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Research Article

# An ADRL Approach of Long Terms and Short Term Effects of Foreign Labour Employment on Nepal's Economy

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## ABSTRACT

*Foreign labor employment plays a critical role in shaping Nepal's economy, influencing GDP growth and remittance inflows, with both long-term and short-term effects that warrant detailed econometric analysis to guide policy and economic planning. The study aims to comprehensively evaluate the status of foreign labor employment in Nepal and its impact on the economy, integrating insights from various methodologies, including status assessment and economic evaluation. Econometric analysis, particularly the ARDL model, confirms a long-term relationship between GDP, foreign employment, and remittances, with implications for policy and planning. The findings are that the expected growth in foreign labor migration to Nepal implies potential wide-ranging implications for the country's economy, social structures, and policy landscape, affecting factors such as employment dynamics, remittance inflows, social cohesion, and infrastructure demand. The outcomes of the error correction*

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*representation for the chosen ARDL model further reinforce the presence of a robust long-term relationship among the variables, with the coefficient of the error term (-1.069490) at the first difference exhibiting a statistically significant negative sign. This underscores the swift dynamics within the analyzed relationships, with the speed of adjustment from the previous year's disequilibrium in GDP to the current year's equilibrium determined to be 106.94%. In conclusion, Nepal's anticipated increase in foreign labor migration has significant implications for its economy, social structures, and policy landscape, affecting employment dynamics, remittance inflows, and infrastructure demand.*

**Keywords:** ARDL model, econometric analysis, foreign labor employment, Nepal economy, policy implications, remittances

## INTRODUCTION

Nepal has untapped potential in agriculture, power (hydroelectricity), tourism, and service. Still, the nation's economic growth is modest. A stagnant economic growth rate, poverty, outdated agricultural methods, unemployment, restricted industrialization, and a trade deficit have slowed progress. Despite challenges, remittances have been vital to Nepal's economy for decades. It accounts for 25% of the nation's GDP and provides foreign exchange. Nepal's payment balance exceeded 84% of its trade deficit. The Nepal Rastra Bank annual report (2022-2023) showed \$9.33 billion in remittance inflows. Remittances have reduced rural poverty and encouraged rural-to-urban migration for better living conditions, healthcare, education, and public services. Professionally, remittances seem like Nepal's best development catalyst. Understanding remittance economics requires a deep and multifaceted understanding.

Remittances are essential for upholding Nepal's macroeconomic stability and providing vital support to its economy. It is important to conduct a comprehensive and rational thought experiment to examine the effects of international employment on domestic economic growth. Imagine a situation where job opportunities overseas are limited, leading to a decrease in earnings from foreign currency. If there is no other source of foreign currency available, the country's foreign exchange reserves would decrease significantly, resulting in an increase in unemployment and poverty. This would inspire the government to implement strong policies that improve agriculture, tourism, industry, and trade. However, foreign employment plays a significant role in bolstering the government's foreign exchange reserves.

The impact of foreign labor employment on Nepal's economy encompasses both short-term and long-term effects, primarily mediated through remittances, labor market dynamics,

and economic growth. The significance of foreign labor migration in Nepal is underscored by its contribution to the national economy, particularly through remittances, which have become a critical source of income for many households. Recent studies indicate that remittances account for approximately 23.5% of Nepal's Gross Domestic Product (GDP) (Mishra, 2022; Thapa et al., 2022). This influx of foreign currency not only enhances household income but also plays a pivotal role in poverty alleviation and economic stability (Waglé & Devkota, 2018; Banjara et al., 2020).

In the short term, the immediate effects of foreign labor employment are evident in the increased remittance flows, which directly improve the living standards of families left behind. For instance, the remittances sent by migrant workers have been instrumental in covering essential household expenditures and investing in education and health, thereby fostering human capital development (Mishra, 2022; Sah, 2019). However, this dependency on remittances also raises concerns about the sustainability of such economic growth, as it may lead to a consumption-oriented economy rather than one driven by production and innovation (Chhetri et al., 2020).

Long-term effects of foreign labor employment are more complex and multifaceted. While remittances contribute positively to GDP and household income, they can also result in labor shortages in key sectors, particularly agriculture, as younger generations migrate for better opportunities abroad. This trend has implications for agricultural productivity and food security in Nepal, as the rural workforce diminishes (Thapaliya, 2023). Furthermore, the reliance on remittances can stifle local economic development by reducing the incentive for individuals to engage in domestic employment opportunities, thereby perpetuating a cycle of dependency on foreign labor markets (Chhetri et al., 2020).

Moreover, the structural changes in the economy due to foreign labor migration can lead to shifts in labor market dynamics. The influx of remittances may encourage a transition from agriculture to service-oriented jobs, altering the traditional economic landscape of Nepal (Thapaliya, 2023; Chhetri et al., 2020). This transformation necessitates a comprehensive policy response to harness the benefits of foreign labor while mitigating its adverse effects, such as labor market imbalances and economic vulnerabilities (Waglé & Devkota, 2018; Mishra, 2022; Chhetri, 2022).

The foreign labor employment phenomenon in Nepal presents both opportunities and challenges. While it significantly contributes to economic growth through remittances and improved living standards, it also poses risks related to labor shortages and dependency.

A balanced approach that promotes sustainable economic development, enhances local employment opportunities, and optimizes the benefits of remittances is essential for Nepal to navigate the complexities of foreign labor migration effectively.

This study seeks to gain a deeper understanding of Nepal's international labor market, as Nepal benefits significantly from the remittances sent by its citizens working overseas. Money transfers from migrant workers to their home countries have been occurring in Nepal since 1814–1816, when young Nepalese were recruited into the British army after the war between British India and Nepal (Thieme, 2004). Following the devastating impact of civil wars on local labor markets, Muller and Thieme (2007) observed a significant increase in people seeking employment opportunities.

The rise in remittance volume negatively impacted employment opportunities for individuals with serious disabilities. Research on remittances and household welfare highlights the significant role of remittances in sustaining Bangladesh's macroeconomic stability and household well-being. Additionally, these remittances profoundly impact durable goods, education, and health (Raihan et al., 2009).

The labor force of Nepal is highly valued and sought after, with many rural households relying on at least one family member who works abroad. Since 2001, the rate of job creation is significantly impacted by the insurgency and external factors. Conditions for life and security were extremely difficult during that period because of the conflict, especially in rural areas. In addition, it sparked interest in searching for jobs overseas (Panta, 2011).

In a research report, Kafle (2018) explored the correlation between remittances and Nepal's economic growth. Trade, economic growth, and remittances are closely interconnected. The findings suggest that there is currently no direct link between remittances and economic growth. As per Gibson and McKenzie (2012), immigration has the potential to impact productivity levels and tax receipts. Ebeke (2010) pointed out that remittance inflows can impact labor decision-making and potentially lead to an increase in consumption taxes while reducing tax receipts from work. The Nepalese economy now views remittances from employees as its cornerstone. David Seddon's DFID study revealed that migrant workers' remittances could potentially contribute significantly to the official GDP. Shrestha (2008) highlighted the significant value of remittance income as a source of foreign exchange earnings and its crucial role in providing support to families.

Pieńkowski (2020) examined the financial consequences of Ukrainian labor emigration post-2014, supported by international and Ukrainian surveys. Local wages increased due

to a decreased labor force from emigration. Many Ukrainian immigrants were employed in jobs not fully utilizing their professional skills, raising concerns about skill underutilization. Remittances which make up 8% of Ukraine's GDP, benefit immigrant families by boosting domestic demand and GDP, and mitigating economic fluctuations. The impact of emigration and remittances on Ukraine's finances varies. Remittances boost VAT, excise, and customs revenues.

The Ukrainian government values attracting skilled individuals, encouraging migrant investment, and facilitating citizens' return. Kasnauskienė (2012) noted Lithuania's high EU emigration rate, with a 2011 remittances-to-GDP ratio of 4.57%, highlighting international migration's role in labor-sending nation development. The study analyzed Indian labor migration to GCC countries, focusing on remittances and their economic implications. Rijal (2013) examined the socioeconomic and health impacts of migration, highlighting adverse effects and potential remedies. Due to stagnant industrial growth and agricultural output, many workers have sought better employment opportunities abroad.

Due to a prolonged civil war, Nepal experienced significant economic repercussions and a large-scale exodus. By 2009, remittances accounted for 23% of GDP, crucially reducing poverty. Approximately 2.02 million Nepalese labor migrants reside overseas, according to the World Bank. According to Chirilă and Chirilă (2017), remittances can counterbalance labor force decline and drive macroeconomic growth in recipient countries.

Eelavani et al. (2017) analyzed the correlation between remittances and economic growth in Sri Lanka, using GDP, REMI, LF, GFCA, and HPTRENDHC. The study found GDP tends to reach long-term equilibrium and shows a significant, enduring causal relationship with the other variables. Given remittances' impact on GDP, the government must strategize and encourage their effective utilization to stimulate economic growth. Khanal (2020) examined COVID-19's growing economic and social impacts in the literature. Research synthesis was the goal.

This study examines Nepal's coronavirus and government lockdown effects of government lockdown. Economic effects. The effects include lower GDP, tax revenue, economic growth, pay rates, price inflation, and employment. The survey showed that nearly every socio-economic sector has underperformed, hurting the economy. Remittances boost the economy, and informal channels have the potential to increase GDP. or migration has significantly reduced poverty and bolstered the economy.

Lai and Sarkar (2022) found that tight labor restrictions in Taiwan harmed worker

satisfaction and standards. Their analysis showed these restrictions affected earnings, work hours, and employment chances, particularly for skilled workers in FDI businesses. UsiThey found that strict labor laws impacted female professionals in foreign-owned businesses the most, using DDD and DDDD estimates. or unrest and quality issues may hurt FDI, so Taiwanese policy must address these challenges. The findings can guide policymakers in Taiwan.

Trade liberalization, the effective exchange rate, and FDI affect South African non-tradable industrial jobs (Chipeta, 2022). The quantitative technique explained trading. Research analyzed non-tradable construction, financial, wholesale, and retail trade jobs. We studied both long-term and short-term linkages using ARDL. Due to sector-specific features and operational systems, trade liberalization affects non-tradable industry employment differentially. Trade liberalization eventually led to an increase in all industry jobs. Other explanations have little long-term impact. Create strong short-term linkages between the effective exchange rate and financial industry employment.

Aarif and Tarique (2022) investigated FDI and service sector employment in India. The ARDL model predicts long-term and short-term service sector FDI and employment. FDI decreases service sector employment, but not statistically. Research shows that FDI brings skilled, uneven technical developments to the host nation, increasing demand for skilled personnel. Due to inadequate skill levels, FDI in the service sector fails to employ India's growing labor population. The ARDL results show long-term FDI-service sector employment co-integration. The data indicate that FDI stock impacts the Inhas an impact onrvice sector.

Population dynamics and pricing impact Nigerian employment (Michael & Abu, 2024). The autoregressive distributive lag (ARDL) model estimated population dynamics, labor employment, and CPI price fluctuations across time. Consumer price index, foreign direct investment, population growth rate, and tax revenue are regressors fothe laboror force, a proxy for employment. Oriakpono and Ladan (2024) examined Nigerian trade liberalization and employemehistorylyThey studied foreign direct investment, currency exchange rates, trade openness, and employment. Traditional linear regression and ARDL models cover short- and long-term trends. The error correction estimates demonstrate a negative trade openness index-employment rate relationship.

Begum (2022) used time series data to study globalization and women's employment. It examines how economic, educational, and health factors affect Pakistani women's labor force participation. ARDL-bound testing calculated the model from the data. The study revealed that globalization harms Pakistani women's workforce participation. Globalization has harmed

women's careers in their country. Mncayi and Shuping (2021) thoroughly researched labor migration. Understanding the primary reasons for low absorption rates could potentially enhance labor policy.

An ARDL model compared long-term and short-term variables. A study discovered a correlation between factors and hiring ability. Hiring drops as men seek jobs. In contrast, as more women seek work, employment increases. South Africa's employment policy addressed these data, says this study. To understand labor market absorption, we recommend examining labor absorption, employment policy, and gender research.

Brzozowski and Sikorska (2023) examined European first-generation immigrants' economic and social adjustment. To conclude, researchers examine education, marital status, disability, and labor market participation. Many studies use OLS regression. Dissatisfaction with Islamic life was great. Second-generation immigrants with foreign parents are happier. Young European immigrant Muslims adapt better to socioeconomic hardships than their parents' generation and local Muslims.

Ahmad and Khan (2022) examined the influence of globalization on Pakistani poverty. They generated conclusions using 1970–2019 time series data and the autoregressive distributed lag (ARDL) model. Ending poverty in Pakistan requires more commercial openness, FDI, and GDP. According to the paper, globalization and poverty-fighting initiatives may help the government eliminate poverty. Gheorghiev (2023) examined Covid-19 migrant governance, state-employer groups, and social security and protection measures. Capitalism variations are used to research immigration and the Czech labor market. Immigration, labor market fragmentation, and flexibility were explored.

Balqish and Maryam (2024) examined Indonesia's 1992–2022 labor and economic issues. That study discovered a strong link between wages and economic development. Manage inflation and economic stability to boost pay. This research analyzes Indonesian salary parameters statistically. Kałuza-Kopias (2023) studied considerations for Ukrainian and Belarusian job seekers in Polish counties. Migrant socioeconomic position, distance from Polish counties, and diasporas all play a role. To estimate population movements, gravity models use distance and a taxonomic measure of county socioeconomic development.

Maisonnave et al. (2022) used consecutive top-down layered micro-simulation dwellings to study poverty and inequality. Data reveal that Covid-19 response actions hurt Senegalese economy. This In mild and severe cases, this has reduced GDP by 5%–7%. industries struggle, but others thrive on global agriculture. Renewable energy's UAE economic effect was

examined by Jaradat and Al-Tamimi (2021).

From 2010 to 2020, researchers investigated renewable energy consumption, per capita GDP, capital formation, employment, trade, inflation, interest, fixed exchange rate, FDI, and trade openness. The autoregressive distributed lag (ARDL) model systematically analyzed these variables' long-term connections. They identified the independent-variable association using multi-linearity.

The theoretical perspectives surrounding the impacts of foreign labor employment on Nepal's economy can be framed through several key lenses, including economic theory, migration theory, and labor market dynamics. These perspectives provide a comprehensive understanding of how foreign labor migration influences both short-term and long-term economic outcomes in Nepal.

From an "economic theory" standpoint, the influx of remittances from foreign labor significantly contributes to Nepal's GDP, which has been reported to account for approximately 23.5% of the national income (Mishra, 2022). This economic boost is primarily driven by the consumption patterns of households receiving remittances, which often leads to increased spending on education, health, and local businesses, thereby stimulating economic growth (Chhetri et al., 2020).

However, this reliance on remittances raises concerns about the sustainability of such growth, as it may foster a consumption-oriented economy rather than one focused on production and innovation (Chhetri et al., 2020). The Keynesian perspective on government intervention also suggests that policies should be implemented to channel remittance inflows into productive sectors to maximize their economic impact (Shrestha, 2023).

The migration theory provides insights into the motivations behind foreign labor migration. Economic migrants often seek better employment opportunities and higher wages abroad, driven by the socio-economic conditions in Nepal, which include high unemployment rates and limited job prospects (Sharma et al., 2021). The United Nations has highlighted that many individuals migrate to escape unfavorable social and political circumstances, which further underscores the socio-economic determinants of migration (Thapaliya, 2023). This theory emphasizes the dual nature of migration, where it serves as both a coping mechanism for individuals and a strategy for national economic development (Waglé & Devkota, 2018).

The "labor market dynamics" perspective examines how foreign labor migration affects local labor markets in Nepal. The outflow of young, skilled workers can lead to labor shortages in critical sectors such as agriculture, which is vital for the country's economy (Mishra, 2022).



This shift can result in decreased agricultural productivity and increased dependency on remittances, creating a cycle where the local economy becomes increasingly reliant on foreign employment opportunities (Mishra, 2022). Furthermore, the changing labor dynamics can lead to a transformation in societal values, where younger generations may view agricultural work as less desirable compared to opportunities abroad, thus exacerbating the rural-urban divide (Thapaliya, 2023).

The theoretical perspectives on the effects of foreign labor employment in Nepal highlight a complex interplay between economic growth, migration motivations, and labor market dynamics. While remittances play a crucial role in bolstering the economy, the long-term implications of labor migration necessitate careful policy considerations to ensure sustainable development and mitigate potential negative impacts on local labor markets.

## **DATA AND METHODS**

**Data Stationarity Testing with ADF Test:** Conducted Augmented Dickey-Fuller (ADF) tests to assess the stationarity of time series data. Tested Real GDP and Remittances at the Level and Foreign Employment at the First Difference. Interpretation relied on critical values and p-values to determine stationarity.

**Model Selection using Information Criteria:** Utilized Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and Hannan-Quinn Criterion (HQ) to evaluate model fit and complexity. Selected the ARDL (1, 0, 0) model due to its optimal balance between fit and complexity.

**Long-Run Relationship Assessment with Bound Test:** Applied the F-Bound Test to ascertain the presence of a long-run relationship among variables in the ARDL model. Compared the F-statistic to critical value bounds for interpretation. Concluded a significant long-run relationship between variables.

**Analysis of Error Correction Model (ECM):** I examined the long-term relationship between variables and modeled short-term dynamics while considering long-term equilibrium relationships. I estimated the coefficients and interpreted the error correction term. The long-term relationship among variables is statistically significant.

**Diagnostic Stability Testing:** The F-statistic and the observed R-squared were used to assess for serial correlation. Conducted the Breusch-Pagan-Godfrey test for heteroskedasticity. The interpretation relied on p-values, indicating no significant serial correlation or heteroskedasticity.

The econometric equation for an ARDL (Auto-Regressive Distributed Lag) model

examines the relationship between GDP, foreign employment, and remittances. The ARDL model is commonly used to analyze both the short-run and long-run effects of independent variables on a dependent variable. Dependent Variable (Y): real GDP growth (gross domestic product); Independent Variable (X): foreign employment (FE): the level of employment in the economy. Remittances growth: international remittances received from migrants working abroad Here's how we can express the ARDL model:

$$Real\ GDP\ Y_t = \beta_0 + \beta_1 FE_t + \beta_2 R_t + \varepsilon_t \dots\dots\dots (1)$$

Where, *Real GDP*  $Y_t$  represents the real GDP at time (t).  $FE_t$  represents employment at time (t).  $R_t$  represents remittances at time (t).  $\beta_0, \beta_1, \beta_2$  are the coefficients to be estimated.  $\varepsilon_t$  represents the error term (residuals). The ARDL model allows us to investigate both short-run and long-run effects. Here are some interpretations:

**Long-Run Relationship:** The equilibrium relationship between the dependent and independent variables typically represents the long-run relationship in an ARDL model. We assume that the variables move together over time, maintaining a long-term equilibrium. We can express the long-run model for GDP (Y), employment (E), and remittances as follows:

$$Real\ GDP\ Y_t = \beta_0 + \beta_1 FE_t + \beta_2 R_t + \varepsilon_t \dots\dots\dots (2)$$

**Short-Run Dynamics:** The short-run dynamics are captured by including the lagged differences of the variables. This allows the model to adjust to short-term changes and return to equilibrium. The short-run model can be represented as:

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^p \alpha_{1i} \Delta Y_{t-i} + \sum_{i=0}^q \alpha_{2i} \Delta FE_{t-i} + \sum_{i=0}^r \alpha_{3i} \Delta R_{t-i} + \lambda ECM_{t-1} + \mu_t \dots\dots\dots (3)$$

Where,  $\Delta$  denotes the first difference operator. (p), (q), and (r) are the lag orders for GDP, employment, and remittances, respectively.  $\alpha_{1p}, \alpha_{2q}$  and  $\alpha_{3r}$  are the short-run coefficients for the lagged differences of GDP, employment, and remittances.  $ECM_{t-1}$  is the error correction term derived from the long-run equilibrium relationship, representing the speed of adjustment back to equilibrium.  $\lambda$  is the coefficient of the error correction term, indicating how quickly variables return to equilibrium after a shock.  $\mu_t$  is the error term for the short-run model.

Error Correction Model (ECM): The ECM integrates the short-run dynamics with the long-run equilibrium, allowing for corrections over time if the variables deviate from their long-term relationship.

$$ECM_{t-1} = Y_{t-1} - (\beta_0 + \beta_1 FE_{t-1} + \beta_2 R_{t-1}) \dots\dots\dots (4)$$

A long-run relationship between the variables is confirmed in this model if  $\lambda$  is negative and statistically significant, and the system corrects its prior period disequilibrium at a rate of  $\lambda$  percent each period.

The validity of the dataset is ensured by using credible secondary sources such as Nepal Rastra Bank, Department of Foreign Employment, and international databases like the World Bank. Stationarity testing with the Augmented Dickey-Fuller (ADF) test confirms the data's suitability for econometric modeling. Variables like real GDP, foreign labor employment, and remittances are chosen based on economic theory, ensuring content validity. Model selection through criteria like AIC and BIC further strengthens construct validity by optimizing the balance between explanatory power and complexity.

Reliability is upheld through consistent and well-documented data sources, ensuring reproducibility. Diagnostic tests confirm the absence of biases, while the inclusion of the Error Correction Model (ECM) ensures the results consistently represent both short-term dynamics and long-term equilibrium. The use of standardized methodologies like the ARDL approach enhances the robustness and replicability of the study's findings.

As the study relies on publicly available secondary data, ethical concerns are minimal. Data sources will be properly cited to ensure transparency and attribution. The study adheres to ethical guidelines by reporting findings transparently without data manipulation. While ethical clearance may not be mandatory, compliance with research ethics outlined by relevant bodies, including the University Grant Commission of Nepal, will be maintained. An ethical approval statement will be sought if required by the institution or funding agency.

## **RESULTS AND DISCUSSION**

The econometric model of autoregressive distributed lag (ARDL) presents a comprehensive framework for analyzing the dynamic relationships between GDP, foreign employment, and remittances, offering insights into the long-term equilibrium and short-term dynamics among them. The ARDL model uses strict methods like the Augmented Dickey-Fuller (ADF) test to make sure that the data is stationary, model selection criteria like the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC), and bound tests to look at long-term relationships. This lets analysts see both the short-term and long-term effects of changes in foreign employment and remittance inflows on GDP flows on GDP.

Through error correction mechanisms, the model shows how things get back to normal after short-term changes. This helps policymakers and researchers understand how economic indicators, labor migration, and remittance flows in Nepal affect each other in a very complex way.

**Table 1***Unit Root of GDP at Level (Augmented Dickey-Fuller Test Statistic)*

	Real GDP		Foreign Employment			Remittance	
	Level		Level		First Difference	Level	
Test critical values:	t-Statistic	Prob.**	t-Statistic	Prob.*	Prob.**	t-Statistic	Prob.**
	-6.3467	0.0000	-5.5038	0.0932	0.0001	-3.9299	0.0060
1% level	-3.6463		-3.6463			-3.7114	
5% level	-2.9540		-2.9540			-2.9810	
10% level	-2.6158		-2.6158			-2.6299	

An Augmented Dickey-Fuller (ADF) test, which determines whether a time series is stationary or not, presents its results in the table. A stationary time series is one whose statistical properties, like mean variance, do not change over time. We conduct a level test on real GDP remittances, utilizing the original data without any modifications. We test foreign employment at the First Difference, which involves a single difference in the data (i.e., calculating the change between consecutive observations).

The ADF test's t-statistic is the result. If the t-statistic is more negative than the critical value at a given significance level, we reject the null hypothesis of a unit root (indicating non-stationarity). The probability values (p-values) indicate the probability of observing the test statistic under the null hypothesis. A lower p-value suggests stronger evidence against the null hypothesis.

The t-statistic is -6.34669, with a p-value of 0.0000. This is more negative than the 1% critical value, so we reject the null hypothesis at the 1% level, suggesting that real GDP is stationary. For foreign employment at level 1, the t-statistic is -5.50382 with a p-value of 0.0932. This is not more negative than the 1% critical value, so we cannot reject the null hypothesis at the 1% level, suggesting that foreign employment may not be stationary at this level. The p-value is 0.0001, so we reject the null hypothesis at the 1% level, suggesting that foreign employment, after differencing once, is stationary.

In remittance, the t-statistic is -3.9299 with a p-value of 0.0060. This is more negative than the 1% critical value, so we reject the null hypothesis at the 1% level, suggesting that remittance, at this level, is stationary. In summary, based on the ADF test results, real GDP and Remittance (at level) appear to be stationary, while Foreign Employment may not be stationary at level but at first difference it is stationary.

**Figure 1**

*Model Selection Graph*

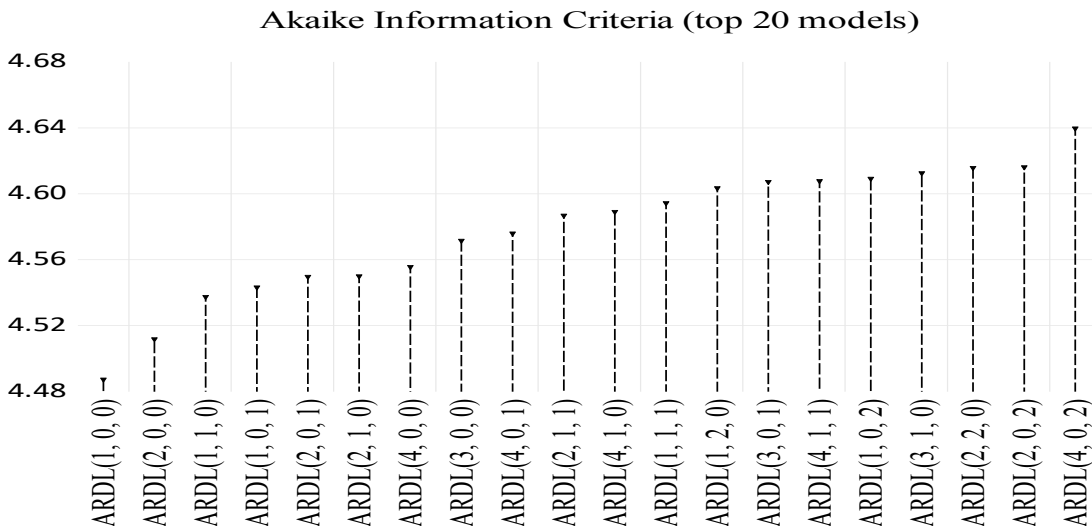


Figure 1 presents the Akaike Information Criterion (AIC) values for the top 20 ARDL models used to model GDP with foreign employment and remittances as predictors. The x-axis lists various ARDL model specifications, such as ARDL (1, 0, 0), ARDL (2, 0, 0), and so forth, indicating the number of lags for each variable (GDP, foreign employment, and remittance). The y-axis displays the AIC values, ranging from approximately 4.48 to 4.64. Lower AIC values represent better models because they balance goodness-of-fit with model complexity.

The model ARDL (1, 0, 0) has the lowest AIC value, indicating it provides the best balance between fit and simplicity. As the AIC values increase from left to right, models become less preferable, with the ARDL (4, 4, 2) design showing the highest AIC among the top 20. The general trend suggests that simpler models with fewer lags tend to perform better in terms of AIC, implying that adding more lags does not necessarily improve the model’s efficiency. This graph helps to identify the most efficient model by highlighting those with the lowest AIC values.

The co-integration results from the ARDL (1, 0, 0) model indicate a significant long-term relationship between GDP and the independent variables, employment and remittance. This long-run co-integration implies that the variables move together over time, and any short-term deviations from this equilibrium are corrected, emphasizing the enduring influence of employment and remittance on GDP.

**Table 2***Result from the Bound Test (F- Bound Test)*

Test Statistic	Value	Signif.	I (0)	I (1)
			Asymptotic: n=1000	
F-statistic	10.59163	10%	2.63	3.35
K	2	5%	3.1	3.87
		1%	4.13	5
Actual Sample Size	33		Finite Sample: n=35	
		10%	2.845	3.623
		5%	3.478	4.335
		1%	4.948	6.028
			Finite Sample: n=30	
		10%	2.915	3.695
		5%	3.538	4.428
		1%	5.155	6.265

The bound test, also known as the F-bound test, is a crucial component of the ARDL approach to cointegration, helping to determine whether a long-run relationship exists between the variables in the model. We calculate the test statistic, specifically the F-statistic, to be 10.59163 in this case. Commonly, we set the significance levels for the test at 10%, 5%, and 1%, which provide critical values to compare the F-statistic against. The lower bounds of these critical values, denoted as I (0), and the upper bounds, denoted as I (1), represent scenarios where the variables integrate of order 0 or order 1, respectively.

The researchers compared the F-statistic to these crucial value boundaries to evaluate the test findings. There is evidence of a long-term link if the F-statistic is greater than the upper bound (I (1)). On the other hand, if it is below the lower bound (I (0)), then no evidence of this kind of link exists. When the F-statistic falls between the boundaries, the outcome is uncertain. In this analysis, the F-statistic of 10.5916 surpasses the upper bound critical values at all significance levels, both for asymptotic and finite sample sizes. This allows us to reject the null hypothesis of no long-run relationship, thereby confirming the presence of a long-run relationship between the variables in the model.

There has been adjusted the critical values for different sample sizes, and in this specific analysis, the sample size is 33. It is essential to use the critical values that correspond to the actual sample size to ensure accurate test results. Overall, the bound test results suggest a statistically significant long-run relationship between the variables in the ARDL model, indicating that changes in the independent variables will have a lasting impact on the dependent variable.

**Error Correction Model (ECM)**

The Error Correction Model (ECM) is a statistical method used in econometrics to analyze the long-term relationship between variables. It addresses non-stationarity issues by modeling the short-term dynamics of the variables while also accounting for any long-term equilibrium relationships among them. Studying the dynamics of time series data with ECM provides valuable insights into the interaction of variables over time and the short-term correction of deviations from long-term equilibrium. This model serves as a powerful tool for understanding and forecasting economic phenomena, aiding policymakers and researchers in making informed decisions.

**Table 3**

*Error Correction Model Estimation of Selected Model: ARDL (1, 0, 0)*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Coint. Eq. (-1) *	-1.0695**	0.1564	-6.8373	0.0000
R-squared	0.5928	Mean dependent var		-0.1467
Adjusted R-squared	0.5928	S.D. dependent var		3.2911
Durbin-Watson stat	1.9538			

\* p- value incompatible with t-Bounds distribution.

Table 3 displays the results of the error correction representation for the selected ARDL model. The coefficient of the error term (-1.0695) at the first difference exhibits a statistically significant negative sign, indicating the robust presence of a long-term relationship among the variables. The highly significant negative sign of the error correction term reinforces the aforementioned relationship. We determine the speed of adjustment from the previous year’s disequilibrium in GDP to the current year’s equilibrium to be 106.9490%. In simpler terms, this coefficient suggests that it takes less than a year (100/106.9490) for the system to achieve equilibrium, highlighting the swift dynamics within the analyzed relationships.

In this case, with an R-squared value of 0.5928, or 59.28%, it implies that roughly 59.28% of the total variability observed in GDP can be explained by variations in employment and remittances as captured by the model. Other factors not included in the model, measurement error, or random fluctuations may account for the remaining 40.72% of the variability. A higher R-squared value generally indicates a better fit of the model to the data, suggesting that the included independent variables are more effective in explaining the variation in the dependent variable.

**Table 4***Diagnostic Stability Test (Breusch-Godfrey Serial Correlation LM Test)*

F-statistic	0.5828	Prob. F (2,27)	0.5652
Obs*R-squared	1.3656**	Prob. Chi-Square (2)	0.5052**
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
Null hypothesis: Homoskedasticity			
F-statistic	4.7713	Prob. F (3,29)	0.518
Obs*R-squared	10.9056**	Prob. Chi-Square (3)	0.522**
Scaled explained SS	9.0208	Prob. Chi-Square (3)	0.590

The residuals from the estimated model lag the residuals by a certain order (usually up to  $p$  lags) and include the lagged residuals as additional independent variables in your model. Next, the model with the lagged residuals has the F-statistic for the joint significance of the lagged residuals. If the F-statistic is significant (i.e., the p-value is less than your chosen significance level), there's evidence of a serial correlation. Alternatively, you can use the observed R-squared and perform a Chi-Square test with the degrees of freedom equal to the number of lags. If the Chi-Square test is significant, it indicates serial correlation.

The F-statistic is approximately 0.58 with a p-value of 0.57, and the observed R-squared is approximately 1.37 with a Chi-Square p-value of 0.51. Since both p-values are greater than the typical significance level (e.g., 0.05), we fail to reject the null hypothesis of no serial correlation. However, it's essential to interpret these results in the context of your specific data and research question. Remember to adjust the lag order ( $p$ ) to reflect your data characteristics and theoretical considerations.

Table 5 presents the results from the Breusch-Pagan-Godfrey test for heteroskedasticity in a regression model. We use this test to check for heteroskedasticity, which indicates that the variance of the errors in a regression model is not constant across observations. Heteroskedasticity can invalidate statistical tests of significance that assume constant variance (homoskedasticity). In this test, the null hypothesis is that there is homoskedasticity (constant variance of error terms).

The table presents three key statistics: the F-statistic, Obs\* R-squared, and scaled explained SS, along with their associated p-values. The F-statistic is 4.7713 with a p-value of 0.5180, indicating that the test does not reject the null hypothesis of homoskedasticity at conventional significance levels. The Obs\*R-squared value is 10.9056 with a p-value of 0.522, suggesting no significant evidence against the null hypothesis of homoskedasticity. Finally, the scaled explained SS is 9.0208 with a p-value of 0.590, further indicating that the null



hypothesis of homoskedasticity cannot be rejected.

The p-values for the different statistics are much higher than the usual levels of significance, like 0.05 or 0.10. This means that there is not enough evidence to reject the null hypothesis of homoskedasticity. We thus infer that the variance of the errors appears to be constant across the data and that there is no substantial heteroskedasticity in the regression model based on the findings of the Breusch-Pagan-Godfrey test.

Real GDP and remittances are stationary at the level as indicated by the Augmented Dickey-Fuller (ADF) test results. Foreign employment is not stationary at the level but becomes stationary after first differencing. The ARDL (1, 0, 0) model is selected as the best fit based on the lowest Akaike Information Criterion (AIC) value, which indicates a balance between model complexity and fit. This model uses one lag for GDP and no lags for foreign employment and remittances. The adjusted R-squared value of the selected model is 0.031781, meaning it explains about 3.18% of the variance in GDP.

The Bound Test confirms the presence of a significant long-term relationship between GDP, foreign employment, and remittances. The F-statistic (10.59163) exceeds the upper bound critical values at all significance levels, indicating cointegration. The ECM shows a statistically significant and negative error correction term coefficient (-1.069), indicating a strong long-term relationship among the variables. The speed of adjustment to equilibrium after a shock is approximately 106.9490% per period, suggesting rapid correction to equilibrium within a year. The short-run dynamics are captured by including lagged differences of the variables, allowing the model to adjust to short-term changes and return to equilibrium. The coefficients for the short-run dynamics indicate how changes in employment and remittances affect GDP in the short run.

The residuals do not exhibit significant serial correlation, as indicated by the F-statistic (0.58, p-value 0.57) and the Chi-Square test (observed R-squared 1.37, p-value 0.51). Heteroskedasticity: The Breusch-Pagan-Godfrey test shows no significant evidence of heteroskedasticity, with all p-values well above conventional significance levels, indicating constant variance of the errors. The selected ARDL model's simplicity and the lowest AIC value highlight its efficiency. The model effectively balances fit and complexity, making it a robust choice for understanding the relationships between GDP, foreign employment, and remittances.

The ARDL model (1, 0, 0) effectively captures the long-term equilibrium relationship between GDP, foreign employment, and remittances while also accounting for short-term

dynamics. The results highlight the significant impact of foreign employment and remittances on GDP, both in the short run and long run. The diagnostic tests confirm the model's reliability, with no significant issues of serial correlation or heteroskedasticity, ensuring that the findings are robust.

The ARDL (1, 0, 0) model, selected based on the lowest AIC value, captures the long-term equilibrium relationship between GDP, foreign employment, and remittances, accounting for short-term dynamics. The augmented Dickey-Fuller test indicates that real GDP and remittances are stationary at this level, while foreign employment becomes stationary after first differencing (Jaradat and Al-Tamimi, 2021; Mncayi and Shuping, 2021; Michael and Abu, 2024). The bound test confirms a significant long-term relationship, with an F-statistic indicating cointegration.

The Error Correction Model (ECM) reveals a significant negative error correction term, suggesting a rapid adjustment to equilibrium within a year. Short-run dynamics show how changes in employment and remittances affect GDP, with diagnostic tests indicating no significant issues of serial correlation or heteroskedasticity. The model's simplicity and efficiency make it a robust tool for understanding the impact of foreign employment and remittances on GDP (Kaluza-Kopias, 2023; Maisonnave et al., 2022).

The ARDL model (1, 0, 0) captures the long-term equilibrium relationship between GDP, foreign employment, and remittances while also addressing short-term dynamics. The overall findings underscore the dual nature of foreign labor employment in Nepal, emphasizing the need for comprehensive support systems, informed policy decisions, and collaborative efforts to maximize the benefits of labor migration while mitigating associated risks (Balquish & Naryam, 2024).

The results of the error correction representation for the chosen ARDL model show that there is a strong long-term relationship between the variables. The error term's coefficient (-1.0695) at the first difference has a statistically significant negative sign. This underscores the swift dynamics within the analyzed relationships, with the speed of adjustment from the previous year's disequilibrium in GDP to the current year's equilibrium determined to be 106.9490%.

## **CONCLUSIONS**

The Auto-Regressive Distributed Lag (ARDL) model's detailed analysis shows a strong long-term link between GDP, foreign employment, and remittances. This link is supported by cointegration results and the Error Correction Model (ECM). The findings emphasize the need for comprehensive support systems and informed policy decisions to maximize the benefits of labor migration. Recommendations for policymakers include diversifying Nepal's economy, enhancing skills development, promoting entrepreneurship, and leveraging research insights for evidence-based policy formulation.

Continuous monitoring and evaluation of remittance-related policies are essential to ensuring their effectiveness and guiding improvements. To maximize the positive impacts and mitigate potential risks associated with remittances and foreign employment, policymakers should focus on creating a robust framework for skill enhancement and economic diversification. This involves investing in sectors like tourism, agriculture, manufacturing, and technology, which have high potential for job creation and value addition. Additionally, promoting entrepreneurship and innovation through targeted educational and vocational training programs will empower the domestic workforce and reduce the economy's over-reliance on remittances.

Furthermore, regional collaboration and reintegration programs for returning migrants are crucial for maintaining economic stability and growth. By adopting these comprehensive strategies, Nepal can better harness the benefits of remittances to drive sustainable economic development and improve overall living standards.

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