Prajnan, Vol. XLII, No. 1, 2013-14

The Determinants of Long Run Finance Development: The ARDL Bound Testing Approach

Rudra P Pradhan

The paper investigates the determinants of long run finance development in India over the period of April 1994 to April 2011. The investigation is carried out by unit root, cointegration, ARDL bound test approach and VECM. The ARDL finds the existence of long run equilibrium relationship between finance development and economic growth. The VECM confirms the existence of bidirectional causality between finance development and economic growth. It also confirms the existence of unidirectional causality from stock market development to economic growth and from finance development to inflation. The paper at the end suggests that financial development should be considered as the policy variable to enhance economic growth in the Indian economy, especially during the globalization era of 1990s.

Keywords: Financial Development, ARDL, VECM

Section I
Introduction

Finance development is considered as a key to economic growth. The relation between the two has attracted much attention in the recent literature, since the seminal work of Bagehot (1873) and Schumpeter (1911). The question is, however, whether financial development precedes economic growth or *vice versa* has been debated in the literature on 'finance-growth nexus' (Mukhopadhyay, *et al.* 2011; Haber, 2008; Ang, 2008; Majid, 2007; Goodhart, 2004; Levine, 2003; Levine, *et al.,* 2000; Luintel and Khan, 1999; Greenwood and Smith, 1997; Demetrides and Hussein, 1996; McKinnon, 1973; Shaw, 1973; Goldsmith, 1969). The attention is mostly on the direction of causality between finance development and economic growth, as it has significantly different implications for the development

Dr Rudra P Pradhan (rudrap@vgsom.iitkgp.ernet.in) is Assistant Professor, Vinod Gupta School of Management, Indian Institute of Technology Kharagpur, West Bengal, India.

We wish to acknowledge, with thanks, the helpful comments and suggestions made by the anonymous referees. The author is also indebted to the editor for his valuable support and suggestions.

policy. However, this causal relationship remains unclear (see, for instance, Calderon and Liu).

There are at least three possible reasons for these inconclusive findings in the literature: short span of data, use of different techniques, and omitted variable bias. Different studies have different problems. For instance, a common view is that studies which focus on the two variable models may be biased due to the omission of relevant variables (Narayan and Smyth, 2009; Clarke, 2005; Chang, *et al*, 2001; Stern, 2000; Hendry and Richard, 1982). Similarly for two cointegrated variables of 1 (1), if vector autoregressive (VAR) is used against vector autoregressive error correction modelling (VECM), then the result may be spurious (Granger, 1988; Engle and Granger, 1987).

In the light of various problems (methodology, omitted variables, and span of data) that have plagued in various literatures in this area, further research on the casual relationship between finance growth nexus is important, given its implications for development policy. In this paper, an attempt has been made to study the finance-growth nexus in India, especially during the post-globalization era of 1990s. The investigation on this period is very important in India, as it is one of the green phases of India's economic development.

The main innovations in this paper, compared to the existing literature on finance-growth nexus, are twofold. First, the use of multivariate framework in which, in addition to economic growth and finance development, we incorporate inflation and stock market development, particularly in the context of India. This marries the Granger causality literatures on the finance-growth nexus, inflation-growth nexus, and stock market-growth nexus. The inclusion of inflation, in particular in the finance-growth nexus is very relevant, as it underlines the issue of macroeconomic stability in the economy. The direct link between inflation and economic growth has been widely studied, particularly because control of inflation is often seen as the single most important goal to which monetary policy can aspire in the pursuit of macroeconomic stability (ECB, 2008). On the other hand, the lack of control has been increasingly linked to banking and financial crises (Duttagupta and Cashin, 2008).

Second, we investigate the issue in the post-globalization era of 1990s. India all through followed a closed economy policies since her independence. It was only after 1985, a shift towards globalization was started. The attempts were, however, seem to be considered as half-hearted, self-contradictory and often self-reversing in nature (Harris, 1987). In contrast, globalization in the 1990s had been much wider and much deeper and decidedly marked a U-turn in many ways in the direction of economic policy followed by India during the last fifty-eight years of centralized economic planning (Pradhan, 2010a; Sachs, *et al*, 1991).

The globalization of 1990s were undertaken in many ways such as devaluation of rupee, dismantling import license system, full convertibility on trade account, fiscal retrenchment and credit squeeze, abolition of export subsidies, introduction of import entitlement scheme for exporters, unification of the exchange rates, removal of the quantitative restrictions, massive reduction in the tariff rates and protection rates, easing the restrictions on foreign investments and so forth (Pradhan, 2006; Ramakrishna, 2003). The impact of globalization is, however, multidimensional and can be judged in many ways in the direction of socio-economic development. That involves both benefits and failures in the Indian economy.

The major benefits that the country has received during this globalization of 1990s are financial sector development and its link with economic growth and stability (see, for instance, Pradhan, 2011). But the impact may be slightly affected by the recent global financial crisis, which hit the world economy in the middle of 2008. Hence, the investigation will give some limelight on the nexus between finance-growth and inflation-growth in India. The residual of the paper is divided into three sections. Section II describes the methodology and discussions. Section III provides conclusion and policy implications.

Section II
Data Base and Methodology

The objective of this paper is to examine the long run determinants of financial development in India, especially in the globalization era of 1990s. The variables used under this study are broad money supply (M_3), used as an indicator to finance development; Index of Industrial Production (IIP), used as an indicator to economic growth; Wholesale Price Index (WPI), used as an indicator to inflation; and market capitalization (MAC), used as an indicator to stock market development. Here, the M_3 is liquid liabilities of the financial system, which includes currency, demand deposits, all time deposits and the liabilities of money market mutual funds. This is the broadest measure of financial depth used, since it includes all types of financial institutions [central bank, deposit money banks, and other financial institutions] (Apergis, *et al*, 2007; Rousseau and Wachtel, 2000). The data are monthly observations from April, 1994 to April, 2011 and has been collected from Handbook of Statistics on Indian Economy, Reserve Bank of India, Mumbai. The investigation starts with studying the stationarity properties of time series variables and then the application of cointegration, autoregressive distributive lag (ARDL) bound testing approach and vector autoregressive error correction modelling (VECM).

1. Testing for Integration

The Augmented Dickey Fuller test (Dickey and Fuller, 1981) and Phillips and Perron test (Phillips and Perron, 1988) are often used to know the order of integration, where the variable can attain its stationarity. However, these two tests are not reliable in small samples, because of poor sample size and power properties (Dejong, *et al*, 1992; Harris and Sollis, 2003). So Dickey Fuller

Generalized Least Squares (Elliot, *et al*, 1996) and Ng and Perron (Ng and Perron, 2001), two alternative tests, are deployed to know the order of integration where the variable can attain stationarity. The detailed discussions about these two tests are available at Pradhan (2010b). If the variable is stationary at the level data, it is integrated of order zero [I (0)]. Likewise if the variable is stationary at the first difference, it is integrated of order one [I (I)] and so on.

2. Testing for Cointegration

Cointegration is a multivariate problem and that occurs between two or more time series variables, if one or more linear combinations of different non-stationary time series produce stationary time series (Engle and Granger, 1987). The linear combination shows the long run relationship between different time series because it is a description of the lasting effects shared by the different time series (Johansen, 1995). The long run relationship, as a statistical point of view, means the variables move together over time so that short term disturbances from the long term trend will be corrected. A lack of cointegration suggests that such variables, have no long run equilibrium relationship and in principle, they can wander arbitrarily far away from each other (Dickey, *et al*, 1991).

The Johansen (1991, 1988) maximum likelihood (ML) test is deployed to detect the cointegration between the time series variables. The econometric procedures of these statistics are as follows:

Let X_t be a (n X 1) vector of variables with a sample of t. Assuming X_t follows I (1) process, identifying the number of cointegrating vector involves estimation of the vector error correction representation (Johansen and Juselius, 1990):

$$\Delta X_t = A_0 + \prod X_{t-p} + \sum_{i=1}^{p-1} A_i \Delta X_{t-i} + \varepsilon_t \qquad (1)$$

Where, vector ΔX_t and ΔX_{t-1} are I (0) representation. The long run equilibrium relationship among X_t is determined by the rank of (say r) is zero, then equation (13) can be transferred to a VAR model of p^{th} order and the variables in level do not have any cointegrating relationship. If 0 < r < n, then there are n X r matrices of α and β such that:

$$\Pi = \alpha\beta' \qquad (2)$$

Where, both α and β are (n x r) matrices. The cointegrating vectors β have the property that $\beta' X_t$ is stationary [I (0)] even though X_t is non-stationary [I (1)]. Johansen likelihood ratio test looks for two statistics: trace statistics and maximum eigen value.

The likelihood ratio test statistic for the null hypothesis that there are at most r cointegrating vectors is the trace test and is computed as:

$$Trace = -T \sum_{i=r+1}^{n} Log\left(1-\hat{\lambda}_i\right) \tag{3}$$

Where $\hat{\lambda}_{r+1}$, ... $\hat{\lambda}_n$ are (n-r) smallest estimated eigen values.

The likelihood ratio test statistic for the null hypothesis of r cointegrating vectors against the alternative of r + 1 cointegrating vectors is the maximum eigen value test and is given by:

$$\lambda_{\max} = -TLog\left(1-\hat{\lambda}_{r+1}\right) \tag{4}$$

Here, the null hypothesis of r cointegrating vectors is tested against the alternative hypothesis of r +1 cointegrating vectors. Hence, the null hypothesis r = 0 is tested against the alternative r = 1, r =1 against the alternative r = 2, and so forth.

3. The ARDL Vector Error Correction Model

In this section, we deploy autoregressive distributive lag (ARDL) bound testing framework by Pesaran and Shin (1995, 1999), Pesaran, *et al* (1996) and Pesaran (1997) to establish the direction causation between FD, WPI, IIP and BSE. There are a number of advantages of using ARDL instead of the conventional Johansen (1988) and Johansen and Juselius (1990) approach. First, conventional cointegration method estimates the long run relationships within a context of a system of the equations, while ARDL method deploys only a single reduced from equation (Pesaran and Shin, 1995).

Second, ARDL approach does not involve pre-testing variables. That means the test examines the long run equilibrium relationship between variables irrespective of whether the underlying regressors are purely I (0), I (1) or fractionally integrated (Pesaran, *et al.*, 2001; Bahmani-Oskooee and Ng, 2002). So, ARDL estimation avoids the problem of non-stationarity time series data. This feature alone, given the characteristics of the cyclical components of the data, makes the standard of cointegration technique unsuitable and even the existing unit root tests to identify the order of integration are still highly questionable. Third, ARDL model avoids the larger number of specification to be made in the standard cointegration test. These include decisions regarding the inclusion of number of variables (both explained and explanatory), treatment of deterministic elements, choice of lag lengths, etc. (Duasa, 2007).

The empirical results are generally very sensitive to the method and various alternative choices available in the estimation procedure (Pesaran and Smith, 1998). With the ARDL, it is possible that different variables have different optimal lags, which is impossible with the standard cointegration test. The ARDL model takes a sufficient number of lags to capture the data generating process in a general-to-specific modelling framework (Laurenceson and Chai, 2003). Most importantly, the ARDL model could be used with limited sample data and can provide robust results to cointegration analysis (see, for instance, Narayan, 2005; Narayan and Smyth, 2005; Pesaran, *et al,* 2000; Pesaran and Smith, 1998).

To study the long run determinants of financial development, the following conditional ARDL [p, q, r, s] model is deployed.

$$\Delta LogFD_t = \alpha_0 + \sum_{j=1}^{p} \alpha_j \Delta LogFD_{t-j} + \sum_{j=1}^{q} \beta_j \Delta LogEG_{t-j} + \sum_{j=1}^{r} \gamma_j \Delta LogINF_{t-j} + \sum_{j=1}^{s} \lambda_j \Delta LogSMD_{t-j} + \delta_1 LogFD_{t-1} + \delta_2 LogEG_{t-1} + \delta_3 LogINF_{t-1} + \delta_4 LogSMD_{t-1} + \zeta_t \tag{5}$$

Where FD is finance development, EG is economic growth, INF is inflation rate, and SMD is stock market development. The broad money supply (M_3) is used as a surrogate to finance development, index of industrial production (IIP) is used as a surrogate to economic growth, wholesale price index (WPI) is used as a surrogate to inflation, and market capitalization is used as a surrogate to stock market development.

The α_0 is a drift component and ζ is white noise error term. The δ_1, δ_2, δ_3, and δ_4 are long run multipliers. The lagged values of ΔFD_t, ΔEG_t, ΔINF_t, ΔSMD_t are used to model the short run dynamic structure. The bound testing procedure for the absence of any level relationship between FD_t and any corresponding variables (EG_t, INF_t, SMD_t) is through exclusion of the lagged levels variables ΔFD_{t-1}, ΔEG_{t-1}, ΔINF_{t-1} and ΔSMD_{t-1} in equation (5). It follows, then, that our test for the absence of a conditional level relationship between FD_t and EG_t, INF_t, and SMD_t entails the following null and alternative hypotheses:

H_0: $\delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$ against

H_1: $\delta_1 \neq 0$, $\delta 2 \neq 0$, $\delta 3 \neq 0$, and $\delta 4 \neq 0$

The F-test is used for testing the existence of long run equilibrium relationship. The test involves asymptotic critical value bounds, depending whether the variables are I (0) or I (1) or a mixture of both. Two sets of critical values are generated, one set refers to the I (1) series and the other is I (0) series. While the critical values for I (1) series are referred to as upper bound critical values, the critical values for I (0) series are referred to as the lower bound critical values.

If the computed F-test statistic lies above the upper level of brand, null hypothesis of cointegration is rejected, indicating the evidence of a long run equilibrium relationship between the variables regardless of the order of integration of the variables. If the test statistic lies below the lower brand, we cannot reject the null hypothesis of cointegration, indicating the absence of long run equilibrium relationship. If the test statistics lies between the bounds, a conclusive inference cannot be made without knowing the order of integration of the underlying regressors (Duasa, 2009).

If there is evidence of a long run relationship of the variables, the following long run model to be estimated:

$$LogFD_t = \alpha_1 + \sum_{j=1}^{p} \alpha_{1j} LogFD_{t-j} + \sum_{j=1}^{q} \beta_{1j} LogEG_{t-j} + \sum_{j=1}^{r} \gamma_{1j} LogINF_{t-j} + \sum_{j=1}^{s} \lambda_{1j} LogSMD_{t-j} + \xi_t \tag{6}$$

It can be noted that the estimation of ARDL is very sensitive to lag length. We use both Akaike information criterion (AIC) and Bayesian information criterion (BIC) to choose the optimum lag length (see, for instance, Burnham and Anderson, 2004) on all of p, q, r and s [see in equation (5)].

Over and above, the ARDL specification of the short run dynamics can be derived by constructing a vector autoregressive error correction model (VECM), which follows the estimation of following regression equations:

$$\Delta LogFD_t = \alpha_2 + \sum_{j=1}^{p} \alpha_{2j} \Delta LogFD_{t-j} + \sum_{j=0}^{q} \beta_{2j} \Delta LogEG_{t-j} + \sum_{j=0}^{r} \gamma_{2j} \Delta LogINF_{t-j} + \sum_{j=0}^{p} \lambda_{2j} \Delta LogSMD_{t-j} + \eta_1 ECM_{1t-1} + \zeta_{1t} \tag{7}$$

$$\Delta LogEG_t = \alpha_2 + \sum_{j=1}^{p} \alpha_{2j} \Delta LogEG_{t-j} + \sum_{j=0}^{q} \beta_{2j} \Delta LogINF_{t-j} + \sum_{j=0}^{r} \gamma_{2j} \Delta LogFD_{t-j} + \sum_{j=0}^{p} \lambda_{2j} \Delta LogSMD_{t-j} + \eta_2 ECM_{2t-1} + \zeta_{2t} \tag{8}$$

$$\Delta LogINF_t = \alpha_2 + \sum_{j=1}^{p} \alpha_{2j} \Delta LogINF_{t-j} + \sum_{j=0}^{q} \beta_{2j} \Delta LogEG_{t-j} + \sum_{j=0}^{r} \gamma_{2j} \Delta LogFD_{t-j} + \sum_{j=0}^{p} \lambda_{2j} \Delta LogSMD_{t-j} + \eta_3 ECM_{3t-1} + \zeta_{3t} \tag{9}$$

$$\Delta LogSMD_t = \alpha_2 + \sum_{j=1}^{p} \alpha_{2j} \Delta LogSMD_{t-j} + \sum_{j=0}^{q} \beta_{2j} \Delta LogEG_{t-j} + \sum_{j=0}^{r} \gamma_{2j} \Delta LogFD_{t-j} + \sum_{j=0}^{p} \lambda_{2j} \Delta LogINF_{t-j} + \eta_4 ECM_{4t-1} + \zeta_{4t} \tag{10}$$

Where, ECM is error correction term obtained from the long run cointegrating relationships. For instance, ECM_{1t-1} is derived as follows:

$$ECM_{1t-1} = LogFD_t - \alpha_1 - \sum_{j=1}^{p} \alpha_{1j} LogFD_{t-j} - \sum_{j=0}^{q} \beta_{1j} LogEG_{t-j} - \sum_{j=0}^{r} \gamma_{1j} LogINF_{t-j} - \sum_{j=0}^{s} \lambda_{1j} LogSMD_{t-j} \tag{11}$$

Here, all coefficients of the short run equation are coefficients relating to the short run dynamics of the model's convergence to equilibrium and η represents the speed of adjustment, and is expected to be negative. The above models are also very sensitive to lag length. We deploy AIC and SIC criteria to choose the optimum lag length of VECM.

Section III
Results and Discussion

The empirical results are reported in this section. The results are of two parts: cointegration (evidence of long run relationship) and direction of causality. Prior to the testing of cointegration, we conducted a test of order of integration for each variable using traditional unit root tests (ADF, DFLGS and Ng-Perron test). Even though the ARDL framework does not require pretesting variables to be done, the unit root test can convince us whether or not the ARDL model should be used.

The Table 1 reports the unit root test results, particularly with respect to ADF, DFLGS and Ng-Perron test. A plot of the variable against time does not indicate the presence of any trend in the variables. Hence, we calculate unit root only at a constant level. The results indicate that the variables (FD, EG, INF and SMD) are integrated of order 1, as the null hypothesis of unit root is rejected at the first difference only (Table 1). This gives signal that there may be cointegration among these variables. The Johansen and Juselius technique, based on maximum likelihood estimation, is deployed first to validate the existence of cointegration before we proceed to ARDL testing. This can give better reflection to ARDL approach of cointegration.

The Johansen and Juselius test basically depends upon two statistics, known as max eigen value statistics and trace statistics. The results of both the tests are given in Table 2. The results find that there exist three cointegrating vectors between finance development, economic growth, inflation, and stock market development. That means they are cointegrated, indicating the presence of long run equilibrium relationship between them. This is again tested and verified by ARDL bound testing approach. Since none of the variables is of I (2) [integrated of order two] by various unit roots test, the best technique to cointegration is the ARDL approach to cointegration (see, for instance, Afzal, *et al*, 2011).

The Table 3 provides ARDL bound test results for examining the relationship between finance development, economic growth, inflation, and stock market development. The results show that the computed F-statistic is above the upper bound value, implying that these variables are bound together in the long run. That means FD, EG, INF and SMD are found to be cointegrated, i.e., they possess long run relationship. So, the ARDL bounds test of cointegration is complemented to Johansen and Juselius's (1990) maximum likelihood test to provide a sensitivity check on the long run equilibrium results (Haliciouglu, 2011).

Coming to individual impact, ARDL results show the evidence that financial development is significantly affected by economic growth at the 1 per cent significance level. The impact of other two variables, such as inflation and stock market development, are not significant (Table 4). This implies that, in the long run, financial development provides active channel for higher economic growth.

It can be noted that there might have been structural changes due to globalization and financial reforms in the early 1990s. To complement this study, the test of parameter stability is highly required. We use cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) to test the same (Brown, *et al.*, 1975). The CUSUM test uses the cumulative sum of recursive residuals based on the first n observations and is updated recursively and plotted against the break point. The CUSUMSQ makes use of the squared recursive residuals and follows the same procedure. That means CUSUM tests can be used even if we do not know the structural break point. If the plot of the CUSUM and CUSUMQ stays within the 5 per cent critical bound then the null hypothesis that all coefficients are stable cannot be rejected. Moreover, if either of the parallel lines is crossed than the null hypothesis (of parameter stability) is rejected at the 5 per cent level. The Figure 1 evidently shows that both the CUSUM and CUSUMSQ plots lie within 5 per cent critical bound and hence, providing evidence that the parameters of the model do not suffer from any structural instability over the period of study.

After having the information about the long run association among the variables, we now proceed to multivariate Granger causality test based on VAR error correction model (VECM). The VECM enables us to explore both the short run and long run dynamics of the variables in the system. Here, we regress the changes in both the dependent and independent variables on lagged deviations as in equations (7-10). The Table 5 reports the estimates of the error correction representations. Based on this test, the long run relationship is measured by the error correction terms (ECTs). The statistical significance of ECT for FD, EG and INF, as the dependent variables, implies that these variables provide an important channel to affect the economy in the long run. However, when SMD is being considered as the dependent variable, the ECT is insignificant, implying that stock market development is insignificant in transmitting financial development effects in the long run. Clearly, these findings are very consistent with those of the ARDL bound testing.

The short run causality shows some interesting findings. The significance of the individual variables in causing the dependent variable in the short run is reflected by the F-statistics stated under the variables' coefficients. The short run causalities shed some lights on the direction of causation, thus on the financial development mechanism taking place in the economy. It shows the existence of bidirectional causality between finance development and economic growth [FD <=> EG]. This, in fact, supports the findings of both ECT and ARDL model. We also find the existence of unidirectional causality from stock market development to economic growth [SMD => EG] and from finance development to inflation [FD => INF]. However, we do not find any causality between stock market development and finance development [SMD <≠> FD], inflation and economic growth [INF <≠> EG], and stock market development and inflation [SMD <≠> INF].

To complement this study, we use generalized impulse response functions (GIRFs). The GIRFs trace the effect of a one-time shock to one of the innovations on current and future values of endogenous variables. The generalized impulse responses provided more insight into how shocks to finance development can affect economic growth and *vice versa*. The results of generalized impulse responses for finance development, economic growth, inflation and stock market development are represented in Figure 2 respectively. The GIRFs are provided the support of causality status among these variables in the multivariate VAR system.

Section IV
Conclusion

The study explores the long run and short determinants of financial development in India over the period April 1994 to April 2011. It is investigated by the application of unit root, cointegration, ARDL bound testing approach and VECM. The unit roots tests conclude that the variables used under this study (financial development, economic growth, inflation and stock market development) are integrated of order one [1 (1)]. The cointegration test concludes that the variables are cointegrated, indicating the presence of long run equilibrium relationship between them.

On the basis of unit root and cointegration findings, the study adopts ARDL and VECM which enable the differentiation of short run and long run dimensions to be made in analyzing the financial development in the economy. The ARDL bound testing approach first confirms that financial development, economic growth, inflation and stock price are bound together in the long run. The evidence supports that economic growth affects finance development positively, while the effect of inflation and stock market development is negative and insignificant. This concludes that economic growth is the most significant factor that contributes to finance development in the economy.

The VECM finds that error correction term (ECT) is significant for finance development, economic growth and inflation, confirms the existence of long run relationship between them. Coming to the direction of causation, the study finds bidirectional causality between economic growth and finance development, unidirectional causality from stock market development to economic growth and from finance development to inflation. The study, however, does not find any causality between stock market development and finance development, inflation and economic growth, and stock market development and inflation.

The policy implication of this study is that financial development can be considered as the policy variables to forecast economic growth in the Indian economy, especially in the globalization era. If policy makers want to maintain sustainable economic growth, then attention must be focused on high financial development and low inflation rate in the long run. This could also be supported with financial sector restructuring, especially on banking and stock market. A piece meal approach to such a vital issue is of serious consequences. It not only affects financial development in particular but also affects the economic development in general.

References

1. Afzal, M; H U Rehman; M S Farooq and K S Sarwar (2011), "Education and Economic Growth in Pakistan: A Cointegration and Causality Analysis", *International Journal of Educational Research,* 50, pp 321-35.
2. Ang, J B (2008), "Survey of Recent Developments in the Literature of Finance and Growth", *Journal of Economic Surveys,* 22, pp 536-76.
3. Apergis, N; I Filippidis and C Economidou (2007), "Financial Deepening and Economic Growth Linkages: A Panel Data Analysis", *International Review of World Economics,* 143, pp 179-89.
4. Bagehot, W (1873), *Lombard Street,* Homewood, IL, Richard D. Irwin.
5. Bahmani-Oskooee, M and R C W Ng (2002), "Long Run Demand for Money in Hong Kong: An Application of the ARDL Model", *International Journal of Business and Economics,* 1, 147-55.
6. Brown, R L; J Durbin and J M Evans (1975), "Techniques for Testing the Consistency of Regression Relations over Time", *Journal of Royal Statistical Society,* 37, pp 149-92.
7. Burnham, K P and D R Anderson (2004), "Multimodel Inference: Understanding AIC and BIC in Model Selection", *Sociological Methods and Research,* 33, pp 261-304.
8. Calderon, C and L Liu (2002), "The Direction of Causality Between Financial Development and Economic Growth", Working Paper, Central Bank of Chile.
9. Chang, T; W Fang and L F Wen (2001), "Energy Consumption, Employment, Output and Temporal Causality: Evidence from Taiwan Based on Cointegration and Error Correction Modelling Techniques", *Applied Economics,* 33, pp 1045-56.
10. Clarke, K A (2005), "The Phantom Menace: Omitted Variable Bias in Econometric Research", *Conflict Management and Peace Science,* 22, pp 341-52.
11. Dejong, D N; J C Nankervis and N E Savin (1992), "Integration *versus* Trend Stationarity in Time Series", *Econometrica,* 60, pp 423-33.
12. Demetriades, P and K Hussein (1996), "Financial Development and Economic Growth: Cointegration and Causality Tests for 16 Countries", *Journal of Development Economics,* 51, pp 387-411.
13. Dickey, D A and W A Fuller (1981), "Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root", *Econometrica,* 49, pp 1057-72.
14. Dickey, D A; D W Jansen and W A Fuller (1991), "A Primer on Cointegration with an Application to Money and Income", *Review Federal Reserve Bank of ST. Louis,* 73, pp 58-78.
15. Duasa, J (2007), "Determinants of Malaysian Trade Balance: An ARDL Bound Testing Approach", *Global Economic Review,* 36, pp 89-102.
16. Duttagupta, R and P Cashin (2008), "The Anatomy of Banking Crises", IMF Working Paper, pp 08-93.
17. ECB (2008), "Price Stability and Growth", *ECB Monthly Bulletin*, European Central Bank, pp 75-87.

18. Elliot, G; T J Rothenberg and J H Stock (1996), "Efficient Tests for an Autoregressive Time Series with Unit Root", *Econometrica*, 64, pp 813-36.

19. Engle, R F and C W J Granger (1987), "Cointegration and Error Correction: Representation, Estimation and Testing", *Econometrica*, 55, pp 251-76.

20. Goldsmith, R W (1969), *Financial Structure and Development*, New Haven, CT, Yale University Press.

21. Goodhart, C A E (2004), *Financial Development and Growth: Explaining the Links*, Palgrave Macmillan, New York.

22. Granger, C W J (1988), "Some Recent Developments in a Concept of Causality", *Journal of Econometrics*, 39 (1-2), pp 199-211.

23. Greenwood, J and B Smith (1997), "Financial Markets in Development, and the Development of Financial Markets", *Journal of Economic Dynamics and Control*, 21, pp 145-81.

24. Haber, S (2008), "The Finance-Growth Nexus: Theory, Evidence and Implications for Africa", Paper Presented at the Conference on African Finance for the 21st Century, Tunis, March 4-5, pp 1-35.

25. Halicioglu, F (2011), "A Dynamic Econometric Study of Income, Energy and Exports in Turkey", *Energy 36*, pp 3348-54.

26. Harris, J (1987), "The State is Retreat? Why has India Experienced such Half-Hearted Liberalization in the 80's", *IDS Bulletin*, 18, pp 28-36.

27. Harris, R and R Sollis (2003), *Applied Time Series Modelling and Forecasting*, Wiley, West Sussex.

28. Hendry, D F and J F Richard 1982), "On the Formulation of Empirical Models in Dynamic Econometrics", *Journal of Econometrics*, 20, pp 3-33.

29. Johansen, S (1988), "Statistical Analysis of Cointegrating Vectors", *Journal of Economics Dynamic and Control*, 12, pp 231-54.

30. Johansen, S (1991), "Estimation and Hypothesis Testing of Cointegrating Vectors in Gaussian Vector Autoregressive Models", *Econometrica*, 59, pp 1551-80.

31. Johansen, S (1995), *Likelihood-based Inference in Cointegrated Vector Autoregressive Models*, Oxford University Press, New York.

32. Johansen, S and K Juselius (1990), "Maximum Likelihood Estimation and Inference on Cointegration with Application to the Demand for Money", *Oxford Bulletin of Economics and Statistics*, 52, pp 169-210.

33. Laurenceson, J and J C H Chai (2003), *Financial Reform and Economic Development in China*, Cheltenham, UK, Edward Elgar.

34. Levine, R (2003), "More on Finance and Growth: More Finance, More Growth?", *Federal Reserve Bank of St. Louis Review*, 85, pp 31-46.

35. Levine, R; N Loayza and T Beck (2000), "Financial Intermediation and Growth: Causality Analysis and Causes", *Journal of Monetary Economics*, 46, pp 31-77.

36. Luintel, K and M Khan (1999), "A Quantitative Reassessment of the Finance-Growth Nexus: Evidence from a Multivariate VAR", *Journal of Development Economics*, 60, pp 381-405.

37. Majid, M S A (2007), "Re-examining the Finance-Growth Nexus: Empirical Evidence from Indonesia", *Gadjah Mada International Journal of Business,* 9, pp 137-56.

38. McKinnon, R (1973), *Money and Capital in Economic Development,* The Brooking Institution, Washington DC.

39. Mukhopadhyay, B; R P Pradhan and M Feridun (2011), "Finance-Growth Nexus Revisited for Some Asian Countries", *Applied Economics Letters,* 18 (16), pp 1527-30.

40. Narayan, P K (2005), "The Relationship Between Saving and Investment for Japan", *Japan and the World Economy,* 17, pp 293-309.

41. Narayan, P K and R Smyth (2005), "Trade Liberalization and Economic Growth in Fiji: An Empirical Assessment Using the ARDL Approach", *Journal of the Asia Pacific Economy,* 10, pp 96-115.

42. Narayan, P K and R Smyth (2009), "Multivariate Granger Causality Between Electricity Consumption, Exports and GDP: Evidence from a Panel of Middle Eastern Countries", *Energy Policy,* 37, pp 229-36.

43. Ng, S and P Perron (2001), "Lag Length Selection and the Construction of Unit Root Test with Good Size and Power", *Econometrica,* 69, pp 1519-54.

44. Ouattara, B (2004), "Modelling the Long Run Determinants of Private Investments in Senegal", CREDIT Research Paper, No. 04/05, pp 1-23.

45. Pesaran, M H and B Pesaran (1997), *Working with Microfit 4.0: Interactive Econometric Analysis,* Oxford University Press, Oxford.

46. Pesaran, M H and R Smith (1998), "Structural Analysis of Cointegration VRS", *Journal of Economic Surveys,* 12, pp 471-505.

47. Pesaran, M H; Y Shin and R Smith (2000), "Structural Analysis of Vector Error Correction Models with Exogenous I (1) Variables", *Journal of Econometrics,* 97, pp 293-343.

48. Pesaran, M H; Y Shin and R Smith (2001), "Bounds Testing Approaches to the Analysis of Level Relationships", *Journal of Applied Econometrics,* 16, pp 289-326.

49. Phillips, P C B and P Perron (1988), "Testing for a Unit Root in Time Series Regression", *Biometrica,* 75, pp 335-46.

50. Pradhan, R P (2006), "Globalization in India: Achievements and Failures", *South Asian Journal of Human Rights,* 12, pp 1-24.

51. Pradhan, R P (2010a), "Globalization in India: With Special Reference to 1990s", *Journal of Economics and International Finance,* 2, pp 76-84.

52. Pradhan, R P (2010b), "Interdependence of FDI between India and ASEAN-5: Evidence from Causality Approach", *International Business Journal,* 3, pp 156-66.

53. Pradhan, R P (2011), "Financial Development, Growth and Stock Market Development: The Trilateral Analysis in India", *Journal of Quantitative Economics,* 9, pp 134-45.

54. Pradhan, R P (2012), "Financial Development and Economic Growth in Selected Asian Countries", in R P Pradhan (eds), *Project Financing,* Bloomsbury Publishing, New Delhi.

55. Ramakrishna, G (2003), "Globalization and Balance of Payments Experience of India", *Indian Development Review,* 1, pp 27-46.

56. Rousseau, P L and P Wachtel (2000), “Banks, Stock Markets and China's Great Leap Forward”, *Emerging Markets Review,* 8, pp 206-17.

57. Sachs, J D; A Varshney and N Bajpai (1991), *India in the Era of Economic Reforms,* New Delhi, Oxford University Press.

58. Samudram, M; M Nair and S Vaithilingam (2009), “Keynes and Wagner on Government Expenditures and Economic Development: The Case of a Developing Economy”, *Empirical Economics,* 36, pp 697-712.

59. Schumpeter, J A (1911), *The Theory of Economic Development*, Cambridge, Mass, Harvard University Press.

60. Shaw, E (1973), *Financial Deepening in Economic Development,* Oxford University Press, Oxford.

61. Stern, D I (2000), “A Multivariate Cointegration Analysis of the Role of Energy in the US Macroeconomy”, *Energy Economics,* 22, pp 267-83.

Table 1
Unit Root Test Results

	ADF Test		*DFGLS Test*		
Variables	*Level*	*First Difference*	*Level*	*First Difference*	*Conclusion*
FD	0.130	–2.64*	0.93	–1.66	1 (1)
EG	0.111	–3.81*	1.56	–1.12	1 (1)
INF	–1.160	–10.2*	1.43	–15.9*	1 (1)
SMD	–0.004	–11.9*	1.36	–11.9*	1 (1)
			Ng-Perron Test		
			At Level		
	MZ_a	MZ_t	*MSB*	*MPT*	
FD	1.083	0.861	0.794	47.40	
EG	1.542	2.803	1.817	239.8	
INF	1.362	1.539	1.131	93.88	
SMD	1.523	1.405	0.923	66.72	
			At First Difference		
FD	–0.356	–0.245	0.689	96.05*	1 (1)
EG	–0.037	1.137	3.667*	672.8*	1 (1)
INF	–87.78*	–6.63*	0.075	0.279	1 (1)
SMD	–89.20*	–6.67*	0.075	0.283	1 (1)

Note: FD: Financial Development; EG: Economic Growth; INF: Inflation; SMD: Stock Market Development; and I (1): Integration of order one.
* indicates statistical significance at 10 per cent.

Table 2
Test of Cointegration (Johansen and Juselius Test)

Hypothesized Cointegrating	*Number of Relationships*	*Test Statistics*		*Critical Values*	
H_o	H_A	λ– Max	λ– Tra	λ– Max	λ– Tra
r = 0	r > 0	193.3*	268.2*	23.92	39.81
r ≥ 1	r > 1	56.59*	74.90*	17.68	24.05
r ≥ 2	r > 2	16.19*	18.31*	11.03	12.36
r ≥ 3	r > 4	2.112	2.112	4.160	4.160

Note: r indicates the number of cointegrating rel ationships. The optimal lag structure of the VAR was selected by minimizing the Akaike Information criterion.
* indicates statistical significance at 5 per cent.

Table 3
Bound Tests for the Existence of Cointegration Relationship

Test-Statistic	*Value*	*Lag*	*Significance Level*	*BCVa*		*BCVb*	
				1(0)	*1(1)*	*1(0)*	*1(1)*
F-Statistic	7.078	1					
			1%	4.614	5.996	5.333	7.063
			5%	3.272	4.306	3.710	5.018
			10%	2.676	3.586	3.008	4.150

Note: BCVa: Bound critical values with restricted intercept and no trend; BCVb: Bound critical values with restricted intercept and trend; I (1): Integration of order one; and I (0): Integration of order zero.

Source: Pesaran, *et al*, 2001; Pesaran and Pesaran, 1997.

Table 4
Long Run ARDL Model Estimates

Dependent Variable: FD			
Independent Variables	*Coefficients*	*Standard Error*	*Prob*
EG	3.142*	0.46	0.00
INF	–0.433	0.44	0.33
SMD	–0.102	0.08	0.21
Constant	0.864	0.28	0.00

Note: FD: Financial Development; EG: Economic Growth; INF: Inflation; SMD: Stock Market Development. Other notations are defined earlier.
* Indicates statistical significance at 1 per cent.

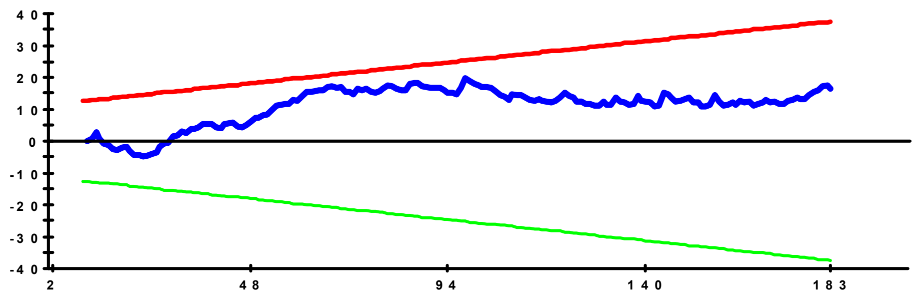
Table 5
Results of Vector Error Correction Model Causality

	Independent Variables					
Dependent Variables	*ΔFD*	*ΔEG*	*ΔINF*	*ΔSMD*	*ECT_{t-1}*	*Inferences*
ΔFD	–	3.813* [0.00]	0.143 [0.88]	-0.74 [0.46]	–3.02* [0.00]	EG = > FD
ΔEG	2.77* [0.00]	–	-0.56 [0.58]	4.51* [0.00]	–8.13* [0.00]	FD = > EG SMD = > EG
ΔINF	3.09* [0.00]	–0.92 [0.36]	–	0.70 [0.48]	–4.15* [0.00]	FD = > INF
ΔSMD	0.316 [0.75]	1.366 [0.17]	–1.37 [0.17]	–	–1.812 [0.07]	No causality

Note: ECT: Error Correction Term. Other notations are defined earlier.
* Indicates statistical significance at 1 per cent.

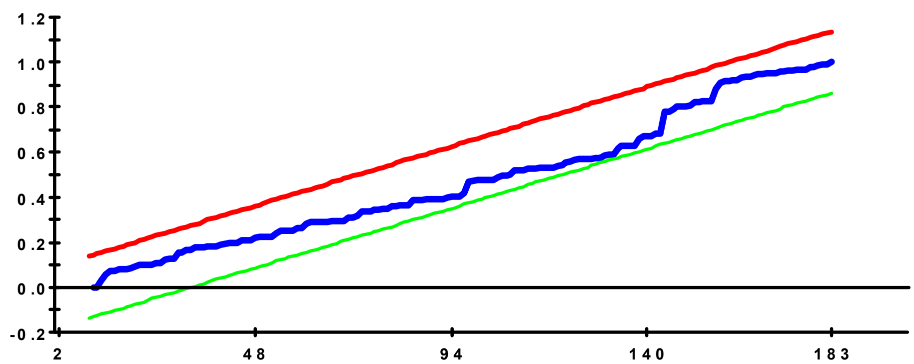
Figure 1
Plot of Cumulative Sum of Squares of Recursive Residuals

Plot of Cumulative Sum of Squares of Recursive Residuals



The straight lines represent critical bound at 5 per cent significance level

Plot of Cumulative Sum of Squares of Recursive Residuals



The straight lines represent critical bound at 5 per cent significance level

Figure 2
Plot of Generalized Impulse Response Functions