CHAPTER V

FINANCIAL DEVELOPMENT AND ECONOMIC GROWTH

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5.1 INTRODUCTION

Economic growth of a country depends on the performance of economic agents and their ability to raise and manage funds for investment. Financial institutions as an organization having collective intelligence facilitate channeling funds from surplus units to deficit units. Therefore, the performance of financial system determines economic growth through successful channeling of resources to the productive areas which is prerequisite for economic growth.

The savers accumulate claims on financial institutions, and the money raised is lent to their final users ultimately. However, even if a country has savings, growth may not materialize due to the inability of the financial system to direct the savings efficiently towards investment. It requires well-functioning payment systems, the availability of price information, manage uncertainty and control risk. Development of mechanisms to deal with problems of asymmetric information between parties to a financial transaction is crucial (Ang and McKibbin, 2005).

As an economy develops, financial intermediaries become more efficient and financial assets increase gradually. More specialized savings and financial institutions emerge and more financing instruments become available with varying risks. Competition reduces costs of transaction to the asset holders. The development of securities markets allows savers to invest their resources directly in financial assets issued by non-financial institutions. Financial systems vary widely across countries: banks, non-bank financial institutions, and stock markets are larger, more active, and more efficient in richer countries (Goldsmith, 1969).

In a well-functioning financial system, financial assets gradually increase relative to gross domestic product. Financial development implies growth of financial assets relative to gross domestic product. Therefore, the relationship between financial development and economic growth is the matter of empirical concern. The identification of indigenous as well as exogenous variable raised the question of direction of causality between the variables. The Granger causality test indicates that if one variable causes other variable, then the effectual variable is exogenous. This conclusion can raise a very important question, that is, the endogenous variable does not have any effect to the exogenous variable in the short-as well as long run.

Growth Rate of Important Economic Variables

Here, we attempt to examine the growth rate of important economic variables for pre- and post-reform era. In order to examine this, following model is used.

$$\log Y = \beta_0 + \beta_1 D + \beta_2 T + \beta_3 DT + \mu$$

where, Y is the specified economic variable, D is the dummy variable where D = 0 for pre-reform period (i.e. 1975 to 1989) and D = 1 for post-reform period (i.e. 1990 to 2003). T is the time period. In the above model β_0 represents intercept for the pre-reform period and $\beta_0 + \beta_1$ is the intercept for the post-reform period. β_2 represents the rate of growth of Y in pre-reform era whereas $\beta_2 + \beta_3$ represents rate of growth of Y in the post-reform era. If β_3 is positive and statistically significant, one can conclude that the rate of growth of a variable has improved in the post reform era. The Table 5.1 highlights growth rates of various variables.

Table: 5.1

Growth Rates of Selected Economic Variables

Sample: 1975-2003, Observations: 29

Method: Ordinary Least Squares (OLS)

Variables		Constant	Dummy	Time	Dummy*Time	Statistics		
		C	D	T	D*T	R2	F	DW
LOG(PRGDP)		8.82	-0.01	0.02	0.01	0.98	356.27	1.15
	t-value	581.12	-0.26	8.21	2.28			
LOG(GDP)		9.55	0.40	0.12	-0.01	1.00	1827.82	0.82
	t-value	241.93	3.26	25.12	-1.09			
LOG(INV)		7.65	0.54	0.15	-0.02	0.99	1131.36	1.17
	t-value	132.49	3.02	21.30	-2.02			
LOG(GDS)		7.38	0.03	0.12	0.02	0.98	325.30	0.96
	t-value	72.90	0.10	9.60	1.01			
LOG(IMP)		7.59	0.70	0.16	-0.02	0.99	843.67	0.67
	t-value	102.95	3.04	17.66	-1.67			
LOG(EXPORT)		7.30	0.31	0.13	0.02	0.98	347.17	0.69
	t-value	63.59	0.87	9.38	0.76			

Source: Appendix A.1

Table: 5.1 (contd.)

Variables	Constant C	Dummy D	Time T	Dummy*Time D*T	Statistics R2	F	DW
LOG(GNS)	7.75	-0.29	0.11	0.04	0.99	569.15	0.97
t-value	105.65	-1.29	12.10	2.68			
LOG(TRD)	8.15	0.55	0.15	-0.01	0.99	602.91	0.64
t-value	93.54	2.03	13.94	-0.49			
LOG(CUR)	6.74	0.40	0.16	-0.02	1.00	4609.90	1.50
t-value	228.34	4.30	43.20	-2.87			
LOG(DD)	6.12	0.26	0.15	-0.01	1.00	2204.80	1.56
t-value	150.72	2.09	29.64	-1.22			
LOG(TD)	6.77	0.42	0.20	-0.03	1.00	0.75	4436.46
t-value	182.36	3.61	45.18	-3.90			
LOG(DEPOSIT)	7.47	-0.09	0.18	0.02	1.00	7746.46	1.48
t-value	269.53	-1.03	52.50	2.99			
LOG(FINAST)	7.74	0.39	0.20	-0.02	1.00	8081.49	1.67
t-value	293.26	4.72	60.93	-5.13			
LOG(M1)	7.17	0.35	0.15	-0.01	1.00	1.34	5224.38
t-value	262.78	4.13	45.87	-2.67			
LOG(M2)	7.68	0.30	0.18	-0.01	1.00	7483.75	0.97
t-value	296.08	3.76	56.05	-2.95			
LOG(PRIVATELOAN)	6.46	-0.15	0.19	0.02	0.99	1635.93	0.72
t-value	99.58	-0.75	24.01	1.63			
LOG(TOTALOAN)	7.09	0.15	0.18	0.00	1.00	6172.01	1.51
t-value	231.05	1.54	49.55	-0.58			
LOG(TOTAST)	8.36	0.03	0.17	0.01	0.99	1117.31	1.90
t-value	120.73	0.15	19.71	0.86			
LOG(EXPIMP)	-0.29	-0.39	-0.03	0.04	0.42	0.00	1.12
t-value	-5.07	-2.18	-3.92	3.68			
LOG(M1GDP)	-2.38	-0.05	0.03	-0.01	0.89	67.18	1.33
t-value	-66.74	-0.45	7.30	-0.83			
LOG(M2GDP)	-1.86	-0.14	0.05	0.00	0.95	175.00	0.79
t-value	-45.40	-1.09	10.51	-0.34			
LOG(PRIVATE)	-0.63	-0.30	0.00	0.02	0.76	26.22	0.71
t-value	-14.52	-2.19	0.84	2.83			
LOG(PRIVY)	-3.09	-0.55	0.07	0.03	0.97	287.59	0.76
t-value	-55.63	-3.19	10.17	2.68			
LOG(BANK)	-0.29	-0.37	-0.01	0.03	0.85	47.95	1.09
t-value	-12.52	-5.10	-4.98	8.04			
LOG(INVGDP)	-1.89	0.06	0.03	-0.01	0.84	43.03	1.79
t-value	-51.15	0.51	5.58	-1.14			
LOG(GDSGDP)	-2.16	-0.45	-0.01	0.03	0.37	4.90	1.14
t-value	-30.13	-2.03	-0.74	2.47			
LOG(CONSGDP)	-0.12	0.01	0.00	0.00	0.10	0.88	0.96
t-value	-9.83	0.15	0.54	-0.65			
LOG(IMPGDP)	-1.95	0.21	0.03	-0.01	0.90	72.88	0.55
t-value	-37.91	1.34	5.40	-0.94			
LOG(EXPGDP)	-2.24	-0.17	0.01	0.03	0.76	26.83	0.63
t-value	-25.72	-0.64	0.61	1.87			
LOG(TRDGDP)	-1.39	0.07	0.02	0.01	0.86	51.40	0.50
t-value	-22.77	0.35	3.12	0.53			
LOG(TRDDFCTGDP)	-3.32	0.89	0.08	-0.08	0.74	23.40	1.47
t-value	-29.93	2.57	6.28	-3.82			

The rate of growth of per capita GDP, total trade, the ratio of total exports to imports, ratio of private sector credit to GDP, the ratio of domestic assets of commercial banks to the sum of domestic assets of commercial banks and Nepal Rastra Bank, have increased after the implementation of reforms. Whereas, there are some indicators, namely, investment, currency, time deposit, financial assets, M2, have significantly lower growth rates in the post reform era.

Ex-post analyses of various financial ratios have been analyzed in the Chapter III depicting financial health, strength and soundness of the financial system. However, in the ex-ante front, the magnitude of the relationship between economic growth (proxied by real per capita GDP – PRGDP) and financial development (FINDEX) can be shown by simple regression model. Considering the problem of multicollinearty in the indicators of financial development, an index of financial development (FINDEX) has been derived by using the Method of Principal Component in chapter IV. The relationship between the logarithm of per capita real gross domestic product (PRGDP) as dependent and FINDEX as independent variable has been shown in following regression result. :

$$\text{Log (PRDGP)} = 9.09 + 0.10\text{FINDEX} \quad (1)$$

$$\text{t-value} \quad (664.38) \quad (12.85) \quad R^2 = 0.86$$

The effect of the financial development (FINDEX) on economic growth (PRGDP) is positive which is represented by positive theoretical expected sign of FINDEX. Both the coefficients are statistically significant at 1 percent level. The value coefficient of determination (R^2) is 0.86 which implies that 86 percent of the variation in the dependent variable (PRGDP) is explained by the independent variable (FINDEX), which is considerably a good fit.

5.2 TEST OF CAUSALITY

The existence of a relationship between variables obtained by regression analysis assumes the dependence of one variable on other variables. However, given various types of theoretical explanations, and other empirical evidences, it is necessary to examine the direction of causality between macroeconomic variables and the indicators of financial development. Granger (1968) has argued that an event happens before another event, then it is possible that first event is causing later but not the other way round. Testing only for long-run causal relationship between financial development and output growth would lead to wrong conclusion. Because most of the benefits of higher level of financial development could be realized in the short-run and the effects may disappear slowly in the long-run, it is important to distinguish the long- and short-run causality. The present study attempts to examine the direction of causality using Error Correction Model (ECM). According to the Engle and Granger (1987) representation theorem, if two variables are cointegrated and each is individually I (1), that is, integrated of order 1 (i.e., each is individually nonstationary), then first variable may Granger-cause second variable, second variable may Granger-cause first variable or each other.

On the above background, it is first necessary to find out whether the two variables are individually non-stationary or cointegrated of I (1). If the variables are not cointegrated, then the whole question of causality may become moot (Gujarati, 2004). The testing procedure involves three steps: First, examining the existence of unit roots of macroeconomic and financial variables by using Augmented Dickey-Fuller (ADF) test. Second, cointegration test for of the same variables by using Engle and Granger two step procedure. If cointegration is detected, the third step is to test for causality by employing the appropriate types of causality tests. For the present study, three tests of causality viz., Test of Short-run Granger Non-causality Test, Weak Exogeneity and Strong Exogeneity Tests, are examined.

5.3 DEFINITION OF VARIABLES

The financial development relationship is described on the basis of theoretical arguments as:

$$F = f(\text{PRGDP}, Z) \qquad (2)$$

Where, F refers to the financial development indicator which is considered as the function of per capita real gross domestic product (PRGDP) and the set of conditioning variable (Z). Following variables are used for the measure of financial development (F).

Indicators of Financial Development and Economic Growth

Different variables are selected as proxies to measure policy action and with proper combination between them. Monetary, fiscal and trade policy indicators have very fragile relationship with long run growth. Further, various indicators of the level of financial sector development are robustly associated with long-run growth. Since the changes in financial development indicators are closely associated with financial sector policy changes, the link between financial sector policies and growth is further deserved. The results are particularly difficult to interpret because it is often used as a general index of distortions and not as a trade or exchange rate policy indicator. Further, diversity of financial services catered for in the financial system with an array of instruments and variety of agents and institution involved in the activities of financial intermediation. As discussed in Chapter IV. Following indicators are used as the proxy of financial development as developed by King and Levine (1993 b) and used commonly.

1. The ratio of Money defined broadly (M2Y) to GDP is conventionally used as the liquid liability of the economy and easily available indicator of financial development. M2 includes currency held outside the banking system plus demand and interest bearing liabilities of banks and non-bank financial intermediaries. It reflects the extent of payment services offered by the financial system to the economy.

2. The ratio of domestic assets of commercial banks to the sum of domestic assets of commercial banks and central bank (BANK) is the next indicator of financial development. It assumes that commercial banks seem more likely to provide financial services than central bank.

3. The ratio of commercial banks' credit to private sector to total loans and advances of the financial system (PRIVATE) is used to measure the availability of total financial assets in the economy. Because banking system extends credit to the private sector as well as government and public enterprises simultaneously. It gauzes the extent of credit available to the private sector out of total assets of the commercial banking sector.

4. The other most frequently used and effective indicator of financial development is the ratio of total credit available to the private sector to GDP

(PRIVY). It depicts the size of private sector credit in terms of the size of the economy.

M2Y and BANK measure the size of financial intermediaries while the PRIVATE and PRIVY measure to whom the financial system allocates the resources. Higher values of PRIVATE and PRIV/Y indicate greater financial development.

Similarly, the ratio of gross domestic savings (GDS) to GDP, gross investment (INV) to GDP, total volume trade (i.e. sum of imports and exports) (TRD) to nominal GDP and real interest rates (R) are used to proxy conditioning variables (Z) for economic growth. Real per capita GDP is the proxy of economic growth.

1. Ratio of gross domestic savings to gross domestic product (GDSY),
2. Ratio of gross investment to gross domestic product (INVY),
3. Ratio of total trade to gross domestic product (TRDY), and
4. Real rate of interest is (R) the average inflation adjusted interest rate.

We take natural log values of all these variables, which are denoted by F and Z in Equation (2).

5.4 TEST OF STATIONARITY

A Model's goodness of fit is determined by the magnitude of unadjusted and adjusted coefficients of determination, R^2. However, the estimated regression equation of time series date with very high R^2 is thought to be spurious because of such data being non-stationary, that is, mean and variance of such a data are characterized time variant. Therefore, the problem of non-stationarity in time series data is resolved by making them stationary prior to analysis. One of the important tools to test the stationary of time series is unit root tests. The validity of the stationary of Nepal's macroeconomic and financial time series variables in this study is adopted by unit root test.

Unit Root Test

If time series data follow random walk, then these data are said to be non-stationary. If data series follow a certain time trend then these are called random walk or non-stationary data. Time series data are characterized by difference stationary or trend stationary. Random Walk Model (RWM) without drift and with drift is mostly stationary after differencing, so that they are called difference stationary. However, a model consisting of a constant and time (t) variable is called deterministic trend and process of making stationary is called trend stationary. Considering all the possibilities, data are modeled as: $\Delta Y_t = \delta Y_{t-1} + u_t$ is RWM without drift, $\Delta Y_t = \beta_1 + \delta Y_{t-1} + u_t$ is RWM with drift, and $\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + u_t$ is RWM with drift around a stochastic trend. Unit root test is applied for the coefficient 'δ' on the following compact equation to find out whether or not the data stationary.

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \alpha \Delta Y_{t-1} + \varepsilon_t \qquad (3)$$

Null hypothesis of unit root or non-stationary of a time series is δ=0 against the alternative hypothesis $\delta \neq 0$. If δ=0, then there is unit root or non-stationary problem in time series data. Since $\delta = (\rho - 1)$, where in order to get δ=0 the value of $\rho = 1$ so that δ=0 and $\rho = 1$ are equal. Therefore, unit root test which shows whether ρ value is significantly away from unity or 1 so that unit root problem or non-stationary problem is eliminated. Therefore, lower the value of "ρ" from unity, greater the possibility of becoming stationary in a given series because a value closer to unity or exactly unity shows the problem of unit root.

If the computed absolute value of the *tau*-statistic ($/\tau/$) given by Augmented Dickey Fuller (ADF) statistic exceeds the table MacKinnon critical *tau*-values, we reject null hypothesis δ=0 of unit root or accepting time series is stationary. In order to test the first difference or trend stationary in time series data, the null hypothesis of unit root problem in level form data in time series data is δ=0, that is, there is unit root problem in level form data against the alternative hypothesis of $\delta \neq 0$, that is, there is no unit root problem in such data. The test results of stationarity of Nepal's macroeconomic and financial time series variables are given in Table-5.1. Statioanrity is tested on log form data.

Table: 5.2

Test of Unit Root on Level Form Data: 1975-2003

Variables	Constant	Trend	One period lag Dependent Variable1	ADF Statistics	MacKinnon Critical Value		
					1%	5%	10%
log(PRGDP)2	X	X	X	3.39	-2.65	-1.95	-1.62
log(PRGDP)3	√	X	X	-0.04	-3.69	-2.97	-2.62
log(PRGDP)4	√	√	X	-2.52	-4.32	-3.58	-3.22
Δlog(PRGDP)5	√	√	√	-2.59	4.33	-3.58	-3.22
log(M2Y)	X	X	X	4.80	-2.65	-1.95	-1.62
log(M2Y)	√	X	X	-2.47	-3.69	-2.97	-2.62
log(M2Y)	√	√	X	-4.63	-4.32	-3.58	-3.22
Δlog(M2Y)	√	√	√	-1.83	-4.33	-3.58	-3.22
log(BANK)	X	X	X	-0.99	-2.65	-1.95	-1.62
log(BANK)	√	X	X	-0.32	-3.69	-2.97	-2.62
log(BANK)	√	√	X	-1.24	-4.32	-3.58	-3.22
Δlog(BANK)	√	√	√	-1.12	-4.33	-3.58	-3.22
log(PRIVATE)	X	X	X	7.68	-2.65	-1.95	-1.62
log(PRIVATE)	√	X	X	0.04	-3.69	-2.97	-2.62
log(PRIVATE)	√	√	X	-2.26	-4.32	-3.58	-3.22
Δlog(PRIVATE)	√	√	√	-3.23	-4.33	-3.58	-3.22
log(PRIVY)	X	X	X	-2.36	-2.65	-1.95	-1.62
log(PRIVY)	√	X	X	-0.20	-3.69	-2.97	-2.62
log(PRIVY)	√	√	X	-2.53	-4.32	-3.58	-3.22
Δlog(PRIVY)	√	√	√	-2.82	-4.33	-3.58	-3.22
log(TRDY)	X	X	X	6.90	-2.65	-1.95	-1.62
log(TRDY)	√	X	X	-1.06	-3.69	-2.97	-2.62
log(TRDY)	√	√	X	-0.31	-4.32	-3.58	-3.22
Δlog(TRDY)	√	√	√	1.12	-4.33	-3.58	-3.22
log(INVY)	X	X	X	6.92	-2.65	-1.95	-1.62
log(INVY)	√	X	X	-0.56	-3.69	-2.97	-2.62
log(INVY)	√	√	X	-1.73	-4.32	-3.58	-3.22
Δlog(INVY)	√	√	√	-0.95	-4.33	-3.58	-3.22
log(GDSY)	X	X	X	-0.42	-2.65	-1.95	-1.62
log(GDSY)	√	X	X	-2.69	-3.69	-2.97	-2.62
log(GDSY)	√	√	X	-2.89	-4.32	-3.58	-3.22
Δlog(GDSY)	√	√	√	-1.60	-4.33	-3.58	-3.22
log(R)	X	X	X	-0.42	-2.65	-1.95	-1.62
log(R)	√	X	X	-2.69	-3.69	-2.97	-2.62
log(R)	√	√	X	-2.89	-4.32	-3.58	-3.22
Δlog(R)	√	√	√	-3.44	-4.33	-3.58	-3.22

Notes:

1. In a finite lag model, only one period lag has been considered here which would expect to solve the problem of serial correlation.
2. Model with absence of constant, trend and one period lag of dependent variable ('X', 'X', 'X') is called RWM without drift parameter. If null hypothesis is rejected in the case of RWM model without drift (i.e. $\beta_1 = 0, \beta_2 = 0, \beta_3 = 1$) it signifies that Y_t is a stationary time series with zero mean,
3. Model with presence of constant and absence of trend and one period lag of dependent variable ('√', 'X' 'X') is called RWM with drift parameter. If the null hypothesis is rejected in the case of RWM model with drift (i.e. $\beta_1 \neq 0, \beta_2 = 0, \beta_3 = 1$), then it implies that Y_t is stationary time series with a non-zero mean [$\beta_1 /(1-\rho)$],
4. Model with presence of constant and trend but no one period lag of dependent variable ('√', '√' 'X') is RWM with drift and trend parameter. If the null hypothesis is rejected in the case of RWM model with drift around a stochastic trend ($\beta_1 \neq 0, \beta_2 \neq 0, \beta_3 < 1$), then it implies that Y_t is stationary around a deterministic trend.
5. Model with presence of constant and trend and one period lag of dependent variable ('√', '√' '√') is RWM with drift and trend and one period lag dependent variable. The last term in the equation (1) is lagged values of the dependent variable "ΔY_t" which considers the problem of serial correlation making the ADF test applicable instead of DF test.

RWM without drift parameter of log (M2Y), log (PRGDP), log(PRIVATE), log(TRDY) and log(INVY) are ruled out because estimates possess positive sign. In this case row "ρ" value will be greater than unity causing divergence of the series with respect to time. However, RWM without drift parameter of is having negative sign as well as greater than the MacKinnon critical value in 1% significant level. Other three specifications (RWM with drift, RWM with drift and trend and RWM with drift, trend and one period lag of dependent variable) of each of the variables show non-stationarity in the level form data where, the null hypothesis of unit root on the basis of MacKinnon critical value has been accepted at 1% significant level.

This implies that the null hypothesis of unit root problem of Nepal's macroeconomic and financial variables are rejected. Similarly, residual terms of the variables are trend stationary for all the variables except first difference of log of TRDY. The ADF test statistic in absolute term for difference and trend data are larger than MacKinnon critical value rejecting null hypothesis of unit root problem.

However, most of the time series data are expected to be found first difference stationary or trend stationary. In order to confirm the validity of the argument, ADF test statistics have been derived from the first difference and trend data in Table-5.2. In order to test the first difference or trend stationary in time series data, The null hypothesis of unit root problem in first difference or trend stationary in time series data is equal to zero, that is, there is unit root problem in first difference and trend data against the alternative hypothesis of 0, i.e., there is no unit root problem in such data. ADF statistics from first difference and trend specifications of model and MacKinnon critical value for rejection of null hypothesis of unit root for difference and trend stationary are given in Table: 5.3

Table: 5.3

Test of Unit Root in First Difference and Trend Data: 1975-2003

Variables	1st Difference Stationary[6]		Trend Stationary[7]	ADF for 1st Difference Stationary	ADF for Trend Stationary	Mackinnon Critical Value for 1st Difference Stationary Process			Mackinnon Critical Value for Trend Stationary Process		
	Constant	Trend	Unit root on $\hat{u}_t$			1%	5%	10%	1%	5%	10%
Δlog(PRGDP)	√	X	√	-8.02	-5.78	-3.70	-2.97	-2.62	-2.65	-1.95	-1.62
Δlog(M2Y)	√	X	√	-7.79	-4.19	-3.70	-2.97	-2.62	-2.65	-1.95	-1.62
Δlog(BANK)	√	X	√	-9.27	-5.06	-3.70	-2.97	-2.62	-2.65	-1.95	-1.62
Δlog(PRIVATE)	√	X	√	-8.82	-4.83	-3.70	-2.97	-2.62	-2.65	-1.95	-1.62
Δlog(PRIVY)	√	X	√	-6.53	-4.60	-3.70	-2.97	-2.62	-2.65	-1.95	-1.62
Δlog(TRDY)	√	X	√	**-0.73**	0.91	-3.70	-2.97	-2.62	-2.65	-1.95	-1.62
Δlog(INVY)	√	X	√	-11.91	-7.04	-3.70	-2.97	-2.62	-2.65	-1.95	-1.62
Δlog(GDSY)	√	X	√	-7.34	-5.45	-3.70	-2.97	-2.62	-2.65	-1.95	-1.62
Δlog(R)	√	X	√	-3.72	-5.81	-3.70	-2.97	-2.62	-2.65	-1.95	-1.62

Notes: 6. Unit root is tested on , for the first difference stationary, where $\hat{Y}_t = \Delta Y_t$ so, $\Delta\hat{Y}_t$ is Δ of ΔY_t.

7. Unit root is tested on $\hat{u}_t$ by using equation $\Delta\hat{u}_t = \delta u_{t-1}$ for trend stationary after obtaining $\hat{u}_t$ by regressing $Y_t = \beta_1 + \beta_2 t + u_t$

Except the first difference of log of TRDY, other variables in Table-5.2 are found first difference stationary at 1% significant level. The computed value of ADF statistic of the variables are greater than the MacKinnon critical value. This implies that the null hypothesis of unit root problem of Nepal's macroeconomic and financial variables are rejected. Similarly, residual terms of the variables are trend stationary for all the variables except first difference of log of TRDY. The ADF test statistic inabsolute term for difference and trend data are larger than MacKinnon critical value rejecting null hypothesis of unit root problem.

In summing up, almost all variables those are not stationary in level form data (in Table-5.3), are shown stationary in first difference as well as trend stationary (in Table- 4). The ADF statistics of most of the variables are greater than MacKinnon critical value at 1% significant level. Therefore, the first difference data are stationary or they are integrated of order 1 or I(1). However, most macroeconomic and financial time series variables are of Difference Stationary Process (DSP) rather than Trend Stationary Process (TSP) (Gujarati, 2004).

The unit root test also supports the findings of unit correlogram test that level form data of Nepal's macroeconomic variables are not found stationary but only first difference tends to be stationary. This means that each of the macroeconomic variables (inflation and its determinants) has varying mean and variance over time.

5.5 COINTEGRATION TEST

The tests of stationarity as shown in the above sections validate that the non-stationarity problem of most of the macroeconomic and financial time series variables of level form data results spurious relation but first difference data are free from this drawbacks. The conclusions derived from differenced data may mislead the long-run relationship between the variables (Engle and Granger, 1987). Relationship between the variables computed under differenced data in different orders show short-term relationship which can be considered as disequilibrium relationship. The long-run relationship can be established by using level form data only when variables are co-integrated in same order however, their linear relationship must be less than the co-integrating order. Therefore, the properties of cointegrating relationship is that: if $X_t \sim I(d)$ and $Y_t \sim I(d)$, then $Z_t = (aX_t + bY_t) \sim I(d^*)$ generally, but for the cointegration to be hold true $d^* < d$. In other words "two time series are said to be co-integrated of order (d, b) denoted CI (d, b) if (i) they are both integrated of order 'd' (ii) but there must be some linear combination between them (e.g. error term derived from cointegrated equation), that is, integrated of order 'b' which must be less than 'd' i.e. d>b". For example, if the residual series $(\hat{u}_t = Y_t - \hat{\beta}_1 - \hat{\beta}_2 X_t)$ from a cointegrating equation $(Y_t = \beta_1 + \beta_2 X_t + u_t)$ is stationary or I(0), the variables of cointegrating equation in their level form data are said to be cointegrated, though they individually are non-stationary or random walk. By satisfying this condition, cointegrating regression equation is meaningful, as it is not a spurious regression.

In order to derive the stable long-run relationship between economic growth and financial development explanatory variables of Nepal, a cointegration test should validate the variables whether they are cointegrated in same order. There is no cointegration between the variables is a null hypothesis against the alternative hypothesis of cointegration. The test results are given in Table: 5.4

Table: 5.4

Test of Cointegration (Sample period 1975-2003)

Variables		ADF statistics	Mackinnon Critical Value			Order of Cointegration
Dependent	Explanatory Variables		1%	5%	10%	
Log(PRGDP)	Log(M2Y)	-2.16	-2.64	-1.95	-1.62	**I(1) in 5% level**
Log(PRGDP)	Log(BANK)	-1.46	-2.64	-1.95	-1.62	Not significant
Log(PRGDP)	Log(PRIVATE)	-2.27	-2.64	-1.95	-1.62	**I(1) in 5% level**
Log(PRGDP)	Log(PRIVY)	-2.00	-2.64	-1.95	-1.62	**I(1) in 5% level**
Log(PRGDP)	Log(INVY)	-1.26	-2.64	-1.95	-1.62	Not significant
Log(PRGDP)	Log(GDSY)	-1.81	-2.64	-1.95	-1.62	**I(1) in 5% level**
Log(PRGDP)	Log(TRDY)	-1.19	-2.64	-1.95	-1.62	Not significant
Log(PRGDP)	Log(R)	-1.19	-2.64	-1.95	-1.62	Not significant

Note: ($\hat{u}_t = \beta_1 u_{t-1}$) has been used to test the cointegration between the variables.

The last column of the table shows that financial variables like log(M2Y), Log(PRIVATE), Log(PRIVY) and Log(GDSY) are cointegrated of order 1, i.e. I(1) or their first difference is I(0) at 5% significant level. However, log(BANK), Log(INVY), log(TRDY) and Log(R) are not cointegrated even at 10% significant level. A cointegrating relationship is confirmed between the variables concerned by rejecting null hypothesis of there is no cointegration in error term since the computed ADF statistics are greater than MacKinnon critical value, where ADF test statistics have been derived from unit root test on residual term of cointegrating equation. The reason behind selecting the specification of estimated residual term without constant term as shown in Table: 5.4 is that residual does not show the time trend or it fluctuates around the mean. This implies disequilibrium terms are fluctuated around zero mean. The level form data of per capital real GDP and its determinant variables (financial development variables) are not wandering away from each other. The disequilibrium error (i.e. $Y_t - \hat{\beta}_1 - \hat{\beta}_2 X_t$) which measure the extent of departures from equilibrium, rarely drift very far from zero. Therefore, though there is short-run fluctuation in variable's trend path, such a fluctuation will no longer remain persistent in the long run. The cointegration result of macroeconomic variables provides sufficient background to derive Error Correction Model which shows both the short-run and long-run relationship.

5.6 ERROR CORRECTION MODEL

If two variables are co-integrated as explained in table 5.4, then the short-run "disequilibrium" relationship between the same can always be represented by an Error Correction Model (ECM), that is, $\Delta y_t = \alpha_0 + \alpha_1 \Delta x_t + u_{t-1} + \varepsilon_t$. This model states that changes in y depend on changes in x and one period lag residual term which is derived from cointegrating equation as the disequilibrium error in the previous period, that is, $u_{t-1} = y_{t-1} - \gamma_1 - \gamma_2 x_{t-1}$. If no equilibrium relationship exists, short-run behavior should not be represented by ECM. According to the ECM argument both the level form data (long-run relationship) and their first differences (short-run relationship) are required in a single regression equation. Among cointegrated variables both the short-run as well as long-run relationship can be represented in Error Correction Model (ECM). Therefore, ECM reconciles the short-run behavior of an economic variable with its long-run behavior.

The ECM of real per capital GDP has been derived on the basis of cointegrated variables selected from cointegration test given in Table: 5.4. The macroeconomic variables for the cointegration test were selected on the basis of robustness of real per capital GDP equation following general to specific methodology. Following multivariate coingetrating equation of inflation has been selected on the basis of statistical significance of coefficients and cointegrating relationship between the variables:

$$LOG(PRGDP) = 9.86 + 0.33LOG(M2Y) + 0.38LOG(PRIVATE) + 0.07LOG(GDSY) \quad (4)$$
$$t \rightarrow \quad (76.66) \quad (6.01) \qquad (3.23) \qquad (0.97)$$

$$\bar{R}^2 = 0.87 \qquad DW=0.64 \quad F=58.15$$

All the coefficients except log(GDSY) in the above cointegrating equation are statistically significant at 1% significant level. Coefficients possess theoretical expected sign. F statistic is statistically significant signifying model as a good model. The DW test shows the problem of autocorrelation in the model. The adjusted R^2 is satisfied showing goodness of fit of the model. The model shows the long-run equilibrium relation between the variables. The result of equation (2) shows the PRGDP elasticity with respect to its major determinants variables. For example: 1 percent increase in the ratio of liquidity to nominal GDP increases per capital real GDP growth by 0.33 percent. In the similar reasoning, other coefficients of the equation can be interpreted. On the basis of above cointegrating equation, ECM can be derived by introducing first difference in every variables of cointegrating equation (i.e.'D' in following equation- prior to LOG of every variables) and one period lag residual term from the cointegrating equation. The resultant ECM is as follows:

$$DLOG\ (PRGDP) = 0.03\text{-}0.22DLOG(M2Y)+0.01DLOG(PRIVATE)+0.07DLOG(GDSY)\text{-}0.05ECT(\text{-}1) \quad (5)$$
$$t \rightarrow \quad (4.79) \quad (-3.07) \qquad (0.21) \qquad (2.60) \qquad (-0.69)$$

$$\bar{R}^2 = 0.36 \ DW=2.31 \quad F=3.31$$

In the above ECM equation, coefficients of constant term, dlog(M2Y) and Dlog(GDSY) are statistically significant at 1% level, but remaining variable are not statistically significant. But on the basis of F statistic, the above model is statistically significant. The equation shows the short-run partial regression coefficients relating the PRGDP and its determinants. The coefficient of M2Y shows theoretical contrary sign. However, for the policy purpose the long-run coefficients are important. After certain time of adjustment, the long-run coefficient is achieved. The major important parameter of interest in the above equation is coefficient of one period lag residual. It possesses expected theoretical sign. The absolute value of the coefficients of one period lag residual gives the degree of adjustment from short-run to long run coefficients. Statistically, the equilibrium error term is zero (i.e. 0.05), suggesting that log(PRGDP) adjusts to changes in its determinant variables in the same time period.

5.7 SHORT-RUN GRANGER NON-CAUSALITY, WEAK EXOGENEITY AND STRONG EXOGENEITY TESTS

The testing procedure for the causalty in a Vector Error Correction Model (VECM) involves three steps. First step is to examine whether there is unit root problem in the time series variables under the present study. We found that log(PRGDP), log(M2Y), log(PRIVATE), log(PRIY) and log(GDSY) variables have unit roots problem by using Augmented Dickey-Fuller (ADF) test. The second step is that these variables are found cointegration using Engle and Granger (1987) approach. The causalty tests can be done on cointegrating variables which shows that both the long-run and short run causalty between the variables. If cointegration is detected, the third step is to test for causalty by employing the appropriate types of causalty tests, that is, short-run Granger Non-Causality test, Weak Exogeneity and Strong Exogeneity Tests.

The presence of cointegrated relationships is consistent with the economic theory which predicts that finance and output have a long-run equilibrium relationship. According to Engle and Granger (1987), cointegrated variables must have a error correction representation in which an error correction term (ECT) must be incorporated into the model. Accordingly, a vector error correction model (VECM) is formulated to reintroduce the information lost in the differencing process, thereby allowing for long-run equilibrium as well as short-run dynamics.

For the five variable case with one cointegratred relationship, the VECM can be expressed in natural logarithum form as follows:

$$\Delta PRGDP_t = \mu_1 + \alpha_{11} ECT_{t-1} + \sum_{j=1}^{p-1} \phi_{1j} \Delta PRGDP_{t-j} + \sum_{j=1}^{p-1} \varphi_{1j} \Delta M2Y_{t-j} + \sum_{j=1}^{p-1} \lambda_{1j} \Delta PRIVATE_{t-j} + \sum_{j=1}^{p-1} \psi_{1j} \Delta GDSY_{t-j} + \varepsilon_{1t} \quad (5)$$

$$\Delta M2Y_t = \mu_2 + \alpha_{21} ECT_{t-1} + \sum_{j=1}^{p-1} \phi_{1j} \Delta PRGDP_{t-j} + \sum_{j=1}^{p-1} \varphi_{1j} \Delta M2Y_{t-j} + \sum_{j=1}^{p-1} \lambda_{1j} \Delta PRIVATE_{t-j} + \sum_{j=1}^{p-1} \psi_{1j} \Delta GDSY_{t-j} + \varepsilon_{2t} \quad (6)$$

$$\Delta PRIVATE_t = \mu_3 + \alpha_{31} ECT_{t-1} + \sum_{j=1}^{p-1} \phi_{1j} \Delta PRGDP_{t-j} + \sum_{j=1}^{p-1} \varphi_{1j} \Delta M2Y_{t-j} + \sum_{j=1}^{p-1} \lambda_{1j} \Delta PRIVATE_{t-j} + \sum_{j=1}^{p-1} \psi_{1j} \Delta GDSY_{t-j} + \varepsilon_{3t} \quad (7)$$

$$\Delta GDSY_t = \mu_5 + \alpha_{51} ECT_{t-1} + \sum_{j=1}^{p-1} \phi_{1j} \Delta PRGDP_{t-j} + \sum_{j=1}^{p-1} \varphi_{1j} \Delta M2Y_{t-j} + \sum_{j=1}^{p-1} \lambda_{1j} \Delta PRIVATE_{t-j} + \sum_{j=1}^{p-1} \psi_{1j} \Delta GDSY_{t-j} + \varepsilon_{5t} \quad (8)$$

Given the two different sources of causality, we can perform three different causality tests i.e. short-run Granger non-causality test, weak exogeneity and strong exogeneity tests.

Table: 5.5

Results of Vector Error Correction Model

Sample(adjusted): 1977 to 2003

Included observations: 27 after adjusting endpoints

Error Correction:	D(LOG(PRGDP))	D(LOG(M2Y))	D(LOG(PRIVATE))	D(LOG(GDSY))
ECT	-0.020722	0.018315	0.146786	0.049610
t-value	(-1.41145)	(0.43061)	(3.73626)	(0.46165)
D(LOG(PRGDP(-1)))	-0.248846	-0.673223	0.187648	-1.808153
T-value	(-0.97768)	(-0.91299)	(0.27550)	(-0.97053)
D(LOG(M2Y(-1)))	0.021437	-0.266295	-0.026070	-1.189198
T-value	(0.19669)	(-0.84335)	(-0.08938)	(-1.49062)
D(LOG(PRIVATE(-1)))	-0.008925	-0.121243	0.197336	-0.821926
t-value	(-0.13705)	(-0.64262)	(1.13236)	(-1.72425)
D(LOG(GDSY(-1)))	0.077653	-0.062830	-0.163858	-0.516065
t-value	(1.53042)	(-0.42742)	(-1.20682)	(-1.38952)
C	0.021739	0.088190	0.005286	0.141539
t-value	(1.99945)	(2.79988)	(0.18168)	(1.77854)
R-squared	0.145980	0.093329	0.417706	0.289251
Adj. R-squared	-0.057359	-0.122546	0.279064	0.120024
Sum sq. resides	0.019216	0.161277	0.137599	1.029523
S.E. equation	0.030249	0.087635	0.080946	0.221416
Log likelihood	59.53487	30.81499	32.95853	5.789671
Akaike AIC	-3.965546	-1.838147	-1.996928	0.015580
Schwarz SC	-3.677582	-1.550183	-1.708964	0.303544
Mean dependent	0.018600	0.060025	0.007285	0.035866
S.D. dependent	0.029418	0.082713	0.095334	0.236033
Determinant Residual Covariance		2.51E-10	Log Likelihood	145.1858
Akaike Information Criteria		-8.680431	Schwarz Criteria	-7.336601

Source: Appendix A1

Granger Non-Causality Test

In equation (4), to test PRGDP in the short-run, we examine the significance of the lagged dynamic terms by testing the null Ho:all φ_{1j}=0 using Wald test. However, Wald test need be performed only when there are two or more zero regression coefficients in the null hypothesis (Ramanatham, 2002:156-157). In the present study, only one lag specification is identified on the basis of Akaik and Schwarz criterion. Therefore, F test will serve our purpose. Non-rejection (or acceptance) of the null hypothesis implies M2Y does not Granger-cause PRGDP in the short-run. In order to derive computed value of F statistic, unadjusted R2 of unrestricted vector error correction model which includes all the variables in the model and unadjusted R2 of restricted vector error correction model which includes only M2Y as independent variable are obtained. Applying $F = \frac{(R_u^2 - R_R^2)/(k-m)}{(1-R_u^2)/(n-k)}$ the computed value of F is 1.70. However, the Table value with 2 degree of freedom (df) in numerator and 23 df in denometer at 5% significant level is 3.38. This shows null hypothesis being accepted. Acceptance of null hypothesis implies that there is no Granger-cause of M2Y to PRGDP in the short run. Similarly the null hypothesis of there is no Granger cause between PRIVATE to PRGDP is also accepted because the computed value F statistic in this case is 1.76 which is less than 3.38 derived earlier in unrestricted VECM. Since, the computed value of F statistic in the case of GDSY and PRGDP is as low as 1.25 signifying acceptance of null hypothesis of there is no Granger-cause of GDSY to PRGDP in the short run.

Weak Exogeneity Test

The weak exogeneity test, which is a notion of long-run non-causality test, requires satisfying the null Ho: $\alpha_{11} = 0$. It is based on a likelihood ratio test which follows a χ^2 distribution. This test is examined on whether α_{11} is significantly closer to zero. If it is significantly equal to zero, the error correction term does not cause to the respective variables in the long-run. Therefore, if computed the log likelihood value is greater than Table log likelihood value, it implies there is causality in respective variables. In the present case, the computed value of log likelihood value is 59.53 in the case of PRGDP which is higher than the Table value of χ^2 distribution with (n-1) i.e. (27-1) degree of freedom value is 38.88. It implies that null hypothesis is rejected. Therefore, there is long-run causality of independent variables to PRGDP. However, the log likelihood value of other variables are lesser than the Table value of likelihood are less than 38.88 showing accepting the null hypothesis showing long run non-causality even in the long run.

Strong Exogeneity Tests

The strong exogeneity test imposes stronger restrictions by testing the joint significance of both the lagged dynamic terms and ECT. The strong exogeneity test requires Granger non-causality and weak exogeneity. In particular, $\Delta M2Y$ does not cause $\Delta PRGDP$ if the null Ho: all $\varphi_{1j} = \alpha_{11} = 0$ is not rejected. Applying the F statistic as in the case of Granger non-causality test above, the computed F value carries at 0.41. However, the Table value with (2,27) df.is 3.38. It signifies null hypothesis is accepted. Our assumption is that if we are not able to reject null hypothesis, $\Delta M2Y$ does not Granger-cause $\Delta PRGDP$. However, in our case we are accepting the joint null hypothesis so that $\Delta M2Y$ Granger-cause $\Delta PRGDP$. In the similar logic, the computed value for $\Delta PRIVATE$ and $\Delta PRGDP$ is also less (1.80) than Table value resulting $\Delta PRIVATE$ Granger-cause $\Delta PRGDP$. Similarly, GDSY has also Granger cause PRGDP.

5.8 CONCLUSION

Non-rejection of the null M2Y, PRIVATE and GDSY does not Granger-cause PRGDP implies that there is no Granger-cause of M2Y to PRGDP in the short run. It is because of the tendency of disequilibrium showing lack of causality between variables. However, in the long run, there is causality from variables like M2Y, PRIVATE, GDSY to PRGDP. It has been examined by the weak exogeneity test. Therefore, in the long-run, all the short-run disequilibrium can be revert back to their long-run equilibrium showing causality between variables i.e. variables indicating financial development affect PRGDP. The strong exogeneity test imposes stronger restrictions by testing the joint significance of both the lagged dynamic terms and ECT. If these restrictions are introduced, all the variables show Non-Granger cause to PRGDP.