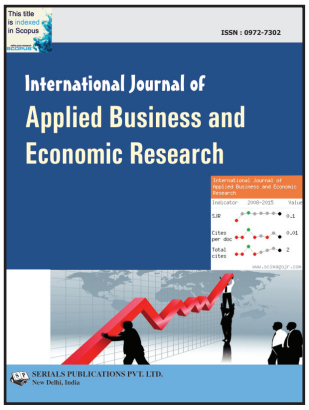

International Journal of Applied Business and Economic Research

ISSN : 0972-7302

available at http: www.serialsjournal.com

Volume 15 • Number 4 • 2017

Empirical Evidence on Nexus between Financial Markets in India: An ARDL Bounds Test Approach

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ABSTRACT

In the aftermath of global financial crisis, the study of the relationship between financial markets has become a moot point in the finance literature. In the literature, there is no much theoretical and empirical consensus on the interrelationship between the indicators of financial markets. Thus, it is imperative to conduct an empirical investigation of the causal relationship between financial markets in an emerging market economy like India. The application of ARDL bounds test provides the evidence of the existence of the long-run equilibrium relationship between the money and capital markets, and also between foreign exchange and money markets in India. However, no causal relationship runs from foreign exchange and capital markets to the money market in the long-run. This finding is very important in the context of inflation and interest rate structure in India.

JEL Classification Code: C32, E44, G19

Keywords: Financial Markets, Interest Rate, Foreign Exchange Rate, Stock Price Index, India.

1. INTRODUCTION

In the aftermath of the global financial crisis, the study of relationship between financial markets has become a moot point in the finance literature. Indian financial sector has been witnessing an emerging trend due to the introduction of both domestic and external financial liberalizations since early 1990s. In the literature, it has been argued that financial liberalization enhances real economic growth through a developed financial system (Shaw, 1973). Financial liberalization also contributes to the process of integration of financial markets within and across countries. Domestic financial liberalization leads to the removal of the entry barriers and to the elimination of administered interest rates while external financial liberalization contributes to

increase in foreign capital movements. In recent years, the international capital movements have increased a considerable extent, and thus, the connections between domestic/international financial markets have become closer. This has increased the fragility of the financial system, especially in the developing world. From the domestic front, it has sometimes been observed that any instability within the forex market has an effect on money and/or capital markets and the other way around. This is more apparent in countries where long- and short-term capital movements are relatively high and the interdependence of financial markets is intense (Çağlayan *et. al.*, 2010). Thus, it is imperative to conduct an empirical investigation of the causal relationship between financial markets in an emerging market economy like India.

The finance literature on the aforesaid issue is of course not very rich, and there is no consensus on the nature of the relationship. However, certain studies are very important and thus, reviewed here. Classical theorists' postulate that the relationship runs from exchange rates to stock prices (Dornbusch & Fisher, 1980) whereas portfolio balance models of exchange rate determination suggests a negative relationship between stock prices and exchange rates (Branson & Frankel, 1983). Studies like Aggarwala (1981) and Sonnen & Hennigar (1988) establish the relation between exchange rate and stock prices. These studies pointed out that a change in exchange rate could change the stock prices of multi-national firms directly and those of domestic firms indirectly. For multi-national firms, a change in the exchange rate would change the value of that firm's foreign operation, which would be reflected in their balance sheets as profit or loss. Consequently, it contributes current account imbalances. Once that profit or loss is announced, firms' stock prices will change. Further, a general downward movement of the stock market will motivate investors to seek better returns elsewhere. This decreases the demand for money and pushes interest rate down, thus, causing huge outflows of funds, and hence, depreciating the currency. On the other hand, for domestic firms, devaluation could either raise or lower a firm's stock price depending upon whether a particular firm is an exporting firm or it is a heavy user of imported input. If it is involved in both the activities, the stock price could move in either direction. Consider the case of a domestic firm, which is an exporting firm. This firm will directly benefit from devaluation due to increased demand for its output. Since higher sales usually result in higher profit, its stock price will increase, whereas in case of a user of imported inputs of domestic firm, devaluation will raise its costs and lower its profits. The news of decline in profits may depress the firm's stock price.

Solnik (1987) employing regression analysis on monthly and quarterly data for eight industrialized countries from 1973 to 1983 found a negative relationship between real domestic stock returns and real exchange rate movements. However, for monthly data over 1979-83, the study observed a weak but positive relation between the two variables. Mok (1993) finds that the relationship between stock returns and exchange rate are bi-directional in the Hong Kong stock market. Bahmani-Oskooee & Sohrabian (1992) analyzed Granger causality to explain the movement between exchange rates and stock prices. They note that causality between stock market and exchange rate is bi-directional in the case of the United States. Abdalla & Murinde (1997) argued that causality between stock prices and exchange rate is unidirectional in India, South Korea and Pakistan. The only exception is the Philippines where stock prices lead exchange rates. Granger *et. al.*, (2000) find that there is bi-directional causality between stock prices and exchange rate in Indonesia and Malaysia and in the case of Taiwan stock prices contain leading information when compared to exchange rates. Bhattacharya *et. al.*, (2003) studied the nature of causal relation between stock market, exchange rate, foreign exchange reserves and value of trade balance in India from April 1990 to March 2001 by applying Cointegration and long-run Granger non-causality test. The study suggested that there was no causal linkage between stock prices, and these three variables under consideration. Khalid & Kawai (2003) investigated the inter-linkages between different markets and different countries in the

Asian region using Granger causality. The study examined the movements of the three market indicators, namely exchange rates, stock price indices and interest rates during the Asian financial crises in 1997. The study found limited support for contagion within the Asian financial markets. In the same year, Kasman (2003) examined empirically the relationship between stock prices and exchange rate by using the daily data from 1990 to 2002 of exchange rates and aggregate stock indices of Turkey. By employing Johansen's Cointegration test and Granger causality test, the study found a long run stable relationship between stock indices and exchange rate. The study also concluded that causality relationship existed only from exchange rate to industry sector index. Phylaktis & Ravazollo (2005) examined the long- and short-run relationship between stock prices and exchange rates in Pacific basin countries. It employed Cointegration and multivariate Granger causality tests to investigate this relationship for the period of 1980 to 1998. The results suggest that a positive relationship exists in these markets. Pan *et. al.*, (2006) examined dynamic linkages between exchange rates and stock prices for seven East Asian countries and found evidence of a causal relationship between the two markets in all countries except Malaysia.

Horobet & Livia (2007) examine the dynamic linkage between stock prices and exchange rates in the small open eastern European economy of Romania. The study employed two variable Cointegration and Granger's causality tests on daily and monthly exchange rates and stock prices data over the period from 1999 to 2007. It found no cointegration for the whole sample period as well as the two sub-periods. From Granger's causality test, we found unidirectional causality from stock market to exchange rates for the whole period and the second sub-period. However, we found bidirectional causation in the first sub-period. To examine the long-run equilibrium relationship between the co-integrated variables, the authors used modified Granger causality tests that include error correction terms. The result of this modified Granger causality test shows that exchange rates lead the stock prices. The study also finds that stock market adjusts quite radically to changes in the exchange rates in a month. Rahman *et. al.*, (2008) empirically studied the issues of possible Granger causality and interactive feedback relationships between exchange rate changes and stock market returns of India and Japan. The study employed the daily data from January 1998 through December 2005. The time series data are found stationary in levels by ADF test for unit root. No discernible evidence of Granger causality is observed between the above variables for Japan. However, such relationship is discovered in case of India, although not quite substantial. Islami (2008) studies the interdependence between foreign exchange markets and stock markets for selected European countries. Monthly data for the nominal stock market indices and nominal exchange rates are used, where Ireland, Portugal, Spain, Greece, Poland, Czech Republic, Slovenia, and Hungary are included in the analysis. From the Cointegration analysis and VAR analysis both long-term links and short-term links for Poland are identified. Conversely, for Slovenia, Hungary, Ireland, Spain, and Greece merely short-term links resulted. Surprisingly, the direction of causation is unambiguously identified from the stock market index to the exchange rate for all six countries considered.

Kutty (2010) examines the relationship between stock prices and exchange rates in Mexico. The Granger causality test shows that stock prices lead exchange rates in the short-run, and there is no long-run relationship between these two variables. Çağlayan *et. al.*, (2010) shows that there is causal link running from interest rates to exchange rate in the pre-crises periods. It also found that bi-directional causality between interest rates and foreign exchange rate in the post-crises period. Sanati (2010) examined the financial markets integration in India in domestic as well as international perspectives, and the results reveals comovement among the domestic money, capital and foreign exchange markets with strong comovement between the short-term money and foreign exchange markets. Gulati & Kakhani (2012) examined the causal relationship

between foreign exchange rates and stock market, and the results suggest the existence of no relationship among them in the short-run. Zubair (2013) estimated the causal relationship between stock market index and monetary indicators during global financial crisis for Nigeria, and the results suggest absence of long-run relationship before and during the crisis. Wilson & Sheefeni (2014) examined the relationship between the exchange rate and the interest rate for Namibia, and the results show no cointegration among them. Muthukumaran & Somasundaram (2014) estimated the causal relationship between interest rate and stock market returns in India, and found the evidence of no short-term relationship among them. Poornima & Ganeshwari (2016) examined the relationship between stock market index and exchange rate, and the results show unidirectional causal relationship among them.

Thus, it is clear that there is no much theoretical and empirical consensus on the interrelationship between the indicators of financial markets. The studies have largely provided mixed evidence on the causal relation between financial markets. This may be due to the emergence of new capital markets, adoption of more flexible exchange rate regime, and the liberalization of financial markets in the emerging markets. Second, the literature lacks ample studies examining the relationship between financial markets in the context of India. Third, there are a few studies which cover up the period of global financial crisis in their sample. Therefore, this paper is an attempt to investigate the causal linkages between financial markets – Foreign Exchange Market, Money Market and Capital Market, in the context of Indian economy. The rest of the paper is organized as follows: Section 2 discusses the data and methodology of the study; Section 3 makes the analysis; and Section 4 concludes.

2. DATA AND METHODOLOGY

The very objective of the study is to investigate the causal linkages between financial markets – Foreign Exchange Market, Money Market, and Capital Market, in the context of Indian economy over the sample period spanning from January 2007 to December 2010. This sample period is deliberately chosen to observe the dynamics of the said relationship during the period of financial slowdowns. The indicators of foreign exchange, money and capital markets are foreign exchange rate (INR/US$), interest rate (lending rate) and general stock price index. The study uses monthly data concerning these indicators, and the data have been collected from the International Financial statistics database provided by IMF. And, all the data are taken in their logarithms to avoid the likely problems of heteroskedasticity.

We have chosen to employ the Autoregressive Distributed Lag (ARDL) Bounds Test approach as proposed by Pesaran *et. al.*, (2001) in order to examine the long-run relationship between the financial markets. The study uses monthly data instead of higher frequency data to avoid the problem of non-synchronous trading (Karim & Karim, 2012). There are certain reasons why we have employed ARDL Bounds test approach. First, this approach provides robust results for a smaller sample size in a time series analysis (Karim & Karim, 2012). Second, Narayan *et. al.*, (2004) noted that the advantage of the ARDL approach is that we can know which one is the dependent variable from the F-test when integration exists. Pesaran & Shin (1999) pointed out that ARDL approach has gained popularity in recent years as a method of examining long-run and cointegrating relationships between variables. The long-run multivariate ARDL model employed in this study can be specified as follows:

Forex Market: $$FEM_t = \alpha_{10} + \beta_{11}MM_t + \beta_{12}CM_t + \varepsilon_{1t} \quad (1)$$

Money Market: $$MM_t = \alpha_{20} + \beta_{21}FEM_t + \beta_{22}CM_t + \varepsilon_{2t} \quad (2)$$

Capital Market: $$CM_t = \alpha_{30} + \beta_{31}FEM_t + \beta_{32}MM_t + \varepsilon_{3t} \quad (3)$$

Using the cointegrating relationships from these ARDL specifications, Pesaran *et. al.*, (2001) developed a methodology for testing whether the ARDL model contains a level (or long-run) relationship between the dependent variable and the regressors. This is nothing but the Bounds Test. In order to implement the Bounds test, let us consider a vector of variables $A_t = (Y_t, X_t)$ where Y_t is the dependent variable and X_t is the vector of regressors. The data generating process of A_t is a p-order vector autoregression. For integration analysis, ΔY_t is modeled as a conditional error-correction model and can be stated as follows:

$$\Delta Y_t = \alpha_0 + \pi_{yy} Y_{t-1} + \pi_{yx.x} X_{t-1} + \sum_{i=1}^{p} \theta_i \Delta Y_{t-i} + \sum_{j=0}^{p} \varphi_j \Delta X_{t-j} + \mu_t \quad (4)$$

Here, π_{yy} and $\pi_{yx.x}$ are long-run multipliers. Lagged values of ΔY_t and current and lagged values of X_t are used to model the short-run dynamic structure. The presence of equity market integration is traced by restricting all estimated coefficients of lagged level variables equal to zero. That is, the null hypothesis $H_0 : \pi_{yy} = \pi_{yx.x} = 0$ is tested for its possible rejection. This hypothesis can be tested using the lower and upper bounds of critical values provided by Pesaran *et. al.*, (2001). The critical values are provided for the cases where all regressors are I(0) and the cases where all regressors are I(1). If the computed F-statistic is less than lower bound critical value, then we do not reject the null hypothesis of no long-run relationship. However, if the computed F-statistic is greater than upper bound critical value, then we reject the null hypothesis and conclude that there exists steady state equilibrium relationship between variables (long-run relationship) under study. However, if the computed value falls within lower and upper bound critical values, then the result is inconclusive. The most important thing is that ARDL Bounds test approach presumes that the error term is serially uncorrelated. Thus, it is important that the lag order p of the underlying ARDL model is to be chosen appropriately (Pesaran *et. al.*, 2001). In this study, Akaike Information Criterion (AIC) is used as a lag length selection criterion as it selects the relevant maximum lag length.

3. RESULTS AND DISCUSSION

In line with the objectives of the study, we first resorted to the stationary test of the time series under consideration. For this purpose we have used the ADF unit root test, and the results are reported in Table 44.1.

Table 44.1
Results of ADF Unit Roots Test

Markets	*ADF Statistic at level*	*p-value*	*ADF Statistic at 1st Difference*	*p-value*
FEM	–1.30	0.87	–4.85	0.001*
MM	–2.26	0.44	–6.61	0.000*
CM	–2.02	0.062**	NA	NA

Source: Authors' Own Estimation * significant at 1% level; ** significant at 10% level;

It is clearly understood from Table 44.1 that the time series for foreign exchange market, and money market are I(1), but that of for capital market is I(0). Hence, the use of ARDL Bounds test is justified. The results of ARDL Bounds test are presented in Table 44.2. The test is conducted for each of the three equations specified in section-2 above for the three financial markets. The first column of the table shows the best fitted ARDL model automatically chosen on the basis of the Akaike Information Criterion (AIC). The second column depicts the dependent variable in each equation mentioned thereof. The third column reports the F-statistic for bounds test. Then for each equation specified in column two, the critical value lower

and upper bounds have been stated at the mentioned level of significance. It is seen from the Table 44.2 that the movements in money and capital markets cause the movements in the foreign exchange market in India. Thus, there is long-run relationship between these markets when the foreign exchange market is treated as the dependent variable in equation (1): ARDL(8,6,7). Similarly, the movements in foreign exchange and money markets cause the movements in the capital market India. Thus, there is long-run relationship between these markets when the capital market is treated as the dependent variable in equation (3): ARDL(7,8,7).

Table 44.2
Results of ARDL Bounds Test

ARDL Model	*Dependent Variable*	*F-Statistics*	*Critical Value Bounds*			*R-sq.*	*Adj. R-sq.*	*BG LM-stat. (p-value)*	*Ramsey Reset Test (p-value)*	*Decision*
			Significance	*Lower Bound*	*Upper Bound*					
ARDL(8,6,7)	**Eq.1**: FMA	4.622	10%	3.17	4.14	0.98	0.95	2.15 (0.341)	1.48 (0.241)	Long-run relationship exist
ARDL(1,0,0)	**Eq.2**: MM	1.363	10%	3.17	4.14	0.84	0.83	0.861 (0.650)	0.062 (0.803)	Long-run relationship does not exist
ARDL(7,8,7)	**Eq.3**: CM	6.799	1%	5.15	6.36	0.98	0.95	3.591 (0.166)	0.195 (0.665)	Long-run relationship exist

Source: Authors' Own Estimation

However, there is no evidence of long-run relationship between the financial markets when money market is treated as the dependent variable in the equation (2): ARDL(1,0,0). All these ARDL model estimates have been justified on the basis of sufficiently higher values of R-squared, Adjusted R-squared, Breusch-Godfrey LM test for autocorrelation, and Ramsey's RESET test for stability/correctness of the ARDL models. In the LM test, the chi-square statistic is based on the null hypothesis of 'no serial correlation' which is rejected for p-value close to zero. In our case the null hypothesis could not be rejected because the chi-square statistic is not significant for any of the ARDL model. Thus, it is accepted that these models do have any problems of autocorrelation. Furthermore, Ramsey's RESET F-statistic is the test for the stability/correctness of the ARDL model in which null hypothesis is 'ARDL model is correct' which is rejected when *p*-value is close to zero. In our case, this null hypothesis could not be rejected for any of the ARDL model because the F-statistic is not significant in any case. Thus, it is accepted that these models are stable and correctly specified. From these findings, it can be inferred that the long-run causality runs from money and capital markets to foreign exchange market in India. Also, the long-run causality runs from foreign exchange and money markets to the capital market. However, no causal relationship runs from foreign exchange and capital markets to the money market in the long-run. Therefore, on the basis of the findings of our study it can be said that the complete financial market integration and interdependency is very much hampered by the financial crises especially in emerging market economies like India.

4. CONCLUSION

This paper empirically examines the dynamics of the causal relationship between foreign exchange, money, and capital markets in India over the sample period spanning from period Jan-2007 to Dec-2010 so as to include the period of global market slowdown and its consequential effects on the financial markets of

India. The use of ARDL bound test reveal that the causality runs from money and capital markets to foreign exchange market during the crisis period. Also, the causality runs from foreign exchange and money markets to the capital market. However, no causal relationship runs from foreign exchange and capital markets to the money market. This implies that interest rate has become an important policy variable in developing countries like India where inflation control is a primary task. A change in the interest rate may affect other financial variables (exchange rate and/or stock market index) of those countries where financial problems are solved using high interest rate, low exchange rate or providing high return when investing in the capital markets. It has also been observed in this study that interest rate appears to influence the foreign exchange rates. For instance, when interest rate increases bonds become relatively more appealing and people from other countries will want more domestic bonds. So, the foreign demand for domestic currency increases. Thus, the nominal exchange rate falls (appreciates). This makes the domestic currency more expensive to buy forex. This appreciation occurs to offset the increased demand for domestic currency. Furthermore, the study provides the evidence that stock prices can influence the exchange rates. An increase in domestic stock prices lead individuals to demand more domestic assets. In order to buy more domestic assets, they require selling foreign assets as they are less attractive now. Therefore, it leads to increase in demand for money and increase the interest rate. Higher interest rate will attract more foreign investment into domestic country leading to an appreciation of local currency. In addition, it is evident that the foreign exchange market influences the capital market. It is due to the huge investments by foreign institutional investors. Looking at the aforementioned dynamics of the relationship between financial markets in an emerging market economy like India, it can be said that the discovery of such relations and implementation of suitable economic policies could generate favourable effects in the national economy.

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