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An Analysis of the Exchange Rate Regime of Nepal: Determinants and Inter-Dynamic Relationship with Macroeconomic Fundamentals

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Abstract

The exchange rate is an important macroeconomic variable that influences internal and external balances. Nepal follows a dual exchange rate such that the Nepali rupee (NPR) is pegged with the Indian rupee (INR) but floats with the United States dollar (USD) and all other currencies. There have been very few studies on the exchange rate of Nepal, of which the majority focus on the bivariate relationship between exchange rate and another variable. However, this paper analyses the multivariate relationship between the USD-NPR exchange rate and major macroeconomic variables. Determinants of Nepal's exchange rate have been derived with multiple regression using the ordinary least square (OLS) approach. Since the explanatory variables could not significantly capture the movement of the dependent variable, a long-run relationship between Nepal and India's exchange rate has been analyzed using Engle-Granger cointegration to establish a relationship as suggested by a graphical representation. This explains that Nepal's exchange rate long run is determined by India's exchange rate than its own fundamentals. In addition, the macro-linkages of Nepal's macroeconomic variables have been analyzed using Standard Vector Autoregressive models followed by impulse response analysis which is useful for policy decisions. Some policy implications indicating the sustainability of Nepal's pegged regime have been drawn based on the empirical analysis.

Keywords: Exchange Rate Regime, Macroeconomic Determinants, Cointegration, Vector Autoregressive Models, Impulse Response, Nepal

JEL Classification Code: O53, F310, C22, C32

1. Introduction

The exchange rate, the price of one currency against the other, is an important macroeconomic variable that facilitates the international trade of goods and services and the transfer of capital. While the history of international trade goes before the medieval period, the wide facilitation of the exchange rate has come into existence only after the adoption of the Gold standard¹ and subsequently with the Bretton woods

system². However, in recent times, each nation adopts either fixed, free-floating, or a regime somewhere in between and maintains a bilateral exchange rate with major trading partners. The US dollar (USD) is considered an international reserve currency by most economies which also serves as a common currency for cross-exchange rates.

The exchange rate also indicates the external competitiveness of an economy. The undercurrent of this competitiveness is an economic performance that is reflected by other macroeconomic variables such as productivity, price level, interest rate differentials, etc. Thus, the exchange rate must be in tandem with other macroeconomic variables, at least in the long run, to avoid economic disequilibria, which can eventually result in financial and/or currency crises³. In a free-floating exchange regime, the exchange rate is adjusted continuously due to the market forces, and thus, arguably, it is believed to be in equilibria with other economic variables. However, in the case of a fixed exchange regime, it has to be revised, deliberately in case of significant change in economic performance over time as against the counterpart. The regime that follows is fixed with one currency but floating with other needs to assess both the arrangement

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scrupulously. Nepal follows a dual exchange rate system such that the Nepali rupee (NPR) is currently pegged with Indian Rupee (INR) but floats with the US dollar (USD) and other convertible currencies. Nepal is a landlocked country in South Asia, sharing its border with India from the East, West, and South, and China from the North. It is a small economy with a \$33.65 billion nominal GDP⁴ and has an open porous border of about 1770 kilometers with India, resulting in high trade and cultural integration. This geopolitical background has directly impacted its exchange rate policy and reforms. The exchange rate between NPR and INR was stable from 1877 to 1932 with a fixed exchange regime. However, it went through a phase of instability from 1932–1960, when NPR replaced the former ‘*Mohar*’ currency in Nepal. Both countries went through a series of major political and economic transitions. (Maskay, 2007). The period from 1956 to pre-liberalization till 1993 witnessed the expansion of NPR, the end of the dual currency system, stability of the INR-NPR exchange rate, and the evolution of foreign exchange reserve management.

The exchange rate management before 1956 was in relation to INR alone, as foreign currency reserves were managed by the Reserve Bank of India (RBI). The buying and selling of other convertible foreign currencies began only after the inception of the Nepal Rastra Bank in 1956. While the INR rate was fixed by the Government, exchange rates against other convertible currencies were adopted from the rate published by the RBI. However, with a motive to enhance international trade, fixed exchange rates of the USD, Pound Sterling, and Swiss Franc against NPR were determined from May 14, 1960. Subsequently, the practice of dual exchange rate of other convertible currencies was introduced on March 31, 1978, but with a fixed USD rate. Eventually, USD started floating daily only from February 12, 1993, after the full convertibility of the current account (NRB, 1981, 2018). Since then, Nepal Rastra Bank and commercial banks have been publishing and quoting their exchange rates independently daily. The exchange rate of USD-INR-and USD-NPR and INR-NPR from 1994 to 2020 is depicted in the graphs below (Figures 1 and 2).

As per the graph above (Figures 1 and 2), it can be observed that USD-NPR and USD-INR exchange rates have been moving upwards, nearly synchronized. Further, the INR-NPR rate has remained the same since February 12, 1993. In a dual exchange rate regime, the constant peg rate is possible only when the macroeconomic performance of Nepal is nearly similar to that of India. However, on the contrary, the economic landscape of these two countries has changed visibly. The graph below presents major exchange rate-determining variables as per existing theory, namely, inflation rate based on consumer prices, trade deficit, and GDP growth rate at current prices (see Figures 3, 4, and 5).

The graphical representation above depict that, the economic performance of India has been better than Nepal nearly consistently over the last three decades. For instance, the economic growth of India in the last 30 years has been nearly 6 percent on an average while Nepal’s average growth for the same period was only around 4.4 percent due to decade-long political turmoil and prolonged transition in the drafting of the new constitution. While the inflation rate of Nepal, on an average, was marginally high than that of India, the trade deficit has been a matter of serious concern to Nepal. Further, Nepal’s trade deficit is ever-widening that reaching a

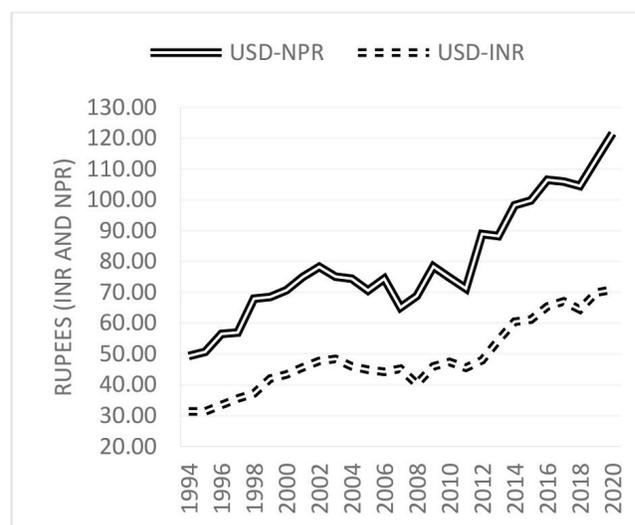


Figure 1: NPR and INR Exchange Rate

Source: Nepal Rastra Bank

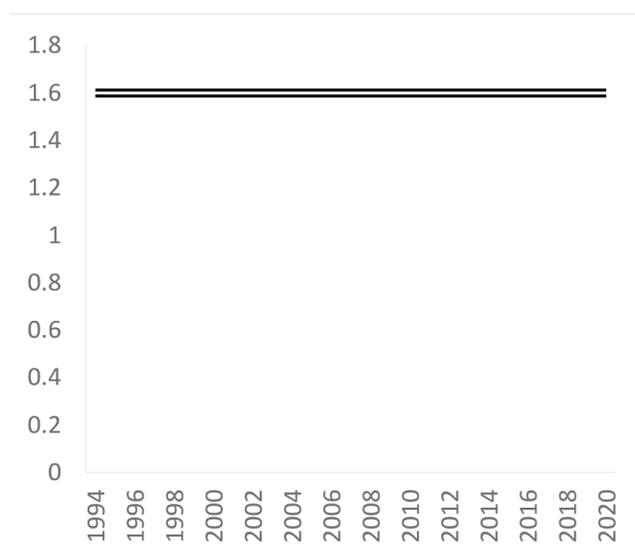


Figure 2: INR-NPR Exchange Rate (NPR Per INR)

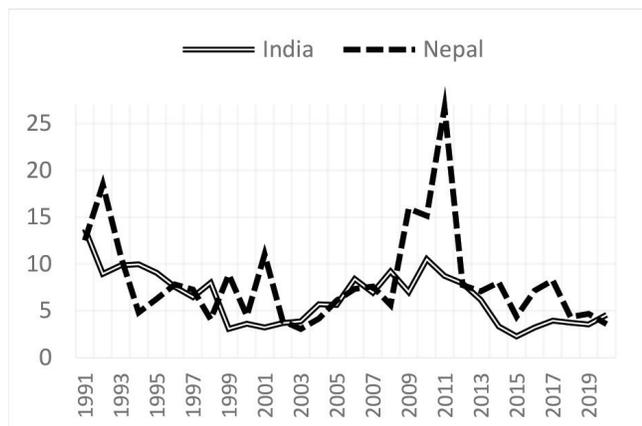


Figure 3: Inflation Rate (Percent) Based on the Consumer Price Index



Figure 4: Trade Deficit (Percentage of GDP)

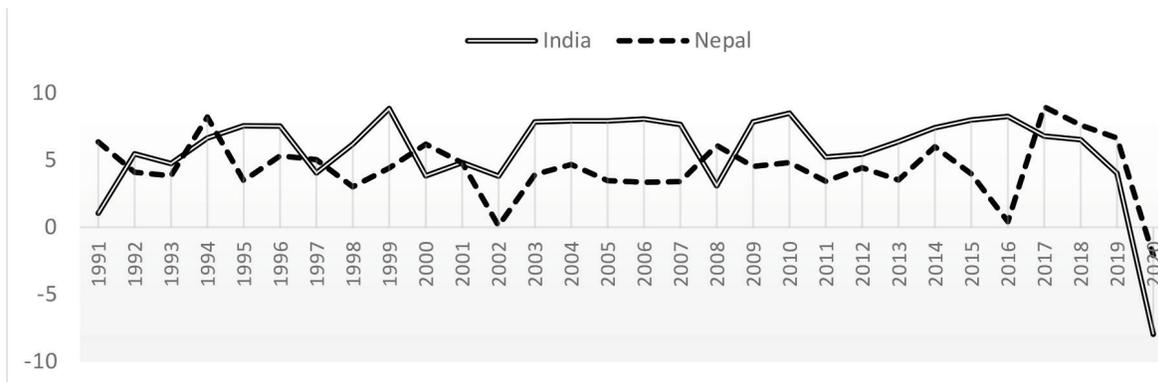


Figure 5: GDP Growth Rate (Percent)
Source: The World Bank

whopping 33.68 percent in 2019. Remittance inflow has been the major source for Nepal to finance its trade deficit.

The exchange rate is determined as per the performance of major macroeconomic fundamentals⁵. However, under a fixed regime, the disequilibrium is likely, especially when the regime is backed by the restricted capital flow. It is because a currency is pegged with unlimited convertibility such that the rate is kept constant by increasing/restricting the supply of pegged currency. However, in the case of Nepal, the pegged rate has not been revised since 1993 despite widened economic gap with India seems quizzical. The rate has been found overvalued which in turn has resulted in an export-competitiveness trap (Paudel & Burke, 2015; Pandey, 2014).

The dual exchange rate system of Nepal requires a two-fold analysis. Firstly, study the efficacy of conventional peg with INR, its alignment, sustainability, and reserves management. Secondly, analysis of the flexible exchange rate system with USD and other convertible currencies. While both are intertwined, the latter seems rationale to assess if the exchange rate reflects economic fundamentals. This is relevant, as there is no existing research work that analyses the USD-NPR exchange rate. Thus, this paper focuses on the second aspect with an empirical application as follows:

- To identify major macroeconomic determinants of the USD-NPR exchange rate.
- To analyze the long-run relationship between USD-INR and USD-NPR exchange rate.
- To estimate inter-dynamics among major economic variables and draw some policy implications.

The second section of this paper contains a review of relevant literature, followed by methodology and empirical analysis in the third section. The fourth section concludes with some policy suggestions.

2. Literature Review

The exchange rate plays a role of a catalyst for macroeconomic stability. In an integrated world, it is a matter of concern for all. While for policymakers, the exchange rate is important to determine output and inflation in the economy, it is important for fund managers to plan their asset allocation (Bhanumurthy, 2006). Nations have adopted different variations of alternative regimes based on their economic objective. Though a fixed exchange rate encourages foreign trade, and investment and restrains inflation, it tends to have a long-term misalignment in the real exchange rate, requires high foreign exchange reserves, and results in inflexibility of economic policy. Similarly, though a flexible exchange rate helps to secure efficient allocation of resources and provides independence to monetary policy, it results in exchange rate volatility and possible speculative attack. This can have an adverse influence on foreign trade and investment in the short run and turn affect economic efficiency and growth in the medium and long run (Gylfason, 2000).

Time horizon is another important facet to determine factors that influence the exchange rate. There are micro-structure approaches that mainly focus on the short term, called the order and flow approach. Under this, perspectives of spot-rate dynamics, bid-ask spread, and portfolio shift models try to explain the cursory movement of the exchange rate. The exchange rate dealers in India are of the view that two factors predominant affecting India's exchange rate are speculation and central bank intervention (Bhanumurthy, 2006). Similarly, in Vietnam exchange rate intervention plays an important role to curb exchange rate volatility; however, it has a little influence on exchange rate movement (Ding & Wang, 2022). However, this may not hold in all the circumstances because all players in the market do not adapt to the same model as their expectation may vary across time period (Frankel & Froot, 1995). Thus, though the real exchange rate in the short run might get deviated due to sharp fluctuations and price rigidity, in the long run, it is determined by international trade and adjustment in the current account (Kaltenbrunner, 2015). Some literature argues that macro fundamental theories have no role in determining short-run exchange rate movement (Evans & Lyons, 1999).

However, the rationale for the fluctuation of the exchange rate in the short run and long run are analyzed differently. The long-run exchange rate determination adopts a macro-approach, known as the asset price-based approach or the stock approach (Chinn, 2012). Under this, most theories state that the exchange rate, in the long run, reflects macroeconomic fundamentals of an economy such as GDP growth, international trade, currency convertibility, inflation, interest rate, bond prices, cumulative trade, and economic policies (Frenkel, 1976; Dornbusch, 1976; Mundell, 1963; Fleming, 1962; Chinn, 2012).

There have been numerous studies on the determinants of the exchange rate in the long run. Studies before the 1970s were studied with the fixed price assumption, where the price level between two countries was assumed static. Mundell-Fleming (MF) model known as the IS-LM-BP model, an extension of the Keynesian IS-LM model, states that in a small economy with perfect capital mobility and static price level where the domestic interest rate is determined by world interest rate, exchange rate adjustment occurs through current and capital flows (Fleming, 1962; Mundell, 1963).

The collapse of the Bretton woods system in 1971 led to the adoption of a floating exchange regime by many industrial countries and in this shift, evolved monetary models. The augmentation of these models as compared to fixed price assumption models was that they included the effect of money demand and purchasing power parity such that inflation influenced the macroeconomic adjustments. It states that the exchange rate depends on the relative price of two currencies and the price, in turn, is dependent on the demand and supply of the stocks of money. The flexible price states that the Purchasing Power Parity (PPP) holds continuously both in the short-run and long-run. However, the sticky price model (Dornbusch, 1976) states that since the goods market reacts sluggishly in comparison to the money market, PPP holds only in the long run.

However, post-Keynesian economists often criticize some versions of the monetary approach for their robustness (Harvey, 1991). For instance, as per the monetary model, higher-income results in stronger currency; however, a higher interest rate induces weaker currency. This is in contradiction to the static version of the MF model that states that higher income induces imports and weakens currency due to capital outflow; a higher interest rate induces capital inflow resulting in stronger currency (Chinn, 2012). However, Taking Fisher's relation into account, an increase in interest rate will result in a weakening of the currency, as inflation differential will feed the interest rate differential in the case of flexible price monetary models, as PPP holds both for the short-run and the long run. But, the impact of the money market gets adjusted immediately against the sluggish goods market, a reason that causes overshooting. Thus, the exchange rate is positively influenced by inflation while negatively influenced by the interest rate.

The main determining factor of the exchange rate as per portfolio balance models is risk premium due to imperfect substitutes of assets that are dominated in different currencies. Though nations have perfect capital mobility, this capital is not a perfect substitute. Thus, the main difference between monetary and portfolio models was the influence of variables on the long-run exchange rate. The formal stated macroeconomic fundamental is the main determinant, while later established capital flows have the most important role (Barbosa et al., 2018).

The role of financial variables in determining exchange rates has been more prominent than with increasing integration of cross-border holding of assets and liabilities (Mundell, 1963). In the case of a high portfolio recipient country like India, Sensex⁶ is the most influencing variable in determining India's exchange rate (Raju & Sharma, 2013). Several other recent studies have taken variables like capital flows, BoP position, GDP at factor cost, foreign exchange reserves, forward exchange rate, and central bank intervention to identify determinants of the exchange rate. (Monica & Santhiyavalli, 2017; Dua & Rajan, 2010). However, in the case of Saudi Arabia, though oil constitutes a major component of the trade basket, it did not have any influence on exchange rate movement (Ben Dhiab et al., 2021).

In recent times, the role of externalities has been another important factor that explains exchange rate movement. (Gongkhonkwa, 2021) studies the influence of the COVID-19 pandemic on the Thai Baht exchange rate and concludes that, as confirmation of COVID cases increases in Thailand, the Baht depreciated with the Chinese yuan (CNY), Malaysian ringgit (MYR), Singapore dollar (SGD), Vietnamese dong (VND), Australian dollar (AUD) and Taiwan dollar (TWD) however, appreciated with the United States dollar (USD), Japanese yen (JPY), Indonesian rupiah (IDR) and Hong Kong dollar (HKD). Similarly, the author further examines the impact of the pandemic taking new cases and death casualties and their role in the movement of the Thai Baht with major other trading currencies.

There have been limited studies on Nepal's exchange rate policy. Most of the studies focus on the relationship of the exchange rate with one or more economic variables such as GDP, trade, remittance, export performance, trade balance, and so on. For instance, a study empirically identifies that the Real Effective Exchange Rate (REER) affects economic activity through the aggregate demand channel in the Nepali economy. Thus, the authors emphasize a need to keep REER constant for a favorable trade situation (Thapa, 2002). Similarly, another study concludes that the exchange rate directly impacts both cash flows and trade flows; thus, depreciation of the nominal exchange rate results in improvement of foreign exchange reserve and trade deficit (Adhikari, 2018). However, in contradiction (Chaulagain, 2015) uses Johansen's cointegration test to analyze the J-curve phenomena in the case of Nepal and conclude that there is no such relationship. The study rather indicates that there is no scope to address trade imbalance through currency devaluation. Unlike trade, however, the impact of the exchange rate on remittance has been found positive. Nepal's remittance inflow is determined by the nominal USD-NPR exchange rate and economic activity in host countries, mainly in India and the Gulf countries, indicating spillover of economic growth. This implies that

when exchange rate volatility has a direct impact on the liquidity of the economy due considerable size of remittance inflow (Budha & Pant, 2016).

The pegged regime with India has been another cornerstone of studies undertaken. (Maskay, 2001) uses the binomial probit model to analyze the probability of adjustment of Nepal's exchange rate policy as against INR. The empirical study identifies that while relative interest rate has significant effects on Nepal's exchange rate probability, money and output growth do not have significant effects. Similarly, Pandey (2014) uses the BEER approach of Clark and MacDonald and also Johansen integration VAR models to assess possible REER misalignment and empirically identify that the exchange rate has been overvalued consistently from 2005 to 2008.

3. Data and Methodology

3.1. Data Source

The time-series data of quarterly frequency has been taken for analysis. Data is obtained from NRB quarterly financial highlights from 2004–05 to 2019–20 based on the Nepali calendar⁷. However, the USD-INR nominal exchange rate is taken from the RBI Handbook of Statistics. The data obtained from NRB was not tabulated on a time series at the source, thus, each cross-sectional observation had to be extracted from a respective quarterly publication. Further, data of Nepal Stock Exchange (NEPSE) Index data for 2004 and 2005 were taken from the Securities Exchange Board of Nepal (SEBON) as these data were not included in the NRB quarterly report.

3.2. Model Specification

The causal analysis of the USD-NPR exchange rate has been analyzed using multiple regression based on the Ordinary Least Square (OLS) approach. The model is chosen as per the monetary approach to exchange rate determination. Monetary models in comparison to portfolio and hybrid are preferred because the latter models have poor empirical implications that many studies could not even find signs of coefficients of bond price correct. Thus, taking USD-NPR as a dependent variable, choices of variables have been ascertained predominantly as per the existing theories. Most of the previous studies have taken a combination of one or more variables such as money stock, total output, interest rate differential, inflation differential, aggregate trade, bond prices differential, and cumulative trade balance as explanatory variables to understand the determination of exchange rate in the long run based on macro approach (Chinn, 2012).

Among the variables, inflation rate, interbank rate as a proxy of interest rate, Nepal stock market (NEPSE) index, Gross Domestic Product (GDP), and total accumulated foreign exchange (forex) reserves are considered for this study. The rationale behind taking GDP instead of trade is that, primarily, net factor import abroad (NFIA), a component of GDP, proxies trade component, and in addition, it is a better proxy of overall economic performance. Further, the reason behind taking forex reserves is to capture the net transfers such as remittance, which is a substantial figure, nearly one-fourth of Nepal's GDP. Similarly, the stock market index influences the exchange rate in many developing economies as they invite capital inflow through portfolio investment. In the case of Nepal the Foreign Investment and Technology Transfer Act, 2019 has given a conditional leeway for foreign investors to participate in the capital market. Moreover, due to the porous border with the possibility of labor and capital from India, their impact on the stock market seems possible.

In the regression estimation, the USD-NPR exchange rate, foreign exchange reserves, GDP, and NEPSE index have been log-transformed to address the issue of skewness and Heteroscedasticity. However, the percentage figure data, namely, interest rate and inflation rate, have been taken as it is to capture the actual causation. The lag effect on the equation has been determined based on apriori information. An appropriate dummy (dum) for 2007–08 Q4 has been taken into account for the global financial crises.

4. Results

4.1. Unit Root Test

Time series data need to be stationary to avoid spurious results. Thus, the unit root testing of each of the time series

variables has been examined using the Augmented Dickey-Fuller (ADF) test using the equation below.

$$\Delta Y_t = \psi Y_t - 1 + \sum_{i=1}^p \alpha_i + \Delta Y_{t-1} + u_t \quad (1)$$

In the equation above, Y_t is the relevant time series variable, Δ is the first difference operator with u_t stochastic error component.⁸ As per the unit root testing, the following results have been obtained (Table 1).

4.2. Empirical Analysis Results

The OLS regression result is obtained as below:

$$\begin{aligned} \Delta (\ln \text{nexr}) = & -0.315 (-1.244) + 0.003 \text{ inf}^{***} (2.639) \\ & + 0.027 (\text{Ingdp}_{t-1}) - 0.005 \text{ inf}^{**} \\ & - 0.079 \Delta (\ln \text{NEPSE})^{***} (-2.639) \\ & + 0.062 \Delta (\ln \text{fxr}_{t-1}) + 0.058063 \text{ dum} (1.862) \\ R^2 = & 0.294 \quad \bar{R}^2 = 0.218 \quad F\text{-statistic} = 3.884^* \\ \text{D-W Stat} = & 2.006 \end{aligned} \quad (2)$$

*** Significant at 1%.

From the regression result above, inflation, interest rate, and NEPSE index are significant explanatory variables at a 99 percent confidence interval. The expected signs of all the variables as per economic theory except for foreign exchange reserves. The equation above explains only 21.8 percent of exchange rate variation which means that the unexplained component of an exchange rate movement is beyond the variables chosen. In terms of statistical validity, any linear combination among two independent

Table 1: Unit Root Test Results

	Explanation of a Variable	Test of Stationarity	Economic Relationship with NEXR ⁹
Ingdp	Log Gross Domestic Product	Stationary at I(0)	Negative
int	Inflation rate	Stationary at I(0)	Positive
int	Interest rate	Stationary at I(0)	Negative
Innexr	Log NPR nominal exchange rate with USD	Stationary at I(1)	–
lnNEPSE	Log Nepal Stock Exchange Index	Stationary at I(1)	Negative
lnfxr	Log Foreign exchange reserves	Stationary at I(1)	Negative
lnstd	Log trade deficit	Stationary at I(1)	
lnrmt	Log Net Remittance flow	Stationary at I(1)	

variables was not found to be highly correlated; hence the issues of multicollinearity do not exist in the equation. This is indicated by the models themselves, as there are 3 significant variables and the adjusted R -squared is also low. Further, the D-W statistic of 2.00 depicts that the issue of auto-correlation of residuals does not exist to influence the regression results significantly. In addition, as per the Breusch-Pagan-Godfrey test, the probabilistic chi-square value was 0.3809, which means that the equation above does not have issues of Heteroscedasticity. Further, the Root Mean Squared Error (RMSE) is 0.046, which indicates a high predictive capability of a model to the extent it explains causality.

The significant impact of the NEPSE index on the exchange rate could be due to the transmission effect arising from capital movement from India, increasing foreign direct investments (FDI) over the years, and unsterilized increase in money supply due to remittance receipts. The main reason why inflation is significant, though with a minimal impact, is the price differential with the rest of the world. Nepal's trade competitiveness has been deteriorating over the years as domestic production has been replaced by foreign goods, causing an increase in imports and a decrease in exports. The steep rise in imports over the years has contributed to the depreciation of the Nepali currency. Similarly, the possible reason for the significance of interest rate can be attached to increased money supply from informal transactions through porous open borders and remittance receipts through informal sources¹⁰. One peculiar phenomenon that is observed in the

case of Nepal is poor macro-economic linkages resulting in the oscillating behavior of variables. For instance, while credit has been increasing nearly around 18 percent annually over the last 20 years, this transmission in GDP is nowhere closer, as it has grown on an average at only 4.4 percent per annum. Thus, stimulated interest rate due to high credit flow in the unproductive sector must have impacted the exchange rate through the asset price channel¹¹. Further, GDP and, accumulated foreign exchange in the regression equation are not significant variables, their impact exchange rate is not statistically valid to interpret.

In a floating exchange rate system, if the exchange rate is not determined by major economic variables, what determines the USD-NPR nominal exchange rate? Since NPR is pegged with its largest trading partner India, does it have any owing to the determination of Nepal's exchange rate? To explore this question, a graph is displayed below that depicts the residuals of the OLS regression model obtained from equation (2) and the quarterly rate of change in the USD-INR exchange rate (Figure 6).

The graph above (Figure 6) displays a striking similarity between the movement of residuals of equation (2) above and the rate of change of the USD-INR rate. This states that an unexplained portion of the exchange rate movement has a very close relationship with USD-INR. A causal analysis taking USD-INR as an exploratory variable in equation (2) was carried out that showed significant influence ($\bar{R}^2=0.87$) with very high coefficient (0.89). However, the regression suffered from very high auto-correlation with

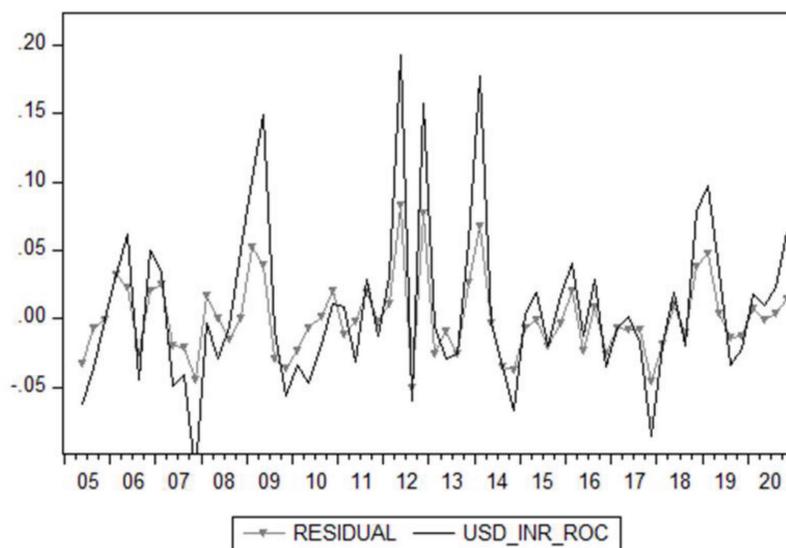


Figure 6: Residual Plot Vs. USD-INR Exchange Rate (Quarterly Rate of Change)

Where y_1 and y_2 are contemporaneously correlated variables. To understand Nepal's macroeconomic environment, eight stationary transformed variables namely interest rate and inflation in actuals, GDP, NEPSE index, forex reserves, remittance, USD-NPR exchange rate, and trade deficit (multiplied by -1 to convert into positive value) after log transformation, have been considered for analysis. Lag lengths of 5 have been chosen based on Akaike Information Criteria (AIC).

4.5. Endogenous Relationship

The endogenous relationship of lags based on VAR results has been populated as follows (Table 3).

From the table above (Table 3), it is observed that, while some variables are significantly influenced by the past performance of other variables, some do not have a strong relationship. For instance, inflation is not influenced by its own lags or any lag of any other variables. On the contrary, Foreign exchange reserves seem to have a strong relationship with all the variables. It is influenced by its own 3 and 4 lag, second lag of NEPSE index, 1 and 4 lag of interest rate, 3 and 5 lag of remittance, 1,4 and 5 lag of inflation, 1,3 and 4 lag of GDP, 1,3 and 4 lag of USD-NPR exchange rate, 1,2 and 4 and 1,2 and 4 lag of trade deficit. This is consistent with the theory, as all forex reserves are majorly dependent on overall economic performance.

Among the other variables, GDP, and interest rate trade deficit are other variables that seem to be significantly influenced by other variables. GDP is influenced by its own preceding lag, second lag of interest rate and forex reserves, 2 and 4 lag of USD-NPR exchange rate, 4 and 5 lag of inflation, and fifth lag of remittance. Similarly, the interest rate is influenced by its own third lag, the first lag of

forex reserves, and the fourth lag of exchange rate and trade deficit. Moreover, a trade deficit is influenced by all of its lag except for the fourth one, the first lag of GDP, the third lag of exchange rate, the fourth lag of interest rate, 2 and 4 lag of inflation, and 2 and 3 lag of NEPSE Index.

4.6. Impulse Response Function

As an extension of the VAR model analysis, we have further analyzed responses of Nepal's exchange rate against each of the macroeconomic variables. The impulse response function is graphically represented as follows (Figure 7).

In an endogenous model with multiple variables and numerous lags, it becomes noisy to understand input-output shock among any two given variables. However, for this, the impulse response function is used to analyze the response of a variable when a positive shock of one standard deviation is given an impulse variable, by employing vector autoregressive models. In the figures above, we have tried to analyze the response of the USD-NPR exchange rate with an impulse on macroeconomic variables taken for VAR analysis.

In the first figure, the appreciation of the exchange rate as a response to a positive shock in interest rate is visible in the first quarter itself, this corrects slightly in the second quarter, overshoots in the third quarter and stabilizes gradually. As per the theory, the exchange rate reacts instantaneously to changes in the money market. Similarly, in the adjacent figure, a positive shock on inflation shows depreciation of the exchange rate as per the theory. It corrects within the third quarter and normalizes from then on. It implies that when inflation increases, the exchange rate instantaneously depreciates and takes to a quarter of the time to converge back to normal indolently.

Table 3: The Endogenous Relationship

	int	inf	lngdp	lnNEPSE	lnfxr	lnrmt	lnnexr	lntd
Lag of int	3		2		1,4			4
Lag of inf			4,5	5	1,4,5			2,4
Lag of lngdp			1		1,3,4			1
Lag of lnNEPSE				5	2	1		2,3
Lag of lnfxr	1		2	1	3,4	4	1	
Lag of lnrmt			5		3,5		2,3,5	
Lag of lnnexr	4		2,4		1,3,4		3	3
Lag of lntd	4			3	1,2,4			1,2,3,5
Adjusted R^2	0.60	0.30	0.98	0.33	0.72	0.31	0.18	0.58
F-statistic	3.11*	1.61	106.70*	1.69	4.61*	1.63	1.31	2.97*

*Significant at 5%.

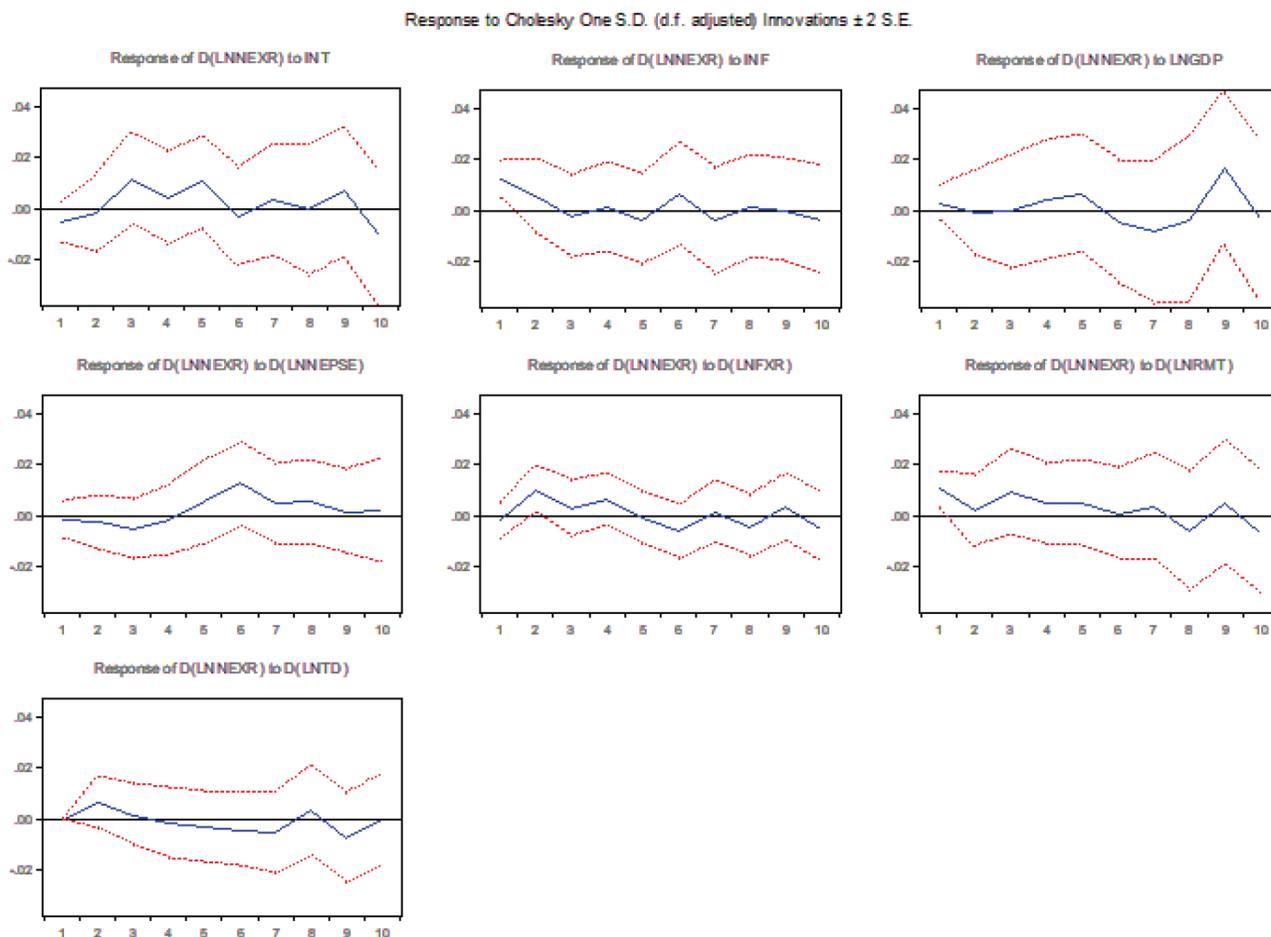


Figure 7: Response of Nepal's Exchange Rate Against Each Impulse Variable

In the third figure, when a positive shock is given to GDP, the exchange rate depreciates, negligibly instead of appreciation. It immediately converges back to normal in the second quarter and stabilizes, showing no significant causal relationship between GDP and exchange rate in the first four quarters. This is consistent with the result achieved from OLS regression, reiterating that GDP was no significant role determinant of the exchange rate in the case of Nepal. Similarly, the inverse relationship between the NEPSE index and the exchange rate is visible in the fourth figure (first figure in the second row). It is visible that the instant positive shock on the NEPSE index has a slight and steady effect on the exchange rate in the first three quarters, before converging in the fourth quarter.

In the fifth figure, the exchange rate shows no response to positive shock given to forex reserves in the first quarter. As per the theory, exchange rate and reserves should have an inverse relationship, however, in the second quarter, the

relationship is positive that corrects gradually from the third quarter. Perhaps, this anomaly is due to a non-significant causal relationship between forex reserves and exchange rate in the case of Nepal. Similarly, in the sixth figure, the exchange rate depreciated instead of appreciation in the first quarter, when a positive shock is given to remittance flow. However, this was corrected to the large extent in the second quarter itself, indicating a lagged influence.

In the last figure, the exchange rate shows a positive response to one standard deviation positive shock on the trade deficit. Since, the trade deficit was a negative series originally, later positively transformed (by multiplying the series by -1) for log application, it is a negative response and contrary to the existing theory. Though the series corrects by the third quarter itself, the relationship is inconclusive in the case of GDP. Further, the J-curve phenomenon was not visible in the case of Nepal and this was found consistent with Chaulagain (2015).

5. Conclusion and Policy Implications

There have been very few studies on the exchange rate regime of Nepal. This paper attempts to explore a novel aspect of Nepal's dual exchange rate regime by identifying major determining factors of the USD-NPR exchange rate. Further, the paper also empirically establishes the long-term relationship between India and Nepal's exchange rate, studies the inter-dynamic relationship among major macroeconomic variables, and draws some policy inputs through impulse analysis. The causal relationship through OLS regression demonstrates that though diminutive, interest rate, inflation rate, and NEPSE index are significant variables that determine exchange rate in the long run. However, the long-run cointegrating relationship between USD-NPR and USD-INR, along with graphical residual movement analysis concludes that India's nominal exchange rate movement is the major force in determining USD-NPR exchange rate movement.

Further, there is a reasonable interaction among macroeconomic variables. Forex reserves are highly sensitive to inflation, GDP, exchange rate, and trade. The requirement of forex reserves in a pegged regime cannot be undermined, thus, its sensitivity is a matter of concern for Nepal. On the contrary, inflation not being influenced by its own lag or lag of any other variables indicate that it is a standalone variable that has only unidirectional causation to GDP, NEPSE index, forex reserves, and trade deficit. The exchange rate is a nominal anchor of monetary policy. Inflation, interest rate, and exchange rate do not show a strong relationship indicating a possible challenge for policymakers to obtain efficient transmission through monetary policy instruments. Further, the trade deficit predominantly influenced by its lags indicates the trade trap, more precisely the export competitiveness trap.

The exchange rate in long run must be majorly determined by the macroeconomic variables. However, when flexible exchange rate movements do not reflect fundamentals and are determined predominantly by the performance of a pegged currency even in the long run, it strongly indicates an anomaly in a currency. Thus, this study indicates that NPR might not be rightly valued. Primarily, the possible reason for such anomaly could be pegged rate alignment itself. Since USD-INR flexible exchange rate majorly determines USD-NPR, it is more to do with the rate at which USD gets translated from INR to NPR. The INR-NPR pegged rate has remained unchanged for the last 27 years, despite significant changes in the economic landscape. A separate study is required to identify possible misalignment of pegged rate, its sustainability, and policy implications to optimally determine a better regime. The sustainability of Nepal's peg rate given that total foreign currency reserves hover only around \$10–12 billion can be a question for discussion. Thus, when small economies peg with larger trading partners, if

misaligned, it needs adjustment as per fair value reflected by fundamentals. Otherwise, the economic repercussions like an increased proportion of shadow economy and export-competitiveness trap will prevail, as is persisting in Nepal, which can eventually lead to inevitable currency crises.

An immediate solution for policymakers is to ensure that macroeconomic variables and output shock are aligned with the pegged country to avoid economic ramifications. Further, the flexible exchange rate must have a very close translation difference to avoid arbitrage opportunities. This invites twin challenges for a country like Nepal. Firstly, to keep currency in alignment secondly, to keep economic performance and shock too in alignment. However, in the long run, there is no option but to constantly assess currency competitiveness and revalue/devalue as per fundamentals, change the regime itself to a softer peg or adopt a floating regime.

Finally, a peg with strongly intervened¹⁴ currency itself invites a deeper question. What if pegged currency itself is not fairly valued? If this holds, Nepal could succumb to importing misalignment from India, even if the pegged rate remains in equilibrium. While this may be stable for bilateral trade and transfer, it may not be optimal. This issue applies to other countries like Bhutan, Lesotho, Eswatini, and Namibia, who have a conventional pegged arrangement with managed floating currencies like Indian Rupee and South African Rand; only countries that are pegged with currencies other than USD, Euro, or composite basket¹⁵.

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Endnotes

- ¹ It was the basis for international monetary system from 1870s to 1932; with an abandonment during the First World War period, where each currency was fixed to certain quantity of gold.
- ² A system that existed from mid 1940s to 1971, such that all other nations' currency was pegged to the US dollar and greenback was in turn pegged with the gold.
- ³ The three generations of currency crises is an example of this fact.
- ⁴ As on 2020, as per the World Bank Data.
- ⁵ Please refer to monetary approach to exchange: An empirical perspective chapter in Exchange Rate Economics: Theory and Practice book by Ronald MacDonald.
- ⁶ Stock Market Index of Bombay Stock Exchange (BSE).

- ⁷ Financial year is from Shrawan 1 to Asar End of Nepali Calendar (typically falls from 16 July to 15 July as per Gregorian calendar).
- ⁸ For details refer to Introductory Econometrics for Finance, Third Edition book by Chris Brooks.
- ⁹ Depreciation of exchange rate is an increase in actual figure. Thus when variable such as GDP increase, exchange rate actually appreciates by reduction in an actual figure.
- ¹⁰ As per the IMF working paper, Shadow Economies Around the World: What Did We Learn Over the Last 20 Years?, a cumulative average shadow economy in Nepal from 1991 to 2015 is 37.5 percent of GDP.
- ¹¹ Another evidence to justify this is to see the rapidly increasing of land prices in Nepal.
- ¹² As per NRB reports, the ratio of INR purchase by NRB is nearly 7 times in 10 years from INR amounting to NPR 73.4 billion in 2008–09 to 516.97 billion in 2018–19 to meet ever ballooning deficit. Part of this purchase is taken by NRB in cash and to sell to the general public. The *Terai* part of Nepal has maximum demand of INR bills for daily purchase across the border. Due to this, during festival times, INR is purchased informally at 1.65 to 1.67 NPR per INR. The Cash INR is always of a high demand in Nepal and significant amount of shadow transaction occur to meet cash INR demand.
- ¹³ Though foreign exchange dealers are allowed to quote their own buying and selling rate, NRB publishes a reference rate of convertible currencies, which is *ex post* with pegged rate.
- ¹⁴ The total purchases and sales of US dollar by the RBI in FY 2019/20 is \$72.2 billion and \$27.1 billion respectively.
- ¹⁵ Annual Report on Exchange Arrangement and Exchange Restrictions, 2019 by the IMF.