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**Asia-Pacific Research
and Training Network on Trade**

**Labour productivity and export performance:
Firm-level evidence from Indian
manufacturing industries since 1991**

Jayeeta Deshmukh and Pradyut Kumar Pyne

No. 126/June 2013

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Abstract

This paper examines the productivity of firms and their ability to enter the export market, i.e., the self-selection hypothesis and the determinants of labour productivity at the firm level for India's major exporting manufacturing industries during 1991-2009. The paper also examines whether export intensity at the firm level differs between domestic-controlled and foreign-controlled firms, and between private and public firms. Applying a 2SLS model, the authors find evidence in favour of the self-selection hypothesis. The authors also find that domestic firms are more export-intensive than foreign firms, and that private firms are more export intensive than public firms. Regarding the determinants of labour productivity at firm level, firm size and raw material intensity are found to be two significant determinants in this regard while the ownership status of the firms has no role here.

JEL Classification: F14, J24, L25

Keywords: Labour productivity, firm size, export performance, Indian manufacturing firms

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1. Introduction

Since 1991, India has been initiating comprehensive reforms in pursuit of higher growth and development. The wide-ranging reforms have included a major shift from a policy of inward-looking industrialization towards outward orientation in order to generate higher export growth and achieve higher rates of gross domestic product (GDP) and development. During the post-reform period, from 1990/91 to 2010/11, the manufacturing goods sector remained the most important principle commodity group in India as it contributed the largest share of India's total merchandise exports (table 1). Despite a sharp decline from 77 per cent of total exports in 2000/01, the sector accounted for about 66 per cent of the country's total merchandise exports in 2010/11 even though the performance of the sector continuously deteriorated. The engineering goods sector has remained the most important manufacturing subsector followed by gems and jewellery in terms of exports, especially during the past decade. The variations in export performance across the different manufacturing subsectors are clearly shown in table 1.

Table 1. Shares of different principal commodity groups in India's total exports

	(Unit: Per cent)				
Principal commodity group	1990-91	1995-96	2000-01	2005-06	2010-11
Primary products	23.83	22.82	15.99	15.89	13.90
Agriculture and allied products	18.49	19.13	13.40	9.91	9.71
Ores and minerals	5.34	3.70	2.59	5.98	4.19
Manufactured goods	71.62	74.69	77.05	70.39	66.08
Leather and manufactures	7.99	5.51	4.36	2.62	1.49
Chemicals and related products	9.52	11.31	13.21	14.33	11.39
Engineering goods	12.40	13.81	15.30	21.07	27.04
Textiles and textile products	23.93	25.26	25.33	15.91	9.16
Gems and jewellery	16.12	16.59	16.57	15.06	16.03
Handicrafts (excluding handmade carpets)	1.23	1.36	1.48	0.45	0.09
Other manufactured goods	0.43	0.84	0.80	0.95	0.87
Petroleum products	2.88	1.43	4.20	11.29	16.48
Others (all commodities)	1.67	1.06	2.76	2.44	3.55

Source: Reserve Bank of India.

Looking at the export behaviour of manufacturing subsectors at the firm level can help in revealing the responsible factors behind such performance. Existing literature identifies factors causing such variations in productivity at the firm level. A number of studies have found that expenditure on upgrading technology, such as research and development (R&D) as well as royalties has had a positive effect on labour productivity (Griliches, 1958 and 1998; Griliches and Mairesse, 1981 and 1995; Nadiri and Mamuneas, 1994; Lichtenberg, 1993; and Lichtenberg and Siegel, 1991). Inward foreign direct investment (FDI), capital intensity, firm size and human capital have been found highly significant in labour productivity at the firm level in a study made by Liu and others (2001), in the context of Chinese electronics industry.

Similarly, firm-level export performance underpins the export success at the national economy level. The existing literature has recognized labour productivity¹ as one of the main determining factors of whether to export or not (Melitz, 2003; Ghironi and Melitz, (2007); and Arnold and Hussinger, 2005) together with other factors such as the size of firms (Raut, 2003), share of wages, share of sales expenses (Bhavani and Tendulkar, 2001). There are other factors such as firm-level R&D expenditure, and non-R&D type innovative activities affecting firm-level export performance (Wakelin, 1998; and Sterlacchini, 1999). Despite an overlap in the vector of determinants across studies, the international evidence on export intensity determinants at the firm level is mixed. Results from different industries and countries point to different directions.

Firm level empirical studies on India mostly focus on the effect of firm size and R&D expenditures on export performance (see, for example, Kumar and Siddharthan, 1994; Patibandala, 1995; Hassan and Raturi, 2003, and Raut, 2003). A study by Bhavani and Tendulkar (2001) showed that access to capital, turns out to be a key determinant for both the export decision function (i.e., to export or to sell in the domestic market), and the export performance function (i.e., the share of exports in output for the garment producing units in Delhi, India). A study made by Abraham and Sasikumar (2010) identified increasing share of low labour cost as an important factor for good export performance for Indian firms who are

¹ Labour productivity comprises several economic indicators including economic growth, competitiveness, efficiency etc.

in Textile and Clothing industry. Upender (1996) calculated the elasticity of labour productivity in Indian manufacturing firms from 1973/74 to 1989/90.

Addressing the need for country-specific and industry-specific evidence, this paper investigates the self-selection hypothesis (i.e., whether the more productive firms become exporters or not), and the determinants of labour productivity at the firm level in India by focusing on the operation of four major Indian manufacturing industries during 1991-2009.

The same self-selection hypothesis question is asked in many studies in the literature. However, this paper makes another extension by examining whether export intensity at the firm level differs between domestic-controlled and foreign-controlled firms, and between private and public firms. A 2SLS estimation procedure is used in this study. A sample of 686 exporting firms is used for this analysis. The source of data was the Centre for Monitoring Indian Economy (CMIE) and the Annual Survey of Industries (ASI) published by the Central Statistical Organization. In constructing the dataset the authors selected firms in the cosmetics, drugs and pharmaceuticals, readymade garments, and gems and jewellery subsectors, which are major manufacturing industries that sell most of their output in foreign markets (see annex).

In section 2 a review is provided of existing literature concerning the modelling on firm-level labour productivity and export intensity. Section 3 explains the data and methodology used in this study. Section 4 presents the descriptive statistics. Section 5 presents the empirical results and interpretation while the conclusion is provided in section 6.

2. Review of literature

Several research studies have been carried out that deal with the determinants of labour productivity in different countries and different industries. Belorgey and others (2006) found the determinants of labour productivity per employee by taking several panels of countries; they drew the conclusion that ICT production and spending had a positive impact on the labour productivity growth rate, whereas the employment rate had a negative impact. They showed that public infrastructure (represented by the density of the road and telephone network) and the level of human capital (estimated from gross enrolment rates in primary and tertiary education) were highly significant in determining the level of labour productivity.

Liu and others (2001) examined the impact of inward FDI on labour productivity in the context of the China's electronic industry; they found that FDI, capital intensity, firm size and human capital were highly significant for labour productivity. Studies by Griliches (1958 and 1998), Griliches and Mairesse (1981 and 1995), Nadiri and Mamuneas (1994), Lichtenberg (1993), Lichtenberg and Siegel (1991), and Guellec and others (2004) showed that expenditure on upgrading technology, like expenditure on R& D and spending on royalties, affected labour productivity positively.

Among the firm-specific attributes, labour productivity is a strong determinant of export intensity. There is widespread evidence of the self-selection hypothesis in which firms that are more productive are more likely to enter the export market and export more of their output. A review of the existing literature by Wagner (2007) considering 45 microeconomic studies with data from 33 countries that were published between 1995 and 2004 concluded that exporters are found to be more productive than non-exporters, and the more productive firms self-select into export markets, while exporting does not necessarily improve productivity. Melitz (2003), and Ghironi and Melitz (2005) showed that a link existed between a firm's productivity and its ability to enter the export market. They also showed that trade would induce only the more productive firms to export, the less productive firms to serve the domestic market and the least productive firms to exit.

Arnold and Hussinger (2005) analysed the relationship between firm productivity and export behaviour in German manufacturing firms by using a total factor productivity approach; they found that highly productive firms self-selected for export market entry, while exporting itself did not play a significant role in productivity improvements. In a sample of agricultural and forestry firms in New Zealand, Iyer (2010) reported that labour productivity was a determinant of export intensity at the firm level. Clerides and others (1998) addressed the question of the self-selection hypothesis and exporting improves productivity further or not by using micro data of manufacturing plants in Columbia, Mexico and Morocco. Bernard and Jensen (1999) did the same for the United States of America while Aw and others (2000) considered Taiwan Province of China and the Republic of Korea. Delgado and others (2002) did likewise for Spanish firms. All these studies showed the importance of self-selection in export markets, they found little evidence to suggest that becoming an exporter improved productivity.

Apart from the labour productivity literature, there is also an extensive body of literature that investigates export performance of foreign-controlled enterprises in host countries vis-à-vis their local counterparts. However, the evidence concerning this issue is far from conclusive. A study by Cohen (1975), based on several export-oriented firms in the Republic of Korea, Taiwan Province of China and Singapore, found that local firms were more predominant in exporting than were foreign firms. Similar studies have been carried out by, for example, Reidel (1975) on Taiwan Province of China, Jenkins (1979) for Mexico, Kirim (1986) for the Turkish pharmaceutical industry, and the Solomon and Ingham (1977) for British mechanical engineering industry, none of which found any significant difference in the export performance of the foreign-controlled enterprises and their local counterparts. Athukorala and others (1995) found no significant relationship between multinational enterprise affiliation and export propensity, although there was evidence that multinational affiliation was an important determinant of a firm's export intensity for Sri Lanka. In the Indian context, Aggarwal (2002) empirically established better performance of multinational enterprises over their local counterparts.

The above brief review of the existing literature shows that firm productivity appears to be a significant determinant of export orientation at the firm level, while in the case of ownership status of the firms, i.e. say foreign or domestic, it is inconclusive. In addition, its impact varies from country to country, and labour productivity at the firm level is highly influenced by firm size, capital intensity, expenditure on upgrading technology and human capital. However, some studies have argued that less developed countries have not been able to improve export intensity following trade liberalization because of poor production processes as well as a lack of efficient institute and physical infrastructure (Rodrik, 1992).

3. Data and methodology

This section presents the data and methodology used in the analysis carried out by the authors.

3.1. Data

The data for this study were drawn from the CMIE PROWESS database and various issues of the ASI. We have collected data on 686 exporting firms during 1991-2009 and converted it into a unbalanced panel format. There are at least two observations per firm and some have nineteen time observations. Sectors considered by this study are drugs and pharmaceuticals, cosmetics, readymade garments, and gems and jewellery, which are the major exporting Indian manufacturing industries (see annex). The dataset comprises only exporting firms. For the empirical analysis and estimation, data on sales value, raw material expenditure, export values, salaries and wages, ownership status and changes in stock value of output at the firm level were collected from PROWESS. Data on firm level employment and production are not available in PROWESS, and the authors calculated these variables. To do this data on total emoluments and total persons engaged at industry level were collected from various issues of ASI at the 3-digit level, and then industry average wage rate (calculated by taking the ratio of total emoluments of j th industry and total persons employed in j th industry) were calculated for the industries covered by this study. However, the fact that the definitions of these industries in ASI changed several times, within the period taken into consideration by the study, was taken into account and the dataset adjusted accordingly by looking at the definitions of industries provided by ASI. Total emoluments at the firm level which have been collected from PROWESS have been divided by the average wage rate of the industry to which each firm belongs in order to find employment at the firm level. The variable 'value of production' at the firm level is constructed by taking the summation of sales value of i th firm at j th industry at time t and the value of change in stock of i th firm at j th industry at time t .

3.2. Methodology

This subsection presents empirical models that address the two main questions raised in this paper. Do more productive firms self-select entry to an export market? What are the determinants of labour productivity at the firm level? The empirical models used for estimation are as follows. To examine the effect of labour productivity on export intensity at firm level and the determinants of labour productivity at firm level we consider the following two equations 1 and 2.

$$(llabpd)_{ijt} = \beta_0 + \beta_1(lfysize)_{ijt} + \beta_2(lra \exp \text{ int})_{ijt} + \beta_3(domf)_{ijt} + \beta_4(pvtpub)_{ijt} + u_{ijt} \quad (1)$$

$$(X \text{ int})_{ijt} = \alpha_0 + \alpha_1(llabpd)_{ijt} + \alpha_2(domf)_{ijt} + \alpha_3(pvtpub)_{ijt} + \varepsilon_{ijt} \quad (2)$$

where

$(llabpd)_{ijt}$ is labour productivity (in natural logarithms) of firm i in jth industry at time t

$(lfysize)_{ijt}$ is firm size (in natural logarithms) of firm i in industry j at time t

$(lra \exp \text{ int})_{ijt}$ is raw material intensity (in natural logarithms) of firm i in industry j at time t

$(domf)_{ijt}$ is the dummy variable for ownership of firm i in industry j , if foreign then 1, 0 otherwise

$(pvtpub)_{ijt}$ is the ownership dummy of firm i at industry j at time t , if private firms, then 1, 0 otherwise

$(X \text{ int})_{ijt}$ is export intensity (in natural logarithms) of firm i at industry j at time t .

This is a simultaneous equation system model, as the dependent variable of equation 1 appears as an independent variable of the second equation. Here, the 2SLS method is used to estimate it as there is very little evidence in the literature that entering the export market improves productivity further and, hence, the cross covariance between export intensity and labour productivity is zero. The coefficient α_1 captures the effect of labour productivity on export intensity at the firm level.

The dependent variable in model 1, labour productivity, is defined as the value-added (value of production) by per worker per year. Firm size is defined as the share of a firm's sales in total industry sales. Ownership variables are actually used as a dummy variable to distinguish private and public as well as domestic and foreign ownership. Raw material expenditure intensity is defined as the ratio of raw material expenditure over firm sales. The dependent variable in the second equation, export intensity, is defined as the ratio of exports over sales.

4. Descriptive statistics

The dataset (table 2) shows that most of the firms in the four manufacturing industries studied are exporting, and that these exporting firms are mainly domestic and private in nature.

Table 2 Percentage of exporting firms and ownership status across different industries

Industries	Total No. of firms	No. of exporting firms	Percentage of firms exporting	No. of foreign firms	No. of domestic firms	No. of private firms	No. of public firms
Cosmetics and toiletries	127	76	59.84	9	67	74	3
Drugs and pharmaceuticals	515	368	71.65	26	342	355	14
Readymade garments	179	128	71.51	0	128	128	0
Gems and jewellery	151	112	74.17	0	112	111	1
Total	972	684	70.57	35	649	666	18

Table 2 shows that in the gems and jewellery industry, the percentage of exporting firms is 74.17 per cent, compared with the overall figure of 70.57 per cent. The overall ownership status of the firms considering the four major exporting industries together, shows that there are total 35 foreign firms and 18 state-owned firms. In the gems and jewellery industry there is no foreign firm and all firms are private except one firm. In the readymade garments industry all firms are private and domestic.

The average labour productivity of the exporters in the manufacturing industry during the period covered by the present study was nearly Rs 25,857,546 per worker per year. On average, exporters sell 38 per cent of their output overseas, exporting firms capture 1.15 per cent of the total sales of the corresponding industry and the raw material expenditure incurred by exporters is 48 per cent of their total sales. These figures are summarized in table 3.

Table 3 Summary statistics of variables

Variables	Mean	Standard deviation	Observations
Export intensity	37.86	30.16	5 552
Raw material intensity	47.62	30.46	6 628
Firm size	1.15	2.72	6 448
Labour productivity	25 857 546	19 532 770	4 121

5. Results and interpretation of the analysis

The results of model 1 and model 2 are presented in tables 4.1 and 4.2. The findings from the study are reasonably intuitive. Firm size, measured by firm sales to the total industry sales, was found to be negatively correlated to labour productivity. In other words, smaller exporting firms are more productive compared to the bigger exporting firms in these major exporting manufacturing industries. On average, a 1 per cent decrease in firm-size counts results in labour productivity increasing by 0.025 per cent. The possible reason behind this is the size of the bigger firms. For example, one firm in the cosmetics industry, Hindustan Unilever Ltd., which captured 51 per cent of industry sales throughout the period covered by the present study, had an average productivity Rs. 0.2539713Cr.per worker per year, which is far below the average labour productivity level.

Another company, Colgate-Palmolive (India Limited), captured 7.36 per cent of total industry sales in the cosmetics industry with an average labour productivity of Rs.0.2046405 Cr. per year. In the gems and jewellery industry, Su-Raj Diamond and Jewellery Limited captured the 14 per cent of the industry sales.

Therefore, in order to remain competitive and stay in the market, smaller firms follow a strategy of being productive so that they gain a cost advantage. Raw material intensity is another significant factor affecting firm labour productivity for such firms. The positive coefficient of this strategy is that the more the expenditure on raw materials, the greater the productivity of a firm. On average, if raw material intensity increases by 1 per cent, labour productivity increases by 0.88 per cent.

Table 4 1. The 2SLS Model: Dependent variable – firm labour productivity

Variables	Model 1
Log raw material intensity	0.0885 (0.004)*
Log firm size	-0.0251 (0.048)**
Domf	0.0752 (0.187)
Pvtpub	-0.03908 (0.528)
Intercept	6.6164 (0.0000)*
R ² (overall)	0.0214
No. of observations	3714

Notes: Figures in parentheses are P values. * Significant at the 1 per cent level and ** significant at the 5 per cent level.

Table 4.2. 2SLS Model: Dependent variable – firm export intensity

Variables	Model 2
Log labour productivity	0.2786 (0.0029)**
Domf	-0.7542 (0.000)*
Pvtpub	0.5679 (0.0000)*
Intercept	-1.05 (0.182)
R ²	0.066
Observations	5552

Notes: Figures in parentheses are P values. * Significant at the 1 per cent level and ** significant at the 5 per cent level.

The second model focuses on the self-selection hypothesis in the Indian context. Labour productivity appears as a significant factor in firm-level export intensity for exporting firms. The results detailed in this paper are consistent with the self-selection hypothesis in the literature that states productive firms self-select to export. On average, a 1 per cent increase in labour productivity results in a 0.2786 per cent increase in export intensity at the firm-level for the major exporting industries in India that are covered by this study. The effect is much stronger for domestic-controlled firms than for foreign-controlled firms, and for private firms than for public firms.

Conclusion

This paper investigates the determinants of labour productivity and export intensity at the firm level for major Indian exporting manufacturing industries such as drugs and pharmaceuticals, cosmetics, readymade garments, and gems and jewellery. An unbalanced panel dataset of 686 exporting firms during 1991-2009 was compiled from the CMIE PROWESS database and various issues of ASI to enable an empirical analysis to be carried out. In addition, 2SLS methodology was used to test the self-selection hypothesis and the determinants of labour productivity at the firm level for the same period.

The relationship between the productivity of Indian manufacturing firms and their participation in export markets is examined. The findings show that the effect of the ownership status on the export intensity at the firm level is that domestic and private firms are more export intensive than foreign firms and state-owned firms, respectively.

Firm size and raw material expenditure are also found to be significant with regard to labour productivity at the firm level. Smaller firms are more productive compared to larger firms and the greater the ratio of raw material expenditure over value of sales, the greater is the labour productivity of a firm.

There appears to be little evidence of studies on the determinants of labour productivity variation and the possible impact of this productivity variation on extensive and intensive margins of trade at firm level for India. In particular, there are no studies of the post-reform period at this micro level in the Indian context. In the international context, the determinants of export intensity and labour productivity are mixed, and are country- and industry-specific.

This paper therefore provides additional data to the existing literature on the self-selection hypothesis and the determinants of labour productivity at the firm level.

There are other mechanisms for productivity improvements that have not been investigated here. Salaries and wages, and R&D expenditure incurred by firms may also improve labour productivity of a firm. The authors will focus on these mechanisms in future studies.

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Annex

Export-to-sales ratio across different subsectors of the Indian manufacturing sector

Annex table 1. Food products

Subsector	1990/91	1994/95	1999/2000	2004/05	2009/10
Dairy products	0.004	0.028	0.017	0.027	0.031
Tea	0.102	0.101	0.056	0.055	0.064
Sugar	0.007	0.008	0.006	0.013	0.005
Coffee	0.000	0.118	0.289	0.262	0.158
Other food products	0.095	0.286	0.179	0.161	0.140

Annex table 2. Tobacco and beverages

Subsector	1990/91	1994/95	1999/2000	2004/05	2009/10
Tobacco	0.032	0.031	0.064	0.059	0.076
Beer and alcohol	0.007	0.008	0.006	0.011	0.015

Annex table 3. Textile products

Subsector	1990/91	1994/95	1999/2000	2004/05	2009/10
Cotton textiles	0.069	0.162	0.193	0.125	0.129
Synthetic textiles	0.033	0.075	0.082	0.089	0.092
Textile processing	0.019	0.037	0.049	0.047	0.044
Readymade garments	0.560	0.418	0.429	0.271	0.268
Other textiles	0.165	0.265	0.292	0.250	0.203

Annex table 4. Chemical products

Subsector	1990/91	1994/95	1999/2000	2004/05	2009/10
Inorganic chemicals	0.067	0.046	0.073	0.099	0.083
Fertilizers	0.001	0.042	0.006	0.015	0.018
Pesticides	0.064	0.063	0.150	0.168	0.178
Paints and Varnishes	0.038	0.006	0.009	0.020	0.009
Dyes and pigments	0.114	0.225	0.246	0.311	0.324
Drugs and pharmaceuticals	0.088	0.117	0.140	0.164	0.186
Cosmetics, toiletries, soap and detergents	0.117	0.175	0.175	0.202	0.174
Organic chemicals	0.031	0.090	0.127	0.144	0.204
Polymers	0.006	0.014	0.035	0.077	0.073
Plastic products	0.048	0.061	0.080	0.104	0.113
Petroleum products	0.008	0.042	0.167	0.039	0.088
Tyres and tubes	0.039	0.105	0.085	0.144	0.136
Rubber and rubber products	0.024	0.114	0.132	0.112	0.127

Annex table 5. Non-metallic mineral products

Subsector	1990/91	1994/95	1999/00	2004/05	2009/10
Cement	0.006	0.032	0.009	0.028	0.021
Glass and glassware	0.020	0.059	0.072	0.082	0.078
Gems and jewellery	0.868	0.560	0.605	0.493	0.487
Refractories	0.033	0.055	0.099	0.080	0.091
Ceramic tiles	0.027	0.105	0.070	0.083	0.053
Abrasives	0.032	0.052	0.068	0.136	0.082
Granite	0.456	0.633	0.618	0.573	0.468
Other non-metallic mineral products	0.014	0.040	0.016	0.017	0.037

Annex table 6. Metal and metal products

Subsector	1990/91	1994/95	1999/2000	2004/05	2009/10
Ferrous metal	0.027	0.056	0.066	0.080	0.086
Non ferrous metal	0.018	0.053	0.048	0.089	0.135

Annex table 7. Machinery

Subsector	1990/91	1994/95	1999/2000	2004/05	2009/10
Non-electrical machinery	0.061	0.063	0.066	0.105	0.103
Electrical machinery	0.030	0.053	0.071	0.089	0.093
Electronics	0.059	0.067	0.089	0.098	0.127

Annex table 8. Transport equipment

Subsector	1990/91	1994/95	1999/2000	2004/05	2009/10
Automobiles	0.020	0.058	0.064	0.053	0.077
Automobile ancillary	0.041	0.063	0.076	0.088	0.191

Annex table 9. Miscellaneous manufacturing products

Subsector	1990/91	1994/95	1999/2000	2004/05	2009/10
Paper and paper products	0.004	0.017	0.009	0.024	0.020
Leather products	0.553	0.508	0.447	0.417	0.352
Books and cards	0.045	0.027	0.051	0.042	0.059
Wood	0.008	0.055	0.047	0.046	0.022
Media print	0.000	0.001	0.054	0.004	0.030
Misc. manufacturing articles	0.074	0.179	0.138	0.085	0.095

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