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LIBERALISATION AND WAGE INEQUALITY IN INDIA

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Foreword

Following the economic reforms program undertaken by India, many studies have estimated the impact liberalisation on labour productivity. However, associated with rising labour productivity is the problem of growing wage inequality between skilled and unskilled workers. But this aspect of liberalisation has generally been ignored in the literature. This paper is a pioneering attempt in estimating the impact of three major components of liberalisation, that are foreign direct investment (FDI), trade and technological progress, on labour productivity and wage inequality in the Indian manufacturing sector.

The study uses cross-industry panel data estimations and the results show that FDI, trade and technological progress have all led to improvements in labour productivity in the post reforms period. However, they have differential impact on wages of skilled and unskilled workers. Wage inequality is found to have increased overtime and this has been caused mainly by higher FDI and skill-biased technological progress. But, trade is found to have lowered wage inequality in Indian industries.

An important policy implication that follows from the results is that to maximise the benefits of FDI, it is important to channelise it towards export-oriented industries, which use larger number of low-skilled workers. This will not only raise the productivity of labour at the lower end but will also lead to lower wage inequality between skilled and unskilled workers. Further, efforts should be made through more research and development (R&D) so as to make technological progress less skill-biased in Indian industries.

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1. Introduction[*]

Liberalisation is often associated with increasing labour productivity in developing countries. However, there is some evidence that increasing openness of an economy is accompanied not only by increasing labour productivity but also by rising wage inequality among skilled and unskilled workers in the organised manufacturing sector[1]. Several studies have documented rising wage inequality between skilled and unskilled workers in developed countries, particularly the United States and United Kingdom, and developing countries, particularly Latin American countries, since the 1980s[2]. One of the major explanations put forward for this rising wage inequality is the rise in the relative demand for skilled labour due to the rise in foreign direct investment (FDI), higher international trade and skill-biased technological change.

Higher FDI in an industry may raise labour productivity and affect wage inequality. FDI affects labour productivity both directly as well as indirectly. Foreign firms are found to have higher labour productivity vis-à-vis domestic firms[3] and are expected to have spill over effects, which occur either through learning process or through competitive pressures[4]. However, many studies[5] have found that foreign ownership is associated with skill-biased technology, which improves the relative position of skilled workers. Technological spillovers to domestic firms further add to the demand for skilled labour and drive up skilled wages thereby contributing to wage inequality between skilled and unskilled labour. However, alternatively, it has been argued by Figini and Gorg (1999) that the impact of FDI on wage inequality is essentially an inverted U-shaped, i.e., with rising presence of FDI in an industry wage inequality may increase initially but may reduce eventually as the domestic firms catch-up with the foreign firms.

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[1] see Galbraith et al. 2004

[2] see Katz and Autor 1999 and Wood 1997 for a review

[3] Davis and Lyons 1991, Conyon et al 1999, Grima et al 1999

[4] See Haddad and Harrison 1993, Barrel and Pain 1997, Figini and Gorg 1999 and Hubert and Pain 2000.

[5] For example, Frenstra and Hanson 1995, Barrell and Pain 1997, Driffield and Taylor 2000, Barry, Grog and Strobl 2001.

Besides FDI, trade may also play an important role in labour markets of the host countries. Exports and imports may improve labour productivity of the host countries since they expose the industry to international and domestic competition and force the firms to improve their productivity and efficiency continuously[6]. The overseas markets are sources of new knowledge and skills while the networks established overseas are sometimes sources of know-how and machinery. However, there exists an inconclusive debate with respect to the role of trade in explaining the changing structure of relative employment and effect on wage inequality.

It has been argued that the effect of trade on wage inequality may be industry-specific (Gera and Massé 1996). Exports are a dominant factor in employment growth in high technology and skill-intensive industries, while import penetration may adversely affect employment growth in low technology and labour-intensive industries. Focusing on the short-run effects on labour markets, Greenaway, Hine and Wright (2000) find a considerable impact of international trade on wages in the UK. It is argued that trade competition from (South-) East Asian Newly Industrialized Countries (NIC) appears to have increased wage inequality. But in a recent review, OECD (2000) argues that trade is not the main driving force behind increased demand for skilled workers in the developed countries. However, in case of developing countries (that have emerged as important exporters of manufactures to industrialised countries) Ghose (2000) argues that growth of trade has in fact led to a decline in wage inequality by increasing demand for unskilled workers. Thus, no consensus has been reached so far regarding the impact of trade on wage inequality.

Apart from FDI and trade, technological progress can also impact on labour productivity and wage inequality in important ways. Openness enhances competition and forces the firms in the industry to maintain continuous innovation. This is accompanied by higher imports of embodied and disembodied technology and larger research and development expenditures by both domestic as well as foreign firms in an industry thereby increasing labour productivity.

[6] Bloch and McDonald 1999

The impact of technological progress on wage inequality has been discussed by both the labour economists (who look at factor-biased technical change) and the trade economists (who look at sector-biased technical change (SBTC) and price change). The labour economists argue that SBTC increase demand and returns to skilled labour[7]. This has been supported by some of the studies in recent years, which show that technical progress has been skilled biased, i.e., it has led to decline in demand for unskilled labour (Machin and Van Reenen 1998, Berman and Machin 2000, Hanson 2001). However, the trade theorists argue that for large changes in technology the pattern of production changes and therefore the net impact on employment and wages may not be evident (Jones 1998, Findlay and Jones 2000, Krugman 2000, Xu 2000).

The above debates make the issue of the effect of liberalisation on wage inequality largely an empirical one. This effect may vary from country to country and also from industry to industry. The main objective of this paper is to empirically estimate the impact of FDI, trade and technological change on labour productivity and wage inequality in Indian manufacturing industries in the post reforms period. For this purpose we undertake an analysis of 78 three-digit level industries using data from two sources: (a) Annual Survey of Industries and (b) Prowess (C.M.I.E) for the period 1991-92 to 1997-98[8].

The study is structured as follows: Section 2 of the study briefly reviews trends in FDI, trade and technology flows in the Indian manufacturing sector in the pre and post reforms period. Section 3 provides a theoretical framework and review of literature for the study. Section 4 and 5 discuss the methodology and the data set used by the study. Section 6 presents the empirical results. And section 7 concludes the study by highlighting some of the policy implications of the study.

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[7] Gottschalk and Smeeding 1997, Schmitt 1995, Taylor 1999

[8] ASI changed its industrial classification from the year 1998 therefore it was not possible to extend the analysis to later years.

2. Trends in Trade and FDI Flows in Indian Manufacturing Sector

Since 1991, India has undertaken a major economic reforms program under which significant and far-reaching changes have been made in industrial and trade policy to encourage FDI flows and trade. Incentives have also been given to encourage higher imports of technology. With the change in the policy environment, the post reforms period has witnessed a marked acceleration in the growth of both FDI and trade flows. Net FDI inflows as a percentage of gross capital formation increased from 0.23% in 1980 to 2.6% in 2002, while total trade in goods and services as a percentage of GDP increased from around 16% to around 31 % respectively. We find that increase in imports of goods as a percentage of GDP was faster than increase in exports of goods as a percentage of GDP but overtime this rise was almost the same, i.e., around 15% in 2002 (Table 1).

Table 1: Trends in India's FDI and Trade Flows: 1990-91 to 1999-2000

Year	FDI, net inflows (% of gross capital formation)	Trade (% of GDP)	Exports of goods and services (% of GDP)	Imports of goods and services (% of GDP)
1980	0.23	15.74	6.28	9.46
1981	0.22	14.87	6.08	8.78
1982	0.17	14.50	6.14	8.36
1983	0.01	14.04	5.99	8.05
1984	0.04	14.39	6.45	7.94
1985	0.20	13.20	5.38	7.83
1986	0.21	12.50	5.32	7.19
1987	0.35	12.85	5.72	7.13
1988	0.13	13.74	6.15	7.59
1989	0.36	15.39	7.12	8.27
1990	0.31	15.71	7.15	8.56
1991	0.13	17.23	8.61	8.61
1992	0.48	18.75	8.99	9.75
1993	0.95	20.04	10.03	10.01
1994	1.29	20.37	10.03	10.34
1995	2.27	23.21	11.00	12.20
1996	2.89	22.36	10.59	11.77
1997	3.87	22.96	10.85	12.11
1998	2.98	24.13	11.22	12.91
1999	2.05	25.47	11.76	13.72
2000	2.56	28.54	13.89	14.65
2001	4.06	27.58	13.48	14.10
2002	2.60	30.82	15.22	15.60

Source: World Development Indicators (2004)

Apart from growth in FDI and trade, liberalised regime has also affected the level of technology acquisition in the manufacturing sector by encouraging technology imports. Three main sources of technological advancement in manufacturing sector include import of embodied technology (e.g., capital goods), import of dis-embodied technology (through royalty payments, technical fees and lump-sum payments) and in-house research and development (R&D). In the post reforms period, import of capital goods has been on an average 0.24 per cent of the total imports and this has not increased much overtime. One of the reasons for this could be that domestic machinery replaced imported machinery in the process of import substitution.

The in-house R&D efforts by industrial firms have also been relatively low in India though they have shown a tendency to improve consistently overtime. R&D intensity increased to 0.33 percent in 1996-97 from 0.05 in 1990-91[9]. However, a considerable volume of technology has entered Indian industry through the route of technology imports, i.e., purchase of technology. In absolute terms, the payment for royalty and technical fees increased from USD 25.1 million in 1985 to USD 200.8 million in 1998 and USD 350.4 million in 2002. However, it is still much lower than those found in other developing countries (e.g., a comparative figure for Malaysia is USD 6278 million, USD 3114 million for China and USD 1103 for Thailand).

3. Theoretical Framework and Review of Literature

3.1 Impact on Labour Productivity

Many studies have found foreign firms to be associated with higher labour productivity as compared to domestic firms in both developed as well as developing countries. The theoretical reasoning for believing this is, as industrial relations literature suggests, the transfer of knowledge within a multinational corporation means that plants will adopt new techniques related to latest research and development and will therefore have higher

[9] Estimations are based on Prowess data set.

levels of technology and labour productivity than domestic plants. Literature on FDI also suggests that foreign firm possesses ownership advantages e.g., brand names, higher level of technology, better marketing and management skills etc. which gives them an advantage over the domestic firms (Dunning 1980).

Along with the direct impact on labour productivity, FDI may also lead to higher productivity through spillover effects. These spillovers may take various forms like knowledge, technological, managerial etc that may improve labour productivity in domestic firms. However, studies show that FDI may lead to technology spillovers only if the technology gap between foreign firms and domestic firms is low. Kokko et al (1996) uses a regression analysis of 159 Uruguayan manufacturing plants and find that spillovers from foreign firms were significant in sub-sample of plants with moderate technology gaps vis-à-vis foreign firms. Banga (2003) finds that in the period 1992-1993 to 1999-2000, Japanese FDI have larger technology spillovers on Indian firms as compared to U.S. firms because of lower technology gap between domestic firms and Japanese firms as compared to U.S firms. Markusen and Venables (1999) and Urata and Kawai (2000) also support the view that FDI has led to technology transfer in the liberalised regime.

Impact of trade on labour productivity needs to be carefully analysed since it is quite possible that it is higher labour productivity in an industry that leads to higher trade. Frankel and Romer's (1999) innovative work on the *causal* effect of trade on average labor productivity across countries is based on the idea that trade is partly determined by (geographic) characteristics of countries that are unrelated to productivity. These characteristics should therefore allow for estimation of the causal effect of trade on productivity using an instrumental-variables approach. They implement this idea empirically for a large set of countries in 1985 and find a positive effect of trade on average labour productivity[10].

[10] see also Frankel and Rose (2000).

Francisco Alcalá and Antonio Ciccone (2001) have also undertaken analysis of the effect of international trade on average labour productivity across countries. Their results show that the causal effect of trade on productivity across countries is large, highly significant and very robust. They examine the channels through which international trade affects average labour productivity and find that trade works through labour efficiency.

The impact of trade in an industry can be proxied by either import or export intensity[11]. Aart Kraay (1997) finds that controlling for past firm performance and unobserved firm characteristic, past exports are a significant predictor of current enterprise performance. The "learning" effects by exporting can be quite large; the estimated coefficients indicate that a ten percentage point increase in a firm's export to output ratio in a given year leads to 13 percent higher labour productivity.

The process of exporting exposes firms to cutting edge technologies from international markets. The networks established overseas are sometimes sources of new knowledge and new machinery, all of which may raise labour productivity. There is also the pressure for exporting firms to maintain continuous innovation since competition in international markets is intense. Bloch and McDonald (2000) find that labour productivity in manufacturing firms in Australia increases with increased exposure to imports as long as the concentration of domestic production exceeds some minimal level.

Technological change can impact on labour productivity in important ways. Higher expenditure on R&D and technology spillovers from FDI can lead to technological progress in an industry. However, many studies have shown that in recent years technical progress has been skilled biased, i.e., it has led to decrease in demand for unskilled labour. Technological changes have favoured those workers with higher levels of skill. The possibility that such a relationship exists today has prompted the widely held conjecture that technology and skilled labour are relative complements, whilst technology and less-skilled labour are substitutes. Machin and Van Reenen (1998) demonstrate that new technology is complementary to skilled labour, and its introduction results in

[11] Anderton and Brenton, 1999; Hine and Wright, 1998.

increased demand for skilled workers. Consequently, an increase in research and development expenditure over time can be expected to raise the demand of the skilled labour (Berman and Machin, 2000).

3.2 Impact on Wage Inequality

Theoretical models[12] show that FDI increases relative demand (and therefore wages) for skilled workers in both the North and the South. The North produces high quality goods reducing demand for unskilled workers and since from South's perspective these activities are relatively skilled, the demand for skilled labour rises as firms relocate their activities from North to South.

Further, it has been argued that FDI along with introducing better technology and leading to improvement of overall labour productivity in the host country's industry, introduces technologies that are skill-biased and are associated with skill upgrading. This brings out a more general point that foreign ownership is often associated with skill-biased technology leading to an improvement in the relative position of skilled workers. They therefore generate higher demand for high quality labour. This result is supported by Barrell and Pain (1997). They show that the technology accompanying FDI is labour augmenting, reducing the demand for unskilled labour and, therefore, relative wages of unskilled workers.

Using partial equilibrium models, Markusen and Venebles (1997,1999) also show that if foreign firms use more skilled labour than national firms do then the skilled wage premium increase with greater investment liberalisation. Barry, Grog and Strobl (2001) formulate a theoretical model and show that increase in foreign capital raises economy wide demand for skilled labour and drive up skilled wages as skilled labour is fully employed. This crowds out domestic exporter from market of skilled labour and lead to substitution of unskilled labour. What happens to wages of unskilled labour will depend on process by which unskilled wages are set. It is also argued that in developing countries

[12] Feenstra and Hanson 1995

unskilled labour is either unemployed or underemployed. Therefore foreign firms pay relatively higher wages (i.e., wages over and above opportunity cost of labour) to unskilled workers and therefore reduce the wage gap.

However, Figini and Gorg (1998) show that the impact of FDI on wage inequality between skilled and unskilled workers is an inverted U shaped i.e., with increasing presence of multinationals, wage inequality first increases, reaches a maximum and then decreases eventually, ceteris paribus. The main idea is related to the Kuznets hypothesis that the development process implies first an increase and then a decrease in inequality. They use data for Irish manufacturing sector and find that FDI first increase the wage gap by introducing new technologies which increase demand for skilled labour, but overtime domestic firms learn new technology and previously unskilled workers become skilled by working with new technology. This reduces the wage gap.

The ambiguity of the results with respect to impact of FDI, trade and technology on wage inequality has increasingly made the issue an empirical one. The impact may also depend on the motives of FDI, i.e., whether it is attracted to low labour cost in developing countries; or it is attracted to domestic market irrespective of labour cost; or it is export-oriented and is using the host country as a part of its value chain. Much of the impact on wage inequality will also depend on whether the technology brought in by foreign firms is labour augmenting i.e., creates demand for skilled labour or not. We therefore undertake an empirical analysis for Indian industries to arrive at the impact of liberalisation on labour productivity and wage inequality.

4. Methodology

4.1 Labour Productivity Equation

To estimate how FDI, trade and technology can impact labour productivity we first estimate a production function. Although in economic theory Cobb-Douglas is the most widely known and perhaps still most widely used specification for production, it has proved inadequate in empirical studies since its assumption of unit elasticity of substitution between labour and capital inputs is empirically unacceptable[13]. To allow for the observed variation in the degree of substitutability between the factors of production Constant Elasticity of Substitution (CES) production function is used, which allows for non-constant returns to scale provided the function remains homogenous of degree μ, (where, when μ=1 implies CRS and μ, less than or greater than one represents decreasing or increasing returns to scales respectively). We therefore consider CES production function with CRS, i.e.,

$$Q = \chi\ [s(k)^{-\rho} + (1-s)\ (L\ e^{\lambda t})^{-e}]^{-1/e}$$

To estimate labour productivity, Kmenta provides an approximation of CES production function by expanding ln Q in Taylor's series around $\rho = 0$, i.e.,

$$\ln (Q) = \ln (\chi) + e^{\lambda t} \ln (k/L) + \ln (L) + (\rho\ e^{\lambda t} (1-s)/ 2)\ [\ln (k/L)]^2$$

$$\ln (Q) - \ln(L) = \ln (\chi) + e^{\lambda t} \ln (k/L) + (\rho\ e^{\lambda t} (1-s)/ 2)\ [\ln (k/L)]^2$$

Labour productivity is therefore found to be a function of:

$$(Q/L)_{it} = F[\ (K/L)_{it}, (K/L)^2_{it}, Q_{it}, FDI_{it}, EXPORTS_{it}, TECH_{it}, Time, Fixed\ Effects]\ldots(1)$$

We undertake several estimates for the purposes of checking consistency, validity and robustness of results across different techniques. Hence, the model is subjected to OLS, fixed-effects, random-effects and GLS estimations. In addition, the different techniques allow the modelling of important statistical characteristics – e.g. gross data outliers, heteroscedasticity and autocorrelation - that normally affect econometric data. Preliminary estimations and comparisons using Hausman specification indicate that random-effects model gives more efficient results as compared to the fixed-effects model.

[13] See Arrow, Chenery, Minhas and Solow (1961)

4.2 Wage Inequality Equation

FDI can have a composite effect on market for skills. Traditional trade theory (the Heckscher-Ohlin model) suggests that FDI in developing countries with abundant low-skilled workers is located in low-skill sectors[14]. New trade models also based on Heckscher-Ohlin foundations consider cases where transnational corporations (TNCs) transfer activities abroad, which are less-skilled compared to the home average but more skilled compared to the host-country average (Feenstra and Hanson, 1995). In addition, new trade models have been developed where TNCs locate abroad because of firm-specific assets (Markusen and Venables, 1997) and foreign firms may have different skill intensities from domestic firms, pushing up the demand on an average for skill labour.

To analyse the effect of FDI on the market for skills we use demand and supply framework. Taking a two-factor CES production function with low-skilled labour (U) and skilled labour (S), following Katz and Murphy (1992), we have

$$F\,(U_t, S_t) = [\chi(\delta_{ut}\,U_t)^{\rho} + (1-\chi)\,(\delta_{st}\,S_t)^{\rho}\,]^{1/\rho}$$

Where δ_{ut} and δ_{st} are functions of labour efficiency units and the parameter $\rho<1$. The labour efficiency index can be interpreted as accumulated human capital or the skill specific technology level. The elasticity of substitution between U and S is $\sigma = 1/(1-\rho)$. In neo-classical theory the technological level changes exogeneously. However, it is perfectly possible that apart from pure technological change the shifts in the pattern of technological change depends on factors such as inward FDI and Trade. We let the labour efficiency indices (skill-specific technological progress) depend on an exogenous time trend, t, FDI in the industry (FDI), export-intensity (EXP) and pure technological progress (TECH).

$$\phi_{ut} \cong \ln \delta_{ut}$$

$$\phi_{ut} \cong \gamma_{1u}t + \gamma_{2u}FDI + \gamma_{3u}\,EXP + \gamma_{4u}\,TECH$$

[14] see Wood, 1995, for the predictions of traditional trade theory for trade liberalisation and wage inequality

$\phi_{st} \cong \ln \delta s_t$

$\phi_{st} \cong \gamma_{1s}t + \gamma_{2s}FDI + \gamma_{3s} EXP + \gamma_{4s} TECH$

using the first-order condition that factor productivity equals the real factor price we derive a formula for the wage of skilled labour (W_{SK}) relative to low-skilled workers (W_{USK}), i.e.,

$$Ln \{W_{SK} / W_{USK}\} = \ln \{1-\chi/\chi\} - 1/\sigma \ln \{S_t/U_t\} + (\sigma-1/\sigma)\gamma_1 t + (\sigma-1/\sigma)\gamma_2 FDI + (\sigma-1/\sigma)\gamma_3 EXP + (\sigma-1/\sigma)\gamma_4 Tech \ldots\ldots..(2)$$

4.3 Estimating Equations

To estimate the impact on labour productivity and wage inequality we undertake several estimates for the purposes of checking consistency, validity and robustness of results across different techniques. Hence, equation (1) is subjected to OLS, fixed-effects, random-effects and GLS estimations. Different techniques allow the modeling of important statistical characteristics e.g. gross data outliers, heteroscedasticity and autocorrelation - that normally affect econometric data. Hausman test is performed to select between random-effects model and fixed-effects model.

5. Database Construction and Sample Characteristics

No single source of data exists for the Indian economy that provides corresponding data on wages, FDI and trade in an industry, which is required by this study. The study therefore draws data from two different sources, i.e., The *Annual Survey of Industries* (ASI), which is published by the Central Statistical Organisation, Government of India and *Prowess*, Centre for Monitoring Indian Economy Pvt. Ltd (CMIE). ASI provides a reasonably comprehensive and reliable dissaggregated estimates for the manufacturing industries. It covers all the production units registered under the Factories Act, 1948[15], 'large ones' on a census basis (with definition of 'large' changing over time) and the

[15] The Factories Act, it may be noted, applies to those units employing 10 or more workers and using power / 20 or more workers not using power.

remaining on a sample basis. Prowess contains database on over seven thousand registered companies.

The data used in the study is constructed for 78 industries at three-digit level of industrial classification (National Industrial Classification) for the period 1991-92 to 1997-98[16]. Data for most of the variables are drawn from ASI while data on foreign direct investment, exports and import of technology for the matched industries is obtained from Prowess (C.M.I.E).

The share of foreign companies in total sales of the industries has been taken as the indicator of the level of FDI in an industry. Export intensity is measured by the ratio of exports to sales. To estimate the impact of imports we use Effective Rate of Protection (ERP) at the industry level. The ERP series has been taken from a study by N.C.A.E.R (India).

To measure the impact of technology, an index of technology acquisition has been constructed using data on R&D expenditure, payment of royalty and technical fees for technology imports, and capital goods imports. The construction of the index has been done in two steps. First, the relevant ratios (e.g. R&D expenditure to sales) have been constructed for the 78 major industry groups from firm level data taken from the Prowess database of the CMIE. Next, applying the principal component analysis and taking the first principal component, the index has been formed. The index combines the three technology related variables using factor loadings as weights. All data are converted into natural logarithms.

There are considerable problems in obtaining good quality time series data on wages by skill level. For our purpose, we use the available information on wage contained in the ASI database. This source provides the average number of full time production-process 'workers' and 'employees' (which includes in addition to 'workers', non-production

[16] The period chosen has been constrained by the availability of comparable data since 1998 onwards since ASI changed its industrial classification from 1998-99.

workers like supervisors, clerks etc.) employed per day after taking account of reported multiple shift working. Wages of production workers is taken as wages of unskilled workers and this is subtracted from wages and salaries of employees to arrive at wages to skilled labour. Table 2 defines variables used in the empirical analysis. Appendix tables (Table A.1 and Table A.2) report the means and standard deviations and correlation coefficient of the variables used in the analysis.

Table 2: Variables Definitions

Variable	Abbreviation	Definition
Output	Y	Total industry sales by value
Gross Value Added	GVA	Increment to the value of goods and services that is contributed by the industry and estimated by deducting value of inputs from value of output
Wage rate	WR	Real Wages per worker
Capital Labour ratio	K/L	Total Capital Employed/Total number of persons employed
Labour productivity	LP	Gross value added/number of persons employed
Wage rate of Skilled Workers	W_{SK}	Wages paid to non-production workers/ number of non-production workers
Wage rate of Unskilled Workers	W_{UNSK}	Wages paid to production workers/ number of production workers
Wage rate of skilled workers/wage rate of unskilled workers	WRSKUNSK	Wage rate of production workers/Wage rate of non-production workers
Foreign Direct Investment	FDI	Sales of foreign firms / total industry sales
Export Intensity	EXP	Exports/Sales
Import Liberalisation	ERP	Effective rate of protection
R&D Intensity	R&D	R&D/Sales
Royalty Expenditures	ROY	Royalty expenditures/sales
Import of capital goods	IMPK	Import of capital goods/sales
Technology Acquisition Index	TECH	Index constructed using R&D intensity, IMPK and ROY

5. Empirical Results

5.1 Impact of Liberalisation on Labour productivity

As discussed earlier, FDI, trade and technology are the three major components of liberalisation that are expected to improve labour productivity. However, a suspicion remains that FDI and trade may not actually improve labour productivity to the extent found by the studies since it may be possible that the extent of FDI and trade is higher in industries with higher productivity levels. To overcome this simultaneity problem we use lags and controls since adding more controls may reduce this differential [see Griffith (1999)].

Table 3 presents the results of estimated equation (1) using OLS, GLS, Fixed-Effects and Random-Effects models. The GLS technique is a more rigorous method than the OLS technique, which allows for heteroscedasticity and autocorrelation to be modeled across panels[17]. Fixed-effects and random-effects models are estimated correcting for heteroscedasticity and autocorrelation. Two sets of equations have been estimated, one using different components of technology acquisition, i.e., R&D expenditures, Royalty payments and import of capital goods and the other using technology acquisition index.

The results based on different models are found to be qualitatively the same. The results of GLS (column 3) and fixed effects model[18] (column 5) show that lagged FDI and exports have significant positive coefficients indicating that FDI and exports have raised labour productivity in the Indian manufacturing industries. Higher competitive pressures both in domestic and international markets may have driven firms to improve their productivity. Another reason for this could be spillovers from foreign firms that may operate via competitive pressures and/or learning effects. Our results support the findings of many other studies with regards to FDI[19].

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[17] GLS also allows for autocorrelation within panels to be modelled in which case the structure with no autocorrelation, correlation parameter common for all the panels and unique correlation parameter for each panel can be modelled separately [see Green (2000); Stata, (2003)].
[18] Fixed effects model is preferred based on Hausman test.
[19] E.g., Djankov and Hoekman (2000), Caves (1996), Blomstrom and Wolf (1994)] and exports [e.g., Francisco Alcalá and Antonio Ciccone (2001).

The level of protection in an industry (measured by ERP) estimates the impact of imports in an industry on labour productivity. Import intensity of an industry, as expected, is found to have a strong negative impact on labour productivity indicating that higher the extent of import liberalisation higher will be the labour productivity. This is in accordance with the results obtained by Bloch and McDonald (1999) for Australia.

Table 3: Impact of FDI, Trade and Technology on Indian Labour Productivity

Dependent Variable: Log GVA/Number of persons employed

Variables	OLS		GLS		Fixed Effects		Random Effects	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LogK/L	0.17** (2.70)	0.16** (2.09)	0.08** (2.90)	0.09** (2.97)	0.16** (2.60)	0.16** (2.65)	0.12** (2.24)	0.12** (2.30)
Log $(K/L)^2$	-0.003 (-0.13)	-0.31 (-0.79)	-0.003 (-0.02)	-0.005 (-0.36)	-0.005 (-0.26)	-0.007 (-0.35)	-0.001 (-0.05)	-0.001 (-0.08)
Log FDI_{t-1}	0.11** (2.43)	0.01* (1.71)	0.006* (1.84)	0.005* (1.67)	0.009* (2.05)	0.01** (2.29)	0.008* (1.94)	0.009** (2.15)
Log Export $Intensity_{t-1}$	0.08** (3.93)	0.05** (2.17)	0.08** (5.38)	0.08** (5.95)	0.08** (3.91)	0.07** (3.70)	0.08** (4.30)	0.08** (4.12)
Log R&D Expenditure $_{t-1}$	0.005 (1.16)	-	0.01** (2.41)	-	0.02** (3.97)	-	0.02** (3.91)	-
Log Roy_{t-1}	0.004 (0.28)	-	0.003 (0.03)	-	0.006 (0.45)	-	0.004 (0.30)	-
Log $IMPK_{t-1}$	0.01 (1.45)	-	0.01 (0.19)	-	0.01 (0.13)	-	0.01 (1.18)	-
Log Tech	-	0.07** (3.08)	-	0.02* (1.89)	-	0.04** (3.03)	-	0.04** (3.18)
Log ERP	-0.002** (-5.68)	-0.002* (-3.69)	-0.001** (-3.17)	-0.001** (-2.95)	-0.001** (-4.45)	-0.002** (-5.43)	-0.001** (-4.85)	-0.002** (-5.80)
Constant	1.15** (10.21)	1.16** (10.33)	0.95** (5.56)	0.96** (8.28)	1.22** (9.01)	1.05** (13.15)	1.25** (8.03)	1.08** (9.47)
N	468	468	468	468	468	468	468	468
Ind Dummies	Yes	Yes	Yes	Yes	No	No	No	No
Adj R^2	0.29	0.34	0.20	0.22	-	-		
Overall R^2			-	-	0.20	0.21		
Wald Chi2			83.26**	72.58**	320.03**	319.88**		
F	13.22*	15.05*	-	-	41.38**	40.67**		
Hausman Chi 2			-	-	9.07	4.15		

Note: ** indicates significance at 1%, * indicates significance at 5%, # indicates significance at 10%.

The estimations are carried out for 78 industries for the period 1991-92 to 1997-98

The impact of technology acquisition on labour productivity is estimated by examining the impact of three different channels of technology acquisition, i.e., R&D intensity, import of capital goods and royalty and technical fee payments. We find that R&D has a significant positive impact on labour productivity (column 5) but the impact of ROY and import of capital goods is not found to be significant. However, technology acquisition index that takes into account the internal relationships between different channels of technological acquisition (e.g., higher R&D may imply lower ROY) has a significant impact on labour productivity (column 8). We can therefore say that the technology policy followed in the post-reforms period, which encouraged higher technology acquisition in the domestic industry, has positively influenced the labour productivity[20].

The impact of FDI, trade and technology is examined after controlling for inter-industry variations in the capital labour ratio. Higher K/L ratio leads to higher labour productivity (the term K/L square enters with the right sign, though is not significant). The results arrived at are robust since they do not differ across different specifications. The results therefore show that after controlling for industry-specific effects FDI, export intensity, import liberalisation and technological progress have all acted as important drivers of labour productivity in Indian manufacturing sector in the post-reforms period.

5.2 Impact of Liberalisation on Wages Inequality.

To estimate the impact of FDI, trade and technology on wage inequality, i.e., difference in wage rate of skilled and unskilled labour, we estimate equation (2) using fixed effects model, as selected by the Hausman test. The results are presented in Table 4. An important result that comes out of the analysis is that there has been an exogenous increase in wage inequality overtime as is evident from the sign of the time variable.

[20] Similar results with regards to technology have been found by some studies for the developing countries for example Chuang and Lin (1999), Hansson (2001)

To explain this increase we focus on some of the determinants of skill-specific wages. The results show that, as expected, the higher the proportion of skilled labour to unskilled labour in an industry the lower is the wage inequality. With respect to the other variables, we find that FDI has a significant positive impact on wage inequality (though the coefficient is very small) once we control for other variables like trade and technology. This is in line with findings of many studies for developing countries [e.g., Feenstra and Hanson (1995) for Mexico, Graham and Wada (2000) for Mexico, Driffield and Taylor (2000) for U.K and Zhao (2001) for China]. Matsuoka (2002) also finds that the foreign-ownership wage premium for Thai manufacturing firms is higher for non-production workers than for production workers. The inference here is that, FDI impacts positively on labour productivity, and in turn demand high quality labour. Recent research also suggests that there are substantial differences in the wages of skilled and unskilled workers in the domestic and foreign owned sector[21].

We further test the hypothesis forwarded by Figini and Gorg (1999), i.e., FDI may have an impact on wage inequality which is essentially inverted U-shaped. Thus, after a period of time as overall skill levels in the industry increases, FDI may eventually reduce wage gap. But we do not find the result to be statistically significant though the coefficient of FDI squared is negative. Our result is in line with the results arrived at by Taylor and Driffield (2000) who conclude that it may take a long time, i.e., may be more than a decade for foreign firms to reduce wage inequality.

However, the results show that export intensity of an industry has a negative impact on wage inequality, after controlling for other effects. Higher exports in an industry are found to have reduced wage inequality. One of the reasons for this could be that in India most of the exports take place from the low-skill and labour-intensive industries therefore higher exports raise the demand and thereby the returns to low skill labour reducing the wage gap**.**

[21] For example, Driffield, (1996), Conyon et al. (1999), Girma et al. (1999).

Apart from FDI and trade, the results show that, rise in wage-inequality over time can also be attributed to technological progress. Import of capital goods is found to have a positive impact on wage inequality and technological acquisition index is also found to have a significant impact on wage inequality. This indicates that in Indian manufacturing industries technological progress has probably been skill-biased. The impact of technological progress is stronger than the impact of trade since overtime we find that wage inequality has increased.

Table 4: Impact of FDI, Trade and Technology on Wage Inequality

Dependent Variable: Log Wages of skilled labour / wages of unskilled labour

Variables	Random Effects Model		Fixed Effects Model	
Log Skilled/unskilled	-0.18** (-5.46)	-0.17**(-5.30)	-0.23**(-3.99)	-0.21**(-3.67)
Time (g1)	**0.01**(3.49)**	**0.01**(2.68)**	**0.02** (2.80)**	**0.01**(2.87)**
Log FDI	**0.01**(2.81)**	**0.01#(1.87)**	**0.001* (1.91)**	**0.002# (1.77)**
Log FDI2	-0.001 (-0.11)	-0.001(-1.17)	-0.001 (–1.22)	-0.001 (-1.30)
Log Exports	**-0.01(-1.11)**	**-0.02(-0.24)**	**-0.03** (-2.42)**	**-0.03** (-2.33)**
Log R&D	-0.001 (-0.54)		-0.004 (-0.13)	
Log ROY	0.003 (0.43)		0.003 (0.94)	
Log IMPK	**0.12* (1.96)**		**0.01** (2.39)**	
Log TECH		**0.06# (1.92)**		**0.03* (1.96)**
Fixed vs. Random Effects (Hausman)	116.10**			
R^2 (Overall)	0.13	0.14	0.15	0.17

Note: 1. ** indicates significance at 1%, * indicates significance at 5%, # indicates significance at 10%.
2.FDI, Exports, ERP and technology variables have lagged values.
3.The estimations are carried out for 78 industries for the period 1991-92 to 1997-98

6. Conclusions and Policy Implications

The paper estimates the impact of three major components of liberalisation, i.e., FDI, trade and technology on labour productivity and wage inequality between skilled and unskilled labour in the Indian manufacturing industries in the post reforms period. The cross-industry analysis shows that FDI, trade and technology have all improved labour productivity in this period but along with higher labour productivity, we find that wage inequality between skilled and unskilled workers has also increased.

The results show that FDI, trade and technology have differential impact on wage inequality. Higher FDI in an industry raises wage inequality, while higher export intensity of an industry is associated with lower wage inequality. Further, technological progress is found to be skilled biased in this period and accordingly higher extent of technology acquisition in an industry is found to be associated with higher wage inequality.

Three points stand out from the above results. First, Indian economic reforms have helped in improving the competitive strength of the organised manufacturing sector by improving labour productivity; Second, FDI and trade have different costs and benefits associated with them. In particular, while FDI has improved labour productivity it has also led to higher wage inequality; and third, technological progress has been skill biased in Indian manufacturing sector and therefore has led to increase in wage inequality between skilled and unskilled labour.

One of the direct implications for policy that can be derived from the above results is that it is important to attract FDI in the export-oriented sector in India. Studies show that though FDI has led to export diversification in the Indian industry, it has not yet entered export-oriented industries that are characterised by low-skilled labour[22]. Entry of foreign firms in export-oriented industries will capture the adverse effects of FDI on wage inequality, as foreign firms will drive up the demand for unskilled labour in these industries. This will also help in improving the skills of the workers in this low-skilled sector.

One of the ways of encouraging FDI in export-oriented sector is by reducing the relative cost of production and operation of foreign firms in this sector. With relaxed labour laws and higher education and training of labour in India, higher FDI is expected to flow into the export sector. Further, efforts should be undertaken in selected industries, especially import competing industries, to improve skills of the employed labour. Departing training programmes by the state and increasing overall investments in education, health, training and industrial relations can do this.

Given the fact that technological progress has been skill-biased in the post reforms period, it is important to undertake research and development in an industry to adapt the imported technology to suit our resource endowment. This will not only raise the potential for employing more workers but will also improve the potential of the economy to benefit from FDI and technological progress. On the whole, it can be said it is important to maximise the benefits of FDI, trade and technological progress in an economy. Improvements in labour productivity should also be followed by reduction in wage inequality between skilled and unskilled workers and this is possible only if benefits of FDI, in terms of improving labour productivity, are channelled towards low-skilled sector and efforts are undertaken to make technological progress less skill-biased through continuous research and development.

[22] Banga 2003

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Appendix

Table A.1: Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
FDI	468	12.84	0.02	5.39	40.09
EXP	468	0.06	0.0001	0.09	0.79
R&D	468	0.0005	0.00007	0.001	0.02
IMPK	468	0.01	0.00001	0.03	0.68
ROY	468	0.002	0.00001	0.004	0.07
LP	468	2.37	1.07	2.87	31.37
WR	468	0.32	0.06	0.15	1.18
W_{SK}	468	0.59	0.80	0.30	2.14
WRSKUNSK	468	1.8	1.80	0.66	4.02
TECH	468	0.17	0.21	0.0001	2.46

Table A.2: Correlation Matrix

	FDI	R&D	IMPK	ROY	EXP	LP	K/L	TECH
FDI	1.00							
R&D	0.26	1.00						
IMPK	0.18	0.11	1.00					
ROY	0.08	0.25	0.20	1.00				
EXP	0.20	0.25	0.20	0.03	1.00			
LP	0.07	0.11	-0.01	0.06	0.22	1.00		
K/L	0.15	0.12	-0.04	0.13	0.02	0.24	1.00	
TECH	0.12	0.35	0.33	0.58	0.15	0.08	0.09	1.00