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External Sector Dynamics, Investment and Economic Growth in Nepal: A VECM Perspective

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Abstract

This study investigates the dynamic relationships between Nepal's real GDP, exports, imports, and gross fixed capital formation (GFCF) using a Vector Error Correction Model (VECM), with remittances included as a control variable. Using annual data from 1975 to 2023, the analysis shows the presence of two long-run cointegration relationships among these variables. The results reveal that while exports negatively impact GDP, they contribute positively in the long run. Imports, particularly of capital and intermediate goods, enhance economic growth in the short term but may lead to external imbalances without corresponding export growth. GFCF remains the primary driver of GDP expansion in both the short and long run. The error correction mechanism suggests that deviations from the long-run equilibrium are corrected at a speed of 56.7% per period. Variance decomposition analysis highlights the growing role of investment in sustaining exports, while GDP growth largely influences imports. The findings emphasize the need for policies that enhance export competitiveness, optimize imports for productive use, and promote investment-driven economic growth to ensure Nepal's long-term macroeconomic stability.

Keywords: *Economic Growth, Exports, GFCF, Imports, VECM*

JEL Codes: *O11, F14, F24, F21, O53*

Introduction

Economic growth remains a critical goal for developing economies, where trade, investment, and external financial inflows like remittances play pivotal roles in shaping macroeconomic stability and long-term prosperity. Classical trade theories, such as Ricardo's (1817) comparative advantage and the Heckscher-Ohlin (1933) model, underscore the efficiency gains from international trade, enabling countries to specialize and enhance productivity, economies of scale, and technological progress (Edwards, 1998; Grossman & Helpman, 1991). Empirical studies, including Balassa (1978) and Krueger (1998), provide evidence that export-led growth significantly boosts GDP by fostering industrial competitiveness and innovation. Similarly, the Solow-Swan growth model (1956) emphasizes capital accumulation, measured through Gross Fixed Capital Formation (GFCF), as a

fundamental driver of economic output (Barro, 1991; Levine & Renelt, 1992). Imports, particularly of capital and intermediate goods, can enhance productivity by providing access to advanced technologies, though excessive reliance on consumer goods may lead to trade imbalances (Grossman & Helpman, 1991; Edwards, 1998). Remittances are an essential source of income for many developing countries. They help families get by and keep the economy stable. But if those funds aren't invested in productive projects, they can sometimes create a dependency instead of boosting growth (Ratha, 2003; Adams & Page, 2005; Chami et al., 2005).

In Nepal, these dynamics offer both opportunities and challenges. The country's persistent trade deficit, with imports far surpassing exports, raises concerns about external imbalances and economic sustainability (Bhattarai, 2018; Khatri & Adhikari, 2021). Nepal mainly exports agricultural and textile products, but these goods face stiff competition globally because Nepal hasn't diversified much and struggles with infrastructure, which limits how much they can boost the economy (Sharma & Bhandari, 2005; Sapkota, 2014). Paudel (2020) employed an Autoregressive Distributed Lag (ARDL) approach to confirm a long-run equilibrium between trade openness and economic growth, highlighting the need for enhanced trade policies and infrastructure. Imports of capital and intermediate goods have been shown to boost productivity by supporting industrial development, yet over-reliance on consumer goods undermines domestic production capacity (Bhattarai, 2018; Khatri & Adhikari, 2021). Investment in GFCF, crucial for long-term growth, is constrained by regulatory bottlenecks and financial limitations, despite its positive impact on GDP through infrastructure and industrial expansion (Dahal, 2015; Poudel & Sharma, 2019; Ghimire, 2022).

Remittances, constituting a substantial share of Nepal's GDP, provide critical financial support but are predominantly used for consumption rather than productive investments, potentially creating dependency effects (Acharya, 2018; Shrestha, 2020). KC (2021) advocates for policies to redirect remittances toward entrepreneurship and infrastructure to maximize their economic benefits. Previous studies, such as Subedi (2016) and Tamang (2021), have applied Vector Error Correction Models (VECM) to demonstrate long-run relationships between trade, remittances, and economic growth in Nepal, while Kumar and Patel (2018) identified similar dynamics in India. These studies confirm the interconnectedness of trade and investment but highlight a critical gap: the lack of comprehensive empirical analyses integrating exports, imports, GFCF, and remittances in a unified framework for Nepal. This gap limits the understanding of how these variables collectively shape Nepal's economic trajectory.

This paper fills a gap by taking a closer look at how Nepal's external sector and investments influence its economic growth. We've used data from 1975 to 2023, looking at annual figures in their actual, non-log-changed levels. To really get to the heart of what's driving growth, we also consider remittances as a control variable, helping us tease apart the effects of trade and investment. The result is a more detailed understanding of Nepal's economic trends, which can help shape smarter policies for long-term, sustainable growth.

Methodology

The study uses annual time-series data from 1975 to 2023 for five key macroeconomic variables: GDP, exports, imports, remittances, and gross fixed capital formation, measured in ten million Nepalese Rupees, sourced from the Ministry of Finance. The GDP series was obtained in real Nepalese Rupees,

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while exports, imports, remittances, and gross fixed capital formation were initially recorded in nominal Nepalese Rupees. To ensure consistency, all four nominal variables were converted into real terms using the GDP deflator, with 2011 as the base year. Variables are analysed in their raw, non-log-transformed levels within the VECM framework to capture long-run equilibrium relationships, preserving the original scale for straightforward economic policy interpretation. The coefficients represent absolute changes, facilitating direct policy implications. The dependent variable is RGDP, whereas explanatory variables include EXP, IMP, and GFCF. REMIT is included as a control variable to isolate the core impact of trade and investment dynamics on economic growth.

The analysis employs a Vector Error Correction Model (VECM) to assess long-term equilibrium relationships and short-term adjustments among the variables. By treating remittances as a control variable, the study ensures that the primary relationships between RGDP, EXP, IMP, and GFCF are not biased by external income inflows, precisely estimating trade and investment effects on Nepal's economic growth.

VECM Model and Model Specification

A VECM model is derived from a Vector Autoregressive (VAR) model when the variables are non-stationary but cointegrated. The general VAR(p) model with p lags for a system of variables is given by:

$Y_t = A_1Y_{t-1} + A_2Y_{t-2}+\ldots+A_pY_{t-p} + BX_t + \epsilon_t$ ……. 1)

Rewriting the above VAR in VECM form

$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \delta(REMIT_t) + \epsilon_t$ ……. 2)

where

ΔY_t represents the first difference between the variables.

ΠY_{t-1} represents the long-run equilibrium relationship.

Γ_i represents short-run adjustment coefficients for lagged differences

$\delta REMIT_t$ represents the influence of remittances as a control variable.

Since the variables are cointegrated, there exists a long-run equilibrium relationship of the form:

$RGDP_t = \alpha + \beta_1EXP_t + \beta_2IMP_t + \beta_3GFCF_t + \beta_4 REMIT_t + \epsilon_t$ ……. 3)

Rearranging, we obtain the error correction term (ECT):

$ECT_{t-1} = RGDP_{t-1} - (\alpha + \beta_1EXP_{t-1} + \beta_2IMP_{t-1} + \beta_3GFCF_{t-1} + \beta_4REMIT_{t-1})$ ……4)

As a result, the signs of the coefficients in the cointegrating vector should be interpreted with care. A negative coefficient on an explanatory variable implies a positive long-run contribution to GDP, and vice versa, because these variables are subtracted from GDP in the error correction formulation. For example, suppose the coefficient of exports (β_1) is negative. In that case, it indicates that an increase in exports reduces the deviation from equilibrium and hence contributes positively to GDP in the long run. This interpretation corrects the potential misreading of coefficient signs and ensures alignment with standard econometric principles used in VECM analysis (Johansen, 1988; Gujarati, 2004).

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Substituting this into the VECM equation,

$$\Delta RGDP_t = \lambda . ECT_{t-1} + \sum_{i=1}^{p-1} \gamma_{1i} \Delta EXP_{t-i} + \sum_{i=1}^{p-1} \gamma_{2i} \Delta IMP_{t-i} + \sum_{i=1}^{p-1} \gamma_{3i} \Delta GFCF_{t-i} + \delta \Delta REMIT_t + \epsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots 5)$$

λ is the speed of adjustment coefficient, which indicates how quickly deviations from the long-run equilibrium are corrected.

ECT_{t-1} represents the lagged error correction term.

$\gamma_1, \gamma_2, \gamma_3$ represent short-run dynamic coefficients for exports, imports, and investment.

δ measures the short-run impact of remittances (control variable) on GDP growth.

Unit root

The unit root test was used to test stationarity at a 1% level of significance. The Augmented Dickey-Fuller (ADF) and Phillips and Perron (PP) tests, two asymptotically comparable methods, are used to find unit roots in the data (Dickey, 1979; Phillips and Perron, 1988). Gujarati (2004) specifies the following for the unit root test:

$$\Delta Y_t = \beta_1 + \beta_{2t} + \delta Y_{t-1} + \sum \infty_{ii} \Delta Y_{t-i} + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots 6)$$

Table 1: Augmented Dickey-Fuller (ADF) Test for Unit Root

Variables	Level		First Difference	
	t-stat	p-value	t-stat	p-value
RGDP	1.2497	0.9981	-6.3774	0.000*
EXP	-1.4819	0.5341	-5.0254	0.000*
IMP	2.7403	1.0000	-9.1479	0.000*
GFCF	0.7242	0.9915	-3.1327	0.031*
REMIT	-2.3024	0.1755	-6.2421	0.000*

Source: Author's calculation

Lag Length Selection

Table 2: Lag Length Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1607.254	NA	1.77e+26	71.78905	72.11024	71.90879
1	-1449.917	272.7163	3.33e+23	65.50744	66.47099*	65.86664*
2	-1441.880	12.50186	4.86e+23	65.86135	67.46727	66.46002
3	-1415.385	36.50432	3.22e+23	65.39490	67.64319	66.23304
4	-1392.223	27.79435*	2.60e+23*	65.07659*	67.96725	66.15420

Source: Author's calculation

Based on the Akaike Information Criterion (AIC), the optimal lag length is 4, as it has the lowest AIC value (65.07659*). This suggests that including four lags in the time series model provides the best

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balance between model fit and complexity according to the AIC, which prioritizes minimizing information loss. Therefore, lag 4 is selected for the model.

Johansen Cointegration Test

The co-integration test was used to ascertain whether there is a long-run relationship among the variables in Nepal or not. The Johansen (1988) method was employed to test for co-integration, which results in two test statistics, the trace test and the maximum eigenvalue test.

Table 3: Unrestricted Cointegration Rank Test (Trace)

Hypothesised No.of CE(s)	Trace Statistic	0.05Critical Value	p-value
None*	106.8747	47.85613	0.0000
At most 1*	41.61065	29.79707	0.0014
At most 2	10.22413	15.49471	0.2639
At most 3	0.087118	3.841465	0.7679

*Trace test indicates 2 cointegrations at the 0.05 level

Table 4: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesised No.of CE(s)	Max-Eigen Statistic	0.05Critical Value	p-value
None*	65.26407	27.58434	0.0000
At most 1*	31.38652	21.13162	0.0013
At most 2	10.13702	14.26460	0.2031
At most 3	0.087118	3.841465	0.7679

*Max-eigenvalue test indicates 2 cointegrating relationships at the 0.05 level

Source: Author's calculation

In both the trace and maximum eigenvalue tests, asterisks (*) indicate statistically significant results at the 5% level. The presence of * at both "None" and "At most 1" reflects the existence of two cointegrating vectors, confirming long-run relationships among the variables. This is not an error, but rather a correct interpretation of Johansen's methodology.

Two cointegrating equations suggest that Nepal's economy is influenced by multiple steady long-term relationships. These equations show different angles of how the economy behaves over time. One of them links GDP with trade and investments, while the other connects exports, imports, and gross fixed capital formation (GFCF) without directly involving GDP. The Johansen test confirms these relationships, so we know the economy tends to settle into these long-term patterns. Overall, this means Nepal's economy adjusts through multiple pathways when things change—that there isn't just a single way it responds. The interpretation of the coefficients presented as part of the error correction term (ECT), the signs appear reversed compared to their economic implications. For instance, a negative coefficient on exports in the cointegrating vector implies a positive long-run contribution to GDP once the model is rearranged.

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VCEM Test

Table 5: VCEM Test Results

Cointegration Eq	Coint Eq1	Coint Eq2
RGDP (-1)	1.000000	0.000000
EXP (-1)	0.000000	1.000000
IMP (-1)	-2.449972	-0.166354
	(0.11486)	(0.01928)
	[-21.3299]	[-8.62813]
GFCF (-1)	-414.4058	24.00422
	(38.4528)	(6.45461)
	[-10.7770]	[3.71893]
C	92677.31	-6501.030

Error Correction	D(RGDP)	D(EXP)	D(IMP)	D(GFCF)
Coint Eq1	-0.567336	0.056488	0.256531	-0.002182
	(0.34718)	(0.01410)	(0.09605)	(0.00099)
	[-1.63411]	[4.007111]	[2.67074]	[-2.20530]
Coint Eq2	-1.663372	-0.399741	0.385806	-0.004821
	(1.38220)	(0.05612)	(0.38240)	(0.00394)
	[-1.20343]	[-7.12270]	[1.00890]	[-1.22395]
D (RGDP (-1))	-0.532796	0.019556	0.313376	-0.002657
	(0.63415)	(0.02575)	(0.17545)	(0.00181)
	[-0.84017]	[0.759511]	[1.78617]	[-1.47021]
D (RGDP (-2))	-0.702296	0.044539	0.127328	-0.003058
	(0.64512)	(0.02619)	(0.17848)	(0.00184)
	[-1.08863]	[1.70033]	[0.71340]	[-1.66320]
D (RGDP (-3))	-0.780727	0.022519	-0.283524	-0.001474
	(0.72510)	(0.02944)	(0.20061)	(0.00207)
	[-1.08863]	[0.75486]	[-1.41334]	[-0.71324]
D (EXP (-1))	-4.811754	-0.017551	-0.468089	-0.010375
	(2.78617)	(0.11313)	(0.77083)	(0.00794)
	[-1.72702]	[-0.15514]	[-0.60726]	[-1.30663]
D (EXP (-2))	3.021046	-0.172486	-0.381400	0.008441
	(2.85174)	(0.11579)	(0.78897)	(0.00813)
	[1.05937]	[-1.48963]	[-0.48342]	[1.03853]
D (EXP (-3))	-0.718587	-0.243282	-1.130948	0.001711
	(2.79474)	(0.11348)	(0.77320)	(0.00797)
	[-0.25712]	[-2.14390]	-1.46269]	[0.21486]
D (IMP (-1))	1.553351	-0.067906	-1.077376	0.008749
	(1.45631)	(0.05913)	(0.77320)	(0.00415)
	[1.06663]	[-1.14838]	[-1.46269]	[2.10792]
D (IMP (-2))	0.877954	-0.192779	-1.304506	0.009303

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	(1.43060)	(0.05809)	(0.39579)	(0.00408)
	[0.61370]	[-3.31877]	[-3.29594]	[2.28168]
D (IMP (-3))	2.255772	0.039635	0.633078	0.005120
	(1.66613)	(0.06761)	(0.46068)	(0.00475)
	[1.35471]	[0.58623]	[1.37423]	[1.07883)
D (GFCF (-1))	198.9718	4.130599	-136.2646	0.993415
	(267.280)	(10.8525)	(73.9461)	(0.76175)
	[0.74443]	[0.38061]	[-1.84275]	[1.30412]
D (GFCF (-2))	258.8999	-15.18556	-101.8698	1.283395
	(250.093)	(10.1547)	(69.1913)	(0.71277)
	[1.03521]	[-1.49542]	[-1.47229]	[1.80058]
D (GFCF (-3))	358.9424	2.776079	126.5614	0.603768
	(280.789)	(11.4010)	(77.6837)	(0.80025)
	[1.27833]	[0.24349]	[1.62919]	[0.75447]
C	9970.601	-3025.317	11277.49	-28.88961
	(13292.6)	(539.726)	(3677.55)	(37.8839)
	[0.75009]	[-5.60529]	[3.06658]	[-0.76258]
REMIT	-55.60894	118.9975	-261.4672	1.020559
	(417.788)	(16.9637)	(115.586)	(1.19070)
	[-0.13310]	[7.01483]	[-2.26210]	[0.85711]
R-squared	0.414610	0.845235	0.725119	0.511495
Adj. R-squared	0.111822	0.765184	0.582939	0.258821

Source: Author's calculation

The cointegration test confirms the presence of two long-term equilibrium relationships among Real GDP, Exports, Imports, and Gross Fixed Capital Formation (GFCF), indicating that these variables move together over time despite short-term fluctuations. This suggests stable economic relationships that persist in the long run. Imports and GFCF have significant negative coefficients in the cointegration equations, suggesting that their long-run equilibrium relationship with GDP involves structural adjustments. Exports and GFCF show a strong relationship, reinforcing the importance of capital investments in enhancing export performance and economic expansion. The Error Correction Model (ECM) explains how short-run deviations from long-run equilibrium are corrected over time. The coefficient for RGDP in CointEq1 is -0.567336, indicating that 56.7% of the deviation from equilibrium is corrected each period. This speed suggests a relatively strong tendency toward macroeconomic stability. The adjustment speed in CointEq2 is -1.663372, suggesting an even faster correction process. This underscores the immediate and significant role of economic policies in stabilizing deviations from long-run trends.

Exports also exhibit a rapid adjustment process, highlighting the importance of a stable macroeconomic environment and trade policies that ensure consistent export performance. In the short run, the first lag of exports (D(EXP(-1))) is -4.811754, indicating that an increase in exports initially reduces GDP. However, this effect reverses in the long run, contributing positively to economic growth. In the short run, exports exhibit a negative impact on GDP, likely due to structural inefficiencies, low value-added exports, and trade-related frictions. Over the long term, however,

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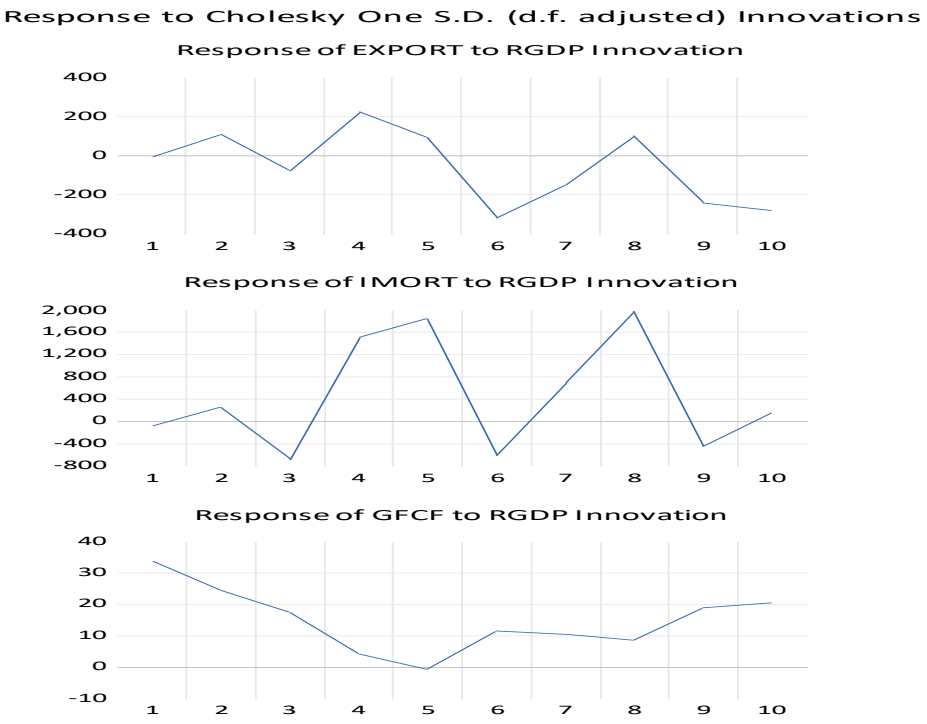
exports show a positive contribution to GDP as the economy adjusts and gains from productivity and trade integration.

Imports positively impact GDP in the short run (1.553351), likely due to capital and intermediate goods enhancing production and economic activity. GFCF has a significant and consistent positive impact on GDP, with its first lag showing a strong effect (198.9718) and its second and third lags continuing to influence GDP growth. Imports, particularly of capital and intermediate goods, positively influence GDP in the short term. This supports the notion that such imports enhance production capacity. Nonetheless, sustained trade imbalances could undermine long-term stability if export performance does not improve accordingly.

GFCF demonstrates a consistent and significant positive effect on GDP in both short and long terms. This reinforces its role as the primary engine of growth through capital accumulation and infrastructure development.

Since remittances are treated as a control variable, their inclusion ensures that the primary relationships between GDP, exports, imports, and GFCF are not biased by external income inflows. The findings suggest that while remittances influence consumption and financial stability at the household level, they are not the primary drivers of GDP dynamics in Nepal. The control variable approach allows for a more precise estimation of how trade and investment impact GDP without overemphasizing the role of remittance inflows. Confirm a stable long-term relationship between GDP, exports, imports, and GFCF, with deviations from equilibrium corrected at a rapid pace (56.7% per period). Short-term fluctuations in exports may be due to external trade barriers, while imports, particularly capital goods, positively impact GDP in the short run. GFCF remains a key driver of economic growth, reinforcing the need for policies that encourage infrastructure and industrial development.

Figure 1: IRF showing GDP's impact on trade and investment variables



Source: Author's derivation

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The IRF graph examines the response of exports to real GDP innovation, imports, and Gross Fixed Capital Formation (GFCF) to a shock in real GDP. Exports initially show an increase, followed by fluctuations. This suggests that economic growth initially boosts exports due to improved domestic production capacity and competitiveness in international markets. However, after the fourth period, exports decline sharply, indicating a lagged negative effect. Imports respond highly, but predominantly positively, suggesting that an increase in GDP leads to a rise in import demand due to increased consumer spending and higher demand for capital and intermediate goods. This aligns with the import dependency hypothesis, where higher economic growth leads to increased reliance on foreign goods and services. GFCF initially shows a declining trend before stabilizing and rising again in later periods. Remittances are controlled to isolate their effect on GDP and independent variables, ensuring that the observed impulse responses reflect the direct impact of real GDP innovations. The IRF results suggest that GDP growth has mixed effects on macroeconomic variables.

Variance decomposition

Table 6: Variance Decomposition of Export

Period	SE	RGDP	EXP	IMP	GFCF
1	14177.64	0.002818	99.99718	0.000000	0.000000
2	19439.67	2.143147	87.19966	0.034430	10.62276
3	21739.49	2.195215	64.28307	0.446179	33.07554
4	24313.91	5.404062	47.42166	15.63397	31.54030
5	26353.02	3.839895	36.06576	23.14587	36.94848
6	27733.82	6.234335	28.99916	16.52944	48.23706
7	29567.93	6.321375	28.54493	16.28786	48.84584
8	31149.84	5.086864	24.87020	21.42209	48.62085
9	32670.11	4.948023	21.04600	16.80975	57.19622
10	3478.72	5.779843	20.38074	16.37294	57.46648

Source: Author's calculation

The variance decomposition results for EXPORT show that in the short run (Period 1), almost all of the variations (99.99%) in exports are explained by their shocks, with negligible contributions from other variables. However, as time progresses, the contribution of real GDP (RGDP), imports, and gross fixed capital formation (GFCF) to exports increases. By Period 10, exports explain only 20.38% of their variations, while imports contribute 16.37%, and GFCF explains 57.19%. This suggests that in the long run, exports are significantly influenced by capital investment and imports. The growing importance of GFCF in explaining exports underscores the role of infrastructure and industrial development in sustaining export growth.

Table 7: Variance Decomposition of Import

Period	SE	RGDP	EXP	IMP	GFCF
1	575.6627	0.04251	12.66256	87.29490	0.000000
2	751.7357	0.292268	13.08035	69.12235	17.50502
3	901.8863	2.031552	11.00588	60.60977	26.35280

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4	1117.883	8.296077	9.302480	61.20198	21.19947
5	1408.072	12.76235	9.418219	56.35496	21.46446
6	1680.433	12.06391	9.088155	50.93310	27.91484
7	1770.068	12.11431	8.831697	52.03195	27.02204
8	2022.416	15.19363	8.169202	52.67695	23.96021
9	2317.720	14.12687	7.930808	48.11453	29.82779
10	2440.055	13.75942	8.047174	48.96737	29.22603

Source: Author's calculation

For imports, the results indicate that in the initial periods, most of the variation is self-explained, with imports accounting for 87.29% of their variations in Period 1. However, over time, real GDP plays an increasing role in explaining import fluctuations, rising to 13.75% by Period 10. Exports and GFCF also contribute to import variations, but their influence remains relatively stable over time. This suggests that economic growth significantly influences import demand, likely due to increased demand for capital and intermediate goods required for production and investment.

Table 8: Variance Decomposition of GFCF

Period	SE	RGDP	EXP	IMP	GFCF
1	3922.414	70.21980	5.021101	20.34887	4.410231
2	4731.899	58.60342	8.563893	11.67728	21.15541
3	5166.668	50.74299	7.037760	9.607274	32.61197
4	5869.487	43.22833	7.317725	8.977887	40.47606
5	6987.959	33.87991	8.485211	8.618828	49.01605
6	7405.650	30.41891	8.414545	7.271831	53.89471
7	7652.243	29.36241	8.530527	6.995610	55.11145
8	8511.726	27.23436	8.486133	8.325031	55.95448
9	8907.508	27.25505	8.090273	7.695306	56.95937
10	9037.021	28.62006	7.937307	7.311337	56.13130

Source: Author's calculation

The variance decomposition of GFCF reveals that in the short run, real GDP is the dominant explanatory factor, accounting for 70.21% of the variations in Period 1. However, its influence declines over time, reaching 28.62% by Period 10. At the same time, the contributions of exports, imports, and GFCF itself increase. By Period 10, exports explain 7.93% of the variations, imports contribute 7.31%, and GFCF accounts for 56.13% of its fluctuations. This finding highlights the critical role of GDP in driving investment in the early periods, while structural adjustments lead to a greater reliance on internal investment dynamics in the long run.

Figure 2: Variance decomposition highlighting the role of GFCF in export variance

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Vol. 6, No. 2, July 2025. Pages: 1-17
ISSN: 2738-9758 (Print), ISSN: 2738-9766 (Online)
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Source: Author's derivation

The variance decomposition of exports reveals the contributions of macroeconomic variables like real GDP, imports, and gross fixed capital formation to export fluctuations. Export innovations initially account for almost 100% of the variance, suggesting that short-term fluctuations are self-driven. However, as time progresses, exports' influence declines, stabilizing at around 60%. Real GDP contributes steadily, while imports, particularly intermediate goods imports, affect export performance. Investment in fixed capital initially influences export activity but diminishes as other macroeconomic factors take precedence.

The variance decomposition graph of imports (IMP) shows that real GDP (RGDP), exports (EXP), and gross fixed capital formation (GFCF) all play a role in shaping import behaviour over a ten-period horizon. Initially, imports explain most variations, but as time progresses, other factors increase. RGDP gradually plays a more significant role, suggesting that economic growth influences import dynamics. Exports also impact import variations, as they are often interlinked through trade dynamics. GFCF contributes to import fluctuations, suggesting that capital investments often rely on imported machinery, equipment, and raw materials. Policies aimed at import substitution and domestic

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production capacity enhancement could help mitigate excessive import reliance while ensuring sustained economic growth.

The variance decomposition graph for Gross Domestic Product (GFCF) shows that real GDP initially accounts for most fluctuations, but its influence declines over time. The contribution of GFCF increases significantly, suggesting that economic growth strongly determines investment levels in the short run. Exports do not significantly drive capital formation, suggesting that domestic policy decisions, financial sector developments, and FDI inflows influence investment levels. Imports have a small influence on GFCF fluctuations, suggesting that domestic economic conditions and policies shape investment patterns more than import variations. The increasing share of GFCF in explaining its fluctuations suggests self-reinforcing investment momentum, likely through improved infrastructure, production capacity, and technological advancements.

Serial Correlation Test

Table 9: Serial Correlation Test Results

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	Df	Prob	Rao F-stat	df	Prob
1	20.06054	16	0.2175	1.303399	(16,67.8)	0.2211
2	19.80771	16	0.2290	1.284704	(16,67.8)	0.2326
3	7.592982	16	0.9601	0.452756	(16,67.8)	0.9606
4	11.00343	16	0.8093	0.671551	(16,67.8)	0.8113

Source: Author's calculation

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	Df	Prob	Rao F-stat	df	Prob
1	20.06054	16	0.2175	1.303399	(16,67.8)	0.2211
2	37.72054	32	0.2240	1.222583	(32,68.0)	0.2409
3	48.76329	48	0.4422	0.996113	(48,56.0)	0.5027
4	70.38120	64	0.2727	1.063226	(64,41.4)	0.4224

Source: Author's calculation

The results from the serial correlation test indicate that for various lag structures, the Lagrange Multiplier (LRE*) statistics and Rao F-statistics yield probability (p-values) above the conventional significance levels (0.05 and 0.10). Specifically, the p-values at different lags remain above 0.21, suggesting that the null hypothesis of no serial correlation cannot be rejected. This means that the model's residuals are not autocorrelated, ensuring that the estimated coefficients remain unbiased and efficient.

The joint test for serial correlation at lags 1 to h confirms this result, as all p-values exceed 0.22. These findings suggest that the model does not suffer from autocorrelation issues, thereby validating the assumption of independent residuals.

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Heteroskedasticity Test

Table 10: Heteroskedasticity Test Results

Chi-sq	Df	Prob.
328.9841	300	0.1202

Source: Author's calculation

The test results provide a Chi-square value of 328.9841 with 300 degrees of freedom, yielding a p-value of 0.1202. Since the p-value is greater than the conventional significance thresholds (0.05 and 0.10), the null hypothesis of homoskedasticity (constant variance) cannot be rejected. This indicates that the residuals do not exhibit heteroskedasticity, implying that the model is correctly specified in terms of variance stability.

Discussions

The study employs a Vector Error Correction Model (VECM) to examine the long-run and short-run dynamics of Nepal's economic growth regarding exports, imports, and gross fixed capital formation (GFCF) while also considering remittances as a control variable. The results from the unit root test confirm that all variables are non-stationary at levels but become stationary at first differences, making them suitable for cointegration analysis. The presence of two cointegrating vectors represents a unique linear combination of variables that defines a separate equilibrium relationship. In practical terms, each cointegrating vector reflects a different long-run association among the variables. For example, one cointegrating equation may capture the equilibrium between GDP and investment (GFCF), indicating how capital formation drives output in the long run. The second may describe the stable relationship among trade variables, exports and imports, with GFCF, independent of GDP. This structure suggests that Nepal's macroeconomic dynamics are governed by multiple equilibria, where trade, investment, and growth interact in complex but predictable patterns. Recognizing these distinct relationships allows for more targeted policy measures and a better understanding of the channels through which shocks propagate and equilibria are restored.

The error correction mechanism (ECM) results reveal that deviations from the long-run equilibrium are corrected relatively quickly, with the speed of adjustment for real GDP (RGDP) being 56.7% per period. This suggests that Nepal's economy has a strong tendency to return to equilibrium after short-term shocks. Exports show an initial negative short-term impact on GDP, which is corrected in the long run. Imports, particularly capital goods imports, positively contribute to GDP in the short term but show diminishing effects over time. GFCF significantly influences GDP in both the short and long run, highlighting the importance of investment in infrastructure and industrial capacity for economic growth.

The impulse response function (IRF) analysis reveals that GDP growth has mixed effects on exports, imports, and GFCF in Nepal. Exports initially increase with GDP growth but decline due to external trade constraints. Imports remain volatile but generally rise with GDP growth, indicating Nepal's reliance on imported goods. GFCF initially declines but stabilizes in later periods, suggesting delayed but positive investment responses to economic growth. Exports become increasingly influenced by capital investment, while imports remain self-driven but are also affected by GDP and trade-related factors. GFCF is initially driven by GDP but becomes self-sustaining.

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Findings

The study reveals a stable long-term relationship between GDP, exports, imports, and Gross Fixed Capital Formation (GFCF). The economy corrects deviations from equilibrium at a rate of 56.7% per period, indicating a fast adjustment process. Short-term exports negatively impact GDP, but this effect reverses in the long run. Imports positively impact GDP in the short run, particularly through capital goods that enhance production capabilities. GFCF plays a crucial role in economic growth, with significant positive effects in both the short and long run.

In the short run, exports exert a negative effect on GDP, likely due to constraints in production capacity, limited product diversification, and weak global competitiveness. However, when interpreted through the cointegrating relationship, where coefficient signs are reversed, a negative coefficient on exports implies a positive long-run contribution to GDP. This aligns with theories of export-led growth, indicating that once structural bottlenecks are addressed, exports can drive sustained output expansion. This contrasts with studies such as Sharma and Bhandari (2005) and Sapkota (2014), which found a strong positive link between exports and GDP. However, it aligns with Paudel (2020), who observed a long-run equilibrium relationship between exports, imports, and GDP. The findings suggest that while export growth is beneficial in the long term, short-term challenges such as low productivity and external trade barriers may hinder its immediate contribution to economic expansion.

Imports, particularly of capital and intermediate goods, show a strong positive short-run effect on GDP. This supports the view that such imports enhance domestic production capabilities. Nonetheless, if import growth is not matched by export expansion, it could exacerbate trade imbalances and external vulnerability in the long term, a concern echoed by previous studies. This finding is consistent with Bhattarai (2018) and Khatri and Adhikari (2021), who found that imported machinery and raw materials enhance production capacity. However, excessive reliance on imports without a corresponding increase in exports could create trade imbalances, as noted by Bayangos and Jansen (2011) in the Philippines. Unlike Hossain and Mitra (2020) in Bangladesh, who found that trade liberalization contributes positively to long-term GDP growth, this study suggests that Nepal's dependence on imports may need to be carefully managed to prevent adverse long-term effects.

Investment, measured by GFCF, is a critical determinant of GDP in Nepal, underscoring the role of capital formation in economic development. GFCF also affects export performance, suggesting that infrastructure and industrial investment are vital for enhancing trade capacity, reaffirming the importance of capital formation in Nepal's economy. This is consistent with findings in Pakistan (Ali et al., 2017) and Sri Lanka (Perera and Jayawardena, 2018), where infrastructure investment has played a key role in sustaining growth. However, unlike Jalil and Feridun (2011) in Pakistan, who emphasized the role of financial sector development in enhancing investment efficiency, this study does not explicitly examine Nepal's financial sector, highlighting an area for future research.

Looking at impulse response analysis, we can see how things play out over time: when GDP takes a hit, both exports and imports generally go up, but they don't react the same way or at the same speed. Meanwhile, GFCF (gross fixed capital formation) tends to respond more slowly, but it does so consistently. Over the long run, changes in GDP, exports, and imports are increasingly explained by GFCF, which emphasises its importance in Nepal's growth story. When we add remittances into the mix as a control variable, it helps us tease out the real effects of trade and investment. Even though remittances aren't the main focus here, including them makes sure our estimates of how trade and

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investment interact aren't skewed by outside income flows. All in all, the study shows that Nepal's long-term development results from a pretty complicated mix of factors investment, trade, and macroeconomic adjustments, all play a part. It suggests that smart policies should pay attention to these connections if the goal is to build a resilient, growth-friendly economy. The research gives some useful insights into how exports, imports, investment, and economic growth fit together in Nepal. That said, it could be even better if it emphasised how these findings compare with previous studies, dug into how different sectors are affected by trade and investment, and offered more detailed comparisons with other countries.

Conclusions

This study confirms that Nepal's economic growth is shaped by a complex interaction of the external sector and investment dynamics. Due to trade restrictions, sluggish growth, and structural inefficiencies, exports initially hurt GDP. However, their long-term effect becomes positive, aligning with the export-led growth hypothesis once essential bottlenecks are addressed. Although imports, especially capital and intermediate goods, boost production and provide immediate benefits, excessive reliance on imports without a matching increase in exports may worsen trade imbalances. Investment, as shown by Gross Fixed Capital Formation (GFCF), consistently and strongly contributes to economic growth over both the short and long term, underscoring its vital role in the country's development path.

Using remittances as a control variable helps isolate the direct effects of trade and investment on output, leading to a clearer understanding of macroeconomic relationships. The model's error correction coefficient of 56.7% indicates that Nepal's economy has a robust inherent tendency to revert to long-term equilibrium after short-term shocks. These results have policy implications for boosting export performance, refining import structures, and strengthening investment frameworks to promote sustainable growth. Moreover, while remittances promote macroeconomic stability, transforming them into long-term productive assets remains a key challenge.

While this study uses actual, non-log-changed data for all variables to keep things straightforward and relevant for policy, future work could try out different methods to check if results hold up. For example, looking at real GDP growth rates instead of just levels, and measuring exports, imports, and gross fixed capital formation as percentages of GDP, might give us a better sense of how these things relate proportionally. This approach can also help minimise biases from trends over time, making the findings more reliable and easier to compare with other research. These results emphasise how important ongoing improvements are in trade infrastructure, managing investments well, and making good use of remittances. Going forward, it would be interesting to see how developing the financial sector impacts trade and investment connections even more effectively. Also, digging into investment patterns within specific sectors can help us better understand the structural factors behind Nepal's sustainable economic growth.

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Data Availability Statement

The study is based on secondary data sourced from the Ministry of Finance, Nepal, covering real GDP, gross fixed capital formation, exports, imports, and remittances as a control variable for the period 1975 to 2023, providing 49 years of observations. The data 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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