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Impact of Exports, Imports, and Gross Fixed Capital Formation on Nepal's Economic Growth: an Ardl Approach

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Abstract

This study investigates the impact of exports, imports, and gross fixed capital formation (GFCF) on Nepal's economic growth using the Auto-Regressive Distributed Lag (ARDL) approach. Analyzing annual data from 1975 to 2023, the study examines both short-run and long-run dynamics of these macroeconomic variables. The findings reveal that exports significantly contribute to economic growth in the long run, while imports exert a negative influence, suggesting structural trade imbalances. GFCF plays a crucial role in boosting GDP, highlighting the importance of capital investment in sustaining long-term development. The error correction model confirms that deviations from long-run equilibrium adjust at 26.58% per year. Stability and diagnostic tests validate the robustness of the model. The report emphasizes the need for strategic trade and investment policies to increase Nepal's capacity for exports, control imports, and foster capital formation to create a more stable and sustainable economic environment.

Keywords: Trade Balance, Capital Investment, ARDL Approach, Macroeconomic Policy, Economic Stability.

Jel Classification: F10, F43, C32, O53, E22

Introduction

Nepal, a landlocked developing country, relies heavily on trade and investment as critical drivers of its economic growth. Exports, primarily agricultural goods and handicrafts, generate foreign exchange and stimulate industrial activity, while imports supply essential capital goods and consumer products. Gross Fixed Capital Formation (GFCF), encompassing investments in infrastructure and machinery, underpins long-term development by enhancing productive capacity. However, Nepal's economic trajectory remains volatile, shaped by a narrow export base, persistent trade deficits, and susceptibility to external shocks. Despite the recognized importance of these macroeconomic variables, their combined impact on Nepal's economic growth particularly through a robust empirical lens remains underexplored, necessitating a detailed investigation to inform policy design.

Existing literature underscores the role of exports in fostering economic growth, with export-led growth models highlighting their contribution to foreign exchange earnings and industrialization. Imports, conversely, present a dual narrative: while they can enhance productivity through technology transfers, excessive reliance on consumer goods often exacerbates trade imbalances, as noted by in the Nepalese context. GFCF is widely acknowledged as a cornerstone of sustained growth, yet its effectiveness in Nepal is constrained by underinvestment and inefficient resource allocation. While studies like and have examined trade or investment individually, a comprehensive analysis integrating exports, imports, and GFCF within a unified framework is lacking. Moreover, these variables' short- and long-term dynamics in Nepal's unique economic context have not been adequately addressed using advanced econometric methods like the Auto-Regressive Distributed Lag (ARDL) approach [1-7].

Over the past few decades, Nepal's economic growth rate has fluctuated significantly due to its unique topography and socio-economic issues. Understanding the key factors influencing this growth is essential for formulating policies that effectively sustain and promote economic development. This study employs the Auto-Regressive Distributed Lag (ARDL) method of cointegration to explore the effects of imports, exports, and gross fixed capital formation (GFCF) on Nepal's economic growth, revealing both short- and long-term dynamics.

The connections among trade, GFCF, and economic growth are widely studied in economic literature. Everyone agrees that exports are essential for economic growth because they provide foreign exchange and advance industrialization. The positive relationship between export performance and economic growth is emphasized by and, especially in models of export-led growth [1, 2]. On the other hand, imports are frequently perceived as drains of native resources. On the other hand, importing capital goods and technology can increase growth and productivity, as shown by [3]. Another important consideration is gross fixed capital formation (GFCF), which represents investments in tangible assets such as machinery and infrastructure. This study fills these gaps by investigating the impact of exports, imports, and GFCF on Nepal's economic growth from 1974 to 2023, employing the ARDL model to capture both short-run and long-run relationships. The significance of this research lies in its potential to unravel the complex interplay of trade and investment, offering empirical evidence to address Nepal's structural challenges such as trade imbalances and limited capital formation. Unlike prior studies, this analysis provides a holistic perspective, bridging theoretical insights with practical policy implications. Doing so aims to guide policymakers in crafting strategies that enhance export competitiveness, optimize import composition, and prioritize capital investments, thereby fostering sustainable economic development in Nepal.

Research Objectives

This study investigates the impact of imports, exports, and GFCF on Nepal's GDP using the ARDL approach. It aims to assess the long-term and short-term effects using the error correction model (ECM), examine short-term dynamics using the ECM, evaluate the robustness and stability of the ARDL model through diagnostic and stability tests, and provide policy recommendations for optimizing trade and investment strategies in Nepal. The study aims to bridge the gap in the literature on these economic variables.

Importance of the Study

This research is highly significant in Nepal's economic development and global trade dynamics. Nepal, as a developing nation, faces unique challenges in balancing trade and investment to ensure sustainable growth. Understanding the roles of exports, imports, and GFCF is crucial for policymakers designing effective trade and investment policies. Given Nepal's reliance on agricultural exports and increasing dependency on imports, it is imperative to identify strategies that promote export growth while managing the trade deficit.

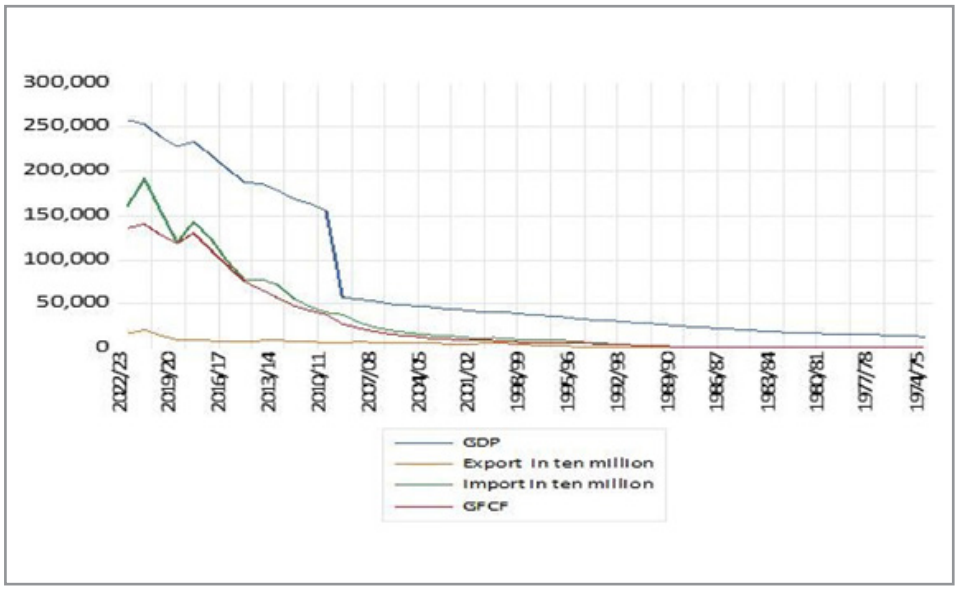

Figure 1: Trend of GDP

The graph showing Nepal's GDP growth from 1974 to 2023 indicates a general upward trend. An increase in exports reflects changes in global demand, Nepal's production capacity, and competitiveness. The steady increase in imports indicates rising domestic demand for foreign goods and services. However, higher imports than exports could indicate a trade imbalance, affecting Nepal's foreign exchange reserves and overall economic equilibrium. An increasing trend in GFCF suggests substantial investments in machinery, equipment, and infrastructure. Fluctuations in GFCF may indicate periods of high or low investment due to changes in governmental policies, economic conditions, or funding availability. The steady GDP growth implies higher productivity and overall economic growth, although signs of economic fragility remain. The main goals of policy measures should be to control imports, increase exports, and guarantee consistent investment in infrastructure and capital formation. The short- and long-term impacts of imports, exports, and GFCF on GDP can be further examined using the ARDL model.

Review of Literature

Theoretical Review

Economic growth theories, such as the Solow-Swan Model, Keynesian Model, and Endogenous Growth Theories, provide valuable insights into the key drivers of long-term development. The Solow-Swan Growth Model is a fundamental economic growth theory that suggests capital accumulation, like Gross Fixed Capital Formation (GFCF), contributes to economic expansion but has limited long-term effects. It suggests that sustained growth relies on technological progress and productivity improvements. Empirical studies confirm that higher investment in physical capital leads to economic expansion, but its effectiveness depends on complementary factors like technology, infrastructure, and human capital [4]. and [5]. For Nepal, GFCF plays a crucial role in enhancing productive capacity, but its long-run impact depends on technological advancements and efficient capital utilisation. Moreover, argue that trade liberalization allows countries to access superior technology and capital goods, leading to productivity improvements. Nepal's reliance on imports for capital goods and machinery can be seen as a mechanism to facilitate long-term growth, despite short-term trade imbalances.

The Keynesian growth model differs from the Solow-Swan model by emphasizing aggregate demand as the primary driver of economic growth (Keynes, 1936). In this framework, investment in GFCF directly boosts aggregate demand, leading to higher output and employment. Similarly, exports contribute positively to economic growth by injecting income into the circular flow, stimulating production and job creation. However, imports, if excessive, act as a leakage, reducing domestic demand and potentially slowing economic expansion.

Nepal's persistent trade deficit suggests that the negative effects of imports may be offsetting some of the gains from exports. Importing raw materials and capital goods, however, can boost industrial development and long-term growth by increasing productive capacity; not all imports are harmful. This aligns with, who found that Nepal's trade structure influences GDP growth, with exports driving expansion while excessive imports pose risks to economic stability [6].

Endogenous growth theories suggest that long-term growth is influenced by investment in human capital, innovation, and knowledge accumulation. Trade promotes knowledge spillovers, technological diffusion, and productivity enhancements. Investment in both physical and human capital drives sustained growth, benefiting export-oriented economies from scale economies and learning-by-doing effects [8, 9].

For Nepal, increasing investment in infrastructure, education, and technology alongside trade liberalization could lead to higher and more sustainable growth [7]. Found that while Nepal's export sector positively contributes to GDP, its effectiveness is constrained by limited technological progress and weak industrialization. Thus, Nepal must focus on diversifying its export base, improving productivity, and investing in R&D to sustain long-term growth.

By combining insights from the Solow-Swan model, Keynesian growth theory, and endogenous growth models, it is evident that Nepal's economic growth is influenced by capital accumulation, trade dynamics (exports and imports), and technological progress.

Empirical Review

Numerous studies have been conducted on the factors that influence economic growth in emerging nations, namely the functions of imports, exports, and capital formation. Since they generate foreign exchange and boost local production, exports are sometimes viewed as the engine of economic expansion. The positive relationship between export performance and economic growth is emphasised by and, especially in models of export-led growth. Conversely, because domestic resources are being exported, imports are typically seen as a negative for economic growth. challenge the conventional wisdom that imports are bad only by pointing out that imports of capital goods and technology can increase productivity and growth [1-3].

Another important consideration is gross fixed capital formation (GFCF), which is the sum of investments made in tangible assets such as buildings, machines, and infrastructure. According to and, higher investment levels increase productive capacity and promote long-term economic growth [4, 5]. Studies by and in the context of Nepal have produced contradictory findings about how these variables affect GDP, underscoring the necessity for thorough empirical research to capture complex relationships [10, 11].

Examined how macroeconomic factors affected the growth of economies in a few chosen nations between 1990 and 2010. They discovered that there was a positive correlation between economic growth and foreign direct investment (FDI) and that higher savings rates were also associated with faster economic growth. Their results, however, indicated that although the labour force and tax revenue had no appreciable effect on economic development, exports had a negative effect. This implies that while higher investment and financial reserves are responsible for the benefits of FDI and savings, structural problems or poor export quality may be the cause of the negative effects of exports. Their research suggested that in addition to examining and changing export tactics, authorities should concentrate on nurturing FDI and promoting savings to promote economic growth [12].

Investigated how Nigeria's economic growth was impacted by foreign trade between 1981 and 2008. Their findings revealed a long-term positive correlation between GDP, exports (EXP), and imports (IMP), indicating that commerce with other countries fosters Nigeria's economic expansion [13]. The Granger causality test also demonstrated that shifts in real GDP are a reliable indicator of future shifts in exports. Their research highlights how important it is to have trade rules that are beneficial to imports and exports to promote overall economic development.

Study examined the impact of imports, exports, Gross Fixed Capital Formation (GFCF), and inflation on economic growth in Egypt from 1970 to 2013. The study used the Augmented Dickey-Fuller and Phillips-Perron tests to check for stationarity and the Autoregressive Distributed Lag (ARDL) and Vector Error Correction Model to analyze long-run and short-run dynamics. Key findings have shown that exports positively impact economic growth, stimulating domestic production and promoting

economies of scale and technological advancements. Imports, on the other hand, have a negative impact, potentially due to reliance on foreign goods and services, stifling domestic industries and causing a trade deficit. Gross Fixed Capital Formation (GFCF) investments may also be inefficient, leading to non-productive investments and debt. In conclusion, exports positively contribute to Egypt's economic growth by bringing in foreign exchange and stimulating production, but the negative impacts of imports and GFCF highlight the complexities of economic dynamics [14].

Used a general-to-specific approach for finding relevant macroeconomic variables affecting Pakistan's economic growth. Annualized data between 1976 and 2014 and the autoregressive distributed lag are employed for conducting the analysis. The main findings of this study were consumer price index, gross fixed capital formation, gross national expenditures, remittance and credit extended to the private sector, which are important from a growth perspective. Gross fixed capital formation and remittance are positively associated with the economic growth of a country. Consumer price index, gross national expenditures and domestic credit extended to the private sector hamper the long-run growth process. Based on empirical findings, it is recommended that relevant authorities augment the gross fixed capital formation, attract foreign remittance, control inflation, reduce government expenditures and alleviate government intervention in the financial market to achieve long-run economic growth [15].

Looked at the connection between macroeconomic factors and economic growth in Nepal from 1975 to 2016. They discovered a cointegration link between GDP and important variables such as trade openness, foreign aid, government spending, human capital, and GFCF. To promote sustainable growth, their report made recommendations for strategic investments and policy changes. It emphasized the importance of ongoing investments in technology and infrastructure, raising the standard of education, and enacting sensible trade laws [16].

Using data from 1965 to 2011, examined the relationship between trade and economic growth in Nepal. Their results demonstrated a one-way causal relationship between GDP and exports over the short and long term, supporting the export-led growth (ELG) theory. On the other hand, they also discovered that imports had a considerable detrimental long-term impact on GDP. This indicates that to strengthen the Nepalese economy, effective policies that increase exports, create the necessary infrastructure for trade and investment capital, and lessen dependency on imported commodities are required [7].

This study extends the literature by empirically analyzing the short and long-term relationships between GFCF, exports, and imports on Nepal's GDP using the ARDL approach. Unlike previous research, this study provides a comprehensive assessment of these factors within a unified theoretical framework, offering valuable policy recommendations for sustainable economic growth in Nepal. Despite these thorough studies, understanding the combined effects of imports, exports, and GFCF on Nepal's economic growth using the ARDL approach is still lacking. By offering a thorough examination of these variables and their particular impact on Nepal's GDP, this study seeks to close this gap.

Research Methodology

Data Sources and Variables

The study is essentially based on secondary data from the Ministry of Finance (MOF). The data collection procedure is relatively simple. The data collected about GDP, gross fixed capital formation, exports, and imports covered the period from 1974 to 2023, which gives forty-nine (49) years of observations, which is statistically large enough to be used for the study. Macroeconomic variables were calculated in real terms using the GDP deflator.

Table 1: Variable Description

S.N.	Notation	Variable	Unit Source
1	GDP	GDP	In ten million (NRs.)
2	EXP	Exports	In ten million (NRs.)
3	IMP	Imports	In ten million (NRs.)
4	GFCF	Gross Fixed Capital Formation	In ten million (NRs.)

The study examines the impact of four variables on Nepal's GDP growth. The first is the dependent variable, Real Gross Domestic Product (GDP), which represents the overall economic output. Understanding the impact of exports, imports, and investment on GDP helps policymakers design effective trade and investment policies. The second variable, exports, is an independent variable that contributes to economic growth by increasing foreign exchange earnings, improving employment, and facilitating industrial expansion. The export-led growth hypothesis suggests that higher exports drive GDP growth through increased production and specialization. The third variable, imports, can have both positive and negative effects on GDP. The study examines whether Nepal's import structure supports or hampers economic growth. The fourth variable, Gross Fixed Capital Formation (GFCF), represents investment in physical capital, which is a key driver of economic growth. The inclusion of GFCF allows the study to assess whether investment in Nepal is contributing positively to GDP growth. Exports (EXP), Imports (IMP), and Gross Fixed Capital Formation (GFCF) are measured at constant prices, and these variables were calculated in real terms using the GDP deflator 2011(=100).

Econometric Approach: ARDL Model

The study uses the Autoregressive Distributed Lag (ARDL) Bounds Testing Approach to analyses the impact of exports, imports, and gross fixed capital formation on Nepal's GDP. This model is suitable for small sample sizes and offers reliable estimates compared to other cointegration techniques. It also estimates long-run and short-run relationships through an Error Correction Model (ECM), crucial for understanding trade and

investment's influence on Nepal's economic growth and how quickly the economy adjusts to shocks. The ARDL method effectively handles endogeneity by including lags of the dependent and independent variables, mitigating potential issues from reverse causality. The study provides policy recommendations based on empirical findings, emphasizing the importance of GFCF investment, infrastructure improvements, technology, and financial markets.

Model Specification

The model in the study demonstrates a functional relationship between dependent and independent variables. Gross Domestic Product (GDP) is considered a dependent variable, and exports (EXP), imports (IMP), and Gross Fixed Capital Formation (GFCF) are used as explanatory variables. Based on theoretical literature, the model can be expressed below.

GDP = f (EXP, IMP, GFCF) ..... (1)

The linear form of equation (1) can be presented as equation (2) below.

$GDPt = \beta 0 + \beta 1\ EXPt + \beta 2\ IMPt + \beta 3\ GFCFt + Ut$ ..... (2)

Here, β0 is the intercept parameter, β1, β2, and β3 are the coefficients to be estimated, U is a random variable, and t represents time. The expressed coefficients are expected to have positive signs, indicating that the explanatory variables have positive effects on Nepal's economic growth rate.

ARDL Approach to Cointegration

The ARDL model, developed by Pesaran and Shin, is chosen for this study because of its flexibility in handling different integration orders, small sample size suitability, simultaneous estimation of short- and long-run dynamics, an error correction mechanism (ECM), and bounds testing approach. Economic time series data can be handled by the ARDL model since it can handle variables of order zero, one, or a combination of both. It also makes it possible to simultaneously estimate dependent and independent variable interactions across the short and long terms, which sheds light on the dynamics and stability of economic linkages over time. The cointegration testing procedure is made robust by using the bounds testing approach.

The most popular and appropriate method for examining the co-integration relationship between the underlying variables is the ARDL model, which was developed by Pesaran and Shin (1999) and, is one of the most popular and appropriate methods for examining whether the variables are integrated in order zero I(0), order one I(1), or mutually integrated. Additionally, this method is considered a statistically more significant way to find the cointegrating relation in small samples [16]. The following is the expression for equation (2) in the ARDL format.

$$GDP_t = \alpha + \sum_{i=0}^{p}\beta_{1i} EXP_{t-i} + \sum_{j=0}^{q}\beta_{2j} IMP_{t-j} + \sum_{k=0}^{r}\beta_{3k} GFCF_{t-k} + \sum_{l=1}^{s}\gamma_l GDP_{t-l} + \varepsilon_t$$

.....(3)

Where p, q, r, and s are the lag orders of the respective variables.

Cointegrating and Long Run Relationship

$$\triangle GDP_t = \alpha + \sum_{i=0}^{p}\delta_{1i} \triangle EXP_{t-i} + \sum_{j=0}^{q}\delta_{2j} \triangle IMP_{t-j} + \sum_{k=0}^{r}\delta_{3k} \triangle GFCF_{t-k} + \lambda ECM_{t-1} + \varepsilon_t$$

.....(4)

where 'Δ' indicates the first difference operator and λ is the error correction coefficient, which measures the speed of adjustment to the long-run equilibrium.

To determine whether a long-term equilibrium relationship exists between the set of variables, the Pesaran and Shin (1999) bounds test for cointegration is used. The hypotheses to test the long-run relationship are presented below.

Null Hypothesis (H0): $\gamma 1 = \gamma 2 = \gamma 3 = \gamma 4 = 0$; No cointegration exists.

Alternative Hypothesis (H1): $\gamma 1 \neq \gamma 2 \neq \gamma 3 \neq \gamma 4 \neq 0$; Cointegration exists.

The variables have a long-term relationship if the bound test result demonstrates cointegration. We compared the F-statistic to critical values to show this relationship. The null hypothesis of no cointegration is rejected if the computed F-statistic is higher than the appropriate upper bound of the essential values; if it is below the appropriate lower bound, the null hypothesis cannot be rejected; and if it lies between the lower and upper bounds, the results are not conclusive [16].

Lag Length Selection

The lag order can be determined using the Hannan-Quinn Criterion (HQC), the Schwartz Bayesian Criterion (SBC), or the Akaike Information Criterion (AIC). After that, the number of lags recommended by the information criteria should be used to estimate the model. Nonetheless, the best lag in the ARDL model was chosen for this investigation using the AIC criterion.

Diagnostic Testing

Because the ARDL model looks for the best linear unbiased estimator (BLUE), diagnostic tests must be carried out. By using tests for stability, serial correlation, heteroscedasticity, and normality in the residuals, this study further validates the results and ensures that the results are statistically robust, much like many other research publications, such as [17, 18]. The findings can be used for the analysis if the model produces results that are satisfactory and do not contain any of the addressed biases.

Regression Specification Error Test

The Ramsey Regression Specification Error Test (RESET) is a statistical test that checks whether non-linear combinations of fitted values can describe the explanatory variable. If they have power, the model needs adjustments, and a null or alternative hypothesis can be used.

LM Test for Serial Correlation

The Breusch-Godfrey test tests serial correlation in regression estimators. It requires covariance (εi, εj) = 0, otherwise, the series has a serial correlation. The test has two null and alternative hypothesis: H0: no correlation, H1: serial correlation.

Test for Heteroscedasticity

The study tests for constant variance in residuals in the regular OLS and ARDL models, ensuring homoscedasticity. If not, the estimated coefficients will not be BLUE and have the minimum variance of unbiased estimators. The Breusch-Pagan test is used.

H0: Non-constant variance of the residuals – Heteroscedasticity. The null hypothesis is accepted if the observed R-squared probability exceeds a five percent level of significance, indicating homoscedasticity, and rejected if the probability value is lower, indicating heteroscedasticity.

Test for Normality of the Residuals

The Jarque-Bera test is used to test the normality of residuals, as nonnormality can cause issues in statistical inference and confidence intervals. The general hypotheses are H0 (normality) and H1 (non-normality), and a low p-value (less than 5%) rejects the null hypothesis, while a high p-value accepts it.

Test for Stability

The Jarque-Bera test is used to test the normality of residuals, which is crucial for hypothesis tests and statistical inference. The test accepts either normality (H0) or non-normality (H1). If the p-value is low or high, the null hypothesis is rejected [19-21]. To assess the stability of long-run and short-run coefficients, CUSUM and CUSUMSQ tests are used. These tests are graphical and based on the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squared recursive residuals (CUSUMSQ). Stability is achieved if the plots stay within the 5% significance level.

Results and Discussions

Unit Root Test

The only statistical characteristic that a stationary time series shares is that its covariance between two time periods is time-invariant, and its mean and variance remain constant over time. Spurious regression is an issue if the time-series data are non-stationary [22]. Thus, the data must be checked for stationarity before conducting any empirical analysis. The Augmented Dickey-Fuller (ADF) test is a technique for determining the unit roots. The results of this study, which diagnose the stationarity of the data using the ADF test, are displayed in the table below.

Table 2: Augmented Dickey-Fuller (ADF) Test

Variables	Level Intercept	Trend & Intercept	First Difference Intercept	Trend & Intercept	Order of Integration
GDP	-2.543406 (0.1119)	-1.329010 (0.8685)	-6.364454 (0.0000)	_	I (1)
EXP	-2.506467 (0.1203)	-2.972645 (0.1504)	-8.006477 (0.0000)	_	I (1)
IMP	-3.127802 (0.0328)	-5.928340 (0.0001)	-3.251101 (0.0246)	_	I (0)
GFCF	-2.211866 (0.2055)	-2.114818 (0.5218)	-7.612456 (0.0000)	_	I (1)

Source: Author's calculation

Table 2 shows the results of the unit root test by using the ADF test. GDP and Exports are stationary at first difference, whereas Imports and GFCF are significant at the level intercept. Therefore, the ARDL model is implemented as the investigation found no second difference and variables are significant at I(0) and I(1) in the unit root test for any of the variables in the study.

Lag Length Selection

Selecting a suitable lag order for the ARDL model is crucial in determining the cointegrating relationship between the variables. The table below displays the ideal lags determined by various standards using the VAR lag selection methodology.

Table 3: Lag Length Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1839.574	NA	4.52e+30	81.93663	82.09723	81.99650
1	-1649.522	337.8711	1.98e+27	74.20097	75.00393	74.50030
2	-1594.197	88.52006	3.51e+26	72.45319	73.89852	72.99199
3	-1540.617	76.20203	6.92e+25	70.78298	72.87068	71.56126
4	-1483.572	70.98916*	1.22e+25*	68.95877*	71.68884*	69.97651*

Source: Author's calculation

Note: * indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion.

The VAR lag selection criteria model was used to find the optimal lag length. There are multiple criteria, such as LR, FPE, AIC, SC, and HQ, for the lag length selection. This study has considered all of these criteria and the chosen lag length 4 based on several * present in a single row, because in line three there are maximum number of * present. The model can select lag lengths up to 4 based on the AIC (Akaike information criterion) criteria.

ARDL Regression Results and Interpretation

The ARDL model has been utilized to estimate the long-run and short-run coefficients for equation (3), considering the cointegration between explanatory variables and real GDP. As a result, the following section presents the long- and short-term relationships among variables using the ARDL model based on the SC criterion

Long Run and Bound Test

Table 4: ARDL Bound Test

Model	f-stat	I (0)	I (1)
GDP per capita / (Exports, Imports, GFCF)	32.53984		
1% critical bound value		3.65	4.66
5% critical bound value		2.79	3.67
10% critical bound value		2.37	3.2

Source: Author's calculation

Note: I (0) indicates the lower bound, and I (1) indicates the upper bound

Table 4 shows the computed F-statistic for the GDP per capita as the dependent variable is 32.53984, which exceeds the upper bounds critical value at a 1%, 5% and 10% level of significance. Hence, the null hypothesis is rejected. Thus, this study concludes that the variables are co-integrated in the long run. This study, therefore, estimates the long-run relationship between the variables through the Auto-regressive Distributed Lag (ARDL) Model.

Table 5: Long-Run ARDL Result

Variables	Coefficient	Std. Errors	t-statistic	Prob.
EXP	10.11275	2.861024	3.534661	0.0012
IMP	-18.36310	4.662045	-3.938849	0.0004
GFCF	21.88099	5.107635	4.283977	0.0001

Source: Author's estimation

Table 5 shows the long-run relationship between the dependent variable and the independent variables with a level of significance at five per cent.

GDP = 10.11275*EXP - 18.36310*IMP + 21.88099*GFCF

The long-term link between the dependent variable (GDP), independent variables (exports as a percentage of GDP), imports, and control variables (gross fixed capital formation as a percentage of GDP) is depicted in the equation above. Over time, the export index has had a positive and considerable impact on the GDP. This indicates that over time, the GDP per capita will rise by 10.11275 units for every unit increase in exports. Which, at the five percent significance level, is significant. In the same way, imports have long-term detrimental effects on GDP per capita. This indicates that a unit increase in imports will result in a long-term negative change in GDP of 18.36310 units. A one percent change in GFCF will result in an improvement in GDP of 21.88099. Since all of the factors are long-term important, GDP per capita will either be impacted by all of the variables over time, or GDP will be correlated with all of the independent and dependent variables.

ARDL Error Correction Regression (ECM)

The error correction model shows the short-run relationship between the dependent and independent variables. In the short run, some variables are moving in different paths, but they can significantly impact on dependent variables. The selected lag model is ARDL (2,2,2,3).

Table 6: Error Correction Model

Variables	Coefficient	Std. Error	t-statistic	Prob.
D (GDP (-1))	0.454291	0.0773533	6.176675	0.0000
D(EXP)	9.192747	1.713506	5.364877	0.0000
D (EXP (-1))	-6.164725	1.758887	-3.504900	0.0013
D(IMP)	-6.1716622	0.369386	-18.18319	0.0000
D (IMP (-1))	4.123554	0.408647	10.09075	0.0000
D(GFCF)	10.93222	0.543623	20.10991	0.0000
D (GFCF (-1))	-5.179450	0.564208	-9.180034	0.0000
D (GFCF (-2))	-1.931053	0.185744	-10.39629	0.0000
CointEq (-1) *	-0.265876	0.019685	-13.50631	0.0000
R-squared	0.927479			
Adjusted R-squared	0.911798			

Source: Author's estimation

The error correction model is displayed in Table 6. The model is valid since it displays the error correction model's coefficients with a negative sign, and the corresponding probability value is significant at 5%. The rate of correlation of the deviating value is displayed by the ECM. At a rate of 26.58% annually, the deviating value is corrected, returning to the equilibrium position

roughly every 10 months [(100/26.58) *12]. The residual term's coefficient value is greater than -1, indicating a strong rate of long-term adjustment to the equilibrium state.

According to the error correction model (ECM), exports harm GDP, but historical values and current exports have a positive impact. Imports have a favourable delayed effect on GDP but a negative immediate effect. GDP is positively impacted by gross fixed capital formation (GFCF), but over time, GDP is negatively impacted. The model's error correction term, which corrects departures from long-term equilibrium at a rate of about 26.59% every period, shows a robust adjustment mechanism. The findings highlight the significance of both immediate and long-term factors in economic planning and policy. The explanatory power of the model is confirmed by its R-squared value of 0.927479 and modified R-squared value of 0.911798.

Diagnostic Test

The ARDL model's reliability is examined in more detail using diagnostic tests like the Regression Specification Error Test, serial correlation test, heteroscedasticity test, normality test, and stability test.

Regression Specification Error Test Result

The Ramsey RESET test is used to check the accuracy of the given functional form, and the results are shown below.

Table 7: Ramsey RESET Test

Omitted Variables: Squares of fitted values			
	Value	df	Probability
t-statistic	0.725492	32	0.4734
F-statistic	0.526338	(1, 32)	0.4734

Source: Author's calculation

The probability values of the F-statistics and t-statistics are both 0.4734, surpassing the 0.05 threshold, thus rejecting the null hypothesis that the model is not in its correct functional form. This indicates that the model shows no sign of any misrepresentation.

Serial Correlation Test

The study conducts autocorrelation testing on the model using residual diagnostics with the Breusch-Godfrey Serial Correlation LM test, which includes one lag. Below is the outcome of the autocorrelation examination for the model.

Table 8: Breusch-Godfrey Serial Correlation LM Test

F-statistic	1.727665	Prob. F (2,31)	0.1944
Obs*R-squared	4.613081	Prob. Chi-Square (2)	0.0996

Source: Author's calculation

Given that the P-value for the data in the table is 0.1944 and above the 0.05 cutoff, the null hypothesis—that there is no serial correlation is supported. This suggests that the variables under investigation do not exhibit serial correlation.

Heteroskedasticity Test Results

When the error variance is inconsistent throughout the predictor variable's values, the heteroscedasticity problem arises. In a regression analysis, heteroskedasticity results in an uneven residual dispersion. The results of the model's heteroscedasticity test are shown below.

Table 9: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.400544	Prob. F (12,33)	0.2148
Obs*R-squared	15.52207	Prob. Chi-Square (12)	0.2141
Scaled explained SS	11.95201	Prob. Chi-Square (12)	0.4495

Source: Author's calculation

The result shows that the P value is 0.2148; thus, the null hypothesis cannot be rejected. Because all p-values are higher than 5%, the null hypothesis is not rejected, indicating that there is no heteroskedasticity between the variables in the model.

Normality Test Result

The study employed visual and statistical methods to determine the normality of the test. The model is examined for Normality testing using the Jarque-Bera test. The summary of the normality test results is presented below.

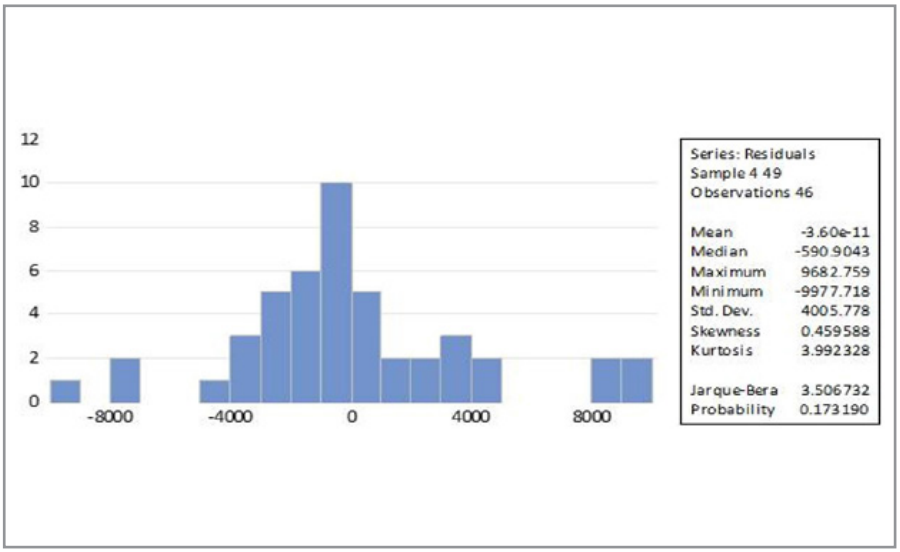

Figure 2: Histogram Normality Test Results

Source: Author's calculation

The results indicated that the model's JB test p-value was higher than 0.05, which prohibited the study from rejecting the null hypothesis. Consequently, it may be concluded that the research's data collection is typical.

Stability Test Result

The stability test is used to assess the consistency of the calculated model parameters. The cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ) statistics were used to evaluate the model's structural stability. The stability test's null hypothesis is the coefficient's consistency. The null hypothesis states that a progressive structural change in the model is indicated by the sequence's value going outside of a predicted range. A sudden change in the parameter is measured by CUSUMSQ, while a systematic change is measured by CUSUM.

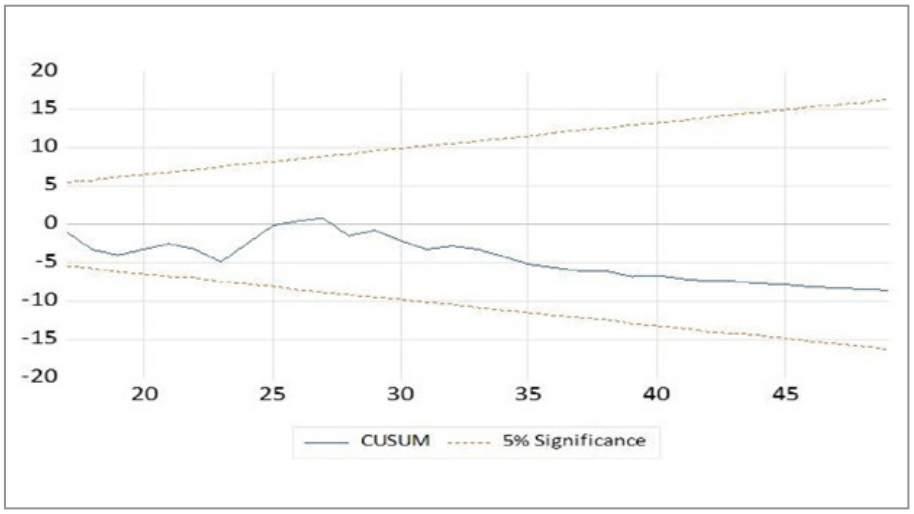

Figure 3: Plot of Cumulative Sum of Recursive Residuals

Source: Author's derivation

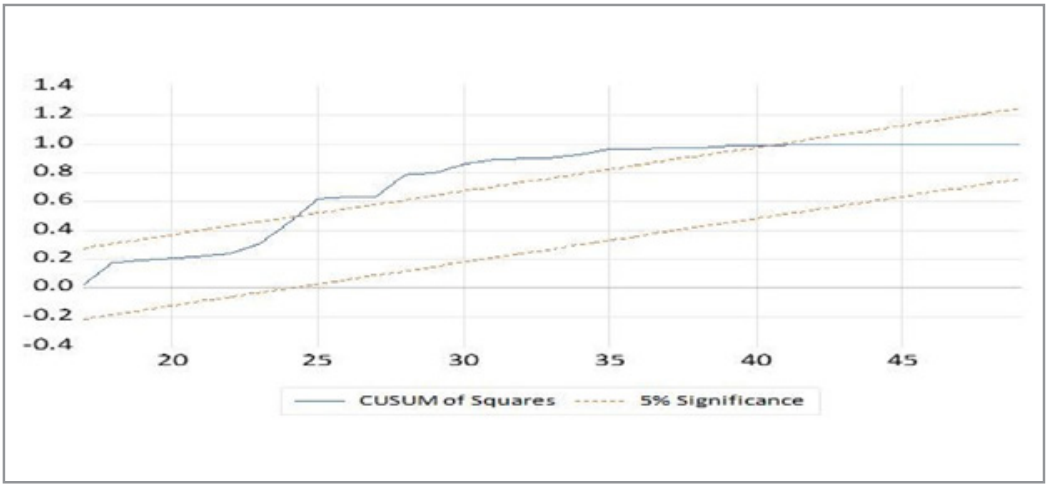

Figure 4: Plot of the Cumulative Sum of Squares of Recursive Residuals
Source: Author's derivation

The cumulative accumulation is shown by the blue line in the graph above, while the critical region at the 5 percent significance level is represented by the dashed red line. The critical region of red lines is where the cumulative total and cumulative sum of squares of the coefficient line fall, indicating that the model is unable to reject the null hypothesis. As a result, the regression model's coefficients stay constant.

Chow Test

This test is performed to check whether structural breaks are present or absent in the series

Table 10: Chow Test

F-statistic	0.951346	Prob. F (4,41)	0.4443
Log likelihood ratio	4.349057	Prob. Chi-Square (4)	0.3608
Wald Statistic	3.805385	Prob. Chi-Square (4)	0.4330

Source: Author's derivation

As the p-value of the F-statistic is 0.4443, which is greater than the 5% level of significance, the null hypothesis was accepted, which means that there is no structural break in the series.

Findings And Discussions

This study employs the ARDL approach to examine the impact of exports, imports, and gross fixed capital formation (GFCF) on Nepal's economic growth over the period 1974–2023. The empirical results provide significant insights into both the long-run and short-run dynamics of these macroeconomic variables, aligning with and extending the existing literature on trade and investment-led growth in developing economies.

The unit root test, conducted using the Augmented Dickey-Fuller (ADF) method, reveals that GDP and exports are stationary at the first difference (I(1)), while imports and GFCF are stationary at the level (I(0)). This mixed order of integration justifies the use of the ARDL model, which is robust for variables at I(0) and I(1) [23, 16]. The bounds test confirms long-run cointegration, with an F-statistic of 32.53984 exceeding the critical upper bounds at 1%, 5%, and 10% significance levels, rejecting the null hypothesis of no cointegration, consistent with the robustness of ARDL in small-sample studies [19]. The optimal lag length of 4, selected via the Akaike Information Criterion (AIC), aligns with lag selection practices in similar studies, further supporting the model's specification [21].

In the long run, the ARDL results (Table 5) indicate that exports exert a positive and statistically significant effect on GDP (coefficient = 10.11275, p = 0.0012), implying that a one-unit increase in exports boosts GDP by approximately 10.11 units. This finding corroborates the export-led growth hypothesis, as posited by and, who argue that exports drive economic expansion through foreign exchange earnings and industrial stimulation. For Nepal, this underscores the critical role of export-oriented policies, consistent with evidence of a unidirectional causality from exports to GDP and findings on trade's positive contribution to growth. Conversely, imports exhibit a significant negative impact (coefficient = -18.36310, p = 0.0004), suggesting that a one-unit increase in imports reduces GDP by 18.36 units. This aligns with observation that Nepal's excessive reliance on imports often consumer goods widens trade deficits and hampers economic stability, and resonates with findings in Egypt of imports' adverse effects when skewed toward consumption. However, it contrasts with view that imports of capital goods can enhance productivity, a perspective supported by in Nigeria, indicating that Nepal's import composition may prioritize consumption over investment.

GFCF demonstrates a strong positive effect on GDP (coefficient = 21.88099, p = 0.0001), with a one-unit increase leading to a 21.88-unit rise in GDP. This reinforces and assertions that capital formation is a cornerstone of long-term growth, reflecting Nepal's need for sustained investment in infrastructure and machinery. This finding echoes emphasis on physical capital's role in economic expansion and evidence of GFCF's positive impact

in Pakistan, though it highlights a gap in prior Nepalese studies like, which underexplored GFCF's relative magnitude compared to trade variables [24].

The short-run dynamics, captured through the error correction model (ECM) (Table 6), reveal nuanced relationships. The error correction term (-0.265876, p = 0.0000) indicates that 26.58% of deviations from long-run equilibrium are corrected annually, suggesting a moderate adjustment speed comparable to findings in for cointegrated VAR models. Exports show an immediate positive impact (coefficient = 9.192747, p = 0.0000), but lagged effects turn negative (coefficient = -6.164725, p = 0.0013), possibly reflecting short-term volatility or capacity constraints, a pattern noted by in contexts where export quality lags. Imports display an initial negative effect (coefficient = -6.1716622, p = 0.0000), followed by a positive lagged effect (coefficient = 4.123554, p = 0.0000), hinting at delayed benefits from capital goods imports, as suggested by and supported by in Nepal-India trade dynamics. GFCF's immediate positive contribution (coefficient = 10.93222, p = 0.0000) weakens with negative lagged effects (e.g., -5.179450, p = 0.0000), indicating that short-term gains may diminish without sustained funding, a challenge also identified by in Nepal's investment landscape [25].

Diagnostic tests affirm the model's robustness: the Ramsey RESET test (p = 0.4734) confirms correct functional form, aligning with standards; the Breusch-Godfrey test (p = 0.1944) shows no serial correlation, consistent with; and the Breusch-Pagan-Godfrey test (p = 0.2148) indicates homoscedasticity, as advocated by [21]. The Jarque-Bera test and stability tests (CUSUM and CUSUMSQ) further validate normality and parameter stability, enhancing confidence in the findings, akin to stability assessments.

These results contribute to the broader literature by integrating trade and investment dynamics within Nepal's context. The positive long-run effects of exports and GFCF align with global evidence, while the negative import impact highlights Nepal-specific vulnerabilities, differing from, where imports spurred growth [14, 15]. This discrepancy underscores the need for Nepal to reorient its import strategy toward productive assets, as recommended by [7]. Compared to and, which offer mixed findings, this study's ARDL approach provides a clearer distinction between short- and long-run effects, addressing a methodological gap noted by [16].

In summary, exports and GFCF are pivotal drivers of Nepal's economic growth, while imports pose a challenge requiring strategic management. These findings reinforce the theoretical frameworks of export-led and investment-driven growth while highlighting practical implications for Nepal, where structural trade imbalances and investment inefficiencies persist, as also emphasized by [24, 6].

Conclusions

The study focuses into the connections between Nepal's economic growth and important economic factors like imports, exports, and gross fixed capital formation (GFCF), both in the short and long term. The analysis shows that these factors have a major impact on Nepal's GDP using the ARDL approach to cointegration.

Exports have a long-term positive impact on GDP, suggesting that rising exports are connected with economic growth. On the other hand, imports reduce GDP, indicating that increased imports could hinder economic expansion. GDP is positively impacted by GFCF, showing the significance of fixed asset investments for long-term economic growth.

The short-term dynamics, as represented by the error correction model (ECM), demonstrate that exports, both past and present, have a positive effect on GDP, but lagged exports have a negative effect. The link between imports and GDP is complicated, including both immediate negative consequences and positive lag effects. GFCF continuously demonstrates a beneficial effect on GDP, highlighting the significance of continuous investment. The model's robustness is confirmed by the diagnostic tests, which show no signs of heteroskedasticity, serial correlation, or specification errors. The model's dependability is confirmed by the stability tests, which show steady coefficients over time, such as the CUSUM and CUSUMSQ tests.

The results of the study highlight how important imports, exports, and investment are in determining Nepal's economic future. To maintain and advance economic growth, policymakers should concentrate on improving export performance, controlling import levels, and encouraging investments in fixed capital. The sectoral effects of these factors could be investigated in future studies to offer more detailed information about Nepal's economic growth.

The sectoral effects of imports, exports, and GFCF on Nepal's economic growth might be further investigated in future studies. More detailed information on these factors' contributions to economic growth may be obtained by examining them within certain industries, such as manufacturing, services, and agriculture. To maintain and stimulate economic growth, policymakers are urged to concentrate on improving export performance, controlling import levels, and encouraging investments in fixed capital. Subsequent studies may examine the sector-specific effects of imports, exports, and GFCF on Nepal's economic expansion, in addition to the contribution of other economic variables, including monetary and government policies and spending. Furthermore, studies might look at the impact of other economic variables, including monetary and government policies and spending, to provide a more thorough picture of Nepal's growth dynamics.

To strengthen Nepal's economy, modifying imports, exports, and gross fixed capital formation. These include expanding value addition, researching foreign markets, encouraging non-traditional exports, diversifying export products, boosting value addition, and developing the infrastructure for logistics and transportation. The main components of an import strategy should be selective importation, local manufacture of heavily imported commodities, and tariff regulations that promote the importing of necessities.

Nepal can enhance its economic growth by diversifying its export base, improving quality standards, negotiating trade agreements, strengthening trade facilitation, encouraging domestic production of imported goods, implementing selective import tariffs, and promoting technology transfer. Boosting gross fixed

capital formation (GFCF) can be achieved through infrastructure development, incentivizing private investment, improving access to finance, and attracting foreign direct investment. Policy coordination, regular monitoring, and investing in human capital training are essential for a balanced growth trajectory. Customised strategies based on empirical findings can help achieve sustained economic expansion.

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Data Availability Statement

The study is based essentially on secondary data which is sourced from, the Ministry of Finance (MOF). The procedure for the data collection is relatively simple. The data that are collected about nominal GDP, gross fixed capital formation, exports and imports covered the period 1974 to 2023 which gives forty-nine (49) years of observation which is statistically large to be used for the study. The data used in this study is available upon request.

Conflict of Interest

I, the author, declare that I have no conflict of interest.

Originality

This paper is original and has not been published in other publications. Similarly, no financial support has been received while working on this paper.

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