BRAC UNIVERSITY

IMPACT OF MANUFACTURING INDUSTRY SPECIFIC FDI INFLOW ON ECONOMIC GROWTH

A STUDY OF OECD NATIONS THROUGH FOUR LEVELS OF TECHNOLOGICAL INTENSITY

Eco499: Undergraduate Thesis

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Dear Professor:

I am submitting my paper titled *Impact of Manufacturing Industry Specific FDI Inflow on Economic Growth* for **ECO499: Undergraduate Thesis** to you for your reading and kind consideration. Please find the enclosure.

The research was conducted to investigate whether the industry specific FDI inflow through four levels of technological intensity bears any impact on economic growth. Only OECD nations were considered for the analysis as industry segregated data was not present for the non-OECD nations. The data was collected from the OECD database and the WDI database for the years from 2000 to 2015 in order to perform a panel fixed effect estimation to test the hypothesis.

The paper aims to add to the existing body of knowledge by looking into the industry segregated impacts of FDI inflow, to further the debate of the pros and cons of FDI investment.

I am grateful to attain the opportunity of submitting my paper to you. I sincerely appreciate and thank the necessary feedback that you have provided to elevate the quality of my paper.

Sincerely,

Mutasim Billah Mubde

Enclosure

Abstract:

Investment is hailed as the primary proponent of growth in all economies which makes Foreign Direct Investment inflow a necessary and important part of growth analysis. The FDI decision however depends on the innovation intensity of various industries, among other factors. This particular concept warrants the importance of investigating the industry specific FDI inflow and its relation to growth. Previous literatures has not looked into the impact of the industry-specific FDI inflow, coupled with innovation intensities, on economic growth and thus, the paper looks into whether manufacturing industry specific FDI inflow through four degrees of innovation intensity has a statistically significant impact on economic growth. Using the OECD categorization of manufacturing industries' technological intensity and taking data on 35 countries over 15 years, from the OECD and WDI database, and using a fixed effects panel estimation with robust standard errors, it is observed that FDI in medium low tech manufacturing industries cause a statistically significant rise in per capita GDP. The finding is interpreted by looking at the resultant market operation structure of the medium low tech industries, which are primarily involved in manufacturing intermediate goods and normal consumer goods. As these industries have a higher product turnover, the impact of this investment can be captured on the short-run or medium-run analysis, whereas the returns on investment in the high-tech industries rarely has any significant impact on the short-run analysis. With regards to these results, policies to attract FDI in medium low-tech industries are inherently beneficial for the recipient nations. Thus, policies enacting FDI liberalization is required to induce higher economic growth.

Keyword: FDI, economic growth, innovation intensity

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1. Introduction:

Investment is the fundamental contributor of economic growth, a notion backed up by all growth theories (Blomstróm et al., 1996; Choe, 2003; Colecchia & Schreyer, 2002; Li & Lui, 2005). This investment rate tends to become less effective in inducing or generating further economic growth as the economy reaches its steady state (Solow, 1956; Ehrlich & Lui, 1999). However, growth is essential for all nations to maintain progress in the economic, political and geo-social spectrums. As an economy moves closer to its steady state, domestic investment by itself falls short in inducing higher growth (Mello, 1997; Prasad et al., 2007). Due to globalization, trade liberalization and technological progress, it has become possible to attract foreign direct investment (FDI) in an economy.

Along with domestic investment, FDI drives economic growth (Basu & Guariglia, 2007). Thus it warrants the attraction of FDI into developed economies. Therefore, it is imperative to understand the differential impacts of manufacturing industry specific FDI inflow as different industries' production patterns are susceptible to different levels of R&D stock and differential market operations. These production patterns are further malleable to various levels of technological intensity or Research and Development (R&D) expenditure (Aghion et al., 2009; Mowery & Rosenberg, 1991). Although, this concept has been debated extensively in economic literature, it warrants proper empirical analysis to understand and perhaps draw out the pattern of this impact. Moreover, it is widely expected that FDI inflow into local markets have great positive effects in increasing productivity, technical know-how, transfer of new technology, technological innovation, managerial innovation, training of employees, and international trade and production networks (Alfaro et al., 2004). In this regard, understanding the channel of technology, knowledge and output flow is key in assessing the returns on investment into these industries and firms. Checking for spill-over externalities created through this Intellectual

Property (IP) creation, along with numerous other factors, is also necessary to properly analyse the impact of this investment on economic growth which is beyond the scope of this paper.

For quantifying the impact of industry specific FDI inflow on economic growth, it is required to distinguish between the various levels of technological intensity and also to segregate the manufacturing industries according to the categories of degrees of intensity. Following the OECD's ISIC Rev.3 Technology Intensity Definition, manufacturing industries are classified into 4 categories based on R&D intensities. Aggregate R&D intensities for the categorization was formed through a group correlation analysis of R&D expenditure divided by value added and R&D expenditure divided by production, in accordance to the STI scoreboard. Aggregate R&D (Innovation) intensities were estimated after converting countries' R&D expenditures-value added and R&D expenditures-production using GDP PPPs. The categorization is based on data for 12 OECD nations: Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Spain, Sweden, United Kingdom and United States. The breakdown of manufacturing industries and their categories are provided in Table A6 of Appendix. Using the given categorization based upon R&D intensities of manufacturing industries in OECD nations, the effect of manufacturing industry specific FDI inflow on economic growth is to be analysed in this study. A note of caution is to be provided regarding the categorization of industries, in the sense that, the guideline of the OECD's definition is formulated using the data on 12 countries. However, the analysis expands this idea onto the additional countries included in the paper, without confirming if this pattern of R&D expenditure persists for the industries of the newly added countries. In regard to this vital observation, it is assumed for this particular study that, the industries of these newly added countries also behave and consist of the same or at least similar R&D expenditure pattern. This assumption can be considered valid as these other nations are also a part of the OECD nations, which either joined in the last 20 years, or did not contain adequate quality data to be included in the OECD's ISIC analysis.

The remainder of the paper provides a brief review of the existing literature on FDI inflow and economic growth in section 2, model specification in section 3, and data and methodology, detailing the data source and method of analysis and subsequent diagnostic tests, in section 4. Results are interpreted and thoroughly discussed in section 5, and concluding remarks are provided in section 6.

2. Literature Review:

The base for the impact analysis of FDI inflow on economic growth follows from the same argument of the impact of domestic investment on economic growth (Acs et al., 2012; Alfaro et al., 2004; Wong et al., 2005). This particular relation, of the 2 types of investments impact, in terms of entrepreneurial base was explored in the works of Acs et al. (2012), to find that, the FDI inflow into entrepreneurial firms[1] induces higher growth as opposed to the FDI inflow into primary sector as the scope for innovation and technological progress in the primary sector is not on par. This phenomena of technological dependency is termed as the missing link in economic growth theories by the author. The argument put forth by the author behind this idea is that, the mechanisms that result in technical progress and knowledge accumulation was largely undefined in the work of Solow (Acs et al., 2012; Alfaro et al., 2004). The theoretical base was improved upon by the works of Romer in his Endogenous Growth theory (Romer, 1986; 1990).

New growth theorists (Romer, 1986; Lucas, 1988; Aghion & Howitt, 1992) linked the progress of technology or innovation to the production of knowledge. The neo-growth theory embanks on economic growth being a result of increasing returns to the aspect of knowledge creation or dispersion rather than capital and labor. The argument of the theory is that the expected returns

[1] Firms with weak market positions that are primarily focused in seizing market share through rapid innovation and market piercing strategies.

in the Solow model is distorted by lower levels of mutual investments in human capital formation, R&D and infrastructure development (Zhang, 2001). Meanwhile, knowledge differs from other factors of production because of it holding the possibility to grow exponentially and on itself (Zhang, 2001). Innovation or knowledge once created can be reused at zero additional cost. Hence, investments in the creation of knowledge can bring about sustained growth. Moreover, there exist a spill over benefit to knowledge (Ching-Fu et al., 2016). Since production and utilization of knowledge is inherently difficult by an individual entrepreneurial firm's own investments, the room for outside investment is required (Wong et al., 2005). Policies in attracting foreign investment is thus necessary to induce growth in the long term (Meier, 2000). Hence, subsequent investments in human capital formation and the encouragement of foreign private investments in knowledge-intensive industries are necessary for inducing a rise in economic growth (Meier, 2000).

Investigating whether there exists a relationship between entrepreneurial activities and economic growth is the primary motivator behind this study. The results in Acs et al. (2012) are perhaps fortified by the notion that, investments in innovation, in essence, works as a positive externality in terms of dispersion of knowledge. The knowledge spill-over in terms of entrepreneurship paves the way for start-ups and new firm creations, which in turn creates jobs (Breschi & Lissoni, 2001), and evidently more output (Ching-Fu et al., 2016). The importance of entrepreneurship in inducing knowledge spill-over is also supported by the works of Wong, Ho and Autio (2005) using Global Entrepreneurship Monitor (GEM) data, and Wang, Yu and Liu (2013) while taking high-technology intensive industrial R&D expenditure's heterogeneous effect into account. The paper Wong (2005) was one of the earliest papers to address technological intensity ranking in assessing the trend and level of innovation intensity in growth empirics.

A concept put through by Alfaro et al. (2004) is that, the stability and accessibility of financial markets play a large role in FDI inflow and outflow. To elaborate, FDI inflow is dependent upon the smoothness of the financial markets activities, in the sense that, instability or negligence in financial market operations will shy away major investors. This is further coupled with the FDI inflow and outflow regulations set forth by nations. However, massive FDI regulation liberalization took place in 71 countries, comprising mostly of developed and developing countries. Over 90% of the FDI regulation changes were in favour of FDI inflow into the host nation. This theoretical necessity of properly functioning financial markets is fortified by the author's empirical results by finding that, nations with better financial market can exploit the advantages of FDI more efficiently as opposed to nations with worse financial market. This is effectively illustrated in the case study of the emergence of Bangladesh's textiles export industry in the early 1980s. 130 Bangladeshi nationals were provided technical training in textiles production in Korea by Daewoo, 88.5% of whom eventually left to build and manage their own textiles export factories (Alfaro et al., 2004). Subsequently, the author provides valuable insight into the endogeneity aspect that might arise in these studies. He argues that, theoretically there might be a two-way correlation between economic growth and FDI inflow, as well as, economic growth and financial market efficiency. It is entirely plausible to think that, a rise in per capita GDP will increase the living standards of the nation's population, in essence improving the infrastructure and result in higher attraction to FDI and also a better efficiency in terms of financial markets (Alfaro et al., 2004).

Along with the importance of financial market efficiencies, Azman-Saini, Baharumshah and Law (2010) would argue for economic freedom as a contemporary determinant of FDI inflow. Following the similar argument put forth by Alfaro et al (2004), the argument for this concept can also be built. The author finds evidence for economic freedom as a necessary factor facilitating FDI inflow. Another factor that is put forth in this regard is the institutional strength of a nation in inducing FDI inflow. This notion is put forth and tested for on 69 developing nations in the works of Borenzstein, Gregario and Lee (1998).

The reverse causality and the long-term relationship of FDI inflow and economic growth, presented in the explanations put forth by Alfaro et al. (2004), is confirmed by the panel cointegration analyses in Guloglu and Tekin (2012), where significant granger causality was observed among RGDP and Intellectual Property (IP) Patents, and between RGDP and R&D expenditure. Evidence of granger causality was also observed in the work of Kotrajaras, Tubtimtong and Wiboonchutikula (2011), where FDI and GDP growth had granger causal relationship for 3 out of 15 East Asian countries used in their analysis, which fortifies the idea of the presence of a long-term relationship between FDI inflow and economic growth of the host nation. This particular concept has been partially taken into account for this paper by taking 1-year lags to reduce the extent of auto-correlation.

The importance of R&D expenditure was established by Bilbao-Osorio and Rodríguez-Pose (2004), and Schneider (2005) in resulting to IP and innovation stock creation. Innovation and IP are two of the major factors in technical progress which yields higher efficiency in productivity. Thus these are the major returns to investment that drives knowledge spill-over, and induces higher growth through increases in production.

Finally, in accordance to introducing sector level analysis, Iram and Nishat (2009) provides valuable insights in this particular spectrum. The sector level analysis of FDI inflow comprised of the primary sector or agricultural sector, the secondary sector or manufacturing sector, and the tertiary sector or services sector. Although the sectors were not divided according to the technological intensity dependency, this paper analyses the sectors, divided according to technological or innovation intensity, as a direct improvement to this particular idea. The segregation of the R&D expenditure and the investment pattern of these industries are the primary motivators behind the study. The diffusion of knowledge and the foreign investment choice in the local market warrants investigating into the industry specific aspects, and in turn the impact of these choices on economic growth. Thus, this paper aims at extending the analysis to multiple developed nations and check the rigorousness of the idea as to whether the manufacturing industry specific differential infusion of FDI impacts the economic growth of the host nation.

3. Model Specification:

A specification that is broadly similar to others (e.g., Alfaro et al., 2004; Azman-Saini et al., 2010) was employed. The impact of FDI inflow into various levels of innovation intensive manufacturing industries on growth for the purposes of empirical analysis is expressed as follows:

$$RGDP_{it} = \alpha_0 + \beta_1 \sum_j FDIHT_{ijt} + \beta_2 RGDP_{it-1} + \beta_3 GEXP_{it} + \beta_4 UNRILO_{it} + \beta_5 GCF_{it} + \beta_6 TEDU_{it} + \beta_7 POPR_{it} + \gamma_i + \theta_t + \mu_{it} \qquad j\text{=HT, MHT, MLT, LT}$$

where i is country index, t is time index, j is high-tech, medium high-tech, medium low-tech and low-tech manufacturing industry index, *RGDP* is the logarithm of Real GDP per capita, *FDI* is the total FDI inflow into industries, *GEXP* is the logarithm of Government Expenditure (Kotrajaras et al., 2011; Iram & Nishat, 2010; Borensztein et al., 1998; Alfaro et al., 2004; Acs et al., 2012), *UNRILO* is the Unemployment rate according to International Labour Organization (Wang et al., 2013; Bilbao-Osorio & Rodríguez-Pose, 2004; Acs et al., 2012), *GCF* is the logarithm of Gross Capital Formation/Domestic Investment (Kotrajaras et al., 2011; Alfaro et al., 2004), *TEDU* is the proportion of population with tertiary education as a proxy for Human Capital (Wang et al., 2013; Schneider, 2005; Kotrajaras et al., 2011; Borensztein et al., 1998; Bilbao-Osorio

& Rodríguez-Pose, 2004; Alfaro et al., 2004; Acs et al., 2012), *POPR* is the population growth rate (Alfaro et al., 2004; Acs et al., 2012), γ_i is the country fixed effects, θ_t is the time fixed effects and μ_{it} is the error term. The control variables specified in the model is frequently used in growth analysis (Alfaro et al., 2004).

4. Data and Methodology:

Industry specific FDI inflow data of 35 countries, over 15 years, were collected from OECD database. Data on Real GDP per capita, Government Expenditure, Unemployment rate, Gross Capital Formation/Domestic Investment and Population data were collected from World Development Indicator (WDI) database. The lagged RGDP data is used to detrend the RGDP variable. Population growth rate was formulated by subtracting the lagged year's population from current year's population and normalized by dividing it with the lagged year's population. Data on proportion of population with tertiary education was collected from OECD education database. Proportion of population with tertiary education is used as a proxy for Human Capital Stock, as education is the primary variable behind Human Capital Stock formation and increments. Data on tertiary education is used as the Human Capital Stock proxy as it is assumed that technologically intensive industries will require skilled labours to operate. However, this assumption is relaxed for the non-manufacturing and low-tech intensive manufacturing industries (Aghion et al., 2009). The panel dataset was unbalanced due to missing data which made some countries drop out of the analysis. The newest countries that have been added to the OECD nations could not be included into the analysis due to discrepancy in economic strengths. There was discrepancy in the missing data for the various FDI inflow according to the innovation intensity levels for each country as well, which resulted in discrepancies in the number of observations used in the different regressions for the analysis. Summarized descriptive statistics is presented in Table 1, with information regarding the mean, the standard deviation, the minimum and the maximum values. Detailed descriptive statistics is provided in the Table A7 of the Appendix.

Table 1:

Descriptive statistics

Variable	Mean	Standard Deviation	Minimum	Maximum
FDIHT	1949.41	6878.32	-6369.85	46492.00
FDIMHT	4002.49	12606.25	-15197.59	109932.00
FDIMLT	2151.64	10172.70	-38152.50	101501.50
FDILT	2283.95	7933.39	-7018.56	116775.10
FDIEE	22975.50	49962.35	-23968.21	415057.00
INFR	3.65	7.07	-4.48	85.73
UNRILO	7.50	3.86	1.80	27.50
UNRNE	7.51	3.87	1.80	27.50
$RGDP_t$	10.32	0.65	8.91	11.63
GCF	25.27	1.54	21.33	28.83
GEXP	25.07	1.51	21.52	28.56
$RGDP_{t-1}$	10.31	0.65	8.91	11.63
POPR	0.64	0.65	-1.87	2.85
TEDU	26.84	10.24	7.45	52.97
USEDU	43.61	15.89	9.55	76.87

Panel analysis using the aforementioned model is used to assess the impact of industry specific FDI inflow on growth. As FDI inherently transfers and emboldens knowledge and human capital growth, it is fundamentally perceived that FDI grows on itself (Zhang, 2001). Due to this particular notion, it is expected that the model might suffer from autocorrelation, which was further strengthened by the Hausman test. Thus, the Fixed Effects models were considered to be unbiased for analysis and interpretation thereof. Heteroskedasticity was checked for afterwards and considerable Heteroskedasticity was present in the models, which nullified the results of Hausman test. The presence of Heteroskedasticity pried the way for Mundlak test which reaffirmed the use of Fixed Effects model as the more appropriate approach for estimating the regression results. Thus the final empirical models consist of both country fixed effects and time fixed effects. The importance of incorporating sector fixed effects might rise from this argument which was accounted for by creating 4 different econometric equations conforming to each level of technological intensity. During the post-estimation phase it was necessary to assess if the model suffers from cross-sectional dependence and autocorrelation, also known as serial correlation. However, it is to be noted that cross-sectional dependence and autocorrelation are only a problem for macro-panel analysis where the number of time periods, t is greater than the number of panels, n (t>n). Since, the panel analysis for this specific case is a micro-panel analysis, i.e. n>t, it was deemed unnecessary to assess or account for minor to no impact of cross-sectional dependence and auto-correlation. Furthermore, it is imperative to note that Panel Fixed Effects estimation accounts for majority of the autocorrelation or serial correlation if they are present. The model was next tested for the linearity assumption and the linearity assumption was met by the model. Finally, multi-collinearity and Variance Inflation Factor (VIF) was checked and it was observed that mean VIF was in the reasonably acceptable range. Since there is no way to test for omitted variable bias in panel analysis, it is widely accepted that inclusion of country, time and other fixed effects accounts for omitted variables if there are any. In this regard, both country and time fixed effects were included in the model and it was assumed that the model no longer suffers from omitted variable bias. All statistical analysis was performed using the statistical package STATA 13.

5. Results and Discussion:

The results from High-Tech, Medium High-Tech, Medium Low-Tech, and Low-Tech are the final empirical results conforming to all the necessary diagnostic and post-estimation tests and checks, taking endogeneity into account partially through taking 1-year lags of all the explanatory variables. It is imperative and consistent that 1% increase in Gross Capital

Formation/Domestic Investment leads to an increase in the growth rate of RGDP per capita. The same is observed for the case of Government Expenditure or public consumption in High-Tech and all the regressions (Table 2). Conforming to every growth theory, an increase in population growth rate has a negative effect on RGDP per capita. This conforms to the theoretical understanding that the investment or savings rate has to offset the population growth rate, the depreciation rate of capital and the growth rate of technology in order to achieve positive growth. A positive effect on growth is observed in the case of FDI inflow into medium low technology intensive manufacturing industries (Table 2). All the results of the analysis have both country and time fixed effects to account for omitted variables.

The primary question that arises is that why there is no significant impact of FDI inflow into high and medium high technology intensive industries on the growth rates for limiting regressions. Perhaps the case for it is true but is not observed in this analysis due to a low time dimension of the analysis. However, apart from this, one of the major reasons behind this non-existent effect is due to the market structure of each of these industries.

For the case of high technology intensive industries, the market structure of the constituent industries might shed some light to these results. To note, spacecraft and aircraft industries pharmaceutical industry, and medical, precision and optical instruments industries primarily produce final goods for only the top income decile of the population. The intermediate goods that are produced by these industries are catered only for a few number of large corporations and firms with the technical know-how and an established R&D department. This limits the circulation of products by a large degree, and in fact are deemed as luxury goods. This classification in the market excludes the dispersion of goods to the general consumers. This also restricts the dispersion of technical knowledge to all sizes of firms due to the inherent inequality in skill and capital structure. This is further exasperated by the expensive nature of healthcare and space exploration. The risks attached into these categories are astronomically high, which leads to exhaustive experimentation and field testing before even approving the prototypes or intellectual property resulting in a massive consumption of time. As for the office, accounting and computing machineries industries, it is to be noted that, in the developed nations, these industries are helmed by very few large corporations and firms. The market structure for these industry output is more relaxed than the other industries with high R&D expenditures, but is unable to pull the whole R&D intensive sector along with it. Lastly, the radio, TV and communications industries are heavily reliant on the outputs and the market structure of both aircraft and spacecraft industries, and computing machineries industries. In theory, it can be expected that high R&D expenditure will lead to higher productivity and output, but in reality, the return on this expenditure is rather low, and only subjected to an exclusive class of corporations and firms. A more resilient and significant result might be seen for the case of China, and by including the developing nations in the analysis for the case of knowledge dispersion and exports of capital and human stock. Thus, FDI inflow into the high technology intensive industries, has no statistically significant impact on the growth rate of GDP per capita, further solidifying the arguments presented above. Looking at long-term effect might show improvements of the results which will be addressed later while discussing endogeneity.

As for the medium high technology intensive industries, the most important factor is that, the output of these industries have a low perishing rate (Baron & Hannan, 2002). Notably, motor vehicles, trailers and semi-trailers industries, railroad equipment and transport equipment industries, and capital goods manufacturing industries (manufacturers of the capital goods not covered by the high technology intensive industries) produce outputs that are used for the long-run, ranging even up to multiple generations in the case of some products. More importantly, the outputs that are produced in these industries are heavily distributed to the developing nations and the underdeveloped nations, which in turn helps in improving the growth scenario of the developing and underdeveloped nations through boosting output, but has little to low impact in the developed nations. This is fortified by the nature of these developed economies in the sense that these nations have already been using their high tech and more efficient outputs for a certain time period already.

Table 2:

Impact of manufacturing industry specific FDI inflow on economic growth

VARIABLES	HT	MHT	MLT	LT
GCF_{t-1}	0.0748	0.0742	0.0715	0.0740
	(0.0455)	(0.0448)	(0.0472)	(0.0464)
$GEXP_{t-1}$	0.0990	0.102	0.125	0.0957
	(0.113)	(0.114)	(0.114)	(0.118)
$RGDP_{t-2}$	0.307**	0.310**	0.301**	0.311**
	(0.134)	(0.131)	(0.130)	(0.132)
$POPR_{t-1}$	-0.0102	-0.0101	-0.0101	-0.00990
	(0.0103)	(0.0104)	(0.0101)	(0.0103)
$TEDU_{t-1}$	0.00251	0.00242	0.00238	0.00241
	(0.00444)	(0.00421)	(0.00421)	(0.00416)
FDI_{t-1}	4.30e-07	1.16e-07	8.86e-07*	3.56e-07
	(8.93e-07)	(7.49e-07)	(4.96e-07)	(6.45e-07)
$UNRILO_{t-1}$	-0.00804**	-0.00793**	-0.00797**	-0.00808**
	(0.00359)	(0.00363)	(0.00347)	(0.00357)
Time dummies	YES	YES	YES	YES
Country dummies	YES	YES	YES	YES
Constant	2.598	2.515	2.085	2.660
	(2.882)	(2.812)	(2.731)	(2.870)
Observations	97	97	97	97
R-squared	0.879	0.879	0.881	0.879
Number of countries	18	18	18	18

HT, MHT, MLT, LT	Fixed Effect Regression with 1-year lags
(...)	Robust Standard errors in first parentheses
***	Significant at the 1% significance level
**	Significant at the 5% significance level
*	Significant at the 10% significance level

To understand the significant impact of FDI inflow into medium low technology intensive industries, we must first look at its output pattern. Primarily, building and repairing of ships and boats, rubber and plastic products, non-metallic mineral products, and basic metals and fabricated metal products industries produce intermediate goods mostly, which is required by a large extent for all forms of manufacturing, agricultural and services sectors. Unlike the high technology and medium high technology intensive industries, the outputs of these particular industries are mostly used by the domestic nations, and thus have a significant impact on the respective nation's growth rates, as these products improve the efficiency and rate of domestic production. Furthermore, majority of the developed nations generate a particular portion of their energy through nuclear power plants, which in turn pushes the importance of refined petroleum products and nuclear fuel in the nations. Since majority of the developing nations and almost none of the underdeveloped nations rely on this technologically intensive energy production system, the goods of the medium low tech industries are circulated for domestic production and usage (Aghion et al., 2009; Todeva & Knoke, 2005). This particular market structure actually paves the way for the FDI inflow into these medium low technology intensive industries to have a positive impact on the particular domestic nation's growth rates. The impact of it, albeit being small, is significant to improve each nation's growth rates.

Finally, for the low technology intensive industries, perhaps the reason for FDI inflow not having a significant impact on growth rate is due to a rather low inflow in the first place. This is further intensified by the extreme saturation of the consumer goods that is produced by the manufacturing industries, recycling, wood, paper, printing, food and beverages, textiles, and textiles products industries. The rather low volume of FDI inflow into these industries does not pose a good enough return to have any impact on the nation's growth rates.

Previous literature have poised the presence of simultaneous causality. The argument for it is that, despite first ascertaining whether FDI inflow improves the output per capita performance of a nation or not, it can be stated that a stable and positive GDP growth gives investors the signal that the economy is performing well and is ripe for investment, which in turn brings in more FDI. Following this argument, taking 1-year lags of all the independent variables reduces the number of observations significantly which reduces the effect of simultaneous causality. Despite this approach, one vital point of note is that, using this particular approach only accounts for endogeneity caused by reverse causality, and not by autocorrelation. Thus, there remains a slight possibility for the coefficient values to be biased and unreliable. Unfortunately, appropriate Instrument Variable could not be found to properly represent the FDI data on 4 different technological intensity spectrums. Thus the endogeneity problem, which might exist, could not be solved. Despite this shortcoming, the coefficients of the regressions provide consistent results to the pre-reported regressions. In fact, taking 1-year lags actually improved the impact of FDI inflow into medium low technology intensive on the growth rate of GDP per capita. Taking 1-year lags slightly reduces the effect of a long-term effect the explanatory variables might have on the dependent variable. The coefficient from Medium Low-Tech regression (3^{rd} column, Table 2) suggests that FDI inflow into medium low technology intensive manufacturing industries actually increases GDP growth rate per capita which is statistically significant at the 10% significance level. This in turn also provides substantial evidence in suggesting that there exists a long-run impact of inward FDI into technology intensive manufacturing industries consistent under the transfer of knowledge, technology and skill phenomena.

6. Conclusion:

The study investigates whether the manufacturing industry specific FDI inflow, through four degrees of innovation dependency, have any significant impact on economic growth. With many economic growth theories relying on technological growth as a deciding factor for improving growth rate, this particular connotation was left unexplored in it’s full, as the industry specific FDI inflow through multiple levels of technological intensity was not assessed to answer whether it produces increment to economic growth. Delving into the primary question behind the study, it is observed that FDI inflow into technologically intensive industries do pose an increment to economic growth according to the analysis. The significant impact of FDI inflow into medium low-tech industries on economic growth is primarily due to the production structure of these industries. As these industries produce intermediate goods and final consumer goods, the returns on these goods are more imminent compared to the production structure of high-tech industries. Confiding into the idea that as developed economies lurk closer to their steady states, where domestic investment rate is optimized, only FDI can work as the vital factor for inducing higher economic growth, the analysis and the results put through in this paper sheds important and, up to an extent, definitive factual base to this idea by adding to the vast numbers of previous work in the matter which also establish a positive impact of FDI on economic growth. Moreover, understanding the market structure of each of these industries with various degrees of technological intensity further strengthens the findings of this analysis. Moreover, it is necessary to study the positive or negative externalities that may be associated with FDI on a segmented industry basis, which could not be incorporated into the study due to the unavailability of industry specific externalities data. Further research into the idea is necessary to assess the consistency and the validity of this result while taking many other factors into account. The major avenues that require visitation in this regard is the three-way relationship of FDI inflow into technologically intensive industries, economic growth and energy consumption. Much more emphasis must be put into understanding and quantifying the returns to scale for each of these industries in properly assessing the returns to technological investment, i.e. innovation, and how much of that is in regard to FDI as opposed to domestic investment, especially for developed and developing economies.

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Appendix:

A1. List of countries:

1. Austria
2. Belgium
3. Czech Republic
4. France
5. Germany
6. Greece
7. Hungary
8. Iceland
9. Israel
10. Italy
11. South Korea
12. Mexico
13. Netherlands
14. Poland
15. Slovak Republic
16. Slovenia
17. Turkey
18. United States of America

A2. Regressions with sector fixed effects analysis

Variables	(1) RE	(2) FE	(3) RE	(4) FE	(5) FE[a]	(6) FE[a]	(7) FE[b]	(8) FE[c]
GCF	0.119***	0.178***	0.119***	0.178***	0.126***	0.126***	0.179***	0.126***
	[0.00576]	[0.00535]	(0.0121)	(0.0128)	[0.00518]	(0.0186)	(0.0129)	(0.0186)
GEXP	-0.121***	0.0122	-0.121***	0.0122	0.0389***	0.0389	0.0113	0.0397
	[0.00620]	[0.0161]	(0.0122)	(0.0427)	[0.0138]	(0.0397)	(0.0425)	(0.0399)
$RGDP_{t-1}$	0.990***	0.699***	0.990***	0.699***	0.809***	0.809***	0.698***	0.809***
	[0.00567]	[0.0138]	(0.0127)	(0.0541)	[0.0119]	(0.0512)	(0.0537)	(0.0515)
POPR	-0.0244***	-0.0319***	-0.0244***	-0.0319***	-0.0202***	-0.0202***	-0.0319***	-0.0202***
	[0.00285]	[0.00256]	(0.00502)	(0.00571)	[0.00208]	(0.00383)	(0.00570)	(0.00384)
TEDU	-0.000511*	0.000652*	-0.000511	0.000652	-0.000420	-0.000420	0.000652	-0.000432
	[0.000271]	[0.000383]	(0.000527)	(0.00133)	[0.000368]	(0.00110)	(0.00132)	(0.00110)
INFR	-0.000295	7.63e-05	-0.000295	7.63e-05	-7.46e-05	-7.46e-05	7.13e-05	-6.79e-05
	[0.000229]	[0.000198]	(0.000448)	(0.000516)	[0.000163]	(0.000458)	(0.000515)	(0.000458)
FDI	1.19e-08	-1.71e-08	1.19e-08	-1.71e-08	-3.00e-08	-3.00e-08**	-2.93e-08*	-2.10e-08***
	[3.27e-08]	[2.61e-08]	(1.13e-08)	(1.33e-08)	[2.20e-08]	(1.10e-08)	(1.50e-08)	(7.58e-09)
FDIHT	3.77e-08	1.77e-08	3.77e-08	1.77e-08	-1.77e-07	-1.77e-07**	-7.72e-09	-1.32e-07*
	[3.45e-07]	[2.75e-07]	(6.70e-08)	(5.96e-08)	[2.21e-07]	(8.48e-08)	(7.61e-08)	(7.33e-08)
FDIMHT	7.23e-08	5.47e-08	7.23e-08*	5.47e-08	4.62e-08	4.62e-08	9.12e-08*	1.90e-08
	[1.39e-07]	[1.11e-07]	(3.94e-08)	(4.89e-08)	[9.07e-08]	(4.95e-08)	(4.97e-08)	(4.96e-08)
FDIMLT	-5.15e-09	6.56e-08	-5.15e-09	6.56e-08	-6.83e-08	-6.83e-08	7.34e-08	-8.73e-08
	[2.06e-07]	[1.64e-07]	(1.31e-07)	(1.22e-07)	[1.31e-07]	(1.22e-07)	(1.24e-07)	(1.21e-07)
FDILT	1.50e-07	1.09e-07	1.50e-07***	1.09e-07**	4.63e-09	4.63e-09	1.49e-07***	-2.06e-08
	[1.94e-07]	[1.54e-07]	(3.65e-08)	(5.14e-08)	[1.24e-07]	(5.59e-08)	(4.73e-08)	(5.74e-08)
HT Sector					0.000425	0.000425	-0.000419	
					[0.00186]	(0.000971)	(0.00122)	
MHT Sector					-0.00188	-0.00188*	-0.00255*	
					[0.00157]	(0.00107)	(0.00130)	
MLT Sector					-0.00151	-0.00151**	-0.00125	
					[0.00178]	(0.000676)	(0.000848)	
LT Sector					-0.00154	-0.00154*	-0.00233*	
					[0.00153]	(0.000847)	(0.00114)	
1999					0.0119***	0.0119		0.0120
					[0.00457]	(0.0141)		(0.0140)
2000					0.0166***	0.0166		0.0167
					[0.00447]	(0.0118)		(0.0117)
2001					-0.00309	-0.00309		-0.00292
					[0.00433]	(0.0111)		(0.0111)
2002					0.00298	0.00298		0.00321
					[0.00432]	(0.0122)		(0.0121)
2003					0.00214	0.00214		0.00247
					[0.00427]	(0.00991)		(0.00987)
2004					0.0119***	0.0119		0.0122
					[0.00438]	(0.0103)		(0.0103)
2005					0.00780*	0.00780		0.00817
					[0.00444]	(0.0116)		(0.0116)
2006					0.0116**	0.0116		0.0120
					[0.00455]	(0.0117)		(0.0117)

2007					0.00961**	0.00961		0.00998
					[0.00473]	(0.0129)		(0.0129)
2008					-0.0159***	-0.0159		-0.0155
					[0.00492]	(0.0123)		(0.0123)
2009					-0.0442***	-0.0442***		-0.0438***
					[0.00524]	(0.0142)		(0.0142)
2010					0.00986*	0.00986		0.0102
					[0.00518]	(0.0133)		(0.0134)
2011					0.00437	0.00437		0.00475
					[0.00528]	(0.0138)		(0.0139)
2012					-0.00559	-0.00559		-0.00525
					[0.00548]	(0.0140)		(0.0140)
2013					0.00206	0.00206		0.00248
					[0.00702]	(0.0165)		(0.0166)
Constant	0.173**	-1.766***	0.173	-1.766*	-2.211***	-2.211**	-1.745*	-2.223**
	[0.0685]	[0.320]	(0.115)	(0.932)	[0.279]	(0.823)	(0.927)	(0.824)
Observations	1,124	1,124	1,124	1,124	1,124	1,124	1,124	1,124
R-squared		0.946		0.946	0.968	0.968	0.946	0.968
Number of countries	30	30	30	30	30	30	30	30

FE[a] Fixed Effect Regression with both time and sector fixed effects
FE[b] Fixed Effect Regression with only sector fixed effects
FE[c] Fixed Effect Regression with only time fixed effects
(...) Robust Standard errors in first parentheses
[...] Standard errors in third parentheses
*** Significant at the 1% significance level
** Significant at the 5% significance level
* Significant at the 10% significance level

VARIABLES	HT[a]	MHT[a]	MLT[a]	LT[a]	HT[b]	MHT[b]	MLT[b]	LT[b]
GCF	0.0813***	0.101***	0.0907***	0.111***	0.0725**	0.0730**	0.0709**	0.0723**
	(0.0229)	(0.0243)	(0.0248)	(0.0208)	(0.0269)	(0.0267)	(0.0272)	(0.0270)
GEXP	0.104**	0.0450	0.0442	0.0469	0.102*	0.101*	0.111**	0.102*
	(0.0405)	(0.0443)	(0.0510)	(0.0442)	(0.0500)	(0.0519)	(0.0522)	(0.0523)
$RGDP_{t-1}$	0.772***	0.803***	0.778***	0.814***	0.798***	0.799***	0.792***	0.798***
	(0.0456)	(0.0547)	(0.0671)	(0.0519)	(0.0539)	(0.0528)	(0.0524)	(0.0517)
POPR	-0.0219***	-0.0204***	-0.0201***	-0.0197***	-0.0218***	-0.0221***	-0.0216***	-0.0218***
	(0.00640)	(0.00646)	(0.00610)	(0.00499)	(0.00738)	(0.00744)	(0.00727)	(0.00740)
TEDU	0.000643	-0.00117	-0.00185	-0.000729	0.000298	0.000245	0.000361	0.000283
	(0.00189)	(0.00106)	(0.00114)	(0.00102)	(0.00210)	(0.00196)	(0.00194)	(0.00192)
FDI	-2.74e-07*	-3.08e-08	-1.66e-07	-5.64e-08	7.31e-08	-9.02e-08	3.82e-07*	9.37e-08
	(1.35e-07)	(1.20e-07)	(1.29e-07)	(7.37e-08)	(6.92e-07)	(1.81e-07)	(2.12e-07)	(2.85e-07)
UNRILO	-0.00120	-0.00278**	-0.00310**	-0.00205*	-0.00211	-0.00213	-0.00206	-0.00211
	(0.00165)	(0.00113)	(0.00116)	(0.00101)	(0.00193)	(0.00194)	(0.00190)	(0.00194)
Time dummies	YES	YES	YES	YES	YES	YES	YES	YES
Constant	-2.377**	-1.651*	-1.057	-2.070**	-2.356*	-2.357*	-2.481**	-2.358*
	(1.073)	(0.917)	(1.131)	(0.800)	(1.180)	(1.204)	(1.164)	(1.204)
Observations	142	260	163	292	115	115	115	115
R-squared	0.971	0.970	0.952	0.970	0.973	0.973	0.973	0.973
Number of countries	24	28	25	27	18	18	18	18

HT[a], MHT[a], MLT[a], LT[a]	Fixed Effect Regression with disparate number of observations
HT[b], MHT[b], MLT[b], LT[b]	Fixed Effect Regression with uniform number of observations
(...)	Robust Standard errors in first parentheses
***	Significant at the 1% significance level
**	Significant at the 5% significance level
*	Significant at the 10% significance level

A3. Joint significance of sector fixed effects

(1) HT Sector = 0
(2) MHT Sector = 0
(3) MLT Sector = 0
(4) LT Sector = 0

chi2(4) = 0.82
Prob > chi2 = 0.9360

Here, the null hypothesis is that sector fixed effects does not have any joint significance over the results. Due to the Prob>chi2 = 0.9369, we fail to reject the null hypothesis and thus sector fixed effects are omitted from the analysis used to get the final results.

A4. Joint significance of time fixed effects

(1)	1999	=	0
(2)	2000	=	0
(3)	2001	=	0
(4)	2002	=	0
(5)	2003	=	0
(6)	2004	=	0
(7)	2005	=	0
(8)	2006	=	0
(9)	2007	=	0
(10)	2008	=	0
(11)	2009	=	0
(12)	2010	=	0
(13)	2011	=	0
(14)	2012	=	0
(15)	2013	=	0
	chi2(15)	=	1952.72
	Prob > chi2	=	0.0000

Through the same argument we see that, time fixed effects indeed has a joint significance on the results of the analysis and hence we reject the null hypothesis and include time fixed effects into the final model.

A5. Regressions without sector fixed effects analysis

VARIABLES	RE	FE	RE	FE	FE[a]	FE[b]
GCF	0.113***	0.175***	0.113***	0.175***	0.0916***	0.0736**
	[0.0193]	[0.0201]	(0.0150)	(0.0139)	(0.0179)	(0.0269)
GEXP	-0.118***	-0.00588	-0.118***	-0.00588	0.107**	0.108**
	[0.0214]	[0.0568]	(0.0146)	(0.0347)	(0.0507)	(0.0502)
$RGDP_{t-1}$	0.980***	0.654***	0.980***	0.654***	0.815***	0.792***
	[0.0192]	[0.0512]	(0.0147)	(0.0738)	(0.0514)	(0.0579)
POPR	-0.0307***	-0.0320***	-0.0307***	-0.0320***	-0.0249***	-0.0225***
	[0.00860]	[0.00850]	(0.00870)	(0.00710)	(0.00502)	(0.00726)
TEDU	0.000364	0.00285*	0.000364	0.00285	0.000687	0.000401
	[0.000996]	[0.00169]	(0.00116)	(0.00213)	(0.00188)	(0.00212)
FDIHT	9.44e-07	2.31e-06	9.44e-07	2.31e-06**	4.53e-07	3.31e-07
	[1.51e-06]	[1.51e-06]	(9.76e-07)	(9.19e-07)	(8.60e-07)	(8.47e-07)
FDIMHT	1.51e-07	-4.66e-07	1.51e-07	-4.66e-07	-2.27e-07	-2.89e-07
	[6.79e-07]	[5.71e-07]	(4.41e-07)	(4.13e-07)	(1.60e-07)	(1.79e-07)
FDIMLT	1.50e-08	4.95e-07	1.50e-08	4.95e-07	5.24e-07**	5.27e-07**
	[8.50e-07]	[7.34e-07]	(8.85e-07)	(9.37e-07)	(2.41e-07)	(2.07e-07)
FDILT	8.20e-07	4.34e-07	8.20e-07**	4.34e-07	-4.11e-08	5.81e-08
	[8.05e-07]	[6.70e-07]	(3.28e-07)	(2.70e-07)	(3.06e-07)	(3.14e-07)
INFR	-0.000395	-0.00109	-0.000395	-0.00109	-0.00161*	
	[0.00127]	[0.00109]	(0.00158)	(0.00184)	(0.000877)	
UNRILO						-0.00213
						(0.00190)
2000					0.0225	0.0320**
					(0.0163)	(0.0128)
2001					-0.0152	0.00351
					(0.0213)	(0.0195)
2002					-0.0174	0.000865
					(0.0200)	(0.0155)
2003					-0.0215	-0.00263
					(0.0174)	(0.0133)
2004					-0.0100	0.0115
					(0.0165)	(0.0141)
2005					-0.0144	0.0108
					(0.0196)	(0.0171)
2006					-0.00774	0.0174
					(0.0194)	(0.0176)
2007					-0.00614	0.0183
					(0.0210)	(0.0197)
2008					-0.0285	-0.00577
					(0.0220)	(0.0207)
2009					-0.0772***	-0.0504**
					(0.0204)	(0.0185)
2010					-0.0194	0.00783
					(0.0204)	(0.0200)
2011					-0.0219	0.00546
					(0.0209)	(0.0213)
2012					-0.0359	-0.00796
					(0.0209)	(0.0207)
2013					-0.0358	-0.00564
					(0.0225)	(0.0238)
Constant	0.341	-0.862	0.341*	-0.862	-3.130***	-2.470**
	[0.214]	[1.141]	(0.187)	(1.221)	(0.964)	(1.152)
Observations	115	115	115	115	115	115
R-squared		0.909		0.909	0.974	0.974

Number of countries	18	18	18	18	18	18

FE^a	Fixed Effect Regression with Inflation Rates instead of Unemployment Rates
FE^b	Fixed Effect Regression with Unemployment Rates instead of Inflation Rates
(...)	Robust Standard errors in first parentheses
[...]	Standard errors in third parentheses
***	Significant at the 1% significance level
**	Significant at the 5% significance level
*	Significant at the 10% significance level

A6. Manufacturing industry classification according to technological intensity

High-technology intensive industries	Medium-high-technology intensive industries
Aircraft and spacecraft	Electrical machinery and apparatus, n.e.c.
Pharmaceuticals	Motor vehicles, trailers and semi-trailers
Office, accounting and computing machinery	Chemicals excluding pharmaceuticals
Radio, TV and communications equipment	Railroad equipment and transport equipment, n.e.c.
Medical, precision and optical instruments	Machinery and equipment, n.e.c.

Medium-low-technology intensive industries	Low-technology intensive industry
Building and repairing of ships and boats	Manufacturing, n.e.c.; Recycling
Rubber and plastic products	Wood, pulp, paper, paper products, printing and publishing
Coke, refined petroleum products and nuclear fuel	Food products, beverages and tobacco
Other non-metallic mineral products	Textiles, textile products, leather and footwear
Basic metals and fabricated metal products	

1. Aggregate R&D intensities formed through a group correlation analysis of R&D expenditure divided by value added and R&D expenditure divided by production, in accordance to the STI scoreboard.
2. Aggregate R&D (Innovation) intensities estimated after converting countries' R&D expenditures-value added and R&D expenditure-production using GDP PPPs.
3. Based on data for 12 OECD nations: Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Spain, Sweden, United Kingdom and United States.

A7. Descriptive Statistics

Variable		Mean	Std. Dev.	Min	Max	Observations
FDIHT	overall	1949.414	6878.321	-6369.851	46492	N = 143
	between		5128.26	-6369.851	24161.44	n = 24
	within		3625.664	-19513.03	24279.97	T-bar = 5.95833
FDIMHT	overall	4002.494	12606.25	-15197.59	109932	N = 277
	between		9593.958	-3341.619	51135.85	n = 28
	within		6782.571	-47686.35	62798.65	T-bar = 9.89286
FDIMLT	overall	2151.64	10172.7	-38152.5	101501.5	N = 164
	between		6862.301	-472.209	28595.67	n = 25
	within		8648.742	-35944	82458.54	T-bar = 6.56
FDILT	overall	2283.945	7933.388	-7018.557	116775.1	N = 318
	between		3700.794	-165.4139	14346.44	n = 27
	within		6874.437	-19081.05	104712.6	T-bar = 11.7778
FDIEE	overall	22975.5	49962.35	-23968.21	415057	N = 279
	between		43801.7	-1008.936	223423.7	n = 30
	within		28158.74	-102564.7	214608.7	T-bar = 9.3
INFR	overall	3.648956	7.065076	-4.479938	85.73324	N = 578
	between		4.846923	-.0662247	29.53013	n = 34
	within		5.203276	-19.6302	59.85206	T-bar = 17
UNRILO	overall	7.497405	3.862401	1.8	27.5	N = 578
	between		3.138664	3.558824	15.27647	n = 34
	within		2.310866	.420934	22.58564	T-bar = 17
UNRNE	overall	7.511938	3.868812	1.8	27.5	N = 578
	between		3.137838	3.558824	15.28235	n = 34
	within		2.322651	.4295846	22.60606	T-bar = 17
$RGDP_t$	overall	10.3175	.6453417	8.905529	11.62597	N = 578
	between		.6447289	9.079033	11.49405	n = 34
	within		.1109824	9.921408	10.61888	T-bar = 17
GCF	overall	25.26612	1.541324	21.33125	28.83222	N = 562
	between		1.533301	21.73982	28.68449	n = 34
	within		.1879164	24.56434	25.93527	T-bar = 16.5294
GEXP	overall	25.07326	1.510346	21.52477	28.55616	N = 578
	between		1.526325	21.7908	28.44929	n = 34
	within		.1267904	24.70349	25.47307	T-bar = 17
$RGDP_{t-1}$	overall	10.31157	.6485284	8.905529	11.62597	N = 544
	between		.6483475	9.074628	11.49059	n = 34
	within		.1088421	9.93129	10.62141	T-bar = 16
POPR	overall	.639728	.652013	-1.871	2.849571	N = 544
	between		.5726152	-.3764807	1.996872	n = 34
	within		.3260223	-1.123341	2.099974	T-bar = 16
TEDU	overall	26.84196	10.24429	7.454459	52.97144	N = 492
	between		9.483442	10.82069	45.54368	n = 33
	within		3.988335	14.11775	38.21624	T-bar = 14.9091
USEDU	overall	43.60972	15.89037	9.546476	76.86713	N = 475
	between		15.18017	13.86114	75.24601	n = 32
	within		2.135742	35.81771	50.48895	T-bar = 14.8438

A8. Hausman specification test

	(b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
GCF	.0735943	.0614081	.0121862	.0135414
GEXP	.1079868	-.0644993	.1724861	.047131
GDP_{t-1}	.7917107	1.005511	-.2138001	.0412343
POPR	-.0225136	-.0104516	-.0120621	.003548
TEDU	.0004007	.0004882	-.0000875	.0013634
FDIHT	3.31e-07	-6.74e-07	1.00e-06	.
FDIMHT	-2.89e-07	1.02e-07	-3.92e-07	.
FDIMLT	5.27e-07	4.25e-08	4.85e-07	.
FDILT	5.81e-08	2.27e-08	3.54e-08	.
UNRILO	-.0021273	.0005118	-.0026391	.0008387
2000	.0320389	.0126133	.0194256	.
2001	.0035062	-.0164613	.0199675	.
2002	.0008649	-.0064321	.007297	.
2003	-.0026333	-.0036186	.0009853	.
2004	.0115472	.009612	.0019352	.
2005	.0108392	.0058678	.0049714	.
2006	.0174008	.0084278	.008973	.
2007	.0183064	.0062729	.0120336	.
2008	-.0057702	-.0203545	.0145843	.
2009	-.0503565	-.0719688	.0216123	.
2010	.0078292	.0073475	.0004817	.
2011	.0054636	-.0008062	.0062698	.
2012	-.0079631	-.0230248	.0150617	.
2013	-.0056435	.0031791	-.0088226	.

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(20) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 134.37
Prob>chi2 = 0.0000
(V_b-V_B is not positive definite)

A9. Heteroskedasticity test

Modified Wald test for group-wise heteroskedasticity in fixed effect regression model

H0: sigma (i)^2 = sigma^2 for all i

chi2 (18) = 1.7e+26

Prob>chi2 = 0.0000

A10. Mundlak test

(1)	mean_lgexp	= 0
(2)	mean_llrgdppc	= 0
(3)	mean_popr	= 0
(4)	mean_pPOPnTE	= 0
(5)	mean_HT	= 0
(6)	mean_MHT	= 0
(7)	mean_MLT	= 0
(8)	mean_LT	= 0
(9)	mean_UNRILO	= 0

chi2(9) = 120.05

Prob > chi2 = 0.0000

A11. Collinearity check (VIF check)

Variable	VIF	SQRT VIF	Tolerance	R-Squared
lgcf	59.81	7.73	0.0167	0.9833
lgexp	63.40	7.96	0.0158	0.9842
llrgdppc	3.46	1.86	0.2889	0.7111
popr	1.49	1.22	0.6722	0.3278
pPOPnTE	2.26	1.50	0.4426	0.5574
HT	2.22	1.49	0.4511	0.5489
MHT	1.71	1.31	0.5848	0.4152
MLT	1.99	1.41	0.5033	0.4967
LT	1.48	1.22	0.6738	0.3262
UNRILO	1.64	1.28	0.6114	0.3886
Mean VIF	13.95			

	Eigenval	Cond Index
1	6.8671	1.0000
2	1.9608	1.8714
3	0.7350	3.0566
4	0.5152	3.6508
5	0.3879	4.2075
6	0.3190	4.6394
7	0.1469	6.8383
8	0.0649	10.2841
9	0.0022	56.1354
10	0.0010	83.1733
11	0.0000	506.4426

Condition Number	506.4426
Det(correlation matrix)	0.0010

Eigenvalues & Cond Index computed from scaled raw sscp (w/ intercept)

A12. Linearity assumption check

$F\ (8, 17)$	=	1.11
$\text{Prob} > F$	=	0.4012