Inward FDI and firm-specific advantages of Indian manufacturing industries

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The unprecedented growth of international productions and Foreign Direct Investment (FDI) flows over the last two decades has led to the upsurge in scientific investigation into the distinctive facets of FDI. Despite the considerable amount of research undertaken, it seems that there is very little comprehensive economic analysis of FDI flows with respect to Indian firms. The present study attempts to bridge this gap by answering the following research question: what are the micro-level causes of FDI inflow, i.e. what are the determinants or pull factors of FDI inflow into Indian domestic firms? In order to analyze this question the study uses a panel data structure constructed over the recent 5 years, ranging from 2006 to 2010 and covering 22 sectors in Indian Manufacturing Industries. Adoption of Fixed and Random effects estimation procedure help to identify that among a set of firm-specific factors, only technological intensity, both in-house and import along with product differentiation have negatively contributed for foreign investors' shareholding of local firms. The export performance, age, asset size and sales volume are among other remaining firm-specific characteristics which lack effective pulling effects in attracting FDI.

Key words: *FDI, firm-specific factors, panel data*.

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1. Introduction

Firm-specific advantages, other-wise better known as monopolistic advantages or ownership advantages, have constituted the building blocks in the research field of foreign direct investment (FDI) since the mid-fifties of twentieth century [Hymer 1960]. Their influence on a firm's decision to engage in FDI (e.g., Dunning [1980]; Lall [1980, 1983]; Terpstra and Yu [1988]; Yu and Ito [1988]) and on parent firms' ownership preferences for foreign subsidiaries (e.g., Agarwal and Ramaswami [1992]; Erramilli and Rao [1993]; Kim and Hwang [1992]) has been intensively investigated both theoretically and empirically. Another, more important, stream of research suggests that the relevance or importance of a particular firm-specific advantage may be contingent upon the characteristics of host countries. Several authors, including Buckley [1990], Casson [1987] and Dunning [1980, 1988a], have stressed that a multinational's firm-specific advantages should be considered in relation to competing enterprises or in reference to the competitive environment in host countries. For instance, an U.S. MNC may conceivably enjoy a greater advantage over firms in third world countries, say India, than those in developed countries.

However, little empirical effort has been expended to test this argument. Perhaps this is because these firms may find that the firm-specific advantages necessary to operate in developing countries are different from those operating in more-developed countries. Therefore, the present study investigates the contingent effect of the host locational factors on the nature of firm-specific advantages enjoyed by foreign MNCs. It focuses on the attractiveness of domestic-market conditions which appeal the MNCs most.

Specifically, the present research paper proposes that the nature of influence of firm-specific advantages on the ownership levels of foreign MNCs investing in India is different from those investing in other countries. The paper examines certain explicit firm-specific factors, namely, technological intensity, product differentiation, capital intensity, degree of internalization, assets size of firm, sales and age that potentially represent sources of firm-specific advantages to MNCs. It develops hypotheses to explain how these factors influence foreign firms' subsidiary-ownership preferences in India. The hypotheses are tested using data from Prowess database of Centre for Monitoring Indian Economy.

The present paper proceeds as follows. Section 2 highlights the trends and patterns of FDI inflow where in the sector-wise, state-wise and country-wise analysis is made along with a brief investment outlook. A brief literature review finds its place in section 3 and the variables are defined and their due justification is provided in subsequent section of 4. The next section 5 gives a detailed data and methodology analysis along with the analytical framework. Results, findings and their discussion are made in section 6. Lastly but not the least the paper ends with a concluding remarks.

2. Trends and Patterns of Inward FDI in India

Inward FDI for a specific country is the direct investment by foreign companies into that country. The country of destination of the investment or the recipient party is referred to as the *host country*. The host country like India opens up her doors for the foreigners with an aspiration of gaining some potential benefits. If we look at the changing pattern of FDI trend across the globe during 1990-2010, we find that the developing countries are competing with the developed nations in terms of IFDI (Source: WIR, 2011). However the developed countries dominate over the developing countries in the frontier of OFDI. Among the developing countries, the Asian countries lead in IFDI over the Latin America and Caribbean countries and Africa. If we select a few but emerging economies like China, Hong Kong, Russia, Brazil, India, South Africa, Chile, Argentina, Singapore, Indonesia, the first two countries have the highest share in IFDI. India's stand is after Russia, Brazil and Singapore in terms of IFDI so far as the latest findings are concerned.

2.1 FDI inflows to India

FDI inflows grew steadily through the first half of the 90s but stagnated between 1996 and 2003 (Table 1).The year-on-year fluctuations until 2003-04 make it difficult to identify a clear trend; however, inflows have been increasing continuously since 2004-05. In the year 2006-07, the growth in FDI inflows is the maximum. During 2008-09, India registered FDI inflows of $33.1 billion and become more than the double in comparison to the previous year. The total cumulative inflows from August 1991 to March 2009 have been to the tune of $121.9 billion.

Table 1
FDI Inflows to India (1991 to 2009)

	Amount of FDI inflows		Annual Growth	
Year	Rs. Crore	US$ million	$ value	Rs. value
1991 (Aug.-Dec.)	3,535	144	-	
1992	6,912	264	(+)83%	(+)95%
1993	18,620	608	(+)130 %	(+)169%
1994	31,122	992	(+) 63 %	(+)67%
1995	64,854	2,065	(+)108 %	(+)108%
1996	87,522	2,545	(+) 23 %	(+)34%
1997	129,898	3,621	(+) 42 %	(+)48%
1998	132,692	3,359	(-) 07 %	(+)2%
1999	92,599	2,205	(-) 34 %	(-)30%
2000	104,411	2,428	(+) 10 %	(+)12%
2001	160,711	3,571	(+) 47 %	(+)53%
2002	161,344	3,361	(-) 59 %	(+)0.39%
2003	95,640	2,079	(-) 38 %	(-)40%
2004	147,814	3,213	(+) 55 %	(+)54%
2005	192,707	4,355	(+) 36 %	(+)30%
2006	503,573	11,119	(+)155 %	(+)161%

2007	654,950	15,921	(+) 43 %	(+)30%
2008	1,397,255	33,029	(+) 107 %	(+)113%
2009	1,309,799	27,044	(-) 18 %	(-)6%
Cumulative total	5,295,958	121,923		

Source: Secretariat for Industrial Assistance, various FDI Fact Sheets

2.1.1 Sector-wise FDI inflows

Over the recent past, the sector-wise inflows of FDI have undergone a change. This is clear from the variation in the sector ranks based on their share in total FDI inflows. For comparison, we divide the period from 1991 to 2009 into two sub-periods of approximately the same length: the initial period of 1991 to 1999 and the second sub-period of 2000 to the latest available (i.e., 2009).

Table 2 presents the ranks, names and shares of FDI inflows for the top 20 sectors as reported in SIA publications. The figures are reported for the two cumulative periods and the year 2009 for which the latest information is available. The FDI inflows appear to be concentrated among the 20 industries. During the initial sub-period, namely, August 1991 to December 1999, the 20 sectors constituted 59.8 per cent of total FDI inflows, whereas during the second sub-period, namely, January 2000 to March 2009, these sectors constitute 79.3 per cent of the total FDI inflows. The emergence of the service sector is clear from a comparison of the shares over the two sub-periods. Other new sector entrants in the list of top five recipient sectors include computer software & hardware, construction activities and housing & real estate.

Table 2
Share of Top Recipient Sectors in FDI inflows to India

	Sector (Share as % of total Investment)		
Rank	1991 to 1999	2000 to 2009	2009
1	Transportation Industry (8.9)	Services Sector (21.2)	Services Sector (21.22)
2	Electrical Equipment (8.0)	Computer Software & Hardware (9.99)	Housing & Real Estate (11.85)
3	Services Sector (7.0)	Telecommunications (7.1)	Telecommunications (9.50)
4	Telecommunications (6.9)	Housing & Real Estate (6.1)	Construction Activities (8.95)
5	Chemicals (6.9)	Construction Activities (5.7)	Power (6.09)
6	Fuels (6.3)	Automobile Industry (3.9)	Automobile Industry (5.03)
7	Food Processing Industries (4.1)	Power (3.6)	Agriculture Services (4.84)
8	Paper and Pulp (1.5)	Metallurgical Industries (3.0)	Electrical Equipment (2.91)
9	Miscellaneous Mechanical Engineering (1.4)	Petroleum & Natural Gas (2.6)	Information & Broadcasting (2.90)
10	Textiles (0.74)	Chemicals (2.4)	Computer Software & Hardware (2.64)
11	Drugs & Pharmaceuticals (1.4)	Cement and Gypsum Products (1.9)	Hotel & Tourism (2.19)
12	Trading (1.1)	Ports (1.7)	Trading (1.93)

13	Metallurgical industries (1)	Trading (1.7)	Metallurgical Industries (1.74)
14	Glass (0.9)	Drugs & Pharmaceuticals (1.7)	Chemicals (1.69)
15	Commercial, Office and Household equipment (0.9)	Electrical Equipment (1.6)	Consultancy Services (1.55)
16	Industrial Machinery (0.6)	Information & Broadcasting (1.5)	Petroleum & Natural Gas (1.41)
17	Rubber Goods (0.5)	Hotel & Tourism (1.4)	Sea Transport (1.07)
18	Hotel & Tourism (0.5)	Consultancy Services (1.4)	Drugs & Pharmaceuticals (0.75)
19	Agricultural Machinery (0.3)	Food Processing Industries (0.9)	Textiles (0.74)
20	Ceramics (0.2)	Electronics (0.8)	Food Processing Industries (0.74)

Source: SIA Newsletter April 2009.

2.1.2 State-wise Distribution of FDI Inflows

The state-wise trends in FDI show that the RBI's regional offices at Maharashtra, New Delhi, Karnataka, Tamil Nadu and Gujarat have been the largest recipients of FDI in terms of cumulative FDI inflows from 2000 to 2009 (Table 3). These states are either known for their strong industrial base (like Gujarat) or as software hubs (like Karnataka and Delhi). This could also be attributed to their better resources, infrastructure like roads and power, investor-friendly policies like single-window clearances and investment promotion schemes like special economic zones. However, the competition among the states to promote their own state in attracting FDI has led to an increasing trend in FDI in other states.

Table 3
RBI's Region-wise Break-up of FDI Inflows to India (2000 to 2009)

S. No.	Regional Offices of RBI	States Covered	Share In Total FDI Inflows
1	Mumbai	Maharashtra, Dadra & Nagar Haveli, Daman & Diu	35.87
2	New Delhi	Delhi, Part Of UP And Haryana	19.40
3	Bangalore	Karnataka	6.34
4	Ahmedabad	Gujarat	5.92
5	Chennai	Tamil Nadu, Pondicherry	5.10
6	Hyderabad	Andhra Pradesh	4.25
7	Kolkata	West Bengal, Sikkim, Andaman & Nicober Islands	1.17
8	Jaipur	Rajasthan	0.47
9	Chandigarh`	Chandigarh, Punjab, Haryana, Himachal Pradesh	0.42
10	Panaji	Goa	0.39
11	Kochi	Kerala, Lakshadweep	0.30
12	Bhopal	Madhya Pradesh, Chattisgarh	0.18
13	Bhubaneshwar	Odisha	0.17
14	Guwahati	Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Tripura	0.06
15	Kanpur	Uttar Pradesh, Uttranchal	0.05

16	Patna	Bihar, Jharkhand	0.00
17	Region Not Indicated		19.92

Source: SIA Newsletter April 2009.

2.1.3 Country-wise FDI Inflows

Among the countries heading the list of FDI inflows into India is Mauritius (Table 4). This could be attributed to the double taxation treaty that India has signed with Mauritius and also to the fact that most US investment into India is being routed through Mauritius. However, Singapore is the second largest investor in India followed by the US and other developed countries like the UK and the Netherlands, which are India's major trading partners. Table 4 shows the share of the top investing countries in India's FDI for the two sub-periods defined earlier. While the significance of Germany and Japan has declined in terms of their share in FDI inflows into India, Cyprus and the UAE have entered the list of top 10 investing countries during the cumulative period (2000-2009).

Table 4
Share of Top Investing Countries in FDI inflows to India

	Country-Wise Share As % of Total Investment		
Rank	1991-1999	2000-2009	2009
1	Mauritius (21.6)	Mauritius (42.8)	Mauritius (42.76)
2	U.S.A. (14.4)	Singapore (11.3)	Singapore (11.32)
3	Japan (5.1)	U.S.A. (5.4)	U.S.A. (7.54)
4	Germany (4)	U.K. (5)	Cyprus (5.93)
5	U.K. (3.8)	Cyprus (4.2)	Japan (4.65)
6	Netherlands (3.7)	Netherlands (3.1)	Netherlands (3.06)
7	South Korea (3.6)	Germany (2.4)	U.A.E. (2.30)
8	Singapore (2.1)	France (1.5)	Germany (2.20)
9	Hong Kong (1.6)	Japan (1.2)	U.K. (1.73)
10	France (1.6)	Russia (1.1)	France (1.10)

Source: SIA Newsletter April 2009.

2.2 **Investment Outlook**

A number of studies in the recent past have highlighted the growing attractiveness of India as an investment destination. According to Goldman Sachs (2003), the Indian economy is expected to continue growing at the rate of 5 per cent or more until 2050. According to the A.T. Kearney (2007), India continues to rank as the second most attractive FDI destination, between China at number one and the United States at number three. India displaced the United States in 2005 to gain the second position, which it has held since then. FDI inflows in 2006 touched $16.8 billion and in 2007, total FDI inflows in India stood at $25 billion, showing a growth rate of 152 per cent over 2005 and 48 per cent over 2006. In 2008, total FDI inflows into India stood at ever-highest $40.4 billion.

UNCTAD ranks countries by their Inward FDI Performance and Inward FDI Potential Indices. While India is the second most attractive country in terms of the foreign investors' confidence

index, it does not rank high on either the performance or potential indices. UNCTAD (2010) provides a matrix of four groups of countries based on their FDI performance and potential wherein countries like Chile, Hong Kong, Malaysia, Singapore and Thailand are "front runners", and China is below potential, all the major South Asian countries, viz., Bangladesh, India, Nepal, Pakistan and Sri Lanka are "under-performers". India's FDI Performance Index in 2010 ranked at 97out of 141 countries based on 12 policy and economic variables. However, it has a relatively high FDI Potential Index at 79.

Another method of assessing the investment potential of an economy is its rank on global competitiveness. The Global Competitiveness Index (GCI) is a comprehensive index developed by the World Economic Forum (WEF) to measure national competitiveness and is published in the Global Competitiveness Report (GCR). It takes into account the micro- and macro-economic foundations of national competitiveness, in which competitiveness is defined as the set of institutions, policies and factors that determine the level of productivity of a country and involves static and dynamic components. The overall GCI is the weighted average of three major components: a) basic requirements (BR); b) efficiency enhancers (EE); and c) innovations and sophistication factors (ISF).

Within the information available (GCI Report, 2010) for 139 countries, Switzerland is ranked the highest, with an overall index of 5.63, and Chad is ranked the lowest with an overall index of 2.73; the overall index is 107 for Bangladesh, 123 for Pakistan and 62 for Sri Lanka. The overall rank of India at 51 is still below that of China at 35. In terms of the components, India holds a relatively low rank for BR (81), but higher ranks for EE (38) and even higher for ISF (42). Compared to China, India's rank is lower in all the three components.

The above mentioned facts clearly demonstrate that many countries across the globe stand taller than India in terms of attracting FDI to their region. However, the figures pertaining to FDI inflows over the last twenty years reveal the fact that India becomes an emerging economy in terms of destination but that is not enough. Therefore, the obvious question arises, i.e. where does the problem lie? So far as the economic research in this field is concerned, there is no dearth in it. But most of them focus on the macro-level or country-specific determinants of FDI inflow. There are of course a few firm-specific analyses in the literature but the present study shows succinctness by making a comprehensive economic analysis of FDI inflows, especially focusing on its firm-specific determinants, by considering a recent and updated version of data ranging over time and across firms.

3. Firm-specific Determinants of FDI:

It is not surprising that there exists no general theory that can comprehensively explain the existence of MNCs and FDI. As a result of this, the FDI literature is diverse and spans over several different disciplines including international economics, economic geography, international business and management. There exist several studies providing overviews of FDI theories, for example, Agarwal[‡] (1980) and Faeth[§] (2009) and among others: Cantwell (1991),

[‡] Agarwal (1980), distinguished thirteen different models in four categories (Hypothesis of Perfect Markets, Hypothesis based on Market Imperfections, Hypothesis on the Propensity to Invest and Determinants of the Inflow of FDI).

Meyer (2001) and Markusen (2002). Most theories of FDI have emerged during the post war period, when the forces of globalization began to grow. The growing importance of MNCs and FDI during the fifties and sixties gave an impetus to researchers to find theories able to explain the behaviour of MNCs and the existence of international production. This chapter presents a review of the different theoretical models and econometric studies in relation to FDI. Some of the important theoretical models and empirical studies of FDI are mentioned below.

Following the seminal works such as Buckley and Casson (1976) and Dunning (1979, 1988), the theoretical explanation of the multinational enterprise is a function of three types of advantage that may be generated for the firm. First, ownership advantage; that in order to succeed in host markets the firm must possess some inherent advantage over the domestic competition. Secondly, location advantage; that by locating assets in a particular country or region, the firm is able to gain due to the factor endowments available in that location. Thirdly, internalization advantage, that FDI must be more efficient than arms-length trading.

Pearce (1993) argues that ownership advantage is generated through R&D. The other firm specific phenomena, associated with the creation of some firm specific advantage can be seen in the same light. Examples of these are advertising, exploitation of economies of scale, industry structure and the conditions of entry. However, the relationship between entry barriers and FDI is somewhat ambiguous.

In addition to firm specific ownership advantage, explanations of FDI are also based on location advantage. This concern the benefit conferred on the organization, due to its presence in a particular location. This is generally related to country specific phenomena, or within the international economics literature, the factor endowments of a particular country or region. However, there is an established link between agglomeration economies and FDI. While particular locations may be expected to confer certain advantages on the firms concerned, the reverse may also be true. Porter (1990) stresses the importance of spatial agglomeration in location theory, and the performance of certain industries and firms. High levels of regional concentration of industries within the UK may therefore be seen as a source of location advantage, beyond merely factor endowments, through agglomeration economies.

The fundamental hypothesis in relation to internalisation is that FDI is in part a response to market failure and are characterized by asymmetric information and agency problems in general (Coase, 1937). Attempts to operationalize the internalization hypothesis within an econometric model are somewhat limited, due to the difficulty of obtaining suitable proxies. Kumar (1987, 1990) and Pearce (1993) however link the importance of internalization directly to the existence of ownership advantages. As such therefore, R&D intensity, advertising intensity, and to a lesser extent, capital intensity, are expected to be the indicators of internalization advantage as well ownership advantage.

[§] Faeth (2009) gave nine theoretical models: early studies of FDI, Neoclassical Trade Theory, ownership advantages, aggregate variables, OLI framework, horizontal, vertical FDI and Knowledge-Capital Model, diversified FDI and risk diversification model and policy variables as determinants of FDI.

4. Selection of variables:

A number of firm-specific factors were mentioned and analysed as potential determinants of FDI inflows into India. But amongst the vast list only a few and most commonly empirically-tested factors are included in our study, they are: R&D intensity, advertisement intensity, intensity of technological imports, degree of internationalization, age, asset size and sales volume of domestic firms. The selection of these potential determinants for the econometric analysis is backed by the theories mentioned in the previous section and most importantly depends on data availability. It is basically focused on two things: (a) the research question and (b) the availability of data at hand. On this basis, the following variables are chosen which are discussed below.

4.1 Technological Intensity:

Previous research pertaining to firm-level FDI patterns has revealed a mixed correlation between research and development intensities of firms and the proportion of subsidiaries organized as sole ventures rather than joint ventures [Stopford and Wells 1972]. According to Hymer [1960], sole ventures are desired in order to appropriate fully the returns on certain skills and ability. Kindleberger [1984] added that relatively low-tech firms invite foreign promoters to open joint ventures in host economy in order to upgrade their technologies through assimilation. Additionally, concerns about loss of proprietary knowledge drive firms to open their own associates rather than choosing franchising or licensing as the mode of operation.

Gatignon and Anderson [1988] found strong support in their study on U.S. multinationals. The probability of holding more equity of a firm increases with less R&D intensity but reversely establishing wholly owned subsidiaries increases with R&D intensity, a surrogate for technological intensity. Firm-level *economies of scale* as suggested by Brainard (1997) is an important factor which influence the strategic operation of firms and for which R&D intensity by firms is taken as the variable. Less is R&D intensity of domestic firms; more is expected in terms of purchasing, managerial, financial and marketing operations of foreign firms over the domestic players by purchasing more and more equity shares. This results in greater chance of foreign market operation rather than limiting itself to domestic area. Therefore,

> **Hypothesis 1**: *More (less) R&D intensive is the domestic firm; less (more) is its chance of being open-up for foreign MNCs.*

4.2 Product Differentiation

Product differentiation is an important firm-specific advantage that can ensure higher economic rent. Firms attempt to differentiate products in many ways, but an important component is creation of positive brand images through the use of marketing promotions including advertising. Empirical evidence based on advanced-country multinationals suggests that higher advertising intensities lead to greater use of higher-equity modes [Gatignon and Anderson 1988]. Both Dunning [1981] and Caves [1982] have suggested that protection of brand image is difficult if the firm does not fully control the subsidiary.

Historically, developing-country MNCs have lacked financial resources [Giddy and Young 1982] and marketing skills [Wells 1983] needed to compete successfully and survive in industries. This led the other MNCs that have established strong brand-images to enter into the host economy [Singh &Jun (1995)]. However, firms in developing-countries have survived on the ability to make undifferentiated or generic products and sell them at low prices [Wells 1983]. The cost-leadership strategy has been pragmatic because such firms have usually produced mature products and entered a particular product market as a follower. But as the foreign MNCs invest in advertising to create brand identities, the firms produces fresh products as a leader rather than merely focusing on their efforts to create a low-cost advantage [Porter 1990]. While cost-based strategies are still important, some modicum of brand differentiation is needed to create and sustain competitive advantage. The latter is possible when the foreign MNCs increase their equity holding of domestic players. Thus,

> **Hypothesis 2**: *More (less) diversified is the product of domestic firm by spending a larger (smaller) percentage of its sales on advertisement; less (more) are its chance of joint production with foreign MNCs by offering its equity to be purchased by the foreign promoters.*

4.3 Capital Intensity

Using and adapting low capital, labour-intensive manufacturing technology represents a major source of competitive advantage for Third-World firms in relation to local as well as multinational competitors in host countries [Diaz-Alejandro 1977; Porter 1990]. Firms from the developing countries, such as India, however, do not fit this mould exactly. Not all Indian firms but many of these achieve low-cost production through mass production of standardized products. Such production requires large capital investment in large-scale, modern facilities. This is mitigated by importing the technology in terms of expenses of firms in technological know-how, royalty fees and license fees. Many Indian firms are willing to make big capital investments in such technological imports to sustain in the market.

If any firm does not involve itself in importing technology or at least not sufficiently, then there will be scarcity of abundant capital investment which will result in small-scale of production. In order to attain the similar level of production or even more, the firm needs to arrange sufficient capital investment alternatively. This alternative arrangement can be asserted by allowing the foreign MNCs to procure more equity holding of such domestic firms. Hence our proposition is:

> **Hypothesis 3**: *Larger (smaller) is the share of sales of domestic firms spent on importing the technology from abroad, less (more) is its prospect of being in a joint venture with foreign MNCs.*

4.4 Internationalization

Grant (1987) argued that measures of internationalization should reflect the relative size and strategic importance of domestic and overseas operations. Studies have adopted various

measures as proxies of internationalization, including: (1) ratio of foreign sales to total sales (Geringer et al., 1989, 2000; Grant et al., 1988; Tallman and Li, 1996), (2) ratio of foreign assets to total assets, (3) number of foreign subsidiaries (Tallman and Li, 1996), (4) number of overseas employees to number of total employees (Kim et al., 1989), (5) number of FDI proposals and approvals (Delios and Beamish, 1999), and (6) entropy index weighted by foreign sales (Kim et al., 1993; Hitt et al., 1997). Gomes and Ramaswamy (1999) regarded each measure as a reflection of the different facets of internationalization. Sullivan (1994), however, speculated that use of different measures would lead to inconsistent results. With this concern in mind, he developed a single indicator of multidimensionality, which has been subsequently criticised in terms of lacking validity (Ramaswamy et al., 1996).

Based on an incremental process view of internationalization, Bartlett and Ghoshal (1989) argued that it would be more telling to measure firms' degree of internationalization by examining their presence in developing countries at their initial stage of internationalization, as compared to the commonly-used ratio (foreign sales to total sales) adopted when studying firms in developed countries. Therefore, it is wise to use the export intensity as a proxy of internationalization. This is because it is more likely to be the dominant vehicle of internationalization for the Indian firms and also appropriate for our limited database. Based on these findings:

> **Hypothesis 4**: *Greater (restrictive) degree of internationalization leads to more (less) FDI inflow to the specific firm.*

4.5 Age

The degree of foreign equity participation in a firm is a cumulative process that builds-up over time and is a function of its experience over the years. The age of a firm is likely to influence the foreign promoters' decision to invest in. Higher is the age, more is expected in terms of reputation, understanding of the market, up-gradation of skills and managerial capabilities. The stock of intangible assets of the firm, which is cumulative in nature, can be expected to grow with age. The established firms may have accumulated valuable production and business experience that gives them a monopolistic advantage. This factor has been tested in many past studies (e.g. Lall, 1983; Chen, 1983), and is expected to affect favourably the foreigners' investment decision. For calculating age, we use the formula of current year *minus* the incorporation year. Hence,

> **Hypothesis 5**: *More (less) experienced firm attracts more (less) FDI inflows.*

4.6 Firm Size and Sales

Larger is the size of firms and bigger is the volume of their sales, there is a greater possibility that such firm can help the foreign MNCs operations by the way of fully internalising the risk and uncertainty associated with host location. Several benefits of assets size and volume of sales are predicted in the literature. For example, resource base, easy access to market information, knowledge of procurement sources and preferential access to capital markets tend to induce the

foreign firms to set-up their production-base there-only. Further, as argued by Caves (1982), the larger the firm (in terms of sales or size or both) in the domestic market, the more profitable and less risky would be on the part of foreign investors to venture with those firms. Several studies on developed country MNEs (Horst, 1972; Blomstrom & Lipsey, 1986) as well as developing country MNEs (Lall, 1986) found size and sales to be an important pull factors for firms. Therefore, the foreign participation in Indian enterprises is postulated to be positive related to firm size (SIZE) and sales (SALES) of the host economy.

> **Hypothesis 6:** *Larger (smaller) in size and more (less) voluminous in sales are plausible pull-factors for more (less) FDI inflows.*

5. Data and Methodology:

The data for the present study has been extracted from the 'Prowess', a firm-level database from the Centre for Monitoring Indian Economy[**] (CMIE). Keeping in view with the availability of data, twenty-two Manufacturing industries are selected, the broad classification (in two-digit) of which is backed by National Industrial Classification (NIC), published in 2008 by the Central Statistical Organization (CSO). The severe distrust on the richness and authenticity of secondary firm-level database, whether it is CMIE that has been considered in the present study or any other alternatives (if available), is one of the prima-cause for excluding the services sector from our analysis. Only 311 firms (number of groups) across the entire manufacturing industries are covered in the sample base for 5 years, i.e. from 2006 to 2010. The selection of firms is according to the following guideline. Only those firms are selected which have foreign equity holding of 10% or more. However there are some missing observations on the firm-specific variables (mentioned above) which reduce the entire number of observations in the sample to 1281.

Analytical Framework

The theoretical work on the firm-specific determinants of FDI and a discussion of various factors affecting FDI has already been presented in the previous section. In this section, we present the explanatory variables in a theoretical model which looks like:

$$FDI_{it} = f(R\&D_{it}, Adv_{it}, Rolty_{it}, Exp_{it}, Age_{it}, Size_{it}, Sales_{it}) \quad (1)$$

We use *i* to index the countries and tto index time and the rationale for including these variables is explained before. The econometric representation of this version:

$$fdi_{it} = \alpha + \beta_1 R\&D_{it} + \beta_2 Adv_{it} + \beta_3 Rolty_{it} + \beta_4 Exp_{it} + \beta_5 Age_{it} + \beta_6 Size_{it} + \beta_7 Sales_{it} + \varepsilon_{it} \quad (2)$$

[**] The Centre for Monitoring Indian Economy (CMIE) is an independent economic think-tank headquartered in Mumbai, India. They provide information solutions in the form of databases and research reports. It has built the largest database on the Indian economy and companies. Prowess is a database of large and medium Indian firms. It contains detailed information on over 25,346 firms and detailed information on each company like; quantitative information on production, sales, consumption of raw material, energy, etc. Totally, the number of indicators per company is close to two thousand. Such information is usually available for over ten years.

A panel data set contains repeated observations over the same units collected over a number of periods. In comparison to a single cross-section or a single time series, it helps economists to specify and estimate more complicated and more realistic models. On the contrary, since we repeatedly observe the same units, it is usually no longer appropriate to assume that different observations are independent (i.i.d) rather it may complicate the analysis, especially when the models are nonlinear and dynamic in nature.

An important advantage of panel data compared to time series or cross-sectional data sets is that, without making any restrictive assumptions, it allows not only to model or explain why individual units behave differently but also to model why a given unit behaves differently at different time periods. Let all variables be indexed by an *i* for the individual(i = 1,...,N)and a *t* for the time period (t = 1,...,T). In very general terms, a linear model can be specified as:

$$y_{it} = \alpha_i + x'_{it}\beta + \varepsilon_{it} \tag{3}$$

where x_{it} is a K-dimensional vector of explanatory variables, not including a constant. This means that the effects of a change in x are the same for all units in all periods, but that the average level for unit *i* may be different from that for unit *j* .The α_i thus capture the effects of those variables that are peculiar to the *i*-th individual and that are constant over time. In the standard case, ε_{it} is assumed to be independent and identically distributed (i.i.d.) over individuals and time, with mean zero and variance σ_ε^2 .If we treat the α_i as N fixed unknown parameters, the model in (3) is referred to as the standard *fixed effects model*.

An alternative approach assumes that the intercepts of the individuals are different but that they can be treated as drawings from a distribution with mean μ and variance σ_α^2 . The essential assumption here is that these drawings are independent of the explanatory variables in x_{it}. This leads to the *random effects model*, where the individual effects α_i are treated as random. The error term in this model consists of two components: (1) a time-invariant component α_i and (2) a remainder component ε_{it} that is uncorrelated over time. It can be written as:

$$y_{it} = \mu + x'_{it}\beta + \alpha_i + \varepsilon_{it} \tag{4}$$

where μ denotes the intercept term. (For more details see appendix A)

Which model to use?

The selection of model between fixed effect and random effect depends on the 'true nature' of the effects α_i, i.e; whether to treat the individual effects as fixed or random as such decision puts a significant amount of difference in the estimates of the β parameters. The fixed effects approach is conditional upon the values for α_i. In contrast, the random effects approach is not conditional upon the individual α_i but 'integrates them out'. Hausman (1978) has suggested a test wherein the two estimators (one from FE and another from RE) are compared. The Hausman test thus tests whether the fixed effects and random effects estimator are significantly different.

6. Results and Discussion:

In an attempt to determine the factor-specific determinants of FDI, in this study the panel data techniques has been employed. These effects are either fixed effect or random effect. A fixed effect model assumes differences in intercepts across groups or time periods, whereas a random effect model explores differences in error variances. The Hausman specification test compares the fixed versus random effects under the null hypothesis that the individual effects are uncorrelated with the other regressors in the model (Hausman 1978). If correlated (H0 is rejected), a random effect model produces biased estimators, violating one of the Gauss-Markov assumptions; so a fixed effect model is preferred. Hausman's essential result is that the covariance of an efficient estimator with its difference from an inefficient estimator is zero (Greene 2003). When we performed the Hausman test specification, the test recommended the use of fixed effects model. Table 5 however reports the relevant estimates with default and robust standard errors considering both the fixed effect model and random effect model. The descriptive statistics and correlation matrix along with Hausman test is mentioned in Appendix B.

Table 5
Panel Data Estimates: Fixed effects and Random Effects (2006-2010)

	Within or Fixed Effect estimation with Default Standard Errors		Within or Fixed Effect estimation with robust Standard Errors		Random Effect estimation with Default Standard Errors		Random Effect estimation with robust Standard Errors	
Variables	Coefficient	t statistic	Coefficient	t statistic	Coefficient	z statistic	Coefficient	z statistic
rd	-.075***	-2.77	-.075*	-1.70	-.026	-1.29	-.026	-0.91
adv	-.077***	-2.63	-.077	-1.32	-.039**	-2.01	-.039	-1.36
rolty	-2.203**	-2.27	-2.203**	-2.18	.728	0.89	.728	0.49
exp	.032	0.62	.032	0.36	-.046	-1.49	-.046	-1.28
lage	.026	0.50	.026	0.27	.053***	3.02	.053**	2.36
lsz	.011	0.63	.011	0.52	-.003	-0.21	-.003	-0.19
ls	.007	0.43	.007	0.36	.019	1.44	.019	1.39
Constant	.214	0.95	.214	0.57	.079514	1.14	.079514	0.95
sigma_u	.25				.2			
sigma_e	.126				.126			
rho	.797				.715			
R^2:within	0.022				0.002			
R^2:between	0.008				0.135			
R^2:overall	0.007				0.099			

*Notes: Here *significant at 10%, ** significant at 5%, ***significant at 1%.*

Dependent Variable:

fs: Foreign Share (% of equity holding by foreign promoters)

Independent Variables:

rd: R&D Intensity (Ratio of expenses of firms on Research and Development to total sales)

adv: Advertisement Intensity (Ratio of expenses of firms on Advertisement to total sales)
rolty: Technology imports Intensity (Ratio of expenses of firms on royalty, technical knowhow fees and license fees to total sales)
exp: export performance of firms (Ratio of value of total exports of firms to total sales)
age: Subsistence of firms (current year-incorporation year)
lsize: Assets size (natural logarithmic transformation of firms' total assets [in Rs. Lakh])
ls: sales volume (natural logarithmic transformation of firms' total sales [in Rs. Lakh])

From the result it seems that all the explanatory variables as specified in the econometric functions are not seen to be significant elements in attracting FDI in Indian manufacturing industries. For instance only three variables, namely R&D intensity, advertisement intensity and technology imports intensity from the fixed effects model and the age variable in addition to the advertisement intensity from the random effects model is seen to be significant. Other firm-specific characteristics are found insignificant in the model. This means the idiosyncratic features of Indian firms do play a role, though not so promising, in attracting the foreigners to participate in their equity holding.

The in-house R&D has a negative relationship with the decision of foreign MNCs trying to invest in Indian firms. The figures indicate that if the ratio of expenses of firms on Research and Development to total sales falls (or rises) by a single percentage, then the foreign participation in the same firm will increase (or decrease) by 0.075%. This indicates that the low-tech firms invite foreign promoters to open joint ventures in host economy in order to upgrade their technologies through assimilation. Besides these, as the host location becomes an attractive destination in the international market, competition becomes severe, and as a result, the firm-level *economies of scale* become scarce. The temptation to grab such scale influences the strategic operation of foreign firms. Moreover, if the domestic firm does not spend sufficiently in its R&D activities to support its technological competitiveness, then it attracts the foreign investors to bring with them a package of managerial, financial and marketing operations which will take care of the domestic firms' technological paucity and the foreigners' foot-hold in the host country become stronger in return. Besides these, the domestic firm may be scuffled between opening-up a joint venture with foreign MNCs or may spend on the in-house R&D. This decision may emerge as two alternative means of technological up gradation.

The variable 'advertisement intensity' is also significant and has a negative sign. The figures indicate that if the ratio of expenses of firms on advertisement to total sales falls (or rises) by a single percentage, then the foreign participation on the same firm will increase (or decrease) by 0.077%.This indicates that those domestic firms which diversify their products on their own restrict the foreign MNCs to enter. On the contrary, those domestic firms which cannot diversify their products on their own due to lack of financial resources and marketing skills, open-up themselves for foreign MNCs. At least the latter enters into the host economy with a package of strong brand-images that mitigate the need of domestic players. Earlier studies (Siddharthan & Lall, 1982; Dunning, 1993) also report similar findings, namely, advertisement intensity negatively related to investment or growth. One possible reason for this empirical phenomenon could be thenature of non-price competition in an oligopolistic industry. Perhaps firms advertise more to counter their rivals' advertising. Firms do not gain by advertising but none can afford

not to advertise. The domestic firms have lacked financial resources and marketing skills needed to compete successfully and survive in industries by the way of diversification of products. This led the foreign MNCs to enter into the host economy by establishing strong brand-images.

The figures indicate that if the ratio of expenses of firms on royalty, technical knowhow fees and license fees to total sales falls (or rises) by a single percentage, then the foreign participation on the same firm will increase (or decrease) by 2.203%. This indicates that those domestic firms which import the required technology to produce or improve the process of production on their own restrict the foreign MNCs to enter. On the contrary, the domestic firms which cannot bear the expenses of technological know-how, royalties' fees and license fees on their own, choose an alternative mode of arrangement, i.e. open-up themselves for foreign MNCs which bring a package of advanced that mitigate the need of domestic players. The negative impact of the technology import variable on foreigners' investment behaviour may be justified on the following grounds. The need for low-cost production through mass production of standardized products requires capital investment in large-scale and in modern facilities. This is mitigated by importing the technology in terms of expenses of firms in technological know-how, royalties' fees and license fees. Many Indian firms are willing to make big capital investments in such technological imports to sustain in the market. If any firm involves itself less in importing technology then there will be scarcity of abundant capital investment and up to date technology which will directly hit the scale of production. In order to attain the similar level of production or even more, the firm needs to arrange sufficient capital investment alternatively. This alternative arrangement can be asserted by allowing the foreign MNCs to procure more equity holding of such domestic firms.

The domestic firms' export performance, age, size and sales figure a positive impact on FDI as well suggesting that an efficient environment that comes likely to attract foreign firms. However such variables fall short of sufficient statistical significance, which delimit their importance and elaborative justification of such firm-specific factors.

Since the panel is short, the strength of the assumption that errors are independent across individuals is weaker and hence may subject to the problem of heteroscedastic. Therefore, the use of robust standard errors is also mentioned along with the default results. The difference can be witnessed in terms of dropping the variable advertising intensity from the category of significant factors affecting the FDI decision while considering the robust results. However the coefficients remain unaltered.

The output from the above models also includes estimates of the standard deviations of the error components. The combined error can be decomposed into sigma_u and sigma_e. The sigma_u gives the standard deviation of the individual effect and sigma_e gives the standard deviation of the idiosyncratic error. If the individual-specific component of the error is dominant over the idiosyncratic component, then rho (ρ) will tend towards unity. The rho is indicating the intra-class correlation of the error which is defined as follows:

$$\rho_u = corr(u_{it}, u_{is}) = \frac{\sigma^2{}_\alpha}{\sigma^2{}_\alpha + \sigma^2{}_\varepsilon}$$

In our findings, the intra-class correlation is higher in FE estimation (0.797) in comparison to RE estimation (0.715).

$R^2$is defined as the correlation between the actual and the fitted values of the dependent variable. In the present panel framework, $R^2$is defined in three different categories which have been discussed as follows:

Within R^2 : $\rho^2\{(y_{it}-\overline{y_i}),(X'_{it}\hat{\beta}-\overline{X'}_i\hat{\beta})$

Between R^2 : $\rho^2(\overline{y_i},\overline{X'}_i\hat{\beta})$

Overall R^2 : $\rho^2(y_{it},\overline{X'}_i\hat{\beta})$

(26)

The three R^2 measures are respectively, 0.022, 0.008 and 0.007 for the within or fixed estimator; 0.002, 0.135 and 0.099 for the RE estimator. So the within estimator best explains the within variation and the within estimator has a low overall R^2 because it neglects the individual effects. The small value of R^2 does not represent a good model and is a problematic phenomenon. However the inclusion of some other firm-specific factors may improve the value of R^2 but the data-constraint delimits further analysis.

7. Conclusions

This chapter investigated the firm-specific factors enhancing the attractiveness of FDI recipient country and is based on a sample of 22 sectors of Indian manufacturing industries. 311 firms across the entire manufacturing industries are covered in the sample base for 5 years, i.e. from 2006 to 2010. However there are some missing observations in the variables which reduce the entire number of observations in the sample to 1281. The database is Prowess under CMIE. This chapter gives a brief account for the earlier studies in this field of firm-specific variables affecting the foreign MNCs' decisions to invest. Due to unavailability of firm-level data, the study delimits its scope to a small number of factors. The justification is given for the reason because of which such variables are considered and their effects backed by the theories. After giving a brief description about the database and theoretical and econometric model, the chapter gives a detailed explanation of the methodology applied. The details about the fixed effect model and random effects model along with the justification for the appropriate choice of model is also described in it.

The empirical part starts with the introduction of dependent variable (Foreign Share in % of equity holding by foreign promoters) and a set of independent variables (R&D intensity, advertisement intensity, technology imports intensity, export performance of firms, subsistence of firms, assets size and volume of sales). From the result it seems that all the explanatory variables as specified in the econometric functions are not seen to be significant elements in attracting FDI in Indian manufacturing industries. For instance only three variables, namely R&D intensity, advertisement intensity and technology imports intensity is seen to be significant. The in-house R&D intensity, advertisement intensity and technology import intensity have negative relationship with the decision of foreign MNCs that want to invest in Indian firms. Other firm-specific characteristics do not confirm the model. This means that the idiosyncratic features of Indian firms do play a role, though not so promising, in attracting the foreigners to participate in their equity holding.

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Appendix A

The Fixed Effects Model:

The fixed effects model is simply a linear regression model in which the intercept terms vary over the individual units *i*, i.e.

$$y_{it} = \alpha_i + x'_{it}\beta + \varepsilon_{it},$$
$$where \varepsilon_{it} \sim IID(0, \sigma_\varepsilon^2) \quad (5)$$

where it is usually assumed that all x_{it} are independent of all ε_{it}. It can be shown that exactly the same estimator for β is obtained if the regression is performed in deviations from individual means and eventually we eliminate the individual effects α_i by transforming the data, such as:

$$\bar{y}_i = \alpha_i + \bar{x}'_i\beta + \bar{\varepsilon}_i, \quad (6)$$

where $\bar{y}_i = T^{-1}\sum_t y_{it}$ and similarly for the other variables. Consequently, we can write as:

$$y_{it} - \bar{y}_i = (x_{it} - \bar{x}_i)'\beta + (\varepsilon_{it} - \bar{\varepsilon}_i) \quad (7)$$

This is a regression model in deviations from individual means and does not include the individual effects α_i. The transformation that produces observations in deviation from individual means, as in the above equation, is called the within transformation. The OLS estimator for β obtained from this transformed model is often called the within estimator or fixed effects estimator. It is given by

$$\hat{\beta}_{FE} = (\sum_{i=1}^{N}\sum_{i=1}^{T}(x_{it} - \bar{x}_i)(x_{it} - \bar{x}_i)')^{-1} + (\sum_{i=1}^{N}\sum_{i=1}^{T}(x_{it} - \bar{x}_i)(y_{it} - \bar{y}_i). \quad (8)$$

If it is assumed that all x_{it} are independent of all ε_{it}, the fixed effects estimator can be shown to be unbiased for β. If, in addition, normality of ε_{it} is imposed, $\hat{\beta}_{FE}$ also has a normal distribution. For consistency and exogeneity, it is required that:

$$E\{(x_{it} - \bar{x}_i)\varepsilon_{it}\} = 0$$
$$\& E\{x_{it}\varepsilon_{it}\} = 0 \quad (9)$$

with explanatory variables independent of all errors, the N intercepts are estimated unbiasedly as

$$\hat{\alpha}_i = \bar{y}_i - \bar{x}'_i\hat{\beta}_{FE}, \forall i = 1, ..., N. \quad (10)$$

The covariance matrix for the fixed effects estimator $\hat{\beta}_{FE}$, assuming that ε_{it} is i.i.d. across individuals and time with variance σ_ε^2 ,is given by:

$$V\{\hat{\beta}_{FE}\} = \sigma_\varepsilon^2(\sum_{i=1}^{N}\sum_{i=1}^{T}(x_{it} - \bar{x}_i)(x_{it} - \bar{x}_i)')^{-1}. \quad (11)$$

A consistent estimator for σ_ε^2 is obtained as the within residual sum of squares divided by N(T−1).That is,

$$\hat{\sigma}_{\varepsilon}^{2} = \frac{1}{N(T-1)}(\sum_{i=1}^{N}\sum_{i=1}^{T}(y_{it} - \hat{\alpha}_i - x_{it}^{'}\hat{\beta}_{FE})^2.$$
$$= \frac{1}{N(T-1)}(\sum_{i=1}^{N}\sum_{i=1}^{T}(y_{it} - \overline{y}_i - (x_{it} - \overline{x}_i)^{'}\hat{\beta}_{FE})^2. \quad (12)$$

Under weak regularity conditions, the fixed effects estimator is asymptotically normal, so that the usual inference procedures can be used (like t and Wald tests).

Essentially, the fixed effects model concentrates on differences 'within' individuals. That is, it is explaining to what extent y_{it} differs from $\overline{y}_i$ and does not explain why $\overline{y}_i$ is different from $\overline{y}_j$. The parametric assumptions about β on the other hand, impose that a change in x has the same (ceteris paribus) effect, whether it is a change from one period to the other or a change from one individual to the other.

The Random Effects Model:

It is a generally happening that all factors that affects the dependent variable, but has not been included as regressors, can be appropriately summarized by a random error term. This leads to the assumption that the α_i are random factors, independently and identically distributed over individuals. Thus we write the random effects model as

$$y_{it} = \mu + x'_{it}\beta + \alpha_i + \varepsilon_{it} \text{ where } \varepsilon_{it} \sim IID(0, \sigma_{\varepsilon}^2) \text{ and } \alpha_i \sim IID(0, \sigma_{\alpha}^2) \quad (13)$$

where $\alpha_i + \varepsilon_{it}$ is treated as a composite error term consisting of two components: an individual-specific component, which does not vary over time, and a remainder component, which is assumed to be uncorrelated over time. That is, all correlation of the error terms over time is attributed to the individual effects α_i. It is assumed that α_i and ε_{it} are mutually independent and independent of x_{it} (for all i and t). This implies that the OLS estimator for μ and β is unbiased and consistent. The error components structure implies that the composite error term $\alpha_i + \varepsilon_{it}$ exhibits a particular form of autocorrelation (unless $\sigma_{\alpha}^2 = 0$). Consequently, routinely computed standard errors for the OLS estimator are incorrect and a more efficient (GLS) estimator can be obtained by exploiting the structure of the error covariance matrix. To derive the GLS estimator, first note that for individual i all error terms can be stacked as $\alpha_i \tau_T + \varepsilon_i$, where $\tau_T = (1,1,...1)^{'}$ of dimension T and $\varepsilon_i = (\varepsilon_{i1,....}\varepsilon_{iT})^{'}$. The covariance matrix of this vector is:

$$V\{\alpha_i \tau_T + \varepsilon_i\} = \Omega = \sigma_{\alpha}^2 + \tau_T \tau^{'}_T + \sigma_{\varepsilon}^2 I_T \quad (14)$$

where I_T is the T -dimensional identity matrix. This can be used to derive the generalized least squares (GLS) estimator for the parameters. For each individual, this can be transformed as:

$$\Omega^{-1} = \sigma_{\varepsilon}^2 [I_T - \frac{\sigma_{\alpha}^2}{\sigma_{\varepsilon}^2 + T\sigma_{\alpha}^2} \tau_T \tau^{'}_T] \quad (15)$$

which can also be written as

$$\Omega^{-1} = \sigma_\varepsilon^2[I_T - \frac{1}{T}\tau_T\tau_T^{'} + \psi\frac{1}{T}\tau_T\tau_T^{'}],$$

where

$$\psi = \frac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2 + T\sigma_\alpha^2} \tag{16}$$

Noting $I_T - \frac{1}{T}\tau_T\tau_T^{'}$ transforms the data in deviations from individual means and $\frac{1}{T}\tau_T\tau_T^{'}$ takes individual means, the GLS estimator for β can be written as:

$$\hat{\beta}_{GLS} = (\sum_{i=1}^{N}\sum_{i=1}^{T}(x_{it} - \bar{x}_i)(x_{it} - \bar{x}_i)' + \psi T\sum_{i=1}^{N}(\bar{x}_i - \bar{x})(\bar{x}_i - \bar{x})^{'})^{-1}$$

$$\times(\sum_{i=1}^{N}\sum_{i=1}^{T}(x_{it} - \bar{x}_i)(y_{it} - \bar{y}_i)' + \psi T\sum_{i=1}^{N}(\bar{x}_i - \bar{x})(\bar{y}_i - \bar{y})). \tag{17}$$

where $\bar{x} = \frac{1}{NT}\sum_{i,t} x_{it}$ denotes the overall average of x_{it}. It is easy to see that for ψ = 0 the fixed effects estimator arises. Because ψ → 0if T →∞, it follows that the fixed and random effects estimators are equivalent for large T. If ψ = 1, the GLS estimator is just the OLS estimator (and Ω is diagonal). From the general formula for the GLS estimator it can be derived that

$$\hat{\beta}_{GLS} = \square\hat{\beta}_B + (I_k - \square)\hat{\beta}_{FE} \tag{18}$$

where

$$\hat{\beta}_B = \sum_{i=1}^{N}(\bar{x}_i - \bar{x})(\bar{x}_i - \bar{x})^{'})^{-1} \times (\sum_{i=1}^{N}(\bar{x}_i - \bar{x})(\bar{y}_i - \bar{y}). \tag{19}$$

is the so-called between estimator for β. The matrix□ is a weighting matrix and is proportional to the inverse of the covariance matrix of $\hat{\beta}_B$. That is, the GLS estimator is a matrix-weighted average of the between estimator and the within estimator, where the weight depends upon the relative variances of the two estimators. However, since the variance components σ_α^2 and σ_ε^2 are unknown in practice, therefore we can use a better alternative approach, i.e. feasible GLS estimator (EGLS). The resulting EGLS estimator is referred to as the random effects estimator for β. Under weak regularity conditions, the random effects estimator is asymptotically normal. Its covariance matrix is given by

$$V(\hat{\beta}_{RE}) = \sigma_\varepsilon^2(\sum_{i=1}^{N}\sum_{i=1}^{T}(x_{it} - \bar{x}_i)(x_{it} - \bar{x}_i)' + \psi T\sum_{i=1}^{N}(\bar{x}_i - \bar{x})(\bar{x}_i - \bar{x})^{'})^{-1} \tag{20}$$

which shows that the random effects estimator is more efficient than the fixed effects estimator as long as ψ> 0.

Which model to use: Fixed Effects or Random Effects?

The selection of model between fixed effect and random effect depends on the 'true nature' of the effects α_i, i.e; whether to treat the individual effects as fixed or random as such decision puts a significant amount of difference in the estimates of the β parameters. The fixed effects

approach is conditional upon the values for α_i. In contrast, the random effects approach is not conditional upon the individual α_i but 'integrates them out'. The random effects model states that

$$E\{Y_{it}|\, x_{it}\} = x'_{it}\beta \tag{21}$$

where the fixed effects model estimates

$$E\{Y_{it}|\, x_{it}, \alpha_i\} = x'_{it}\beta + \alpha_i \tag{22}$$

Here, the β coefficients in these two conditional expectations are the same only if $\mathrm{E}\{\alpha_i|x_{it}\}=0$.

Hausman (1978) has suggested a test for the null hypothesis that x_{it} and α_i are uncorrelated. The general idea of a Hausman test is that two estimators are compared. Let us consider the difference vector $\hat{\beta}_{FE} - \hat{\beta}_{RE}$.To evaluate the significance of this difference, we need its covariance matrix. In generalthis would require us to estimate the covariance between $\hat{\beta}_{FE}$ and $\hat{\beta}_{RE}$, but because the latter estimator is efficient under the null hypothesis, it can be shown that (under the null):

$$V\{\hat{\beta}_{FE} - \hat{\beta}_{RE}\} = V\{\hat{\beta}_{FE}\} - V\{\hat{\beta}_{RE}\} \tag{23}$$

The Hausman test statistic is as:

$$\xi_H = (\hat{\beta}_{FE} - \hat{\beta}_{RE})'[\hat{V}\{\hat{\beta}_{FE}\} - \hat{V}\{\hat{\beta}_{RE}\}]^{-1}(\hat{\beta}_{FE} - \hat{\beta}_{RE}), \tag{24}$$

where the $\hat{V}$ denote estimates of the true covariance matrices. Under the null hypothesis, which implicitly says that $\mathrm{plim}\,(\hat{\beta}_{FE} - \hat{\beta}_{RE})=0$, the statistic ξ_H has an asymptotic Chi-squared distribution with K degrees of freedom, where K is the number of elements in β. The Hausman test thus tests whether the fixed effects and random effects estimator are significantly different.

APPENDIX B

Table B.1
Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
fs	1889	0.296561	0.260265	0	0.9745
rd	1890	0.402116	0.490455	0	1
adv	1890	0.442857	0.496855	0	1
rolty	1890	0.003207	0.008621	0	0.108741
ls	1772	4.925895	2.283965	-4.60517	10.65348
lsz	1807	5.065049	1.921736	-2.99573	10.41393
exp	1890	0.171691	0.497924	0	18.75908
lage	1885	3.296054	0.647899	0	4.70048

Table B.2
Correlation Matrix

	fs	rd	adv	rolty	ls	lsz	exp	lage
fs	1							
rd	0.163	1						
adv	0.0355	0.0461	1					
rolty	0.2193	0.2082	0.0636	1				
ls	0.2435	0.4297	0.125	0.1806	1			
lsz	0.2068	0.4039	0.0787	0.1437	0.8882	1		
exp	-0.0607	0.01	-0.0497	-0.053	0.0473	0.0964	1	
lage	0.1733	0.3327	0.0324	0.1219	0.2445	0.2459	-0.0861	1

Table B.3
Hausman Test

	Coefficients			
	(b) FE	(B) RE	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
rd	-0.0754566	-0.02562	-0.04984	0.0186
adv	-0.0774232	-0.039	-0.03842	0.022245
rolty	-2.203159	0.727965	-2.93112	0.518571
ls	0.0073909	0.019001	-0.01161	0.011345
lsz	0.011109	-0.00272	0.013831	0.011853
lage	0.0261023	0.053045	-0.02694	0.049615
exp	0.0318046	-0.04632	0.078125	0.040433

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(7) = (b-B)'[(V_b-V_B)^(-1)](b-B) = 74.03 Prob>chi2 =0.000

APPENDIX C

NIC Division	Industries
Division 10	Manufacture of food products
Division 11	Manufacture of beverages
Division 12	Manufacture of tobacco products
Division 13	Manufacture of textiles
Division 14	Manufacture of wearing apparel
Division 15	Manufacture of leather and related products
Division 16	Manufacture of wood and products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
Division 17	Manufacture of paper and paper products
Division 18	Printing and reproduction of recorded media
Division 19	Manufacture of coke and refined petroleum products
Division 20	Manufacture of chemicals and chemical products
Division 21	Manufacture of pharmaceuticals, medicinal chemical and botanical products
Division 22	Manufacture of rubber and plastics products
Division 23	Manufacture of other non-metallic mineral products
Division 24	Manufacture of basic metals
Division 25	Manufacture of fabricated metal products, except machinery and equipment
Division 26	Manufacture of computer, electronic and optical products
Division 27	Manufacture of electrical equipment
Division 28	Manufacture of machinery and equipment
Division 29	Manufacture of motor vehicles, trailers and semi-trailers
Division 30	Manufacture of other transport equipment
Division 31	Manufacture of furniture
Division 32	Other manufacturing