, living standards, financial systems, global competitiveness, and economic growth. Government support promotes innovation, increasing economic growth, return on investment, and productivity (Satrovic, Muslija, J. Abul, Gligoric, & Dalwai, 2021).

Timor-Leste is located in Southeast Asia and has a rich culture, with Portuguese as its official language. The country relies on oil and natural gas, which are among its most critical natural resources. These resources, along with other domestic revenues and international investments in the stock market, significantly contribute to government revenues. Since domestic revenues are insufficient to cover the state budget, the Petroleum Fund continues to play a substantial role in total government spending, accounting for 86% (Scheiner, 2021). Remittances have recovered significantly over the last four years without domestic employment and seasonal worker programs. Coffee accounts for 95% of non-oil exports. Budget cuts and inflation reached high levels in 2023 (Asian Development Bank, 2024). As a result, remittances contribute significantly to family life by covering daily needs, family education, and investments. Additionally, remittances can benefit local communities, strengthen their resilience, and help Timor-Leste achieve the Sustainable Development Goals (International Organization for Migration, 2023). Figure 1: Personal remittances increased from 2009 to 2012, with a total receipt of USD 507 million, and decreased again by USD 34 million in 2013. There has been a renewed increase over the last five years, totaling USD 833 million between 2019 and 2023. From 2019 to 2022, FDI in Timor-Leste declined. Researchers have noted this decline: the decline in investment can be attributed to policy challenges, specifically those related to government stability and investment security, as well as the influence of social, environmental, and macroeconomic institutions Ansari and Khan (2023) and Edo and Nnadozie (2023) concur.

Furthermore, COVID-19 significantly impacted the global economy and investment flows, leading to a 30% decline in FDI projects and capital flows between 2019 and 2020 (Adegboye & Okorie, 2023). Apart from the previously mentioned factors that hinder FDI in Timor-Leste, infrastructural issues also pose a significant obstacle. For example, poor infrastructure costs more and generates less revenue, which inhibits foreign investment. The study was conducted by Shaari, Asbullah, Zainol Abidin, Karim, and Nangle (2023).

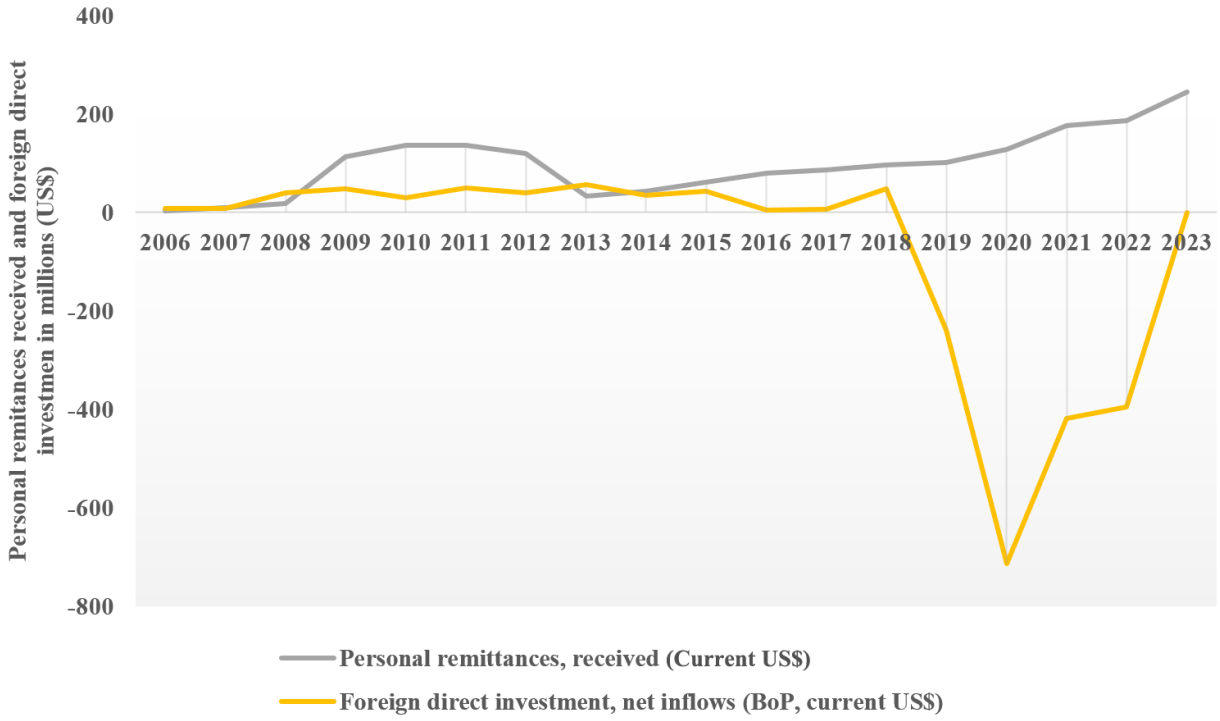

Figure 1. Illustrates the trends: Personal remittance and FDI.

Numerous studies have identified crucial areas for analysis concerning the correlation between remittances, FDI, and economic growth. Alsamara (2022) underscores the insufficient focus on the uneven influence of remittances on economic development in nations like Qatar. Mutai, Ibeh, Nguyen, Kiarie, and Ikamari (2025) emphasize the contradictory findings on remittances, FDI, and imports in Kenya and point to the need for broader applicability. Similarly, Thaker, Karim, and Ali (2024) emphasize the contradictory findings on the impact of FDI in India. Alam, Ikram, Kumar, Haseeb, and Ali (2022) emphasize the contradictory findings on the impact of FDI in India, while Wondimu (2023) discusses the use of outdated data and the lack of causality testing in studies in Ethiopia. According to Abdi, Zaidi, Halane, and Warsame (2024), there is a lack of research on the impact of trade openness and FDI in Somalia despite the country's open economy. The lack of research on remittances, FDI, and aid highlights the need for thorough techniques to understand their combined influence on economic growth. Bird and Choi (2020) suggest that to obtain more accurate insights into several conditions, additional study is necessary to report these inadequacies.

This study makes several significant contributions to the empirical literature on GDP, FDI, and GCF. First, it provides a novel analysis of Timor-Leste, a relatively new country primarily dependent on natural resources such as oil, gas, and unexplored minerals. Second, features like FDI and GCF are vital in promoting investment to support Timor-Leste's Strategic Development Plan 2011-2030 and its economic diversification goals. In this context, remittances are the second-largest contributor to GDP, and their substantial contribution to the nation's economic development is essential. Third, while many studies have examined the relationship between remittances, FDI, GCF, and economic growth, to our knowledge, no study has specifically analyzed their contribution to GDP per capita in Timor-Leste using an econometric model. We employ a time series data analysis with a small sample to address this gap, explicitly utilizing the Autoregressive Distributed Lag (ARDL) model. Finally, the empirical results of this study show that FDI has a dual impact on economic growth in Timor-Leste. In the short run, FDI contributes positively and significantly to GDP growth, but its long-term effects are detrimental. In contrast, GCF consistently demonstrates a beneficial and notable impact on long-term economic progress, highlighting its vital role in the nation's development. Conversely, remittances have little effect on Timor-Leste's economic growth, as evidenced by their lack of significant short- or long-term effects on GDP.

2. LITERATURE REVIEW

2.1. Remittance and Economic Growth

In the last decade, remittances have received significant attention as an essential source of foreign funds for developing countries, with the principal phenomena discussed being their impact on poverty reduction and economic growth. As a result, there is great interest in analyzing the relationship between migrant remittances and economic development. The study by Bucevska and Naumoski (2023) contributes to this discourse by examining the behavior of remittances and FDI during the business cycle and their impact on economic growth. Using the Dumitrescu-Hurlin panel Granger causality test from the first quarter of 2008 to the second quarter of 2021, the empirical results show bidirectional causality between remittances per capita and GDP per capita. These results indicate that remittances influence economic growth, and GDP per capita influences remittance inflows.

In contrast, the study by Depken, Nikšić Radić, and Paleka (2021) and Islam (2022) confirmed that remittances positively affect economic growth, as studies on the economies of South Asia and Croatia show. In South Asia, remittances contribute significantly to economic growth, with unidirectional causality between remittances and growth. The findings suggest that remittance-attracting policies, such as migration-friendly policies, export diversification, and selective FDI inflows, could enhance economic performance. Similarly, a unidirectional causal relationship between remittances and economic growth was identified in Croatia, indicating that remittances are generally linked to economic growth. However, economic growth does not necessarily lead to an increase in remittances.

Remittances have been proven to positively affect economic growth in several regions. However, variables such as unemployment, human capital, and other economic factors influence the extent of this impact. Remittances significantly contribute to GDP growth in Ghana, especially when the unemployment rate is below 8.57%. In countries with higher human capital, remittances positively influence economic growth, whereas their impact is less significant in countries with lower human capital. Evidence from Eastern Europe indicates a positive correlation between remittances and GDP, and foreign direct investment (FDI) also promotes economic growth. Additionally, remittances are positively and significantly associated with economic growth in Asian countries, with cointegration tests confirming a long-term relationship between these variables (Abdulai, 2023; Azizi, Aftabi, Azizkhani, & Yektansani, 2024; Comes, Bunduchi, Vasile, & Stefan, 2018; Dutta & Saikia, 2024). In addition, the PSTR and GMM models used by Tchekoumi and Nya (2023) lead to two significant results. First, the two regimes suggest a nonlinear relationship between migrants' remittances and economic development, which indicates a threshold effect. Second, remittances harm economic growth in the second regime, whereas they have a positive and significant impact in the first regime. The results suggest that trade openness, private investment, and political stability are the most critical determinants of the nonlinear relationship between remittances and economic development.

Remittances vary from country to country and change over time, with positive and negative effects on economic growth and development. Remittances can indirectly contribute to population control and sustainability, but they need formal channels to encourage capital production and investment. Remittances positively impact long-term GDP development, but their short-term impact can be unfavorable. In several countries, remittances obstruct economic development before finally making a promising long-term contribution. In South Asia, remittances have diverse effects; in some, like India, they hinder economic growth, while in others, they have a favorable impact.

Furthermore, remittance outflows negatively affect exchange rates and economic growth. The study emphasizes the importance of a robust financial system that enables efficient remittance investments in productive sectors. Studies by Hossain, Podder, and Asaduzzaman (2019); Periola and Salami (2024); Sutradhar (2020) and Yadeta and Hunegnaw (2022) confirm this point. In addition, globalization boosts the economy by enabling the free movement of people and production factors. Investors and workers in the diaspora generate income and remit it to their country of origin. The study by Oyadeyi, Adediran, and Kabir (2024) shows positive effects on nominal GDP, nominal GDP per capita, and real GDP, with weaker evidence for the latter. The authors recommend better systems for receiving remittances and investment policies.

2.2. FDI and Economic Growth

Several studies have analyzed the relationship between FDI and economic development in different countries. Sahu (2021) found that the inflow of FDI positively impacts the economic growth of 45 developing countries in the short and long term. The effects were most pronounced in the emerging economies of Asia and Africa. In their study, Mawutor et al. (2023) demonstrated a negative impact of FDI on Ghana's economic growth. They primarily attributed this negative influence to Dutch disease. The researchers used an autoregressive distributed lag (ARDL) model to analyze the short- and long-term impacts comprehensively. Kalai and Zghidi (2019) confirmed that FDI and the degree of trade openness favor economic growth in the long run. The effects of the two variables are statistically significant in both the short and long term. Sarker and Khan (2020) conducted a study in Bangladesh to investigate the relationship between FDI and GDP. They discovered a long-run relationship and unidirectional causality between GDP and FDI using an extended ARDL model. As mentioned earlier, the studies investigate various effects of FDI on economic growth, considering both short-term and long-term dynamics as essential factors (Kalai & Zghidi, 2019; Mawutor et al., 2023; Sahu, 2021; Sarker & Khan, 2020).

Numerous studies have examined the connection between FDI, economic growth, and other factors in various countries. Sijabat (2023) found a unidirectional causal relationship between official development assistance (ODA), FDI, and GDP. ODA shows a negative correlation with GDP and FDI. Gorus, Yilanci, and Kongkuah (2023)

discovered a bidirectional cause-and-effect relationship between foreign direct investment and globalization in ASEAN countries, indicating that they influence each other over time. In their study, Ogudu, Pan, and Wu (2024) found a significant positive correlation between FDI and GDP in Nigeria over a long period.

On the other hand, they found that trade openness harmed GDP. Moreover, they identified a one-way causal relationship between GDP and trade openness. Sengupta and Puri (2020) demonstrated that FDI had a favorable effect on GDP, primarily in India. However, they were unable to establish a mutual relationship. Additionally, they highlighted the differences in GDP and FDI patterns between Bangladesh and Pakistan, where they observed weaker or declining relationships. With fluctuating linkages and correlations across different regions, these studies illustrate the complex and context-dependent influence of FDI on economic growth.

Various contexts have analyzed the relationship between FDI and GDP, yielding varying results. Adebayo, Onyibor, and Akinsola (2020) demonstrated that in Nigeria, exports and trade openness have a positive long-term impact on FDI inflows, a finding that the FMOLS and DOLS techniques substantiate. Using wavelet coherence and correlation techniques confirmed these macroeconomic variables' positive correlation and causal relationships. Sethi, Das, Sahoo, Mohanty, and Bhujabal (2022) found a short-term link between GDP per capita, FDI, and financial development in a group of countries. The FMOLS and DOLS results also show that both FDI and economic development positively affect GDP per capita. Nguyen (2022) highlighted that the positive impact of FDI on GDP in ASEAN-6 countries depends on financial development, with thresholds identified for domestic lending and market capitalization. In addition, government spending, population growth, and inflation also have a significant impact on economic growth. Malik and Sah (2023) found a significant short-term relationship between FDI and economic development within the BRICS countries, but the Pedroni cointegration test for residuals revealed no long-term relationship. They found that greater trade openness can attract FDI but can also correlate with a decline in economic growth, as shown by the variance decomposition analysis.

Numerous studies have studied the relationship between FDI and GDP, with noteworthy results for several countries. Bergougui and Murshed (2023) showed that FDI positively influences GDP but that FDI in the primary sector negatively impacts GDP growth. Ayenew (2022) conducted a study that revealed that FDI positively influences the long-term economic development of sub-Saharan African countries. According to the study, a 1% increase in FDI leads to a 0.138% increase in economic growth. In their study, Song et al. (2021) found that FDI inflows positively affect income inequality, although economic growth has a weaker effect. They also discovered that financial development and trade openness influence income inequality. Labidi, Ochi, and Saidi (2024) harmonized with the comprehensive findings of other studies and painted the beneficial effect of FDI on GDP. Comes et al. (2018) demonstrated that FDI has a statistically significant and positive influence on GDP in Eastern Europe, highlighting its role as a GDP accelerator.

2.3. GCF and Economic Growth

In Xia, Qamruzzaman, and Adow (2022) study, the authors examine the relationship between remittances, FDI, and GCF with human capital development in the ten countries that receive the most remittances. The principal results highlight the importance of human capital as a crucial pillar of economic growth by demonstrating positive and statistically significant correlations between these parameters and human capital development. Human capital accumulation is vital for sustainable development, enabling ongoing growth, and aligns with contemporary growth theory. The authors emphasize that there is no longer any doubt about the significance of human capital for economic success. Instead, it is widely recognized how important it is to invest in human capital to promote long-term financial prosperity. According to empirical research, including studies by Kesar, Bandi, Jena, and Yadav (2023) economic growth is positively and considerably obstructed by gross fixed capital formation.

In addition, the study by Satrovic et al. (2021) examines the interdependence between gross capital formation, public expenditure on research and development (R&D), and innovation in Turkey from 1990 to 2017. The authors

used a time series analysis and employed Toda and Yamamoto's econometric approach to examine the causal relationships between these variables. The study's main finding is a bidirectional causal relationship between gross domestic expenditure on R&D, gross capital formation, and innovation, with public spending on R&D and capital formation providing a Granger causality condition for innovation at the 1% significance level. The study reveals that the main driver of Turkey's economic growth is innovation, as demonstrated by the increase in patent applications since the early 1990s. Additionally, the study highlights the role of the government in investing in education through R&D to enhance the country's innovation capacity. The authors address the challenges faced by Turkey's innovation system, including fragmentation and low research spending. They recommend strategic investments in education, R&D, labor force skills, and international cooperation. The study employs Granger causality tests to demonstrate the interactions between R&D spending and innovation.

The study by Pasara and Garidzirai (2020), which focuses on South Africa, finds a positive long-run relationship between GCF and GDP, while unemployment does not affect economic growth in the short run. Their Granger causality tests show that economic growth causes GCF, and both GCF and GDP cause unemployment. They recommend fiscal policies that stimulate capital investment to promote economic growth and job creation. Similarly, Keji (2021) identifies human capital as a critical factor for long-term economic growth in Nigeria and calls for increased investment in education and health to promote sustainable growth. Furthermore, Sasmal and Sasmal (2023) examine the role of social spending on human capital formation and economic growth in India, concluding that higher social spending promotes growth by increasing productivity and capital accumulation. They argue that higher literacy promoted by social spending has a positive effect on income, even though poverty may hinder improvements in literacy. Finally, Bethencourt and Perera-Tallo (2024) study the distribution of human capital across production, bureaucracy, and education during development. They conclude that in the early stages, a significant share of human capital flows into bureaucracy and education, which limits its impact on production. The efficiency of an institution is primarily determined by its quality of human capital allocation, which influences its overall contribution to economic growth.

3. METHODOLOGY

The primary objective of this study was to analyze the impact of remittances, FDI, and GCF on economic growth in Timor-Leste. This empirical analysis uses remittance, FDI, and GCF variables to assess economic growth based on observations over 18 years, from 2006 to 2023. The data, sourced from the World Bank, were transformed into natural logarithms (see Table 1). This transformation addresses the problem of heteroscedasticity and eliminates the potential stationarity or integration of the time series data. The ARDL model is a practical econometric approach for analyzing short-term and long-term relationships between variables. It is beneficial when dealing with time series data that may contain both stationary (I(0)) and non-stationary (I(1)) variables or when working with small sample sizes (Thaker et al., 2024). Therefore, the ARDL model is applied in this study as described by Ngubane, Mndebele, and Kaseeram (2023). The ARDL equation is presented as in Equation 1.

$$y_t = \alpha_0 + \sum_{i=1}^{p} \delta_j y_{t-i} + \sum_{i=0}^{q} \vartheta'_i X_{t-i} + yt + u_t \qquad (1)$$

The long-term ARDL model with all variables considered in this study is represented by Equation 2.

$$GDP_t = \alpha + \sum_{i=1}^{n} \omega_1 RMT_{t-p} + \sum_{i=1}^{n} \delta FDI_{t-p} + \sum_{i=1}^{n} \vartheta GCF_{t-p} + \varepsilon_t \qquad (2)$$

In the above equation, economic growth per capita (GDP) is the dependent variable and is modeled as a function of remittances (RMT) and foreign direct investment (FDI). The constant term is symbolized by α, while the sum of lags is captured by $\Sigma_{i=1}^{n}$. The coefficients for remittances are denoted by ω_1, and the coefficients for FDI are denoted by δ, and the coefficients for GCF are denoted by ϑ. The final term, ϵ_t, represents the error term.

Another method of boundary value testing to determine long-term correlations in ARDL models with time series data can be estimated based on the error correction model (ECM). Therefore, the error correction model for the short run is represented by the following Equation 3.

$$GDP_t = \alpha + \sum_{i=1}^{n} \omega_1 \Delta RMT_{t-p} + \sum_{i=1}^{n} \delta \Delta FDI_{t-p} + \sum_{i=1}^{n} \vartheta \Delta GCF_{t-p} + \lambda ECT_{t-1} + \varepsilon_t \quad (3)$$

The short-term coefficient is represented by the symbol with the first difference operator. λ is a coefficient representing the error correction mechanism, which should have a value between 0 and 1, be negative, and be statistically significant. The ECT value indicates the extent to which the velocity, measured based on the imbalance of the previous period, can be readjusted to the current period's equilibrium.

Table 1. Summary of data sources and proxy variables.

Symbol	Variable	Dependent/ Independent	Variable measured by	Source of data
LN_GDP	Economic growth per capita	Dependent	GDP per capita (Current US$)	https://data.worldbank.org/indicator
LN_RMT	Remittance	Independent	Personal remittances received (current US$)	https://data.worldbank.org/indicator
LN_FDI	Foreign direct investment – net inflow	Independent	Foreign direct investment, net inflows (BoP, current US$)	https://data.worldbank.org/indicator
LN_GCF	Gross capital formation	Independent	Gross capital formation (Current US$)	https://data.worldbank.org/indicator

4. EMPIRICAL RESULT

Table 2 shows the descriptive statistics converted to logarithms for GDP (LN_GDP), remittances (LN_RMT), gross capital formation (LN_GCF), and foreign direct investment (LN_FDI). These statistics include mean, median, standard deviation, maximum, minimum, skewness, kurtosis, and Jarque-Bera. The symmetrical distribution of the mean and median values of LN_GCF and LN_FDI, along with the correlation between the two, indicates a close relationship. However, the highest mean value is LN_GCF at US$ 19,785, followed by LN_RMT at US$ 18,040. The maximum and minimum values illustrate the data distribution: LN_GCF ranges from 17.824 to 20.413, LN_FDI from 15.516 to 17.838, LN_GDP from 6.123 to 7.916, and LN_RMT from 15.108 to 19.313. Additionally, the standard deviation reflects the range of data variation, with LN_RMT having the largest (1.097) and LN_GDP the smallest (0.485). The distribution's shape is determined by skewness and kurtosis. A left-skewed distribution has negative skewness, and LN_GCF and LN_RMT exhibit higher negative skewness. The likelihood values for LN_GCF (0.006) and LN_RMT (0.0401) suggest these distributions do not fit a normal distribution, unlike LN_FDI (0.354) and LN_GDP (0.864).

Table 2. Descriptive Statistics.

Variables	LN_FDI	LN_GCF	LN_GDP	LN_RMT
Mean	17.018	19.785	7.033	18.040
Median	17.497	20.115	7.116	18.405
Maximum	17.838	20.413	7.916	19.313
Minimum	15.516	17.824	6.123	15.108
Std. Dev.	0.872	0.713	0.485	1.097
Skewness	-0.783	-1.659	-0.165	-1.354
Kurtosis	1.823	4.833	2.469	4.097
Jarque-Bera	2.079	10.180	0.293	6.401
Probability	0.354	0.006	0.864	0.041
Observations	13	17	18	18

Table 3 presents the results of the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, which show the variables' different stationarity properties. LN_GDP is non-stationary at the level and in the first difference but

becomes stationary in the second. LN_RMT is stationary at the level and retains stationarity in the first and second differences. LN_FDI is non-stationary at the level, shows weak stationarity in the first difference, and becomes strongly stationary in the second difference. Finally, the second difference further confirms the stationarity of LN_GCF at the level. The results indicate that LN_RMT and LN_GCF exhibit general stationarity at their level, whereas LN_GDP and LN_FDI necessitate differencing to attain stationarity. The results suggest the need for appropriate differencing or cointegration procedures when modeling these variables to prevent non-stationarity-related issues.

Table 3. Result of unit root analysis.

Variables	Level of test	Augmented Dickey-Fuller (ADF)	Phillips–Perron(pp)	Conclusion
LN_GDP	Level	-1.9004	-2.0075	Nonstationary
	1st difference	-2.8518	-2.5190	Nonstationary
	2nd difference	-5.4053***	-5.4248***	Stationary
LN_RMT	Level	-3.1530**	-3.1530**	Stationary
	1st difference	-4.3710***	-3.1972**	Stationary
	2nd difference	-6.1571***	-6.5873***	Stationary
LN_FDI	Level	-2.4049	-2.3010	Nonstationary
	1st difference	-2.7723*	-2.5216	Stationary
	2nd difference	-4.0945**	-4.3231***	Stationary
LN_GCF	Level	-4.2848***	-4.8736**	Stationary
	1st difference	-2.1536	-2.8092*	Stationary
	2nd difference	-5.3954***	-11.3828***	Stationary

Note: (*), (**), and (***) stand for the significance levels of 10%, 5%, and 1%, respectively. Explain the variables.

Table 4 presents the results of the ARDL model show both long-run and short-run dynamics between GDP and the explanatory variables: RMT, FDI, and GCF. Over time, past GDP significantly negatively impacts current GDP, indicating a correction of about 58.6% to equilibrium deviations. FDI can crowd out domestic investment or lead to inefficiencies. Conversely, GCF has a positive and significant long-term effect, suggesting that investment in capital formation contributes positively to long-term GDP growth. However, remittances do not have a statistically significant impact on GDP in the long term. In the short run, the dynamics change: direct investment significantly positively affects GDP, indicating an immediate benefit of foreign investment. In contrast, remittances and GCF do not considerably affect GDP in the short run. The results suggest that while FDI can boost economic growth in the short term, its long-term impact is less favorable, while capital formation supports sustainable long-term growth.

Table 4. Long-run and short-run coefficients.

Variables	Short-Run		Long-Run	
	Coefficient	[Std.Error]	Coefficient	[Std.Error]
	-1 D.GDP			
ADJ L.GDP			-0.586**	[-3.78]
LR				
RMT			-0.00000268	[-1.23]
FDI			-0.00000355***	[-4.85]
GCF			0.00000185**	[3.64]
SR				
D.RMT	0.000000595	[0.39]		
D.FDI	0.00000173**	[4.51]		
D.GCF	-0.000000165	[-0.34]		
_cons	287.7	[1.92]		
N	17			

Note: ***: Significant at the 1% significance level, **: Significant at the 5% significance level.

The bounds test in EViews checks whether there is a cointegrating relationship between the variables in the ARDL model, as presented in Table 5. The study rejected the null hypothesis, indicating that this level does not correlate. The F-statistic is 24.18027, and the upper bounds are 3.586, 4.306, and 5.966, respectively. The F statistic is significantly higher than the upper bound, which indicates a cointegrating relationship. This significance suggests a long-run equilibrium relationship and allows for the investigation of both the short-term and long-term coefficients.

Table 5. Bound test.

ARDL (GDP = RMT, FDI, GCF)	F-statistics	Significance	I (0)	I (1)
K = 3	24.18027	10%	2.676	3.586
		5%	3.272	4.306
		1%	4.614	5.966

Note: K = 3 indicates the number of explanatory variables. * I(0) and I(1) are respectively the stationary and non-stationary bounds.

Table 6. Diagnostic test.

Diagnostic test	F-stat	P- value
Jarque-Bera test	0.053	0.9736
Heteroscedasticity test Breusch-Pagan-Godfrey	1.018	0.4736
Ramsey Reset	3.109	0.0852
Breusch-Godfrey Serial Correlation LM Test	1.138	0.3531

The diagnostic results show a model that fulfills the most important econometric assumptions (see Table 6). The Jarque-Bera test indicates that the residuals are approximately normally distributed. Additionally, the Breusch-Pagan-Godfrey test shows no evidence of heteroscedasticity, suggesting that the variance of the residuals is constant. The Ramsey RESET test confirms that the model is correctly specified and that there are no issues related to omitted variables or incorrect functional forms. Furthermore, the LM Breusch-Godfrey test indicates no serial correlation in the residuals. Overall, the model appears well-specified and meets the key diagnostic criteria.

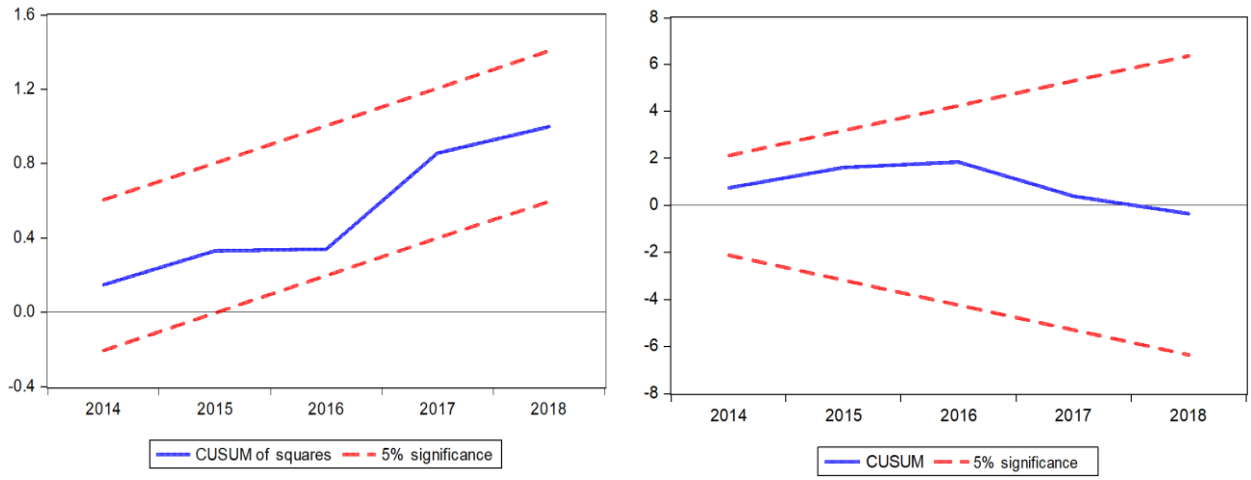

Figure 2. Stability of the coefficients of the autoregressive distributed lag (ARDL) model based on the cumulative sum of recurrent residuals (CUSUM) and the cumulative sum of squares of recurrent residuals (CUSUM of squares).
Note: The straight lines represent critical limits at a 5% confidence level.

CUSUM and CUSUM-square diagrams illustrate the model's stability test from 2014 to 2018, As shown in Figure 2. The cumulative number of residual squares confirms the diagram within the significance limit of 5%, which indicates stable variance. However, the CUSUM diagram of the cumulative number of recursive residuals also remained within the significance limit. Nonetheless, the upper limit showed an insignificant shift in the model parameters during 2017-2018.

5. DISCUSSIONS

By comparing the results of other studies to those of the Timor-Leste ARDL model, we can better understand the relationship between GDP, remittances, FDI, and capital formation. The ARDL model in Timor-Leste suggests that FDI has a significant negative impact on GDP in the long run, which is consistent with the findings of Thaker et al. (2024), who also observed a negative long-term effect of FDI on Afghanistan's GDP. This evidence supports the notion that an increase in FDI can crowd out domestic investment or lead to inefficiencies, as observed in both countries. In contrast, Wondimu (2023) and Alam et al. (2022) found that FDI has a positive and lasting effect on economic growth in Ethiopia and India. The results emphasize that the impact of FDI can vary depending on country-specific factors such as the efficiency of investment use and the economic climate. Regarding remittances, the results from Timor-Leste show that there is no significant or lasting impact on the country's GDP. Alsamara (2022) research aligns with this, revealing the detrimental and notable effects of remittance outflow on Qatar's real GDP per capita.

Contrary to the findings of Mutai et al. (2025) who found that remittances positively affect long-term economic growth in Kenya, this suggests that the effectiveness of remittances may differ depending on the country's dependence on these funds and their use within the economy. The persistent positive impact of GCF in Timor-Leste is consistent with the widely accepted notion that investment in capital formation promotes sustainable economic growth, as shown by the results of several studies. However, the individual studies in the table did not specifically examine GCF. The immediate impact of FDI on GDP in Timor-Leste is consistent with the the conclusions of Alam et al. (2022) and Comes et al. (2018), who found similar positive effects of FDI on economic growth in India and Central and Eastern Europe, respectively. Nevertheless, the adverse lasting impacts of FDI in Timor-Leste suggest that early economic growth may not be possible without competent regulation of capital inflows. The findings from Timor-Leste emphasize the intricate interplay between FDI, remittances, and capital formation in promoting economic growth. These patterns are consistent with those from other countries, emphasizing the importance of contextual variables in influencing these interactions.

6. CONCLUSIONS, POLICY IMPLICATIONS, AND RECOMMENDATIONS

6.1. Conclusions

This study investigates the role of remittances, FDI, and GCF in promoting economic growth in Timor-Leste using data from 2006 to 2023. The results indicate that FDI has a dual impact: while it has a positive and significant effect on GDP growth in the short term, it negatively affects GDP in the long term. Conversely, GCF emphasizes its positive and significant sustainable impact on long-term economic growth, highlighting the importance of GCF for the country's development. In contrast, remittances do not significantly affect GDP in the short or long term. Therefore, remittances play only a limited role in driving economic growth in Timor-Leste.

6.2. Policy Implication

Sustainable economic growth in Timor-Leste is effective if government policies effectively manage remittances, FDI, and GCF in the investment process. The findings of this study indicate the need for a strategic approach to maximize the positive impact of financial flows on the economy. Given the significant association between these variables and GDP growth, policymakers must plan development strategies and implement policies consistent with the country's development goals in sustainable development. Thus, these policies and decision-makers must reflect short-term and long-term opportunities to guarantee sustainable economic progress toward achieving SDG 8: economic growth.

Remittances are a significant financial flow for the economic growth of Timor-Leste. The remittances are important because they assist many households in Timor-Leste by supporting domestic consumption, investment, and other household needs such as education, culture, and health. With this significant contribution, they can help reduce poverty. Given the global trend that remittances tend to be more stable than other financial flows, the

government can strengthen the policy framework to maximize the benefits of this resource. Policies that encourage the use of investments by households to support productive activities, such as in small and medium enterprises (SMEs) and education, can increase the economic impact rather than relying solely on consumption. In addition, the rapid provision of financial services can reduce transaction costs and help households attract more remittances.

In addition, financial education is critical for remittance recipients to invest effectively. So, it is handy and beneficial in promoting financial inclusion through savings and expanding access to services in remote areas. Similarly, the government needs to have and manage a database on remittance flows, and its utilization can help formulate policies that better support economic growth objectives. In addition, migration policies must be improved to facilitate safe and legal migration routes, especially in processing labor documents such as residence permits and employment contracts through bilateral or multilateral cooperation.

Attracting FDI is an essential prerequisite for the diversification of Timor-Leste's economy. Developing Special Economic Zones (SEZs), as planned in Oe-cusse, is a strategic step to attract international investment. The government must create a conducive business environment for investors by providing incentives, ensuring legal protection, reforming regulations to avoid dependence on the central government, reducing bureaucratic barriers, and lowering barriers to market entry. In addition, the sustainable development of infrastructure such as roads, electricity, and telecommunications are crucial to the success of these zones. However, investments must be harmonized with the country's development goals to avoid dependence on sectors with unproductive added value. In addition, macroeconomic stability must be ensured to create investment opportunities that attract FDI and trade. This study contributes to the creation of a favorable investment climate. Therefore, human resources are crucial in all FDI to improve knowledge and skills and better utilize foreign technologies. Additionally, political factors play a vital role in overcoming political tensions, and enhancing legal certainty and clarity can help increase investor confidence, thereby boosting FDI inflows. This study contributes to creating a favorable investment climate. Consequently, human resources are essential in all FDI to enhance knowledge and skills and to better utilize foreign technologies. Furthermore, political factors are critical in resolving political disharmony, and improving legal certainty and order can help increase investor confidence and, consequently, FDI inflows.

GCF is an investment made in fixed assets, such as infrastructure, and contributes significantly to economic growth. Thus, the Government of Timor-Leste has allocated significant funds for infrastructure development to increase the productivity of various financial activities dramatically. However, besides physical infrastructure, there is a need to invest in human resource development, including education, vocational training, and health, to create a more competitive labor force that can attract higher-value FDI so that FDI can benefit.

6.3. Recommendation

1. Maximize the impact of remittances:

- Strengthen policies to encourage households to use remittances for productive investments, especially in small and medium enterprises (SMEs) and education.
- Improve financial services to reduce transaction costs and attract more remittances.
- Promote financial literacy to ensure adequate investment by both senders and recipients of remittances.
- Expand access to financial services in remote areas to improve financial inclusion.
- Develop and maintain a comprehensive database on remittance flows for better policy formulation.
- Improve migration policies to facilitate safe and legal migration, simplifying labor documentation procedures.

2. Attracting and optimizing FDI:

- Development of Special Economic Zones (SEZs) to attract international investment and ensure a favorable business environment through tax incentives, legal protection, and the reduction of bureaucratic barriers.
- Align investments with national development goals to avoid dependence on low-value-added sectors.
- Ensure macroeconomic stability to create a favourable investment climate and attract FDI.

- Invest in human resource development to improve the knowledge and skills required to utilize foreign technologies effectively.
- Eliminate policy disharmony and strengthen legal certainty to increase investor confidence.

3. Improve GCF:

- Prioritize infrastructure development to improve productivity in various sectors of the economy.
- Complement investment in physical infrastructure with human resource development initiatives in education, vocational training, and health to create a more competitive labour force that can attract more FDI.

4. By focusing on remittances, FDI, and the GCF, Timor-Leste can reduce its dependence on oil and gas revenues and build a more resilient and diversified economy.

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