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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 aggregate FDI in India was most significant in capital-intensive industries and those with large market size. Similarly, investment from Japan and UK was most significant in capital-intensive industries. However FDI from the US was significant in less-energy intensive industries, while within the pollution-intensive industries, market size was the main determinant of investment inflow. Only investment from Singapore located in in employment-generating industries. We infer that the pattern of FDI in India has been largely towards capital-intensive industries, and in polluting industries with large market size. But growth in FDI inflow failed to exploit scale economies and generate jobs during the last decade.

JEL codes: F230, Q520

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1. Introduction

The industrial reforms and liberalization policies in India during the nineties ushered in new opportunities for foreign investment in India. Some of the major amendments in foreign investment policy included opening up of new sectors for FDI (construction, power, etc.); expansion of the list of high priority manufacturing industries for foreign investment; increase in foreign equity limit in manufacturing and 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] which led to substantial increase in FDI inflow.[2] During 2000-10, the inbound FDI in the Indian manufacturing sector increased five-fold, from Rs. 46.3 billion in 2000 to Rs. 240.4 billion in 2010 (at constant 2004-05 prices). The increased capital flows in the industrial sector is a welcome sign, especially since FDI stock and output in the manufacturing sector in India through the 1990s was found to be mutually reinforcing (Chakraborty and Nunnenkamp 2008).

Within the Indian manufacturing sector, inbound FDI in *polluting* industries also increased, 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 found significant evidence of higher FDI in countries (including India) with lower environmental stringency for dirty industries, namely chemicals and metals, 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

[1] Under the automatic route a 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) within a period of one month. DIPP Press Note No. 2 (2000) allowed FDI through automatic route in all industries.

[2] Total FDI grew from Rs. 122 billion to Rs. 701 billion (in 2004-05 constant Rs) during 2000-10.

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 evidence of pollution haven effect (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.

Since there is no data on pollution-load or pollution abatement cost by industry in India, we use a discrete variable to denote the polluting nature of an industry, based on the CPCB classification of 17 highly polluting industries. We use unpublished DIPPP data on FDI inflows in India at disaggregated industry level from the group of top 10 investing countries (that contribute around 80% in total FDI inflows) in India. Using ASI data (at 3-digit NIC level) on industry-specific characteristics, we test for the industry characteristics that attracted FDI inflows. We control for the polluting industries to test for differential impact of industry characteristics on FDI inflows in the dirty industries.

We find that aggregate FDI inflows (total as well as those routed through Mauritius[3]) have been most significant in capital-intensive industries during the last decade. Capital-intensity was also significant in attracting investment from Japan and the UK. However for the larger investing countries like the US and Singapore, other industry characteristics played a more significant role. In particular, FDI from the US was most significant in less energy-intensive industries, while scale economy (employment-generating) was highly significant for FDI from Singapore. For polluting industries, market size was a significant determinant for aggregate FDI as well as for FDI from the US and UK.

The rest of the paper is organized as follows: Section 2 is a brief literature review; Section 3 gives a snapshot of FDI inflows in India during 2000-10 and the descriptive statistics of Indian industries at NIC 3-digit classification; Section 4 outlines our empirical model; Section 5 discusses the data; Section 6 summarizes our results; and Section 7 concludes.

2. Literature Review

Foreign direct investment according to Dunning (1977) takes place when there are ownership, location and internalization (OLI) advantages, i.e. when (i) foreign investors possess ownership advantages in production process over the firms of other nationalities in serving particular markets; (ii) it is beneficial for a foreign investor to either extend existing value-adding chains or establishing a new one; and (iii) foreign investors utilize these advantages in conjunction with at least some factor input in the host country other than home country. These advantages differ according to industry, country and enterprise characteristics.

[3] Since Mauritius has been a route for round-tripping for investment benefits, we interpret FDI from this source as aggregate FDI of several countries, rather than being as a single source country of FDI into India.

The *OLI* framework can be used to explain the *knowledge-capital* models where knowledge has ownership. Knowledge, defined as headquarter services including R&D, management, etc, 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, the industry characteristics that determine foreign direct investment include factor-intensity (Helpman 1984), scale-economies (Brainard 1993; and Markusen 1998), and domestic market size (Markusen 1998).

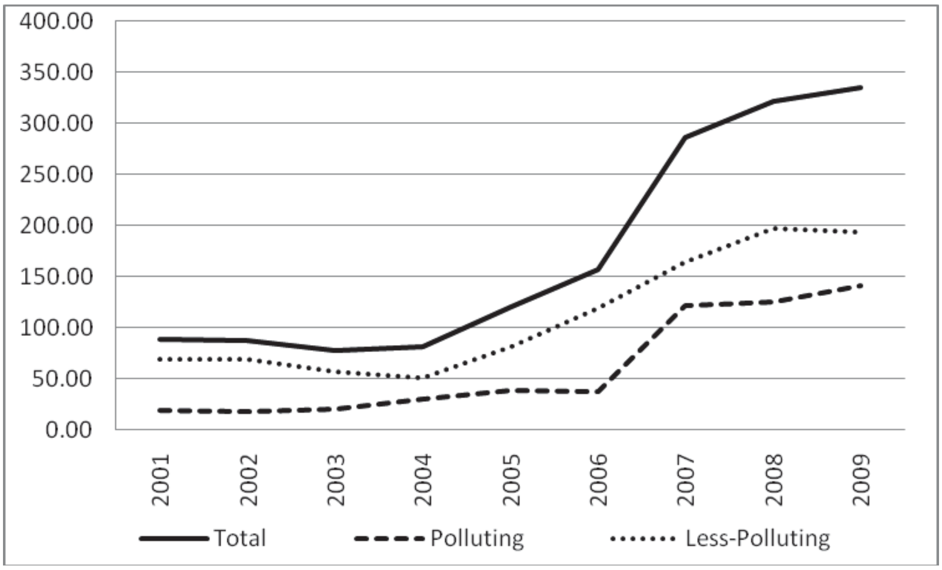
Studies on FDI and pollution have also used industry features as determinants of foreign investments. Countries with relatively stringent environmental regulations may invest in pollution-intensive industries in developing countries (with lax regulations) to take advantage of lower production costs. 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). However, the difference in stringency of environmental regulations is only one among several factors that determine the movement of capital in dirty industries. It is important to note that pollution-intensive industries are relatively capital-intensive in nature, and hence foreign investment is more likely to move towards developed countries than developing countries (Eskeland and Harrison 2003; and Elliott and Shimamoto 2008). Polluting industries in developed countries have also been observed to be skill-intensive and R&D-intensive (Manderson and Kneller 2012), and there is no significant evidence of outward 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 abundant capital 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. The literature suggests that industry characteristics are key determinants in attracting foreign investment. While India featured in some of the cross-country analysis of developed countries, there is no analysis at disaggregated industry level analyzing the role of industry characteristics on FDI inflows, particularly investment in pollution-intensive industries.

Although studies on Indian manufacturing have not analyzed polluting industries, the analyses have covered 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 during 1980s and 1990s (Uchikawa, 1999). Studies have also observed a change in skill endowment in India with rise in tertiary education; as a result the country emerged suitable for industries requiring process driven technology and technical know-how, including 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 attractive for foreign investors (Nagaraj 2003; Balasubramanyam and Sapsford 2007; Wei 2003; and Chakraborty and Nunnenkamp 2008).

3. Pattern of FDI Inflow in Manufacturing in India and Industry Features

The inflow of real FDI from top 10 investing countries in India in manufacturing sector, increased substantially during the period 2000-10, especially after 2004. The trend in manufacturing FDI inflow, distinguishing between our polluting versus less-polluting industries, is depicted in Figure 1.[4] The lack-lustre trend in FDI during 2000-03 observed here was also true for total FDI inflows (including manufacturing, services, and construction) in India which remained low following the aftermath of the Asian crisis in the late nineties (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.[5]



Source: Own Calculation using DIPP Data on FDI Inflows

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

Within the manufacturing sector, FDI inflows in pollution-intensive industries increased at 9% per annum during 2000-10. The rise in FDI inflows in pollution-intensive industries was

[4] Three-year moving average is taken to smooth annual fluctuations in FDI inflows.

[5] DIPP Press Note No. 4(2006).

driven by a spike in investment in drugs from Japan (Rs. 161 billion),[6] and in metallurgical industries from Mauritius (Rs. 17.4 billion) and the US (Rs. 15.5 billion).

On the whole, foreign investment within polluting industries from top 10 investing countries has been highest in metallurgical (37.8%), followed by drugs and soaps (22.4%), and chemicals and chemical products (12.6%) during the 2000-10. Inbound investment 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.

We consider the characteristics of pollution-intensive industries with less-polluting industries at the 3-digit NIC[7] classification for the period 1999 through 2009. We consider an industry to be *polluting* if it falls under the CPCB's list of *highly polluting industries*. The CPCB's 17 highly polluting industries include: Aluminium Smelter, Caustic Soda, Cement, Copper Smelter, Distilleries, Dyes and Dye intermediates, Fertiliser, Integrated Iron and Steel, Tanneries, Pesticides, Petrochemicals, Drugs and Pharmaceuticals, Pulp and Paper, Oil Refineries, Sugar, Thermal Power Plants, Zinc Smelter. However, since the Annual Survey of Industries (ASI) of India does not cover thermal power plants, it is excluded from our analysis.

The industry characteristics of manufacturing industries, distinguishing between *polluting* versus *less-polluting*, are summarized in Table 1. We find that a typical polluting industry is

[6] In 2008 Ranbaxy Laboratories, one of the Pharmaceutical giant in India, was bought over by Daichi, a Japan based multinational company.
[7] Manufacturing Industries in India are classified according to National Industrial Classification (NIC).

relatively more capital-intensive and energy-intensive than less-polluting industry. This is consistent with several studies which indicate 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.

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 polluting industries. Industrial Growth in output of industries for 1999 is calculated over 1998.

4. Empirical Model

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

$$\log(FDI_{it}) = \beta_0 + \alpha_i + t_t + \beta_1 \log(K\_Lratio_{it-1}) + \beta_2 \log(K\_Lratio_{it-1}) * Polluting + \beta_3 Scale_{it-1} + \beta_4 (Scale_{it-1} * Polluting) + \beta_5 marketsize_{it-1} + \beta_6 (marketsize_{it-1} * Polluting) + \beta_7 Industrygrowth_{it-1} + \beta_8 (Industrygrowth_{it-1} * Polluting) + \beta_9 Energy\,\mathrm{int}ensity_{it-1} + \varepsilon_{it} \quad (1)$$

In the above equation, FDI_{it} is real FDI inflows in industry i in year t.[8] It should be noted that 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.[9] However, as Globerman and Shapiro (2002) observed FDI behavior is more comprehensively measured for flows than for stocks, and 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). Here we use FDI flows rather than stock.

Our model includes industry fixed effect α_i (to control for unobserved heterogeneity across industries) and time fixed effect t_t (to capture economy-wide changes that affect decision to invest in India within manufacturing sector). We use lagged values of all industry characteristics as we assume investment in current period is based on characteristics of industries in previous period. We also 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 classified as *polluting* (based on CPCB's list) and 0 for less-polluting industries. As indicated earlier, our *polluting* industries include metallurgical;

[8] Alternatively we could consider the de-scaled value of FDI inflow in each industry i in year t (descaling by total manufacturing FDI received in year t). These results are qualitatively similar to those reported in this paper.

[9] Waldkirch and Gopinath (2008) use FDI flows by industry by source country, and they derive estimable equation for equilibrium or desired FDI stock. They used the Tobit model according to which FDI flows equal to desired (latent variable) FDI stock for industries under certain conditions.

petroleum refineries; chemicals and chemical products; drugs and soaps; leather and leather products; ceramic and cement; fermentation; paper and pulp; and sugar. Dummy variables for pollution- intensive industries are interacted with industry characteristics to distinguish the impact of industry characteristics on FDI inflows in pollution-intensive industries.

The characteristics of industries include capital intensity, employment per factory, market size, industrial growth and energy intensity. In equation (1), K_Lratio_{it-1} represents capital intensity of industry *i* in year *t-1*. The capital-intensity of industries is measured by ratio of real net fixed assets to number of workers in industry *i* in year *t-1*.[10] Our measure of capital intensity of industries is consistent with that used by Waldkirch and Gopinath (2008). The measure of capital covers the 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 to attract FDI and thus, the coefficients β_1 and β_2 are expected to be positive.

Another determinant of foreign investment is employment per factory of industries, $Scale_{it-1}$, measured by average number of workers employed per factory in industry *i* in year *t-1* (as in Cole and Elliott 2005). Since polluting industries typically have 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 growth prospects 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)

[10] 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) use 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.

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 $Marketsize_{it-1}$, 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. $Industrygrowth_{it-1}$ is a signal for the growth prospect of the i^{th} industry as observed by potential investor in period t-1. We measure industrial growth in output in year *t-1* over period *t-2*,[11] and expect that industries with high market growth over the previous period would receive more FDI. Kumar (2005) showed that there is 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.

We also include the energy-intensity of production, which serves as a proxy for pollution-intensity of industries. $Energyintensity_{it-1}$ is measured by the share of value of fuels consumed in industry in value of total output of industry *i* in year *t-1*. The definition of energy intensity is consistent with Eskeland and Harrison (2003). If pollution-intensive industries in India attract more FDI inflows to save on environmental cost, we expect the coefficient β_9 to be positive.

[11] Elliott and Shimamoto (2008) measure industrial growth of output of host country in period *t* over period *t-1*. However, 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 any endogeneity between FDI inflows and industrial growth.

5. Data

We use the disaggregated industry level data on actual FDI inflows in manufacturing sector in India by top 10 investing countries for the period 2000 through 2010. This unpublished data was provided by Directorate of Industrial Policy and Promotion (DIPP), Ministry of Commerce, Government of India, and gives the data on foreign equity inflows[12] by top 10 investing countries for various industries under manufacturing, services and construction. For the purpose of this study we utilize the FDI inflows in only the manufacturing industries. Industries receiving FDI inflows in manufacturing sector are classified according to Industrial (Development and Regulation) Act, 1951.

The top 10 countries investing in India include Mauritius, Singapore, US, Japan, UK, Germany, France, Netherlands, Cyprus and UAE, which together contributed for more than 80% of the total FDI inflows in India during the last decade. Considering the aggregate FDI received by India from the top 10 countries, about half the FDI is routed through Mauritius, while Singapore, US and Japan account for 30%, followed by the UK which accounts for about 6% of the total.

Industry characteristics are measured using data obtained from the Annual Survey of Industries (ASI)[13] for the period 1999 to 2009. The ASI is the main source of industry data in India and reports industry-wise data related to production. The classification of industries in the ASI is based on National Industrial Classification (NIC), we use the data the 3-digit NIC level and concord it with the DIPP industry classification. It should be noted that the ASI reports data

[12] 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.

[13] ASI reports data for registered manufacturing units.

according to financial year i.e. April to March, while data on FDI inflows is provided according to the calendar year. So we assume that FDI inflow in a calendar year, say 2000, is based on the industry characteristics observed in the previous financial year 1999-2000.

During our sample period industry classification changed from NIC1998 to NIC2004 and from NIC2004 to NIC2008. The first step to get comparable data for DIPP industries is to match different NIC classifications and then, concord with DIPP classification of industries. Different classifications of industries are matched with each other, from NIC1998 to NIC2004 and from NIC2004 to NIC2008, based on concordance provided by Central Statistical Organization (CSO). The 3-digit industries at NIC2008 are matched with DIPP industries with the help of NCAER (2009) report. In our final dataset we have 28 categories of manufacturing industries.

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 regression results of equation (1) are shown in Table 2 and Table 3. Table 2 gives the results for aggregate FDI inflows from the top 10 countries as well as that routed through Mauritius, while Table 3 gives the results for the FDI from specific developed countries of Singapore, US, Japan and the UK.

Capital intensity of industries is positive and statistically significant for aggregate FDI inflows from the top 10 investing countries and that from Mauritius (regressions 1-4, Table 2). While the impact of capital intensity of industries on FDI inflows is not different for pollution-intensive and less-polluting industries, for polluting industries market-size was also a significant factor (see regression 2).

Table 2. Regression Results of Aggregate FDI from the Top 10 investor countries

	Aggregate from 10 countries		*From Mauritius*	
	(1)	(2)	(3)	(4)
Log(K/L)	0.665**	0.708*	0.688*	0.741*
	[0.284]	[0.359]	[0.388]	[0.380]
Industrial growth	0.004	0.173	0.461	0.459
	[0.318]	[0.357]	[0.511]	[0.537]
Scale	4.333	4.745	0.002	0.002
	[2.752]	[2.842]	[0.005]	[0.004]
Energy intensity	-0.066	-0.047	0.174	0.193
	[0.094]	[0.094]	[0.147]	[0.144]
Market Size	0.078	-0.202	0.091	-0.038
	[0.066]	[0.150]	[0.126]	[0.182]
Log(K/L)*Polluting		-0.391		-0.369
		[0.779]		[1.410]
Industrial Growth*Polluting		0.001		0
		[0.006]		[0.015]
Scale*Polluting		0.002		-0.021
		[0.020]		[0.039]
Market Size*Polluting		0.345**		0.196
		[0.157]		[0.248]
Observations	292	292	239	239
Number of industry groups	28	28	28	28
R-squared	0.220	0.230	0.211	0.216
Adj R-squared	0.178	0.176	0.158	0.148
F test	26.290	34.820	8.413	14.81
Prob >F	0.000	0.000	0.000	0.000

Dependent Variable is the log of real FDI in industry *i* in year *t*.
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.

However, FDI from Singapore and the US have not been in the capital-intensive industries. Investment from Singapore was most significant in industries with higher scale of production (at the factory level), and in labour-intensive polluting industries (regressions 1-2, Table 3). While FDI from the US was most significant in less energy-intensive (less-polluting industries), and within the polluting industries FDI was significant in those with relatively small-scale industries but larger market size (see regression 4, Table 3). FDI inflows from Japan and UK were most significant in capital-intensive industries as seen in Table 3 (regressions 5-8), and market size of polluting industries also attracted FDI from the UK.

Our finding that large market size did play a role in attracting FDI inflows in pollution-intensive industries (but not less-polluting industries), on the whole as well as from the US and UK, re-affirms the results from earlier studies that FDI in Indian manufacturing is largely 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.

The insignificance of operating scale of factories (average employment per factory) in our aggregate FDI analysis and FDI from specific source countries (except for Singapore) reinforces the observed phenomenon of "jobless growth" in Indian manufacturing that has continued even in the post-liberalization period (Kannan and Raveendran 2009, Thomas 2013).

Table 3. Regression estimations of FDI inflow from selected developed countries

	Singapore		*United States*		*Japan*[#]		*United Kingdom*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log(K/L)	0.509	0.909	0.136	0.012	1.202*	1.116*	0.742	1.156*
	[0.503]	[0.580]	[0.323]	[0.371]	[0.612]	[0.594]	[0.601]	[0.656]
Industrial growth	0.279	0.061	0.27	0.631	0.929	1.185	0.463	0.892
	[0.676]	[0.698]	[0.429]	[0.467]	[0.917]	[1.059]	[0.679]	[0.679]
Scale	0.018***	0.016***	0.004	0.005*	-0.005	-0.004	0.004	0.004
	[0.004]	[0.006]	[0.003]	[0.003]	[0.006]	[0.006]	[0.006]	[0.007]
Energy intensity	-0.145	-0.033	-0.350***	-0.363***	-0.057	-0.062	-0.064	0.048
	[0.268]	[0.281]	[0.121]	[0.117]	[0.266]	[0.281]	[0.341]	[0.322]
Market Size	0.288	0.287	-0.038	-0.374	0.182	0.076	-0.021	-0.641***
	[0.190]	[0.197]	[0.130]	[0.262]	[0.336]	[0.407]	[0.193]	[0.193]
Log(K/L)*Polluting		-2.808**		0.392		0.367		-2.613
		[1.264]		[1.033]		[3.135]		[2.649]
Industrial Growth*Polluting		0.006		-0.014		-0.009		0
		[0.019]		[0.012]		[0.014]		[0.021]
Scale*Polluting		0.019		-0.049**		0.01		0.01
		[0.031]		[0.022]		[0.105]		[0.053]
Market Size*Polluting		-0.141		0.523*		0.149		0.791**
		[0.360]		[0.292]		[0.588]		[0.332]
Observations	178	178	248	248	137	137	216	216
Number of industry groups	28	28	28	28	24	24	28	28
R-squared	0.389	0.401	0.118	0.141	0.185	0.188	0.104	0.141
Adj R-squared	0.333	0.329	0.0608	0.0693	0.092	0.064	0.036	0.057
F test	48.19	89.89	3.226	7.983	3.023	6.656	5.091	7.485
Prob >F	0	0	0.004	0.000	0.010	0.000	0.000	0.000

Dependent Variable is the logarithmic value of real FDI in industry *i* in year *t* from the country concerned.
Data on FDI inflows is from 2000 to 2010 and on ASI is from 1999 to 2009. ASI data is lagged by one year.
[#] Since FDI inflow into India from Japan showed unusual spike in 2008, this year has been dropped in the analysis.
*** p<0.01, ** p<0.05, * p<0.1, Robust standard errors are in brackets.

7. Conclusion

Our study analyzed the impact of industry-specific characteristics that have been significant in determining FDI inflows into India by examining the inbound investment from the top 10 source countries. In our analysis we distinguished between the category of pollution-intensive and less-polluting industries, based on the classification of the Indian Central Pollution Control Board, to discern whether industry characteristics polluting industries had any significant impact on FDI inflow.

On the whole, we found that FDI inflow during the last decade was significant in capital-intensive industries, and market-size of polluting industries was also found to be a significant determinant. However, FDI inflow from the US was most significant in less-energy intensive industries, and FDI from Singapore was most significant in industries with larger scale of production at the factory level (hence higher employment) and in labour-intensive polluting industries. On the other hand, FDI from Japan and UK was most significant in capital-intensive industries. Larger market size of polluting industries was significant in attracting FDI from the US and the UK.

We infer that inbound FDI in Indian manufacturing came into capital-intensive industries (whether polluting or less-polluting), and within polluting industries those with larger markets. Inbound FDI did not exploit scale economies and thus failed to generate manufacturing jobs (except for FDI from Singapore) despite increasing investment and output– fueling the phenomenon of "jobless growth" in post-liberalization period in India.

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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 $consumed_{it}$ / $Output_{it}$)*100)]

Industries covered in the analysis

	Polluting industries
1.	Metallurgical industries
2.	Petroleum and natural gas
3.	Basic chemicals, fertilizers, photographic film, glue
4.	Drugs and soaps
5.	Paper and pulp (including paper products)
6.	Sugar
7.	Fermentation industries
8.	Leather, leather goods
9.	Cement and ceramic
	Less-polluting
10.	Prime Mover (other than electrical generators)
11.	Electrical Equipment
12.	Electronics
13.	Computer hardware
14.	Telecommunications
15.	Automobile industry
16.	Sea Transport/Air Transport industry
17.	Railway related component
18.	Machinery
19.	Misc. mechanical and engineering industries
20.	Commercial, office and household equipments
21.	Instruments
22.	Textiles
23.	Food processing
24.	Rubber goods
25.	Glass
26.	Timber products
27.	Diamond, gold ornaments
28.	Printing of books (including litho printing industry)

Note: The industry categories are based on the DIPP classification for FDI inflows in India. In the concordance with NIC codes, some DIPP manufacturing industry codes were clubbed.

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