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Inflation Transmission between Nepal and India under Fixed Exchange Rate

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Abstract

Given the fixed exchange rate, open boarder, and special trading relations between Nepal and India, this paper investigates how the Indian price level affects the Nepali price level. Using annual as well as quarterly data from International Monetary Fund's International Financial Statistics, results shows that the Indian inflation is affecting Nepalese price level significantly, but not vice versa. Our result indicates that about 66 percent of Nepal's inflation is attributed to Indian inflation.

Introduction

Nepal is a small open economy. It is surrounded by India, a growing South Asian economic power, from three sides, and the border between two countries is unregulated. Nepal's main trading partner is India as well. Nepali rupee (NR) has been pegged with Indian rupee (IR) for a long time. Currently, the exchange rate is fixed as 1.60 NRs for 1.00 IR. This current level of peg has been unchanged since Feb 12, 1993. Before 1993 as well Nepal pegged her exchange rate with the IR with some ups and downs. For example, on June 6, 1966 Nepali currency appreciated against IR by 57.5 percent due to the devaluation of IR. Within a year, NR was devalued almost by 25 percent. Given its proximity with India, Nepal's foreign trade is mostly concentrated with India. Even after becoming a member of the world trade organization (WTO) in 2003, Nepalese foreign trade has not been diversified. For example, foreign trade data shows that in the first quarter of 2007/08, the share of Nepal's export was 65 percent to India and import share was 62.3 percent from India (NRB, 2008).

Given its heavy dependence on the Indian market and the fixed exchange rate regime with IR, Nepal looks very vulnerable to price shock in Indian market. Is Nepal importing inflation from India? In this context, the objective of this paper is to analyze the impact of Indian inflation to Nepalese domestic price level. More specifically, given the fixed

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exchange rate and special trading relations, this paper investigates how the Indian price level affects the Nepalese domestic price level. We use the annual data from International Monetary Fund's (IMF) International Financial Statistics (IFS) to analyze the effect of Indian inflation on Nepalese price level. As an alternative to annual data, we also use quarterly inflation from the same source. The results from Ganger causality test shows that the Indian inflation is affecting Nepalese price level significantly, but not vice versa. Our result shows that about 66 percent of Nepal's inflation is attributed to Indian inflation.

Literature Review

Empirical studies indicate that the outcome of the fixed exchange rate would go either way: high inflation or low inflation. Suranovic (2005) presents general description of how fixed exchange rate can lead to the higher or the lower inflation depending upon the domestic fiscal policy. He argues that if the government runs deficit financing with printing money (also called monetization of debt), under fixed exchange rate, the interest rate goes down that results into outflow of foreign reserve. To defend the fixed exchange rate, the central bank must buy the excess money supply by the private investors that will result into balance of payment deficit lowering the domestic money supply. The net effect would be less money supply and less inflation. On the contrary, he argues that if the government devaluates its domestic currency under fixed exchange rate, it may experience more not less inflation.

Bordo and Schwartz (1988) provide a detailed account of the operation channels of transmission mechanism under the fixed and floating exchange rates using historical records. While doing so, the authors use two standard approaches: traditional open economy and Keynesian closed economy. Under the open economy world with fixed exchange rate, the transmission mechanism they described is as follows: when a domestic economic increases its money supply, it results into higher domestic expenditure, higher nominal income, and ultimately the higher price level. This higher price leads to favorable terms of trade, but results into trade deficit. The trading partner experiences the opposite, the trade surplus. Under the old fixed exchange rate regime, the domestic country finances its deficit by selling its gold stock that leads higher money supply in the foreign country (trading partner) that ultimately leads to higher price level. Under Keynesian approach, the authors argue that under fixed exchange rate, the foreign monetary disturbances are imported to the domestic country that would lead to sterilization in the short run, and ultimate abandonment of fixed exchange rate in the long run.

Cheung and Yuen (2001) present a practical case of small open economy, mostly described in the theoretical models, using Hong Kong and Singapore economies as real world open economies examples. These two city-economies are truly small open economies with trade-GDP ratio over 2 (trade volume is more than two folds as compared to GDP). Hong Kong is under strict fixed exchange rate regime (currency board) with reference to US dollar, and the Singapore has been maintaining managed float. They use

the US as the large world economy for the empirical analysis. The authors test the effect of US inflation to these two small open economies. Using the monthly data between 1984 through 1997, they found that the US inflation affects the inflations of these small economics but not vice versa. Their cointegration test shows that CPIs in three countries are moving together in the long run, but the inflation in the small economy is caused by the large economy. They also found that the US price effect is stronger in the case of Hong Kong than Singapore indicating that fixed exchange rate is more susceptible to importing inflation from the rest of the world in the case of small open economy. This study hints a possible scenario between Nepalese and Indian inflation (as in the case of Hong Kong and the USA).

Jeong and Lee (2001) examine the transmission patterns of inflation under fixed as well as the flexible exchange rate regimes among the G-7 countries and their sub-sets using vector autoregressive (VAR) analysis. Using the monthly data from 1957 through 1997, they find that the price levels are cointegrated and the transmission of inflationary disturbances across countries is less pronounced under the flexible exchange rate regimes as compared to fixed exchange rates. In order to compare the fixed vs. flexible exchange rate regimes, the authors divided the data between fixed exchange rate period (1957-1972) and flexible exchange rate period (1973-1997). Their findings show that among the G-7 countries, the US is the main producer of the inflationary innovation.

Browne (1984) investigates the international transmission of inflation to a small open economy under fixed exchange rates with high capital mobility. His contention is that transmission of inflation takes place not only through the trade route, but through the channel of capital movements. Using seven-equation structural model, the author derives an inflation equation, and estimates that equation using Ireland and UK data for two different periods: between 1972 to 1979 and 1979 to 1983. During the former period, Irish currency was maintained in a one-to-one parity with British currency, called the sterling link, and the later period covers the European Monetary System (EMS) period, called the EMS link. The author finds that the change in U.K. monetary base has a one-to-one effect on the change in the inflation rate of Ireland under the sterling link, but not under the EMS. His model provides support to the idea that under the fixed exchange rate regime, the central bank can exercise domestic monetary policy in the sort run, as oppose to the popular argument, but its effect will be insignificant in the long run.

Fisher (2001) reviews the world exchange rate regimes and argues that the world should have bipolar exchange rate regimes that either the floating or the hard peg but no intermediate exchange rate regime, such as soft peg or the managed peg. Fisher argues that the adjustable peg would not be sustainable for the developed or emerging market countries. He suggests that for a small economy, heavily dependent in its trade and capital account transactions on a particular large economy, it may make sense to adopt the currency of that country, particularly if provision can be made for the transfer of seigniorage. But he recommends more research in case of the developing economies that are not yet integrated into global financial system.

Unlike Fisher (2001), Obstfeld and Rogoff (1995) argue that the fixed exchange rate could not survive for a long time without a major hurdle. They cite numerous examples, such as Italy, Portugal, Spain, Sweden and Mexico, about how the fixed exchange rate regime got into trouble in the recent past. Numerous examples are presented about not only the hard peg, but also the soft peg and the board-band exchange rate regimes were in trouble. Their suggestion is that exchange rate should not be used as a policy target, rather a policy indicator of monetary policy. Because fixed exchange rate means forgoing the monetary policy for stabilization purposes, they argued that there is no substitute for a monetary policy as a fiscal policy takes too much time to deliver its impact and it has intergenerational distributional issues, and commercial policies may be tied with international obligation of the country. They argue that the utility of the fixed exchange rate has been diminished due to the emergence of the world capital markets. These suggestions are just opposite to what Nepal has been experiencing since 1973. The pegged exchange rate has been maintained with few reviews, and since 1993, it has not been reviewed. In the words of these authors, Nepal may fall into the category of the highly dependent economy with India so that the peg is sustainable for such a long period of time.

Sjaastad (2000) develops a model of price determination of tradable goods and shows how the exchange rate arrangement in a large economy influences a price level in small economy. While doing so, he divides the world economies between 'major-currency', the influential economies, and 'minor-currency', the smaller economies. He presents an empirical result from a small open economy, Switzerland that has been maintaining flexible exchange rate. Based on the results, the author concludes that a fixed exchange rate against any major currency would destabilize domestic real interest rate in the case of small open economy.

Given these theoretical and empirical evidences, we expect that the under the existing fixed exchange rate between NR and IR, the Indian inflation is expected to have significant impact on Nepalese domestic price level.

Data and Hypothesis

For the analysis, annual CPI for Nepal and India for the period 1974-2007 is used. For the robustness check, we also use an alternative measure of the CPI that is quarterly inflation rates. This quarterly inflation rate series is available for the period 1970:1 through 2008:2. Tables 1 and 2 present the summary statistics of the variables used in the analysis. In Table 1, the summary statistics of CPI indices with base 2000 is presented where table 2 presents the summary statistics of the quarterly inflation in two countries. The table shows that the average inflation between 1970:1 to 2008:2 is slightly higher in Nepal (8.45%) as compared to India (7.87%). But the variation of the price level during that period is relatively higher in India than in Nepal. The data are summarized graphically and presented in an Appendix. These graphs show that there is a close co-movement of two inflations.

Table: 1 Summary Statistics of CPIs of Nepal and India, 1974-2007

Variable	Obs	Mean	Std. Dev.	Min	Max
CPIN	34	57.81	41.18	11.05	140.22
CPII	34	58.05	39.96	13.69	136.78

Table: 2 Summary Statistics of Quarterly Inflation of Nepal and India, 1970-2008:2

Variable	Obs	Mean	Std. Dev.	Min	Max
Nepal Inflation %	154	8.45	5.58	-4.30	21.84
India Inflation %	154	7.87	5.81	-11.04	30.89

The hypothesis here is that as Nepal is a small open economy with open boarder with India, the fixed exchange rate of Nepalese currency with Indian currency results into the import of Indian inflation to Nepal, i.e., Indian inflation significantly affects Nepalese domestic price level, but not the vice versa as India is a large country as compared to Nepal.

Empirical Method and Results

Unit Root Test for Stationarity

A series is said to be stationary if its probability distribution are stable over time. In the regression analysis, we want to find out the relationship between two or more variables. If those time series are unstable or non-stationary, we do not expect to find anything important by running regression as those time series are unstable, and the relation is arbitrary. So, it is necessary to make sure that given time series have stable relationship over time, and that relationship does not change.

The basic formal test for stationarity of a given time series data is the Dickey-Fuller Unit Root Test. Consider the following Autoregressive of order one (AR(1)) process:

(1) $y_t = \alpha + \rho\, y_{t-1} + \varepsilon_t$,

where ε_t is error process with zero mean. The null and alternative hypotheses that y_t has a unit root are stated as

H_0: $\rho = 1$, H1: $\rho < 1$.

If H_0 is true, then the time series is non-stationary. In practice, we use the following equations for the unit root test

(2) $\Delta y_t = \alpha + \delta\, y_{t-1} + \varepsilon_t$,

where the null hypothesis is H_0: $\delta = 0$. Again, if H_0 is true, there is unit root (unstable time series). This test is called the Dickey-Fuller (DF) test for the unit root. If we allow lagged dependent variables in (2) in order to include more complicated dynamics in the system, the test is called the Augmented Dickey-Fuller (ADF) unit root test. In that case, we modify (2) as follows:

(3) $\Delta y_t = \alpha + \delta y_{t-1} + \Sigma \theta_i \Delta y_{t-i} + \varepsilon_t$,

The number of lags in (3) depends on the fact that if those lag-dependent terms are significant, and if the error process is white noise with the given number of lag-dependent variables. The objective of the inclusion of the lagged dependent variables is to clean up the serial correlation in Δy_t (Wooldridge 2000). Given the annual data for a limited period of time, we use single lag to preserve the degrees of freedom (that avoids over parameterizations). This lag selection is supported by the Ng-Perron test.

Table 3 presents the ADF test results. The test statistics (mu) is smaller than the critical values for both countries indicating the absence of unit root process. In this case, we can use the level data without taking first difference in the empirical analysis.

Table: 3 Augmented Dickey Fuller Test for Unit Root

			Critical Values			White Noise Test	
Country	lags	mu-test	1%	5%	10%	Q statitics	p>Chisq(14)
Nepal	1	0.677	-2.646	-2.374	-2.067	12.05	0.60
India	1	0.605	-2.646	-2.374	-2.067	14.33	0.42

Cointegration Analysis

The co-integration test explores if two CPI series are moving together in the long run. If a time series is non-stationary, then we can make the use of those series in the regression analysis by taking the first difference of those series. For example if Nepalese CPI is non-stationary, we should use $\Delta CPIN_t$ (= $CPIN_t - CPIN_{t-1}$), instead of $CPIN_t$ series in the analysis. However, if two series are co-integrated, then differencing makes the case worse by throwing away the useful information of their long-run relationship.

The co-integration test, in the case of two variables (say CPIN, Nepalese consumer price index and CPII, Indian consumer price index), runs as follow. Run the following regression:

(4) $CPIN_t = \alpha + \beta\, CPII_t + u_t$

Then, run the following auxiliary regression:

(5) $\Delta u_t = \rho\, u_{t-1} + \varepsilon_t$

Then we test the null hypothesis H_0: $\rho = 0$, against the alternative H_1: $\rho < 0$. If we reject H_0, this indicates that the series are co-integrated. In practice, we use the Johansen's

method for computing the estimates. Tables 4 and 5 present the results of the co-integration test. The test statistics (max lambda = 141.15 greater than the critical value of 15.67) indicate that there is one co-integrating vector. Based on the co-integration test, vector autoregressive VAR analysis is performed.

Table: 4 Johansen-Juselius Cointegration Rank Test

H0:		H1:	
Eigenvalues (lambda)	rank<=(r) r	Max-lambda statistics (rank<=(r+1))	Trace statistics (rank<=(p=2))
0.986	0	141.15*	141.23*
0.002	1	0.077	0.077

* Significant, i.e., reject the null of no cointegration.

Table: 5 Osterwald-Lenum Critical values (95% interval)

H0:	Max-lambda	Trace
0	15.67	19.96
1	9.24	9.24

VAR Analysis

As the CPI series are co-integrated and stationary, we use the simple VAR analysis in order to test the inflation transmission between Nepal and India. VAR modeling uses a simultaneous equation system where each dependent variable is a function of the lagged values of all the independent variables. In VAR modeling, the main assumption is that all variables under consideration are interdependent. The two variables VAR model looks as follows:

$$(6.1) \quad CPIN_t = \alpha_{10} + \Sigma\alpha_{1i}\, CPIN_{t-i} + \Sigma\beta_{1i}\, CPII_{t-i} + u_{t1}$$

$$(6.2) \quad CPII_t = \alpha_{20} + \Sigma\alpha_{2i}\, CPIN_{t-i} + \Sigma\beta_{2i}\, CPII_{t-i} + u_{t2}$$

As the CPIs of both countries are stationary, we use the level of both variables for the VAR analysis. Tables 4a and 4b present the VAR results.

The autoregressive nature of Nepalese price level can be seen in Table 6, where the current price level is affected by previous period's price level. However, the effect of Indian inflation on Nepalese price level is significant up to two lags. On the contrary, Indian price level is unaffected by the Nepalese inflation. In order to see if the same results hold with different measures of the inflation, we use quarterly inflation data for Nepal and India between 1970:1 - 2008:2. The results are quite robust as shown in Table 7. There is no substantial difference between this set of results and the results from the annual CPIs.

Table: 6 Vector Autoregression (VAR) Analysis for CPI Series

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Nepal Equation						
Nepal CPI						
L1.	0.983	0.255	3.86	0.000	0.483	1.483
L2.	-0.027	0.263	-0.10	0.918	-0.542	0.488
India CPI						
L1.	0.693	0.306	2.27	0.023	0.094	1.293
L2.	-0.624	0.288	-2.16	0.031	-1.189	-0.058
India Equation						
Nepal CPI						
L1.	0.086	0.220	0.39	0.696	-0.346	0.518
L2.	0.137	0.227	0.60	0.547	-0.308	0.581
India CPI						
L1.	1.393	0.264	5.27	0.000	0.875	1.911
L2.	-0.582	0.249	-2.34	0.019	-1.070	-0.094

Table: 7 Vector Autoregression (VAR) Analysis for Quarterly Inflation Series

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Nepal Equation						
Nepal						
L1.	1.191	0.083	14.33	0.000	1.028	1.354
L2.	-0.425	0.079	-5.32	0.000	-0.582	-0.268
India						
L1.	0.244	0.092	2.67	0.008	0.065	0.424
L2.	-0.055	0.093	-0.59	0.556	-0.237	0.127
India Equation						
Nepal						
L1.	-0.010	0.070	-0.15	0.880	-0.148	0.127
L2.	0.085	0.067	1.27	0.206	-0.047	0.217
India						
L1.	1.546	0.077	20.03	0.000	1.395	1.698
L2.	-0.668	0.078	-8.52	0.000	-0.821	-0.514

Granger Causality Test

As a final test of the inflation transmission from India to Nepal, we use the Granger causality test that tells the direction of causality, i.e., whether the Nepalese domestic

price level is affected by Indian inflation and vice versa. The Granger causality test result is presented in Table 8. The result shows that the direction of causality is from Indian inflation to Nepalese domestic price level, but not the vice versa. That means, Indian inflation affects Nepalese domestic price level, but Nepalese inflation has no impact on Indian price level. This result is consistent with what we generally expect. To sum up, the Granger causality test in Table 9 verifies this results that Indian inflation Granger cause Nepalese price level, but not vice versa.

Table: 8 Granger causality Wald tests, Annual CPI Series

Equation	Excluded	chi2	df Prob > chi2
Nepal India	5.3341	2	0.069
Nepal ALL	5.3341	2	0.069
India Nepal	2.4481	2	0.294
India ALL	2.4481	2	0.294

Table: 9 Granger causality Wald tests, Quarterly Inflation Series

Equation	Excluded	chi2	df Prob > chi2
Nepal India	19.761	2	0.000
Nepal ALL	19.761	2	0.000
India Nepal	4.5647	2	0.102
India ALL	4.5647	2	0.102

Examining the contribution of Indian Inflation on Nepalese Price Level

Finally, we ran a Sjaastad (2000) type regression analysis where Nepalese quarterly inflation rate as a dependent variable and Indian inflation rate as an independent variable. As these are percentage changes, no need to take logs or taking differences. The result shows that about 66 percent of the Nepalese inflation is attributed to the Indian Inflation (Table 10). This contribution is comparable to the share of Nepal's trade with India.

Table: 10 OLS estimates of effect of Indian Inflation on Nepalese Price Level

Nepalese Inflation	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Indian Inflation	0.66	0.057	11.66	0.000	0.55	0.77
Constant	3.25	0.55	5.87	0.000	2.16	4.34
N = 154, Adj. R^2 = 0.469						

Conclusion

This paper analyzes the transmission of Indian inflation to Nepalese price level given the fixed exchange rate that Nepalese currency is maintained with Indian currency for the past several decades. Using the CPI indices of Nepal and India for the period 1974-2007, we find that Indian inflation is transmitting to Nepal at a significant proportion, and the transmission is not the two way traffic meaning that Nepalese inflation has no effect on

Indian price level. The average inflation rate for the reference period is higher in Nepal than in India, and one may suspect that Nepal may have been importing inflation from India through fixed exchange rate. Given that Nepal has been maintaining a fixed exchange rate between Nepalese currency and Indian currency for the long time, it is hard to find any counter factuals that what would have happened if there was a flexible exchange rate between Nepalese and Indian currencies. For the robustness check, we also use the quarterly inflation series form both countries and conduct a VAR analysis. The results are quite stable regardless of the data series used for the analysis.

References

Bordo, M. B., & Schwartz, A. J. (1988). Transmission of real and monetary disturbances under fixed and floating exchange rates. *Cato Journal*, 8(2), 451-472.

Browne, F. X. (1984). The international transmission of inflation to a small open economy under fixed exchange rates and highly interest-sensitive capital flows. *European Economic Review*, 25, 187-212.

Cheung, Y. W., & Yuen, J. (2001). Effects of U.S. inflation on Hong Kong and Singapore. *Working Paper, Honk Kong Institute for Monetary Research.*

Fisher, S. (2001). Distinguished lecture on economics in government exchange rate regimes: Is the bipolar view correct? *The Journal of Economic Perspectives*, 15(2), 3-24.

Jeong, J. G., & Lee, Y. (2001). International transmission of inflation under alternative exchange rate regimes: Empirical evidence and its application. *Global Finance Journal*, 12, 121-137.

NRB (Nepal Rastra Bank) (2008). *Nepal Rastra Bank Bulletin 2008*. Kathmandu: Nepal Rastra Bank.

Obstfeld, M., & Rogoff, K. (1995). The mirage of fixed exchange rates. *The Journal of Economic Perspectives*, 9 (4), 73-96.

Sjaastad, L. (2000). Exchange rate strategies for small countries. *Zagreb Journal of Economics*, 4(6), 3-33.

Suranovic, S. M. (2005). *International finance theory and policy*. Retrieved from http://internationalecon.com/Finance/Fch110/F110-2.php (accessed Nov 08, 2008).

Wooldridge, J. (2000). *Introductory econometrics: A modern approach*. South-Western College Publishing, Cincinati, OH

Appendix

Figure 1: Nepal-India CPI Indices, 1974-2007

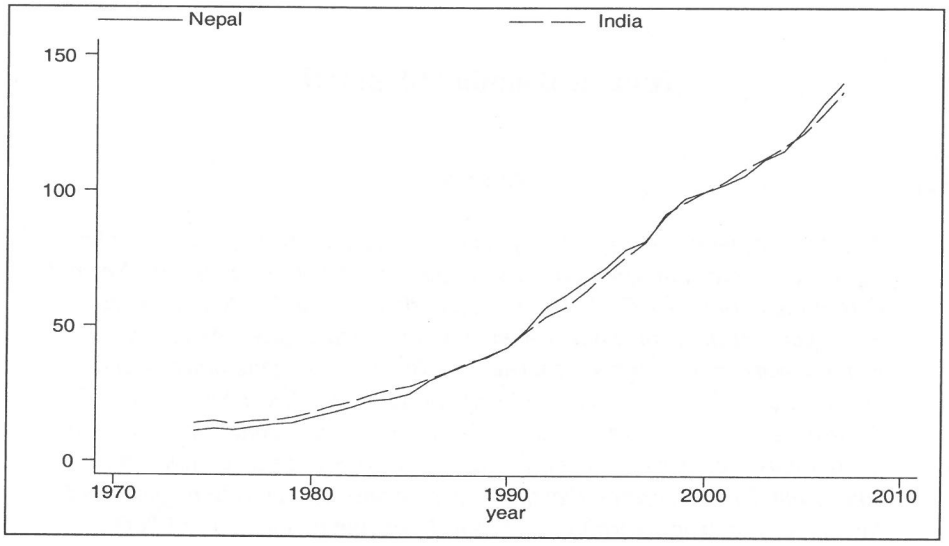

Figure 2: Nepal-India Quarterly Inflation, 1970:1-2008:2