Project Report

Time series analysis for causal relationship between Trade, Foreign Direct Investment and Economic Growth of India

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Abstract

This report documents the study done as a part of course project in the course Time Series Analysis. In this project we study the correlation and causality in the linkages among Foreign Direct Investment, Trade and economic growth over the period of 1975 to 2010. India has witnessed a drastically positive change in FDI inflows in the last few decades. In theory it is often considered that economic growth induces FDI inflows. Also, Trade and FDI may stimulate economic growth. This project aims to establish these notions. With Cointegration analysis we prove that there is a long run relationship between the examined variables. The result of Granger causality test shows a directional causal relation between the three variables. The results of this study will prove crucial for economic policy research.

Contents

1 Introduction

Foreign direct investment (FDI) and trade are often seen as important catalysts for economic growth in the developing countries. Through FDI, technology can be transferred from the developed to the developing countries. International trade is also known to be an instrument of economic growth (Frankel and Romer, 1999)[12]. With the help of Trade more efficient production of goods and services through shifting production to countries who gain from such productions and have the necessary resources.

It has been established through various previous macro emperical studies that there is weak support for an exorgenous positive impact of FDI in economic growth (Carkovic and Levine, 2002 [7], Alfaro et al., 2013). The previous studies have found that a countrys capacity to take advantage of FDI inflows might be limited by local conditions, such as the development of the local financial markets or the educational level of the country. FDI brings technology which translates into higher growth only when the host country has a minimum threshold of stock of human capital (Borensztein, De Gregorio, Lee, 1998 and Xu, 2000)[8].

Growth also has effect on Trade and vice versa (Rodriguez and Rodrik, 2000). Although the connection between Growth and Trade has been made in several works relating this topic, both theoretical and empirical, the association between them is difficult to be established. The growth literature leads to problems such as the endogeneity of the variables whereas empirical policy literature has been proved to be weak in trying to make a clear correlation between openness and growth. Openness, namely, the sum of exports and imports to Gross Domestic Product (GDP), has been considered one of the main determinants of economic growth.Although long-run economic growth and technological progress seem to lead to changes in the pattern of international trade, these effects are far from being conclusive.

Exports are likely to reduce the foreign exchange constraints and can hence provide greater access to international markets (Melina Dritsaki, Caido Dritsaki and Antonios Adamopoulos, 2004). Many early studies of the links between exports and growth confirm a statistical relationship between export growth and out put growth (Michaely, 1977; Krueger, 1978; Balassa, 1978; and Fedder, 1982).

In an open economy, technology and trade, especially through exports and imports and thus promote economic growth (Grassman and Gelpman, 1997, Chapter 9; Frankel and Romer, 1999; Frankel, Romer, Cyrus, 1996).

The observations on the FDI growth nexus and Trade growth nexus lead us to examine the third side of a triangular relations; FDI Trade nexus (Frank S.T. Hsiao, and Mei chu. Hsiao, 2006).

The empirical evidence on the causal relationships between FDI investment and trade is equally contradictory, with results ranging from unidirectional causality, bidirectional causality, or even no causality between FDI and trade (Mayang Pramadhani, Rakesh Bissoondeeal and Nget Driffield, 2007), Pacheco Lopez (2005) finds a two way relationship between FDI and exports and FDI and imports in Mexico using a Granger causality test. Anther study by Liu et al (2001)[10] concludes that there were inter linkages between FDI,

Exports and imports in china. They suggest that a growth of imports in china. They suggest that a growth of imports results in a growth of FDI Inflows. In turn the growth of FDI causes the growth of exports.

The results obtained by empirical studies, which recently have applied causality test to examine the nature of a causal relationship between exports and economic growths are also mixed. Although some studies have found a positive association, others resulted in reverse conclusions.

The importance of FDI on an economy may be doubtful. While the size of FDI may be very small compared with the level of GDP and even exports, it has been observed that FDI generally goes to the key industries like electric and electronic and high-tech manufacturing sectors of these economies, and plays a crucial role in promoting technology transfer and exports in these sectors. Thus, FDI may have a strong influence on the growth of GDP in a country.

The growth of world foreign direct investment (FDI) in recent years has been remarkable. The US dollar value of world FDI inflows reached US$1.3 trillion in 2000 from just over US$ 200 billion in 1993. In 1980, FDI stock represented the equivalent of only 5 per cent of world GDP; this percentage had almost tripled to 14 per cent by the end of the 1990s. The share of developing countries in FDI inflows has been raised from 17.1 per cent in 198890 to 21.4 per cent in 19982000 (UNCTAD 2000). Over the last decade FDI flows have grown at least twice as fast as trade (Gorg and Greenaway 2004)[11]. Empirical evidence that FDI has made a positive contribution to the economic growth of developing countries has accumulated fast. Some recent examples are Marwah and Klein (1998) for India; Li, Liu and Rebelo (1998), Sun (1998) and Liu (2002) for China; Ramirez (2000) [9] for Mexico; Lim and McAleer (2002)[**?**] for Singapore; Marwah and Tavakoli (2004)[6] for Indonesia, Malaysia, Philippines and Thailand. Borensztein, Gregorio and Lee (1998) and Makki and Somwaru (2004) are also among the cross-country studies which find positive impacts of FDI on economic growth in developing countries. In general, most governments believe inward FDI can contribute to the growth of the host countrys economy. Not surprisingly, since the 1980s, attracting FDI has been one of the most important policy goals of developing countries.

Foreign Direct Investments can contribute to economic growth because they tend to be more productive than the investments of local firms. Foreign Direct Investments have led to significant positive spillover effects on the labour productivity of domestic firms. Against this background, this paper investigates the Causal relationship between Trade, Foreign Direct Investment and Economic Growth for India. FDI in India increased to US$ 5472 millions in 2001 from US$ 2315 millions in 2000. It increased further to US$ 5627 millions in 2002. After a decline in 2003, it increased to US$ 6598 millions in 2005. The average value of FDI in this period works out to US$ 5551.2 millions of US Dollars. In this period FDI increased by 1.2 times in India. (IFS 2006-07). Total FDI inflows into India in the period April 2000August 2014 touched US$ 341,357 million. FDI inflows to India increased 17 per cent in 2013 to reach US$ 28 billion, as per a United Nations (UN) report. When we extend our idea of quantile regression and combine them with Decision tree

methods and Random Forest methods we arrive at a more wholesome picture of the datasets.

2 Mathematical Background and Overview of Techniques

2.1 Test for stationarity

2.1.1 Unit root test

Time series analysis is about the identification, estimation and diagnostic checking of stationary time series.

Definition: The sequence y_t is said to be covariance stationary if for all t and $t - s$

- $\mathrm{E}(y_t)=\mathrm{E}(y_s)=\mu$
- $\mathrm{E}(y_t - \mu)^2 =\mathrm{E}(y_{t-s} - \mu)^2=\sigma$
- $\mathrm{E}(y_t - \mu)(y_{t-s} - \mu)=\mathrm{E}(y_{t-j} - \mu)(y_{t-j-s} - \mu) = \gamma_s$

2.1.2 The Augmented Dickey-Fuller Test for Unit Roots

Dickey and Fuller (1979, 1981) devised a procedure to formally test for the presence of a unit root. The Augmented Dickey-Fuller test simply includes AR(p) terms of the X_t term in the three alternative models. Therefore we have:

$$\triangle X_t = \gamma X_{t-1} + \sum_{i=1}^{p} \beta_i \triangle X_{t-1} + \epsilon_t$$

$$\triangle X_t = \gamma X_{t-1} + \sum_{i=1}^{p} \beta_i \triangle X_{t-1} + \epsilon_t$$

2.2 Cointegration Tests

2.2.1 Engle-Granger method

Engle and Granger developed this crucial technique in 1987 [1]. According to them, the steps for determining whether two integrated variables conintegrate of same order are :

- pre-test each variable to determine its oder of intergration.
- estimate the error correction model.

If the integrated variables are found to be integrated to the same order, then it must be tested whether these variables are cointegrated (Johansen, 1988).

But as we donot know the coefficients in the linear combination of the two random variables, we use leas squares method to find the unknown parameters. Once we have the parameter, as we know that the linear combination must be stationary for the two random variables to be co-integrated, we apply the tests which we use for detecting covariance stationarity(Dicky-fuller etc).

2.2.2 Johansen Test

This test permits more than one cointegrating relationship so is more generally applicable than the EngleGranger test which is based on the DickeyFuller (or the augmented) test for unit roots in the residuals from a single (estimated) cointegrating relationship.[3] In fact, Johansens procedure is nothing more than a multivariate generalisation of the Dickey-Fuller test.[2] Consequently, he proposes two different likelihood ratio tests namely

- The trace test
- Maximum eigenvalue test

Johansens method takes as a starting point the vector autoregression (VAR) of order p given by

$$X_t = \Pi_1 X_{t-1} + \Pi_2 X_{t-2} + ... + \Pi_p X_{t-p} + u_t$$

where X_t is an $n * 1$ vector of variables that are integrated of order one. u_t is an $n * 1$ vector of innovations while Π_1 through Π_p are m*n coefficient matrices.

Trace test

The trace test tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of n cointegrating vectors. The test statistic is given by

$$J_{trace} = -T \sum_{i=r+1}^{n} ln(1 - \hat{\lambda}_i)$$

Maximum eigenvalue test

The maximum eigenvalue test, on the other hand, tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of $(r + 1)$ cointegrating vectors. Its test statistic is given by

$$J_{trace} = -T(1 - \hat{\lambda}_{r+1})$$

where T is the sample size, and $\hat{\lambda}_i$ is the i^{th} largest canonical correlation.

2.3 Causality Tests

2.3.1 Granger Causality Test

Granger (1988) [4] pointed out that if a pair of time series is cointegrated, then there must be causation in at least one direction. According to the Granger causality (Granger, 1969) approach a variable Y is caused by X, if Y can be predicted better from past values of Y and X, than from past values of Y alone. Moreover X 'Granger causes' Y if past values of X can help explain Y.If Granger causality holds this does not guarantee that X causes Y. But, it suggests that X might be causing Y. Four patterns of causality can be distinguished:

- unidirectional causality from X to Y;
- unidirectional causality from Y to X;
- feedback or bi-directional causality; and
- no causality.

. For a simple bivariate model, the pattern of causality can be identified by estimating regression of Y and X on all the relevant variables including the current and past values of X and Y respectively and by testing the

appropriate hypothesis. The causal relations between stationary series x_t and y_t can be established based on the following equations:

$$X_t = c + \sum \gamma_j X_{t-j} + \sum \beta_j Y_{t-j} + u_{X_t}$$

$$Y_t = c + \sum \gamma_j X_{t-j} + \sum \beta_j Y_{t-j} + u_{Y_t}$$

γ_j *and* $\beta_j, j = 0, 1, ...k$; (k suitably chosen) are parameters.

c is a constant and u_t is disturbance terms with zero means and finite variances

The null hypothesis that y_t doesnt Granger cause x_t if β_j(j>0) are non zero. In the same manner, x_t Granger causes y_t if γ_j(j>0) is jointly non zero.

Sometimes we check for Granger causality simply (albeit imperfectly) using only t-tests.The P-values for the t-states on individual coefficients can be used to determine whether Granger causality is present. Using the 5 % level of significance, then if any of the P-values for the coefficients $\beta_1, ..., \beta_q$ were less than .05, you would conclude that Granger causality is present. If none of the P-values is less than .05 then you would conclude that Granger causality is not present.

3 Results and Discussions

3.1 Unit root tests

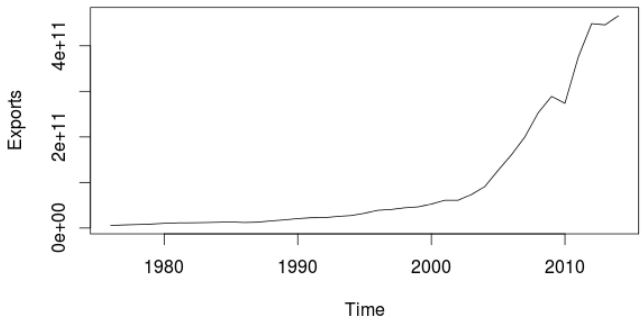

Figure 1: Time series of exports.

At zero difference we are unable to reject the null hypothesis of the unit root test in all the three time series. In the first difference series since the p values are less than 0.05 in the three time series of GDP, real

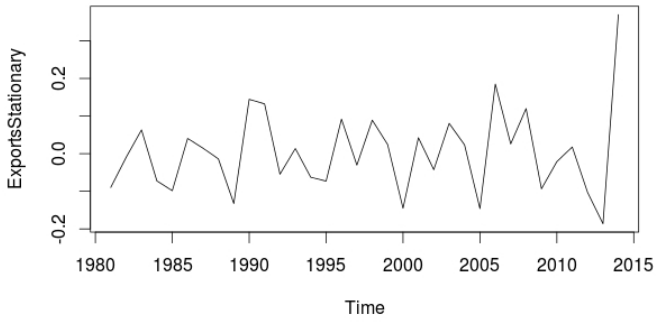

Figure 2: First difference series of exports.

mechandise export and FDI we can reject the null hypothesis and hence can say that first difference series are covariance stationary.

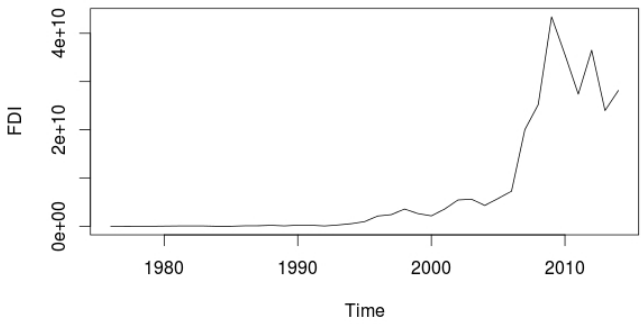

Figure 3: Time Series FDI.

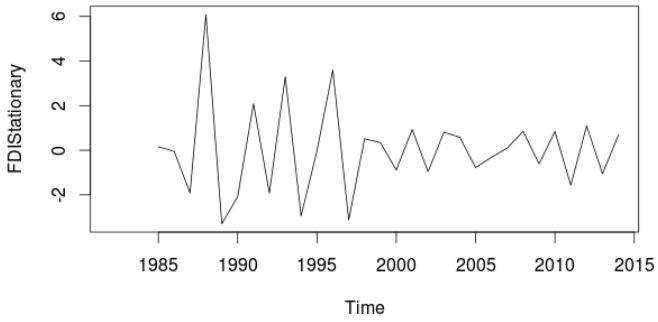

Figure 4: First difference series of FDI.

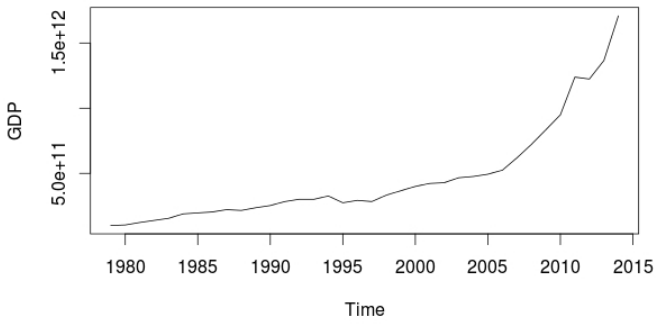

Figure 5: Time series of GDP.

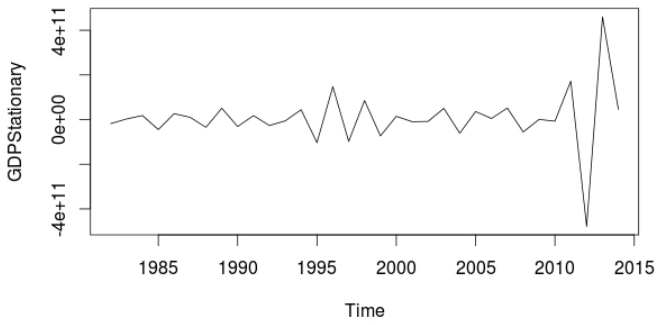

Figure 6: First difference time series of GDP.

3.2 Cointegration tests

The p value for $r = 0$ is at 0.05 (5%) significance level. So we can reject the null hypothesis.

The p values for rest of r are such that we can not reject the null hypothesis and thereby all three have cointegration among them.

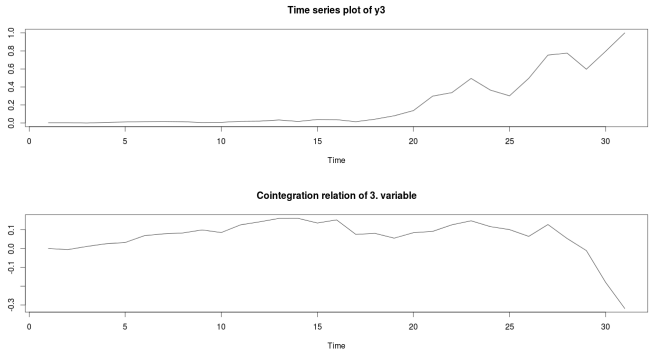

Figure 7: Johansen tests for r= 0

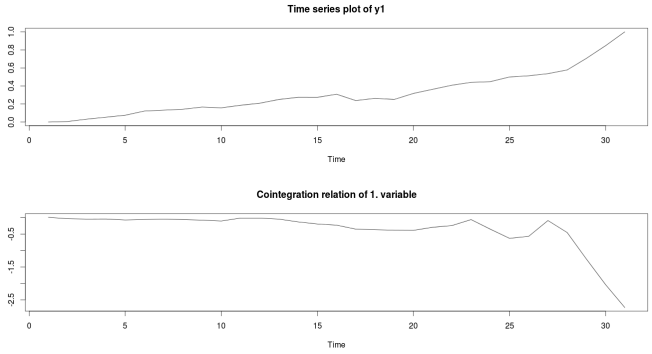

Figure 8: Johansen test for r $\leq$ 1

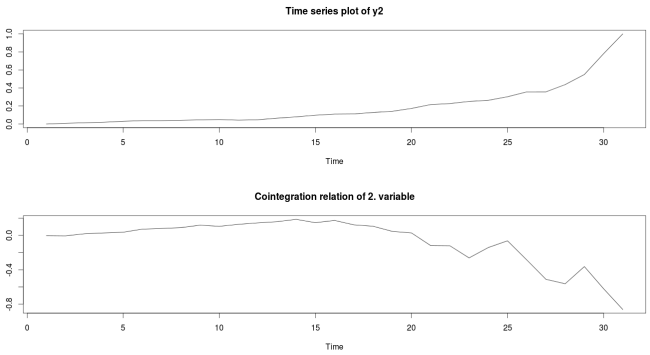

Figure 9: Johansen test for r $\leq$ 2

3.3 Granger Causality Test

Null Hypothesis X does not Granger cause Y. If p-value is less than 0.05 then we reject the null hypothesis. And thereby we have X causes Y.

3.3.1 Observations:

- FDI causes GDP but not vice versa
- Export causes GDP but not vice versa
- Export causes FDI not vice versa

where causation is interpreted as Granger causality.

4 Conclusion

Through this study, we examine the directionality of relationship between economic growth rate, FDI and Exports of India.The results of the study establish that there is no reciprocal causality relationship between these variables in India. Granger Causality Test yields that the direction of causality is from Exports to Growth rate, and there is no causality from FDI to Exports. Moreover, there is a causal relationship from FDI to Growth rate, whereas there is no causality from Growth rate to Exports and from Growth rates to FDI. The aforementioned causal linkages establish that FDI and exports in India is one of the factors affecting economic growth, however conomic growth rate does not have an effect on the presence of FDIs and exports in India.

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