Financial Deepening in Nepal: An Asymmetric Analysis With Per Capita Income and Private Sector Credit

Aditya Pokhrel[1], Renisha Adhikari[2]

1. Mr. Pokhrel is an Assistant Director of Nepal Rastra Bank.
   ✉ aditya.mphilphd@gmail.com,
   🆔 https://orcid.org/0009-0003-9226-0837
2. Mrs. Adhikari is an Assistant Director of Nepal Rastra Bank.
   ✉ renisha03@gmail.com,
   🆔 https://orcid.org/0009-0008-6888-2843

Abstract

This study examines the asymmetric relationship between private sector credit and per capita income defining financial deepening using annual time-series data from 1994 to 2021. The analysis employed Zivot unit-root testing to identify a significant break in the model and NARDL cointegration analysis to account for this structural break, while also assessing the long-term asymmetric relationship. Findings suggested a cointegrating relationship with private sector credit, indicating that positive shocks in private sector credit contribute to its growth, thereby boosting per capita income and promoting financial deepening in Nepal. Although short-term negative shocks in the private sector were notable, their impact on long-term income growth was minimal. The study highlights the government's role in fostering positive growth of private sector credit to enhance financial deepening in Nepal, cautioning against excessive credit disbursement during recessions or crises, which could undermine financial deepening in the long run; however, the short-run policy revisions during the time of crises are thinkable. This study addresses a geographical gap in prior research by incorporating nonlinearity and structural break unit-root tests, previously unexplored, thereby introducing a novel contribution to the existing body of literature.

Keywords: asymmetric relationship, NARDL, positive shocks, financial deepening, structural break

JEL Classification: C32, C32, E32, G21, C52

Introduction

Financial deepening, as defined by Arestis and Demetriades (1997), pertains to the augmentation of financial services provision relative to the economic scale, thereby facilitating economic advancement through the direction of savings towards productive ventures. The World Bank characterizes financial deepening as the expansion and enhancement of access to financial services encompassing credit, insurance, and payment facilities, leading to more effective allocation of resources and alleviation of poverty (World Bank [WB], 2019). Particularly in Nepal, where formal financial service accessibility remains constrained, fostering financial deepening is paramount to foster inclusive growth and diminish poverty (WB, 2020). Considering Nepal's existing economic hurdles such as inadequate investment levels and restricted financial access, fortifying financial deepening

emerges as crucial to invigorate economic activity and nurture sustainable development (Asian Development Bank [ADB], 2021). With this, the integral role of the Nepalese banking system in financial deepening lies in its ability to mobilize savings and allocate credit to sectors conducive to capital formation, thereby bolstering economic efficiency.

In economies experiencing financial deepening, various key indicators typically exhibit enhancements. Firstly, financial deepening correlates with an augmentation in per capita income as it facilitates a more effective allocation of resources and broadens investment prospects (Gurley & Shaw, 1955). Secondly, there is a notable expansion in private sector credit, empowering enterprises to enlarge their operations, invest in innovation, and contribute to economic advancement (World Bank, 2019). Thirdly, an expansion of broad money, serving as an indicator of overall liquidity within the economy, occurs concomitantly with the progression of financial deepening, thereby stimulating economic activity and consumption (Levine, 1997). Lastly, the elevation of gross national savings is observed as financial intermediation improves, resulting in increased levels of domestic savings available for investment (Demirgüç-Kunt & Levine, 1996).

The crucial role of banking systems in facilitating access to financial services, mobilizing savings, and efficiently allocating credit underpins the significance of financial deepening in both the global economy and Nepal (Sharma, 2018). Particularly in Nepal, where formal financial service accessibility remains constrained, bolstering financial deepening through robust banking systems is imperative for fostering inclusive growth and alleviating poverty (WB, 2020). Moreover, within the global economic context, financial deepening enhances stability and resilience by refining risk-sharing mechanisms and augmenting financial intermediation efficiency (Beck, Demirgüç-Kunt, & Levine, 2007).

Previous studies on financial deepening in Nepal have identified several shortcomings, particularly related to the methods used and the analyses conducted. Not particularly focused in financial deepening, but many of these studies primarily focused on linear relationships between financial development indicators and economic variables, overlooking potential complexities and asymmetries in these connections (Paudel & Acharya, 2020). Paudel and Acharya (2020) used traditional linear regression models (ARDL) to explore how financial development affects economic growth in Nepal, but such approaches may not fully capture the intricate dynamics and inherent asymmetries in the relationship. Similarly, Gautam (2015) examined the factors influencing financial development and Economic Development in Nepal using Johansen cointegration test, without considering potential asymmetries and non-linear relationships that could exist. These limitations highlight the need to employ more advanced statistical techniques, such as non-linear autoregressive distributed lag (NARDL) models, to better understand the asymmetric behavior of financial deepening in Nepal. Understanding the asymmetric behavior of financial deepening in Nepal is important for grasping how different shocks and disturbances impact the financial system and the overall economy. By using NARDL model, researchers can investigate how positive and negative shocks affect the evolution of financial development in different ways (Botev, Égert, Jawadi, 2019). This is especially relevant in Nepal, where the financial system is susceptible to various internal and external shocks, including changes in regulatory policies, economic downturns, and natural disasters.

Recognizing the asymmetric responses of financial deepening to such shocks can provide valuable insights for policymakers and stakeholders in devising effective strategies to promote financial stability and sustainable economic growth.

This research is motivated by the necessity to address the limitations of prior investigations into financial deepening in Nepal and to explore its asymmetric behavior, recognizing its potential impacts on policymaking and economic advancement. The aim of this study is to employ non-linear autoregressive distributed lag (NARDL) analysis to scrutinize the asymmetric tendencies of financial deepening in Nepal, with the objective of shedding light on how positive and negative shocks influence financial development dynamics. This paper adds to the existing body of literature by utilizing the NARDL approach, which offers a more comprehensive understanding of the asymmetric behavior of financial deepening. NARDL has proven effective in capturing asymmetries in economic relationships, as demonstrated by Shin et al. (2014) and Pesaran et al. (2001). Through the adoption of this methodology, this study enriches the original contribution by providing nuanced insights into the intricacies of financial deepening dynamics in Nepal.

Literature Review

Theoretical Review

Financial deepening, as outlined by McKinnon and Shaw (1973), refers to a crucial concept in comprehending the mechanisms of economic progress. It entails the expansion and increased significance of financial intermediaries within an economy, resulting in a more effective distribution of resources and improved availability of credit for individuals and enterprises. McKinnon and Shaw asserted that financial deepening is vital for encouraging investment and nurturing economic expansion. They highlighted the pivotal role of financial institutions in mobilizing savings and directing them towards productive ventures, thereby facilitating the accumulation of capital and fostering economic advancement (McKinnon & Shaw, 1973). This theoretical framework emphasizes the importance of examining financial deepening in Nepal, where enhancing financial access and encouraging investment play pivotal roles in attaining long-term economic growth and alleviating poverty.

The other dynamic of the theory is the Keynesian Economics. Keynesian economics, which centers on aggregate demand and governmental involvement, offers perspectives on the correlation between financial deepening and economic performance. In line with Keynesian principles, the expansion of financial depth, marked by improved credit accessibility and liquidity, has the potential to invigorate aggregate demand by fostering increased consumption and investment. Keynes (1936) stressed the significance of effective demand in shaping output and employment levels, indicating that fluctuations in investment, influenced by alterations in financial circumstances, can magnify economic fluctuations. Hence, financial deepening, by facilitating broader credit availability for households and enterprises, can reinforce consumption and investment, thereby bolstering overall economic growth and stability.

Empirical Review

Andabai and Igbodika (2015) conducted a study on causality analysis of financial deepening and performance of Nigerian economy. The study analyzed the relationship between financial deepening and Nigeria's economic performance from 1990 to 2013. Using

time series data from the, the study found a long-term equilibrium relationship between financial deepening and economic performance, with a 70 percent short-term adjustment from disequilibrium. About 63 percent of the economic performance variations were explained by changes in financial deepening. The study referred that the government policies must manage the money supply for economic growth and measures by the central bank to enhance fund flow and credit extension, and strict supervision to restore market efficiency and boost confidence.

Gautam (2015) undertook a research entitled role of financial development in economic growth of Nepal: an empirical analysis with the aim to explore the correlation between financial development and economic growth within Nepal. The study delved into the interplay between economic growth and financial development in Nepal from 1975 to 2012. Through tests, including ADF, P-P, co-integration, and granger causality, alongside the vector error correction method, it explored how financial development influenced on economic growth. The findings revealed that financial development served as a catalyst for economic growth in the short term, while economic growth, in turn, sustained financial development over the long term. The study advocated for comprehensive reform initiatives within the financial system to bolster efficiency and resilience, particularly in the aftermath of economic crises.

James and Eloho (2020) conducted a study on financial deepening and economic development in Nigeria exploring the correlation between financial deepening and economic development in Nigeria spanning from 1987 to 2018. The study employed a time-series data, to investigate the relationship between indicators of financial deepening and various economic development metrics, such as GDP growth rate and per capita income. The primary findings of the research suggested a substantial positive association between financial deepening and economic development in Nigeria. The study suggested that enhancements in the depth of the financial sector, including improved access to credit and liquidity, contribute positively to overall economic growth and development. The findings emphasized the significance of implementing policies aimed at bolstering financial deepening to facilitate enduring economic development in Nigeria.

Paudel and Acharya (2020) conducted a study entitled financial development and economic growth: evidence from Nepal to explore the linkage between financial development and economic growth in Nepal from 1965 to 2018 using the ARDL approach. Despite Nepal's potential with its proximity to large markets like India and China, this study stated that Nepal has been a poor landlocked developing country. The study investigated how financial activities impact economic growth in this context, considering recent political shifts and efforts to attract foreign direct investment (FDI). Findings suggested a significant positive relationship between financial development and economic growth, except for foreign direct investment. This underscored the need for policymakers to prioritize creating an investment-friendly environment to attract the desired FDI levels.

Samuel-Hope et al. (2020) conducted a study on examining the influence of financial deepening on Nigeria's growth, to analyze how financial deepening has affected Nigeria's economic growth over a 38-year period. The study aimed to explore the connections between various factors like time and savings deposits in commercial banks, money supply, private

sector credit, and the country's overall economic growth. An Autoregressive Distributed Lag (ARDL) technique was employed. Results indicated the presence of a long-term relationship, though none of the individual factors examined emerged as statistically significant. The study found that private sector credit as a proportion of GDP exhibited a negative relationship with GDP growth, whereas money supply relative to GDP showed a positive association with economic growth. Deposits in commercial banks, both in terms of time and savings, were found to have a detrimental impact on national growth.

Shapoval and Yukhta (2021) undertook a study on effect of financial deepening on economic growth: does it encourage income group transition? The study aimed to explore the relationship between economic growth indicators (GDP per capita growth, GNI per capita) and financial depth metrics (domestic credit to the private sector and credit availability) from 2000 to 2020. Using correlation analysis, the study found that increased credit availability and expanded domestic credit to the private sector positively influence economic growth, specifically GNI per capita and GDP per capita growth. Linear relationships were observed between GNI per capita and credit availability, as well as between credit availability and domestic credit to the private sector from 2000 to 2020. The study suggested target values of domestic credit to the private sector for income group transitions, emphasizing the strengthening impact of financial deepening on income growth as income levels rise.

Gap in Research

The research gap lies in the application of nonlinear ARDL analysis to investigate the relationship between financial deepening and income growth in Nepal. While prior studies have explored this relationship using linear ARDL models, none have utilized nonlinear ARDL methods in Nepal. This gap is significant because nonlinear ARDL models offer a more nuanced understanding by capturing potential nonlinearities and asymmetries. Given Nepal's unique economic context and the importance of financial access for growth, employing advanced econometric techniques is crucial. Therefore, this study aims to address this gap by employing a nonlinear ARDL approach to examine the connection between financial deepening and economic growth in Nepal, providing insights not previously explored.

Materials and Method

Research Design

The quantitative research design was adopted to investigate the asymmetric patterns of financial deepening in Nepal. Initial steps gathered and refined time series data, followed by crafting a non-linear Autoregressive Distributed Lag model. This model integrated lagged variables to grasp evolving dynamics and examine potential asymmetrical impacts. Diagnostic assessments was conducted to validate the model, ultimately providing valuable insights for policymakers and stakeholders invested in Nepal's economic progress.

Data

This research analyzed annual time series data spanning from 1994 to 2021, capturing the period post-financial liberalization in Nepal (NPC, 2002). Significantly, the research opted to exclude the post-effects of the COVID-19 pandemic, as the COVID relief programs remained ongoing until the present (NRB$_a$, 2021). The study employed per capita income (PIN) as the dependent variable, representing GDP divided by the total population. Broad

money (M2) to GDP ratio (BM) served as another dependent variable, while the ratio of GDP to private sector credit (PRC) and the ratio of gross national savings to GDP (GRS) were utilized as independent variables. All variables were measured in Nepalese rupees (NRs) in millions. Due to data constraints, the sample size (n) was limited, with data sourced from the Nepal Rastra Bank's quarterly economic bulletin (NRB$_b$, 2022).

Model Specification

This study adapted the model proposed by Ohwofasa and Aiyedogbon (2013) and James and Eloho (2020) to explore how private sector credit, gross national savings, and broad money influence per capita income. Financial deepening was evaluated by examining how the independent variables (especially private sector credit and its non-linearity) interacted with per capita income. Following the approach outlined by James and Eloho (2020), the research focused solely on private sector credit (PRC) as the independent variable to streamline the investigation. This decision was supported by the model's validity, ensuring alignment with the study's objectives. The research model specifically examined the asymmetric relationship between per capita income (PIN) and private sector credit (PRC) among the selected variables.

The model adapted is,

$$PIN = f(BM, PRC, GRS) \ldots \ldots \ldots \ldots \ldots (i)$$

As per Lütkepohl and Xu (2009), the empirical equation utilized the logarithmic form of the series to handle nonlinearities, correct data skewness (outliers), and directly capture elasticities. This transformation aids in addressing the nonlinear relationship between the dependent and independent variables while facilitating the direct estimation of elasticities. Consequently, the variables are represented in logarithmic form (base 10).

Within the framework of quantitative research design, a time-series inferential approach was adopted, employing the nonlinear Autoregressive Distributed Lag (ARDL) technique to explore the asymmetric relationship between per capita income and private sector credit, following the methodology outlined by Shin et al. (2014). The analysis involved conducting long-run bound tests and examining cointegrating coefficients. The decision to employ the nonlinear ARDL technique was motivated by the works of Ben et al. (2021). Prior to this, unit root tests were conducted using the Augmented Dickey Fuller test, Phillip Perron test (Enders, 2017), and Zivot and Andrews (1992) unit root test, allowing for the examination of data with one structural break. According to Shin et al. (2014), the application of nonlinear ARDL is suitable when all variables in the study are either I(1) or a combination of I(0) and I(1). Following the recommendation of Pesaran et al. (2001), the Akaike information criteria were utilized to determine the optimal lag length, with the lags possessing the lowest AIC values selected as the appropriate lag length for the study.

To account for asymmetry effects, the NARDL approach decomposed the variable representing the private sector credit into two distinct components: PRC^+, denoting the partial sum of positive changes in the private sector credit and negative change in private sector credit, denoted by PRC^- —both of them were used as separate regressors. The long-run model incorporating asymmetry was expressed as:

$$PIN_t = \delta_t + BM + PRC_t^+ + PRC_t^- + GRS + v_t \ldots \ldots \ldots \ldots \ldots (ii)$$

Similarly, the nonlinear depiction indicating both short-term and long-term factors was presented as follows in the equation format.

$$\Delta PIN_t = \delta_t + \Sigma_{i=1}^{p-1}\lambda_i \Delta PIN_{t-1} + \Sigma_{i=1}^{q}\gamma_i^+ \Delta PRC_{t-i}^+ + \Sigma_{i=1}^{q}\gamma_i^- \Delta PRC_{t-i}^- + \Sigma_{i=1}^{q}\gamma_i \Delta BM_{t-i} +$$
$$\Sigma_{i=1}^{q}\gamma_i \Delta GRS_{t-1} + \rho PIN_{t-i} + \phi^+ PRC_{t-i}^+ + \phi^- PRC_{t-i}^- + \epsilon_t \dots\dots\dots\dots\dots\dots\dots. (iii)$$

The subscript 'i' denotes the number of lagged variables included for the independent variables, whereas ρ stands for the long-term error correction component. $\lambda_i, \gamma^+, and\ \gamma^-$ are the nonlinear short-run coefficients, and similarly $\rho, \phi^+, and\ \phi^-$ are the nonlinear ARDL long-run coefficients with asymmetric terms. The examination of asymmetric long-term cointegration bounds was conducted using Fisher's F test (Pesaran et al., 2001). The null hypothesis would be $H_0: \rho = \phi^+ = \phi^- = 0$, and the alternative hypothesis would be $H_0: \rho \neq \phi^+ \neq \phi^- \neq 0$. Should the null hypothesis be rejected, it would affirm the existence of cointegration (Shin et al., 2014).

$$PRC_t^+ = \Sigma_{j=1}^{t}\Delta\Delta PRC_J^+ + \Sigma_{j=1}^{t}\max (\Delta X_j, 0)$$
$$PRC_t^- = \Sigma_{j=1}^{t}\Delta PRC_J^- + \Sigma_{j=1}^{t}\min (\Delta X_j, 0)$$

The determination of the long-term coefficient entails dividing the negative coefficient of $PRC_t^+(\phi^+)$ by the coefficient of $PIN_{t-1}(\rho)$, in addition this process involves dividing the negative value of the coefficient. of $PRC_t^-(\phi^-)$ by the coefficient of $PIN_{t-1}(\rho)$ (Shin et al., 2014). The Wald test was used to assess long-term asymmetry, testing the significance of asymmetric coefficients and the formulated null hypothesis. $H_0: \frac{\phi^+}{\rho} = -\phi^-/\rho$ referring the alternative hypothesis to be, $H_0: \frac{\phi^+}{\rho} \neq -\phi^-/\rho$. When the null hypothesis was rejected, it indicated the existence of long-term asymmetry. The degree of change in LE differs when PRC increases compared to when it decreases (Pesaran et al., 2001). Following the analysis of long-term asymmetry, the asymmetric dynamic multiplier was implemented. These dynamic multipliers illustrate how PIN_t adjusts to its new long-term equilibrium after a positive (POS) or negative (NEG) shock in PIN_t. The cumulative dynamic multiplier effects from PRC_t^+ and PRC_t^- on PIN were computed (Pesaran et al., 2001).

$$m_h^+ = \Sigma_{j=0}^{h} \frac{\Gamma PIN_{t+j}}{\Gamma PRC_t^+}, m_h^- = \Sigma_{j=0}^{h} \frac{\Gamma PIN_{t+j}}{\Gamma PRC_t^-}, \text{ for either } h = 0,1,2,\dots$$

Referring when, $h \to \infty$, then $m_h^+ \to -\phi^+/\rho$ and $m_h^- \to -\phi^-/\rho$.

Following the acquisition of the final model, diagnostic and stability tests were administered subsequent to constructing the asymmetric long-run model. These assessments included the BPG heteroscedasticity test, BG LM serial correlation test, Jarque Bera test for normal distribution, CUSUM and CUSUM sum of squares test, and the RAMSEY reset test for functional stability (Gujrati, 2003).

Results and Discussion

Unit Root Tests (Break and Without a Break)

Prior to implementing the NARDL analysis, it was essential to assess the unit roots of the variables. According to Shin et al. (2014), it is crucial that the variables do not exhibit integration of order I(2) and beyond I(2) for the nonlinear analysis. Consequently, the Zivot

and Andrews (1992) test was conducted on both the dependent variable and the asymmetric variable chosen for nonlinear examination.

Table 1

Findings from the Augmented Dickey-Fuller, Phillips-Perron, and Zivot and Andrews tests.

		ADF	PP	ZA	
		t-stat	*t*-stat	*t*-stat	Break Date
PIN_t	Intercept	0.53	0.37	-3.90*	2010
	Intercept and Trend	-1.86	-1.78	-2.85***	2002
ΔPIN_t	Intercept	-3.64**	-3.63**		
	Intercept and Trend	-3.59***	-3.58***		
PRC_t	Intercept	0.35	-1.00	-3.27***	2016
	Intercept and Trend	-3.85**	-3.87**	-4.89**	2012
ΔPRC_t	Intercept	-6.11*	-6.51*		
	Intercept and Trend	-5.84*	-6.27*		
BM_t	Intercept	0.95	1.41		
	Intercept and Trend	-1.08	-1.27		
ΔBM_t	Intercept	-4.49*	-4.47*		
	Intercept and Trend	-4.69*	-4.69*		
GRS_t	Intercept	-1.57	-1.51		
	Intercept and Trend	-1.80	-1.81		
ΔGRS_t	Intercept	-5.96*	-6.04*		
	Intercept and Trend	-4.15*	-6.66*		

*Note.* Zivot Andrews Unit Root Test (one break); lag length based on Schwarz Information Criterion (SIC).
*,**,*** denotes significance level at 1 percent, 5 percent, and 10 percent respectively.

The unit root tests (ADF and PP) demonstrated that PIN, PRC, BM, and GRS are stationary at integration order I(1). According to the Zivot Andrews test, both PIN and PRC do not exhibit a unit root at integration order I(0). The analysis considered the intercept form and identified the break dates for PIN and PRC as 2010 and 2016, respectively.

Break Date Descriptions

Prior to 2010, Nepal's per capita income declined due to a changing political climate and a challenging transition from agriculture to service industries. Labor shortages, strikes, and power supply issues further hindered economic growth (MoF, 2010). However, after political situation tended to improve in the country, a shift emerged after 2010 with a significant rise in labor migration, particularly to the Middle East. WB (2021) confirms a surge in remittances from $2.1 billion in 2010 to $8.4 billion in 2021. Similarly, tourist arrivals improved significantly after 2009 (NTB, 2019). This influx of remittances and a revitalized tourism sector appear to be key factors contributing to the observed rise in Nepal's per capita income after 2010.

According to the Nepal Rastra Bank (2022), the growth in private sector credit (PRC) in 2016 was attributed to the implementation of post-earthquake reconstruction tasks by the government following the earthquake in 2015. Additionally, the economy was showing signs of recovery during this period. In 2016, the Nepal Rastra Bank concentrated on enhancing the resilience of Bank and Financial Institutions through the implementation of merger and acquisition regulations. This focus on regulatory frameworks contributed to an increase in private sector credit beyond the year 2016 NRB$_c$ (2022).

Figure 1

Zivot Andrews Break - PIN and PRC
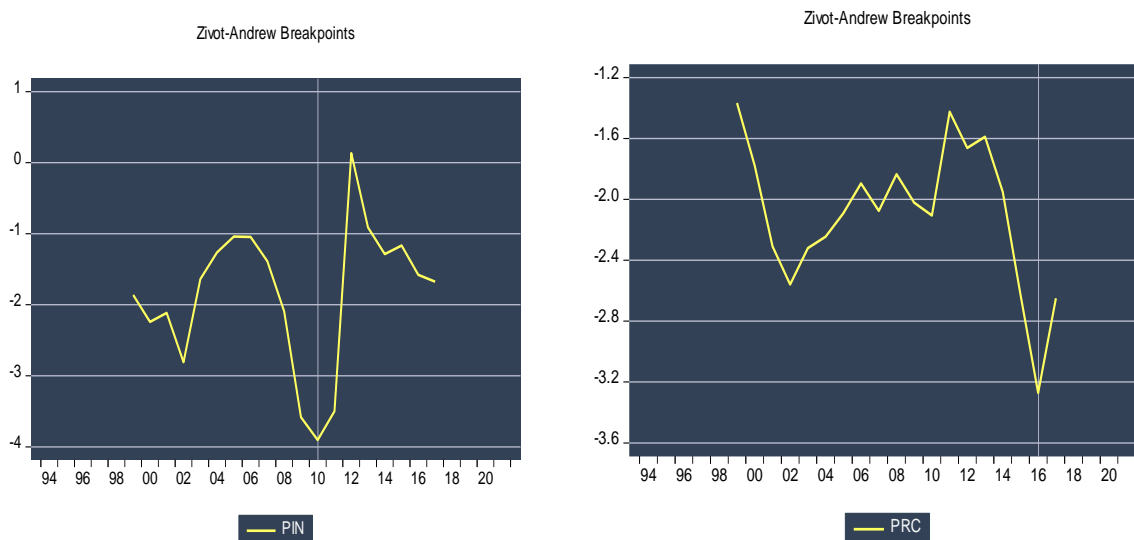
Lag Length Selection

The optimal lag was determined by evaluating the AIC and BIC values. The ARDL model with the lowest lag was selected for the NARDL analysis. Specifically, an ARDL specification with lags of (3, 2, 1, 0, 2) was chosen (as provided by the software). The corresponding AIC and BIC values for this ARDL specification were -6.162439 and -5.528624, respectively. These lower values led to the selection of this model for the NARDL analysis. The lag periods for PIN, BM, GRS, PRC_POS, and PRC_NEG were determined to be 3, 2, 1, 0, and 2, respectively. These lag periods were selected based on the lowest values of AIC and BIC to ensure that the model chosen for the study remains parsimonious. The lag selection sequence for the model followed the Akaike information criterion (AIC) methodology proposed by (Pesaran et al., 2001).

Bounds Test

The preferred model was utilized to conduct bound tests, employing Fisher's statistics within the nonlinear category, ensuring stability through significant F-test values. The F-statistic value was 5.816 with 4 degrees of freedom (k). The upper and lower bounds at the 1 percent significance level were 4.27 and 3.29, respectively. This indicates that both the upper bound *(I(1))* and the lower bound *(I(0))* were lower than the F-statistic value of 5.816. This resulted in rejecting the null hypothesis (H_0: no long-run cointegration relationship exists) and affirming the presence of long-run cointegration.

ECM and Coefficients

The Error correction Model was obtained and the value of ECT (-0.2094 or 20.94 percent) reflected that the long-term cointegration relationship was deemed statistically significant at the 5 percent level, indicating that the economy was moving towards equilibrium from its short-term disequilibrium (negative ECT). Positive shocks to PRC were statistically significant in the long run at a 5 percent significance level. These positive shocks were observed to positively impact PIN in the long term, with a coefficient of 0.65. However,

negative shocks, under one period lag effect, were not statistically significant and did not seem to have a long-term effect, with a coefficient of -0.72. In the short term, positive shocks to PRC did not affect PIN and were not statistically significant. Conversely, negative shocks were statistically significant at the 10 percent significance level in the short term, particularly with a one-period lag and through negative terms, with a coefficient of -2.60.

Asymmetric Coefficients – Long Run

Table 2

Asymmetric Coefficients – Long Run

Variable	Coefficient	Std. Error	*t*-statistic	*p*-value
PRC_POS	0.65168	0.24027	2.71224	0.0189*
PRC_NEG(-1)	-0.72612	1.67668	-0.43007	0.6726

Note. * denotes significance at 5 percent level of significance

The table presents asymmetric long-run coefficients. Positive fluctuations in private sector credit, assuming all else remains constant, a one percent increase in the private sector credit, leads to a 0.65 percent increase in per capita income for Nepal. This suggests that policies aimed at enhancing private sector credit, such as credit expansions facilitated by Nepal Rastra Bank, result in positive shocks, subsequently boosting per capita income. The rise in income attributed to these positive shocks, including initiatives like concessional and refinance loan programs, encourages entrepreneurial activities and income generation among the populace. Individuals exhibit a persistent response to such positive shocks, likely influenced by governmental efforts to stimulate credit and positively impact the economy. Conversely, negative variations in private sector credit do not significantly impact per capita income even with a lag of one period. Instances such as credit provisions during natural disasters like earthquakes or the COVID-19 pandemic primarily serve to sustain businesses without a notable effect on per capita income. These phenomena manifest in the long run, whereas the opposite holds true in the short run.
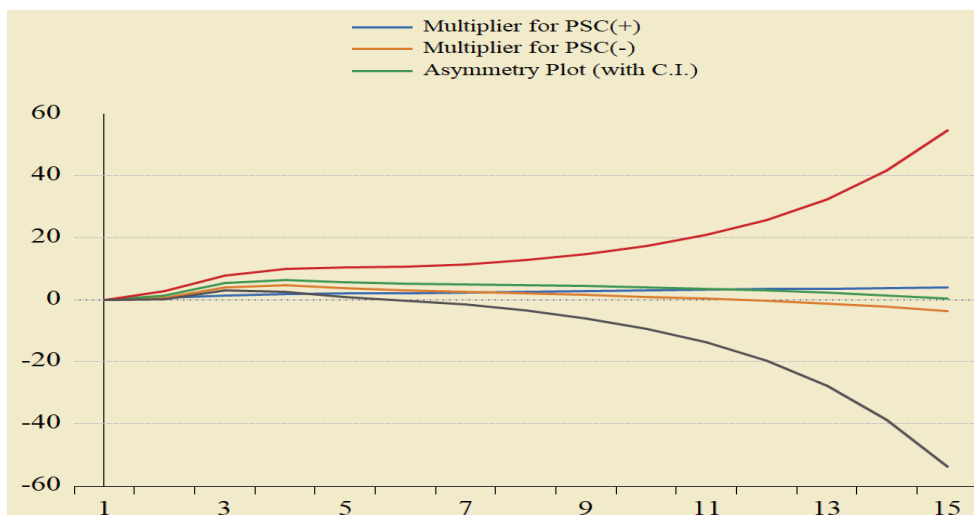
Negative shocks to private sector credit negatively impacted per capita income in the short term, with a one percent decrease in private sector credit resulting in a 0.72 percent increase in per capita income. During periods of adverse variations in private sector credit, such as shocks stemming from natural calamities or economic downturns like recessions, credit is directed towards supporting affected sectors through measures like boosting loan repayment facilities (by the central bank), as seen during the COVID-19 crisis under Nepal Rastra Bank's initiatives. Consequently, per capita income decreases in the short term as individuals rely more on savings during periods of economic adversity. The converse is also true in the short run.

Asymmetric Cumulative Multiplier

The analysis of asymmetric cumulative multipliers depicted the process by which the dependent variable aligns with its new long-term equilibrium following either a positive or negative unitary shock in the regressors (Shin et al., 2014). Figure 2 illustrates the examination of dynamic multipliers.

Figure 2

The Cumulative Asymmetric Dynamic Multiplier

In the context of the cumulative asymmetric multiplier model, the blue line depicts the response of Private Sector Credit (PRC) to both positive and negative shocks in the Per Capita Income (PIN). The green line signifies the asymmetry along with its confidence interval. It is noted that PRC reacts positively to positive shocks in PIN, particularly in the long term. All the lines, including the green, blue, and brown, fall within the red and grey lines, indicating a long-run symmetry within the model. In the short term, the brown line surpasses the blue line, indicating the considerable impact of negative shocks. However, over time, positive shocks exert a more pronounced influence on PRC, while negative shocks become less significant and fall outside the confidence interval. Positive shocks, such as government initiatives to boost output and employment, notably enhance private sector credit in the long run. Conversely, negative shocks, such as recessions or calamities, do affect PRC, but their significance diminishes. The government could demonstrate a proactive stance by prioritizing positive shocks and recognizing the importance of addressing negative shocks, which also play a role in determining PIN in the short term.

Stability and Diagnostic Tests

In the diagnostic assessment of the model, various tests are employed. Residual tests examine for serial correlation using the Breusch-Godfrey LM (BG-LM) test, for heteroscedasticity using the Breusch-Pagan-Godfrey (BPG) test, and for normal distribution utilizing the Jarque-Bera test. Stability tests are conducted via the Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) tests. Finally, the functional form is assessed using the Ramsey RESET test.

Table 3

Diagnostic Tests

Stat	$\chi2$	*p*-value*	*F*-stat	*p*-value*	JB	*p*-value*
BG LM	1.55090	0.4605	0.3307	0.7260	-	-
BPG	10.6137	0.5263	0.7377	0.6967	-	-
Jarque Bera test	-	-	-	-	3.0473	0.2179
RAMSEY test	-	-	0.4346	0.5233	-	-

In assessing the model's diagnostic validity, firstly, the Breusch-Godfrey LM Serial Correlation Test did not reject the null hypothesis (p-value = .7260 > .05), indicating the

absence of serial correlation within the model. Similarly, the Breusch-Pagan-Godfrey Test for Heteroscedasticity yielded a non-rejection of the null hypothesis (p-value = .6967 > .05), indicating homoscedasticity within the model. Furthermore, the Jarque-Bera Test for normality in the residuals did not reject the null hypothesis (p-value = 0.2179 > .05), suggesting that the residuals were normally distributed. The Ramsey RESET test was employed to assess the correctness of the model's functional form and model specification (Shin et al., 2014). The null hypothesis for the model is correctly specified and has no omitted variables, was tested using an F-test statistic, resulting in an F-statistic of 0.4346 (p-value =.5233 > .05), confirming the correctness of the functional form and the absence of omitted variables within the model.

Figure 4

Test of CUSUM and CUSUM Sum of Squares
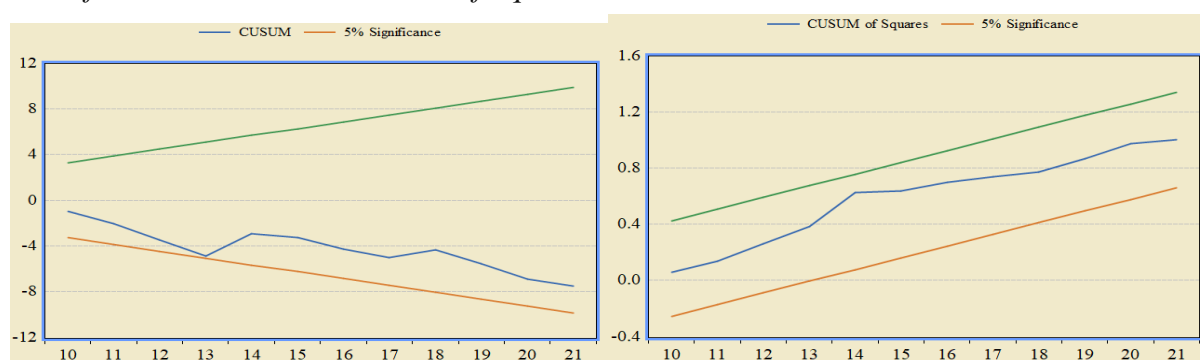
The stability of the nonlinear Auto Regressive Distributed Lag (ARDL) model in the long term was confirmed through the application of the CUSUM and CUSUM of Squares tests. The cumulative sums and cumulative sum of squares of the recursive residuals were found to fall within the 5 percent limit, indicating adherence to the model's stability criteria. This observation provides assurance regarding the stability of the nonlinear model over the long term.

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Conclusions, Implications, and Further Scope

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Conclusions

In conclusion, the findings underscore the critical role of private sector credit in driving the growth of per capita income in Nepal in the long run. Positive fluctuations in private sector credit, along with factors such as gross national savings and broad money, contribute to an increase in per capita income, thereby fostering financial deepening in Nepal. Positive fluctuations in private sector credit exhibit a significant impact on per capita income, indicating the effectiveness of policies aimed at fostering credit expansion, particularly initiatives facilitated by Nepal Rastra Bank. These positive shocks, including concessional and refinance loan programs, stimulate entrepreneurial activities and income generation, contributing to sustained economic development. Conversely, while negative shocks to private sector credit initially dampen per capita income in the short term, their long-term impact diminishes, highlighting the resilience of the economy. The analysis reveals a clear asymmetry in the response of private sector credit to positive and negative shocks, with positive shocks exerting a more pronounced influence over time. Thus, policymakers should prioritize strategies to capitalize on positive shocks while also addressing negative shocks to

ensure short-term stability and long-term prosperity. Ultimately, this trend is expected to facilitate the advancement of financial deepening within Nepal.

Implications

The analysis of the role of private sector credit in Nepal's economic growth yields several important implications. Firstly, it emphasizes the significance of policies geared towards improving private sector credit, given their substantial influence on per capita income and overall economic progress. This assertion is in line with the research conducted by Beck, Demirgüç-Kunt, and Levine (2007), which underscores the positive relationship between financial development, including access to credit, and economic advancement. Moreover, the conclusion highlights the necessity for policymakers to prioritize initiatives that foster positive shocks to private sector credit while adeptly managing negative shocks to promote the financial deepening in Nepal. This sentiment echoes the findings of Ramey and Shapiro (1998), who advocate for government interventions aimed at stabilizing the economy to mitigate the adverse impacts of economic downturns, such as those stemming from fluctuations in credit availability.

Further Scope

Future research could further investigate how policies enhancing private sector credit, including other variables impact financial deepening in Nepal. Additionally, examining the interaction between private sector credit and other macroeconomic factors could offer a comprehensive understanding of financial deepening. Utilizing advanced techniques like econometric modeling, machine learning, and big data analytics (text mining) may reveal intricate relationships within large datasets. Qualitative methods such as interviews and case studies could provide valuable insights from key stakeholders, shedding light on the practical implications of financial deepening policies. Overall, there's significant scope for research to enhance understanding and devise effective strategies for sustainable financial deepening in Nepal.

Disclaimer: The opinions expressed in this research reflect the personal perspective of the researchers and do not represent the official stance of Nepal Rastra Bank.

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