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Does Stock Market Development Cause Economic Growth? A Time Series Analysis for Indian Economy

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Abstract

The present study examines the causal relationship between stock market development and economic growth for the Indian economy over the last decade or so. By applying the techniques of unit–root tests and the long–run Granger non-causality test proposed by Toda and Yamamoto (1995), we test the causal relationships between the real GDP growth rate and three stock market development proxies. Our results are in line with the *supply leading* hypothesis in the sense that there is strong causal flow from the stock market development to economic growth. A bi directional causal relationship is also observed between real market capitalization ratio and economic growth.

Keywords: Stock Market Development, Real GDP Growth, Toda and Yamamoto Causality Test, India

1. Introduction

Academic literature on the relationship between financial development and economic growth dates back to as early as the early twentieth century (Schumpeter, 1911).The issue has been of great interest and generated considerable amount of debate among economists for many years. The debate primarily revolved around two major questions: *first* whether at all there is a relationship between development of financial sector on economic growth and *second*: what could be the nature and direction of the causal relationship, if any i.e. does development of financial sector promote economic growth or does economic development foster financial sector development? The possible directions of causality between financial sector development and economic growth were highlighted by Patric (1966) in his '*supply leading*' and '*demand following*' hypotheses. The 'supply leading' hypotheses claims a causal relationship from financial development to economic growth by saying that intentional creation and development of financial institutions and markets would increase the supply of financial services and thus lead to economic growth while the demand following hypothesis claims that it is the growth of the economy which causes increased demand for financial services which in turn leads to development of financial markets.

An extensive volume of literature and research work has emerged attempting to answer the above questions, both at the theoretical and empirical level. The findings and views expressed in these works have been generally conflicting in nature. Some studies like King and Levin (1993a, b), Levin and Zervos (1998), Demirguc and Maksimovic (1996) have found positive causal effects of financial development on economic growth in line with the 'supply leading' hypothesis. These studies claim that countries with better developed financial systems particularly those with large efficient banks and a large well organized and smoothly functioning stock markets tend to grow much faster by providing access to much needed funds for financially constrained economic enterprises. Kletzer and Pardhan (1987), Beck (2002), also argue along similar lines but they also tried to establish that financial development is much more effective in promoting economic growth in more industrialized economies than in agricultural economies. Their view has been contradicted in some other studies which argue that countries at their early stage of development benefit more from financial sector development than their older and mature counterparts (Fry, 1995). However most of these studies being cross country regression based studies; there were some inherent weaknesses in such analysis that drew considerable criticism from contemporary researchers. Levine and Renelt (1992) talks about omitted variable bias or misspecification, Evans (1995) and Pesaran and Smith (1995) highlight the effect of heterogeneity of slope coefficients across countries, while problems of causality and endogeneity are explored by Demetriades and Hussain (1996) and Harris (1997). Motivated by such criticism, Levin et.al (2000) examined empirically the same issue by incorporating adequate corrections for the effects of simultaneity bias and country specific effects, effects of other determinants of growth and biases arising from model specific errors like omitted variables. Their conclusions identified a causal relationship running from financial development indicators to economic growth even after controlling for such factors. Support for the 'demand following' argument is also there in the research works over the last four or five decades. Robinsson (1952) argued that financial development primarily follows growth in the real economy, as a result of increased demand for financial services. Lucas (1988) stated that the role of financial sector development in causing economic growth of a country has been 'badly overstressed'.

The growing importance of stock markets in developing countries around the world over the last few decades has shifted the focus of researchers to explore the relationship between stock market development and economic growth. The motivation is derived primarily from the obvious policy implications of the findings of such studies for the developing economies. Developing countries have found place in a few country specific studies so far such as Habibullah (1999), Chang (2002) for China and Bhattacharyya and Sivasubramaniam (2003) for India. India as a country has seen tremendous development of its financial sector and particularly stock markets in the last two decades specially after the liberalization spree of the early 1990s. We came across some other papers in the Indian context that explored similar sort of linkage between real sector and financial sector development (Agrawalla and Tuteja, 2007; Sarkar, 2007; Chakraborty, 2008 etc.). The contribution of our paper to the relevant literature lies first of all, in focusing on the link between stock market developments and the growth for the Indian economy using different indicators of the former, viz., liquidity, volume of transactions, volatility etc., rather than constructing a composite index that simultaneously reflect some of these indicators, as in the study by Agrawalla and Tuteja (2007). It was felt that such a composite index may not adequately capture the influence of each indicator of stock market development separately on economic growth.

Secondly, this paper focuses *only* on stock market development and its causal linkage with economic growth, rather than interactions between the growth of real GDP and broad indicators of *overall* financial development, viz., financial depth, bank credit etc., as is evident in the study by Chakraborty (2008). Banking sector has been entrusted as the predominant agent for fostering economic development since independence. However only after the liberalization spree in the early 1990s that the stock market has caught the attention as an important alternative source of funding for the corporate, and its role in the process of overall economic development has started to assume importance. Given that the current study period is from 1996:Q4 – 2007:Q1, and the tremendous growth in terms of market capitalization, trading volume and liquidity registered by the stock market in India during that time simultaneously with near double digit economic growth, our focus is primarily to unravel the linkage between only the stock market development and real economic growth during this time period. While most of the earlier studies try to capture the interlinkage over a large span of time (Sarkar, 2007), the present study is more focused on the impact of the initial reform period, as it considers the period 1996-2007.

The underlying objective of the present study is to explore the presence of a causal relation between development in real sector and the stock market in India and to understand the exact direction of the relation. The study employs recent time-series econometric methods like Granger causality test (1969) and its subsequent improved version Toda Yamammotto approach (1995) for the analysis. The study period chosen was just over a decade between 1996-2007. Our results suggest a causality flow from the financial sector to the real sector which is in line with the *supply leading* hypothesis of Patric (1966) and supported in several works mentioned before. Given the increasing importance of financial sector in the Indian economy, the findings should hopefully have significant policy implications.

The remaining part of the paper is organized as follows: section 2 talks about the methodology and data, section 3 discusses the principal results obtained. The paper ends with some concluding observations in section 4.

2. Methodology and Data Measurement

A brief outline of the traditional causality test, viz., Granger causality (1969) and subsequent improvements, namely, Toda and Yamamoto (1995) version of Granger causality is presented below, followed by discussion of the principal variables employed.

2.1. Granger Causality Test

Traditionally Granger (1969) causality is employed to test for the causal relationship between two variables. This test states that, if past values of a variable y significantly contribute to forecast the future value of another variable x then y is said to Granger cause x. Conversely, if past values of x statistically improve the prediction of y, then we can conclude that x Granger causes y. The test is based on the following regressions:

$$y_t = \beta_0 + \sum_{k=1}^{M} \beta_k y_{t-k} + \sum_{l=1}^{N} \alpha_l x_{t-l} + u_t \tag{1}$$

$$x_t = \gamma_0 + \sum_{k=1}^{M} \delta_k y_{t-k} + \sum_{l=1}^{N} \gamma_l x_{t-l} + v_t \tag{2}$$

where y_t and x_t are the two variables, u_t and v_t are mutually uncorrelated error terms, t denotes the time period and '*k*' and '*l*' are the number of lags. The null hypothesis is $\alpha_l = 0$ for all *l*'s and $\delta_k = 0$ for all *k*'s versus the alternative hypothesis that $\alpha_l \neq 0$ and $\delta_k \neq 0$ for at least some *l*'s and *k*'s. If the coefficient α_l's are statistically significant but δ_k's are not, then x causes y. In the reverse case, y causes x. But if both α_l and δ_k are significant, then causality runs both ways.

Recent studies on time-series econometrics have highlighted several crux issues pertaining to Granger causality test. *First*, the direction of causality depends critically on the number of the lagged terms included. If the chosen lag length is smaller than the true lag length, the omission of relevant lags may cause bias. Conversely, the inclusion of extraneous lags in the equation may cause the estimates to be inefficient. In our model, we have used the Akaike and Schwarz information criterion (AIC / SIC) to fix the choice of lag length. *Secondly,* traditional Granger causality test is based on the assumption that the variables are stationary, or even if non-stationary must have the same order of integration. As observed by Toda and Phillips (1993), any causal inference in Granger jargon is questionable when there are stochastic trends and the F – test is not valid unless the variables in levels are cointegrated. There are tests for cointegration and cointegrating ranks namely, error correction model (ECM) due to Engle and Granger (1987) and the vector autoregression error correction model (VECM) due to Johansen and Jesulius (1990). Unfortunately, these tests are not easily comprehensible and requires fulfillment of the sufficient rank conditions based on *trace* and *maximum eigen value* test for cointegration.

2.2. Toda and Yamamoto Test

Toda and Yamamoto (1995) proposed an alternative causality test which can be applied "whether the VAR's may be stationary (around a deterministic trend), integrated of an arbitrary order, or cointegrated of an arbitrary order" (Toda and Yamamoto, 1995, pp. 227). The testing procedure is similar to Granger causality, but augmented with extra lags depending on the maximum order of integration of the series under consideration. It is essentially a two step procedure:

Step 1: To identify the maximum order of integration ($d_{\max}$), we need to test for stationary of the series. The most popular and widely used test of stationarity is the unit root test, also known as the "augmented" Dickey and Fuller (ADF, 1979) test. This test involves estimating the following equation:

$$\Delta y_t = (\phi - 1)y_{t-1} + \sum_{j=1}^{k} \delta_j \Delta y_{t-j} + \varepsilon_t \tag{3}$$

where $\varepsilon_t \sim$ WN (0, σ^2).

Test of unit root requires testing the null $H_0 : (\phi - 1) = 0$, the series is non-stationary *versus* the alternative $H_1 : |\phi| < 1$, under the assumption that ε_t is a Gaussian white noise. It involves carrying out the usual *t*- ratio of the estimate of $(\phi - 1)$ to its standard error. But Dickey and Fuller (1979) have shown that this statistic does not have a Student's *t*- distribution under H_0, i.e., when the series is non-stationary. The authors have computed critical values of the statistic on the basis of Monte Carlo simulations.

While the null hypothesis of a driftless random walk is appropriate for some series, many often contain a drift parameter and a linear trend. Then an appropriate test may be suggested by way of an extension of the testing methodology described above. Here we test for the significance of the coefficient $(\phi - 1)$ associated with y_{t-1} in the following regression:

$$\Delta y_t = \beta_0 + \beta_1 t + (\phi - 1)y_{t-1} + \sum_{j=1}^{k} \delta_j \Delta y_{t-j} + \varepsilon_t \tag{4}$$

where β_0 is the drift parameter.

Step 2: We construct a vector autoregressive model (VAR) in their levels with a total of (k + $d_{\max}$) lags, where *k* is the optimal number of lagged terms included which is determined by AIC / SIC criteria. Thus, if *k = 1* and if two series y_t and x_t have different orders of integration, viz., I (0) and I (1) respectively so that $d_{\max} = 1$, then one extra lag is added to each variable. Thus a VAR with *2 lags* is constructed as follows:

$$\begin{bmatrix} y_t \\ x_t \end{bmatrix} = \begin{bmatrix} \beta_{10} \\ \beta_{20} \end{bmatrix} + \begin{bmatrix} \beta_{11}^{(1)} & \beta_{12}^{(1)} \\ \beta_{21}^{(1)} & \beta_{22}^{(1)} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ x_{t-1} \end{bmatrix} + \begin{bmatrix} \beta_{11}^{(2)} & \beta_{12}^{(2)} \\ \beta_{21}^{(2)} & \beta_{22}^{(2)} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ x_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \tag{5}$$

A Wald test (also called the modified Wald or MWALD) is carried out to determine the relationship between the two variables. The Wald statistic follows asymptotic $\chi 2$ distribution, and can be applied even if y_t and x_t are I (0), I (1) or I (2), non-cointegrated and/or the stability and rank conditions are not satisfied, provided "…the order of integration of the process does not exceed the true lag length of the model…" (Toda and Yamamoto 1995, pp. 225).

2.3. Data Measurement

The current study focuses on Indian economy spanning over a period of more than eleven years (1996-2007). Any study on stock market development should preferably be based on daily (or monthly) frequency, given the dynamic nature of the market. But given the fact that monthly GDP figures in India are not available and only since 1996 first quarter, the Central Statistical Organization (CSO) has started computing the data quarterly, in the present study, we have used quarterly data on output and indicators of stock market development and volatility for the period 1996:Q4 – 2007:Q1.

The variables we have used are as follows:

a. Economic development is measured by the growth rate of real GDP at constant prices (base year: 1993-94 = 100).
b. Stock market development is measured by two proxies: real market capitalization ratio (*size proxy*) defined by the ratio of market capitalization to real GDP, and real value traded ratio (*activity proxy*) defined by the ratio of trading volume to real GDP.
c. In addition stock market volatility is used as a measure of efficient allocation of investment resources (Arestis et. al, 2001). A four-quarter moving standard deviation of the end-of-quarter change in stock market prices is employed to that extent. We employed BSE Sensex as the representative of Indian Stock markets given its undoubted popularity amongst investors, and market practitioners across the board.

The data on market capitalization and trading volume is collected from the CMIE Business Beacon Database; while that of real GDP has been compiled from Handbook of Statistics on Indian Economy published by Reserve Bank of India. The data on Sensex closing values are collected from CMIE Prowess database

3. Empirical Results

As discussed in the earlier section, we first check whether the series under consideration are stationary or not. In the latter case, we also determine their order of integration. The results of Augmented Dickey Fuller (ADF, 1979) unit root test are depicted in Tables 1 and 2. The results suggest that stock market volatility (SMV) is stationary, that is, I(0). On the other hand, all the remaining variables, viz., real market capitalization ratio (MCR), real value traded ratio (VTR) and real GDP growth rate (GDPGR) has a unit root, but the first difference of each is stationary. In other words, they are characterized as I(1). Thus the four variables in our model are not cointegrated and hence F-test in Granger causality may not be reliable in inferring leads and lags among such variables, with different orders of integration (Toda and Phillips, 1993).

Table 1: Results for the Unit Root Tests in Levels

Variables	ADF	
	Constant, No trend	**Constant, With trend**
MCR	0.888933	-0.418838
VTR	-2.874403***	-2.873620
SMV	-3.339017**	-3.302009***
GDPGR	-2.514559	-1.345150

Note: Asterisk (**) and (***) denote statistically significant at 5% and 10% levels respectively

Table 2: Results for the Unit Root Tests in First Difference

Variables	ADF	
	Constant, No trend	**Constant, With trend**
MCR	-6.492979*	-7.371780*
VTR	-3.475124**	-3.413814***
GDPGR	-6.429985*	-6.636057*

Note: Asterisk (*), (**) and (***) denote statistically significant at 1%, 5% and 10% levels respectively

Given that the maximum order of integration ($d_{\max}$) equals 1, we next determine the number of lagged terms (k) to be included using AIC / SIC rule and find it to be 2. Finally, we construct a VAR in levels, similar to that depicted in (5) with a total of ($k + d_{\max}$) equaling 3 lags.

$$\begin{bmatrix} MCR_t \\ VTR_t \\ SMV_t \\ GDPGR_t \end{bmatrix} = B_0 + B_1 \begin{bmatrix} MCR_{t-1} \\ VTR_{t-1} \\ SMV_{t-1} \\ GDPGR_{t-1} \end{bmatrix} + B_2 \begin{bmatrix} MCR_{t-2} \\ VTR_{t-2} \\ SMV_{t-2} \\ GDPGR_{t-2} \end{bmatrix} + B_3 \begin{bmatrix} MCR_{t-3} \\ VTR_{t-3} \\ SMV_{t-3} \\ GDPGR_{t-3} \end{bmatrix} + \mathrm{E}_t \tag{6}$$

where B_0 is the intercept vector and E_t is the vector of error terms. The above system of equations is estimated by seemingly unrelated regression (SUR) method. For example, if we want to test that *GDPGR* does not Granger-cause *MCR*, the null hypothesis will be H_0: $\beta_{14}^{(1)} = \beta_{14}^{(2)} = 0$, where $\beta_{14}^{(i)}$, $\mathrm{i} = 1, 2$, are the coefficients of *GDPGR* appearing in the first equation in (6). The results of the Toda-Yamato tests of Granger causality are in Table 3.

Table 3: Results of Long Run Causality due to Toda-Yamamoto (1995) Procedure

Null Hypothesis	**MWALD Statistics**	**p-values**
Real GDP Growth Rate (GDPGR) versus Market Capitalization Ratio (MCR)		
GDPGR does not *Granger cause* MCR	16.52278*	0.0009
MCR does not *Granger cause* GDPGR	24.35467*	0.0000
Real GDP Growth Rate (GDPGR) versus Value Traded Ratio (VTR)		
GDPGR does not *Granger cause* VTR	2.030571	0.5661
VTR does not *Granger cause* GDPGR	7.272058**	0.0466
Real GDP Growth Rate (GDPGR) versus Stock Market Volatility (SMV)		
GDPGR does not *Granger cause* SMV	3.768079	0.2876
SMV does not *Granger cause* GDPGR	7.243791***	0.0645

Note: Asterisk (*), (**) and (***) denote statistically significant at 1%, 5% and 10% levels respectively

The results suggest bi-directional causality between real GDP growth rate and real market capitalization ratio at 1% level of significance. Further the null hypotheses that real GDP growth rate does not Granger cause value traded ratio and real GDP growth rate does not Granger cause stock market volatility are also rejected respectively at 5% and 10% levels. Thus uni-directional causality runs from real economic sector to both stock market activity and volatility.

4. Conclusion

The present paper makes a modest attempt to explore the causal relationship between stock market development and economic growth in the Indian economy for the period from 1996:Q4 – 2007:Q1. The study primarily revolved around two major questions: *first* whether at all any relationship exists between stock market development and economic growth and *secondly*, what could be the nature and direction of the causal relationship, if any i.e. does development of stock market promote economic growth or vice versa? To test this hypothesis, we employ the methodology of *Granger non-causality* proposed by Toda and Yamamoto (1995). In this study, the BSE Sensitive Index is used as a proxy for the Indian stock market. The three important indicators for stock market development variables included in the study are real market capitalization ratio (*size proxy*), real value traded ratio (*activity proxy*) and stock market volatility. Real GDP growth rate is used as a proxy for economic development.

The main findings of the paper can be summarized as follows: first, the results show bi-directional causality between real GDP growth rate and real market capitalization ratio. Secondly, the results suggest unidirectional causality from both stock market activity and volatility to real GDP growth in Indian economy. In other words, Toda Yamamoto (1995) causality test results suggest that stock market development leads to economic growth at least for the period under study for the consideration, which is in line with the 'supply leading' hypotheses. The funds raised by the corporate from the financial markets during the study period thus played an important role for the appreciable growth registered by the Indian economy. With the Indian stock market assuming more and more importance this finding could have significant policy implications for the market regulators and economic planners in future.

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