FDI, Technology Acquisition and Labour Demand in an Emerging Market Economy: *A Firm-Level Exploration of Indian Manufacturing Industries*

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Abstract

The paper investigates the impact of foreign direct investment on firm-level labour demand in India. FDI inflow and hence MNE participation in India during the post reforms period might have serious implications on the labour market. The evidence of inter-firm variations in labour demand across sectors is indicative of the existence of factors specific to firms. This paper estimates the impact of ownership, labour productivity and technology acquisition on firm-level employment across industries post 2000. Hausman Taylor estimation results show that foreign ownership does not play a significant role in determining firm-level labour demand in Indian manufacturing. In particular, technology acquisition by foreign firms is not labour displacing for major sectors. However productivity has a negative impact on firm-level employment.

1. Introduction

1.1 The developing economies integrate with the world with the process of liberalization. One of the critical issues in this process of integration which the governments need to address is the impact of such liberalization on labour market in terms of wages and employment (Banga, 2005). With major economic reforms since the 1990s, including reforms in the FDI policies, FDI inflows through MNE operations in India have witnessed a robust rising trend. Effect of such inflow of FDI on labour market particularly on employment and wages continues to be a very crucial issue for the labour surplus emerging market economies like India. This is one such issue which has not been explored much in the Indian context. With the MNEs operating, there has also been a rapid rise in the import of foreign technology both in embodied and disembodied form. FDI and imported technology might improve labour productivity in the developing economies but can have differential impact on wages and employment depending on the differences in the labour laws across countries. This issue of the impact of FDI and import of technology on labour market outcomes also deserves adequate attention. In specific, this paper investigates into the impact of FDI on firm-level employment across manufacturing industries in India. In this paper, post-2000 period has been chosen for analysis on account of quantum rise in export and technological intensities in conjunction with a sharp rise in FDI particularly in India after 2000. In the (econometric) analysis that follows, the study controls for factors including technology, productivity and foreign ownership in determining firm-level labour demand in Indian manufacturing enterprises. It is in this aspect where the study in particular, contributes to the existing literature. This analysis however, does not look into important issues including firm-level wage determination and wage inequality in the emerging market economies.

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1.2 The standard trade theory based on the Hecksher-Ohlin model would suggest that with trade liberalization there would be a favorable effect on the manufacturing employment of the developing countries. The H-O-S framework suggests that employment reduces with increased imports while it increases with increased exports. However, such implications are very industry specific. There can be a variety of factors by which liberalization might affect labour the most important being trade, FDI, international technology transfer and labour productivity. If FDI is concentrated in labour intensive industries, the positive impact of FDI on the level of employment would be substantial. FDI can also lead to increased employment amongst local firms as a result of backward and forward linkages. If an MNE firm makes long term commitment in the host country, it can provide stable employment (Jenkins, 2006). Theoretical literature suggests that the impact of FDI on total employment can be understood in two different ways. One argument is that with inflow of FDI there is an exogenous growth of output which in turn enhances employment opportunities. Apart from bringing in a package of productive resources in to the host country, FDI creates a significant possibility of job creation not only in the FDI intensive sectors but also in supporting domestic industries (Hill and Athukorola, 1998). Further, MNE affiliates facilitate access to foreign markets through exports which generate sources of employment. The benefits do not remain confined to the quantitative increase in employment but also improves the quality of the workforce in terms of skill and knowledge spillovers (Young et. al, 1988). One channel of such spillover is through turnover of employees (Fosfuri et. al, 2002; Glass and Saggi, 2002; Gorg and Strobl, 2005) and managers (Gershenberg, 1987; Pack 2001). As against this argument, the impact of Foreign Direct Investment on the labour market of the host economy can also be deduced from the Industrial Organization theory. As Hymer (1960), Kindleberger (1969), Caves (1971) argue that foreign firms possessing sophisticated technology, managerial and organizational skills, and marketing and distribution networks have some monopolistic advantage over the domestic firms. Thus varying labour market outcome can arise from the kind of technology employed by the foreign firms as compared to the local firms. The technology introduced by the MNEs is highly capital intensive and skill based. This might reduce employment potential as they are expected to have lower employment elasticity of output as compared to the domestic firms with labour intensive techniques of production (Pradhan and Sahoo, 2004). The idea that FDI may not bring in technology which is labour augmenting may lead to an absolute reduction in the overall employment (Nickel and Bell, 1996; Vivarelli and Pianta, 2000; Tayor and Driffield, 2000). This is typical to the developing market economies. Again, greater openness might affect employment by influencing the quantity and kind of labour required to produce a given output. Such effects are largely on account of changes in factor prices which arise out of changes in factor demand. As a result of competitive pressure, firms experience increased productivity influencing aggregate employment (Greenaway et al, 1999). Such trade-induced productivity effect can be a result of decrease in X-inefficiency (Chand and Sen, 2002) or trade-induced technological transfers (Jenkins and Sen 2006).

1.3 The experience of different countries has been varying with respect to the effect of trade liberalization and inflow of FDI on the level of employment. Nunnenkamp, Bremont and Waldkrich (2007) investigated the effect of FDI on the employment generation of Mexican manufacturing industries. A panel data analysis across 200 manufacturing firms reveals that FDI has a significant positive impact on the manufacturing employment of Mexico. Fu and Balasubramanyam (2005) found a strong linkage between FDI and

employment as well as FDI and exports in China. Craigwell (2006) investigates the impact of FDI on employment in the English and Dutch Speaking Caribbean. Empirical results following a panel data estimation technique reveal that FDI in a sample of Caribbean countries leads to an approximate one to one increase in employment. In a recent empirical study on Chinese manufacturing from the period 1998-2004, Karlsson, Lundin, Sjoholm and He (2009) conclude that FDI has contributed to employment in the Chinese manufacturing through its access to international markets and other firm characteristics which favour growth of employment. Liyan and Liu (2012) in an analysis exploring specific relationship between FDI and employment of three strata industries in China, indicate that in secondary and tertiary industries, growth of FDI in the long run promotes employment and this is particularly true for the tertiary industries. Based on a sample of Chinese state owned enterprises for the period 1999 to 2003, Gorg et.al (2006) examine the effect of privatization and foreign acquisition on employment. The results suggest that foreign acquisition increases employment.

1.4 A few studies recently have explored the labour market impact of international trade from a developing country perspective (Revenga 1997; Moreira and Najberg 2000; Sen 2009; Raj and Sen 2012). However, the results remain inconclusive. Sen (2009) concludes that Bangladesh and Vietnam experienced positive employment growth due to trade openness in contrast to Currie and Harrison (1997) who found no statistically significant impact of trade reform on employment in Morocco for private sector enterprises. Such absence of any impact of trade on employment has also been reported by Lang (1998) for New Zealand.

1.5 Goldar (2000) analyzed Indian manufacturing for the period 1980-81 to 1997-98 and found that trade liberalization raises labour demand elasticity. Pradhan et al. (2004) analysed the role of FDI in the labour market outcomes of wage and employment in the Indian manufacturing. The findings suggest that foreign firms do not have any adverse effects on the manufacturing employment in India as compared to their domestic counterparts. Banga (2005) examines the impact of FDI, trade and technology on employment and wages of the Indian organized manufacturing industries. The results show that FDI, trade and technological progress have differential impact on wages and employment. While higher extent of FDI in an industry leads to higher wage rate, it has no effect on employment. However, higher export intensity of an industry increases employment of the industry.

1.6 Empirical literature also provides studies which contradict the observation that FDI has a positive impact on employment (Machin and Van Reneen, 1998; Berman and Machin, 2000; Hanson, 2001). Onaron (2008) found that in Austrian manufacturing industries during 1990-2005, employment declined due to increased import penetration. Revenga (1992), Feenstra and Hanson (1996) concluded that increase in import competition or outsourcing has significant effect in terms of decrease in employment in the United States. Davis and Mishra (2007) however argued that such effects on employment depend on whether imports are substitutes or complementary to production in the host country. If imports are not substitutes but complementary inputs to what is produced domestically, then a positive effect on employment is possible. Revenga (1997) confirmed this complementary relationship between import of inputs and employment in Mexico during 1980s. Hasan, Mitra and Ramaswamy (2003, 2007) found that labour demand elasticities with respect to wages increased after trade reforms in India particularly in the states which have flexible labour

markets. Sen (2008, 2009) investigates the effect of international trade on India's manufacturing industries for the period 1975-1999. Using Generalized Methods of Moments, his results do not reveal any significant effect of export orientation and import penetration on employment. He concludes that international trade might not have impact on manufacturing employment. Similar results were revealed in the works of Chister, Kupets and Lehmann (2005) for Ukraine and Abdi and Edwards (2002) for South Africa.

1.7 Studies also reveal the impact of FDI on wages (Singh and Jun, 1997; Hatzius, 1997, Guha and Ray, 2000), firm productivity (Gorg and Greenaway, 2004; Lipsey and Sjoholm, 2005) and exports (Lipsey and Sjoholm, 2004b, Swenson, 2007). Elia, Mariotti and Piscitello (2008) in a slightly different angle investigate the effects of outward FDI on the home country employment and skill composition. Empirical evidence refer to an Italian case through the period 1996-2002 and shows that outward FDI has a significant negative impact on the demand for the low skilled workers in the parent company's "industrial region" , but this is true only for FDI in low wage countries. On the contrary, Navaretti, Castelleni and Disdier (2006) for France and Italy find no evidence of negative effect of outward investments to cheap labour countries on labour demand.

1.8 Any further research on the issue of FDI and labour market outcomes in an emerging country such as India thus has to investigate into the factors at a further disaggregate level as well as to understand the role of foreign ownership. This research work investigates into these dimensions of firm.

1.9 The paper is organized as follows. Section 2 provides some stylized facts on the trend of employment of the Indian manufacturing industries during 2001-2010. Section 3 discusses the analytical framework, the empirical model and method, and the database for analyzing the effect of FDI on aggregate firm level employment. Section 4 presents the empirical results. Section 5 summarizes the major findings of the paper following them by implications for policy.

2. An overview of employment across sectors (2001-2010)

2.1 Some facts on the trend of employment across sectors

2.1.1 As discussed in the earlier section, with FDI inflows and MNE operations, access to world-class technology became cheaper and easier for manufacturing firms in India. This encouraged dependence on technology imports particularly in the form of raw materials. Further, expenditure on indigenous R&D in some high-technology industries like chemical and machinery also increased post 2000 (Ghosh, 2014). Such technology choices across sectors might, on one hand, accelerate export and output growth, but on the other hand increase capital intensity in production. Here it will be relevant to look into employment implications of FDI inflows. Such observations can be posited against the phenomenon of 'jobless growth' as often observed in the Indian economy during post reforms.

2.1.2 Discussion on the trends of employment across sectors in Indian manufacturing as is done in this section has certain limitations. This is on account of non-availability of data on firm-level employment. Further, as observed in the Appendix I, firm-level employment data are estimated only for the period 2000-2010. Despite these limitations, we find that

variations in employment can be noticed across Indian manufacturing sectors post 2000. Table 1 reveals that there has been a sharp rise in employment till 2005, followed by a fall in all major sectors between 2006 and 2010. The fall in employment may be on account of the global economic recession.

3. Analytical framework

The effect of foreign direct investment on total employment works through two different channels. On one hand, with an inward investment, an increase in output can lead to an increase in labour demand, while on the other, capital-intensive technology introduced by FDI through MNE operations may reduce employment potentials. However, sector-biased technical progress increases demand and returns to skilled labour (Gottschalk and Smeeding 1997, Schmitt 1995, Taylor 1999). This leads to a decline in the demand for unskilled labour (Machin and Van Reneen 1998, Berman and Machin 2000, Hanson 2001). Thus, it is important to understand the impact of technology acquisition on net employment, evidence of which suggests ambiguity in the outcome (Krugman 2000, Xu 2001).

Further, with the growing literature on firm heterogeneity, it is evident that technology decisions are taken at the firm-level rather than at the industry level. Hence, the issue of impact on firm-level employment as a result of technology decisions by firms becomes very pertinent. Further, with inflow of FDI and MNE operations in the country, ownership patterns of firms assume importance while studying the firm-level employment patterns. Unfortunately, these issues remain largely unaddressed in the literature. This calls for an analysis of the effects of MNE ownership and technological acquisition on employment at the firm-level in India. This study attempts to fill in this gap in the existing literature by understanding the effect of ownership and technology acquisition on firm-level Indian manufacturing. In what follows is a brief delineation of the theoretical and the estimable models.

3.1 *The Theoretical Model*

Consider the Cobb-Douglas production function of a firm as:

$$Q = AL^{\alpha}K^{\beta} \tag{3.1}$$

where α and β are positive parameters, with $\alpha + \beta = 1$.

With cost minimization of the firm the objective function is:

$$Min\ C = w * L(Q) + r * K(Q); \text{ subject to } Q = AL^{\alpha}K^{\beta} \tag{3.2}$$

where, C = Cost

Q = Output

L = Labour

K = Capital; w and r are the input prices for L and K respectively.

Considering $MP_L/MP_K = w/r$, we have:

$$(\alpha/\beta)\,(Q/L) * K/Q = w/r \tag{3.3}$$

or, $\alpha/\beta * K/L = w/r$

or, $K = (\beta/\alpha)\,(w/r) * L$

Substituting in (3.1) we have:

$$Q = AL\alpha\{(\beta/\alpha)(w/r)\mathrm{L}\}\beta$$

$$\text{or, } Q = A\,L\alpha + \beta\{(\beta/\alpha)(w/r)\}\beta$$

Taking logarithm, we have:

$$logQ = log\,A + (\alpha + \beta)\,logL + \beta log\,(\beta/\alpha) + \beta log(w/r)$$

or

$$logQ = log\,A + (\alpha + \beta)\,logL + \beta(log\beta - log\alpha) + \beta(logw - log\,r)$$

or,

$$logL = log\,Q/(\alpha + \beta) - logA/(\alpha + \beta) - \beta(log\beta - log\alpha)/(\alpha + \beta) - \beta(logw - logr)/(\alpha + \beta) \quad (3.4)$$

3.1.1 The labour demand function thus can be written as: $L^* = f(Q,A,w,r)$. In Equation (3.4) 'A' stands for the productivity implying a parametric shift in this production function. The study also incorporates technology acquisition in the labour demand function. In this analysis labour productivity is used instead of total factor productivity.

3.1.2 However, a firms' ideal labour demand is different from its actual labour demand due to presence of rigidities and frictions in the labour market. Following Hasan, Mitra and Ramaswamy (2007), let us introduce labour market frictions in the framework. Let the actual labour demand in log terms be denoted by L^A and the ideal demand be denoted by L^*. We introduce a lagged expression by L^A_{-1}. Let $0 < \lambda < 1$ denote the extent of labour market frictions. Then we can write the actual labour demand as a weighted average of the ideal labour demand and lagged level of employment, the relative weight of lagged employment being an increasing function of labour market rigidity. Hence the actual labour demand function is written as:

$$L^A = \lambda L^A_{-1} + (1 - \lambda)\,L^* \quad (3.5)$$

3.1.3 This model is a partial adjustment model, (1-λ) being the speed of adjustment. The model is suggestive of the fact that only a part of the gap between desired and actual employment is met in every period and the proportion of the gap increases with labour market flexibility. Inserting the ideal labour demand function into the actual labour demand function we have the dynamic labour demand function as:

$$L^A = \lambda L^A_{-1} + (1 - \lambda)\{log\,Q/(\alpha + \beta) - logA/(\alpha + \beta) - \beta(log\beta - log\alpha)/(\alpha + \beta)$$

$$- \beta(logw - logr)/(\alpha + \beta) \quad (3.6)$$

3.2. *The Estimable model*

3.2.1 The impact of FDI on aggregate employment in Indian manufacturing industries can be analyzed using a dynamic labour demand function. A lagged employment term is introduced in dynamic labour demand function as employment slowly adjusts to the changes in wages and output. With FDI inflows, the MNEs operate in the host economy and can have substantial effect on labour demand. Further, this opens up the possibility to import

foreign technology as well as develop local research and development. Hence, in this model we have controlled for ownership and technology. Further, as labour demand is derived demand it is output constrained. Following Hasan, et al. (2007), the labour demand function is derived as follows:

$$L_{it} = f(L_{it-1}, w_{it}, r_{it}, pdtivity_{it}, Q_{it}, Tech_{it}, own) \tag{3.7}$$

where

L_{it} = Employment level of i^{th} firm in t^{th} time period

w_{it} =Average wage rate in i^{th} industry in t^{th} time period

r_{it} = Real user cost of capital in i^{th} firm in t^{th} time period

$Pdtivity_{it}$ =Labour productivity of the i^{th} firm in t^{th} time period

$Tech_{it}$ = Technology intensity (domestic and imported) of the i^{th} firm in t^{th} time period

Q_{it} = Total sales of the i^{th} firm in t^{th} time period

Own= Ownership

With linearization, the estimable labour demand equation is expressed as:

$$LogL_{it} = a_1 + b_0 LogL_{it-1} + b_1 Logw_{it} + b_2 Logr_{it} + b_3 Logpdtivity_{it} + b_4 LogQ_{it} + b_5 LogTech_{it} + b_6 own + \varepsilon_{it} \tag{3.8}$$

where $b_{i,\, i=1 \text{ to } 6} > 0$. Here, the variable 'own' is denoted by a dummy, which takes the value 1 for foreign ownership and 0 for domestic ownership.

3.3 *Estimation Method and Data Description*

3.3.1 This section of the paper delineates the estimation methodology and data description used for the analysis of impact of FDI and technology acquisition on firm-level employment. In order to understand the impact of FDI and foreign ownership on firm-level employment in Indian manufacturing, we use the Hausman-Taylor estimation method. As discussed earlier, the Hausman-Taylor estimator generates coefficients of time-invariant regressors, which in this case is ownership. This is the relationship of interest in this paper. On account of lack of exact data on production and non-production workers, labour demand elasticities are estimated for total labour employed in the sector. Productivity and lagged labour demand are considered to be endogenously determined within the system.

3.3.2 An empirical research work is largely contingent upon time comparable good database. In this paper, firm-level data from the PROWESS Database from the Centre for Monitoring Indian Economy (CMIE) have been used. PROWESS provides information from audited financial statements and thereby uses company balance sheets and income statements as sources of information. The database covers both listed and unlisted firms from a wide cross-section of manufacturing, services, utilities and financial industries

covering 60-70 per cent of organized sector in India, 75 per cent of corporate taxes and 95 per cent of excise duties collected by the Government of India (Goldberg et al., 2010).

3.3.3 In this study, information on only manufacturing firms is used. The industries chosen for the purpose of analysis are chemicals (including drug and pharmaceuticals), machinery, transport equipment, food and beverages, textiles and basic metals. The choice of these industries has been primarily guided by the fact that these industries cover approximately more than 70 per cent of Indian manufacturing sector. Further, FDI inflows in these sectors have been increasing during post reforms. Again, as these industries widely differ in terms of their technology intensities (ISIC Revision 2), the selected industries cover high/medium-high technology industries like chemicals, machinery and transport equipment as well as medium-low/low technology industries like basic metals, food and beverages and textiles.

3.3.4 The firms are identified according to ownership for finding the "FDI firms" as against "non-FDI firms". PROWESS provides data for foreign promoter's equity holdings. If for a company, equity holding of the foreign promoter exceeds 25 percent, it is classified as a foreign owned firm or a "FDI firm". PROWESS reports data on foreign promoter's equity holdings for post 2001 period. However numerous missing values of equity participation do not auger well with the empirical analyses being carried out. However, the database provides separate information on the ownership group of firm in the sense of whether a firm is 'Private Indian', 'Private Foreign' or a 'State-run' enterprise etc. This information is used in the study to identify domestic and foreign ownership of firms. We use a dummy variable indicating ownership taking the value one if the firm is foreign and the value zero if the firm is domestic. A total of 868 observations for the chemicals industry, 532 observations for the machinery industry, 266 observations for the transport equipments industry, 146 observations for the food & beverages industry, 368 observations for the textiles and garments industry and 98 observations for the basic metal industry are obtained after sifting for possible erroneous observations. The final set of observations includes both domestic and foreign owned firms. Panel structures for each of the six industries are constructed over a period of ten years.

3.3.5 Importantly, Prowess database does not provide data on number of employees. However, information on wages and salaries of a firm is available. We make use of the Annual Survey of Industries (ASI) database to construct the employment variable. For this purpose, 2-digit National Industrial Classification (NIC) 1998, 2004 and 2008 is considered (See Appendix I for Concordance).

4. The Empirical Results

4.1 The Hausman-Taylor estimation results of equation (3.8) showing the effect of FDI on firm-level employment are presented in Table 2. The Wald statistic justifies the overall significance of the model. The estimation coefficients signify elasticity of labour demand with respect to each independent variable. The results show that foreign ownership, measured in terms of a dummy variable, does not have any positive impact on firm-level employment across Indian manufacturing sectors. This result is in conformity with the findings of Banga (2005) that suggests that FDI does not have any significant role in generating employment in Indian manufacturing. The only exception to this pattern is food

and beverages. This can be largely on account of growing exports in this sector during post-reforms. Further, the composition of food and beverages in the export basket has changed from the traditional food items to more value-added items like marine products, processed and packaged food etc. during this period, which is suggestive of the possibility of employment expansion through diversification in this sector. Foreign ownership, thus, plays an important role in determining firm-level employment in this sector.

4.2 The lagged endogenous variable has significant positive impact on employment for all industries excepting chemicals and machinery industries. This arises out of labour market imperfections in terms of frictions and rigidities. This is observed particularly in the case of low and medium technology industries. Average wage has the expected result of a significant negative impact on the demand for firm-level labour for machinery, transport equipment, food and beverages, basic metals and textile industries. This implies that in these industries an increase in average wage leads to the displacement of firm-level labour. Interestingly this is not the case for chemicals where a significant positive relationship is found between average wage and labour demand. Purohit (1989) finds that the ratio of wage to the value of output is the lowest for certain industries including chemicals and engineering. Such low ratio is possibly because of low average wage rates and/or high average productivity of workers. Figure 1 suggests that the average wage rate in the chemical industry is the lowest followed by machinery and food and beverages. Hence, it is expected that these industries would also have high average firm-level labour productivity in the firms. This is suggestive of a favourable situation for the demand for labour. It is quite possible that under such circumstance, the entrepreneurs in the presence of growing output hire more labour and are likely to pay higher average wages. Hence, it is expected that the firms in such industry groups expand and thereby increase their demand for labour.

4.3 The user cost of capital has no statistically significant impact on demand for labour in most industries. The exceptions are chemicals and textiles, where a negative and significant relationship is found. This implies that capital and labour are complements for each other in these industries. With the phasing out of the Multi-Fibre Agreement (MFA) since 1995 the textile industry was exposed to international competition. Relaxation of restrictions on foreign technology and equipments were aimed at making the industry more efficient to face such international competition. However, this did not have an adverse effect on the firm level labour demand of the industry.

4.4 Table 2 also shows that technology acquisition by firms displaces labour significantly in the low technology textiles industry. This is in conformity with the findings of Das and Kalita, (2009) who find that labour intensity declined for the labour intensive industries during post reforms. With import liberalization in the early 1990s, Indian manufacturers acquired imported technology and adapted them in their production processes particularly in textiles and metals industries with a view to technology upgradation. Such technology acquisition gave these industries competitive edge both in terms of prices as well as in scale. This perhaps, has a negative impact on employment in textiles, despite growth and export growth. For other industries however, no significant effect on employment is noticed. Another important factor that determines firm-level employment significantly across sectors is firm level output. Estimation results suggest that as the output of firms expands the demand for labour rises significantly across all sectors. Importantly, labour productivity

has implications for labour market outcomes in Indian manufacturing. Increase in productivity significantly displaces labour across all major sectors barring food and beverages. This is an expected result as with increase in productivity, an increase in wage is expected. The firms thus are likely to employ less labour.

4.5 On the whole, the results show that ownership does not have any significant impact on firm-level employment across sectors in Indian manufacturing, except food and beverages. Barring chemicals and machinery, evidence of significant path dependence is noticed in case of employment. Increase in average wage is expectedly found to have negative impact on firm-level labour demand. However, chemical industry is an exception to this finding. The user cost of capital also has a significant negative impact on labour demand in chemicals and textiles industries implying complementarity between labour and capital in these sectors. Technology acquisition displaces labour only in the low technology textile industry. Employment significantly increases with output but is displaced with increase in productivity across sectors.

5. Summary of Findings

5.1 In this paper, impact of FDI on labour market outcome in terms of firm-level labour demand in Indian manufacturing is studied in the post reforms period. Evidence suggests that the average employment in Indian manufacturing as a whole shows an increasing trend since 2001 particularly in conjunction with rising FDI across sectors. However, there are variations across sectors. Such stylized facts led to inquire into, in particular, the impact of FDI on firm-level employment. Here FDI is accounted for in terms of foreign ownership. The Hausman-Taylor estimation technique is used for empirical estimation.

5.2 MNE operations, along with technology acquisition, have implications for labour demand. Foreign ownership however does not play any significant role in determining firm-level labour demand in Indian manufacturing. The only exception is the food and beverage industry. Estimation results suggest path dependence of employment for most manufacturing industries. An increase in the average wage leads to significant displacement of firm-level labour across all sectors barring chemicals. This is an interesting result which is suggestive of expansion in this sector leading to higher employment generation. The user cost of capital has differential impact on labour demand across sectors. The results suggest that capital and labour are complementary factors in textiles and chemicals. Though an increase in output significantly increases labour demand, technology acquisition by such firms does not have any impact on labour for most sectors. However, for textile industry, technology acquisition is labour displacing. Importantly, productivity has significant impact on employment across sectors. Increase in productivity is found to displace labour across sectors.

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Fig 1: Average Wage Rate across Sectors, 2001-2010

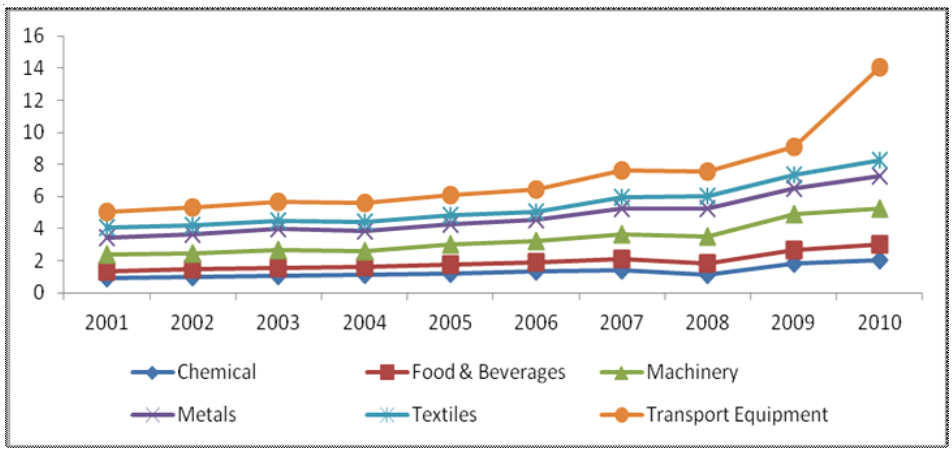

Table 1: Employment across Manufacturing Sectors (figures in crores)

Year	Chemical	Machinery	Transport Equipment	Metal	Food and Beverage	Textile
2001	638	1398	314	1654	1054	252
2002	508	1539	342	1560	1159	351
2003	923	1470	399	1355	1224	479
2004	1070	1706	471	1756	1188	654
2005	1259	1596	557	2265	1131	690
2006	1588	1453	663	2248	1216	977
2007	2001	1726	637	2565	1404	1124
2008	1887	1927	858	2569	1303	1227
2009	3391	1518	864	2954	1277	1090
2010	3834	2050	683	2606	1015	2163

Source: Calculations based on PROWESS and ASI database.

Table 2: Determinants of Firm-level Employment: Hausman-Taylor Estimation

	Chemical	Machinery	Transport Equipment	Food and Beverage	Textile	Basic Metal
Own (Time invariant exogenous variable)	.057 (0.54)	.15 (1.04)	.03 (0.63)	**1.83*** ** (1.71)	.36 (1.25)	-.37 (-0.89)
logq	**.93*** (62.92)	**.73*** (31.51)	**.98*** (88.83)	**.61*** (6.71)	**1.03*** (32.04)	**.90*** (18.39)
logw	**.00001*** (29.95)	**-.16*** (-3.87)	**-.97*** (-59.79)	**-.62*** (-3.08)	**-.96*** (-13.28)	**-.70*** (-3.72)
logr	**-3.04*** (-58.19)	-.24 (-1.62)	-.16 (-0.91)	**.**35 (0.57)	**-1.97*** (-18.71)	.13 (0.59)
logtech	.011 (1.42)	-.008 (-0.83)	.003 (1.03)	**-**.014 (-0.70)	**-.02**** (-2.39)	-.003 (-0.25)
logL_{t-1} (Endogenous)	.012 (1.60)	.037 (2.19)	**.02**** (2.46)	**.07**** (2.16)	**.17*** (8.82)	**.03***** (1.69)
logPdtivity (Endogenous)	**-.88*** (-38.67)	**-.69*** (-23.08)	**-.96*** (-46.88)	.024 (1.20)	**-.79*** (20.51)	**-.80*** (-14.96)
Wald Chi Square	183.37*	1788.81**	2307.19*	130.80*	1298.04*	1097.34*
Number of observations	868	532	266	146	368	98

Note: 1. z values are provided in parentheses

2. * denotes 1% level of significance, ** denotes 5% level of significance, *** denotes 10% level of significance.

3. L_{t-1} denotes labour with one year lag.

APPENDIX

A Note on variable construction

The variables constructed for the purpose of analysis are as follows:

Labour: Number of persons engaged in a firm is arrived at by dividing expenditure on salaries and wages of the firm by the average wage rate of the industry (at 2 digit level) to which the firm belongs. Average wage rate is calculated as Total emoluments/ Total persons engaged.

Wage: Average wage rate of the relevant industry.

Output: Total Sales of a firm is used as an indicator of output.

Real user cost of capital: This variable is constructed by deflating the nominal user cost of capital by industry specific WPI. Nominal user cost of capital is arrived at by multiplying WPI of machinery and machine tools with the sum of average prime lending rate and the rate of depreciation. Following Hasan et al. (2007), the rate of depreciation is considered at 10 per cent. Data on prime lending rate is obtained from Reserve Bank of India database. WPI data used in the study are availed from the Office of the Economic Advisor, Ministry of Industry, Government of India. The study period covers time points of indices with all the two base years. The indices with earlier base periods were converted to bring these time series to uniform base period, 2004-05=100.

Technology intensity: The ratio of the sum of expenditures on R&D, import of raw material, import of capital good and forex payment for technical know-how and royalty payments of firms to firm sales.

Productivity: Ratio of value of output to salaries and wages.

We use a dummy variable indicating ownership taking the value one if the firm is foreign and the value zero if the firm is domestic.

Table A.1: Average Wage Across Sectors (2001-2010)

Year	Chemical	Food & Beverages	Machinery	Metals	Textiles	Transport Equipment
2001	0.93	0.44	1.01	1.05	0.60	1.02
2002	1.00	0.45	1.02	1.18	0.53	1.11
2003	1.08	0.46	1.1	1.32	0.54	1.19
2004	1.13	0.47	1.01	1.23	0.56	1.23
2005	1.21	0.52	1.25	1.26	0.59	1.28
2006	1.32	0.56	1.35	1.31	0.52	1.35
2007	1.44	0.65	1.53	1.64	0.69	1.71
2008	1.11	0.73	1.66	1.76	0.74	1.58
2009	1.83	0.82	2.23	1.66	0.82	1.76
2010	2.06	0.95	2.24	2.02	0.96	5.81

Note: Calculations based on ASI Database; Figures in Rupees Crores.

Table A.2: Classification Concordance between NIC 1998, NIC 2004 and NIC2008

Description	**NIC 1998 2-digit**	**NIC 2004 2-digit**	**NIC 2008 2-digit**
Chemical and Chemical Products	24	24	20+21
Basic Metals	27	27	24
Food Products and Beverages	15	15	10+11
Motor Vehicles, Trailers and Semi Trailers+Other Transport Equipment	34+35	34+35	29+30
Textile Products+Wearing Apparel, Dressing and Dyeing of Fur	17+18	17+18	13+14
Machinery and Equipment NEC +Accounting and Computing Machinery	29+30	29+30	26+27+28