Economic Impact of Foreign Direct Investment in Sri Lanka

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Abstract

This paper investigates the long-run relationship and causality between real per capita GDP, foreign direct investment (FDI) and the level of the infrastructure in Sri Lanka over the period 1980 to 2011. Level of the infrastructure has been measured by using a summary measure based on principal component analysis. Analysis shows that there is a long-run relationship between real per capita GDP, foreign direct investment (FDI) and the level of the infrastructure. The empirical results further confirm the unidirectional causality from level of the infrastructure to FDI.

I. Introduction

Foreign Direct Investment (FDI) as a growth stimulus tool has received great attention from developing countries in recent decades. In a closed economy without access to foreign saving, investment is financed from domestic savings. However, in an open economy, investment may be financed through both domestic savings and foreign capital flows, including FDI. Therefore FDI enables host countries to achieve investment levels beyond their capacity to save. Over the last couple of decades, FDI flows have increased significantly and remain the largest form of capital flows into developing countries, far

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surpassing portfolio investment, foreign loans and other forms of financial assistance[1]. FDI now accounts for more than half of the private capital flows between countries in the world. Therefore the contribution of FDI to economic growth has been studied quite extensively in the recent literature of studies focused on FDI. A preponderance of studies shows that FDI encourages the economic development of a country through both direct and indirect channels (Borensztein et al. 1998, Asafu-Adjaye, 2000, Fan and Dickie 2000).

The positive role of infrastructure in the economic development of a country also has been emphasized in both the theoretical literature and empirical studies (Rioja 2004, Ramiraz and Nazmi 2003, Wang 2002, Kessides 1993, Ford and Poret 1991). Infrastructure facilities contribute to economic development by improving productivity and by providing amenities that enhance the living standards of the society. Therefore, infrastructure is generally believed to be one of the essential factors for economic development, especially roads, telecommunications services, electricity, water supply *etc*.

More recently, a number of studies have suggested a potential role for advanced infrastructure, in particular, in attracting FDI (Reynolds et al. 2004, Yol and Teng 2009). A country's capacity for absorbing FDI depends highly on the infrastructure facilities in terms of physical and regulatory framework available in the economy for foreign investments. Therefore, countries with advanced infrastructure absorb more FDIs than do countries with a relatively low-level infrastructure facilities. According to the World Investment Report 2011, despite the slow recovery from the economic downturn of 2008-09 and uncertainties in developed economies particularly in euro zone, developed countries accounted for 52 per cent of FDI flows in 2011.Although the World Investment Report 2011 highlights the increased participation of MNCs(Multi National Companies) in the infrastructure sector of developing countries, development in regulatory infrastructure and reforms are not inline with those FDI inflows.

Within this global investment environment, the relationships between FDI, infrastructure and economic growth are a subject of debate in this era. Sri Lanka introduced an open market economy with trade and FDI liberalisation in 1977 and became the most open economy in South Asia. Most of the other South Asian countries introduced FDI liberalisation policies after the mid-1980s; therefore, South Asia was not

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1 *www.unedforum.org/policy/economic/fdi.pdf*
www.undp.org/content/dam/undp/library/Poverty Reduction/Inclusive development/Towards Human Resilience/Towards_SustainingMDGProgress_Ch3.pdf

generally a large recipient of FDI. In the 1980s with early liberalisation, Sri Lanka attracted an annual average of US$ 40 million in FDI flows, while large South Asian economies recorded lower FDI flows with respect to the size of their GDP. During this period, the average annual flow of FDI was around US$ 2 million per annum for Bangladesh, US$ 100 million for India and around US$ 90 million for Pakistan (UNCTADstat 2012). The past three decades have witnessed a dramatic increase in foreign capital flows into Sri Lanka. The inflows of FDI increased from US$ 47 million in 1979 to US$ 752 million in 2008[2]. Sri Lanka is trying to offer relatively better infrastructure facilities to foreign investors compared with most of the other South Asian nations, with high public investment in infrastructure sector. Thus, the empirical investigation of the dynamic interactions between FDI, infrastructure and economic growth is important for researchers and policy makers both in Sri Lanka and in other developing countries in order to examine the effectiveness of liberalisation policies on FDI and infrastructure development in enhancing economic prosperity.

The development of a number of theories to explain FDI was led by the growing interest in FDI as a stimulus tool for rapid economic development. These theories explain the reasons for an investor's preferences for some locations, selection of different entry modes or reasons for inward FDI or outward FDI, *etc*. Although most of the FDI theories are focused on determinants of the FDI, impact of FDI on the host economy or infrastructure has been highlighted in some of them. In neoclassical theory, Heckscher–Ohlin (HO) model introduced by the Samualson in 1941 explains the mobility of investment from countries with low marginal productivity of capital to the countries with high marginal productivity of capital (Leamer 1995). Since the underlying assumptions of HO model are based on perfect competition, balanced trade, constant return to scale and full employment, it is inadequate to explain real world phenomena such as FDI flows in imperfect market competition along with the risk and uncertainties. Therefore HO model failed to explain the FDI flows among developed countries and to make distinction between FDI and other investment. Eclectic theory of FDI developed by Dunning (1977) poses two questions: (*i*) Why the local demand is not met by local firms? (*ii*) When a firm wants to expand production, why does it choose FDI? He argued that for investing in a foreign country, three conditions should be satisfied by the firm that invite FDI; first, the firm should have a comparative advantage such as brand named technology, *etc*., second, it should be beneficial to invest rather than sell the rights and third, it should be profitable to use these advantages. Kojima's hypothesis presented in 1973 explains FDI as transferring modes of technology, managerial skills and technology. It classifies FDI into

[2] *http://www.fdi.net/index.cfm?infocntry=179 viewed 02 October 2009*

two types, as trade oriented and anti-trade oriented. The trade-oriented FDI is based on comparative advantages. These FDIs encourage trade in both host and home country while improving welfare, but the second type does not improve trade.

Many researchers have attempted to quantify the impact of FDI inflows on the economic growth of the host country. Most of these highlight the positive impact of FDI on economic growth while more recent studies also prove the same positive impact of FDI on economic growth while emphasising the necessity of the threshold level of other factors, such as infrastructure and institutional frameworks (Borensztein et al. 1998, Jyun-Yi and Chih-Chiang 2008, Alfaro et al. 2001).

Early theoretical works on FDI also include the influence of infrastructure on FDI. Hymer (1970) developed a model highlighting the importance of infrastructure for attracting FDI and ultimately, for the level of economic development. Meanwhile, the impact of infrastructure on economic growth has been investigated by many researchers. Interest in the impact of infrastructure on economic growth was first triggered by a series of papers published by Aschauer (1989). Later, Ford and Poret (1991), Wang (2002) and Kessides (1993) also tested the interaction between infrastructure and economic growth.

Despite the fact that FDI flows have focused on the infrastructure development and the economic development of emerging economies, most empirical studies examine the impact of FDI on the economic growth rather than investigating the interaction between FDI, infrastructure and per capita GDP. Comprehensive analysis should analyse, how FDI impacts on GDP, the impact of the infrastructure on economic growth and the type of relationship that exists between FDI and infrastructure. Therefore this paper is an attempt to combine these three branches of research to fill the lacuna in empirical literature and test the relationship among these 3 variables within a multidimensional framework.

Economists and policy makers have analysed the contribution of FDI and infrastructure separately in accelerating the process of economic growth in developing countries. However, most studies make implicit assumptions that causality runs from FDI and infrastructure to economic growth. Such an assumption precludes the possibilities of reverse causation or a simultaneous relationship between the variables. Therefore, the foremost objective of this study is to investigate the possible links between FDI inflow, economic growth and infrastructure based on a systematic approach such as vector autoregression (VAR), rather than merely operating with a production function equation which explains that growth is driven by the factors such a labour, capital, FDI *etc*.(Unidirectional causality). The study seeks to examine whether a stationary long-run relationship exists among FDI inflow, economic growth and infrastructure and causality between those three variables along with the direction of the dynamic interaction between them.

Trends in FDI

During the British Colonial Period from 1815–1948, the UK was the major source of FDI in Sri Lanka. British FDIs focused on the development of infrastructure facilities that were required for their investment in the plantation sector of the country. After achieving independence in 1948, Sri Lanka followed different strategies with changes in government until 1977. FDI flows were negligible as a percentage of GDCF (Gross Domestic Capital Formation) until the late 1970s. The annual average inflow of FDI during the 1970–1977 was only US$ 0.5 million and it was around only 0.2% of GDCF. With the economic policy reforms introduced in 1977, the FDI flows rapidly increased continuously until 1983. The annual average FDI inflows, as a percentage of GDCF, increased to 4.2% in the period 1978–1982.

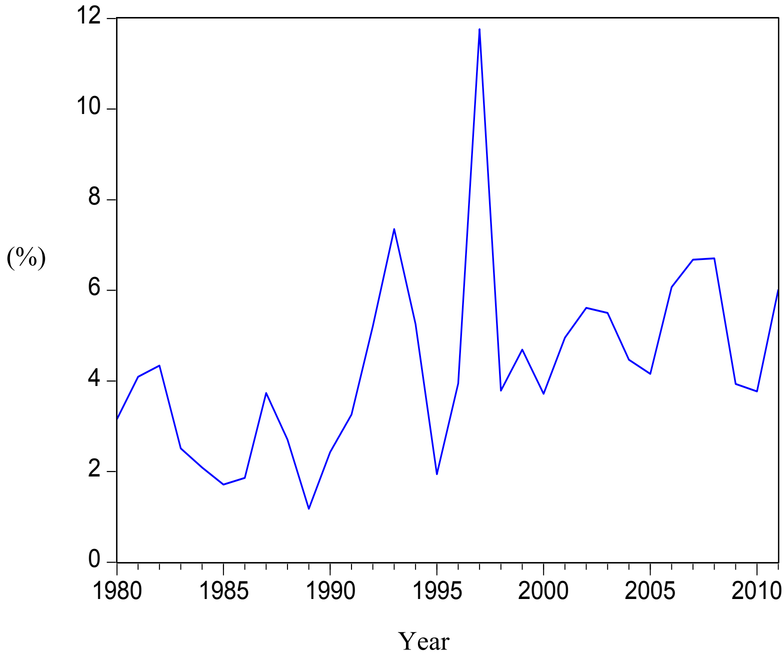
However, the impressive upward trend in FDI flow was disrupted by the escalation of ethnic problems into a civil war in 1983. Sri Lanka lost its investment potential due to the uncertainty created by the civil war. As an example, two electronic manufacturing giants, namely Motorola and the Harris Corporation which obtained BOI approval to establish plants inside the Katunayaka free trade zone in 1982; withdrew their investment projects from Sri Lanka with the uncertainty created by the war(Kelegama 2006).

In addition, the Japanese yen appreciated in value in the mid-1980s and Sri Lanka may have had an opportunity to attract Japanese investment, as had other East Asian economies, if there had been a peaceful environment in the country. Even with the civil war, Sri Lanka was able to maintain the average FDI flow of 3.2% as a percentage of GDCF until the Marxist-armed insurrection started in the southern part of the country in 1988. Due to the conflict in both the northern and southern parts of the country, FDI flows significantly dropped in 1988 and 1989. However, in late 1989 the government managed to crush the rebels in the southern part of the country and armed struggle was again limited to the Northern and Eastern Provinces.

With the second wave of trade and FDI liberalisation in the early 1990s, Sri Lanka attracted significant FDI flows. Privatisation of state-owned enterprises also contributed to attracting significant amounts of FDI between 1990 and 2001. More than two-thirds of the state-owned enterprises were acquired by foreign investors in 1990s (CBSL 2002). In the 1990s, the largest 20 foreign investors went into telecommunications, power generation, port and other infrastructure development and industrial sectors. More than one-third of the FDI flows in the 1990s came through the privatisation of state-owned enterprises (Athukorala and Jayasuriya 2004).

Figure 1

FDI as a Percentage of GDCF



However in the second half of the 1990s, FDI inflows recorded somewhat of a deceleration due to the external shocks and the political environment in Sri Lanka. The sector was affected by the escalation of violence in the Northern and Eastern Provinces of the country and the consequences of the East Asian currency crisis. Before the recovery from the set-back in the late 1990s, the adverse impact of the 9/11 attack in 2001 was felt in FDI flows. In addition, the LTTE attacked Sri Lanka's only international airport in the same year, and this also badly affected to the FDI flows. Again, a somewhat conducive economic environment was visible in the country after 2002, with the signing of a peace agreement with the LTTE Tamil rebel group. Although the LTTE withdrew from negotiations and the government decided to crush the rebels in 2005, FDI flows into the sector have shown a steady growth over 2003-2010. In year 2011 country attracted significant inflow of FDI consequent to achieving sustainable peace after the government forces crushed the LTTE rebels in May 2009.

Following this introduction, section II provides Literature Review on Economic Growth and FDI. Further, section III focuses on the model specification, data and methodology used to assess these relationships and the statistical tests applied in this methodological framework. The empirical analysis is presented in section IV and section V concludes the research with the conclusion, policy recommendations and limitations of the study.

II. Literature Review on Economic Growth and FDI

Empirical research in this area falls roughly into two groups. First, there is a plethora of empirical studies that examine the impact of FDI flows on economic growth based on cross-sectional or panel data from groups of countries. Some of the studies have examined other factors, such as domestic investment, trade, financial sector development, *etc*., while assessing the impact of FDI on economic growth. Only the studies focused on finding the determinant of FDI in this category have addressed the relationship between infrastructure and economic growth. Those have incorporated proxy variables, such as telecommunications and road developments to represent infrastructure developments. Second, the relationship between FDI and economic growth has been investigated by many researches focused on one country using time series data. Most of those studies are focused on GDP-FDI nexus, and the role played by the some other variables such as financial sector development and infrastructure development have been taken into consideration.

When considering the econometric methodologies used, previous studies in this area made use of regression models and causality analysis. The neo-classical growth theory defines aggregate growth as a sum of the total factor productivity growth and the weighted sum of the growth rate of factor inputs while incorporating the Hicks-neutral technological change. Therefore, some studies investigate the impact of FDI and infrastructure on economic growth using these aggregate production function models based on both cross-sectional data and time series data. This method implicitly assumes that the selected economic variables (explanatory) cause the growth without formal testing of the direction.

The issue of causality between FDI and some other macro economic variables has been empirically examined in a number of more recent studies. Two approaches based upon bivarite and multivariate models have been used. The general tests for causality within the bivariate models are the Granger test, Sims test and Geweke test. On the other hand, multivariate models of correlation are characterised by examining the variance decompositions functions and impulse response functions.

Among the recent cross sectional studies, Borensztein et al. (1998) examined the effect of FDI on economic growth using seemingly unrelated regressions technique (SUR) in production function framework for 69 developing countries over the period 1970–1989. The results suggested that FDI contribute more to economic growth than domestic investment in the developing countries studied. Further, the transfer of technology is the vehicle for developing the economy through FDI inflows. However, Borensztein et al. mentioned that the contribution of the FDI to the host country's economic growth is highly dependent on the absorptive capability available in the economy to attract new technology into the country. This absorptive capacity is highly correlated with human capital, which was estimated using average educational attainment of the labour force in each country. Although the theoretical models imply that FDI promotes economic growth in the host country, Alfaro et al..(2001) revealed that the efficiency and development of the local financial market in the host country is crucial for a positive impact of FDI on growth. Alfaro et al used OLS and instrumental variable regression to analyse three samples of cross-country data (39-41 countries). The study emphasised that the spillover effects of the FDI are increased with financial infrastructure. The findings of the research team's calibration exercise are: (*i*) the impact of FDI with developed financial infrastructure is twice the impact of FDI when there is poor financial infrastructure, (*ii*) productivity of foreign firms further increases with sound financial infrastructure and (*iii*) other host country conditions such as market structure and human capital levels are also important and have a positive impact on FDI. The causal relationship between foreign direct investments (FDI) and economic growth in developing countries was examined by Zhang (2001a) using data from 11 economies in East Asia and Latin America from 1970 to 1995. A stationarity test and co-integration techniques were used to assess the relationship between FDI and growth. The study found that FDI improved growth in five of the eleven countries. Of these eleven countries, four were Asian. The study indicated that the impact of FDI on growth varied with the economic environment of the host country. When the host country encouraged export-oriented FDI with pro-free trade and pro-education policies, the impact tended to be positive on growth. Besides the study by Borensztein et al. (1998), Jyun-Yi and Chih-Chiang (2008) examined whether the impact of FDI on GDP growth is dependent on other factors, namely initial GDP, human capital and volume of trade, by using a sample based on 62 countries covering the years 1975 through to 2000. The technique used for the study is the threshold regression technique developed by Caner and Hansen (2004). Initial GDP, human capital and volume of trade are assigned as threshold variables. They found that the impact of FDI on economic growth is positive and significant when the host country has improved human capital and high level of initial GDP. These results are consistent with those of Borensztein et al. (1998). Some researchers have found that the state of infrastructure plays a significant role in attracting FDIs into a country. Some highlight infrastructure facilities such as telecommunications as a determinant of the FDI. For example, Reynolds et al. (2004) examined the empirical relationship between FDI flows and the level of telecommunications infrastructure using data from 212 countries for 1960–1998. While proving the positive relationship between FDI and telecommunications infrastructure, the study revealed that privatisation increases the number of phones per 100 by 1.2, the amount of FDI by 0.52 cents per dollar of GDP. Carkovic and Levine (2005) assessed the relationship between FDI flows and economic development in 72 countries from 1960–1995 using a dynamic panel approach of OLS estimating method into panel data. The results show that the FDI flow is positively related to economic growth, and from the sensitivity analysis it was found that the relationship between FDI and TFP (total factor productivity) is not significant. Further study revealed there is no positive impact on economic growth from portfolio investment.

While Borensztein et al. (1998) highlighted human development levels and Alfaro et al. (2001) emphasised the importance of financial markets, Busse and Groizard (2008) argued that good government regulation is required for FDI to have a positive impact on economic growth of the country. Busse and Groizard studied 89 countries, using the standard growth regression model and instrumental variable regression models. The data were for 1994–2003. The study showed that the tax holidays offered by the host countries are not effective if there is a poor regulatory system in the country. Some recent studies have also suggested that the institutional framework and fewer labour and business regulations are essential to stimulate growth through international trade of host countries (Bolaky and Freund 2004).

Atiken and Harrison (1999) examined the effect of FDI on domestic firms in Venezuela by using a weighted least-square regression model. The study focused on spillover effects of FDI based on data from 4,000 Venezuelan manufacturing plants between 1976 and 1989. The study revealed that foreign participation increased the productivity of firms with less than 50 employees. Although previous research generally revealed the positive impact of FDI on productivity, this study found that the impact on productivity of the domestic firms was negative. Therefore the net positive impact of the FDI is quite small for the country. However, the results of the study may be biased since foreign firms acquired most of the productive plants and invested in the more productive sectors of the Venezuelan economy. Asafu-Adjaye (2000) investigated the effect of foreign direct investment on Indonesian economic growth by using time-series data for 1970–1996. He used the error-correction regression model along with the Johansen co-integration test. The results suggested that the FDI, gross domestic savings, other private capital flows and human capital jointly influenced economic growth and the impact of FDI is significant. In addition, the education level of the labour force, which was used as a proxy for human capital, and gross domestic saving also contributed to the rate of Indonesian economic growth separately. Fan and Dickie Ruane (2000) studied the contribution of FDI to the growth and stability of Indonesia, Singapore, Thailand, Malaysia and the Philippines during 1987–1997. They used the Cobb-Douglas growth accounting regression models to evaluate the effect of FDI on economic growth. The results of the study showed that FDI has made significant contributions to the economic growth of these five ASEAN economies. The contribution of FDI was estimated at between 4–20% of GDP growth. Further study highlighted that FDI played an important role in averting external shock during the period of financial crisis. Besides the FDI impact of growth on East Asian and Latin American countries, Zhang (2001b) assessed the direct and indirect affect of FDI on the Chinese economy using provincial data for 1992–2004. A panel data set was used to evaluate the impact of FDI. The study indicated that FDI contributed to Chinese economic development directly by promoting exports and improving productivity, and indirectly with spillovers. An important conclusion was that the estimated marginal product of the foreign capital is higher than local capital with higher levels of productivity in foreign firms in China. The dynamics of the relationship between FDI, economic growth and domestic investment were examined by Kim and Seo (2003) by applying VAR models to South Korea. The results revealed that FDI has some positive effect on economic growth; however, its effect seems to be not significant. On the other hand, the economic growth of South Korea was found to have had a statistically significant effect on the FDI flows in to the country. Athukorala and Karunaratne (2004) examined the impact of FDI on the economic development of Sri Lanka using co-integration and a ECM models over the period 1959–2002. The study was based on the FDI-led growth hypothesis. He found that the direction of causality was not towards FDI to GDP growth. Further, the impact of domestic investment and trade liberalisation was found to have a positive effect on GDP growth. Wijeweera and Mounter (2008) examined the causality relationship among five macroeconomic variables, namely wage rate, exchange rate, GDP per capita, external trade, FDI and interest rate for Sri Lanka. The study used VAR techniques. The findings indicate wage rate – as the variables studied – is the most important determinant of FDI. Despite this, the study emphasised that the other four variables should also be considered for policy formulation.

III. Model Specification and Data Sources

Following framework model is employed to investigate the relationship between real per capita GDP, FDI and the level of the infrastructure.

$$Y\ (GDP) = f\ (INFR,\ FDI)$$

In this analysis, three variables were considered to investigate the relationships among them. The system consists of real per capita GDP of Sri Lanka (GDP), real FDI, and level of infrastructure (INFR). FDI in rupee terms is deflated by GDP deflator to derive real FDI. In some of the time series studies, only one variable is used to measure the financial or physical infrastructure due to limitations in accommodating more variables into the analysis of a small data set. However, this study has used logarithms of total number of fixed telephone lines, no. of Bank Branches, electricity generation and total length of A&B class roads in the country to develop a summary measure by using principal component analysis[3] to quantify the level of infrastructure. This summary measure avoids the problems of multi-collinearity and over-parameterisation as an index of infrastructure level of the country. The sample period uses annual time series data over the period from 1980 to 2011. These annual data were obtained from the UNCTAD database, various issues of Economic and Social Statistics of Sri Lanka and Annual reports published by the Central Bank of Sri Lanka .

Cointegration Relationship

Investigation of the stationarity properties of variables allows researchers to avoid spurious regressions. Therefore it is essential to test the stationary properties of the selected variables. Unit root tests are conducted to test the stationarity properties of the selected variables. The first step in applying the unit root test is to determine the stationary properties of the levels of the time series. If the variable is non-stationary, then it is preferable to carry out the same test including a trend and/or a constant term. However, most of the financial and economic data series are non-stationary at levels and differenced series should be checked as the second step. If the variable achieves the stationary properties when it is differenced once, the variable is termed as integrated of

[3] *Pls.see the Appendix A for calculation of principal components*

order one or I(1). Most financial and economic data series are I(1) and this would imply the presence of stochastic trend in those series. But the higher order differencing is not recommended for empirical analysis due to the loss of information and difficulties in interpretation. The typical unit root tests employed in econometric studies are the Dickey and Fuller test (DF), the Augmented Dickey-Fuller Test (ADF) and the Phillips-Perron (PP) test. The ADF test can be considered as an improved version of the DF test. The ADF test is used to check the stationary properties of the variables considered in this study.

Granger (1981) first introduced the concept of cointegration, referring to the long-run "equilibrium" relationships in economics. Later this concept was supported by Nelson and Plosser (1982) who argued that taking differences of the series until stationarity is achieved, as remedial measure to spurious regression may lead to a loss of information regarding long-run properties. The precise definition of cointegration can be derived from its statistical concepts. The long-run equilibrium relationship between two variables could be presented as follows in the case of a bivariate model:

$$y_t = \gamma_1 + \gamma_2 x_t + \varepsilon_t \text{ ----------------- (1)}$$

If y_t and x_t are at equilibrium, then the disequilibrium term $\varepsilon_t = y_t - \gamma_1 - \gamma_2 x_t$ is equal to zero. However, there are many instances when Y is not in its equilibrium relative to X such that the disequilibrium terms will be non-zero. To have real meaning for the equilibrium relationship, the disequilibrium errors observed over time should tend to fluctuate at about zero (Eagle and Granger, 1987). If the equilibrium relationship such as model (1) exists, it would imply that the disequilibrium ε_t is I(0) - *i.e.* and the linear combination of two variables must also be I(0). Therefore, conditions for the existence of a long-run relationship is that the error term or linear combination of two variables is I(0).

Error correction models

One way of solving the spurious problem is to get the difference series of I(1) variables and run a regression model as follows:

$$\Delta y_t = \gamma_1 + \gamma_2 \Delta x_t + \varepsilon_t$$

This model gives us correct estimates of γ_1 and γ_2 parameters and solves the problem of spurious regression. However, the model does not hold true in the long run. In order to solve this problem, error correction models (ECM) are useful:

$$\Delta y_t = a_0 + b_1 \Delta x_t - \pi \hat{\varepsilon}_{t-1} + u_t$$

This ECM model includes both short-run and long-run information. The b_1 is the impact of the changes in x_t on y_t in the short-run. On the other hand, π is the adjustment affect, which shows how much of the disequilibrium has been corrected (Asteriou and Hall 2007).

Johansen's Full information Maximum Likelihood (FIML) approach

Although there are three approaches for testing cointegration, this study uses one approach, namely Johansen's Full Information Maximum Likelihood (FIML) approach. When more than two variables are to be considered, there is a possibility of having more than one cointegration vector. In this situation, the variables in the model might form several equilibrium relationships governing the joint evaluation of all the variables. Therefore Johansen's FIML approach is the best approach relative to other two approaches.The FIML approach provides a good framework for estimating the cointegration relationships in the context of Vector Auto Regressive (VAR) error correction models (Johansen 1988, Johansen and Juselius 1990). There are two methods for determining the number of cointegration vectors and both involve estimation of the matrix π . The tests are based on the rank of the matrix as r and eigenvalues. Johansen and Juselius (1990) provided the critical values for both test statistics.

Causality test for ECM

One good feature of the VAR model is that it allows us to test for directional causality. The causality tests give an indicator about the ability of one variable to predict the other variable. If there are two variables, x_t and y_t, each affect the other with distributed lag, the relationship between these two variables can be captured by using the VAR model. Four possible relationships can be identified in this model; (*a*) x_t causes y_t (*b*) y_t causes x_t (*c*) there is a bidirectional causality, and (*d*) two variables are independent. Granger (1969), as cited in (Asteriou and Hall 2007), developed a test to examine the causality. The test defines causality as follows: a variable y_t is said to be granger cause x_t , if x_t can be predicted with greater accuracy by using past values of the y_t variable rather than by not using such past values, all other terms remain unchanged:

Granger causality test

$$y_t = a_1 + \sum_{i=1}^{n} \beta_i x_{t-i} + \sum_{j=1}^{m} \gamma_j y_{t-j} + \varepsilon_{xt} \text{ ------------------------(2)}$$

$$x_t = a_2 + \sum_{i=1}^{n} \theta_i x_{t-i} + \sum_{j=1}^{m} \delta_j y_{t-j} + \varepsilon_{yt} \text{ ------------------------(3)}$$

where it is assumed that both ε_{yt} and ε_{xt} are uncorrelated white-noise error terms.

The steps in the Granger causality test are as follows:

Step 1

Regress y_t on lagged y terms as in equation (4):

$$y_t = a_1 + \sum_{j=1}^{m} \gamma_j y_{t-j} + \varepsilon_{xt} \text{ ---------------- (4)}$$

Find the regression sum of square (RSS) and label it as RSS_R.

Step 2

Regress y_t on lagged y terms plus lagged x terms as in equation (5):

$$y_t = a_1 + \sum_{i=1}^{n} \beta_i x_{t-i} + \sum_{j=1}^{m} \gamma_j y_{t-j} + \varepsilon_{xt} \text{ -------------------- (5)}$$

Find the regression sum of square (RSS) and label it as RSS_u.

Step 3

Define the null and alternative hypothesis as follows:

$H_0 : \sum_{i=1}^{n} \beta_i = 0$ or x_t does not cause y_t

$H_1 : \sum_{i=1}^{n} \beta_i \neq 0$ or x_t does cause y_t

Step 4

Calculate the test statistics F for coefficient restrictions using the standard Wald test as follows:

$$F = \frac{(RSS_R - RSS_U)/m}{RSS_U /(n-k)}$$

Test statistics F follows the F_{n-k}^{m} distribution and $k = m + n + 1$

If the test statistics (F) exceeds the F-critical value corresponding to F-Distribution, reject the null hypothesis and conclude that x_t does cause y_t.

To check the causality in cointegrated variables, the following ECM form of equation can be used:

$$\Delta y_t = a_1 + \alpha_{1i} \sum_{i}^{m} \Delta x_{t-i} + \alpha_{2k} \sum_{k}^{n} \Delta y_{t-k} + \alpha_3 v_{t-1} + \varepsilon_t$$

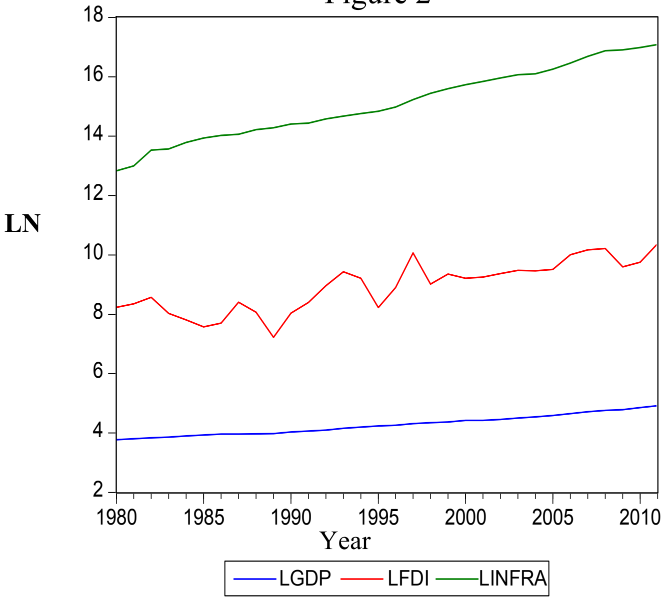
where $v_{t-1} = y_{t-1} - \alpha x_{t-1} - \alpha_2 z_{t-1}$ is the residual of cointegration equation. The null hypothesis for x does not Granger-cause y, given z, is $H_o : \alpha_1 = \alpha_3 = 0$. This shows that there are two sources of causation for y, either through lag terms Δx or through lagged cointegration vector. The hypothesis is tested using the standard F test. As cited in Asteriou and Hall (2007), Granger and Lin (1995) argue that the conventional causality test is not valid for cointegrated variables. Therefore this study used VECM to measure the causality in empirical analysis.

IV. Empirical analysis and findings

The aim of this section is to provide statistical validation of the existence of long-run relationships and causality among the following selected variables, namely FDI, Real GDP per capita and level of infrastructure in Sri Lanka.

The first step involves investigating the stationarity properties of the three variables, FDI, real GDP per capita and level of infrastructure, so as to ensure the variables are I(1) series, which enables the use of cointegration techniques to assess the long-run relationship. Plotting the variable against the year can be considered to be a preliminary indicator used in analysis of trends in time series data. The plot of logarithms of the three variables in Figure 1 shows that all data series demonstrate an upward trend.

Figure 2



Univariate analysis of each variable was carried out to investigate the stationary properties of the data series. It is required to have I(1) data series for the cointegration test, which can be used to find existence of a cointegration relationship. In order to find the presence of the unit root in each series, this study uses ADF test and the results of the ADF test are given in Table 2 and Table 3.

Table 1: ADF test for unit root on the level series

Variables	*No Constant & No Trend*	*Constant & No Trend*	*Constant & Trend*
LGDP	12.25429	3.080602	-0.111291
LINFRA	7.647764	-1.223449	-3.481143
LFDI	0.978890	-1.404797	-4.248370*

Table 2: ADF test for unit root on the first differenced series

Variables	*No Constant & No Trend*	*Constant & No Trend*	*Constant & Trend*
LGDP	-0.206335	-3.775239**	-4.925005**
LINFRA	-2.436660*	-5.238118**	-2.836852
LFDI	-6.113743**	-6.202526**	-6.170224**

Significant at 5% level* * Significant at 1% level*

Unit root tests for stationarity are performed on both levels and the first difference of the selected variables. The typical three types of models with varying deterministic components have been considered while performing the ADF tests. The results indicate that all three series are stationary in differences. Therefore, we can conclude that the three time series are all integrated of order 1, I(1). Therefore the cointegration test can be performed on this three data series to check the long-run relationship among the variables.

Testing for Cointegration of variables

Selection of appropriate lag length is very important in examining cointegration using Johansen's FIML approach. After inspecting the values of Akaike Information Criteria (AIC) and Schwarz's Bayesian criteria (SBC), as well, as diagnostics concerning autocorrelation, heteroskedasticity, possible ARCH effects and normality in residuals, 4 lags were selected as the optimal lag length for the existence of the cointegration relationship.

Table 3 presents the results of the Johansen's FIML test for the model. According to both the Trace test and Eigenvalue test there is one cointegration relationship existing among the three variables. Both tests do not reject the null hypothesis of number of cointegration relationships (r) = 0 at 5% significant level.

Table 3: Results of Johansen's test for multiple cointegrating vectors

Hypothesised cointegrating H_0	No. of relationships H_1	Test statistics		Critical values (95%)	
		Max. eigenvalue	Trace	Max. eigenvalue	Trace
r=0	r>0	32.95222*	41.02500*	21.13162	29.79707
r=1	r>1	7.588251	8.072776	14.26460	15.49471
r=2	r>2	0.484525	0.484525	3.841466	3.841466

Note: *r indicates the number of cointegrating relationships. The optimal lag structure of the VAR was selected by minimising the AIC criterion. Critical values are taken from Johansen and Juselius (1990).*

* *indicates rejection at the 95% critical values.*

Error correction model (ECM) of the following VAR system is used to examine the relationship between variables.

$$\Delta LGDP_t = \alpha_1 + \alpha_{gdp}\hat{\varepsilon}_{t-1} + \sum_{i=1}^{m}\phi_{11}\Delta LGDP_{t-i} + \sum_{i=1}^{m}\phi_{12}\Delta LFDI_{t-i} + \sum_{i=1}^{m}\phi_{13}\Delta LINFRA_{t-i} + u_1$$

$$\Delta LFDI_t = \alpha_2 + \alpha_{fdi}\hat{\varepsilon}_{t-1} + \sum_{i=1}^{m}\phi_{21}\Delta LGDP_{t-i} + \sum_{i=1}^{m}\phi_{22}\Delta LFDI_{t-i} + \sum_{i=1}^{m}\phi_{23}\Delta LINFRA_{t-i} + u_2$$

$$\Delta LINFRA_t = \alpha_3 + \alpha_{Infra}\hat{\varepsilon}_{t-1} + \sum_{i=1}^{m}\phi_{31}\Delta LGDP_{t-i} + \sum_{i=1}^{m}\phi_{32}\Delta LFDI_{t-i} + \sum_{i=1}^{m}\phi_{33}\Delta LINFRA_{t-i} + u_3$$

i = Number of lags

ε_{t-1} = Error Correction terms

u_1, u_2, u_3 = White noise disturbance terms

Since the Trace test and Eignvalue test confirm the existence of a cointegration relationship among variables, the cointegration equation is written in the following form using values of cointegration matrix generated by the E-views.

Cointegration Equation

$LGDP = 0.392944 - 0.013480\, LFDI + 0.264194\, LINFRA$

T-Stat : [0.80774 -24.7217]

According to this cointegration equation, there is a long-run relationship between GDP per capita, FDI inflows and level of infrastructure. Level of infrastructure positively impact on GDP in log-run and impact is significant at 1% level. However the impact of the FDI on GDP per capita is negative but not significant. The diagnostic tests also show the relevancy of normality assumption and absence of significant autocorrelation in the residual.

In the context of development strategy, there is intense interest in the causal connections among the selected variables. According to Engle and Granger (1987), if non-stationary variables are cointegrated then a vector autoregression (VAR) in the first difference is specified incorrectly. Since a cointegration relationships are found between GDP per capita, FDI and infrastructure, an error correction model (ECM) is used to test for causality among these variables. The results in Table 4 provide evidence of a causal relationship between some variables.

Table 4: Causality results based on vector error correction model (VECM)

Dependent variable	Exogeneity Wald Tests X^2-statistics		
	$\Delta LGDP$	$\Delta LFDI$	$\Delta LINFRA$
$\Delta LGDP$		6.043380	0.726763
$\Delta LFDI$	4.030914		10.79784*
$\Delta LINFRA$	6.980598	3.230782	

**Significant at 5% level*
Note: Causality running from columns to rows.

The results revealed a significant impact of level of infrastructure on FDI. Impact of FDI on GDP is also to be expected according to economic theories, but findings do not support the existence of that type of causality. However the analysis shows that the increased in FDI with the improvement in infrastructure. Therefore study proved the validity of argument that infrastructure impact on the attraction of FDI into host country. Further, causality test results revealed the absence of other causality among three variables selected for this study.

V. Conclusion and Policy Recommendations

The objective of this study was to identify possible long-run relationships and direction of causalities among per capita GDP, FDI inflows and level of infrastructure in Sri Lanka. The study has used inferential analysis based on ECM models to evaluate the relationship between the variables in multidimensional space while considering all the possible dynamic interactions between them.

When the long-run relationship is considered, level of infrastructure has a stronger relationship with GDP per capita since the coefficient of level of infrastructure is statistically significant. According to growth theory, investment plays a key role in the production process of a country and infrastructure which is a part of investment is also an important factor that stimulates economic growth through various channels. Many empirical studies have investigated the long-run relationship between level of infrastructure and GDP and proved the existence of a positive long-run relationship between two variables. On the other hand, study does not show the existence of positive long-run relationship between GDP and FDI based on the data for the same reference period over 1980–2011 as the estimated coefficient is not significant with a negative sign. Sri Lanka liberalised the economy in 1977 and subsequently FDI inflows increased significantly up to 1982. However, the impressive upward trend in FDI flow was disrupted by the escalation of civil unrest in 1983. Sri Lanka lost its investment potential due to the uncertainty created by the civil war. Therefore the lack of a relationship between GDP per capita and FDI may be due to the substantial fluctuation in FDI after year 1982.

The findings with respect to causality indicate that the level of infrastructure of the country plays a key role in attracting FDI into Sri Lanka. Level of infrastructure is a determinant of FDI for MNCs to invest in developing countries. Therefore, causality running from level of infrastructure to FDI is justifiable, particularly in developing countries like Sri Lanka. Since level of infrastructure causes FDI, more attention should be paid to infrastructure development as poor infrastructure would be an impediment to future growth in FDI inflows.

According to the findings, strategies to enhance level of infrastructure of the country should be developed by the policy makers to enhance the economic growth of Sri Lanka. MNCs seeking to invest in infrastructure development also consider the income level of the host country and structure of the income distribution in order to assess the expected return on their investments. The income elasticity of services changes with the improvements in income level. Therefore, improvement in income level of the country in recent years would positively affect to attract the FDI, particularly for infrastructure developments.

In addition, institutional reforms and legislative changes are also included in broad definition of the infrastructure of the country to pave the way for sustainable economic growth. Therefore, it is essential that policies are focused on creating a holistic enabling environment to achieve overall economic growth.

Limitations of the Study

This study uses a composite index derived from four (4) variables of infrastructure namely total length of A&B class roads (ROAD), No. of Bank Branches (BANKB), total number of fixed telephone lines (TELECOM) and installed electricity generation capacity (ELECT) of the country as proxies to measure the level of infrastructure facilities of the country. However some other infrastructure such as water supply, payment systems, government services, mobile phone lines, internet lines, port expansion *etc*., were not taken into consideration due to the unavailability of time series data. Therefore composite index derived from four (4) variables may not be a good proxy for level of infrastructure of Sri Lanka.

Although the variables used to measure the level of infrastructure indicate the availability of facility, the decisions of investors may also be based on quality factors and the available technology, which is not reflected in variables relating to infrastructure. This may account for the fact that India is attracting high-tech IT related foreign investment with lower teledensity than Sri Lanka. Therefore, the lack of a representation of quality factor in the proxy variables for the infrastructure is a limitation of this study.

FDI and infrastructure developments have been dampened by the unfavorable economic environment within the country due to the civil war, which originated from poverty and the loss of confidence and understanding among communities and political parties. The civil war has had different phases from 1976 to 2009, ranging from guerrilla tactics to intensified conventional fighting between the two forces. The confidence of investors and other development activities may depend on the intensity of the war. A proxy variable that reflects the impact of civil war which may have varied with its intensity was not included in the study due to the unavailability of such an indicator.

Sri Lanka introduced reforms on trade, FDI and the services relating to infrastructure during reference period of this study from 1980 to 2011, and different regimes can be identified with respect to the liberalisation of each sector. To capture these changes, econometricians have adapted dummy variables for analysis. However, the application of those types of structural brakes to this study was prevented by the small sample size.

In evaluating the interactions between per capita GDP, FDI and level of infrastructure, the study was handicapped by the lack of empirical studies. Few studies have focused on evaluating the direct impact of FDI on the industrial sector and economy as a whole. The spillover effect of FDI was hardly captured by those studies. Research papers based on comprehensive studies of the economic impact of the infrastructure are not available for Sri Lanka. Therefore, historical descriptive data or studies based on other countries have been used as references for the study.

Appendix A

Logarithms of total length of A&B class roads (ROAD), No. of Bank Branches (BANKB), total number of fixed telephone lines and installed electricity generation capacity (ELECT) of the country were used to develop a summary measure by using principal component analysis to quantify the level of infrastructure. The results derived from principle component analysis are presented in Table A.

Table A: Principle component analysis summary Results

Principal Component	PC 1	PC 2	PC 3	PC 4
Eigenvalues	3.694892	0.143066	0.122715	0.039327
% of variance	0.9237	0.0358	0.0307	0.0098
Cumulative %	0.92370	0.95950	0.99020	1.00000

	Loading Eigen Vector			
Variable	PC 1	PC 2	PC 3	PC 4
ROAD	0.493736	0.762045	0.333855	0.253087
BANKB	0.502146	-0.227456	-0.634312	0.541997
TELECOM	0.493492	-0.602323	0.626982	0.023792
ELECT	0.510430	0.068979	-0.305094	-0.801012

According to the principle component analysis 92% of the standard variance of the selected four (4) variables are explained by the first principle component. Therefore the first principle components which explain 92% of the variation of the data is the best combination of variables. The first principle component was calculated using the weights of the respective loading vector for this analysis.

Appendix B

VEC Granger Causality/Block Exogeneity Wald Tests

Sample: 1980 2011
Included observations: 27

Dependent variable: D(GDP)

Excluded	Chi-sq	df	Prob.
D(FDI)	6.043380	4	0.1959
D(INFRA)	0.726763	4	0.9480
All	6.447600	8	0.5972

Dependent variable: D(FDI)

Excluded	Chi-sq	df	Prob.
D(GDP)	4.030914	4	0.4018
D(INFRA)	10.79784	4	0.0289
All	11.99809	8	0.1513

Dependent variable: D(INFRA)

Excluded	Chi-sq	df	Prob.
D(GDP)	6.980598	4	0.1369
D(FDI)	3.230782	4	0.5200
All	8.309980	8	0.4038

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