Pull factors of FDI: A cross country analysis of advanced and developing countries

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Abstract:

Usual trend of FDI movement among the advanced economies (AE) has changed significantly in the past few decades and increasing volume of FDI flow to and from developing economies (DE) are also being witnessed. Intuitively, countries with stable macroeconomic situation, good development indicators with political stability and strong institutions attract more FDI flow. Based on the panel data of 22 countries of AE and DE for the period 2010-2012, this paper aims to examine the macroeconomic determinants of FDI flow for four broad groups (a) to AE from AE, (b) to AE from DE (c) to DE from AE and (d) to DE from DE. It is observed that the determinants of FDI flow varies significantly across the groups. Further, as FDI flow to a country partly depends on prevailing macroeconomic situation, collective information of macroeconomic determinants to FDI is captured in terms of a composite index (CI). CI is also used to rank the countries within the broad groups of FDI flow to understand the macroeconomic enabler in the host country to attract FDI. Moreover, correlation of a particular indicator with the CI reflect the intensity of influence of individual macroeconomic variable on FDI flow.

This paper also contributes to the literature by way of proposing a methodology to circumvent multicollinearity issue which arises as selected determinants of FDI are found to be interrelated. It constructs composite indices (Primary Composite Index PCI and Secondary Composite Index SCI) by way of weighted linear combinations of the determinants with optimum weight structures in such a way that PCI and SCI are uncorrelated and together can explain the variation in FDI relatively better than the usual principal component analysis approach. The results indicate differences in the role played by macroeconomic variables in explaining the determinants of FDI flows from AE to AE, AE to DE, DE to AE and DE to DE.

Key Words: Foreign Direct Investment, Advanced economies, Developing economies, Multicollinearity, Panel regression, principal component analysis

JEL Classification: F21 F23, C52

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I. INTRODUCTION

1.0 Firms invest in a foreign country in search of profit and safety or strategic needs. Empirical Studies have shown that foreign direct investment (FDI), which is a major component of cross-border capital movements, is helpful for technological progress, productivity improvements and thereby plays a critical role for the long-term growth and development of the recipient countries. As a result, countries are keen to attract and retain FDI by way of strengthening various socio and macroeconomic parameters as well as governance issues which are believed to be analysed by the multinational enterprises (MNEs) before making long-term investments. Therefore, for the policy makers, identification of macro variables in the order of relative importance is important to attract FDI.

In the recent past, we have witnessed spurt in Foreign Direct Investment (FDI) and it is growing at much faster rate than global exports growth. According to the world investment Report WIR, UNCTAD (2015), world FDI stock to GDP has sharply increased from 9.8% in 1990 to 34.5% in 2013 and during the same reference period, sales of foreign affiliates to GDP also has increased from 21.2% to 44.8%, whereas, exports of goods and services increased from 19.4% to 30.6%. Although, FDI predominantly initiates at advanced economies (AE), we are now witnessing a new phenomenon of significant reverse flow of FDI from developing economies (DE) as well. Also the characteristics of MNE's from DE are quite different as compared to MNE's of AE. According to WIR (2015), DE's share in total outward FDI reached to 35 per cent in 2014, up from 13 per cent in 2007. MNE's of DE have expanded their foreign operations mostly through greenfield investments as well as cross-border M&As. During 2007-2014, 52% (average) of FDI outflows by DE MNEs were in equity and there is not much variation in the share over the period. Whereas, AE MNEs FDI is in the nature of reinvested earnings and the reinvested earnings as a percentage of their FDI outflows has increased from 34% in 2007 to 81% in 2014.

Two types of exogenous macroeconomic parameters are at work to influence FDI decision of MNEs. Pull factors or host country specific factors i.e. macroeconomic characteristics specific to host country (recipient of FDI) which attracts FDI, together with various push factors or home country factors i.e. macroeconomic factors in the home country (source country of FDI) which act as driving force for outward FDI, significantly determine the direction and intensity of FDI flow to host country.

Usual trend of FDI movement among the AE has changed significantly in the past two decades or so and DE are now witnessing a large amount of FDI flow to and from AE. Intuitively, countries with stable macroeconomic situation, good development indicators with political stability and strong institutions attract more FDI. As a result, FDI flows are not homogeneous across countries and also there are diverse motives of MNEs behind FDI and what really pulls FDI to a country still remains an open question and literature survey indicate a large variation in specifications/ determinants for bilateral FDI flow.

This paper re-examines the wide range of macro indicators of 22 countries[1] (both AE and DE) for the period 2010-2012, in order to find out macroeconomic determinants (mainly net of pull and push factors) which influence MNE's investment decision and also investigate whether these determinants are different for FDI flow to (a) AE from AE, (b) AE from DE (c) DE from AE and (d) DE from DE. The paper also contributes to the literature by way of devising a novel way to circumvent multicollinearity[2] issue in the multiple regression equation. The new approach followed in the paper is a two-step process. It constructs composite indices (Primary Composite Index- PCI and Secondary Composite Index- SCI) by way of weighted linear combinations of the explanatory variables with optimum weight structures in such a way that PCI and SCI are uncorrelated and together can explain the variation of the dependent variable which is generally better than the usual principal component analysis approach. Further, FDI flow to a country partly depends on prevailing macroeconomic situation and collective information of these macroeconomic determinants to FDI flow is reflected in the constructed composite index CI. Therefore, correlation or any other measure of association of any macro indicator with the CI will reflect the intensity of influence of individual macroeconomic indicator on FDI flow. Moreover, CI can be used to rank the countries within the broad groups of FDI flow to understand the macroeconomic enabler in the host country to attract FDI and the rank for a country may vary across broad groups.

[1] **Advanced Economies**: Australia, Austria, Belgium, Canada, France, Germany, Italy, Japan, Norway, Spain, Sweden, Switzerland, UK, USA; **Developing Economies**: China, Brazil, Russia, Mexico, India, South Africa, South Korea and Thailand.

[2] Multicollinearity: Detail given in Annex III

2. SURVEY OF LITERATURE

2.1 Theoretical Background: There exist a large number of studies that examine micro and macro aspect of FDI theories. Microeconomic theory of FDI emphasis on market imperfections and motive of MNEs to expand their market share and ownership advantage (product superiority or cost advantages, economies of scale, superior technology, managerial advantage etc.), therefore, MNEs will find it cheaper to expand directly into a foreign country. Also explanation of FDI includes regulatory restrictions (tariffs and quotas), risk diversification. Macroeconomic theories on FDI explain why MNE choose a particular foreign location and for that purpose depends on international trade theory and also investigate comparative advantages including environmental dimensions in choosing a location.

Despite the 'liabilities of foreignness' how MNEs successfully compete with the local firms are explained by Hymer (1960) and argued that MNEs have certain ownership advantage (technological advantages, financial advantages, organisational advantages). Also product cycle theory of Vernon (1966) which relates different stages of production life cycles with FDI actually connects micro and macro aspect of FDI theory. Johanson and Vahline (1977) suggest gradual internationalisation of firms through different stages. However, recent studies have shown that new firms especially from the emerging markets with little experience on foreign markets, penetrate and integrate early with other foreign markets (these firms are termed as "Born global" into the literature (Hashai and Almor, 2004)). The eclectic paradigm, also known as OLI paradigm, was developed by Dunning (1977, 1988). OLI paradigm is a combination of three factors i.e. ownership (O) advantage (industrial organization theory), location (L) advantages (international immobility of some factors of production) and internalization (I) advantage (transaction cost economics) which explain different types of FDI. A firm should possess some sort of comparative advantage over other firms of the host country and the firm believes that it would gain immensely by internalization of these assets which implies that an internal expansion is preferred instead of depending on market (e.g. license agreement with another firm). The ownership advantage of the firm can be better exploited when it is combined with the favourable factor inputs located in the host country. Williamson (1981), Teece (1986) and Casson (1987) have focused on this OLI paradigm and focuses on firm's decision to internalise the production process by investing abroad instead of licensing in an imperfect markets.

'Ownership' advantage as described by Dunning (1977) states that firm may go out for FDI if it has sufficient enough ownership advantage to counter the 'Liability of Foreignness' in foreign country. This explains nicely the outward FDI initiative of AE MNEs who are assumed to have

significant ‘Ownership’ advantages (O^+). However, DE MNEs don’t have such ‘ownership’ advantages; instead, they are facing some kind of ownership disadvantages (O^-) which is obstructing them from growing further or they may be facing threat from rivals (domestic/foreign firms) – threat to its existence. Therefore, DE MNEs who have intentions and means are eager to make good their ‘ownership deficiency’ (O^-) and go for FDI in search of critical asset of their need, which will help them back at home. By initiating FDI, firms from emerging markets may or may not gain in short run but will be gainful in long run. Hence, firms either possessing ownership advantages (O^+) or ownership disadvantages (O^-) may initiate FDI. OLI framework suggests that firm may initiate FDI to a foreign location which provides significant ‘Location’ advantage (L^+). Location advantage explains resource seeking motives of some firms and their FDI. However, there are some firms in DE which are facing insufficient and inefficient infrastructure (soft/hard) i.e. Location disadvantage (L^-) at home country and are opting to some foreign locations which offer better infrastructure. Therefore, location advantages (L^+) at host as well as location disadvantages (L^-) at home may trigger FDI i.e. combination of pull and push factors are at work to determine direction and level of FDI.

Numerous studies focuses on how exogenous macroeconomic factors influence MNEs FDI decision. These include economic activities (size of the economy, openness of economy, economic stability), legal and political system, business environment, investment incentives and infrastructure. These determinants can largely be categorized into pull factors and push factors which influence location choice of MNEs. In case of Horizontal FDI, access to markets on the face of trade frictions and in case of vertical FDI, access to low wages to aide production process are important motives of MNEs for FDI (Markusen (1984), Helpman (1984)). Also there are unconventional reason for FDI such as FDI to a staging foreign location as a production center to export further to other neighboring countries, hub-and-spoke model of vertical integration where sub-processes/intermediate products are produced at various foreign locations and then integrated to final product at another location and hereby improving efficiency and economies of scale [Ekholm, Forslid and Markusen (2003), and Bergstrand and Egger (2004), Baltagi, Egger and Pfaffermayr (2004)].

2.2. Industrial Policy and Foreign Direct Investment

Industrial Policy (IP) refers to Government interventions on tariff, subsidies, tax break beyond its optimal value. Loosely speaking there are two types of IP i.e. (a) pro-market IP (free market - market liberalization and privatization) stimulate market competition and benefit new entrants with the objective to spread innovation and technology know-how and set-off a Schumpeterian process of creative destruction (Khan and Blankenburg 2009) and (b) pro-business IP aim to protect existing industries especially infant-industry and development of existing business. Both pro-market as well as pro-business IP are subject to criticism including corruption (Acemoglu et al. 2006, North et al. 2009, Rodrik et al. 2004).

There are views that market is self-regulated and therefore, while complementary policies such as building roads and ports are non-controversial, however, as such specific IP may not be necessary, at least for the advanced economies. IP adopted by different countries in totality is a zero-sum game or in worse case, it could lead to an inefficient allocation of resources in which countries are not specialized according to its comparative advantage.

However, some studies argues that advanced economies at the early stages of development practiced pro-business IP and protected the then infant-industry to help it to grow (Chang 2002, Aghion et al. 2012). Although low completion, as part of pro-business IP, may have long-term negative effects on existing industries, in many cases infant-industry benefits from anticompetitive policy. Generally, countries at early stages of development focuses on pro-business IP including import substituting industrialization with an export oriented strategy (ISI-EOS) and at later stage move to pro-market IP. In the Indian context, Rodrik and Subramanian (2005), observed that high levels of growth in the 1980's were triggered by pro-business IP rather than by pro-market IP.

Therefore, developing countries which largely follow pro-business IP may attract FDI as part of ISI-EOS, whereas, advanced economies which largely follows pro-market IP anyway promote competition and open to free flow of capital and FDI. Moreover, presence of externalities (such as learning externalities from exports might justify export subsidies, whereas, knowledge spillovers from foreign companies could justify tax incentives for FDI) is the main theoretical reasons for deviating from policy neutrality and opt for pro-business type IP.

Pro-business IP or infant-industry protection policies may be justifiable if the country consider that it possesses latent comparative advantages in the protected industries or it perceive that the

international price for this industry is higher than justified by the true opportunity cost of this good (Harrison and Rodriguez-Clare, 2009).

Import substitution strategy may allow expansion of manufacturing sector, but production may take place in unsophisticated ways and without increasing in productivity. Positive spillovers arise only when modern technologies, which is possible through FDI, are used in a sector. Instead of providing production or export subsidy, productivity enhancing collective action, for example, providing necessary infrastructure in terms of making available reliable cargo flights for flower exports made a vast difference to bloom flower export business in Ecuador (Hernández et. al. 2007)

2.3. Determinants of FDI:

In this section we describe the most important determinants of FDI as identified by the literature.

2.3.1. Size of the Economy: Macroeconomic performance indicators such as growth rates of the economy, development of socio-economic infrastructure and other supportive policies creating a stable and enabling environment and indicates about potential of host environment (Kumar N, 2005) and is linked to prospect of profitable FDI. The market size of an economy is an important determinant of FDI inflows. MNEs are attracted to countries with large and expanding markets with greater purchasing power, so that firms can expect higher profit from their investments [Jordaan (2004)]. Large market is required for efficient utilization of resources and exploitation of economies of scale [Charkrabarti (2001)]. GDP or per capita GDP as a proxy to market size is one of the robust determinant for horizontal FDI inflows but irrelevant for vertical FDI [Schneider and Frey (1985), Tsai (1994) and Asiedu (2002)]. However, there are some studies [Jaspersen and Knox (2000)] which observed negative effect of GDP on FDI. Yet some other studies [Loree and Guisinger (1995), Wei (2000), Hausmann and Fernandez-Arias (2000)] observed no significant impact of GDP on FDI.

2.3.2. Economic Openness: 'T*ariff jumping*' hypothesis suggests that foreign firms that seek to serve local markets may decide to set up subsidiaries in the host country if it is difficult for the host country to import their products, in other words, FDI occurs as trade protection generally imply higher transaction costs associated with exporting. Empirical studies suggest that the effect of openness on FDI depends on the type of FDI. When FDI is market-seeking, trade restrictions i.e. less openness can have a positive impact on FDI [Blonigen (2002), Jordaan (2004)].

2.3.3. Economic Stability: Financial situation of a country may change due to various reasons and unlike other kind of capital flow, FDI cannot be easily withdrawn when the financial situation of the host country worsen. Therefore, FDI inflow might be sensitive to the financial risk of the host country. High foreign debt (relative to GDP) reduces repayment capability as well as currency depreciation of borrowing country and increase the financial risk of the country which is detrimental to FDI inflow. High fiscal deficit and current deficit of a country lead to high financial risk. A high inflation rate in the host country may also prevent FDI inflow as the real local currency value of capital invested in the host country and future return may become lower with high inflation. High inflation may also result in depreciation of the local currency and may also discourage FDI inflow [Asiedu (2002), Chakrabarti (2001)].

2.3.4 Legal and political System: FDI involves high sunk cost and therefore it makes investors very sensitive to uncertainty [Helpman, Melitz and Yeaple (2004)]. Unless MNEs are confident about institutional soundness, significant risk premium will be included in sunk costs to capture these possibilities. Under very high political risk environment, MNEs may even believe that the host country's government might appropriate some of the returns on FDI or even implement enforced nationalization (e.g. in Argentina). Therefore, political risk and Institutional quality are important determinant of FDI. Good governance is associated with higher economic growth. Poor institutions that enable corruption tend to add to investment costs and reduce profits. The high sunk cost of FDI makes investors highly sensitive to uncertainty, including the political uncertainty that arises from poor institutions. However, literature survey on political risk to FDI Inflow is mixed. Some studies reported that FDI flows are affected by many factors pertaining to legal and political system of the host country such as ethnic tension, government stability, internal and external conflict, corruption, institutional quality, legal system [Wei (2000), Gastanaga et. Al. (1998), Baniak et. al. (2005)]. Regulatory framework, bureaucratic hurdles and red tape, judicial transparency, corruption in the host country are found insignificant [Wheeler and Mody (1992)]. Some studies did not find any significant effect of democracy and political risk on FDI inflow [Asiedu (2002), Noorbaksh et al (2001)].

2.3.5. Business Environment and Infrastructure: The business environment in the host country is also key driving force for FDI inflows. Empirical studies suggest that Labor costs is a key determinant for FDI inflows [Some studies suggest that productivity of labor and its cost, human capital play a key role in explaining FDI [Noorbakhsh et al. (2001)]. Tax policies, bureaucracy of host country are also important determinant of FDI inflows [Cassou (1997), Hartman (1984), Bénassy-Quéré et al. (2007)]. Studies have identified clustering effects: foreign firms appear to

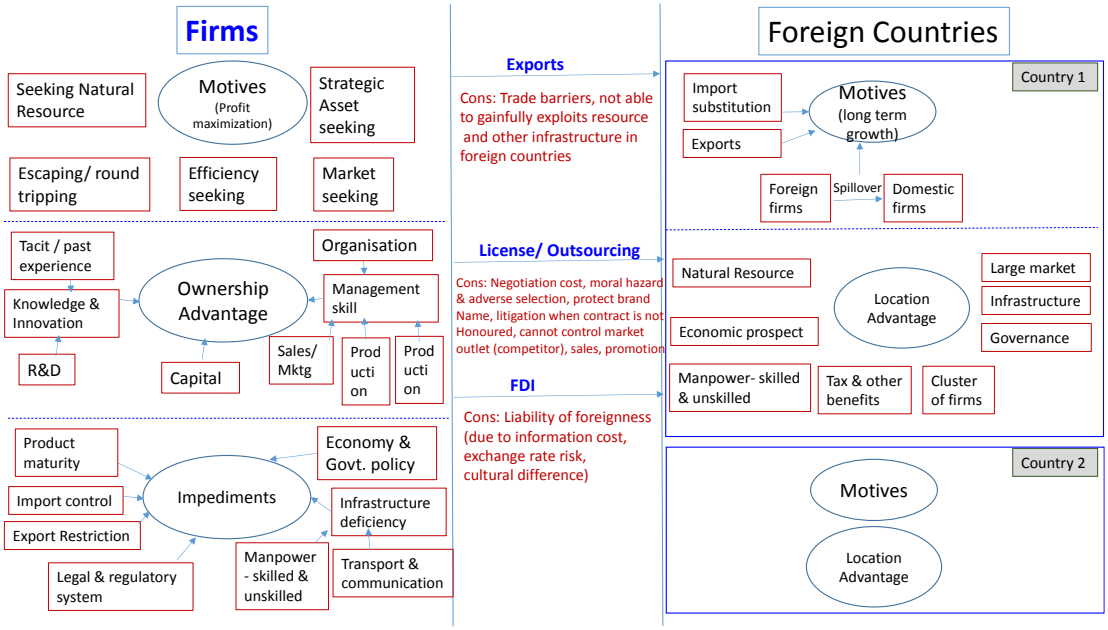
gather together either due to linkages among projects or due to herding as a larger existing FDI stock is regarded as a signal of a benign business climate for foreign investors. The investment climate is important institutional instrument which help in attracting FDI inflows (Narula and Dunning, 2000). Cleeve (2008) used tax holidays, repatriation of profits and tax concessions as an indicator for investment incentives but did not find significant effect on FDI inflows. However, Gastanaga et al. (1998) and Wei (2000) observed statistically significant effect of corporate taxation on FDI. The infrastructure of a particular country is also an important factor for FDI investors. A developed communication and transportation infrastructure has a positive influence on inward FDI flows [Guisinger (1995), Wheeler and Mody (1992)]. Schneider and Frey (1985) argued that large share of working-age population with secondary education attract FDI.

2.3.6. Exchange rate: Generally speaking a stable exchange rate may not have an impact on FDI decision as investment in foreign location can be considered as future stream of profit denominated in host currency and when it converted back to home currency of MNEs (repatriation) at the same exchange rate then obviously exchange rate per se does not affect present value of foreign investment. However, there are views which suggest that MNEs are more willing to invest in a country when host currency is weak i.e. low-cost investment Bloningen (1997). Also there is opposite view (currency area hypothesis) which suggest that MNEs are less likely to invest in a country which has weak currency as a strong currency in the host often indicates greater competitiveness. Foreign assets becomes more expensive for a firm when host currency is appreciated vis-à-vis home currency therefore may impact negatively to FDI inflow into the host country (Chakrabarti, 2001; Cassou, 1997; Froot and Stein, 1991). Few studies show opposite result.

On the other hand, if exchange rate for a particular host country (vis-à-vis home country of MNEs) is volatile, risk averse MNEs may be reluctant to invest in that host country. However, in certain cases higher volatility may lead to increase FDI, if such exchange rate uncertainty is linked with export demand shocks then risk averse MNEs increase FDI instead of export (Goldberg and Kolstad (1995) observed similar result for US FDI in Canada, Japan, and the UK).

2.4 Summary: In this section we provide a brief summary of theoretical background dealing with investment decision as well as the factors that determine FDI flow from host country perspective. The analytical framework followed in this paper is given in chart 1.

Chart 1: FDI framework



3. METHODOLOGY

Effect of various macroeconomic factors in terms of intensity and direction may be different for FDI flow to AE from AE, to AE from DE, to DE from AE and to DE from DE. Also as macroeconomic factors both pull factors and push factors works simultaneously to influence FDI inflow to a country which is actually outward FDI of another country, therefore, this paper consider net factors (Pull factor – Push factor) as possible determinants of inward FDI (bilateral).

Intuition as well as various empirical studies suggests numerous macro indicators which may have possible association with the FDI. Out of these factors some of the factors exhibit very low empirical association with FDI for any of the four groups of countries. These indicators are also sometime highly correlated which lead to multicollinearity issue in the multiple regression equation. Multicollinearity issue at times so severe that, for example, indicators which show pair wise (with FDI) highly significant correlation (significant in the regression/panel equation involving single determinants) shows insignificant association in the multiple regression involving multiple determinants.

3.1. Principal component analysis (PCA[3])

PCA reduces the dimensionality of data while retaining variation, as much as possible, present in the interrelated variables. PCA transform original data set into uncorrelated principal components (PC). PCs are linear combination of constituent indicators and are ordered so that most of the variation present in the original data set are retain by the first few PCs(selected based on certain criteria, for example, Eigen value greater than one). To avoid multicollinearity issue various study used PCA where PCs itself or composite index based on PCs are used to regress FDI. Sometimes PCA is used for different segments or set of related indicators which are logically related with high correlation among themselves and PCs of each segment are used as substitute to original variables to regress the dependent variable (FDI). In the usual PCA approach, as generally only first few components are chosen (with eigenvalue more than 1), some of the components with lower eigenvalue which may show good association with the target value are ignored. Few indicators which are not closely associated with majority of other indicators may have higher loading/share in the non-selected PCs. As a result, there may be non-selected PCs which possess relevant information to explain variation in the target variable, but put in no use and thereby result in below potential performance.

3.2. Multiple composite indices (MCI) method

To tackle the multicollinearity issue of interrelated determinants, we uses a different approach which produces composite indices similar to PCs. This is generally a two stage process and each stage compute a composite index of determinants taking into consideration the strength of association of these determinants with the target variable (FDI).

Pre-processing: All variables (determinants as well as the target variable) standardized to (0,1) scale by min-max method (by subtracting minimum value of that variable and then dividing it by the range of the same variable).

Step 1: Initial list of macroeconomic determinants of FDI are analysed on panel regression framework to find out whether empirically significant association exist with FDI. The pruned list of determinants have some explanatory power of different degrees in explaining the variance of the dependent/target variable. . Composite indices are constructed as weighted average of the different combination of estimated values of the target variable (based on the panel regression equation involving single explanatory variable to the target variable) where weights are some measure of association (e.g. correlation) of corresponding estimate with the target variable. Such

[3] Detail given in Annex IV

composite indices are constructed based on many combination of the selected determinants with an aim to identify one which has maximum correlation with FDI. This is termed as primary composite index (PCI), which is essentially certain linear combination of selected determinants and it contains common information of interest pertaining to association of these selected set of determinants with the dependent variable. PCI is used as the baseline indicator to regress the dependent variable.

Step 2: If some determinants, which represents certain aspect of an economy, are highly correlated (among themselves) but have relatively weaker association with the target variables then, if somehow large proportion of such determinants are selected from a sector in the sample, by construction that sector of the economy will unduly dominate PCI by mere over representation in the selection of variables and other important sectors may lose out although they might have stronger association with the target variable.

- Therefore, to explore further, whether there are any residual information related to association of any selected indicator beyond the PCI constructed in the previous step (to capture under representation or over representation of individual indicator in the PCI), we regress each of the selected determinants on the PCI and extract the residual which represent information over and above contribution made to PCI by the indicator. Moreover, some other indicators which may have hidden association with FDI but somehow masked with noises and as a result in its original form these indicators have not shown significant association with FDI. Some of these indicators (which were not part of PCI as they were not significantly associated with FDI), however when regressed on PCI the resultant residuals may be significantly associated with Y_t. These residuals series (corresponding to each determinants) form the basis of the second information set which is further examined to check whether it contains any useful information or explanatory power for the dependent variable by way of regressing dependent variable (i.e. FDI) individually on each of these residuals. A secondary composite index (SCI) is constructed as weighted average of the estimated values of the dependent variable obtained from those regression equation where residuals of the determinants turn out to be significant in explaining the dependent variable and weights are some measure of association (e.g. correlation) of corresponding estimate with the target variable. As these residuals are independent of PCI therefore SCI is also independent to PCI.

- SCI which is again certain linear combination of the selected variables and also uncorrelated with PCI may show good association with the dependent variable, albeit inferior to PCI in

terms of explaining power. However, when both PCI and SCI are used as explanatory variables to regress the dependent variable they better explain jointly than individually.

3.3. Construction of indices (PCI and SCI):

Let X_{it} be the i^{th} determinants /indicator at time t, where i=1(1)n; t=1(1)T and Y_t be the target variable.

Let $x_{it}=(X_{it}- \min(X_{it})) / (\max(X_{it})-\min(X_{it}))$, time period t=1(1)T; $0<=x_i<=1$; and

$y_t=(Y_t- \min(Y_t)) / (\max(Y_t)-\min(Y_t))$, for all t; $0<=y_t<=1$;

Let $y_t= c_i+b_i*x_{it}+e_t$ ……..(1)

Where $e_t \sim N(0,\sigma^2)$, c_i and b_i are unknown coefficient.

Let $\hat{Y}'_{it}$ be the estimate (Panel regression RE/FE) of y_t in eq (1) corresponding to i^{th} indicator, and r_t be the corresponding correlation with Y_t. For various combination of these indicators, which are significantly associated with Y_t, composite indices (PCI_{jt}) are computed.

Let $PCI_{jt} = \sum_{j\epsilon\ (combination\ of\ i)} \hat{Y}'_{it} * w'_i * D_i$;

where $w'_i = \frac{r_i}{\sum_i D_i * r_i}$ and $D_i = 1$ if b_i is statistically significant else 0.

Let ρ_j= correlation (PCI_{jt}, Y_t). PCI= PCI_j where ρ_j is maximum.

Let $x_{it}= p_i+q_i*PCI_t+z_{it}$ ……..(2)

Where $z_{it} \sim N(0,\sigma^2)$, p_i and q_i are unknown coefficient, i=all determinants under study.

Let $\hat{z}_{it}$ be the residual estimated from of eq (2) corresponding to i^{th} indicator.

Let $y_t= r_i+s_i*\hat{z}_{it}+u_{it}$ ……..(3)

Where $u_{it} \sim N(0,\sigma^2)$, r_i and s_i are unknown coefficient corresponding to ith indicator.

Let $\hat{Y}''_{it}$ be the estimate of y_t in eq (3) corresponding to ith indicator and r_i is the correlation coefficient of $\hat{z}_{it}$ with Y_t.

Let $SCI_t = \sum_{i=1}^{k} \hat{z}_{it} * w''_i * E_i$; where $w''_i = \frac{r_i}{\sum_i E_i * r_i}$ and $E_i = 1$ if s_i is significant else 0.

Both PCI_t and SCI_t are linear combination[4] of x_i's. Also by construction, PCI_t and SCI_t are uncorrelated/ independent, therefore, these can be used together to explain y_t without any multicollinearity issue.

[4] $PCI_t = \sum_{i=1}^{k} \hat{Y}'_{it} * w'_i = \sum_{i=1}^{k} (\hat{c}'_i + \hat{b}'_i * x_i) * w'_i$ is a linear combination of x_i
$x_{it}= p_i + q_i * PCI_t + z_{it}$; => $z_{it}= x_{it} - (\hat{p}_i + \hat{q}_i * PCI_t) = x_{it} - (\hat{p}_i + \hat{q}_i * (\sum_{i=1}^{k} (\hat{c}'_i + \hat{b}'_i * x_i) * w'_i))$

Y_t= a+ b_1*$PCI_t + b_2 * SCI_t + \varepsilon_t$……..(4)

PCI_t and SCI_t thus constructed based on interrelated determinants with special focus to Y_t would explain the variation in Y_t as much as PCs of PCA can do or might be better. Composite Index (CI) is the estimated value of Y_t in eq (4). CI an also be constructed as weighted average of PCI and SCI and weights are corresponding correlation of PCI and SCI with FDI. CI reflects relative aggregated macroeconomic situation of a country relevant for attracting FDI and can be used to rank countries in terms of attractiveness to FDI flow.

4. DATA sources and variable construction

Secondary data of annual frequency were used in this paper and were sourced from World Bank Development indicators database and United Nations Conference on Trade and Development (UNCTAD) data base for the period 2010-2012. The time period was chosen so as to include maximum covariates of all selected countries.

The inflow of FDI to host country is related to macroeconomic indicators associated to host country as well as home country i.e. net of pull and push factors. The covariates for FDI considered in this paper are primarily based on review of the literature. Covariates are selected as proxy to market size, market demand, population, infrastructure, technology, FDI openness and political stability of the host and home country. The data set contains bilateral FDI flow (more than 450 combination countries) and associated selected determinants. These list of bilateral FDI flows do not include FDI flows to-and-from offshore finance centers (OFC) whose characteristics are significantly different as compared to standard FDI flows and so is its determinants, partly because such financial flows may also involve substantial round tripping investment. Following indicators are examines as possible determinants of FDI.

= $x_{it} - \sum_{i=1}^{k} \hat{f}_i' * x_i$ + L= $\left(1 - \hat{f}_i\right) * x_i - \sum_{j=1}^{k} \hat{f}_i' * x_{j \neq i} + L$; i.e. z_{it} *is the* linear combination of x_i and similarly $\hat{Y}_{it}''$ is also linear combination of x_i and therefore SCI is also linear combination of x_i.

4.1. Technology

Access to modern technology helps in increasing productivity of the firm and also has positive spillover effect. Possession of advance technology act as firm specific advantage (FSA) and MNE's employ them in foreign countries where it can reap more benefits than simply being at home (Hymer 1960, Dunning 2006). Also strategic asset seeking firms of DE invest overseas to explore technological advantages and human capital in AE and also to gainfully combine with their existing technological capabilities. We use (i) difference of Researchers in R&D (per million people) at host and home (d_RD), (ii) difference of Trademark applications at host and home (d_Trademark), (iii) ICT goods imports (% total goods imports) by home country (home_ict_imp), (iv) ICT goods exports (% of total goods exports)by home country (home_ict_exp), (v) Sum of ICT goods exports (% of total goods exports) by host & ICT goods imports (% total goods imports) by home country (ict_exportimport), (vi) sum of ICT goods imports (% total goods imports) by Host & ICT goods exports (% of total goods exports) by Home and (ict_importexport) (vii) difference of education expenditure (% of GNI) as technology and human capital factors of FDI inflow (host-home) at host and home (d_edu_exp).

4.2. Industrial activities

Manufacturing activities at host as well as at home country of MNE are important consideration for cross country FDI flow. (viii) Co2 emission (metric tons per capita) is assumed as proxy for manufacturing activities and difference between host and home (d_co2) is considered as possible determinants of FDI flow. Also (ix) difference of Manufactures imports (% of merchandise imports) of host and home country (d_mfg_imp) is considered as determinant of FDI flow.

4.3. Infrastructure

Infrastructure base is important enabling factors for FDI flows. Lack of infrastructure at home may act as push factor whereas availability of infrastructure at host country may act as pull factors of FDI. (x) difference of Electric power consumption (kWh per capita) at host and home (d_elec), (xi) difference of Air transport, passengers carried/population at host and home (d_Air), (xii) difference of Automated teller machines (ATMs) (per 100,000 adults) at host and home (d_ATM) are used as possible determinants of FDI inflow.

4.4. Exchange rate

Exchange rates as determinant to FDI flow has been examined both in terms of changes in the exchange rate between host and home countries as well as volatility of exchange rates. (xiii) Appreciation / depreciation of bilateral level of the exchange rate (yoy_exch_rate) as well as (xiv) volatility of exchange rates (exch_rate_cv) are analysed to understand its effect on FDI flow.

As MNE intends to repatriate some of the proceeds of FDI to host country or other location they prefer consistency in exchange rates or less uncertainty in exchange rate (Campa (1993)). Based on US FDI with Canada, Japan, and the United Kingdom, Goldberg and Kolstad (1995) conclude that risk averse MNEs will increase FDI when exchange rate uncertainty increases if such uncertainty is correlated with the export demand shocks in the markets they intend to serve i.e. FDI will replace exports when exchange rate uncertainty is high. In this paper we use coefficient of variation of exchange rate i.e. standard deviation of annual (bilateral) exchange rate for last 10 years / average annual exchange rate for the same period as the proxy for uncertainty of exchange rate and also year on year change of annual average exchange rate.

4.5. Market size, prospects and cost of production

GDP reflects host countries' market size whereas GDP growth indicates pace of economic development and are thought to be positively associated with FDI inflow. However, Nunnenkamp (2002) did not find any such correlation. Moreover, for countries which witness consistent rise in GDP, generally, other macro-economic indicators are also found to be favourable (for example lower inflation) which indicates competence of Governments and monetary authority and thereby increase the prospect of FDI inflow. Large working age population, lower interest rate helps firms to produce products at lower costs thereby may have positive influence on FDI flow. In this paper we use (xv) difference (Host-home) of Population ages below 65 (% of total) (d_popuabove65), (xvi) difference of Real interest rate (%) at host and home (d_real_int),(xvii) difference of compensation of employees (% of expense) at host and home (d_sal), (xviii) difference of GDP growth (annual %) at host and home (d_GDP), (xix) difference of Inflation in term of GDP deflator (annual %) at host and home (d_infl), (xx) difference of S&P Global Equity Indices (annual % change) at host and home (d_sp) and (xxi) log of host GDP (host_gdp_avg2010).

4.6. Miscellaneous indicators:

(xxii) Geographical distance between capital of two country (d_distance), (xxiii) difference of Customs and other import duties (% of tax revenue) at host and home (d_custom), (xxiv) sum of Cost to import (US$ per container) at host and Cost to export (US$ per container) by home country (d_imp_and_exp), (xxv) difference (host – home) of Political Stability and Absence of Violence/Terrorism: Estimate (host_home_pol_stability), (xxvi) Control of corruption (d_cont_corruption), (xxvii) Rule of law (d_rule) (xxvii) Regulatory quality (d_regul) (xxviii) Central government debt as % of GDP (d_fisc_def) (xxviii) Current account balance as % of GDP (d_cur_act) (xxix) to (xxxii) inward and outward FDI stock to GDP ratio (host/home_ifdi/ofdi_gdp_avg2010), at home country as well as host country were considered.

5. RESULTS

This section presents the result of empirical analysis carried out in this paper. The results are presented in the following steps:

i. Descriptive statistics of macro-economic variables for all 4 groups viz. FDI flow from AE to AE, AE to DE, DE to AE and DE to DE.
ii. Identification of the determinants of FDI inflow for each of the 4 groups based on estimation of coefficient using panel data analysis (random effect). For the sake of comparison, we have also used pooled regression.
iii. Computation of Composite Index (CI) of identified determinants based on (a) Principal Component Analysis as well as (b) two-stage multicollinearity correction (TMC) and comparison thereof.
iv. Ranking of countries within the four groups based on CI to gauge macro-economic attractiveness

5.1. Descriptive statistics

Developing economies (DE) outward and inward FDI are growing at fast pace, however, in absolute term it is much lower than that of advanced economies (AE). Moreover, the data reveals that majority of FDI outflow is from AE to AE itself. AE & DE may have different set of macro features which are of interest with varied intensity to MNEs from AE and DE having different set of objectives.

Various macroeconomic indicators as determinants to FDI inflow were examined. Average FDI flow to AE from AE is almost eight times of FDI flow to AE from DE. Macro indicators significantly varies across the groups. Air transport in AE is much higher than DE and is highly correlated with FDI flow to AE from DE.

Per capita emission of Co2 in metric tons (d_Co2) assumed as a proxy for industrialization of a country is found to be relatively higher in AE than DE and also positively correlated with inward FDI to AE from DE, however, negatively correlated with FDI flow to DE from AE. Per capita electricity consumption, assumed as proxy for infrastructure available in the country, is much higher in the AE than in DE and also inward FDI at AE from DE is found to be positively correlated. Similar scenarios observed for other infrastructure development indicators.

Average fiscal deficit at AE is much higher than DE. Current account balance as % of GDP in AE is lower than DE and is negatively correlated with FDI flow to AE from DE. Proportion of population ages above 65 (non-working age population) is much higher (max 23% in Japan and minimum 13% in USA) in the selected AE as compared to DE (Maximum 13.1% in Russia and minimum 5% in SA) and is negatively correlated with FDI flow.

Average GDP growth, Inflation and real interest rate in AE is much lower than DE. Real interest rate is also observed to be a driver for FDI. MNE from AE with abundant of capital attracted to counties with relatively higher real interest rate Political stability, control of corruption, rule of law and regulatory quality in AE are significantly better in AE than DE.

Market size of the host country is an important determinant to attract FDI. Exchange rate volatility generally affect cross border movement of capital. However, it is observed that for FDI to AE from AE reacts positively to higher volatility perhaps FDI replaces exports when exchange rate uncertainty is high, however, higher volatility in exchange rate negatively related to FDI flow to AE from DE.

Table 1: Descriptive statistics

Variable description in	Average of determinants				Correlation with FDI			
	to AE from AE	to AE from DE	to DE from AE	to DE from DE	to AE from AE	o AE from DE	to DE from AE	to DE from DE
#obs	394	93	249	39				
FDI (mn $)	41059.69	5074.19	13970.65	3318.18				
d_edu_exp	-0.13	0.83	-0.38	1.12	0.108	0.106	0.252	0.021
d_air	-6.29	143.13	-138.29	2.19	0.084	0.189	0.068	-0.127
d_atm	9.01	41.10	-10.68	-4.37	-0.013	0.108	-0.154	-0.107
d_fisc_def	-0.73	39.87	-42.45	1.09	-0.059	-0.018	-0.151	0.499
d_co2	0.14	4.23	-2.30	-0.88	0.096	0.194	-0.314	-0.234
d_sal	0.43	-2.03	5.77	6.70	0.075	-0.056	0.023	-0.187
d_cur_act	-1.08	-1.76	-1.26	-1.02	-0.066	-0.411	-0.043	-0.365
d_elec	-521.24	5036.42	-5000.78	-866.19	0.133	0.217	-0.074	-0.170
d_gdp	0.00	-3.31	2.86	-1.71	-0.019	-0.104	0.024	0.116
d_ict_exp	0.12	-5.07	3.93	-7.37	-0.014	-0.193	-0.241	-0.418
d_ict_imp	0.37	-1.92	2.41	-2.11	0.057	-0.092	-0.171	-0.364
d_infl	-0.15	-5.14	5.04	0.76	0.121	0.100	0.124	0.395
d_mfg_imp	-0.03	4.38	-14.12	-19.77	-0.177	-0.209	-0.205	-0.395
d_march_trade	-10.49	4.84	-6.57	10.63	-0.030	-0.245	0.096	-0.357
d_popu65	-0.11	8.31	-9.67	-0.06	-0.135	-0.319	-0.115	-0.208
d_real_int	-0.85	-4.32	4.09	4.44	0.106	0.097	0.405	0.496
d_rd	-89.92	2068.65	-2443.70	-826.86	-0.027	-0.169	-0.192	-0.272
d_time_exp	0.11	-8.26	6.38	-0.38	0.006	0.007	-0.003	0.289
d_trade	-9.70	-3.15	-5.18	2.74	-0.044	-0.220	0.037	-0.434
d_trademark	7309.68	-194948.86	69511.74	-409446.90	0.019	-0.087	-0.164	0.079
d_imp_and_exp	2374.51	2622.58	2698.10	2280.18	0.068	0.061	0.096	0.270
d_pop_less_65yr	-2.05	-10.88	0.34	-8.92	-0.074	-0.032	-0.299	0.231
host_gdp_avg2010	3.06E+12	4.91226E+12	2.1683E+12	2.43608E+12	0.360	0.204	0.087	0.147
d_pol_stab	-0.06	1.12	-1.26	-0.09	-0.012	-0.046	0.113	0.095
d_cont_corruption	-0.05	1.88	-1.83	-0.01	-0.004	-0.017	0.026	0.022
d_law	-0.01	1.69	-1.60	-0.15	0.006	0.009	-0.129	0.050
d_regul	0.01	1.38	-1.22	0.04	0.017	-0.051	-0.074	-0.256
d_sp	-1.41	-2.02	4.66	3.40	-0.011	0.055	-0.168	-0.460
exch_rate_cv	0.09	0.15	0.16	0.15	0.235	-0.302	0.013	0.418
yoy_exch_rate	0.40	0.19	-4.73	-0.08	0.041	0.276	-0.106	-0.199
d_distance	5327.86	8380.18	8511.24	7463.31	-0.081	-0.115	-0.102	0.102

5.2. Selection of determinants

Although, pooled OLS indicates significant association of some of the indicators with the IFDI, Random / Fixed effect panel regression model shows no such association. To determine association of indicators with FDI we preferred random/fixed effect analysis of panel data as in pooled OLS country and time effect may distort the true association of indicators with IFDI.

Table 2: Selection of determinants of FDI based on panel regression

	Pooled OLS				Panel (RE/FE)			
	to AE from AE	to AE from DE	to DE from AE	to DE from DE	to AE from AE	to AE from DE	to DE from AE	to DE from DE
FDI (mn $)								
d_edu_exp	y		y				-y	
d_air	y	y			y			
d_atm			-y				y	
d_fisc_def			-y	y	y	y	-y	
d_co2	y	y	-y				-y	-y
d_sal					y			-y
d_cur_act		-y		-y		y		-y
d_elec	y	y						-y
d_gdp						y		
d_ict_exp		-y	-y	-y			-y	
d_ict_imp			-y	-y	-y			-y
d_infl	y		y	y		y	-y	
d_mfg_imp	-y	-y	-y	-y	-y			
d_march_trade		-y		-y		y		y
d_popu65	-y	-y	-y			y	-y	
d_real_int	y		y	y	y	-y	y	
d_rd			-y	-y				
d_time_exp				y				
d_trade		-y		-y				
d_trademark			-y				y	-y
d_imp_and_exp				y		y		y
d_pop_less_65yr			-y		y		-y	
host_gdp_avg2010	y	y			y			
d_pol_stab			y			y	y	
d_cont_corruption						-y		-y
d_law			-y		-y	y	-y	
d_regul								
d_sp			-y	-y				
exch_rate_cv	y	-y		y		-y		
yoy_exch_rate		y	-y			y		-y
d_distance								

** y indicates significant positive association and –y indicates significant negative association.*

5.3. Composite Index for FDI flow to AE from AE

Infrastructure as well as depth of market as proxy by passenger air transport is found to be positively associated with FDI flow to AE from AE. Higher skilled labor force in AE reflected in higher salary as % of total expenses, positively associated with FDI flow from AE. Higher ICT as well as manufacturing import are observed to be negatively associated with FDI flow to AE from AE. Market size and political stability are found to be positively associated with FDI flow. PCI based on selected determinants which produce highest association with FDI is as follows

$$PCI_t = (0.0749*\hat{Y}'_{\text{d\_Sal},t} + 0.1775*\hat{Y}'_{\text{d\_mfg\_imp},t} + 0.1058*\hat{Y}'_{\text{d\_real\_int},t} + 0.3557*\hat{Y}'_{\text{host\_gdp},t})$$

Where $\hat{Y}'_{\text{host\_gdp},t}$ is Panel (RE/FE) regression estimate of Y_t When it is regressed only on host GDP indicator and 0.3597 is its correlation of $\hat{Y}'_{\text{host\_gdp},t}$ and Y_t; similarly other components.

SCI based on residuals of all determinants when they are regressed on PCI and those residuals which are found to be significantly associated with FDI is as follows

$$SCI_t = .0940 * \hat{Y}''_{d\_real\_int,t} + 0.0299 * \hat{Y}''_{d\_imp\_and\_exp,t} + 0.0336 * \hat{Y}''_{d_{Sal},t} + 0.0137 * \hat{Y}''_{d\_Law,t} - 0.1353 * \hat{Y}''_{d\_Fisc\_def,t} - 0.1565 * \hat{Y}''_{d\_Co2,t} - 0.1710 * \hat{Y}''_{d\_ICT\_imp,t} - 0.1842 * \hat{Y}''_{d\_popu\_less65,t} - 0.1071 * \hat{Y}''_{d\_Host\_GDP,t} - 0.1953 * \hat{Y}''_{d\_Distance,t}$$

Where $\hat{Y}''_{d\_real\_int,t}$ is OLS estimate of FDI when it is regressed only on $\hat{Z}_{d\_real\_int,t}$ which is residual obtained when d_real_int is regressed on PCI and 0.0940 is its correlation of $\hat{Y}''_{d\_real\_int,t}$ with FDI. PCI and SCI are independent (no correlation between them). CI (final composite index) is the estimated value of Y_t when it is regressed on PCI and SCI.

PCA is the estimated value of Y_t when it is regressed on the selected principal components (PC), where PCs are obtained based on principal component analysis of the selected determinants. CI is observed to have highest association with FDI.

Table 3: FDI flow from AE to AE: Correlation coefficient: PCA and multistage indices with FDI

AE to AE	FDI	PCI	SCI	CI	PCA
FDI	1				
PCI	0.4071	1			
SCI	0.3480	0	1		
CI	0.5356	0.7601	0.6498	1	
PCA	0.2470	0.5688	-0.2969	0.2395	1

5.4. Composite Index for FDI flow to DE from AE

Although, pooled OLS indicates significant association of some of the indicators with the inward FDI, however, panel regression (Random / Fixed effect) model shows no such association. To determine association of indicators with FDI we use results of random/fixed effect model, as in case of pooled OLS country and time effect may distort the true association of indicators with FDI.

Fiscal deficit, manufacturing activity (Co2), ICT export, Inflation are observed to be negatively associated with FDI flow to DE from AE. Infrastructure in terms of ATM, real interest rate (capital benefit of MNEs), Trademark application (increasing instinctual capabilities and legal infrastructure) and political stability are found to be positively associated with FDI flow to DE from AE. PCI based on selected determinants which produce highest association with FDI is as follows

$PCI_t = (-0.314*\hat{Y}'_{\text{d\_Co2},t} - 0.2414*\hat{Y}'_{\text{d\_ICT\_Exp},t} - 0.1242*\hat{Y}'_{\text{d\_Infl},t} - 0.1153*\hat{Y}'_{\text{d\_popuabv65},t} + 0.4049*\hat{Y}'_{\text{d\_real\_int},t} + 0.1643*\hat{Y}'_{\text{d\_Trademark},t} + 0.1129 * \hat{Y}'_{\text{d}_{\text{Pol}_{\text{stab}}},t} - 0.129 * \hat{Y}'_{\text{d\_Law},t})$

Where $\hat{Y}'_{\text{d\_Co2},t}$ is OLS estimate of Y_t When it is regressed only on d_CO_2 indicator and 0.314 is the corresponding correlation with Y_t (FDI). SCI based on residuals of all determinants when they are regressed on PCI and those residuals which are found to be significantly associated with FDI is as follows

$$SCI_t = \hat{Y}''_{d\_edu\_exp,t} * 0.0078 - \hat{Y}''_{d_{ATM},t} * 0.0563 - \hat{Y}''_{d\_Fisc\_def,t} * 0.0931 + \hat{Y}''_{d_{Elec},t} * 0.1410 + \hat{Y}''_{d_{Infl},t} * 0.0958 + \hat{Y}''_{d_{real_{int}},t} * 0.1324 + \hat{Y}''_{d_{RD},t} * 0.0450 + \hat{Y}''_{d_{Trademark},t} * 0.0475 + \hat{Y}''_{host_{gdp},t} * 0.1574 - \hat{Y}''_{d_{Law},t} * 0.1232 - \hat{Y}''_{d_{distance},t} * 0.3320$$

Where $\hat{Y}''_{d\_ATM,t}$ is OLS estimate of FDI when it is regressed only on $\hat{Z}_{d\_ATM,t}$ which is residual obtained when d_ATM is regressed on PCI and 0.0563 is its correlation of $\hat{Y}''_{d\_ATM,t}$ with FDI. CI is the final composite index is the weighted average of PCI and SCI, where weights are corresponding correlation with FDI (CI can also be computed as estimated value of FDI when it is regressed on PCI and SCI).

PCA is the estimated value of Y_t when it is regressed on the selected principal components (PC), where PCs are obtained based on principal component analysis of the selected determinants. CI is observed to have highest association with FDI.

Table 4: FDI flow to DE from AE: Correlation coefficient: PCA and multistage indices with FDI

From DE to AE	FDI	PCI	SCI	CI	PCA
FDI	1				
PCI	0. 6019	1			
SCI	0. 3809	0	1		
CI	0. 7123	0. 8450	0. 5347	1	
PCA	0.4883	0.8752	-0.1224	0.6742	1

5.5. Composite Index for FDI flow to AE from DE

Political stability, rule of law, depreciation of host currency, merchandise trade, current account balance are observed to be positively associated whereas real interest rate and exchange rate volatility are found to be negatively associated with FDI flow to AE from DE. PCI based on selected determinants which produce highest association with FDI is as follows

$$PCI_t = (0.4113*\hat{Y}'_{\text{d\_Cur\_Act},t} + 0.2763*\hat{Y}'_{\text{exch\_rate\_yoy},t} - 0.3023*\hat{Y}'_{\text{exch\_rate\_CV},t})$$

SCI based on residuals of all determinants when they are regressed on PCI and those residuals which are found to be significantly associated with FDI is as follows

$$SCI_t = -0.1823 * \hat{Y}''_{d\_edu\_exp,t} - 0.2955 * \hat{Y}''_{d_{Sal},t} - 0.0796 * \hat{Y}''_{d_{Infl},t} - 0.0824 * \hat{Y}''_{d_{Mfg_{imp}},t} - 0.1084 * \hat{Y}''_{d_{real_{int}},t} + 0.0887 * \hat{Y}''_{d\_imp\_and\_exp,t} + 0.1046 * \hat{Y}''_{d_{host_{gdp}},t} - 0.0547 * \hat{Y}''_{d_{pol_{stab}},t} - 0.1205 * \hat{Y}''_{d_{cont_{corruption}},t} - 0.127 * \hat{Y}''_{d_{yoy_{exch_{rate}}},t} + 0.1266*\hat{Y}''_{d\_distance,t}$$

CI is the final composite index is the estimated value of FDI when regressed on PCI and SCI. PCA is the estimated value of Y_t when it is regressed on the selected principal components (PC), where PCs are obtained based on principal component analysis of the selected determinants. CI is observed to have highest association with FDI. PCA is estimated value of FDI when it is regressed on important principal components (with eigenvalue more than 1) of selected significant determinants.

Table 5: FDI flow to AE from DE: Correlation coefficient: PCA and multistage indices with FDI

To AE from DE	FDI	PCI	SCI	CI	PCA
FDI	1				
PCI	0.4787	1			
SCI	0.3230	0	1		
CI	0.5775	0.8290	0.5593	1	
PCA	0.5127	0.9095	0.1456	0.8321	1

5.6. Composite Index for FDI flow to DE from DE

Determinants of FDI flow to DE from DE are quite different. Low manufacturing activities (Co2 emission), low skilled workers (Salary as % of total expense), current account deficit, infrastructure deficiency (electricity consumption), lower intellectual progress (Trademark application), higher corruption and appreciation of host currency lead to higher FDI flow to DE from DE. PCI based on selected determinants which produce highest association with FDI is as follows

$$PCI_t = (-0.3643*\hat{Y}'_{\text{d\_ICT\_imp},t} + 0.3569*\hat{Y}'_{\text{d\_March\_Trade},t} - 0.0786*\hat{Y}'_{\text{d\_Trademark},t} + 0.2698*\hat{Y}'_{\text{d\_Imp\&Exp},t} - 0.1987 * \hat{Y}'_{\text{yoy}_{\text{exch}_{\text{rate}}},t} - 0.1697 * \hat{Y}'_{\text{d\_Elec},t}))$$

SCI based on residuals of all determinants when they are regressed on PCI and those residuals which are found to be significantly associated with FDI is as follows

$$SCI_t = \hat{Y}''_{d_{cont_{corruption}},t}$$

CI is the final composite index is the estimated value of FDI when regressed on PCI and SCI. PCA is the estimated value of Y_t when it is regressed on the selected principal components (PC), where PCs are obtained based on principal component analysis of the selected determinants. CI is observed to have highest association with FDI.

Table 6: FDI flow from DE to DE: Correlation coefficient: PCA and multistage indices with FDI

To AE from DE	FDI	PCI	SCI	CI	PCA
FDI	1				
PCI	0.5244	1			
SCI	0.2392	0	1		
CI	0.5764	0.9098	0.4151	1	
PCA	0.5189	0.8922	0.2363	0.9098	1

5.7. **Composite Index (CI) – uses and interpretation:** FDI flow to a country partly depends on prevailing macroeconomic situation and collective information of macroeconomic determinants to FDI flow is reflected in the constructed composite index CI. Therefore, correlation or any other measure of association of any macroeconomic indicator with this synthetic CI may reflect the intensity of influence of individual macroeconomic on FDI flow. Moreover, CI can be used to rank the countries within the broad groups of FDI flow (a) to AE from AE (b) to AE from DE (c) to DE from AE and (d) to DE from DE and to understand macroeconomic enabler in the host country to attract FDI. CI also helps in to understand country specific relative macroeconomic enabling situation for FDI, for example a country in AE whether it is more favorable to MNEs from AE than DE.

During the sample period (2010-2012) it is observed that USA has most desirable macroeconomic situation for FDI flow from both AE and DE, whereas, Brazil has most desirable macro situation among DE in attracting FDI flow from both AE and DE.

5.8. Summary of results:

FDI flow to AE from AE: Host GDP size, exchange rate volatility, working age population, Salary as % of total expense, trademark application are some of the important macro determinants.

In case of FDI flow to AE from DE, Current account deficit, fiscal deficit, working age population, merchandise trade, market size (host GDP), exchange rate volatility, exchange rate are some of the important macro determinants.

In case of FDI flow to DE from AE, Infrastructure (ATM, electricity consumption, air transport, expenditure on education), manufacturing activity, fiscal deficit, ICT trade, real interest rate, working age population, merchandise trade are important macro determinants.

In case of FDI flow to DE from DE, Current account deficit, fiscal deficit, trade, real interest rate, working age population, merchandise trade, manufacturing import, exchange rate volatility etc. are important macro determinants.

Table 7: Country's Rank within broad groups - in terms of macroeconomic situation to attract FDI

Country: Rank	FDI to AE-from AE	Score
1	USA	0.73
2	France	0.47
3	Italy	0.45
4	Switzerland	0.45
5	Spain	0.43
6	Austria	0.42
7	Germany	0.41
8	UK	0.40
9	Sweden	0.37
10	Canada	0.36
11	Japan	0.34
12	Australia	0.28

Country: Rank	FDI to AE-from DE	Score
1	USA	0.79
2	UK	0.74
3	Spain	0.73
4	Canada	0.71
5	Japan	0.71
6	Australia	0.70
7	Austria	0.64
8	France	0.62
9	Germany	0.62

Country: Rank	FDI to DE-from AE	Score
1	Brazil	0.59
2	Russia	0.44
3	Mexico	0.43
4	China	0.42
5	SA	0.39
6	India	0.36
7	Thailand	0.35
8	Korea	0.31

Country: Rank	FDI to DE-from DE	Score
1	Brazil	0.52
2	India	0.43
3	SA	0.37
4	Korea	0.30
5	China	0.27
6	Russia	0.27
7	Mexico	0.22
8	Thailand	0.16

Table 8: Correlation of determinants with the composite index

	correlation with CI			
	to AE from AE	to AE from DE	to DE from AE	to DE from DE
d_edu_exp	0.1021	0.0664	0.3112	0.1839
d_air	0.0892	0.2083	0.2604	-0.235
d_atm	0.0159	-0.1212	-0.3107	-0.1428
d_fisc_def	-0.0467	0.3263	-0.2973	0.6506
d_co2	0.1195	0.0181	-0.4533	-0.4472
d_sal	0.1503	-0.0291	0.0334	-0.466
d_cur_act	-0.0382	-0.6838	0.0146	-0.6424
d_elec	0.1228	-0.0201	-0.2168	-0.2777
d_gdp	-0.0775	-0.0161	0.0112	0.0756
d_ict_exp	0.0738	0.0101	-0.5766	-0.6474
d_ict_imp	0.0714	0.1928	-0.4235	-0.4933
d_infl	0.1044	-0.0198	0.374	0.56
d_mfg_imp	-0.0023	-0.0316	-0.4191	-0.6043
d_march_trade	-0.0243	-0.3926	0.0174	-0.7348
d_popu65	-0.2711	-0.6298	-0.2425	-0.4829
d_real_int	0.1069	0.1289	0.5074	0.7361
d_rd	-0.1483	-0.4313	-0.3498	-0.2983
d_time_exp	-0.1192	-0.144	0.1594	0.1711
d_trade	-0.0206	-0.4018	-0.0215	-0.7632
d_trademark	0.354	0.1036	-0.1114	-0.0007
d_imp_and_exp	0.0645	0.1734	0.2207	0.3496
d_pop_less_65yr	-0.141	0.2771	-0.4029	0.3552
host_gdp_avg2010	0.7407	0.4483	0.2609	0.2336
d_pol_stab	-0.1042	-0.2933	0.0476	0.1324
d_cont_corruption	-0.1434	-0.1334	0.021	0.0388
d_law	-0.0297	-0.0685	-0.1876	0.0139
d_regul	-0.1155	-0.1322	-0.2267	-0.3215
d_sp	-0.0087	0.1445	-0.314	-0.6776
exch_rate_cv	0.3282	-0.6248	0.0341	0.4202
yoy_exch_rate	-0.1749	0.3017	-0.0984	-0.2213
d_distance	-0.1151	-0.0673	-0.0741	0.5512

6. SUMMARY AND CONCLUSION

Usually, firms analyse various macro parameters in foreign (host) countries vis-à-vis home country before choosing a country for their overseas investment. Pull factors or host country factors i.e. macroeconomic characteristics specific to host country which attracts FDI, together with various push factors or home country factors significantly influence the direction and intensity of FDI flow to host country. Moreover, these factors may have differential effect (direction, intensity, level of significance) on FDI flow depending on source (Advance Economies AE/ Developing Economies DE) and destination (AE/DE). Also these factors are highly correlated which lead to multicollinearity issues.

Based on various macro indicators of 22 countries (both AE and DE) for the period 2010-2012, the paper investigate strength of association of macro determinants (push and pull factors) with the FDI flow for four sets of homogenous group of countries i.e. FDI flow (a) from AE to AE (b) from AE to DE (c) from DE to AE and (d) from DE to DE.

Selected determinants for FDI are found to be highly interrelated which lead to multicollinearity issue and interpretation of the results in the multiple regression equation setup becomes confusing. To circumvent multicollinearity issue, this paper uses a new method which involve construction of primary composite index (PCI) and secondary composite index (SCI) using certain linear combinations of the determinants with optimum weight structures in such a way that PCI and SCI are uncorrelated and together can explain variation in the dependent variable better than widely used principal component analysis to resolve multicollinearity issue.

Determinants of FDI flow are very different for different set of countries, not only on intensity or level of significance but also sometimes the association is in the opposite direction. Fiscal deficit, manufacturing activity (Co2), ICT export, Inflation are observed to be negatively associated with FDI flow to DE from AE. Infrastructure in terms of ATM, real interest rate (capital benefit of MNEs), Trademark application (increasing intellectual capabilities and legal infrastructure) and political stability are found to be positively associated with FDI flow to DE from AE.

In case of FDI flow to AE from AE, Infrastructure as well as depth of market as proxy by passenger air transport is found to be positively associated. Also higher skilled labor force in host AE as reflected in higher salary as % of total expenses, attracts FDI flow from AE. Higher ICT as well as

manufacturing import are observed to be negatively associated with FDI flow. Market size and political stability are found to be positively associated with FDI flow to AE from AE.

However, political stability, rule of law, depreciation of host currency, merchandise trade, current account balance are observed to be positively associated whereas real interest rate and exchange rate volatility are found to be negatively associated with FDI flow to AE from DE.

Determinants of FDI flow to DE from DE are quite different. Low manufacturing activities (Co2 emission), low skilled workers (Salary as % of total expense), current account deficit, infrastructure deficiency (electricity consumption), lower intellectual progress (Trademark application), higher corruption and appreciation of host currency lead to higher FDI flow to DE from DE.

FDI flow to a country partly depends on prevailing macroeconomic situation and collective macroeconomic determinants to FDI flow is reflected fullest in the constructed composite index CI. Therefore, correlation or any other measure of association of any macroeconomic indicator with the synthetic CI may reflect the intensity of influence of individual macroeconomic on FDI flow. Moreover, CI can be used to rank the countries within the broad groups of FDI flow to AE from AE, to AE from DE, to DE from AE or FDI flow to DE from DE to understand differences in macroeconomic enabler in the host country to attract FDI. CI also helps in to understand relative macroeconomic situation of a country, for example, a country in AE grouping may be perceived differently by MNE's of AE origin and DE origin.

During the reference period (2010-2012) among the selected countries, it is observed that USA within AE has most desirable macroeconomic situation for FDI flow from both AE and DE, whereas, Brazil has most desirable macro-economic condition among DE in attracting FDI flow from both AE and DE.

To sum up, the results indicate differences in the role played by macroeconomic variables in explaining the determinants of FDI flows from AE to AE, AE to DE, DE to AE and DE to DE.

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Annex I

1. **FDI flows to Advance economies from Advance economies (AE to AE)**

1.1 Selection of determinants of FDI based on panel regression**:** coefficient and corresponding probabilities i.e. P>|t| given within ().

	To AE from AE			
	FE	RE	Pooled	BE
d_edu_exp	-0.039(0.598)	0.015(0.81)	**0.151(0.033)**	0.16(0.187)
d_air	0.493(0.161)	**0.326(0.081)**	**0.244(0.094)**	0.26(0.241)
d_atm	0.144(0.386)	0.039(0.685)	-0.018(0.794)	-0.015(0.901)
d_fisc_def	**0.254(0.019)**	0.092(0.237)	-0.077(0.245)	-0.086(0.445)
d_co2	-0.13(0.413)	0.05(0.514)	**0.098(0.057)**	0.105(0.232)
d_sal	**0.345(0.01)**	**0.178(0.027)**	0.09(0.138)	0.083(0.415)
d_cur_act	-0.035(0.399)	-0.04(0.295)	-0.083(0.188)	-0.078(0.472)
d_elec	-0.065(0.788)	0.133(0.161)	**0.163(0.008)**	0.169(0.104)
d_gdp	0.015(0.303)	0.015(0.32)	-0.024(0.714)	-0.048(0.741)
d_ict_exp	-0.093(0.191)	-0.063(0.25)	-0.014(0.787)	-0.018(0.831)
d_ict_imp	**-0.172(0.03)**	-0.084(0.183)	0.07(0.256)	0.072(0.493)
d_infl	-0.04(0.178)	-0.03(0.306)	0.216(0.016)	0.292(0.085)
d_mfg_imp	-0.024(0.908)	-0.19(0.046)	**-0.229(0)**	**-0.237(0.03)**
d_march_trade	-0.016(0.935)	-0.033(0.734)	-0.039(0.553)	-0.038(0.732)
d_popu65	0.035(0.931)	-0.204(0.125)	**-0.23(0.007)**	-0.232(0.1)
d_real_int	**0.076(0.037)**	**0.083(0.018)**	0.141(0.036)	0.149(0.207)
d_rd	-0.076(0.529)	-0.05(0.541)	-0.034(0.598)	-0.028(0.802)
d_time_exp	-0.165(0.533)	-0.028(0.799)	0.008(0.908)	0.001(0.993)
d_trade	-0.164(0.477)	-0.06(0.51)	-0.051(0.385)	-0.041(0.684)
d_trademark	0.214(0.203)	0.072(0.422)	0.024(0.706)	0.015(0.892)
d_imp_and_exp	**-0.133(0.097)**	-0.048(0.43)	0.076(0.177)	0.072(0.452)
d_pop_less_65yr	**16.944(0.01)**	-0.107(0.421)	-0.113(0.145)	-0.114(0.39)
host_gdp_avg2010	-	**0.3(0)**	**0.3(0)**	**0.3(0)**
d_pol_stab	-0.062(0.378)	-0.046(0.439)	-0.015(0.819)	-0.005(0.962)
d_cont_corruption	0.115(0.294)	0.064(0.424)	-0.006(0.931)	0.006(0.962)
d_law	**-0.234(0.094)**	-0.08(0.355)	0.008(0.904)	0.018(0.874)
d_regul	-0.062(0.197)	-0.045(0.3)	0.019(0.736)	0.031(0.757)
d_sp	-0.006(0.711)	-0.006(0.706)	-0.017(0.834)	-0.021(0.924)
exch_rate_cv	0.011(0.756)	0.048(0.14)	**0.209(0)**	**0.206(0.007)**
yoy_exch_rate	0.021(0.232)	0.022(0.208)	0.059(0.417)	0.094(0.55)
d_distance	-	-0.069(0.3)	-0.063(0.11)	-0.069(0.301)

FE: Fixed effect panel regression; RE: Random effect panel regression; BE: Between effect panel regression; Pooled: OLS regression

1.2 PCA: first five selected principal components (PCs)

to AE from AE	PC1	PC2	PC3	PC4	PC5
d_fisc_def	-0.32	0.23	-0.29	0.06	-0.20
d_cur_act	0.29	0.42	0.00	-0.15	0.17
d_gdp	0.33	0.06	-0.21	-0.10	-0.27
d_infl	0.16	-0.43	0.35	-0.04	0.08
d_march_trade	0.13	0.27	0.52	-0.28	0.14
d_popu65	-0.16	0.56	-0.17	-0.21	-0.05
d_real_int	-0.04	0.30	0.41	0.56	0.28
d_imp_and_exp	-0.01	-0.10	-0.29	0.08	0.62
d_pol_stab	0.39	0.28	0.02	0.05	0.06
d_cont_corruption	0.46	0.01	-0.14	0.01	0.00
d_law	0.45	-0.14	-0.12	-0.15	-0.04
exch_rate_cv	0.05	0.04	0.31	0.19	-0.60
yoy_exch_rate	0.24	0.03	-0.25	0.67	-0.09

1.3 Regression of FDI on principal components

Source	SS	df	MS
Model	1.22626594	5	.245253189
Residual	20.4387683	388	.052677238
Total	21.6650343	393	.055127314

Number of obs = 394
F(5, 388) = 4.66
Prob > F = 0.0004
R-squared = 0.0566
Adj R-squared = 0.0444
Root MSE = .22952

lifdi2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pc1	.0025208	.0058797	0.43	0.668	-.0090391	.0140808
pc2	-.0160255	.0079372	-2.02	0.044	-.0316308	-.0004203
pc3	.0237602	.0093187	2.55	0.011	.0054387	.0420817
pc4	.0366421	.0109003	3.36	0.001	.015211	.0580731
pc5	-.0125498	.0113748	-1.10	0.271	-.0349138	.0098142
_cons	.4339666	.0115628	37.53	0.000	.411233	.4567002

2. **FDI flow to Advanced economies from Developing economies (to AE from DE)**

2.1 Selection of determinants of FDI based on panel regression: coefficient and corresponding probabilities i.e. P>|t| given within ().

	To AE from DE			
	FE	RE	Pooled	BE
d_edu_exp	-0.094(0.649)	0.041(0.638)	0.061(0.312)	0.072(0.463)
d_air	0.018(0.963)	0.129(0.236)	0.131(0.069)	0.139(0.231)
d_atm	-0.033(0.795)	0.028(0.719)	0.061(0.303)	0.063(0.52)
d_fisc_def	0.625(0.036)	0.116(0.352)	-0.014(0.867)	0.008(0.951)
d_co2	-0.136(0.487)	0.06(0.447)	0.101(0.062)	0.099(0.265)
d_sal	0.034(0.912)	-0.004(0.966)	-0.031(0.592)	-0.004(0.965)
d_cur_act	-0.069(0.593)	-0.205(0.005)	-0.253(0)	-0.27(0.004)
d_elec	-0.079(0.698)	0.091(0.304)	0.128(0.037)	0.13(0.196)
d_gdp	0.14(0.01)	0.091(0.067)	-0.065(0.32)	-0.168(0.175)
d_ict_exp	0.042(0.845)	-0.082(0.296)	-0.099(0.064)	-0.101(0.24)
d_ict_imp	-0.195(0.489)	-0.067(0.469)	-0.054(0.379)	-0.051(0.609)
d_infl	0.153(0.036)	0.13(0.039)	0.072(0.338)	0.043(0.756)
d_mfg_imp	0.069(0.889)	-0.118(0.196)	-0.119(0.045)	-0.125(0.19)
d_march_trade	0.663(0.084)	-0.126(0.232)	-0.167(0.018)	-0.191(0.084)
d_popu65	1.824(0.056)	-0.214(0.064)	-0.246(0.002)	-0.244(0.039)
d_real_int	-0.312(0.031)	-0.038(0.635)	0.055(0.354)	0.087(0.364)
d_rd	0.006(0.973)	-0.083(0.263)	-0.084(0.105)	-0.105(0.21)
d_time_exp	0.058(0.663)	0.018(0.806)	0.004(0.949)	0(0.997)
d_trade	0.204(0.368)	-0.102(0.296)	-0.146(0.034)	-0.175(0.115)
d_trademark	-0.213(0.2)	-0.082(0.327)	-0.05(0.407)	-0.035(0.722)
d_imp_and_exp	0.79(0)	0.172(0.04)	0.032(0.562)	0.029(0.744)
d_pop_less_65yr	-14.412(0.322)	-0.017(0.849)	-0.017(0.757)	-0.017(0.856)
host_gdp_avg2010	-	0.084(0.202)	0.08(0.05)	0.084(0.21)
d_pol_stab	0.473(0.033)	0.054(0.583)	-0.029(0.661)	-0.049(0.648)
d_cont_corruption	-0.321(0.092)	-0.067(0.419)	-0.009(0.873)	-0.007(0.944)
d_law	0.774(0.07)	0.041(0.682)	0.006(0.931)	-0.002(0.981)
d_regul	-0.127(0.584)	-0.052(0.559)	-0.03(0.626)	-0.04(0.684)
d_sp	0.049(0.285)	0.048(0.288)	0.043(0.603)	-0.012(0.962)
exch_rate_cv	-0.237(0.047)	-0.21(0.006)	-0.185(0.003)	-0.192(0.068)
yoy_exch_rate	0.104(0.006)	0.115(0.001)	0.175(0.007)	0.365(0.044)
d_distance	-	-0.078(0.502)	-0.079(0.273)	-0.078(0.508)

2.2 PCA: first five selected principal components (PCs)

to AE from DE	PC1	PC2	PC3	PC4	PC5
d_fisc_def	0.091	-0.257	-0.344	0.520	-0.211
d_cur_act	-0.263	0.401	0.215	0.304	-0.163
d_gdp	-0.169	0.103	-0.241	0.585	0.317
d_infl	-0.294	-0.295	0.302	-0.057	0.150
d_march_trade	-0.187	0.425	-0.005	-0.106	0.212
d_popu65	-0.361	0.210	0.252	0.266	-0.327
d_real_int	0.292	-0.281	0.183	0.311	-0.340
d_imp_and_exp	0.196	0.289	-0.514	0.052	0.221
d_pol_stab	0.342	0.274	0.347	0.182	-0.017
d_cont_corruption	0.429	0.219	0.255	0.044	-0.002
d_law	0.419	0.273	0.008	-0.054	-0.069
exch_rate_cv	-0.203	0.295	-0.144	-0.110	-0.319
yoy_exch_rate	0.037	-0.064	0.345	0.243	0.618

2.3 Regression of FDI using composite indices

```
      Source |       SS       df       MS              Number of obs =      93
-------------+------------------------------           F(  5,    87) =    6.20
       Model |  .538246651     5  .10764933             Prob > F      =  0.0001
    Residual |  1.50949245    87  .017350488            R-squared     =  0.2628
-------------+------------------------------           Adj R-squared =  0.2205
       Total |  2.0477391     92  .022258034            Root MSE      =  .13172

------------------------------------------------------------------------------
      lifdi2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         pc1 |   .0145019   .0072572     2.00   0.049     .0000774    .0289263
         pc2 |  -.0298478   .0086674    -3.44   0.001    -.0470752   -.0126204
         pc3 |  -.0000581   .0100723    -0.01   0.995    -.0200779    .0199617
         pc4 |  -.0170208    .012597    -1.35   0.180    -.0420586     .008017
         pc5 |   .0477683   .0130766     3.65   0.000     .0217773    .0737594
       _cons |   .7115653   .0136589    52.10   0.000     .6844168    .7387138
```

3. **FDI from Advanced economies to Developing economies (to DE from AE)**

3.1 Selection of determinants of FDI based on panel regression: coefficient and corresponding probabilities i.e. P>|t| given within ().

	To DE from AE			
	FE	RE	Pooled	BE
d_edu_exp	-0.121(0.019)	-0.053(0.264)	0.259(0)	0.27(0.018)
d_air	0.168(0.621)	0.148(0.428)	0.139(0.282)	0.139(0.537)
d_atm	0.177(0.056)	0.041(0.563)	-0.157(0.015)	-0.16(0.157)
d_fisc_def	-0.129(0.08)	-0.136(0.025)	-0.15(0.017)	-0.15(0.173)
d_co2	-0.037(0.646)	-0.14(0.022)	-0.28(0)	-0.282(0.004)
d_sal	-0.057(0.627)	-0.017(0.836)	0.025(0.723)	0.025(0.836)
d_cur_act	-0.005(0.865)	-0.008(0.784)	-0.042(0.497)	-0.045(0.689)
d_elec	0.228(0.175)	0.034(0.745)	-0.09(0.246)	-0.091(0.5)
d_gdp	0.004(0.78)	0.004(0.764)	0.026(0.711)	0.051(0.775)
d_ict_exp	-0.078(0.238)	-0.121(0.02)	-0.191(0)	-0.192(0.027)
d_ict_imp	-0.043(0.621)	-0.093(0.188)	-0.191(0.007)	-0.193(0.118)
d_infl	-0.047(0.03)	-0.042(0.049)	0.151(0.05)	0.204(0.176)
d_mfg_imp	0.096(0.617)	-0.133(0.161)	-0.207(0.001)	-0.208(0.061)
d_march_trade	0.241(0.187)	0.167(0.133)	0.123(0.131)	0.123(0.388)
d_popu65	-0.509(0.039)	-0.251(0.049)	-0.156(0.069)	-0.156(0.299)
d_real_int	0.114(0.011)	0.161(0)	0.378(0)	0.386(0)
d_rd	0.092(0.324)	-0.037(0.58)	-0.165(0.002)	-0.166(0.079)
d_time_exp	0.013(0.647)	0.012(0.663)	-0.003(0.961)	-0.004(0.969)
d_trade	0.083(0.573)	0.056(0.541)	0.039(0.566)	0.039(0.743)
d_trademark	0.159(0.031)	0.096(0.158)	-0.266(0.009)	-0.28(0.121)
d_imp_and_exp	0.073(0.201)	0.075(0.121)	0.079(0.132)	0.079(0.39)
d_pop_less_65yr	1.906(0.417)	-0.351(0.005)	-0.357(0)	-0.357(0.006)
host_gdp_avg2010	-	0.092(0.431)	0.092(0.173)	0.092(0.433)
d_pol_stab	0.087(0.187)	0.094(0.097)	0.117(0.075)	0.117(0.309)
d_cont_corruption	0.061(0.435)	0.052(0.432)	0.029(0.688)	0.028(0.822)
d_law	-0.18(0.118)	-0.147(0.054)	-0.121(0.042)	-0.121(0.245)
d_regul	-0.026(0.641)	-0.036(0.469)	-0.073(0.243)	-0.074(0.501)
d_sp	0.014(0.265)	0.012(0.348)	-0.198(0.008)	-0.503(0.012)
exch_rate_cv	0(0.99)	0(0.987)	0.012(0.844)	0.013(0.906)
yoy_exch_rate	0.021(0.586)	0.017(0.661)	-0.355(0.097)	-0.761(0.154)
d_distance	-	-0.128(0.353)	-0.128(0.108)	-0.128(0.356)

3.2 PCA: first five selected principal components (PCs)

to DE from AE	PC1	PC2	PC3	PC4	PC5
d_edu_exp	0.277	-0.495	0.029	0.111	-0.009
d_atm	0.372	0.324	-0.195	-0.145	0.298
d_fisc_def	-0.028	0.175	0.437	-0.363	0.291
d_co2	0.090	0.240	-0.511	0.185	0.379
d_ict_exp	0.187	0.450	0.221	0.212	-0.334
d_infl	-0.355	-0.242	-0.379	0.055	0.284
d_popu65	-0.034	0.334	-0.130	-0.569	0.030
d_real_int	0.131	-0.293	0.425	-0.163	0.418
d_trademark	-0.106	0.248	0.270	0.518	0.113
d_pop_less_65yr	-0.259	0.166	0.206	0.303	0.508
d_pol_stab	0.499	-0.116	-0.006	0.006	0.208
d_law	0.520	0.014	-0.055	0.209	0.030

3.3 Regression of FDI using composite indices

```
      Source |       SS       df       MS              Number of obs =     249
-------------+------------------------------           F(  5,   243) =   15.21
       Model |  2.67826397     5  .535652795            Prob > F      =  0.0000
    Residual |  8.55591249   243  .035209516            R-squared     =  0.2384
-------------+------------------------------           Adj R-squared =  0.2227
       Total |  11.2341765   248  .045299099            Root MSE      =  .18764
```

lifdi2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pc1	.0032814	.0073513	0.45	0.656	-.011199	.0177617
pc2	-.0618269	.0078008	-7.93	0.000	-.0771927	-.0464611
pc3	.0148017	.0091112	1.62	0.106	-.0031454	.0327487
pc4	-.0297078	.0099655	-2.98	0.003	-.0493376	-.010078
pc5	-.0127575	.0103327	-1.23	0.218	-.0331106	.0075955
_cons	.4161981	.0118913	35.00	0.000	.3927748	.4396213

4. **FDI from Advanced economies to Developing economies (to DE from DE)**

4.1 Selection of determinants of FDI based on panel regression: coefficient and corresponding probabilities i.e. P>|t| given within ().

	To DE from DE			
	FE	RE	Pooled	BE
d_edu_ex	0.218(0.609)	0.077(0.733)	0.02(0.897)	0.018(0.949)
d_air	0.69(0.251)	0.01(0.965)	-0.108(0.441)	-0.111(0.663)
d_atm	-1.328(0.107)	-0.174(0.432)	-0.083(0.517)	-0.081(0.729)
d_fisc_de	-0.22(0.481)	0.213(0.178)	0.353(0.001)	0.359(0.07)
d_co2	-0.768(0.065)	-0.34(0.097)	-0.193(0.151)	-0.189(0.442)
d_sal	-0.95(0.061)	-0.281(0.172)	-0.143(0.255)	-0.14(0.542)
d_cur_act	-0.239(0.079)	-0.266(0.027)	-0.402(0.022)	-0.424(0.213)
d_elec	-2.882(0.011)	-0.266(0.278)	-0.137(0.302)	-0.135(0.577)
d_gdp	0.02(0.825)	0.029(0.732)	0.101(0.484)	0.121(0.679)
d_ict_exp	0.225(0.569)	-0.197(0.234)	-0.286(0.008)	-0.289(0.14)
d_ict_imp	-0.325(0.353)	-0.277(0.1)	-0.262(0.023)	-0.262(0.212)
d_infl	0.091(0.4)	0.137(0.154)	0.311(0.013)	0.337(0.158)
d_mfg_im	0.472(0.604)	-0.285(0.192)	-0.331(0.013)	-0.333(0.168)
d_march_	1.19(0.003)	0.137(0.546)	-0.31(0.026)	-0.322(0.202)
d_popu65	-0.522(0.598)	-0.2(0.401)	-0.179(0.205)	-0.179(0.487)
d_real_int	-0.277(0.43)	0.233(0.268)	0.495(0.001)	0.508(0.07)
d_rd	-0.144(0.513)	-0.179(0.248)	-0.217(0.094)	-0.219(0.359)
d_time_e	0.017(0.94)	0.124(0.443)	0.244(0.074)	0.251(0.319)
d_trade	0.397(0.34)	-0.197(0.327)	-0.368(0.006)	-0.374(0.122)
d_tradem	-0.43(0.029)	-0.266(0.09)	0.072(0.634)	0.093(0.741)
d_imp_an	0.469(0.078)	0.308(0.058)	0.201(0.097)	0.197(0.374)
d_pop_le	1.508(0.769)	0.14(0.407)	0.139(0.157)	0.139(0.436)
host_gdp_	-	0.137(0.612)	0.137(0.37)	0.137(0.622)
d_pol_sta	0.493(0.203)	0.201(0.33)	0.08(0.565)	0.076(0.764)
d_cont_co	-0.6(0.022)	-0.239(0.147)	0.016(0.893)	0.024(0.911)
d_law	0.714(0.231)	0.128(0.549)	0.039(0.763)	0.037(0.876)
d_regul	0.249(0.537)	-0.095(0.619)	-0.197(0.116)	-0.2(0.381)
d_sp	-0.083(0.299)	-0.118(0.129)	-0.454(0.003)	-0.613(0.061)
exch_rate	0.121(0.667)	0.265(0.134)	0.363(0.008)	0.368(0.143)
yoy_exch_	-0.099(0.036)	-0.101(0.022)	-0.194(0.225)	-0.545(0.383)
d_distanc	-	0.066(0.728)	0.066(0.538)	0.066(0.735)

4.2 PCA: first three selected principal components (PCs)

to DE from DE	PC1	PC2	PC3
d_co2	0.475	0.164	0.053
d_sal	-0.159	0.089	0.633
d_cur_act	0.284	0.495	0.022
d_elec	0.516	0.056	0.069
d_ict_imp	-0.115	0.592	-0.170
d_march_trade	-0.256	0.307	0.472
d_trademark	-0.241	0.408	-0.405
d_imp_and_exp	0.093	-0.090	-0.393
d_cont_corruption	0.451	-0.107	0.129
yoy_exch_rate	0.232	0.294	0.068

4.3 Regression of FDI using composite indices

```
      Source |       SS       df       MS              Number of obs =      39
-------------+------------------------------           F(  3,    35) =    4.30
       Model |  .566928101     3  .188976034           Prob > F      =  0.0110
    Residual |  1.53843246    35  .043955213           R-squared     =  0.2693
-------------+------------------------------           Adj R-squared =  0.2066
       Total |  2.10536056    38  .055404225           Root MSE      =  .20965

------------------------------------------------------------------------------
      lifdi2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         pc1 |  -.0110951   .0179392    -0.62   0.540    -.0475135    .0253233
         pc2 |  -.0659341   .0227979    -2.89   0.007    -.1122163   -.0196519
         pc3 |  -.0503413   .0247085    -2.04   0.049    -.1005022   -.0001803
       _cons |   .3158781   .0335717     9.41   0.000      .247724    .3840322
```

Annex II

Variables and their definitions

i. d_RD : difference of Researchers in R&D (per million people) at host and home
ii. d_Trademark: difference of Trademark applications: total at host and home
iii. home_ict_imp: ICT goods imports (% total goods imports) by home country
iv. home_ict_exp: ICT goods exports (% of total goods exports)by home country
v. ict_exportimport: Sum of ICT goods exports (% of total goods exports) by host & ICT goods imports (% total goods imports) by home country
vi. ict_importexport: sum of ICT goods imports (% total goods imports) by Host & ICT goods exports (% of total goods exports) by Home and
vii. d_edu_exp: difference of Adjusted savings: education expenditure (% of GNI) as technology and human capital factors of FDI inflow (host-home) at host and home
viii. d_co2: Co2 emission (metric tons per capita) difference between host and home
ix. d_mfg_imp : difference of Manufactures imports (% of merchandise imports) of host and home.
x. d_elec: difference of Electric power consumption (kWh per capita) at host and home
xi. d_Air: difference of Air transport, passengers carried/population at host and home,
xii. d_ATM: difference of Automated teller machines (ATMs) (per 100,000 adults) of host and home
xiii. yoy_exch_rate: Appreciation / depreciation of bilateral level of the exchange rate ; Exch rate (annual freq)= 1 unit of host currency= 'x' unit of home currency; yoy exch rate= $(x_t/x_{t-1})*100-100$;
xiv. exch_rate_cv : coefficient of variation of exchange rates exch=std dev $(x_t \ldots x_{t-12})$/average $(x_t \ldots x_{t-12})$
xv. d_popuabove65: difference (Host-home) of Population ages below 65 (% of total)
xvi. d_real_int: difference of Real interest rate (%) at host and home
xvii. d_sal: difference of compensation of employees (% of expense) at host and home
xviii. d_GDP: difference of GDP growth (annual %) at host and home
xix. d_infl: difference of Inflation in term of GDP deflator (annual %) at host and home
xx. d_sp : difference o fS&P Global Equity Indices (annual % change) at host and home
xxi. host_gdp_avg2010: log of host GDP
xxii. d_distance: Geographical distance between capital of two country
xxiii. d_custom : difference of Customs and other import duties (% of tax revenue) at host and home
xxiv. d_imp_and_exp: sum of Cost to import (US$ per container) at host and Cost to export (US$ per container) by home country
xxv. host_home_pol_stability: difference (host – home) of Political Stability and Absence of Violence/Terrorism: Estimate,
xxvi. d_cont_corruption: difference (host – home) of control of corruption estimate.
xxvii. d_law: difference (host – home) of rule of law
xxviii. d_regul: difference (host – home) of regulatory quality
xxix. d_fisc_def: difference (host – home) of Central government debt, total (% of GDP)
xxx. d_cur_act: difference (host – home) of Current account balance (% of GDP)

Annex III

Multicollinearity

Multicollinearity refers to high inter-dependence among the explanatory variables in a regression set up. Particularly when the economic indicators are considered, multicollinearity is natural outcome of economic interaction. Such high correlation among the regressors creates the problem of near singularity of the residual variance-covariance matrix and thereby inflates the parameter estimates leading to unrealistic interpretation. For instance, the parameter estimates $\hat{\beta}$ in the following regression set up is given by

$$\beta = (X'X)^{-1}X'\underbrace{Y}$$

where

$$(1)\ Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \cdots + \beta_n X_{nt} + \epsilon_t$$

$$\Rightarrow (2) Y_t = \beta X_t + \epsilon_t$$

Thus the presence of strong dependence among variables is not desirable for robust estimation of model parameters. Now considering (1), we get

$$(1)\ Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \cdots + \beta_n X_{nt} + \epsilon_t$$

$$\Rightarrow Var(\widehat{\beta_i}) = [\underbrace{\frac{\sigma^2}{\sum_{t=1}^{T}(X_{it} - \bar{X}_i)^2}}] \times [\underbrace{\frac{1}{1 - R_i^2}}]$$

Here the variance of OLS estimate of β_i is proportional to R_i^2 where R_i^2 is the R-square value of x_i when x_i is regressed over other regressor. The first part of the variance expression depends upon error variance and sample variance of X_i and the second part is proportional to R_i^2. Thus higher R_i^2 is likely to inflate the variance of $\widehat{\beta_i}$. This concept has been extended to define VIF for i-th variable which can be used for detecting multicollinearity. Higher value of VIF indicates presence of multicollinearity among the regressor. VIF is defined as

$$VIF_i = \frac{1}{(1 - R_i^2)}$$

In case the variable x_k for some $k \in [1, n]$ is highly correlated with other regressor, then R_k^2 is likely to be higher and so will be $\frac{1}{(1-R_k^2)}$. Generally, for a variable VIF value exceeding 4 indicates high multicollinearity and require further investigation.

Annex IV

Principal Component Analysis (PCA)

PCA is a powerful data analysing tool often used to identify patterns in data, and highlight their similarities and differences, especially, in data of high dimension where graphical representation of data is not available. Once patterns in the data is found, data can be compressed by reducing the number of dimensions, without loss of much information. PCA transform the var-cov matrix in term of eigenvector and eigenvector with the highest eigenvalue is the principle component of the data set. PCA give us the original data solely in terms of the eigenvectors. Once eigenvectors are found from the covariance matrix, the next step is to order them by eigenvalue, highest to lowest so that one can decide to ignore the components of lesser significance and the final data set will have less dimensions than the original.

The space spanned by the observed variables can be widely sparse in nature which can be measured by the variance-covariance matrix of the observed data. Due to inter-dependence among the variables, the covariance terms are expected to be non-zero. PCA tries to transform the original variables into a new set of orthogonal variables such the variability of the observed data can be explained by the transformed data. In vector space, this is equivalent to transform the observed data (X) into new set of variables (Y) such that

$$(1)\ P: R^N \to R^N \ni Y = P.X$$

Geometrically P is a rotation of X into space of Y in such a manner that Y is orthogonal i.e. $Y'_i * Y_j = 0$ for $i \neq j$. Thus given orthogonality of P, the row vectors of P (i.e. $P_{i,.}$ for i=1(1) N) is the basis of space spanned by X. Now

$$S_Y = \left(\frac{1}{N-1}\right) YY^T = \left(\frac{1}{N-1}\right)(PX)(PX)^T = \left(\frac{1}{N-1}\right) PXX^T P^T = \left(\frac{1}{N-1}\right) PAP^T$$
$$= \left(\frac{1}{N-1}\right) PEDE^T P^T = \left(\frac{1}{N-1}\right)[PE]D[PE]^T = \left(\frac{1}{N-1}\right) ZDZ^T$$

We select P in such a manner that $P_{i,.}$ is the eigenvector of XX^T. Now

$$S_Y = \left(\frac{1}{N-1}\right)(PP^{-1})D(PP^{-1})^{-1} = \left(\frac{1}{N-1}\right) D$$

Thus the eigenvectors are principal components and the proportion of variability explained by each principal component is determined by the eigenvalue share of corresponding eigenvector.

The application of PCA can be many fold from dimension reduction to orthogonal transformation.