Asian Journal of Empirical Research
Volume 14, Issue 2 (2024): 29-38.

http://www.aessweb.com/journals/5004

Foreign direct investment on economic growth in Nepal: A sector specific analysis

Bishnu Raj Aryal[a]
Sudan Kumar Oli[b†]
Gajendra Prasad Shah[c]
Sabina Gopali[d]

[a,b,c]*Herald College Kathmandu, Nepal.*
[d]*Yunna Technology and Business University, Kunming, China.*

† ✉ sudankumaroli@gmail.com *(Corresponding author)*

Article History
Received: 17 January 2024
Revised: 1 March 2024
Accepted: 15 March 2024
Published: 19 April 2024

Keywords
ARDL model
Economic growth
Foreign direct investment
Nepalese economy
Sectoral growth
Time-Series analysis.

ABSTRACT
This paper investigates the impact of Foreign Direct Investment (FDI) on the economic development of Nepal through a comprehensive and sector-specific analysis. With a growing interest in attracting foreign investments to foster economic growth, this study aims to provide nuanced insights into the diverse effects of FDI across various sectors in the context of Nepal. Utilizing a robust methodology that incorporates quantitative and qualitative approaches, the research examines key economic indicators and sectoral performance data over a specified period. This paper employs a sophisticated econometric framework that includes unit root tests to assess the stationarity properties of the time series data, ensuring the reliability of subsequent econometric models. The ECM and ARDL models facilitate the examination of both short-term and long-term dynamics between FDI and economic development variables, ARDL Bound test, is applied to investigate the existence of cointegration among the variables, providing insights into the long-term equilibrium relationship. Additionally, Granger causality tests are conducted to discern the directionality of causal relationships, helping to discern whether FDI leads to economic development or vice versa. The empirical results reveal compelling insights into the relationship between FDI and economic development in Nepal. Robustness checks further validate the reliability of the findings, enhancing the overall robustness and credibility of the study's empirical results. The comprehensive analysis provides valuable insights for policymakers and stakeholders aiming to formulate targeted strategies for fostering sustainable economic development in Nepal through FDI.

Contribution/Originality: This paper provides significant insights to the reader in order to understand the contribution of foreign direct investment to different economic sectors of Nepal. In addition to this, this paper has employed robust analysis methods; the ARDL model is employed to determine the short-run and long-run dynamics of analysis.

DOI: 10.55493/5004.v14i2.5053
ISSN(P): 2306-983X/ ISSN(E): 2224-4425

How to cite: Aryal, B. R., Oli, S. K., Shah, G. P., & Gopali, S. (2024). Foreign direct investment on economic growth in Nepal: A sector specific analysis. *Asian Journal of Empirical Research*, *14*(2), 29–38. 10.55493/5004.v14i2.5053

1. BACKGROUND
Geographically nestled between Tibet, the Autonomous Region of China, and India, Nepal, despite its small size, boasts significant geographical diversity, encompassing Terai, Hilly, and Himalayan regions. Despite this natural richness, Nepal's classification as a least developed country stems from deficits in human capital, technology, education, governance, and employment opportunities (Do & Iyer, 2010). The government of Nepal in different stages tries to address all these scenarios by attracting foreign investors.

According to Jude and Levieuge (2017) Investment in terms of capital, technology, and skill by individual companies or the government of one country into business or assets located in another country is termed a Foreign Direct Investment (FDI).The introduction of FDI is recognized as a pivotal step in Nepal's industrialization journey, with historical instances such as the establishment of Biratnagar Jute Mill in 1936 marking the initial foray into industrial growth (Kharel, 2020). Subsequent government initiatives, like the sixth five-year plan (National Planning Commission, 1980) paved the way for formal regulations and incentives to attract foreign investors, setting the groundwork for economic expansion.

Post the restoration of multiparty democracy in 1990, Nepal underwent policy reforms, introducing trade liberalization and market reforms across various sectors to encourage FDI (Kharel, 2020). Recent legislative updates, such as the Foreign Investment and Technology Transfer Act (FITTA) of 2019 and its subsequent version in 2021 (Government of Nepal, 2021) aim to create a conducive environment for foreign investors by easing investment requirements and revising trade policies. For more simplicity, an updated version of FITTA 2021 (Government of Nepal, 2021) requires only 70% of the proposed investment before starting operations, and the remaining 30% within the following two years. The Government of Nepal (GON) revised its previous trade policy in 2015 and make it more liberal. This update aims to support domestic industries, regulate increasing imports, and enhance exports, to use trade as a driving force for the country's economic development. Additionally, the industrial policy of 1992 has been replaced by the new industrial policy in 2011. The new policy focuses on achieving robust and consistent economic growth by fostering both domestic and foreign investment.

The contemporary era, characterized by globalization, technology adoption, and the presence of free trade market economics, signifies Nepal's active participation in global trade dynamics. Membership in organizations like the World Trade Organization (WTO) and the Multilateral Investment Guarantee Agency (MIGA), coupled with participation in initiatives such as the Belt and Road Initiative (BRI) and agreements like the Bilateral Investment Protection and Promotion Act (BIPPA), showcases Nepal's concerted efforts to encourage foreign investments (Bista, 2011).

The recent endorsement of the Millennium Challenge Corporation (MCC) further emphasizes Nepal's commitment to fostering a favorable environment for foreign investments, aiming to bolster economic activities, production, distribution, marketing, and job creation across commercial and agricultural sectors.

The primary objective of this study centers on conducting a thorough investigation into the correlation between foreign direct investment (FDI) and economic growth in Nepal, employing a sector-specific analysis. Additionally, the study aims to identify and analysis of sectors in Nepal that have experienced substantial FDI inflows and their contribution to the overall economic growth. This study's focal point lies in elucidating the impact of Foreign Direct Investment (FDI) on Nepal's economic growth through sector-specific analysis, emphasizing the formulation of policies and the necessity of regulatory acts to ensure optimal market functionality. The study's findings will yield valuable insights for policymakers, aiding in decision-making processes regarding policy formulation and regulation implementation. Moreover, the study holds substantial benefits for investors and the business community, providing crucial information regarding the most opportune sectors for their investment endeavors. Furthermore, this study holds promise as a foundational resource for future researchers seeking to delve deeper into related subject matters, serving as a reference point and facilitating further investigation in this domain. In essence, this study aims to shed light on the intricate relationship between FDI and Nepal's economic growth, offering multifaceted insights with significant implications for various stakeholders involved in the country's economic development and foreign investment landscape.

The study analyzing the impact of FDI on Nepal's economic growth through sector-specific analysis anticipates several limitations. These include constraints related to time, budget, data availability, reliability, generalizability, and the spillover effect. Quantitative analysis faces challenges due to varying and potentially limited data reliability concerning FDI and sector-specific economic indicators. Moreover, time constraints imposed a limitation on conducting an in-depth analysis, especially concerning the long-term effects of FDI on Nepal's economic growth. Nonetheless, the study aims to provide valuable insights within the available timeframe and serve as a foundation for future research in this domain. The remaining section of this paper is divided as follows, the previous introductory part of FDI is here followed by a review of existing literature in section 2. Section 3 includes data and methodology. Finally, section 4 provides comments on the empirical results lastly, the conclusion section encapsulates key findings, analysis importance, and concludes by summarizing the study's significance and contributions.

2. LITERATURE REVIEW

This section encompasses the presentation of theoretical perspectives and empirical studies that explore the impact of FDI on economic development.

2.1. Theoretical Arguments on FDI and Economic Growth

The connection between FDI and a nation's economic growth has captivated attention in both developed and emerging economies, yet empirical studies exploring sector-specific analysis concerning FDI's impact on economic growth remain limited. Commencing the review, Alfaro (2003) conducted a cross-country examination to determine how FDI inflows impact various sectors of the economy, including primary, manufacturing, and services. The study found positive contributions from FDI inflows solely to the manufacturing sector due to enhanced spillover effects. Conversely, FDI inflows in the primary sector, including agriculture, showcased negative impacts on growth due to limited spillover potential. However, the findings regarding the service sector remained inconclusive. Similarly, Blomström, Kokko, and Mucchielli (2003) emphasized the importance of local economies harnessing foreign

technologies and skills to create positive spillover effects, advocating policies to strengthen this effect, leading to increased tax incomes, technological advancements, and labor expertise. Sayek (2007) investigation on the influence of the sectoral distribution of FDI on a nation's economic growth, resonating with Alfaro's previous findings, highlighted the manufacturing sector's potential for generating economic growth. However, FDI directed towards the primary or service sectors exhibited adverse effects. In contrast, Msuya (2007) study focusing on the impact of FDI on agricultural productivity in Tanzania revealed a positive spillover effect benefiting organized small-scale farmers under integrated production schemes, necessitating long-term investment policies and robust smallholder-investor relationships.

Sahoo and Mathiyazhagan (2003) analysis within the Indian context using a panel co-integration test revealed no significant co-integration between FDI and domestic sectors of the economy. However, the positive elasticity coefficient between exports, Gross domestic produc and industrial production underlined FDI's contribution to economic growth, suggesting the promotion of export-oriented industries. Chakraborty and Nunnenkamp (2008) similarly examined FDI's impact on India's economic growth through Granger Causality Tests, emphasizing a mutually reinforcing relationship between FDI and the manufacturing sector, advocating for FDI promotion in IT-related industries to foster local entrepreneurship and human capital development.

Agustin Benetrix and Ugo (2023) highlighted in a World Bank blog that while Foreign Direct Investment (FDI) is considered a crucial element in the development strategies of policymakers in both emerging and developed economies, academic literature has presented somewhat inconclusive findings regarding the direct link between FDI and economic growth.

2.2. Empirical Review on the FDI and Economic Growth

Jana, Sahu, and Pandey (2019) conducted a recent study in India that examined how Foreign Direct Investment (FDI) inflows are managed by contrasting a sector-specific and aggregate strategy in relation to economic growth. In an emerging country such as India, the study intended to evaluate the effects of sector-specific foreign direct investment (FDI) on the growth of the corresponding sectors using a time-varying parameter model with vector autoregressive specifications. The findings indicated that the growth of the agricultural sector was not greatly aided by inward FDI. The existence of reverse causality, which suggests that agricultural output draws additional FDI, was an interesting discovery, nevertheless. Additionally, the research revealed a short-term positive impact of FDI inflows on manufacturing sector output and validated a two-way causal relationship between FDI and service sector economic growth. Walsh and Yu (2010) investigation across 26 advanced and emerging nations identified factors influencing FDI inflows, indicating that FDI in the primary sector had no significant link to macroeconomic stability. Variables such as development level, institutional quality, exchange rates, school enrollment, and labor market flexibility played a pivotal role in determining secondary and tertiary sector investments. Ultimately, the study concluded that macroeconomic conditions play a crucial role in attracting FDI, especially in the services sector in developed countries. In a similar vein, Phuyal and Sunuwar (2018) study examined the sector-wise impact of FDI on Nepal's economic growth, highlighting a positive and significant impact of FDI investment in industry, tourism, and agriculture sectors within a 10-year sectoral data interval. It advocated for new policies and plans to optimize FDI inflows for maximum economic growth.

The empirical study by Iram and Nishat (2009) used data from 36 years' worth of macroeconomic variables to assess how Foreign Direct Investment (FDI) affects the manufacturing and services sectors. Their conclusions emphasized the industrial sector's significant potential for long-term economic growth. Majagaiya (2011) looked into the relationship between Nepal's economic expansion and foreign direct investment (FDI). By employing tests for Granger Causality, Unit Root, and Co-integration, their investigation revealed a slight positive correlation between the microeconomic variables. Nonetheless, their results indicated that FDI had a minimal effect on Nepal's GDP growth rates. Using a large dataset from 117 nations, Shenali Nupehewa (2022) investigated the interdependent link between Foreign Direct Investment (FDI) and the economic development of seven separate regions. The study identified the Asian area as the reciprocal causal relationship between foreign direct investment and global economic growth. On the other hand, an unidirectional causality effect was observed in the American region. Remarkably, a non-specific causal relationship was found in the Mediterranean, African, Oceanian, and European regions.

2.3. Reviews on Nepalese Context

Foreign Direct Investment (FDI) holds substantial significance as an external funding source for developing nations like Nepal. Recent initiatives in Nepal have aimed at implementing legal, institutional, and regulatory changes to attract FDI inflows. However, a survey report by the Economic Research Department (2022) on FDI indicates a notable increase of 14.8 percent in Nepal's FDI stock, reaching 227.9 billion by the end of the fiscal year 2020/21. Notably, paid-up capital constitutes the largest proportion (53.9%) of the overall FDI stock, while reserves and loans collectively constitute 31.6% and 14.5%, respectively. The telecommunications sector emerges as a favored destination for FDI, representing 30.8% of the total FDI stock and 40.0% of cumulative paid-up capital in this sector. Khanal (2020) study examining the impact of FDI on Nepal's GDP and inflation conducted a quantitative analysis using regression models to assess variable effects. The findings revealed that an increase in FDI yields higher GDP, contributing to economic growth. Recommendations include formulating supportive policies and strategies by the local government to attract more FDI, with a focus on sustainable development, infrastructure development, workforce training, and promoting local entrepreneurship by offering investor-friendly opportunities. Similarly, Bhattarai (2023) highlighted obstacles such as political instability, bureaucratic delays, a lack of skilled manpower,

and poor infrastructure for investors. Despite these challenges, investors continue to express interest in different sectors, acknowledging the Nepalese government's efforts to address these issues and promote investment.

Shrestha (2022) report, an overview of FDI in Nepal published by the Nepal Economic Forum, examines into the disparity between approved FDI and net FDI inflow, along with an evaluation of the ease of doing business. Despite recent improvements in the ease of doing business score in 2020, net FDI inflow is not uniformly increasing. The implementation of FITTA-2019 has played a pivotal role in enhancing net FDI inflow. However, there remain constraints that necessitate government attention for further improvements. Drawing from the preceding discussions and research objectives, the study formulates the following testable hypotheses:

Hypothesis (H_1): There exists a significant relationship between Foreign Direct Investment (FDI) inflows in the agricultural sector and contribution growth of the agricultural sector in the economy.

Hypothesis (H_2): There is a significant relationship between Foreign Direct Investment (FDI) inflows in the manufacturing sector and manufacturing contribution growth in the economy.

Hypothesis (H_3): There is a substantial relationship between Foreign Direct Investment (FDI) inflows in the service sector and contribution growth of the service sector in the economy.

3. DATA AND METHODOLOGY

The study's quantitative approach utilized secondary sources spanning the time-series data from 1995 to 2022 to investigate the relationship between FDI and sector-wise economic growth in Nepal. Data on FDI was primarily sourced from the Nepal Rastra Bank's survey report on foreign direct investment, encompassing information on FDI stock, paid-up capital, reserves, and loans. Additionally, data from the annual reports of the Ministry of Finance, Central Bureau of Statistics, Department of Industry, and World Bank were referenced for required information. Sector-wise economic growth data was obtained from the Ministry of Finance's Economic Survey, providing insights into economic growth rates and consumer price inflation across different provinces in Nepal. This data was employed to analyze the impact of FDI on sector-wise economic growth. The FDI inflows in agriculture, manufacturing and service sectors are denoted as FDI_AGR, FDI_MFG and FDI_SVR respectively.

First, the study uses unit root tests to evaluate the stationarity of the variables and descriptive statistics to understand the basic properties of the variables used in the analysis. In order to establish both short- and long-term dynamic correlations between the variables, this acts as a foundation to further analyses such as cointegration tests, ARDL bound tests, ARDL modeling, and Error Correction Model (ECM) impulse response analysis. The direction of causality is also ascertained by Granger causality testing. Moreover, to ensure robustness, the study subjects the data to serial correlation, normality, heteroscedasticity tests, and stability assessments using the cumulative sum (CUSUM) technique.

To investigate the relationship between dependent and independent variables, the study uses linear regression analysis. The empirical impact of Foreign Direct Investment (FDI) on economic growth in Nepal is assessed by the panel data equation. This regression model glances at the relationships between different FDI categories and different sectors of the Nepalese economy. The dependent variable in this model is the gross domestic product (GDP), while the independent variable is foreign direct investment (FDI).

$$Ln\,(GDP\_AGR)_t = \beta_0 + \beta_1 Ln\,(FDI\_AGR)_t + e_t \quad (1)$$

$$Ln(GDP\_MFG)_t = \beta_0 + \beta_2 Ln\,(FDI\_MFG)_t + e_t \quad (2)$$

$$Ln\,(GDP\_SRV)_t = \beta_0 + \beta_3 Ln\,(FDI\_SRV)_t + e_t \quad (3)$$

Here, Ln (GDP_AGR), Ln (GDP_MFG), and Ln (GDP_SRV) are dependent variables. Similarly, β_1Ln (FDI_AGR), β_2Ln (FDI_MFG), and β_3Ln (FDI_SRV) are corresponding independent variables. β_0 represents intercept term and e is the error term capturing unexplained variability.

Further, multiple linear regression approach can be used to integrate the equations for Agriculture, Manufacturing, and Service sectors into a single equation. This allows to create a model that considers the impact of FDI in all three sectors on Real GDP.

$$Ln(R\_GDP)_t = \beta_0 + \beta_1 Ln\,(FDI\_ARG)_t + \beta_2 Ln\,(FDI\_MFG)_t + \beta_3 Ln\,(FDI\_SRV)_t + e_t \quad (4)$$

Here,

Ln(R_GDP) is the natural logarithm of the overall real GDP for the entire economy.

Ln (FDI_ARG) is the natural logarithm of the FDI specifically directed to the agriculture sector.

Ln (FDI_MFG) is the natural logarithm of the FDI specifically directed to the manufacture sector.

Ln (FDI_SRV) is the natural logarithm of the FDI specifically directed to the service sector.

ARDL test,

The Autoregressive Distributed Lag (ARDL) model is commonly used econometric tool for analyzing the relationship between variables as, it combines both short-term dynamics (autoregressive term) and long-run equilibrium relationships (lags of variables) in a time series data. In a context of above topic, we can specify ARDL model as follows:

$$GDP_t = \alpha + \delta_1 GDP_{t-1} + \delta_2 FDI\_ARG_{t-1} + \delta_3 FDI\_MFG_{t-1} + \delta_4 FDI\_SRV_{t-1} + \beta_1 (FDI\_AGR)_t + \beta_2 (FDI\_MFG)_t + \beta_1 (FDI\_SRV)_t + e_t \quad (5)$$

Where,

α = *Constant.*

$\delta_1, \delta_2, \ldots \delta_4$ = *Long term coefficient of variables.*

$\beta_1, \beta_2, \beta_3$ = *Short term coefficient variables.*

e = *Error term.*

The ARDL model allows us to estimate the short-term and long-term impacts of FDI in different sectors on economic development of Nepal. We can test hypothesis about the relationship between variables using hypothesis tests. Finally, the result suggests the best way for further analysis of data.

4. DATA ANALYSIS AND DISCUSSION

4.1. Descriptive Statistics

As pointed by Hair Jr, Black, Babin, and Anderson (2019) descriptive analysis is the basic statistical tool used for summarizing and presenting basic characteristics of data, which provides a clear snapshot of its features without making inferences beyond the data itself. Table 1 represents the basic summery statistics of our variables. Mean shows the average value of the series, as service sector receives greatest portion of FDI and agriculture sector least. Middle value of the series is also highest for service sector taking a reference of median. Standard deviation shows the deviation of all observations from the average value. Skewness measures the normality of the series.

Table 1. Descriptive statistics.

Particular	Actual FDI	FDI_AGR	FDI_MFG	FDI_SVR	Real GDP
Mean	5518.249	0.598148	1225.170	1994.730	1557460.000
Median	1829.000	3.100	484.600	695.200	1441548.000
Maximum	19513.000	119.000	6477.800	11673.400	3199526.000
Minimum	-470.000	-230.300	0.000	0.000	849921.000
Std.dev.	6882.161	53.173	1694.031	2808.344	572477.800
Skewness	1.02197	-2.747	1.757	1.839	0.985
Kurtosis	2.558	15.238	5.429	6.342	3.581
Jarque-Bera	4.919	202.454	20.524	27.799	4.492
Observations	27	27	27	27	27

Note: Value of foreign direct investment inflows is in bills of Nepali rupees.

4.2. Correlation Analysis

According to, Warner (2012) in his book "Applied Statistics: From Bivariate Through Multivaritate Techniques" coefficient correlation analysis as a major statistical method that utilized to measure and evaluate the relationship between two or more than two variables. The correlation coefficient measures the strength and direction of the linear relationship between two variables. It ranges from -1 to 1.

Table 2 represents the coefficient correlation for this data set. The positive nature of all coefficients implies positive and direct correlation between each other. In between some variables such as actual FDI and FDI in service sector have coefficient very near to 1, means they have strong positive correlation and degree of association is very high.

Table 2. Correlation coefficients.

Variables	LnGDP	LnFDI_AGR	LnFDI_MFG	LnFDI_SVR	LnActual FDI
LnGDP	1.000				
LnFDI_AGR.	0.785**	1 .000			
LnFDI_MFG	0.699**	0.609**	1 .000		
LnFDI_SVR	0.837*	0.819*	0.869*	1.000	
LnActual FDI.	0.816*	0.832*	0.868*	0.991*	1.000

Note: * High correlation (> 0.8) and ** Moderate correlation (0.6 - 0.8).

Table 2 shows that that there is positive relationship between lnGDP and lnFDI_AGR, lnFDI_MFG, lnFDI_SVR, and lnActual FDI.

4.3. Unit Root Test

Unit root test is used to check for the stationarity in time series data. Greene (2012) in "Econometric Analysis," likely discusses unit root tests as statistical procedures used to determine the stationarity or non-stationarity of time series data. The data having trend is considered as non-stationary data and having no trend is considered as stationary data. The Table 3 presents the results of the Augmented Dickey-Fuller (ADF) unit root test for various variables at different levels.

Table 3. Augmented Dickey-Fuller (ADF) unit root test.

Variables	Level		First difference		Remarks
	Intercept	Trend and intercept	Intercept	Trend and intercept	
Real GDP	0.985	0.999	0.984	0.015**	I(1)
FDI_ARG	0.007***	0.296	0.041**	0.006***	I(1)
FDI_MFG	0.999	0.889	0.000***	0.000***	I(1)
FDI_SVR	0.355	0.028**	0.000***	0.008***	I(1)
Actual_FDI	0.923	0.557	0.001***	0.001***	I(1)

Note: ADF unit root test has been done at level and at first difference under intercept and trend and intercept test. The asterisk ** and *** indicates the level of significant at 0.05 and 0.001 level.

The variables are stationary at the first difference I(1) except FDI_ARG at level I(0). This means that after differencing once, the series become stationary, suggesting the presence of a unit root in the original series (non-stationarity). Stationarity is a prerequisite for the reliable estimation of the ARDL model and the subsequent interpretation of the ARDL bound test results.

4.4. Lag Selection Criteria

In the seminal paper titled "A new look at the statistical model identification," published in the IEEE Transactions on Automatic Control in Akaike (1974) introduced the Akaike Information Criterion (AIC), a widely used method for model selection and evaluation.

Table 4. VAR lag oder selection criteria.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-47.619	NA	0.001	7.016	7.252	7.013
1	42.356	107.969*	1.68e-07*	-1.648*	-0.232*	-1.663*

Note: * Indicates lag order selected by the majority of criteria under likelihood ratio- LR, final prediction error- FPE, Akaike information criterion-AIC, Schwarz criterion- SC, and Hannan-Quinn criterion-HQ.

Table 4 presents the number of lags that were found suitable for this study. The positive values for different criteria and substantial improvements in statistics suggest that Lag 1 should be the more appropriate lag length for the model compared to Lag 0.

4.5. ARDL Bound Test

As a statistical tool, the Autoregressive Distributed Lag (ARDL) bound test determines the long-term relationship between two or more variables in a time series scenario. This approach involves using F-tests or Wald tests, as suggested by Pesaran, Shin, and Smith (2001) to evaluate the first differences and lagged levels of the variables' combined significance inside a single regression framework. Verifying the existence of a sustained relationship between the variables under investigation is the goal.

The combined significance of both lagged levels and first-difference terms is evaluated using the F-statistic used in the ARDL bound test, as depicted in Table 5. An influential F-statistic indicates cointegration, which means that the variables under study have a consistent, long-term relationship.

Table 5. F-bound test.

Null hypothesis: No level relationship				
Test statistic	**Value**	**Significance level**	**Lower bound I(0)**	**Lower bound I(1)**
F-statistic	28.01715	0.10	2.45	3.52
K	4	0.05	2.86	4.01
		0.05	3.25	4.49
		0.01	3.74	5.06

The F-statistic value is 28.01715 and this value is higher than both lower I(0) and upper bound I(1) critical value at 0.01 level of significance i.e. 5.06. As per the decision criteria, if the F-statistic exceeds the critical values, it rejects the null hypothesis of no long-run relationship between the variables and conclude that there is long-run cointegration between variables. On the other hand, t-statistics are used to assess the individual significance of coefficients associated with lagged levels and first-difference terms. Significant t-statistics for specific coefficients indicate the importance of those variables in the model.

Table 6. t-bound test.

Null hypothesis: No level relationship				
Test statistic	**Value**	**Significance level**	**Lower bound I(0)**	**Lower bound I(1)**
t-statistic	5.784	0.100	-2.570	-3.660
		0.050	-2.860	-3.990
		0.050	-3.130	-4.260
		0.010	-3.430	-4.600

According to the results presented in Table 6, the t-statistic (5.783703) is compared with critical values (I(0)=-2.86 and I(1)=-3.99) at a significance level of 5%. Analogous to the F-Bound Test, rejection of the null hypothesis here signifies a long-term association between the variables. To sum up, both the F-statistic and t-statistics in the ARDL bound test play a crucial role in discerning the presence and characteristics of the long-term relationship among variables, offering insightful information for academics working on time series analysis.

4.6. Long Run Dynamics

Table 7 presents the long-run dynamics analysis results. The coefficient of FDI_AGR is negative (-0.023682), t-statistic is low (-0.222436), and the probability (p-value) is high (0.8328). This suggests FDI in the agriculture sector might not significantly impact GDP in the long run. The coefficient of FDI_MFG is positive (0.213365), t-Statistic is (2.289630), and the probability (p-value) is (0.0707). This indicates a potential positive impact of FDI in the

manufacturing sector on GDP, even though not highly significant at the 0.05 significance level but approaching significance.

Table 7. Long run dynamics analysis.

Variable	Coefficient	T-statistic	p-value
LNFDAGR	-0.024	-0.223	0.833
LNFDIMFG	0.213*	2.289	0.071
LNFDISVR	0.735***	4.086	0.010
LNACTFDI	-0.746***	-4.037	0.010

Note: Dependent variables is real GDP and independent variables are natural logarithm of foreign direct investment inflows in agriculture, manufacturing, service sector and aggregate inflows in over all sectors. The asterisk * and *** represents the level of significant at level 0.10, 0.05, and 0.001 level.

The coefficient of FDI_SVR is positive (0.734500), t-Statistic is (4.085932), and the probability(p-value) is (0.0095). FDI in the service sector appears to have a significant positive impact on GDP in the long run. The coefficient of Actual_FDI is negative (-0.746323), the t-Statistic is (-4.037246), and the probability (p-value) is (0.0099). Actual_FDI seems to have a significant negative impact on GDP in the long run. Finally, it suggests a possible long-run relationship between GDP and FDI in the service sector and actual FDI. However, the significance of the manufacturing sector's impact is borderline, and the agriculture sector's impact seems inconclusive based on the current results.

4.7. Short-Run Dynamics

The ARDL model is widely used economic technique used for analyzing the short-run relationships between variables. According to Pesaran et al. (2001) it allows for the estimation of dynamic relationships among variables, in the context of time series data. The ARDL (Autoregressive Distributed Lag) model results for the dependent variable Real GDP, with a maximum of one lag on the dependent variable and model selection based on Akaike Information Criterion (AIC), are as follows:

Table 8. Short-run dynamics analysis.

Variable	Coefficient	t-statistic	p-value
LnGDP(-1)	1.081***	77.838	0.000
LnFDI_AGR	0.028***	7.112	0.001
LnFDI_AGR(-1)	-0.026**	-3.421	0.019
LnFDI_MFG	0.058***	9.472	0.000
LnFDI_MFG(-1)	-0.075***	-24.076	0.000
LnFDI_SVR	-0.023	-1.877	0.119
LnFDI_SVR(-1)	-0.036**	-2.582	0.049
LnActualFDI	-0.059***	-4.923	0.004
LnActualFDI(-1)	0.119***	8.581	0.000
Constant term	-1.055**	-5.489	0.003

Note: Dependent variables is real GDP and independent variables are natural logarithm of foreign direct investment inflows in agriculture, manufacturing, service sector and aggregate inflows in over all sectors. The asterisk **, and *** represents the level of significant at level 0.10, 0.05, and 0.001 level.

The findings of Table 8 suggests that FDI_AGR, FDI_MFG, Actual FDI and their lag of order 1 is significant and exhibit short-run relationship. FDI_SVR(-1) (After taking lag) is significant and suggest a weaker short-run relationship. FDI_SVR is insignificant with high p-value (=0.1194), does not meet the condition for short-run relationship.

4.8. Error Correction Analysis

The Error Correction Model (ECM) serves as a vital tool in time series analysis, which helps for the examination of short-term dynamics while analyzing the calculations towards long-run equilibrium among variables. Pesaran et al. (2001) emphasized the significance of ECM for the correction of disequilibrium between variables, reflecting the influence of short-term dynamics on long-term relationships.

Table 9. Error correction term estimation.

Variable	Coefficient	t-statistic	p-value
C	-1.056***	-15.097	0.000
D(LnFDIAGR)	0.028***	11.895	0.000
D(LnFDIMFG)	0.058***	38.129	0.000
D(LnFDISVR)	-0.023**	-2.810	0.038
D(LnActual FDI)	-0.059***	-7.933	0.001
ECT	-0.080***	-15.879	0.000

Note: Dependent variables is real GDP and independent variables are natural logarithm of foreign direct investment inflows in agriculture, manufacturing, service sector and aggregate inflows in over all sectors. The ECT is error correction term which is a speed of adjustment with negative sign. The asterisk **, and *** represents the level of significant at level 0.05, and 0.001 level.

Table 9 presents the primary outcomes derived from the Error Correction framework; a regression technique utilized to explore the short-term dynamics for long-term adjustment. The coefficient of the error correction term (-0.080269) indicates that approximately 8.03% of any deviation from the long-term equilibrium between the variables is rectified in each period. This result supports the idea that the variables included in this model have a stable, long-lasting relationship.

4.9. Pairwise Granger Causality Test

A key tool in time series analysis for examining and evaluating directional causal relationships between variable pairs is the Pairwise Granger Causality Test. Based on the Granger Causality theory, this test determines if historical data on one variable might provide useful information for predicting data on another (Lutkephol, 2007). It helps to closely examine the relationship between variables and helps to determine whether FDI in certain industries Granger-causes GDP growth. The purpose of this report is to investigate possible causal relationships between variable pairs in our dataset using the Pairwise Granger Causality Test.

Table 10. Pairwise granger causality tests.

Null hypothesis	Obs.	F-statistic	p-value
LnFDISVR does not granger cause LnREAL_GDP	17	0.093	0.912
LnREAL_GDP does not granger cause LnFDISVR		8.343***	0.005
LnFDIMFG does not granger cause LnREAL_GDP	17	2.484	0.125
LnREAL_GDP does not granger cause LnFDIMFG		6.730**	0.011
LnFDIAGR does not granger cause LnREAL_GDP	12	6.754**	0.023
LnREAL_GDP does not granger cause LnFDIAGR		0.626	0.562
LnACTUALFDI does not granger cause LnREAL_GDP	17	0.0736	0.929
LnREAL_GDP does not granger cause LnACTUALFDI		11.538***	0.002

Note: Pairwise granger causality test estimation have done for real GDP natural logarithm of foreign direct investment inflows in agriculture, manufacturing, service sector and aggregate inflows in over all sectors. The asterisk **, and *** represents the level of significant at level 0.05, and 0.001 level.

The analysis according to Table 10 suggests a significance unidirectional causality from FDI in the service sector, manufacture sector and agricultural sector to real GDP. This finding indicates that changes in FDI in different sectors may have a predictive influence on the country's economic growth. The test also highlights a significant unidirectional Casual relationship between from Real GDP to Actual FDI. This implies that fluctuation in economic growth might predict changes in actual FDI inflows.

4.10. Robustness Check

The above-mentioned results must undergo additional diagnostic tests to evaluate the stability of the model, check for normality, and ensure that our variables do not exhibit serial autocorrelation and heteroskedasticity.

4.11. Bresch-Godfrey Serial Correlation L.M Test

The Breusch-Godfrey Serial Correlation LM Test is used to check for serial correlation (autocorrelation) in the residuals of a regression model, especially when there might be correlation among the residuals at certain lags. It further enhances the reliability and robustness of the regression analysis (Porter, 2021). Its aim is to detect serial correlation in regression residuals.

Table 11. Serial correlation L.M test.

F-statistic	1.052	Prob. F(2,3)	0.451
Obs*R-squared	6.184	Prob. chi-square (2)	0.045

Note: Null hypothesis: No serial correlation at up to 2 lags.

Table 11 presents findings of the Bresch-Godfrey L.M test. p-value is greater than the typical significance level (0.05), it suggests that there is no significant evidence to reject the null hypothesis of no serial correlation up to 2 lags. There is no significant evidence to suggest serial correlation up to 2 lags.

4.12. Heteroskedasticity Test

The results from a Heteroskedasticity Test, under the null hypothesis of homoskedasticity (constant variance). In "Introductory Econometrics: A Modern Approach" by Wooldridge (2012) heteroskedasticity is explained as one of the classical assumptions in regression analysis where the variance of the residuals or error terms in a regression model varies across different levels of the independent variables.

Table 12. Heteroskedasticity test.

F-statistic	2.962	Prob. F(9,5)	0.122
Obs.*R-squared	12.630	Prob. chi-squared(9)	0.180
Scale explained SS	0.809	Prob. chi-squared(9)	0.999

Note: Null hypothesis: Homoskedasticity.

Table 12 shows the findings of Heteroskedasticity test. The test does not provide strong evidence to reject the null hypothesis. Thus, there is heteroskedasticity in the residuals of the regression model based on this test. In another words, it suggests that there might be other factors influencing economic growth and FDI inflows that were not included in this analysis.

4.13. Stability Test

The Cumulative Sum Control Chart (CUSUM) is a statistical tool used for detecting shifts or changes in the mean of a process over time. These diagnostics aim to investigate whether the relationships, parameters, or coefficients in a model remain consistent and unchanged over various time periods or subsets of data (Greene, 2012). It is used to check model stability over different sub-periods. Stability diagnostics in CUSUM charts involve analyzing the behavior of the CUSUM plot to determine whether the process is stable or if there's evidence of a significant change.

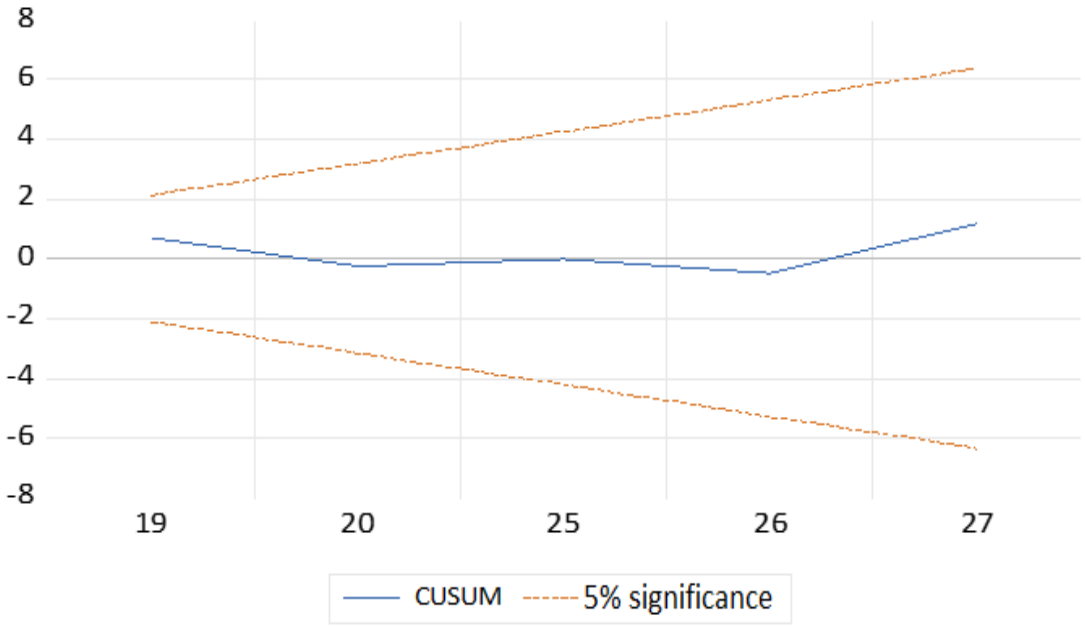

Figure 1. CUSUM test.

Figure 1 presents the CUSUM test which is the last diagnosis test exhibiting the stability of our empirical framework. This CUSUM graph clearly endorses the stability of the model. The plot of CAUSUM remains between 5% critical bounds and suggests the process in a state of statistical control or stability.

5. CONCLUSIONS

The analysis of 27 years of data on Foreign Direct Investment (FDI) and its influence on Nepal's economic growth, specifically in the manufacturing, service, and agriculture sectors, yields significant insights. The study focuses on understanding how foreign investments are distributed across different sectors, examining their respective impacts. Descriptive analysis confirms a normal distribution of data, indicating reliability for further analysis.

Key findings from the statistical analysis include a positive linear relationship between Real GDP and overall FDI, as well as its sectoral distribution. This suggests a significant role of FDI in stimulating economic growth, consistent with previous research by Khanal (2020). Sectoral impact analyses reveal unidirectional causality from Real GDP to manufacturing, service, and actual FDI inflow, while Granger causality tests differ from Chakraborty and Nunnenkamp (2008) regarding the agriculture sector. The unidirectional causality from agricultural FDI to Real GDP suggests a direct influence on economic growth, potentially through increased productivity and exports.

The lack of direct causality from FDI in manufacturing and service sectors to Real GDP implies an indirect impact, where these sectors act as intermediaries channeling FDI benefits to other areas. The unit root test confirms stationary variables after the first difference, essential for time series analysis. The ARDL test and ARDL bound test support a long-run relationship, further confirmed by the error correction model. Residual diagnostics indicate a model fit close to a normal distribution.

While the LM test shows no serial correlation up to 2 lags, suggesting uncorrelated error terms, the heteroskedasticity test indicates potential limitations in fully explaining variance in Real GDP. The analysis underscores the need for a comprehensive understanding of factors influencing economic growth beyond FDI, such as infrastructure, education, and political stability. Encouraging FDI through improved business environments and incentives can stimulate growth, but a holistic approach that addresses various elements is crucial for sustained economic development. Future research should explore additional factors and alternative models to enhance explanatory power and inform more effective strategies for Nepal's economic growth and development.

Funding: This study received no specific financial support.
Institutional Review Board Statement: Not applicable.
Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Agustin Benetrix, H. P., & Ugo, P. (2023). *World bank*. Retrieved from https://blogs.worldbank.org/developmenttalk/elusive-link-between-fdi-and-economic-growth

Akaike, H. (1974). A new look on the statistical model identification. *IEEE Transactions on Automatic Control, 19*(6), 716-723. https://doi.org/10.1109/tac.1974.1100705

Alfaro, L. (2003). Foreign direct investment and growth: Does the sector matter. *Harvard Business School, 1*(1), 1-31.

Bhattarai, A. (2023). *Studdentsnepal.com*. Retrieved from https://studentsnepal.com/foreign-investment-in-nepal-fdi/

Bista, R. (2011). Foreign direct investment and BIPPA in nepalese economy: A policy issue paper. *Artha Journal, 31*(1), 1-5. https://doi.org/10.4337/9781785369735.00017

Blomström, M., Kokko, A., & Mucchielli, J. L. (2003). The economics of foreign direct investment incentives in foreign direct investment in the real and financial sector of industrial countries. In (pp. 37-60). Berlin, Heidelberg: Springer Berlin Heidelberg.

Chakraborty, C., & Nunnenkamp, P. (2008). Economic reforms, FDI, and economic growth in India: A sector level analysis. *World Development, 36*(7), 1192-1212. https://doi.org/10.1016/j.worlddev.2007.06.014

Do, Q.-T., & Iyer, L. (2010). Geography, poverty and conflict in Nepal. *Journal of Peace Research, 47*(6), 735-748. https://doi.org/10.1177/0022343310386175

Economic Research Department. (2022). *Survey report on foreign direct investment in Nepal (2020/21)*. Kathmandu: Nepal Rastra Bank.

Government of Nepal. (2021). *Foreign investment and technology transfer rule 2021*. Kathmandu: Ministry of Communiction and Information Technology.

Greene, W. H. (2012). *Econometric analysis* (7th ed.). New York: Pearson.

Hair Jr, J. F., Black, W. C., Babin, B. J., & Anderson, R. (2019). *Multivariate data analysis* (8th ed.). London: Cengage Learning.

Iram, S., & Nishat, M. (2009). Sector level analysis of FDI-growth nexus: A case study of Pakistan. *The Pakistan Development Review*, 875-882. https://doi.org/10.30541/v48i4iipp.875-882

Jana, S. S., Sahu, T. N., & Pandey, K. D. (2019). Foreign direct investment and economic growth in India: A sector-specific analysis. *Asia-Pacific Journal of Management Research and Innovation, 15*(1-2), 53-67. https://doi.org/10.1177/2319510x19849731

Jude, C., & Levieuge, G. (2017). Growth effect of foreign direct investment in developing economies: The role of institutional quality. *The World Economy, 40*(4), 715-742. https://doi.org/10.1111/twec.12402

Khanal, M. (2020). Impact of FDI on GDP and inflation in Nepal. *Journal of Economics and Finance, 11*(5), 52-55.

Kharel, K. R. (2020). Foreign direct investment in Nepal: A study on its impact on employment. *Interdisciplinary Journal of Management and Social Sciences, 1*(1), 53-65. https://doi.org/10.3126/ijmss.v1i1.34511

Lutkephol, H. (2007). Testing for granger -causality in: H. Petri, ed new introduction to multiple time series analysis. In (pp. 316-320). New York: Springer.

Majagaiya, K. P. (2011). Relationship between foreign direct investment and economic growth case study of Nepal. *International Journal of Business and Mangement, 6*(6), 242-247. https://doi.org/10.5539/ijbm.v6n6p242

Msuya, E. (2007). *The impact of foreign direct investment on agriculture productivity and poverty reduction in Tanzania*. Japan: Kyoto University.

National Planning Commission. (1980). *Main objective and strategies of the sixth plan*. Kathmandu: National Planning Commission.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics, 16*(3), 289-326. https://doi.org/10.1002/jae.616

Phuyal, R. K., & Sunuwar, S. (2018). A sectoral analysis of foreign direct investment on the economic growth of Nepal. *Journal of Business and Social Sciences Research, 3*(1), 1-14.

Porter, D. N. G. (2021). *Essentials of econometrics* (4th ed.). New York: Sage Publications.

Sahoo, D., & Mathiyazhagan, M. K. (2003). Economic growth in India:" Does foreign direct investment inflow matter?". *The Singapore Economic Review, 48*(02), 151-171. https://doi.org/10.1142/s0217590803000748

Sayek, D. A. a. S. (2007). The role of the sectoral composition of foreign direct investment. *International Economics and Foreign Trade Politics, 2*(3), 33-64.

Shenali Nupehewa, S. L. D. P. M. T. R. J. A. L. (2022). More than just investment: Causality analysis between foreign direct investment and economic growth. *Plos One, 17*(11), 1-28. https://doi.org/10.1371/journal.pone.0276621

Shrestha, S. (2022). *Nepal economis forum*. Retrieved from https://nepaleconomicforum.org/overview-of-foreign-direct-investment-in-nepal/

Walsh, M. J. P., & Yu, J. (2010). *Determinants of foreign direct investment: A sectoral and institutional approach*: International Monetary Fund.

Warner, R. M. (2012). *From bivarite through multivaritr techniques* (2nd ed.). United States of America: Sage Publicatios.

Wooldridge, J. M. (2012). Hetroskedasticity in: E. Joyner, ed. Introductory econometrics a modern approach. In (pp. 268-302). Natorp Boullevard: Cengage Learning.