Asymmetrical and Symmetrical Relationship between Financial Sector Development and Economic Growth: Evidence From Nepal

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Abstract

The financial sector plays a pivotal role in accumulating and mobilizing funds within the economy, the sector that produces feedback effects for the economic progress of the nation. This paper examines the symmetrical and asymmetrical relationship between financial sector development and economic growth in Nepal. With time series data spanning from 1975 to 2019 AD, both symmetric autoregressive distributed lag (ARDL) and asymmetric effect ARDL (NARDL) models were employed in this paper. Furthermore, the study applied principal component analysis (PCA) to develop the financial sector development indicator. The findings revealed the pivotal role of financial sector development in driving economic growth in Nepal, although significant negative asymmetrical effects posed challenges to long-term growth. Additionally, alongside financial sector progress, factors—such as inflation and learning by doing—contributed to growth, while trade alone failed to have sufficient potency to spur economic expansion. While financial sector development enhanced Nepal's productive capacity, it was not observed singularly driving trade-led growth. Policymakers must prioritize relaxing policies and funneling resources effectively toward fostering financial sector growth and counteract potential negative impacts on economic development.

Keywords: financial sector development, economic growth, inflation, ARDL, NARDL, asymmetries

JEL classification: C22, E31, G10, O47

Introduction

The development of financial sectors, a key propeller of economic growth and development, plays a crucial role in economic development by facilitating capital mobilization, investment, hedging, and risk management. The financial sector provides saving and investment opportunities, thereby channeling it into productive ventures and fostering economic growth. Goldsmith (1969), Gurley and Shaw (1955), McKinnon (1973), and Schumpeter (1911) provide some crucial conceptual and theoretical support to the finance-growth nexus. Finance has a prominent role in the endogenous growth theory, through its

positive impact on the levels of capital accumulation and savings (Romer 1986) or of technological innovation (Grossman & Helpman, 1991; Romer, 1990).

The financial system in Nepal underwent three phases of development in the latter part of the nineteenth century (Maskay & Subedi, 2009; Paudel & Acharya, 2020). The first phase involved the establishment of domestic financial institutions, such as *Tejrath Adda* (1880 AD), Nepal Bank Limited (1937 AD), and Nepal Rastra Bank (1956 AD). The second phase, marked by the Nepal Rastra Bank (NRB) Act of 1955, structured the financial landscape, and the ongoing third phase is represented by the NRB Act of 2002, significantly enhancing financial system regulation for efficiency. Global financial liberalization in the 1980s influenced Nepal, prompting reforms in response to persistent balance of payments (BOP) deficits in the early 1980s, guided by the economic stabilization program of 1985 with the World Bank and the International Monetary Fund (IMF) support and finally, the restoration of democracy in the 1990s ushered in a market-oriented policy approach and extensive financial reforms (Ozaki, 2014; Shrestha, 2004).

The Nepalese financial sector has been growing at an amazingly fast rate over the last three decades (Maskay & Subedi, 2009). The need to evaluate the role of the financial sector development growth in increasing the level of the economies' accessibility to finance should be understood (Cooray, 2009; Gautam, 2015; Paudel & Acharya, 2020; Puatwoe, & Piabuo, 2017). The financial sector, consisting of financial institutions, financial instruments, and financial processes, performs its function through these channels of economic growth (Mishkin & Eakins, 2018). Initially, the financial development as a means of payment was supported but the development of urban communities and industrialization made the spectrum of the financial system wider. It is commonly understood that financial sector development is a multifaceted notion with the potential to be a key mechanism for long-term economic progress. It is critical to economic development and growth. The effectiveness and efficiency with which these responsibilities are performed, notably intermediation between the surplus and deficit units of the economy, is heavily influenced by the financial system's level of development (Nkoro & Uko, 2013). The importance of the financial system to economic development is unclear. Some researchers such as Hicks (1969) hold the view that the financial system plays a crucial role in the mobilization of capital for industrialization.

The essence of the financial sector development and growth nexus has been well recognized and emphasized in the field of economic development. Although recent writings on this subject seem to accept the hypothesis that financial development is crucial for successful economic growth (Jung, 1986). Financial markets and institutions play an important and inextricable role in the growth process, and we must move away from the notion that the financial system is a minor sideshow that reacts passively to economic growth and modernization. There is also evidence that the level of financial development predicts future economic growth, capital accumulation, and technical advancement (Levine, 1997). The financial sector is one of the main engines in the process of economic growth through the means of collecting savings and supplying the appropriate credit, providing payment services, and offering insurance products to reduce the operational and trade costs, eventually improving the overall living standards (Herring & Santomero, 1995).

Since the late 1980s, the development of endogenous growth theory has consistently guided the complex process of developing new growth theories and their drivers. Despite its

critical role in economic policy formation and implementation, academics and policymakers in Nepal pay insufficient attention to this issue. Thus, a scientific endeavor appears necessary to investigate some theories that would aid in illustrating the importance of financial sector development to economic growth. Even though economic liberalization and structural reforms in the early 1990s paved the way for free trade, Nepal's economy, particularly the manufacturing and service sectors, remains inefficient in comparison to the rest of the world (Ozaki, 2014).

The financial sector directs resources towards the most productive uses and promotes long-term growth through improved income distribution. In the context of Nepal, which has previously implemented liberalization policies, it is critical to examine the impact of such financial sector development on Nepalese economic growth. Measuring the depth and availability to finance is an important topic for both policymakers and researchers. Any negative and positive shocks might influence economic growth in different magnitudes. In this paper, therefore, linear and non-linear relationships between financial sector development and economic growth are investigated. The available literature primarily estimated the linear relationship between the financial sector and economic growth in the Nepali context. Thus, it can fill the literature gap and explore the linear as well as non-linear relationship between them. The paper employs the autoregressive distribution lag (ARDL) and asymmetric effect ARDL techniques to estimate the symmetrical and asymmetrical effects of financial sector development on the growth of Nepal. The paper attempts to find the answer to the following research questions: Is there any evidence of short-run and long-run linear and non-linear (asymmetrical) impact of financial sector development on the economic growth of Nepal?

Literature Review

Classical to new growth models emphasize capital accumulation, labor forces, and technological progress to accelerate the economic growth of any economy (Todaro & Smith, 2020). Thus, integrating technical advancements into the capital stock became crucial for long-term economic growth. The financial sector played a key role in facilitating technological progress (Thiel, 2001). Modern growth theories by Romer and Lucas in the 1980s emphasized knowledge-driven technological change, fostering continuous innovation and cost reduction through learning by doing. Financial sectors actively intend to create innovative investment opportunities to assure cost-effectiveness, encouraging specialization and enhancing transactions for economic growth. Realizing economies of scale would further optimize economic growth (Lee, 1991).

Goldsmith (1969), McKinnon (1973), and Shaw (1973) made the founding contribution to financial development in promoting economic development. There has been a contrasting view among scholars on the contribution of the financial sector to economic growth. The works of Lucas (1988), Miller (1998), and others have ignored finance as an important element in the determinant of growth. Conversely, Gurley and Shaw (1955), Schumpeter (1911), and others advocated that financial development plays an instrumental role in the economic growth of the nation.

The growing number of empirical and theoretical literature shows the financial development contributes to economic growth (Jbili, 1997). Levine et al. (2000) used panel data from 1960 to 1995 across 77 countries to examine the causal linkage between financial development and economic growth; their findings concluded that enhancing the development

of the financial sector expedite rate of economic growth and increased factor productivity. Ray (2013) used the Granger causality test to examine the connection between financial development and economic growth in India from 1990-91 to 2010-11; the study suggests a robust role of financial development in the growth process of India. Hassan et al. (2011) empirically demonstrated the positive relationship between finance-growth relationship in low- and middle-income countries. Hasan and Barua (2015), using the World Bank data from 1974 to 2012, examined the relationship between financial development and economic growth in Bangladesh, India, Nepal, Pakistan, and Sri Lanka. The paper found that financial development significantly contributes to the economic development of these nations.

A different proposition is found from the research of Halkos and Trigoni (2010). The authors studied the casual relationship between finance and economic growth in the 15 countries for the period 1975-2005, employing the VAR model. The findings suggest no immediate relationship between financial development and economic growth; however, the growth in the banking sector's size may adversely affect economic growth in the short run. Using data from 1980 to 2010 with cointegration and causality test, İnce (2011) investigated the relationship between financial development and economic growth in Turkey. The study outcome indicated the absence of a long-term relationship between economic growth and financial development. Khalifa Al-Yousif (2002), focusing on 30 developing nations, concluded that the bidirectional link between finance and economic growth cannot be generalized to all counties. Law and Singh (2014), in their research in 87 developed and developing countries, concluded that more finance is not a precondition for the economic growth.

Similarly, a few studies have been conducted in Nepalese context to examine the effect of financial development in the economic growth. Timsina (2014) investigated the relationship between private sector credit and economic growth in Nepal, using time-series data for the period of 1975-2013, Johansen co-integration approach, and error correction model. The empirical result found the positive relationship between bank credit to growth in the long run only; in the short-run, the author observed feedback effect from economic growth to the private sector credit. Employing ARDL approach and data from 1965 to 2018, Paudel and Acharya (2020) examined the role of financial development in economic growth and found that the financial development causes economic growth.

The above literatures show the mixed relationship between financial development and economic growth: The results are both the positive as well as contradictory. The studies were conducted with regard to developed and developing countries and south Asian countries. Some papers exclusively dealt with Nepalese contexts. The prior studies were not found studying the asymmetric and symmetric relationship between financial sector development and economic growth in Nepal. To plug the gap, therefore, this study examined the symmetrical and asymmetrical impact of financial sector development on economic growth.

Methods and Materials

Data and Its Sources

The paper aims to estimate the symmetrical and asymmetrical relationship between financial sector development and economic growth in Nepal. To achieve this objective, a financial sector development index was constructed as a proxy for financial development, while annual GDP growth served as a proxy for economic growth. The dataset spans 45 years,

covering the period from 1975 to 2019 AD. All data were sourced from the World Development Indicators (WDI) of World Bank open database. The financial sector development indicator (FSDI) was developed and employed in several studies (Ang & McKibbin, 2007; Batuo et al., 2018; Chen et al., 2020; Hye et al., 2012; Uddin et al., 2013). Here, the index was developed by employing principal component analysis (PCA), integrating three pivotal indicators of financial sector depth, access, and efficiency—namely, broad money as a percentage of GDP (M2), domestic credit to the private sector by banks as a percentage of GDP (DCPSB), and domestic credit to the private sector as a percentage of GDP (DCPS). PCA procedures were employed to ascertain the weights and predict the FSDI. The outcomes of the principal components are presented in Table 1.

Table 1

Principal Components for FSDI

Component	Eigenvalue	Difference	Proportion (% variations)	Cumulative (%)
PC 1	2.98324	2.966	0.9944	0.9944
PC 2	0.0167503	0.0167365	0.0056	1.0000
PC 3	0.0000138378		0.0000	1.0000
	Eigenvectors			
	M2	DCPSB	DCPS	
PC 1	0.5757	0.5781	0.5782	
PC 2	0.8175	-4.4196	-0.3945	
PC 3	0.0146	0.6998	-0.7142	

Note. PC = principle component, M2 = broad money supply (% of GDP), DCPSB = domestic credit to the private sector by banks (% of GDP), DCPS = domestic credit to the private sector (% of GDP)

The eigenvalue of principal component 1 was greater than 1, explaining 99.44% of the variations in the financial sector development index. The three principal components covered the standardized variance of three variables for the financial sector development index—M2, DCPSB, and DCPS—as 99.44%, 0.56%, and 0%, respectively. To predict the FSDI, PC 1 was selected, and the respective weights were estimated as a linear combination of the three paramount component variables of FSDI. The predicted FSDI and economic growth were presented in Figure 1. The FSDI of Nepal exhibited a negative trend approaching zero up to 2005, followed by an upward trend until the end of the study period. On the other hand, however, the GDP growth of Nepal displayed random fluctuations throughout the study.

In this study, percentage annual GDP growth (ln*growth*) was taken as a proxy for economic growth. The financial sector development index (FSDI) was considered as the independent variable (ln*fsdi*), alongside other variables such as the annual GDP deflator or inflation rate (ln*inflation*), the percentage of manufacturing sector value added to GDP (ln*learning*), and the percentage of trade to GDP (ln*trade*), which served as control variables. Subsequently, all data were transformed into logarithmic form. The negative series of GDP growth and FSDI, say *x*, were expressed in log form, say ln*x*, following the technique applied by Busse and Hefeker (2007).

$$\ln x = \ln \left(x + \sqrt{(x^2 + 1)} \right)$$

Model Specification

This study employed autoregressive distributed lag (ARDL) modeling techniques, along with asymmetric ARDL or non-linear ARDL (NARDL) models, to investigate both the symmetrical and asymmetrical relationships between financial sector development and

economic growth in Nepal. Before estimating the ARDL models as developed by Pesaran and Shin (1999) and Pesaran et al. (2001), the augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1979, 1981) and Phillips and Perron (1988) test were conducted to assess the stationary properties of the time series data and determined the order of integration. The general specification of the study model was expressed as follows:

$$\ln growth_t = \beta_0 + \beta_1 \ln fsdi_t + \beta_2 \ln inflation_t + \beta_3 \ln learning_t + \beta_4 \ln trade_t + \varepsilon_t$$

To estimate both the symmetrical short-run and long-run dynamics, the ARDL bound test for cointegration proposed by Pesaran et al. (2001) was employed. The F-statistics resulting from the bound test confirmed the presence of a linear level relationship. The ARDL (p,q) model employed in this study comprised both short-run and long-run dynamics, as depicted in the following equation:

$$\Delta \ln growth_t = \beta_0 + \beta_1 \ln growth_{t-1} + \beta_2 \ln fsdi_{t-1} + \beta_3 \ln inflation_{t-1} + \beta_4 \ln learning_{t-1} +$$

$$\beta_5 \ln trade_{t-1} + \sum_{i=1}^{p} \phi_i \Delta \ln growth_{t-i} + \sum_{i=1}^{q} \eta_i \Delta \ln fsdi_{t-i} + \sum_{i=1}^{q} \xi_i \Delta \ln inflation_{t-i} +$$

$$\sum_{i=1}^{q} \theta_i \Delta \ln learning_{t-i} + \sum_{i=1}^{q} \omega_i \Delta \ln trade_{t-i} + \varepsilon_t$$

In this equation, the long-run relationship is represented by the coefficients β_i (where i = 1,…5), while the short-run relationship is represented by the coefficients of the first difference variables. Similarly, p is optimal lags for dependent variable and q is the optimal lags for regressors. Utilizing the ARDL model, a bound test was employed to ascertain the existence of a long-run relationship among the variables. If the F-statistics exceed the critical value of the upper bound $I(1)$, the null hypothesis $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$, indicating no level relationship, is rejected. Upon confirmation of cointegration, an error correction model (ECM) was then employed to examine convergence in the long run in the event of disequilibrium and short-run shocks. The ECM can be specified as follows:

$$\Delta \ln growth_t = \sum_{i=1}^{q} \phi_i \Delta \ln growth_{t-i} + \sum_{i=1}^{q} \eta_i \Delta \ln fsdi_{t-i} + \sum_{i=1}^{q} \xi_i \Delta \ln inflation_{t-i} +$$

$$\sum_{i=1}^{q} \theta_i \Delta \ln learning_{t-i} + \sum_{i=1}^{q} \omega_i \Delta \ln trade_{t-i} + \varphi ECT_{t-1} + \varepsilon_t$$

Here, φ represents the coefficient of the error correction term, which is anticipated to be negative and statistically significant, indicating the speed of convergence towards equilibrium in the event of short-run deviations into the long-run equilibrium (Adhikari & Gajurel, 2020; Narayam & Smith, 2006; Pesaran et al., 2001). Finally, the ARDL model was specified to examine both the short-run and long-run symmetrical relationship. Subsequently, various diagnostic and stability tests were performed to confirm the robustness of the ARDL estimation.

Another objective of this paper was to investigate whether there exists an asymmetric relationship between financial sector development and economic growth in Nepal. This relationship was estimated by examining the impact of positive and negative shocks or changes in financial sector development on the economic growth of Nepal and by using the non-linear ARDL (NARDL) approach. The asymmetric effect ARDL model (NARDL) was employed to assess the presence of such a relationship. Shin et al. (2014) stated that the bound test for cointegration for asymmetric effects can be applied as per the ARDL model developed by Pesaran et al. (2001). To execute the NARDL approach, each independent variable was

decomposed into positive and negative changes using partial sum decomposition to estimate the asymmetric or non-linear relations of these changes in financial sector development on growth. The partial sum mechanism decomposed the series x_t into x_t^+ and x_t^- for positive and negative changes, respectively, as outlined by Shin et al. (2014).

$$x_t^+ = \sum_{j=1}^{t} \Delta x_j^+ = \sum_{j=1}^{t} \max (\Delta x_j, 0)$$

$$x_t^- = \sum_{j=1}^{t} \Delta x_j^- = \sum_{j=1}^{t} \min (\Delta x_j, 0)$$

Following the partial sum process of decomposing the negative and positive regressors, the NARDL model can be utilized. The NARDL model can be specified by the following equation:

$$\Delta \ln growth_t = \beta_0 + \beta_1 \ln growth_{t-1} + \beta_2^+ \ln fsdi_{t-1}^+ + \beta_2^- \ln fsdi_{t-1}^- + \beta_3^+ \ln inflation_{t-1}^+ + \beta_3^-$$

$$\ln inflation_{t-1}^- + \beta_4^+ \ln trade_{t-1}^+ + \beta_4^- \ln trade_{t-1}^- + \sum_{i=1}^{p} \phi_i \Delta \ln growth_{t-i} + \sum_{i=1}^{p} \eta_i^+ \Delta \ln fsdi_{t-i}^+$$

$$+ \sum_{i=1}^{p} \eta_i^- \Delta \ln fsdi_{t-i}^- + \sum_{i=1}^{p} \xi_i^+ \Delta \ln inflation_{t-i}^+ + \sum_{i=1}^{p} \xi_i^- \Delta \ln inflation_{t-i}^- + \sum_{i=1}^{p}$$

$$\omega_i^+ \Delta \ln trade_{t-i}^+ + \sum_{i=1}^{p} \omega_i^- \Delta \ln trade_{t-i}^- + \varepsilon_t$$

The bound test for cointegration, as proposed by Pesaran et al. (2001), was also applied in the NARDL framework to ascertain the level relationship between the variables of interest. The null hypothesis, $\beta_1 = \beta_2^+ = \beta_2^- = \beta_3^+ = \beta_3^- = \beta_4^+ = \beta_4^- = 0$, is rejected if cointegration is present, indicated by an *F*-statistic exceeding the critical value of the upper bound *I*(1). Additionally, the long-run asymmetric relationship between financial sector development and economic growth in Nepal was confirmed by employing the Wald test with asymptotic χ^2 distribution for the null hypothesis of the symmetrical relationship as $\dfrac{\beta_2^+}{\beta_1} = \dfrac{\beta_2^-}{\beta_1}$, against asymmetrical relationship. Finally, diagnostic and stability tests, as well as dynamic multiplier plots, were employed to assess the robustness of the model.

Results and Discussion

Descriptive Summary of All Variables of Interest

This study aims to investigate both the asymmetric and symmetric relationships between variables, utilizing ARDL and the asymmetric effect ARDL (NARDL). Before applying these econometric models, it is essential to understand the nature of the data.

Table 2

Statistical Summary of Variables of Interest

	ln*growth*	ln*fsdi*	ln*inflation*	ln*learning*	ln*trade*
Mean	1.960924	-0.046297	2.660335	1.797414	3.687482
Median	2.188693	-0.239013	2.754280	1.764337	3.785619
Maximum	2.965983	1.590944	4.008490	2.200070	4.159438
Minimum	-1.811277	-0.974001	-1.983377	1.339528	3.103142
Std. Dev.	0.969592	0.811666	0.922759	0.285886	0.261150
Skewness	-2.604765	0.640801	-3.026225	-0.043051	-0.291028
Kurtosis	10.02865	2.038570	15.88510	1.725124	2.180330
Jarque-Bera	143.5145	4.812848	379.9839	3.061357	1.894965
Probability	0.000000	0.090137	0.000000	0.216389	0.387716

Table 2 presents a summary of the statistical characteristics of the variables of interest. The standard deviation of all series was observed to be relatively small, suggesting low variability in the data. Furthermore, the Jarque-Bera coefficient indicated that all series, with the exception of ln*growth* and ln*inflation*, followed a normal distribution.

Figure 1

Financial Sector Development Index and Economic Growth of Nepal From 1975 to 2019.
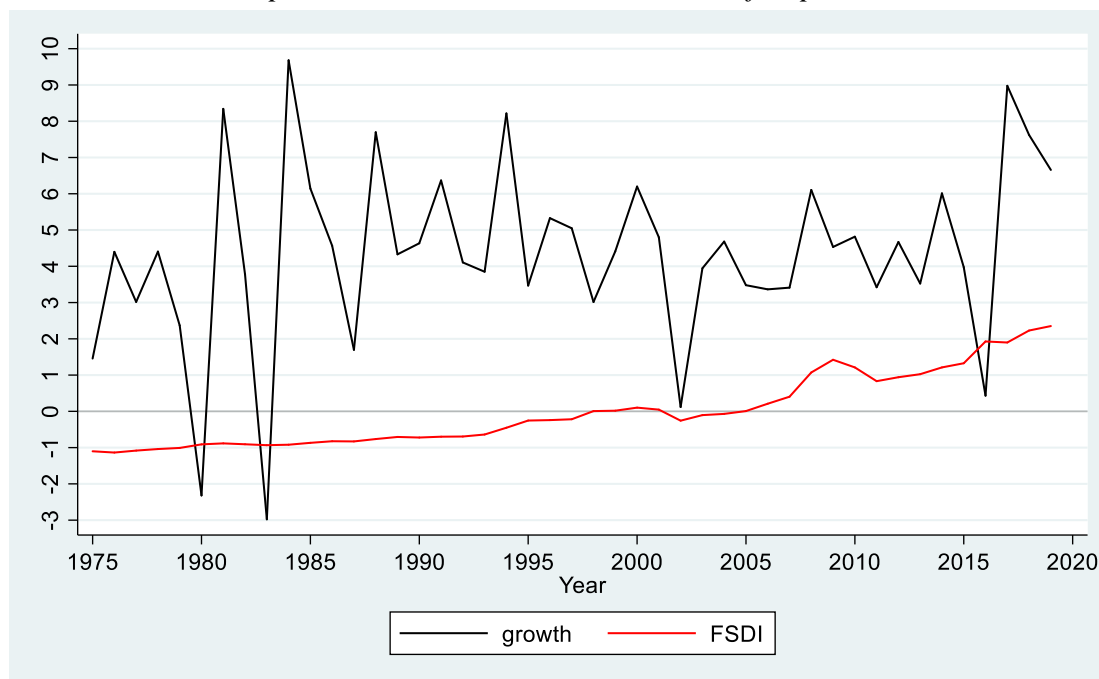
Moreover, assessing the stationarity of the series is crucial for conducting the cointegration test within the ARDL framework. To determine the order of integration, the Augmented Dickey-Fuller (ADF) test proposed by Dickey and Fuller (1979) and the Phillips-Perron (PP) test introduced by Phillips and Perron (1988) were employed. The ARDL framework is also applicable when there is a mixed order of integration, with none of the variables exhibiting an order greater than or equal to 2, *I*(2). These tests are conducted with the null hypothesis of the variable possessing a unit root against the series being stationary. The results of the ADF and PP tests are presented in Table 3.

Table 3

ADF and PP Unit Root Test Results

Variables	ADF				PP			
	At level		At Δ		At level		At Δ	
	C	C & T	C	C & T	C	C & T	C	C & T
ln*growth*	-5.96***	-6.53***	-7.15***	-7.07***	-7.51***	-7.97***	-17.39***	-17.18***
ln*fsdi*	0.83	-2.31	-5.07***	-5.17***	0.84	-2.01	-4.92***	-5.29***
ln*inflation*	-5.00***	-5.05***	-8.38***	-8.***	-5.00***	-5.16***	-13.78***	-22.75***
ln*learning*	-3.19**	-0.77	-4.63***	-3.94**	-1.44	-0.43	-4.63***	-5.07***
ln*trade*	-1.87	-1.81	-5.48	-5.50***	-2.19	-1.80	-5.44***	-5.45***

Note 1. C = with constant, C & T = with constant and trend, Δ = first difference, ADF = Augmented Dickey-Fuller test, PP = Phillips–Perron test; * indicates significant at 10%, **significant at the 5%, and *** significant at the 1%.

The results of the ADF and PP tests indicated that all variables, except ln*growth* and ln*inflation*, did not possess a unit root at the first difference. Therefore, the variables exhibited a mixed order of integration, with none of them having an order of integration of $I(2)$. Given the stationarity of the data, it is feasible to proceed with running the ARDL model to estimate long-run cointegration (Dangal & Gajurel, 2019; Pesaran et al., 2001).

Bound Test for Cointegration

Pesaran et al. (2001) introduced the ARDL bound test for examining long-run relationships. Table 4 reveals that there existed cointegration, indicating a long-run association between ln*fsdi* and ln*growth*, as evidenced by an *F*-statistic of 15.17 exceeding the critical value of the upper bound $I(1)$ at the 1% significance level, consisting of several empirical studies (Adu et al., 2013; Uddin et al., 2013). The long run association here existed because the financial sector facilitates the transfer of funds from surplus units, such as lenders or savers, to deficit units, such as borrowers or spenders, via financial markets and intermediaries. This process can stimulate economic growth (Mishkin & Eakins, 2018). The long-term relationship between financial sector development and economic growth seems to be pivotal, as it entails capital accumulation and efficient allocation, risk diversification, accelerated rate of investment, facilitation of trade openness, promotion of innovation and technological progress, credit facilitations, and ensuring financial stability, all of which collectively drive sustained and steady economic growth. Conversely, when ln*fsdi* serves as the dependent variable, the *F*-statistic of 0.54 was lower than the lower critical bound $I(0)$, suggesting no cointegration. When all variables are treated as dependent variables, however, the analysis demonstrated cointegration, signifying a long-run cointegration among the variables of interest.

Table 4

Results of ARDL Bound Test

Model	ARDL (p,q)	*F*-statistic	Cointegration
$F_{\ln growth}$ (ln*growth* |ln*fsdi* ln*inflation* ln*trade* ln*learning*)	ARDL(2, 0, 3, 2, 0)	15.17158	Yes
$F_{\ln fsdi}$ (ln*fsdi* | ln*growth* ln*inflation* ln*trade* ln*learning*)	ARDL(2, 0, 0, 0, 1)	0.541782	No
$F_{\ln inflation}$ (ln*inflation* | ln*growth* ln*fsdi* ln*trade* ln*learning*)	ARDL(2, 2, 3, 0, 1)	40.61423	Yes
$F_{\ln learning}$ (ln*learning* |ln*growth* ln*fsdi* ln*inflation* ln*trade*)	ARDL(3, 2, 0, 2, 3)	3.786201*	Yes
$F_{\ln trade}$ (ln*trade* |ln*growth* ln*fsdi* ln*inflation* ln*learning*)	ARDL(1, 0, 2, 0, 2)	1.182078	No
	Significance	I(0)	I(1)
Critical Value	10%	2.45	3.52
k = 4	5%	2.86	4.01
	2.5%	3.25	4.49
	1%	3.74	5.06

Short and Long run Symmetrical Relationship (ARDL Estimations)

The bound test for cointegration provided evidence supporting the presence of cointegration between financial sector development and economic growth in Nepal. The short and long-run dynamics can be estimated by employing the error correction model and the long-run form of level equations, setting the maximum lags 3 as indicated by the Akaike Information Criterion (AIC). The results of the automatically selected ARDL (2, 0, 3, 2, 0) model are presented in Table 5. The negative and statistically significant error correction term (ECT$_{t-1}$)

indicated a long-run causal relationship between financial sector development and economic growth. With values ranging between -1 to -2, however, it suggested any disequilibrium or shocks in the short run resulted in oscillatory convergence in the long run. As suggested by Narayam and Smith (2006), when the coefficient value of the lagged ECT falls within the range of -1 to -2, it results in dampened fluctuations in financial sector development around the equilibrium path in the long run.

The coefficient of determination, $R^2 = 0.820753$, indicated that approximately 82% of the variations in economic growth were explained by financial sector development including other control variables. The model demonstrated a good fit, as evidenced by the overall significance of the F-statistic at the 1% level of significance. Moreover, the Durbin-Watson statistic (1.849609) fell within the range of 1.5 to 2.5, suggesting no evidence of autocorrelation in the model.

Table 5

Short and Long run ARDL Results

| Variable (ln*growth*)	Coefficient	Std. Error	t-Statistic	Prob.
Panel A: Levels Equation				
ln*fsdi*	0.389419	0.133767	2.911174	0.0067
ln*inflation*	0.280677	0.168575	1.664999	0.1063
ln*trade*	-0.982610	0.792636	-1.239673	0.2247
ln*learning*	1.457824	0.554592	2.628642	0.0134
Panel B: Short run				
C	4.212017	0.461677	9.123302	0.0000
Δln*growth*(-1)	0.451995	0.125370	3.605302	0.0011
Δln*inflation*	0.340159	0.187029	1.818752	0.0789
Δln*inflation*(-1)	-0.140213	0.139552	-1.004733	0.3231
Δln*inflation*(-2)	-0.471302	0.119531	-3.942928	0.0004
Δln*trade*	0.120364	1.355961	0.088767	0.9299
Δln*trade*(-1)	2.677474	1.390004	1.926235	0.0636
ECT(-1)	-1.966624	0.212101	-9.272123	0.0000
Panel C: Diagnostic Tests				
R^2	0.820753	Durbin-Watson stat		1.849609
Adj. R^2	0.783849	χ^2 Breusch-Pagan-Godfrey Heteroskedasticity		16.29019 [0.131]
F-statistic	22.24038 [0.00]	χ^2 Breusch-Godfrey Serial Correlation LM		0.353611 [0.838]
		χ^2 ARCH		0.758678 [0.3837]

In the short run, ln*fsdi* was omitted from the model, indicating that its impact predominantly observed over the long term in influencing economic growth in the country. The results also indicated that lagged economic growth itself had a positive influence on current-year growth. Past economic productivity accumulated productive resources, fostering investment and accelerating future productivity; similarly, the previous year's GDP impacts the current year's GDP through business cycle dynamics, investment optimism, saving and consumption habits, policy stimulants, and technological progress, thereby contributing to a degree of inertia in economic growth. Likewise, inflation (ln*inflation*) positively affected GDP growth at the 10% significance level, consistent with the Keynesian views and Tobin effects. Generally, the inflation experienced in the current year may lead to the overvaluation of output across various sectors of the economy, potentially contributing to an increase in GDP growth for the same period. If it rises by increasing money supply, that reduces the interest rate and ultimately output rises (Karki et al., 2020; Mundell, 1963; Solow, 1956; Thrirwall & Barton,

1971). However, lagged inflation tends to decrease current-year economic growth. The inflation observed in the preceding year may diminish the purchasing power of individuals and consequently dampen aggregate demand, thereby exerting an adverse impact on investment in productive activities and potentially diminishing GDP growth. It is congruent with the study of Stockman (1981) which was reported that inflation reduced welfare and output. Besides, trade (ln*trade*) did not exhibit statistical significance in its relationship with economic growth in Nepal. Nevertheless, trade from the previous year can positively impact economic growth in the short run, consisting with empirical results (Adhikari, 2015; Asfaw, 2014; Keho, 2017). The development of the financial sector facilitates industrial finance, which in turn promotes trade, ultimately resulting in increased output within the economy. Nepal's trade is predominantly import-driven. The increase in trade openness corresponds to a rise in imports as a share of total trade in Nepal (Ministry of Finance [MoF], 2020). Imports serve as a significant source of government revenue and can be leveraged to expedite economic growth as advocated by trade-led hypotheses.

On the other hand, in the long run, ln*fsdi* exhibited a statistically significant positive relationship with ln*growth*, because the pivotal role of the financial sector in mobilizing and allocating savings into productive ventures, the central focus of this investigation retains its significance for developing economies (Uddin et al., 2013). Specifically, it was observed that a 1% increase in ln*fsdi* corresponded to a 0.389% increase in ln*growth*. This result was empirically validated by several studies in different economic contexts (Gautam, 2015; Paudel & Acharya, 2020; Shahbaz & Rahman, 2012; Thangavelu et al., 2004). Additionally, learning by doing, proxied by manufacturing value added (ln*learning*), demonstrated a positive and significant association with ln*growth*. This finding suggests that financial development, in conjunction with learning by doing, tends to accelerate economic growth. This study's findings is in line with an empirical study, which reported that labor force is experiencing benefits from knowledge spillovers, consequently enhancing its productivity and thereby stimulating economic growth (Anwar & Nguyen, 2012). In the long run, however, ln*trade* and ln*inflation* did not exert statistically significant impact on ln*growth* in Nepal. This nonsignificant finding, however, contradict those findings of prior studies, contrasting with Barro (2013) about inflation and Bastola and Sapkota (2015) about trade dynamics. The trade and inflation are not the emergent drivers of economic development; however, the development can be contributed especially by technological progress, institutional stability, and the accumulation of human capital.

Figure 2
Stability of the ARDL Model
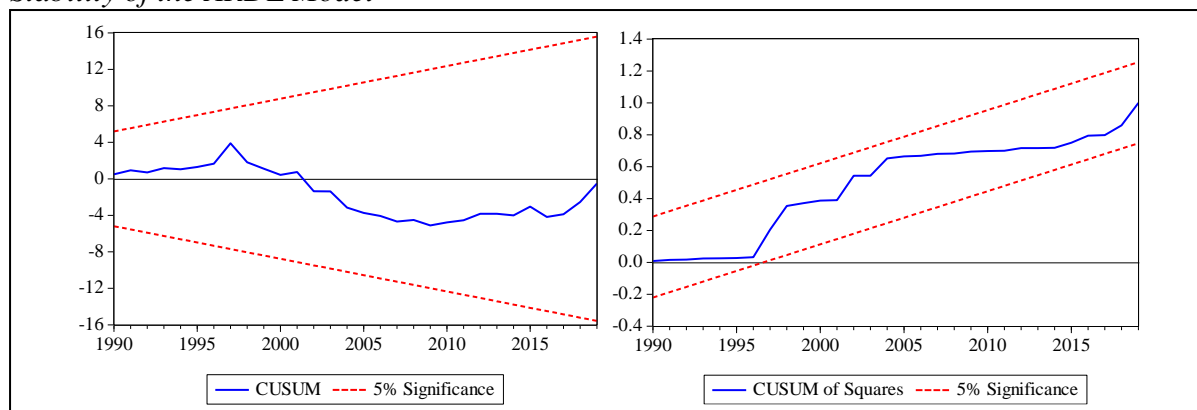
The stability of the overall estimated symmetrical model was confirmed by the CUSUM and CUSUM of squares (Figure 2), which fell within the critical boundary at the 5% significance level. Furthermore, the χ^2 statistics for heteroskedasticity (both Breusch-Pagan-Godfrey and ARCH) and serial correlation were not statistically significant, indicating the absence of conditional heteroskedasticity and serial correlation in this estimation. Consequently, the overall model was deemed robust and stable.

Short and Long run Non-linear or Asymmetrical Relationship (NARDL Estimations)

Recently, Shin et al. (2014) proposed the use of the asymmetric effect ARDL or non-linear ARDL (NARDL) framework to estimate the effects of positive and negative changes on the target variable. Asymmetric framework incorporates the bound test for cointegration mechanism developed by Pesaran et al. (2001). In the current study, a regressor, ln*learning*, was excluded from the NARDL model due to concern regarding stability and model robustness. To conduct the NARDL estimation, the bound test for cointegration was performed. The *F*-statistic value of 12.59 (Table 6) exceeded the upper bound $I(1)$, thereby rejecting the null hypothesis of no level relationship. This confirmed the presence of a long-run asymmetric relationship between financial sector development and economic growth in Nepal.

Table 6

Bound Test for NARDL Cointegration Results

Test Statistic	Value	Significance	I(0)	I(1)
F-statistic	12.59227	10%	2.12	3.23
k	6	5%	2.45	3.61
		2.5%	2.75	3.99
		1%	3.15	4.43

The bound test permitted the employment of the error correction model, allowing for the partial sum process of decomposition as positive and negative series for each regressor to estimate the asymmetric effects on ln*growth* in Nepal. The asymmetric effect ARDL (NARDL) model was fitted, as indicated by the R^2 value in panel C of Table 7. The R^2 value suggests that about 89% of the variations in ln*growth* were explained by ln*fsdi* with other control variables. The overall model exhibited robustness, as evidenced by the significant *F*-statistic. Additionally, the nonsignificant values of the χ^2 statistics for heteroskedasticity (including ARCH) and serial correlation indicate that the model was free from heteroskedasticity and serial correlation.

Furthermore, as depicted in Figure 3, the CUSUM and CUSUM of squares fell within the critical boundaries, confirming the stability of the NARDL model. Thus, the estimated results of the NARDL were statistically robust (panel C of Table 7). The estimated short-run and long-run results of the NARDL ARDL(2, 1, 2, 3, 3, 0, 3) are presented in Table 7.

Table 7

Short and long run NARDL estimations

Variable (ln*growth*)	Coefficient	Std. Error	t-Statistic	Prob.
Panel A: Levels Equation				
ln*fsdi_pos*	-0.034569	0.355241	-0.097310	0.9234
ln*fsdi_neg*	5.045791	1.872579	2.694568	0.0139
ln*inflation_pos*	1.189256	0.357252	3.328901	0.0033
ln*inflation_neg*	0.828505	0.378349	2.189791	0.0406
ln*trade_pos*	0.058758	0.850444	0.069090	0.9456
ln*trade_neg*	-2.916388	3.778068	-0.771926	0.4492
Panel B: Short Run				
C	1.150751	0.219504	5.242506	0.0000
Δln*growth*(-1)	0.583259	0.121068	4.817622	0.0001
Δln*fsdi_pos*	-3.036522	1.026079	-2.959346	0.0078
Δln*fsdi_neg*	18.51045	2.923796	6.330963	0.0000
Δln*fsdi_neg*(-1)	-7.807915	2.989737	-2.611573	0.0167
Δln*inflation_pos*	0.071380	0.470863	0.151595	0.8810
Δln*inflation_pos*(-1)	-0.358069	0.209539	-1.708836	0.1030
Δln*inflation_pos*(-2)	-0.401527	0.131633	-3.050343	0.0063
Δln*inflation_neg*	0.542227	0.407699	1.329968	0.1985
Δln*inflation_neg*(-1)	-1.103188	0.379497	-2.906970	0.0087
Δln*inflation_neg*(-2)	-1.028741	0.358729	-2.867739	0.0095
Δln*trade_neg*	-6.334511	3.149452	-2.011306	0.0580
Δln*trade_neg*(-1)	12.96955	3.547039	3.656444	0.0016
Δln*trade_neg*(-2)	4.356386	2.205026	1.975662	0.0622
ECT(-1)	-2.070061	0.193380	-10.70465	0.0000
Panel C: Diagnostic Tests				
R^2	0.894766	Durbin-Watson stat		2.343
Adj.R^2	0.838101	χ^2 Breusch-Pagan-Godfrey Heteroskedasticity		25.280 [0.1048]
F-statistic	15.79[0.00]	χ^2 Breusch-Godfrey Serial Correlation LM		2.631 [0.1048]
Long run asymmetric F-statistics	8.964 [0.0072]	χ^2 ARCH		0.238 [0.6256]

The preliminary bound test provided evidence of a long-run asymmetric effect, *ceteris paribus*, between economic growth and financial sector development in Nepal, consistent with earlier ARDL models. The Wald test for long-run asymmetry [$F = 8.964$, $p = 0.0072$] confirmed the presence of asymmetric long-run effects of ln*fsdi* on ln*growth* that evidenced from several empirical findings (Chen et al., 2020; Ibrahim & Alagidede, 2020; Qamruzzaman & Jianguo, 2018). However, the long-run estimations revealed only negative shocks in ln*fsdi* put negatively significant effect on ln*growth*, implying that a 1% decrease in ln*fsdi* resulted in a 5.045% decrease in ln*growth*. Put differently, the negative shock, if managed, can increase economic growth. This finding is consistent with a recent study by Ahmed et al. (2020) which reported that a decrease in FIDS reduced funds to finance productive investments. On the flip-side, there are no significant effects of positive shocks in ln*fsdi* on ln*growth*, providing insights that there is no sufficient financial development in Nepal to accelerate economic growth significantly.

Moreover, positive and negative shocks or changes in inflation positively and negatively influence ln*growth* in the long run, respectively. Specifically, a 1% rise in ln*inflation* led to a 1.189% increase in ln*growth*, the findings that was consistent with Ngoc (2020), while

a negative shock in inflation decreased ln*growth* by 0.829%. However, the net effect of inflation was positive on economic development, suggesting that inflation may foster economic growth by incentivizing spending and investment, driving up aggregate demand, and encouraging trade and industries— to expand production and to meet increased consumer demand as theorized by the Keynesian school. Furthermore, the long-run estimates presented in panel A of Table 7 indicate that ln*trade* did not have any evidence of asymmetrical effects on ln*growth*. The reasons for these effects may include prolonged trade deficits and dominance of imports, unequal distribution of trade gains, limited export opportunities, and the presence of trade barriers within the Nepali economy. Finally, the error correction term (ECT_{t-1}) was negative and statistically significant, ranging between -1 and -2, revealing that any short-run disequilibrium and shocks can converge to the long run in a damped manner and has sufficient evidence of the causality between financial sector development and economic growth.

However, in the short run, conversely, a positive shock in ln*fsdi* negatively influenced ln*growth*; a 1% increase in ln*fsdi* resulted in a reduction of ln*growth* by 3.037%. Similarly, current negative shocks in ln*fsdi* were negatively associated with ln*growth*, indicating that a 1% decrease in ln*fsdi* led to a 18.51% decline in ln*growth*. Nevertheless, the previous year's negative shocks in ln*fsdi* positively impacted ln*growth* in Nepal in the short run, with ln*growth* rising by 7.81% following a 1% decrease in ln*fsdi*. Note that the net negative shock is crucial to retard economic growth in Nepal. It contrasted with several findings at diverse contexts (Chen et al., 2020; Jalil & Feridun, 2011; Kinuthia & Murshed, 2015). Negative shocks in the financial sector may discourage investors and reduce financial resources available for further capital formation, ultimately diminishing short-term economic growth. These shocks could stem from factors, such as financial crises, volatile markets, or disruptions in banking systems.

Additionally, with Panel B of Table 7, the results indicates that previous year's ln*growth* itself also accelerated the current economic growth of Nepal. Furthermore, there are no significant asymmetric effects of current year ln*inflation* on ln*growth* in the short run. However, positive shocks in ln*inflation* in the previous year negatively influenced ln*growth*, while negative shocks in ln*inflation* in previous years positively affected ln*growth*; similarly, previous negative shocks in ln*trade* negatively impacted ln*growth* in Nepal.

Figure 3

Stability of NARDL Model
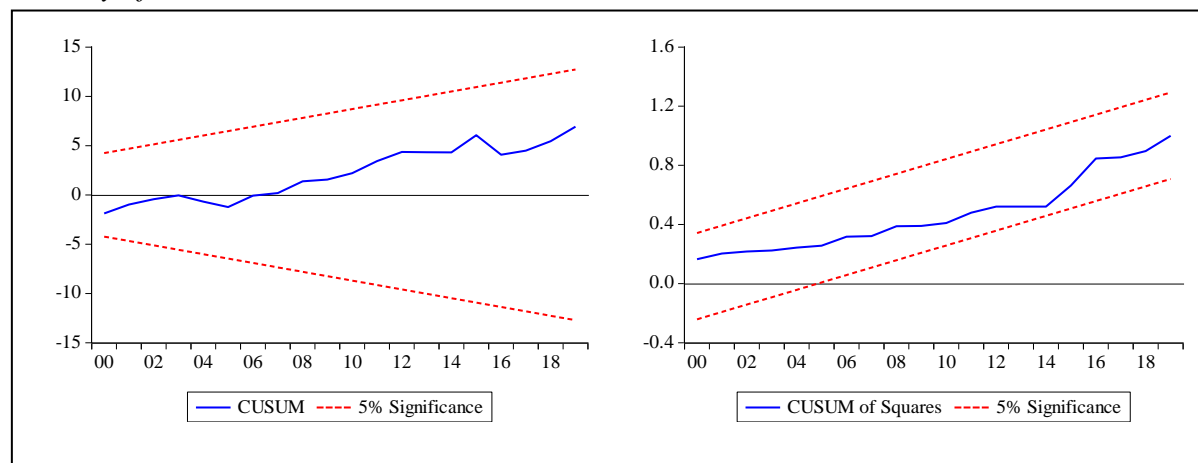
The asymmetric cumulative dynamic multipliers enable us to observe the asymmetric adjustment patterns following positive and negative shocks to the explanatory variables (Shin, 2014). Figure 4 illustrates the dynamic asymmetric multiplier of positive and negative shocks in ln*fsdi* in response to ln*growth*. In the graph, the thick black line (multiplier for ln*fsdi* $^+$) did not travel between the critical boundary lines (thin red dashed lines) and showed no significant impact of positive shocks in ln*fsdi* on ln*growth* in the short and long run. However, the ln*fsdi* negative shock multiplier line indicates that a 1% decline in ln*fsdi* decreased ln*growth* by about 18% in the short run, which gradually converged to a 5% decrease in the long run. Thus, the net effects of shocks in ln*fsdi* behaved similarly to negative shocks in both the short and long run. This finding confirms the presence of asymmetric effects, with negative shocks rather than positive in ln*fsdi,* significantly impacting ln*growth* in Nepal.

Figure 4

Dynamic Asymmetric Multipliers of ln*fsdi on* ln*growth*
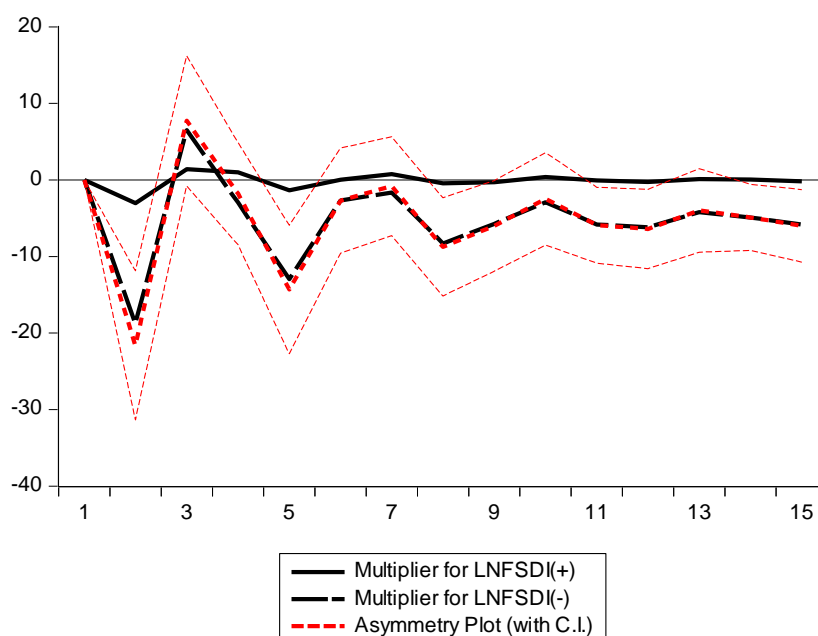
Conclusion and Implication

The study investigates the symmetrical and asymmetrical impact of financial sector development on economic growth in Nepal, using ARDL and NARDL methodologies and employing data spanning from 1975 to 2019 AD. Initially, the financial sector development index, constructed using PCA, indicated an increasing trend in financial development in Nepal. Furthermore, both symmetrical and asymmetrical effect models suggest the presence of long-run cointegration between financial development and economic growth in Nepal.

The short-run results of the ARDL analysis indicate lagged economic growth, lagged trade openness, and inflation having a positive effect on economic growth in Nepal. However, lagged inflation negatively impacted on economic growth. Conversely, the current year's trade openness did not show statistical significance with economic growth in Nepal. On the flip-side, in the long run, there existed a positive and significant relationship between financial development and economic growth in Nepal. Similarly, the influence of learning by doing, as proxied by value added in the manufacturing sector, also positively affected economic growth

in Nepal over the long term. Trade openness and inflation, however, did not exhibit statistically significant effects on economic growth in the long run.

The NARDL results reveal a long-run asymmetric relationship between financial development and economic growth in Nepal. Specifically, the long-run estimations of asymmetric effect ARDL indicate that only negative shocks in financial sector development significantly and adversely affected economic growth. Conversely, positive changes were not statistically sufficient to bolster economic growth in Nepal. Similarly, there was an asymmetric relationship between inflation and economic growth in Nepal. Furthermore, the long-run estimates suggest that trade openness had no asymmetrical effects on economic growth in Nepal. On the other hand, in the short run, however, a positive shock in financial sector development negatively influenced economic growth; likewise, current negative shocks in financial sector development were negatively associated with economic growth. Nevertheless, previous year's negative changes in financial sector development positively impacted economic growth in Nepal. It is observed therefore that a net negative shock appears to be crucial in retarding economic growth in Nepal; furthermore, there do not appear to be no significant asymmetric effects of current year inflation on economic growth in the short run.

The overall findings reveal that the development of the financial sector seems to be crucial for boosting economic growth in Nepal. Conversely, negative asymmetrical effects appear significant and may hinder long-term economic growth in the country. Similarly, alongside financial sector development, inflation and learning by doing could facilitate growth in Nepal. Trade alone however, is not sufficiently fruitful to accelerate economic growth. Thus, the results indicate that while financial sector development is beneficial for enhancing the productive capacity of Nepal's economy, it alone may not promote trade-led growth. On the other hand, negative changes and any regulatory policies regarding the financial sector may impede economic development in Nepal. Policymakers therefore should focus on promoting the development of the financial sector by adopting more loose policies and mobilizing resources toward productive channels to accelerate growth in the country. Policymakers should focus on improving financial sector access, depth, efficiency by relaxing policy gridlock to address negative shocks in financial development and inflation.

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