CHAPTER - 7

DYNAMICS OF SHORT-RUN SHOCKS AND STABILITY OF THE LONG-RUN RELATIONSHIP BETWEEN EXCHANGE RATE AND RELATIVE PRICE LEVEL IN THE SECOND SUB-PERIOD

7.1 Introduction:

Cointegration study in Chapter-6 confirms the existence of long-run relationship between Rupee / Nepalese Rupee exchange rates and relative price levels prevailing in India and Nepal over the sub-period 1993:2 – 2006:1. It becomes then imperative to examine if such relationship were stable. The long-run relationship becomes *stable* if the innovations or shocks transmitted through the channels of exchange rate (e_t) or relative price level (p_t) converge and dissipate before long. The *stability* of the long-run relationship is studied through the estimation of a relevant *Vector Error Correction Model* (VECM) for the variables concerned.

The *Vector Error Correction* term in the VECM allows for a wide range of short-run dynamics and restricts the long-run behaviour of the endogenous variables to converge to this *cointegrating relationship*. The *cointegrating term* acts as the *error correction term* since the deviation from the long-run equilibrium is corrected gradually through a series of *partial short-run adjustments*. Thus the *Vector Error Correction Modeling* provides valuable information about the short-run relationship between the *cointegrated variables*.

7.2 The Vector Error Correction Model (VECM)

The estimable relevant *Vector Error Correction Model* for e_t and p_t over the sub-period 1993:2 – 2006:1 consists of the following equations

$$\Delta e_t = \alpha_1 + \rho_1 z_{t-1} + \beta_{1i} \sum_{i=1}^{m} \Delta e_{t-i} + \gamma_{1i} \sum_{i=1}^{m} \Delta p_{t-i} + \omega_t \tag{7.1}$$

$$\Delta p_t = \alpha_2 + \rho_2 z_{t-1} + \beta_{2i} \sum_{i=1}^{m} \Delta e_{t-i} + \gamma_{2i} \sum_{i=1}^{m} \Delta p_{t-i} + v_t \tag{7.2}$$

Δe_{t-i} = First Differenced Series of e_t at time t-i; i =1,2,.....,m

Δp_{t-i} = First Differenced Series of p_t at time t-i; i =1,2,.....,m

Z_{t-1} is the *error correction term* since the *Johansen Cointegration Tests* confirm the existence of *only one Cointegration Equation* between e_t and p_t. The lag length (m), in the estimation, is determined through the *Akaike Information Criterion* (AIC) and *Schwartz Information Criterion* (SIC) etc.

7.3 Results of the Estimated VEC Model (Sub-Period 1993:2 – 2006:1)

The VEC Model, consisting of the equations (7.1) and (7.2), has been estimated for the sub-period 1993:2 – 2006:1. Results of the estimation are being presented through the Tables (7.1) and (7.2) below.

Table – 7.1

Results of the VEC Model Estimation (Equation 7.1)

Sub-period : 1993:2 – 2006:1

Sample (adjusted) : 1994:3 – 2006:1

Included Observations : 47 (after adjusting end points)

Dependent Variable	Explanatory Variable/Constant	Coefficient	S.E	t-stat.
Δe_t	Constant	-0.0006	0.0007	-0.832
	Z_{t-1}	-0.018	0.020	-0.906
	Δe_{t-1}	-0.626	0.166	-3.759
	Δe_{t-2}	-0.419	0.199	-2.106
	Δe_{t-3}	0.068	0.199	0.343
	Δe_{t-4}	0.034	0.165	0.207
	Δp_{t-1}	-0.017	0.096	-0.180
	Δp_{t-2}	-0.143	0.097	-1.466
	Δp_{t-3}	0.024	0.089	0.266
	Δp_{t-4}	-0.222	0.090	-2.478

$R^2 = 0.445$ Adj $R^2 = 0.310$ F-Stat. = 3.297

Log Likelihood = 189.246 AIC = -7.627 SIC = -7.234

Determinant Residual Covariance = 1.22E-09

Table – 7.2

Results of the VEC Model Estimation (Equation 7.2)

Period : 1993:2 – 2006:1

Sample (adjusted): 1994:3 – 2006:1

Included Observations : 47 (after adjusting end points)

Dependent Variable	Explanatory Variable/Constant	Coefficient	S.E	t-stat.
Δp_t	Constant	-0.0006	0.0007	0.832
	Z_{t-1}	0.095	0.031	3.089
	Δe_{t-1}	-0.156	0.250	-0.623
	Δe_{t-2}	-0.088	0.299	-0.295
	Δe_{t-3}	0.044	0.300	0.148
	Δe_{t-4}	0.310	0.248	1.249
	Δp_{t-1}	0.266	0.145	1.835
	Δp_{t-2}	-0.053	0.147	-0.362
	Δp_{t-3}	0.105	0.135	0.780
	Δp_{t-4}	-0.535	0.135	- 3.968

R^2 = 0.520 Adj R^2 = 0.403 F-Stat .= 4.452

Log Likelihood = 170.049 AIC = -6.811 SIC = -6.417

Determinant Residual Covariance = 1.22E-09

7.4 Stability of the VEC Model

The roots of the *Characteristic Polynomials* corresponding to autoregressive structures in equations 7.1 – 7.2 are given by the Table 7.3.

Table – 7.3

VEC Stability Condition Check

Roots of Characteristic Polynomial

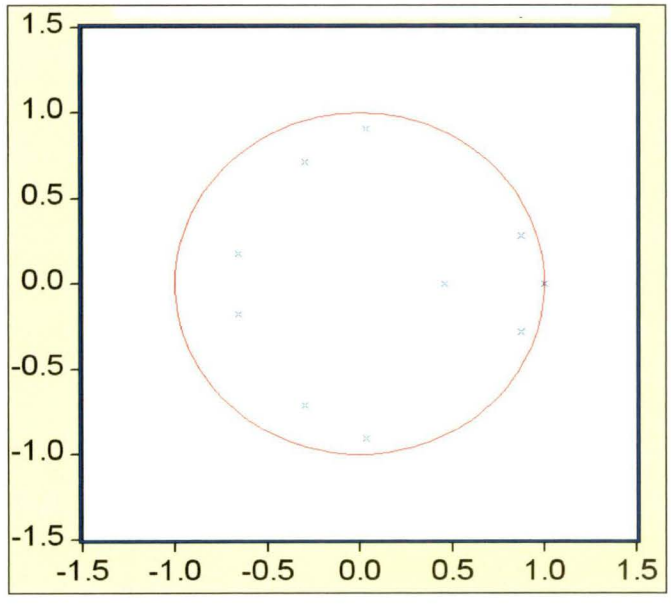
Endogenous Variables: e_t, p_t

Exogenous Variable: C

Root	Modulus
1.000000	1.000000
0.871367 - 0.279482i	0.915091
0.871367 + 0.279482i	0.915091
0.033917 + 0.904525i	0.905161
0.033917 - 0.904525i	0.905161
-0.299843 - 0.715164i	0.775477
-0.299843 + 0.715164i	0.775477
-0.656717 + 0.174623i	0.679537
-0.656717 - 0.174623i	0.679537
0.457074	0.457074
VEC specification imposes 1 unit root(s).	

Figure 7.1

Inverse Roots of AR Characteristic Polynomial



7.4.1 Findings From the Table 7.3

It is observed from the Table 7.3 that

i. the absolute values of the characteristic roots are less than unity.
ii. four of the characteristic roots are positive.
iii. four of the characteristic roots are negative.
iv. one of the characteristic roots is not significantly different from zero.

Again the *inverse roots of AR Characteristic Polynomials* lie within the unit circle. This is being shown in the Figure 7.1. *However, VEC specification imposes one unit root.* All these findings confirm the stability of the estimated VEC model consisting of equations (7.1) and (7.2).

7.5 Findings From the VECM Estimation (Table 7.1)

It is observed from the Table 7.1 that

(i) $\hat{\rho}_1$, being insignificant even at 5% level, indicates that short-run shocks, transmitted through the channel of exchange rate, fail to affect the long-run relationship which exchange rate maintained with relative price level.

(ii) $\hat{\gamma}_{14}$, being significant (at 1% level) even in the presence of Δe_{t-i} (i = 1, ...4) in the vector of regressions for Δe_t, indicates that relative price level *Granger Caused* exchange rate in the short-run over the period of study.

(iii) $\hat{\gamma}_{14} < 1$ indicates that the four period back relative price level led to less than proportionate change in exchange rate.

(iv) $\hat{\gamma}_{14} < 0$ again indicates that exchange rate declined following four period back rise in relative price level. This may apparently be in contradiction with the proposition of *Purchasing Power Parity Doctrine*. In PPP theory, e_t is directly related to p_t. So rise in relative price $\frac{P_{India}}{P_{Nepal}}$ means a fall in the purchasing power of Indian currency leading to depreciation of Indian currency. In such case more Rupees are needed to per unit of Nepalese currency. Consequently, e_t must rise.

It may however be noted that $\hat{\gamma}_{14}$ represents change in Δe_t following change in Δp_t. Consequently, $\hat{\gamma}_{14}$ represent the rate of change in exchange rate in response to rate of change in relative prices (i.e. rate of relative inflation). Consequently, $\hat{\gamma}_{14} < 0$ implies that rate of depreciation of Indian currency declines following rise in Indian inflation rate over that in Nepal.

Thus the basic proposition of the *PPP Theory* remains valid when $\hat{\gamma}_{14} < 0$. Moreover, $\hat{\gamma}_{14} < 0$ guarantees that there exists no run-away depreciation of Indian currency

following rise in relative inflation rate. Consequently, the *stability* of the long-run relationship between exchange rate and relative price level is being ensured by $\hat{\gamma}_{14} < 0$.

7.6 Findings From the VECM Estimation (Table 7.2)

The Table 7.2 shows that

(i) $\hat{\rho}_2$, the coefficient of Z_{t-1} in the equation 7.2, is significant even at 1% level. This indicates that the short-run shocks, transmitted through the relative price level channel, significantly affected the long-run relationship which exchange rate maintained with relative price level.

(ii) $\hat{\rho}_2 > 0$ indicates that, given the positive relationship between exchange rate and relative price level, relative price level rises in order to raise exchange rate when it falls below the *target rate*. Thus the adjustment of short-run exchange rate to its *long-run target value* becomes possible because of the positive variation in relative price level.

(iii) $\hat{\rho}_2 < 1$ indicates that relative price level does not make over adjustment in order to ensure adjustment of observed exchange rate to its long-run target value. Thus the long-run equilibrium relationship between exchange rate and relative price level remains *stable* even in the face of short-run variations in exchange rate.

(iv) $0 < \hat{\gamma}_{24} < 1$ is significant at 1% level. This implies that variations in current relative inflation rate are less than proportionately related to those in four period back inflation rates.

(v) $\hat{\beta}_{2i}$ (i=1,2,3,4) are not significant even at 10% level. These imply that variations in relative price level are not '*Granger Caused*' by those in exchange rates in the short-run.

7.7 Economic Interpretations of Results of the Estimated VEC Model

Economic implications of the findings from the estimated equations (7.1) and (7.2) are as follows:

i. Insignificant [even at 10% level] $\hat{\rho}_1$ in the estimated equation (7.1) indicates that exchange rate failed to exhibit any significant adjustment following short-run deviations from its target (i.e. long-run) value.

ii. Significant (even at 1% level) $0 < \hat{\rho}_2 < 1$ in the estimated equation (7.2) indicates that relative price level underwent significant adjustments causing appropriate variations in exchange rate so that exchange rate could adjust to its target (long-run) value. However, $\hat{\rho}_2 < 1$ indicates hat relative price level did not exhibit '*over adjustment*' in this process.

iii. Significant (at 1% level) $\hat{\gamma}_{14}$ indicates short-run *Granger Causality* running from relative price level to exchange rate over the sub-period 1993:2-2006:1.

iv. Insignificant (even at 10% level) $\hat{\beta}_{2i}$ (i=1,2,3,4) imply *absence of Granger Causality* running from exchange rate to relative price level in the short-run over the sub-period 1993:2 – 2006:1.

7.8 Overview of Findings From the Estimated VEC Model

Following inferences may be drawn on the basis of the findings from the study with the estimated VEC Model regarding the relationship between exchange rate (e_t) and relative price level (p_t) over the sub-period 1993:2 – 2006:1.

i. The long-run relationship that exchange rate maintained with relative price level was stable.

ii. Exchange rate exhibited no significant adjustment following its short-run variations from the target (long-run) values.

iii. The shocks, transmitted through the exchange rate channel, had no significant impact on the long-run relationship.

iv. *Relative price level exhibited significant adjustment in order to induce appropriate variations in exchange rate so that short-run deviations of exchange rate from its target (long-run) values could wither away.*

v. *The shocks, transmitted through the relative price level channel, thus had significant impact on the maintenance of long-run relationship (between* e_t *and* p_t*). Thus the short-run dynamics of relative price variations defined a* ***'Stable Equilibrium Process'***

vi. *These did exist* **'Uni-directional' short-run 'Granger Causality'** *running from relative price level to exchange rate.*

vii. *Exchange rate failed to* ***'Granger Cause'*** *relative price level in the short-run.*

viii. *Relative price level* (p_t)*, consequently, emerged as an* ***exogenous variable*** *in the VEC model.*
