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What Attracts FDI in Indian Manufacturing Industries?

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Abstract

In this paper we examine the pattern of inward FDI at the disaggregated industry level (NIC 3-digit), and test for the industry-specific characteristics that have been significant in attracting foreign investment in India during 2000-10. Since highly polluting industries (based on Central Pollution Control Board classification) have accounted for a substantive share of the FDI inflows, we control for these industries to discern the differential impact of industry characteristics in the dirty manufacturing sector. Our analysis of the FDI inflows focuses on a panel of top ten investing countries, as well as individual countries with relatively stringent environmental norms. Our results indicate that, on the whole (as well as from Japan), FDI inflows are significant in capital-intensive industries with high growth rate. In case of the US, the foremost industrialized country investing in India, the composition of FDI has shifted significantly towards less energy-intensive industries and labor-intensive non-polluting industries, while inflows within polluting industries have been towards the capital intensive industries with large market size.

Keywords: FDI, Polluting industries, India

JEL codes: F230, Q520

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1. Introduction

The industrial policy reforms of 1991 and further amendments during the nineties opened opportunities for foreign investment in India. Some of the major amendments in foreign investment policy during the nineties include opening up of new sectors for FDI (construction, power, etc.); expansion of the list of high priority manufacturing industries for foreign investment; and increase in foreign equity limit to 51% in manufacturing and even more in certain other industries; and removal of requirement of dividend balancing (except certain industries).

Beginning 2000, the government allowed foreign investment through automatic route in all industries for FDI/ NRI/ OCBs (Overseas Corporate Bodies) [1] and this led to significant increase in FDI. Inbound investments in India during 2000-01 increased under automatic route. The total FDI inflows in India rose, from Rs. 122 billion in 2000 to Rs. 700 billion in 2010 (in constant prices Rs. 2004-05). While FDI has witnessed dramatic rise in the services sector, it has also increased significantly in the manufacturing sector. Moreover, the FDI stock and output in the manufacturing sector in India through the 1990s was found to be mutually reinforcing (Chakraborty and Nunnenkamp 2008). In more recent years, real FDI in India within manufacturing sector from top 10 investing countries has increased more than four times, from Rs. 46.3 billion in 2000 to Rs. 240.4 billion in 2010 (in constant prices 2004-05 prices).

Within the manufacturing sector, inbound investment in *polluting* industries has also increased significantly, from Rs. 19.2 billion in 2000 to Rs. 81.6 billion in 2010 (in constant prices 2004-05 prices). An earlier analysis of US FDI outflows across a group of countries (including India) found significant evidence of higher FDI in countries with lower environmental

stringency for dirty industries, namely chemicals and metals (which are also capital intensive), during 1985 and 1990 (Xing and Kolstad 2002).

Countries with relatively more stringent environmental regulations may invest in pollution-intensive industries in developing countries to lower production costs, a phenomenon known as the *pollution haven effect*. The literature on FDI at the disaggregated industry-level has shown that industry features including capital-intensity, skill intensity, market size, scale, etc., serve as key determinants of FDI flows across countries. Polluting industries are capital-intensive, and analysis of outbound-FDI from US into Mexico and Brazil found evidence of pollution haven effect (Cole and Elliott 2005), similarly a study of inbound-FDI into Mexico from high-income OECD countries, including the US, also found Waldrich and Gopinath 2008). Ambiguity, however, remains in the evidence of such migration of polluting industries towards developing countries (Eskeland and Harrison (2003), Elliott and Shimamoto 2008, and Manderson and Kneller 2012).

While India has featured in some of the cross-country studies examining outbound investment of developed countries in polluting industries, there is no analysis of FDI inflows into India at the disaggregated industry level and the role of industry specific characteristics including the polluting nature of the industry. This study tries to fill that gap.

While there is no data on pollution load by industry, we use a discrete variable to indicate the polluting nature of an industry, based on the CPCB classification of 17 highly polluting industries. We control for these polluting industries to test for differential impact of industry characteristics on FDI inflows of dirty industries. We use unpublished DIPPP data at disaggregated industry level data on FDI inflows in India in manufacturing sector by industry by

year from the group of top 10 investing countries contributing around 80% in total FDI inflows in India. We use the ASI data (at 3-digit NIC level) for industry characteristics. We test for industry specific characteristics that have determined the composition of FDI inflows from these countries. We control for pollution-intensive industries to discern any difference in the impact of industry characteristics on pattern of FDI inflows for pollution-intensive versus less-polluting industries. Inflows from the US, one of high income countries, have been most significant in less energy intensive industries. Labor intensive industries have been significant determinant of investments from the US in less-polluting industries, while inflows in pollution-intensive industries have been relatively more attracted to capital intensive and industries with large market size than less-polluting industries. Inbound investments from Japan have been most significant in capital intensive less-polluting industries.

The rest of the paper is organized as follows: Section 2 briefly discusses the literature on industry characteristics which have influence on FDI in polluting industries and FDI inflows in India; Section 3 covers FDI inflows in India and features of pollution-intensive industries and less-polluting in India; Section 4 outlines our empirical model; Section 5 reveals data sources; Section 6 summarizes our empirical results; and Section 7 concludes the paper.

2. Literature Review

The literature on FDI suggests multiple reasons for foreign direct investment. Dunning (1977) outlined several determinants of foreign direct investments under the *Ownership*, *Location*, and *Internalization* (*OLI*) framework. Under the *OLI* framework an enterprise engages in foreign value-adding if three conditions are satisfied- (i)first, foreign investors possess ownership advantages in production process over the firms of other nationalities in serving particular

markets; (ii) second, it is beneficial for a foreign investor to internalize either by extending existing value added chains or adding the new one; and (iii) third foreign investors utilize these advantages in conjunction with at least some factor input in the host country other than home country. These advantages will differ according to industry, country and enterprise characteristics.

The *OLI* framework can be used to explain the *Knowledge-capital* models under which knowledge, treated as ownership, is combined with industry and country characteristics. In these models, knowledge is defined as headquarter services including research and development, management, etc. Knowledge is required to produce new varieties of differentiated products and can be supplied to production units located in different locations depending on characteristics of Industries. In the *Knowledge-capital* models, industry characteristics are used to explain foreign direct investment, including factor intensity (Helpman 1984), scale economies (Brainard 1993; and Markusen 1998), and domestic market size (Markusen 1998).

Studies on FDI and pollution have also used industry features as determinants of foreign investments. Countries with more stringent regulations on environment may invest in pollution-intensive industries in developing countries (with lax regulations) to take advantage of lower production costs. An analysis of outflows from US to a number of countries, including India, found evidence of investment in most pollution-intensive and capital intensive industries (Xing and Kolstad 2002). Studies have pointed out that difference in stringency of environmental regulations is not the only factor that determines the movement of capital in dirty industries, rather there are other factors also which attract foreign investment in these industries. Like Helpman (1984) demonstrates factor intensity of industries as a reason for foreign direct

investment, several studies on pollution-intensive industries have theoretically and empirically identified that these industries are capital intensive so foreign investment is more likely to move towards developed countries than developing countries (Eskeland and Harrison 2003; and Elliott and Shimamoto 2008). Former study tested movement of capital from US and France, top investing industrialized countries, at industry level in Cote d'Ivoire, Mexico, Morocco and Venezuela, while latter study examine outward investment of Japan into Malaysia, Indonesia and the Philippines. In addition to capital intensity, another study suggests polluting industries are also skill intensive and R&D intensive (Manderson and Kneller 2012). They have not found evidence in foreign investment by UK based pollution-intensive multinational firms towards developing countries.

Cole and Elliott (2005) demonstrated the effect of sectoral differences in environmental regulations and capital intensities on outflows of FDI from the US to Mexico and Brazil. While there is no evidence of investment in pollution-intensive industries to developing countries, these industries may shift to specific countries with relatively more capital abundance than stringency of environmental regulations. Waldkirch and Gopinath (2008) found evidence of migration of polluting firms through inbound investment in Mexico from group of OECD countries and the US only by using firm level characteristics.[2] The literature suggests that industry characteristics are key determinants in attracting foreign investment. While India is featured in some of the cross-country analysis of developed countries, there is no analysis on India at disaggregated industry level analyzing role of industry characteristics on FDI inflows, particularly investment into pollution-intensive industries.

Studies on Indian in manufacturing have not directly highlighted the polluting industries, though the analyses have included some of the dirty industries (like chemicals, metal products, etc. Gross fixed capital formation in Indian chemicals, and metals products industries increased during the initial industrialization period and even in during 1980s and 1990s (Uchikawa, 1999). Studies have also observed change in skill endowment in India with rise in tertiary level education in, as a result the country becomes suitable for industries requiring process driven technology and technical know-how, such industries include pharmaceuticals, chemicals, and high technology engineering industries (Balasubramanyam and Sapsford 2007). A micro level study shows chemicals, metals products and transport equipment industries have large domestic market in India (Uchikawa, 1999) and an attraction for foreign investors (Nagaraj 2003; Balasubramanyam and Sapsford 2007; Wei 2003; and Chakraborty and Nunnenkamp 2008).

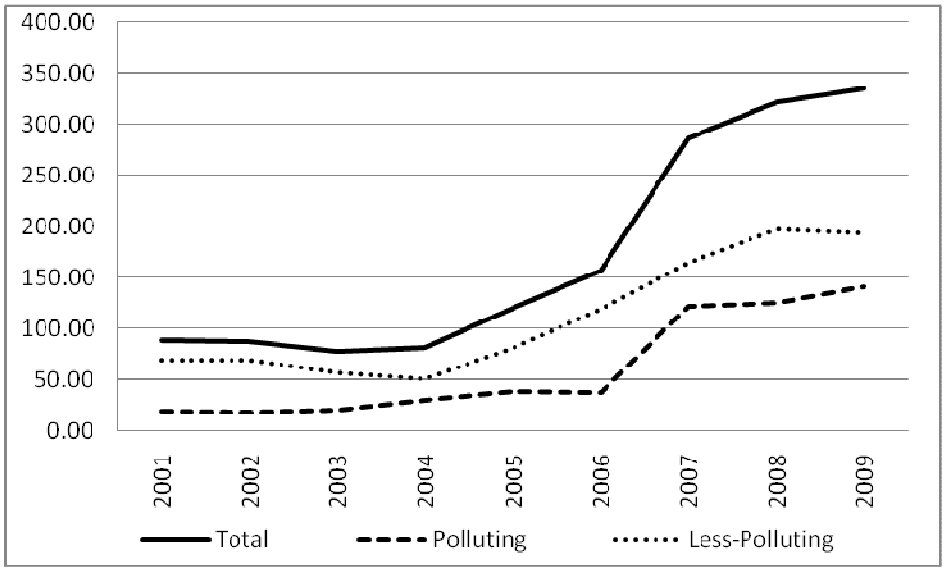
3. Pattern of Inflows of FDI and Features of Manufacturing Sector in India

Here we briefly outline the FDI inflows in Indian manufacturing during the period 2000-10 and characteristics of pollution-intensive and less-polluting industries in India for the period from 1999 to 2009.

FDI Inflows into India in Manufacturing Sector

In order to analyze the role of FDI in pollution-intensive industries in manufacturing sector, we show aggregate real FDI inflows from top 10 investing countries in India in manufacturing sector, pollution-intensive, and less-polluting industries in Figure 1 during the period 2000-10.[2] FDI inflows in manufacturing sector from top 10 investing countries declined during the initial years (2001 to 2003), but increased dramatically after 2004. This pattern is also observed in total FDI inflows (including manufacturing, services, and construction) in India which remained low

during the initial years of last decade because of aftermaths of the Asian crisis (Baer and Sirohi 2013), but increased after 2004 due to simplified procedures for approvals and increase in private equity (Rao and Dhar 2011). Another major policy change in manufacturing sector (except drugs) came in the year 2006 when foreign equity in high priority industries increased from 51% to 100% through automatic route.[3]



Source: Own Calculation using DIPP Data on FDI Inflows

Figure1: Three-year Moving Average of FDI Inflows in India from Top 10 Investing Countries (Rs. billion in 2004-05 prices)

Within manufacturing sector FDI inflows in pollution-intensive industries have increased during the last decade (2000-2010), with a growth of 9% per annum. The sharp rise in FDI inflows in the year 2008 in pollution-intensive industries is driven by spike in investments in drugs from Japan (Rs. 161 billion)[4], and in metallurgical from Mauritius (Rs. 17.4 billion) and the US (Rs. 15.5 billion). On the average foreign investment within polluting industries from top 10 investing countries is highest in metallurgical (37.8%) during the period from 2000 to 2010, followed by

drugs and soaps (22.4%), and chemicals and chemical products (12.6%). Inbound investment has mainly increased after 2004 in metallurgical from USA; petroleum refineries from Singapore; fermentation, and ceramic and cement from Netherland. Chemical and chemical products consistently attract significant FDI inflows from US, Japan, Germany and UK in the last decade (2000-10). Drugs and Soaps have been attracting consistent FDI inflows from US, Netherland, Germany and Singapore. Investments from Mauritius dominate in each of the dirty industry.

Characteristics of Industries in India

To compare the characteristics of pollution-intensive industries with less-polluting industries, we employ data on entire 3-digit NIC[5] manufacturing industries for the period 1999 to 2009. We classify polluting nature of industries based on CPCB classification of most pollution-intensive industries. During the period 1999 to 2009 industry classification changed from NIC-98 to NIC-2004 to NIC-2008. In order to get comparable data we match NIC-04 with NIC-98 and NIC-2008 at 3-digit based on concordance between different versions of industry classification (NIC) published by Central Statistical Organization (CSO) in India.

Based on final dataset we measure different industry characteristics for pollution-intensive and less-polluting industries, such as capital intensity, employment per factory (a proxy for scale), market size, industrial growth and energy intensity. Capital intensity is measured by ratio of real net fixed assets to number of workers; employment per worker is defined as average employment per factory; market size is measured by share of output of an industry in total output of manufacturing; industrial growth is growth in output of industry in current year over previous year; and energy intensity is defined by share of value of fuels consumed in an industry in value of output of industry. The definitions of industry characteristics are described in detail in

Appendix A.1. Average industry characteristics over the period from 1999 to 2009 of pollution-intensive and less-polluting industries are summarized in Table 1.

An average pollution-intensive industry is relatively more capital intensive and energy intensive than less-polluting industry. This is not surprising as several studies have indicated that pollution-intensive industries are capital intensive and energy intensive (Xing and Kolstad 2002; Cole and Elliott 2005; Eskeland and Harrison 2003; and Manderson and Kneller 2012). The market size of an average pollution-intensive industry is also relatively larger than less-polluting industries. We also find capital intensive dirty industries have also large market size. This is substantiated by high and positive correlation between capital-intensity and market size of pollution-intensive industries, the correlation is 0.76 and significant at 5% level. Overall, pollution-intensive industries in India are associated with several characteristics such as larger market size, capital intensity and energy intensity.

Table 1: Summary Statistics of Industry Characteristics of Less-Polluting and Polluting Industries for the period 1999 to 2009

	Between 3-digit NIC-2004 Industries			
	Mean	Std. Dev.	Minimum	Maximum
Less - Polluting Industries				
K-L Ratio	7.50	6.00	0.43	28.33
Employment per factory	76.01	83.46	6.05	478.9
Market Size (%)	1.15	1.33	.008	6.17
Industrial Growth (%)	19.88	12.75	3.02	79.84
Energy Intensity (%)	3.51	3.46	0.77	20.89
Pollution-Intensive Industries				
K-L Ratio	20.29	34.26	1.82	136.4
Employment per factory	55.85	21.37	28.42	93.63
Market Size (%)	3.57	3.88	.38	13.05

Industrial Growth (%)	16.06	18.34	-22.60	129.4
Energy Intensity (%)	7.23	5.68	1.27	21.72

Note: Summary statistics is based on 40 less-polluting industries and 15 pollution-intensive industries. Industrial Growth in output of industries for 1999 is calculated over 1998.

4. Empirical Model

Several studies have used sector/industry level characteristics to examine outbound FDI from developed countries to developing countries in pollution-intensive industries. In Cole and Elliott (2005) the outflows of US are represented by stock of FDI because FDI stock are measured at historical cost which does not allow to measure flow of FDI. Another study, Waldkirch and Gopinath (2008) also use flow of FDI by source country but they adjust for FDI stock by incorporating existing FDI stock.[6] The empirical determinants of FDI are difficult to identify for FDI stock because the year-to-year change in stock is lower if this is based on absolutely large accumulated base value (Globerman and Shapiro 2002). They further point out FDI behavior is more comprehensively measured for flows than for stocks. Several studies testing the impact of industry and country characteristics on FDI inflows have used flows (Elliott and Shimamotto 2008; and Globerman and Shapiro 2002). Since FDI behavior is represented by flows, in this study we use FDI flows rather than stock.

Following Cole and Elliott (2005) and Waldkirch and Gopinath (2008) we model the FDI inflow in Indian manufacturing sector at disaggregated industry level by source country (*j*). The estimable equation for industry *i* from source country *j* in year *t,* is as follows:

$$
\begin{aligned}
FDI_{ijt} = {} & \beta_0 + \alpha_i + \delta_j + t_t + \beta_1 K\_Lratiohost_{it-1} + \beta_2 (K\_Lratiohost_{it-1} * Polluting) + \\
& \beta_3 Emplhost_{it-1} + \beta_4 (Emplhost_{it-1} * Polluting) + \beta_5 marketsizehost_{it-1} + \\
& \beta_6 (marketsizehost_{it-1} * Polluting) + \beta_7 Industrygrowth_{it-1} + \\
& \beta_8 (Industrygrowth_{it-1} * Polluting) + \beta_9 Energy\,\text{int}ensityhost_{it-1} + \varepsilon_{ijt}
\end{aligned} \tag{1}
$$

Where FDI_{ijt} in equation (1) is the share of FDI inflows in industry *i* from source country *j* in year *t* in total FDI in manufacturing from source country *j* in year *t*. While Cole and Elliott (2005) measure composition of FDI outflows from the US using stock, we measure the composition of inbound FDI into India using flow.

Right hand side of equation (1) describes characteristics of industries in India (host country). This study includes only host country industry characteristics because Mauritius remains a route for round-tripping of investment, we interpret FDI from this source being aggregated over several countries, rather than as a single source country. Therefore, it is difficult to measure industry characteristics of single home country. Also, data in this study is classified according to DIPP industry classification which does not have one-to-one correspondence with any other international industry classification. We capture home country industry characteristics through country fixed effects (δ_j) in equation (1). In equation (1) we incorporate industry fixed effects (α_i) to control for unobserved heterogeneity across industries and time fixed effects (t_t) to capture economy wide changes that affect decision to invest in India within manufacturing sector. We use lag period of all industry characteristics as we assume investment in current period is based on characteristics of industries in previous period.

We distinguish the polluting nature of industries in the model by using discrete variable for polluting industries based on CPCB classification. The binary variable, as denoted by *Polluting,*

is 1 for industries declared as pollution-intensive by CPCB and 0 for less-polluting industries. Industries for which dummy variable is 1 include metallurgical; petroleum refineries; chemicals and chemical products; drugs and soaps; leather and leather products; ceramic and cement; fermentation; paper and pulp; and sugar and tea. Dummy variable for pollution- intensive industries is interacted with industry characteristics to distinguish the impact of industry characteristics on FDI inflows in pollution intensive industries.

Characteristics of industries include capital intensity, employment per factory, market size, industrial growth and energy intensity. In equation (1), $K\_Lratiohost_{it-1}$ represent capital intensity of industry *i* in year *t-1*. Capital intensity of industries is measured by ratio of real net fixed assets to number of workers in industry *i* in year *t-1*.[8] The definition of capital intensity of industries is consistent with Waldkirch and Gopinath (2008). Interaction between capital intensity of industries and dummy for polluting industries describes capital intensity of polluting industries. Capital intensity of industries basically includes essential infrastructure required for starting the production and pollution-intensive industries need this infrastructure for production (Cole and Elliott 2005; Eskeland and Harrison 2003; and Manderson and Kneller 2012). Therefore, we expect capital intensive industries in India attract FDI inflows and thus, the coefficients β_1 and β_2 are expected to be positive.

Another determinant of foreign investment is average employment per factory of industries. Cole and Elliott (2005) define average worker per firm as a proxy for scale economies in host country in sector *i* in year *t-1*. In this study we measure employment per factory, as denoted by $Emplhost_{it-1}$, by average worker employed per factory industry *i* in year *t-1* in host country. Interaction between average employment and dummy for polluting industries shows average

employment of polluting industries. Given that pollution intensive industries have typically lower average employment per factory we would expect β_4 to be negative. The coefficient of β_3 can be positive or negative.

Other factors affecting foreign investment are related with market size and market growth of industries in the host country. Market size shows domestic consumption of industrial output, therefore industries with large domestic market attracts more FDI. Cole and Elliott (2005) measure market size by share of output of each sector in total output of manufacturing because data on domestic consumption by sector in host country is not available. We also face the same problem of non-availability of data on domestic consumption of output by industry in India, thereby measure market size, as denoted by $marketsizehost_{it-1}$, by share of output of industry *i* in year *t-1* in total output of manufacturing in year *t-1*. Market size of polluting industries is shown by interaction of the variable market size with dummy for polluting industries. The coefficients β_5 and β_6 are expected to be positive.

Market growth, as denoted by $Industrygrowth_{it-1}$, is a signal for prospectus of industries. Elliott and Shimamoto (2008) measure industrial growth of output of host country in period t over period t-1. Similarly, we measure industrial growth in output of industry *i* in year *t-1* over period t-2.[7] Interaction term between industrial growth and dummy for polluting industries depicts industrial growth of polluting industries. Industries with high market growth over last year tend to receive more FDI. Kumar (2005) shows good correspondence between industrial growth in previous period and FDI inflows in current period in India. Therefore, we expect the coefficient β_7 and β_8 to be positive. Another industry characteristic is a proxy for pollution

intensity of industries. Energy Intensity, as denoted by $Energy\,\text{int}\,ensityhost_{it-1}$, is measured by share of value of fuels consumed in industry *i* in year *t-1* in value of output of industry *i* in year *t-1*. The definition of energy intensity is consistent with Eskeland and Harrison (2003). Pollution intensive industries in India attract more FDI inflows to save environmental cost. Therefore, we expect the coefficient β_9 to be positive.

5. Data

Foreign investments in India are allowed through automatic route, government route, and acquisition of shares. Under automatic route, foreign investor can invest into any industry upto the ceiling allowed without any prior notice to the government, while under government route approval from the government is required for investment in certain industries which are listed under negative list and require compulsory license, and if the amount of investment exceeds the permissible limit.[9]

We collect the most disaggregated industry level data on actual FDI inflows in manufacturing sector in India by top 10 investing countries during the period 2000 to 2010. Top 10 countries investing in India including Mauritius, Singapore, UK, Germany, US, France, Netherland, Cyprus, UAE and Japan, contribute around more than 80% in total FDI inflows in India in the last decade. This unpublished data was provided by Directorate of Industrial Policy and Promotion (DIPP), Ministry of Commerce, Government of India. DIPP provided data on foreign equity inflows[10] by top 10 investing countries for various industries under manufacturing, services and construction. For the purpose of this study we utilize inflows in various manufacturing industries. Industries receiving FDI inflows in manufacturing sector are classified according to Industrial (Development and Regulation) Act, 1951.

Industry characteristics are measured using data on Indian Industries which is obtained for the period 1999 to 2009 from Annual Survey of Industries[11] (ASI). ASI is the main source of industry data in India and reports industry-wise data related to production. From the ASI we use data on net book value of fixed assets, number of workers, value of output of, number of factories, and fuels consumed to measure different industry characteristics. Classification of industries in ASI is based on National Industrial Classification (NIC) at 2-digit, 3-digit and 4-digit. The most disaggregated annual data available in public domain during our sample period is at 3-digit NIC industries. ASI reports data according to financial year i.e. April to March. Since data on FDI inflows is provided according to the calendar year, ASI data for year, say 2000-01, is reported for 2000 because majority of the period covered in 2000.

During our sample period industry classification changed from NIC-98 to NIC-04 and from NIC-04 to NIC-08. The first step to get comparable data for DIPP industries is to match different NIC classifications and then, concord with DIPP industries. Different classifications of industries are matched with each other, from NIC-98 to NIC-04 and from NIC-04 to NIC-08, based on concordance provided by Central Statistical Organization (CSO). 3-digit Industries at NIC-08 are matched with DIPP industries with the help of NCAER (2009) report. Now, the Final dataset consist of FDI inflows and information on industries for 28 manufacturing industries.

All the variables in current rupees are deflated using appropriate price index and deflator. FDI inflows are deflated using Gross fixed capital formation (GFCF) deflator with base 2004-05. Data on GFCF deflator during the sample period is taken from National Accounts Statistics (NAS), CSO. WPI of machine and machine tools with base 2004-05 is used to deflate net book

value of fixed assets. The data on WPI of machine and machine tools for the period from 1999-00 to 2000-10 is obtained from Office of Economic Advisor, CSO.

6. Empirical Results

The fixed effect estimations have been done for pooled data of top ten investing countries and the bilateral FDI from countries with largest share in total FDI inflows in manufacturing i.e. Mauritius, US, Japan and Singapore.

The fixed effect regression results of equation (1) are shown in Table 2. Capital intensity of industries is positive and statistically significant for FDI inflows from top 10 investing countries, Mauritius and Japan in less-polluting industries, while the coefficient of interaction term between capital intensity and polluting industries is statistically insignificant for these specifications. This implies impact of capital intensity of industries on FDI inflows (from top 10 countries taken together, Mauritius and Japan) is not different for pollution-intensive and less-polluting industries. However, the inflows from the US have been significant in labour intensive less-polluting industries, while inflows in pollution-intensive industries are relatively more attracted to capital intensive industries. These results are not surprising as pollution-intensive industries are capital intensive (Cole and Elliott 2003; Xing and Kolstad 2003; Eskeland and Harrison 2003; and Manderson and Kneller 2012). Average employment per factory is a significant determinant of FDI inflows in India from Singapore.

The coefficient of market size and the related interaction term are statistically insignificant for pooled FDI inflows, and investments from Mauritius and Singapore. Less-polluting industries with low market size is a significant determinant of FDI inflows from Japan.

On the other hand, large market size has relatively larger impact on FDI inflows from the US in pollution-intensive industries than less-polluting industries. This is true as FDI in India in manufacturing is largely local market seeking (Chakraborty and Nunnenkamp 2008; Balasubramanyan and Sapsford 2007; and Wei 2003). However, it is not clear from our measure of market size that FDI is attracted to domestic market or foreign market. Another determinant of FDI, industrial growth in output of less-polluting industries is positive and statistically significant for FDI inflows from all top 10 source countries and from Japan, and its impact on inbound investment is same for pollution-intensive and less-polluting industries.

The coefficient of energy intensity of industries is significant only for the US. However, the results indicate US investments in less-energy intensive industries. This is true since on an average 85% (approx) of the US investment is into industries in which share of fuels in value of output is less than or equal to 5% during the period from 2000-2010. The less-energy intensive industries include some of the pollution-intensive industries such as petroleum and natural gas; drugs and soaps; sugar and tea; fermentation; and leather and leather products. Hence, we can say pollution intensity of industries is not an attractive determinant for US investment in India.

Table 2: Estimated Results- Fixed Effects Regression Results

Dependent Variable is the share of FDI in industry *i* from source country *j* in year *t* in total FDI in manufacturing from source country *j* in year *t*.

	Pooled	Mauritius	US	Japan	Singapore
ln(K_L) Ratio	2.361*	5.435***	-3.203*	5.737*	3.373
	[1.217]	[1.971]	[1.882]	[3.412]	[5.151]
ln(K_L) Ratio *Polluting	-0.016	0.364	5.997*	-1.782	-6.977
	[2.183]	[3.442]	[3.335]	[5.799]	[7.478]
Employment per factory	0.015	-0.003	0.024	-0.06	0.178**
	[0.021]	[0.034]	[0.016]	[0.041]	[0.087]
Employment per factory *Polluting	0.009	0.085	-0.028	0.24	-0.014

	[0.047]	[0.081]	[0.090]	[0.169]	[0.161]
Market Size	-0.353	0.055	-1.237	-4.143*	0.252
	[0.457]	[0.487]	[0.835]	[2.412]	[0.795]
Market Size*Polluting	0.583	0.692	1.786*	3.803	1.024
	[0.525]	[0.619]	[1.000]	[2.501]	[1.199]
Industrial Growth	0.024*	0.019	0.024	0.112**	0.027
	[0.013]	[0.025]	[0.022]	[0.044]	[0.046]
Industrial Growth*Polluting	-0.041	-0.001	-0.024	-0.018	-0.002
	[0.025]	[0.038]	[0.037]	[0.084]	[0.066]
Energy Intensity	-0.37	0.244	-0.981**	1.17	-0.869
	[0.334]	[0.453]	[0.409]	[1.011]	[0.736]
Constant	-4.349	-24.227***	13.518	-19.248	-6.835
	[4.667]	[8.784]	[8.205]	[12.445]	[15.902]
Country Fixed Effects	Yes	No	No	No	No
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	2,852	308	308	264	308
R-squared	0.148	0.569	0.663	0.409	0.298
Adjusted R-squared	0.131	0.493	0.604	0.296	0.175
F test	0.599	0.946	1.026	0.739	0.987
Probability >F	0.953	0.527	0.431	0.776	0.476

Data on FDI inflows is from 2000 to 2010 and on ASI is from 1999 to 2009. ASI data is lagged by one year.
*** p<0.01, ** p<0.05, * p<0.1, Robust standard errors are in brackets.

In sum, we find capital intensity of less-polluting industries as a significant determinant of FDI inflows in India from pooled FDI inflows from top 10 source countries, Mauritius, and Japan. Investments from the US are significant in labor intensive less-polluting industries and less-energy intensive industries, while FDI in pollution-intensive industries have been relatively more influenced by capital intensity and large market size.

7. Conclusion

This study analyzed impact of industry-specific characteristics that have been significant in determining FDI inflows into India, by examining the composition of the FDI by individual source country. In our analysis we distinguish between the category of *pollution-intensive* and

less-polluting industries, based on the classification of the Indian Central Pollution Control Board, to distinguish the impact of industry characteristics on FDI inflows for pollution-intensive industries. We also examine the pattern of FDI from the four largest source countries, namely the US, Japan, Singapore and Mauritius, which together account for most of the manufacturing FDI in India. (Since Mauritius remains a route for round-tripping for investment benefits, we interpret FDI from this source being aggregated over several countries, rather than as a single source country).

We find capital intensity and industrial growth of less-polluting industries significantly attract FDI from top 10 investing countries. FDI inflows from the US, the single largest industrialized country investing in India (based on cumulative FDI over the years), have been significant in labor intensive less-polluting industries, while capital intensive and market size of pollution-intensive industries have been main attraction for inflows. FDI from the US has also been significantly attracted to less-energy intensive industries. FDI from Japan is seen to have been most significant in capital intensive less-polluting industries. Investments from Singapore are significant in less-polluting industries with largest average employment per factory. We infer that FDI in India seeks to take advantage of capital intensive less-polluting industries, while FDI in pollution-intensive industries have been attracting to capital intensive and industries with large market size.

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Endnotes

1. Under automatic route foreign investor can invest, to the extent allowed, without any prior notice to the Government. The information of investment can be given to regional office of Reserve Bank of India (RBI), Central Bank of India, within the period of one month. DIPP *via* Press Note No. 2 (2000) allowed FDI through automatic route in all industries.
2. Three-year moving average is taken to smooth annual fluctuations in FDI inflows.
3. DIPP Press Note No. 4(2006)
4. In 2008 Ranbaxy Laboratories, one of the Pharmaceutical giant in India, was bought by Daichi a Japan based multinational company.
5. Manufacturing Industries in India are classified according to National Industrial Classification (NIC).
6. Waldkirch and Gopinath (2008) use FDI flows by industry by source country, although they derive estimable equation for equilibrium/desired FDI stock. They used Tobit model according to which FDI flows equal to desired (latent variable) FDI stock for industries under certain conditions.
7. Ahluwalia (2002), and Rao and Dhar (2011) point out that FDI inflows which carry technology and skills cause industrial output to grow. Therefore, we take lag period of Industrial growth to remove endogeneity between FDI inflows and industrial growth.
8. Studies focusing on Indian manufacturing represent capital input either by Perpetual Inventory Method (PIM) or real net fixed assets. Some studies such as Goldar and Kumari (2002); Banga and Goldar (2007); Chaudhuri (2002); Vinish Kathuria (2000); and Vinish Kathuria (2002) uses PIM which deflate benchmark capital stock as well as annual investment (Gross Investments) by gross fixed capital formation deflator. However, the lacuna of PIM lies in two key assumptions- base year of benchmark series of capital stock and annual depreciation. Another study, Hasan, Mitra and Ramaswamy (2007), have used deflated net fixed assets as a measure of capital input.
9. Reserve Bank of India is underlying authority for investment through automatic route, and Foreign Investment Promotion Board (FIPB)/Secretariat of Industrial Approvals (SIA) consider applications of approval.
10. Foreign Equity inflows shows foreign investor buying more than 10% of equity shares of an Indian company. Foreign equity inflows of industry are the aggregate of foreign equity in individual Indian companies within an industry.
11. ASI reports data for registered manufacturing units.

Appendix A: Definition of Variables

Capital Intensity-	Ratio of real net fixed assets of industry *i* in year *t* to number of workers in industry *i* in year *t*. Real net fixed assets are in Rs. million at 2004-05 prices. Fixed assets are depreciated value at the end of accounting year. Book value of net fixed assets is deflated by WPI of machinery and machine tools with base 2004-05. Number of workers include all persons employed directly or through any agency whether for wages or not and engaged in any manufacturing process or in cleaning any part of the machinery or premises used for manufacturing process. Labor engaged in the repair and maintenance or production of fixed assets for factory's own use or labor employed for generating electricity or producing coal, gas etc. are included. (((Fixed assets*100)/WPI)/number of workers)
Average Employment -	Average worker employed per factory. (number of workers/number of factories)
Market Size-	Share of output of industry *i* in year *t* in total output of manufacturing in year *t*. ((value of output/total output of manufacturing)*100)
Industrial Growth-	Growth in value of output of industry *i* in current year *t* over previous year *t-1*. $((output_{it} - output_{it-1})/ output_{it-1})*100)$
Energy Intensity-	Share of fuels consumed in industry *i* in year *t* in value of output of industry *i* in year *t*. Fuel consumed represent purchase value of all fuels consumed by the factory during the accounting year but excluding the items which directly enter into the manufacturing process. $((fuel\ consumed_{it} / value\ of\ output_{it})*100)$