RESEARCH ARTICLE

CONSTRUCTION OF COMPOSITE INDEX OF LEADING INDICATORS FOR FDI CYCLE FOR BRICS ECONOMIES.

Dinesh Kumar Choudhury[1] and Rajendra Narayan Paramanik[2].
1. Assistant Professor, Department of Economics, Sri Sathya Sai Institute of Higher Learning Prasanthi Nilayam-515 134, Andhra Pradesh, India.
2. Assistant Professor, Department of Economics & Finance, BITS Pilani, Pilani Campus, Vidya Vihar- 333031, Rajasthan, India.

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Manuscript Info	*Abstract*
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FDI plays an important role in economic growth. In this paper, we study the long term dynamics of FDI and we propose a composite index of leading indicators for FDI Cycle for the BRICS economies. The period of study is 1996 to 2014. After carefully selecting the choice variables for the leading indicator which include exchange rate, total factor productivity, human capital, gross domestic product growth, gross capital formation and trade, we use the Principal Component Analysis (PCA) to construct the index for the FDI cycle. It is found that all the above mentioned variables will be helpful in predicting the turns i.e peaks and trough in the FDI cycle which is important from policy perspective.

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Introduction:-

Foreign Direct Investment plays a vital role in growth and development of an economy. It implies access to capital, technical know- how, managerial expertise, global marketing networks and best practices of corporate governance. FDI inflows are non-debt creating and more stable than portfolio flows. Portfolio investment is prone to quick reversal in the event of adverse expectation. FDI is important for an economy as it helps in transfer of technology, increasing employment, reduces poverty, foster competition, strengthen links with international markets, contributes to human capital development through employee training and contribute to corporate tax revenue. Owing to so many advantages of FDI, many countries try to create favourable conditions to attract more FDI inflows into their economies.

In the past few decades, some emerging economies such as Brazil, Russia, India, China and South Africa (BRICS) have acquired a crucial role in world economy as producers of goods and services, receivers of capital and as potential consumer markets. At present, these five countries encompass over 43 percent of world's population and account for nearly 30 percent of global GDP in terms of PPP with over 17 percent share in world trade. BRICS economies are playing a formidable role in shaping macroeconomic policy after the Global financial crisis. These economies are identified as fastest growing countries and engines of the global recovery process.

According to World Investment Report (2015), BRICS economies together attracted 21 percent of global FDI inflows in year 2014. As international production and consumption has been shifted to emerging market economies MNCs are increasingly investing in both efficiency seeking and market seeking projects in economies.

Corresponding Author:- Dinesh Kumar Choudhury.
Address:- Assistant Professor, Department of Economics, Sri Sathya Sai Institute of Higher Learning Prasanthi Nilayam-515 134, Andhra Pradesh, India.

There are many theories which try to explain the determinants of FDI inflows. These theories are helpful towards the development of a systematic framework for emergence of FDI. The theory of capital movement was the earliest explanation, which was viewed as a part of portfolio investments. Hymer's (1960) pioneering contribution was the first explanation of FDI in the industrial organisation. Hymer explains that MNCs indulge in FDI only if they possess some advantage or edge over local firms arising from intangible assets such as brand-name, patent-protected technology, managerial skill and other firm specific factors.

John Dunning (1981) proposed all inclusive theoretical structure of FDI flows. He established Ownership- Location- Internalisation (OLI) paradigm, a theory which is relevant even today. It represents combination of three partial theories of FDI, which is focussed on the ownership advantages, the location advantages, the internalisation advantages.

The first type of FDI is called market-seeking FDI, whose aim is to serve local and regional markets. It is also called horizontal FDI, as it involves replication of production facilities in the host country. A second type of FDI is called resource-seeking: when firms invest abroad to obtain resources not available in the home country, such as natural resources, raw materials, low labour cost. Particularly in the manufacturing sector, when MNCs directly invest in order to export, factor cost becomes important. The third type of FDI, called efficiency-seeking, takes place when the firm can gain from the common governance of geographically dispersed activities in the presence of economies of scale and scope.

So far various empirical studies have been conducted by researchers to identify the factors that influence the inflow of FDI. This review briefly focuses on the empirical studies on determinants of FDI. Agarwal (1980) in his study "Determinants of FDI" which is based on developing countries experience found that labour cost, country size, nature of exchange rate regime and political factors are the major determinants of FDI. Lucas (1990) found that lack of human capital discouraged foreign investment in less developed countries. Dunning (1988) maintains that the skill and education level of labour can influence both the volume of FDI inflows and the activities that MNCs undertake in a country. The World Investment Report of 1998 published by UNCTAD states that infrastructure is a determining factor on the inflows of FDI. Zhang and Markusen (1999) confirm that the availability of skilled labour in the host country affects the volume of FDI inflows. Artige and Nicolini (2005) states that market size measured by GDP or GDP per capita seems to be the most robust FDI determinant in econometrics studies. Pravakar Sahoo (2006) used Panel Cointegration and Pooled OLS to identify the determinants of FDI in South Asian countries. His study reflects that major determinants are market size, labour force growth rate, infrastructure index and trade openness. Vijayakumar, N. et al., (2010) in the paper "Determinants of FDI in BRICS Countries: A Panel Analysis", finds that market size, labour cost, infrastructure, currency value and gross capital formation as the potential determinants of FDI inflows of BRICS countries. Pravin Jadhav (2012) in the paper "Determinants of Foreign Direct Investment in BRICS economies: Analysis of economic, institutional and Political factor "explores the role of economic, institutional and Political factor in attracting FDI in BRICS economies. He found that economic factors are more significant than institutional and political factors in BRICS economies. He found market size as measured by real GDP is significant determinates of FDI. Nawal Kishor and Raman Preet Singh (2015) in the paper "Determinants of FDI and its impact on BRICS countries: A Panel Data Approach" examines the impact of factors determining FDI inflows of BRICS countries from 1994-2014. They found that GDP, market capitalisation and infrastructure are significant variables for FDI inflows into BRICS.

A vast amount of empirical literature has been developed to analyze the determinants of FDI as whole, but the results on empirical evidences are mixed depending on the choice of country, time-periods and applied methodology. But no attempt was ever made to study FDI Cycle which helps in looking long term dynamics of FDI which is important from policy perspective of many macroeconomies since FDI plays a major role in long term sustainable growth. Therefore, this study aims to propose a leading indicator for FDI Cycle for BRICS countries. The rest of the paper is organised as follows: section 2 gives the data, variables and methodology used; in section 3 we presents the empirical results with discussions and finally section 4 provide concluding remarks.

Data and Methodology:-
In this section, we give the data, variables used in this study. Then we explain the methodology of construction of composite leading indicator.

Data and Variables:-
For the selection of appropriate indicators, yearly data from World Development Indicator and Penn World Table is taken for the period of 1996 to 2014 for all variables. Initially a number of variables, pertaining to different economies were considered for construction of Composite Index of Leading Indicator (CILI). Finally six variable, namely Gross Domestic Product growth, Gross Capital Formation, Total Factor Productivity, Exchange Rate, Human Capital and Trade.

Foreign direct investment, net inflows (BoP, current US$):-
Foreign direct investment refers to direct investment equity flows into the reporting economy. It is the sum of equity capital, reinvestment of earnings, and other capital. Data are in current U.S. dollars. This is used to extract the FDI Cycle.

GDP growth (annual %) (GDP):-
Annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2005 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. FDI tends to flow to countries with higher economic growth.

Gross capital formation (constant 2005 US$) (GCF):-
Gross capital formation (formerly gross domestic investment) consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. Higher gross capital formation leads to greater economic growth which is result of improvement in the investment climate which further helps to attract higher FDI inflows. Data are in constant 2005 U.S. dollars.

Trade (% of GDP) (TR):-
Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product. Trade is generally expected to be positive and significant determinant of FDI.

Human Capital (HC):-
Index of human capital per person, based on years of schooling (Barro/Lee, 2012) and returns to education (Psacharopoulos, 1994). Human Capital can lead to higher productivity and profitability as a direct result of the increased capacity of the employees to perform their tasks

Total Factor Productivity (TFP):-
TFP Level at current PPPs (USA=1). TFP is considered as a proxy for technological change and is also called Solow Residual. Growth of TFP is considered as a plausible crucial factor affecting FDI Cycle Fluctuation of BRICS Economies.

Exchange Rate (ER):-
Exchange Rate measured as national currency/USD. Exchange Rates, defined as the domestic currency price of a foreign currency matter both in terms of their level and their volatility. It can influence both the total amount of FDI that takes place and the allocation of this investment spending across a range of countries. When a currency depreciates, meaning that its value declines relative to the value of another currency, this has implication on FDI as it reduces that country's wages and production costs relative to its foreign counterparts which serves as location advantages.

Methodology:-
This subsection provides the description of the different steps involved in construction of the leading indicator As the phenomenon of FDI inflows forms cyclical movements, in the first step this Cyclical Component is extracted by Christiano-Fitzgerald (2003) filtering technique. It is an approximation to the ideal band pass filter which is used to de-trend and smooth the data series in the frequency domain. Cyclical component of any macroeconomic fundamental is an important factor from long term perspective of policy framing of any economy. It is important to know that a long term trend and a cyclical component of any time series data. Identifying the deviations of FDI from its long term trend is a crucial indicator of the economic health of any country as FDI plays its role in shaping the output and hence GDP of economy. That is why this empirical work has been conducted with the FDI cycle and this exercise is a strong departure from the traditional method of working with per capita FDI flows or growth of FDI.

In the next step, we found the growth rates and expressed them in their standardised form i.e. ratio of their deviation from corresponding mean to the standard deviation is taken i.e X-μ/σ

Standardisation of each variable will mitigate the possible over-influence (under influence) of some variable over the other due to the scale differences. We used the Harding and Pagan (2002) method for detection of the Peaks and Troughs called the turning points of the FDI Cycle. Later, we constructed the Leading Indicator based on Principal Component Analysis (PCA) Method.

Christiano-Fitzgerald Random Walk band-pass filter described in Christiano and Fitzgerald (Int Econ Rev, 2003). They demonstrate that the filter, an approximation to the "ideal" band-pass filter, is reasonable for economic time series which are approximately random walk processes. The pl and pu arguments specify the minimum period of oscillation and maximum period of oscillation of the desired component of the time series. For quarterly data, minimum and maximum observed common values are 6 and 32 respectively, which preserve the components of the data with period between 1.5 and 8.0 years. For monthly data, these common values are 18 and 96, which preserves the component of the data with period between 1.5 and 8.0 years. For annual data, common values are 2 and 8. The filter has been formulated to de-trend and smooth the data series in the frequency domain. This is adopted for the extraction of the cyclical component from the time series. The CF filter does not allow for any trimming of series at terminal points. It converges to the optimal and ideal band pass filter.

Details of the methodology are documented in the paper by Christiano and Fitzgerald (1999).
A brief sketch of methodology is provided below
The cyclical component can be calculated as follows
$Y_t = B_0 X_t + B_1 X_t + B_2 X_t + …. + B_{T-1} X_t$ for t= 3,4,5 ….. T-2
Where $B_j = [\sin(jb) - \sin(ja)] / \pi j$, j>=1
$B_0 = [b-a] / \pi$, $a = [2\pi]/pu$, $b = [2\pi]/pl$

Here pl and pu are two extreme limits, lower and upper respectively, of the period of oscillation of the cycle under consideration with the constraint pl<pu<1 and the parameter pu & pl are cut off cycle length. Cycles longer than pl and shorter than pu are retained in the cyclical term.

The variable FDI, net inflows (Bop, current US$) of BRICS Economies, is filtered to extract the FDI Cycle Component of each Economies.

Harding and Pagan (2002) Peaks and Troughs Detection technique:-
It identifies potential turning points as the local minima and maxima in the series. Candidate points must then satisfy two conditions: phases are at least 'p' quarters long, and complete cycles are at least 'c' quarters long---where 'p' and 'c' are chosen parameters. This "BBQ" algorithm was proposed by Harding and Pagan (2002) as a quarterly ("Q") implementation of the original Bry and Boschan (1971) ("BB") monthly algorithm.

Window (#) -window over which local minima and maxima are computed; default is window (2)
Phase (#)-minimum phase length; default is phase (2)
Cycle (#)-minimum cycle length; default is cycle (5)

Principal Component Analysis (PCA) for Construction of Composite Index Leading Indicator (CILI):-
In this section, the construction of CILI for predicting the cyclical fluctuation of FDI Cycle is discussed.
For the consideration of a good leading indicator the most important feature is that it should have high correlation with reference series at specified level.

A weighted average of all these series will generate CILI which should predict the fluctuation of FDI Cycle in advance. The Principal Component Analysis (PCA) method is used for assignment of appropriate weights to each component.

Principal component analysis (PCA) is a statistical technique used for data reduction. The leading eigenvectors from the eigen decomposition of the correlation or covariance matrix of the variables describe a series of uncorrelated linear combinations of the variables that contain most of the variance. In addition to data reduction, the

eigenvectors from a PCA are often inspected to learn more about the underlying structure of the data. PCA display the eigenvalues and eigenvectors from the PCA eigen decomposition. The eigenvectors are returned in orthonormal form, i.e., orthogonal (uncorrelated) and normalized (with unit length, L'L =I).

PCA involves the construction from the original set of variable Xj (j=1,2….k), a new set of variables Pi(i=1,2…..k) called the principal components(PCs). These new variables are linear combination of the X's.
P1=a11X1+a12X2+…+a1kXk
P$_2$=a21X1+a22X2+ …..+ a2kXk
………..
Pk=ak1X1+ak2X2+……+akkXk

The weights applied to the original series (aij) in the construction of PCs are known as Factor Loadings.
PC has some advantages: Firstly they are uncorrelated (orthogonal), in other words, there is zero multicollinearity among PCs. Secondly the first PC will account for maximum possible proportion of the variance of the set of Xs and each successive principal component accounts for a variance smaller than that of preceding principal component.

In practice, first component usually captures a sufficient amount of variation to be an adequate representation of original set.

Index Construction from PCA-We extract the factor loading (weightages) for respective macroeconomic variable. First principle component is considered for the analysis since it accounts for on an average 50% variation in the underlying series. So the index for each country can be represented as –
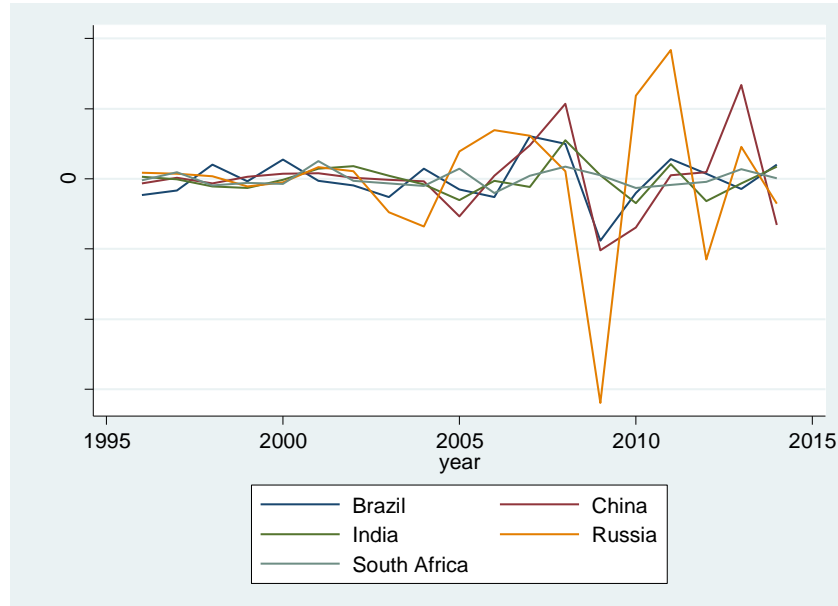$\sum_{i=1}^{n} wixi$=index
Where w$_i$ is the assigned weights for x$_i$ variable.

Empirical Findings:-
The following figure 1 show the FDI cycles of each of the BRICS Economies from 1996 to 2014.
Fig 1:- FDI Cycle of BRICS Economies from 1996 to 2014

It is clearly visible from the graph that there is a large scale fluctuation in FDI Cycle from 2003 onwards. One reason can be that Fed has decreased their interest drastically to 1% during that year. During 2008 we can see there is dip in FDI Cycle for all BRICS Economies. The dip is due to financial crisis which lead to the global meltdown.

The Estimated Equation (Index) of the each of BRICS economies is given below:
For Brazil C=0.5031*GCF+0.4756*GDP-0.4552*ER-0.2316*HC+0.4574TFP-0.2248*TR
For Russia: C=0.5177*GCF+0.5115*GDP-0.3237*ER-0.1813*HC+0.5042*TFP-0.2802*TR

For India: C=0.4633*GCF+0.5699*GDP-0.3494*ER+0.1175*HC+0.5605*TFP-0.1025*TR
For China: C=0.4381*GCF+0.6107GDP-0.2093*ER-0.3254*HC+0.5250*TFP+0.0990*TR
For South Africa:
 C=0.4991*GCF+0.5506GDP-0.0768ER+0.1735*HC+0.5030TFP+0.3984*TR

Performance of Composite Index:-
This section summarizes the performance of newly constructed Composite Index Leading Indicator. An ideal CILI
should posses the power to predict turning points.

In the following graph as well as in the table, the performance of the two series, namely the standardised FDI Cycle
and newly constructed CILI is compared to examine the predictive power of CILI.

Fig 3: Comparison of standardized FDI Cycle and Composite Index of BRICS Economies
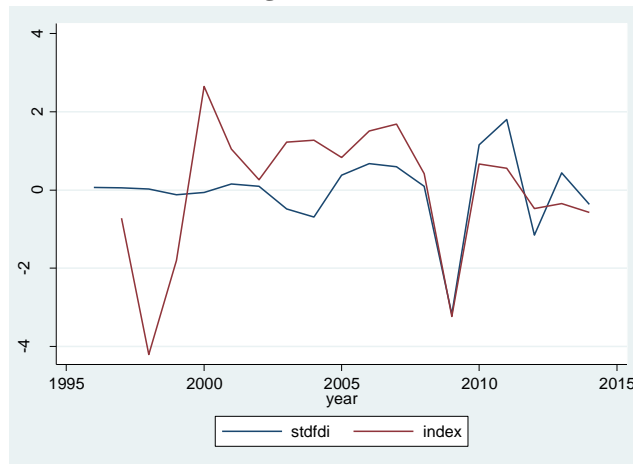
Fig 3.1:- Brazil

Fig 3.2:- Russia

Fig 3.3:- India

Fig 3.4:- China

Fig 3.5:- South Africa

Table 3.1:- Predicted Peaks and Troughs of Standardized FDI Cycle of BRICS Economies

Country	Peaks	Troughs
Brazil	-	2003(1999)
Russia	2001(2000)	2004(2002)
India	-	1999(1998),2010(2008)
China	2013(2007)	2005(1999)
South Africa	2008(2006)	-

- Figures in the parentheses indicate the corresponding year for peaks or trough for FDI Cycle by the Index.

From the Fig 3 and Table 3.1 we can clearly see that the composite index can predict the peaks and troughs of BRICS Economics. Let us analyse country wise, firstly in case of Brazil the trough in year 2003 is predicted by the index in year 1999. In case of Russia the index is helpful in predicting both peak and trough. The peak in the year 2001 is predicted by the index in year 2000 and the trough in the year 2004 is predicted by the index in year 2002. From fig 3.2 we can see in year 2009 both the standardised FDI Cycle and the index has trough at the same time, this is called coincident indicator. Coming to India the troughs in year 1999 and 2010 is predicted by the index in year 1998 and 2008 respectively. In case of China the index is helpful in predicting both peak and trough. The peak in the year 2013 is predicted by the index in year 2007 and the trough in the year 2005 is predicted by the index in year 1999. For South Africa the peak in the year 2008 is predicted by the index in the year 2006.

Concluding Remarks:-
FDI is a crucial factor for development and growth. So studying the long term dynamics of FDI is of great importance. This paper attempts to study the FDI Cycle which is the cyclical component of FDI inflows for the period 1996 to 2014 for BRICS economies and specially focus on constructing a yearly composite Index leading indicator for forecasting the FDI Cycle fluctuations. In this regard, we choose the variable carefully and use Christiano – Fitzgerald filter for extraction of the cyclical component of FDI inflow. Later we use the Principal Component Analysis (PCA) method for assignments of weight to different variables for construction of the index. It is found that key variables like GDP growth, Exchange Rate, Gross Capital Formation, Human Capital, Total Factor Productivity and Trade are very useful in predicting the turns i.e peak and trough in FDI Cycle. The FDI Cycle dynamics can help policy makers to take necessary decisions and actions to combat undesired consequences for the economy.

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Appendix:-

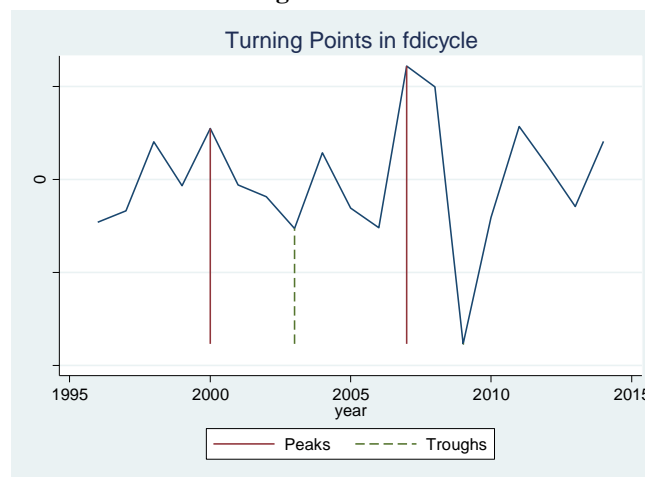**Fig 2:-** Peaks and troughs of FDI Cycle for BRICS (Harding and Pagan Method).
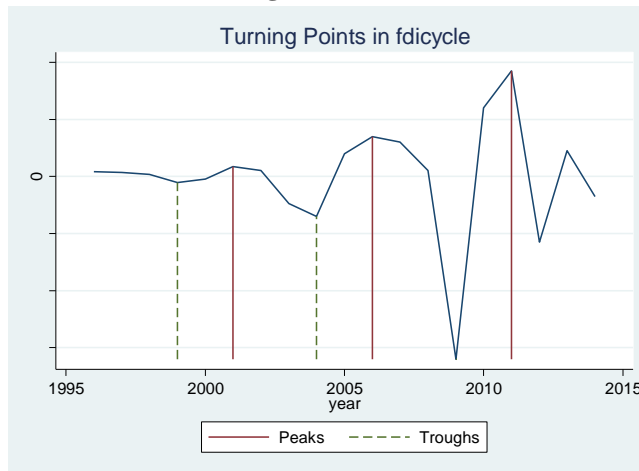
Fig 2.1:- Brazil
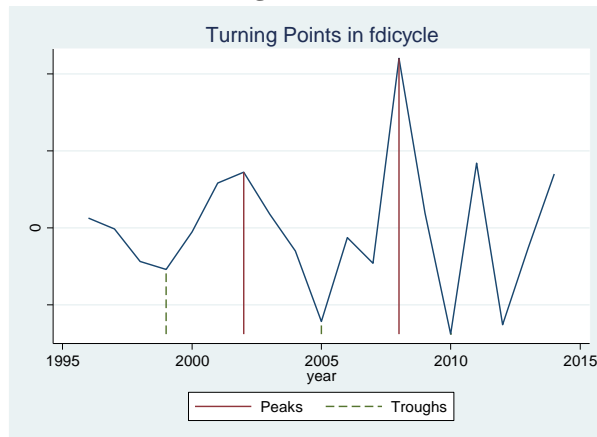
Fig 2.2:- Russia

Fig 2.3:- India

Fig 2.4:- China

Fig 2.5:- South Africa