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THE EFFECT OF INFORMATION TECHNOLOGY ON WAGE INEQUALITY: EVIDENCE FROM INDIAN MANUFACTURING SECTOR

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ABSTRACT

A persistent widening of skill based wage inequality in the Indian Organised Manufacturing sector has been reported by many researchers. Two main hypotheses had been tested in developed economies to explain such a phenomenon; an inter-sectoral shift in demand structure and an intra-sectoral shift in production technology. A decomposition of the change in wage share of skilled workers showed that sector bias explained very little of the changes in the share of skilled worker wages while more than 85 percent of the changes occurred within industries, giving support to the argument of changing skill mix within industries, rather than between industries. While scale effect and capital skill complementarities do tend to give partial explanations for the increasing share of skilled worker wage share, the most consistent and quantitatively large explanation seems to appear from the effect of Information Technology intensity in the production process, whatever the specifications be. Moreover, argument of the skill biased wage inequality is only weakly supported by mere IT adoption, but it is the intensity in IT use that is the most dominant factor. However there is no evidence for an enhanced effect of IT on wage shares since the signing of the ITA agreement and the probably increased import of IT goods. Neither is there any evidence to show that technology endowed capital goods have had an impact on the changes in skill biased wage share during 1998-99 to 2004-05.

Key words: Skill Biased Technological Change, Wage Inequality, Information Technology, Indian Manufacturing sector.

JEL Classification: J31, L6, O33

I. Introduction

A persistent widening of skill based wage inequality in the Indian organised manufacturing sector had been reported by Berman et al (2005), Nagaraj, (2000) and Ramaswamy (2008) among others. Between 1980-81 and 2004-05 the share of non-production workers' wages in the wage bill increased from 35 percent to 48 percent and the relative wage per non-production worker, in comparison to the production worker increased from 1.5 to 2.06 percent[1]. Moreover, average wage differential, the ratio of wage rate of non-production to production workers increased from 2:1 to 3.3 :1 during the period, indicating widening wage inequality between the two groups. A shift did exist in the share of non-production labour in total employment as well. Share of non-production workers increased from 23 percent to 26 percent, conversely the share of production workers declined from 77 to 74 percent during the period 1980-81 to 1998-99[2]. The shift in wage share along with the changes in share of non-production workers represents a rising demand for skilled workers relative to less skilled workers.

The Heckshier Ohlin (H-O) theoretical predictions and their further implications drawn by the Stopler Samuelson model argue that, based on factor cost advantages, the labour surplus developing economies would have comparative advantage in producing and exporting labour intensive products, while the capital abundant developed economies

1 See Appendix table 1

2 However, the share of non-production workers declined from 26 to 23 percent during the period 1998-99 to 2004-05.

would have comparative advantage in producing and exporting capital intensive products. In turn, since production technology of labour intensive products generate demand for less skilled labour, the relative wages of less skilled workers in the developing economies would increase, and in the developed economies the relative demand and thereby wages for skilled workers would increase.

However, contrary to the H-O trade theoretic predictions of rising relative demand for sector specific unskilled or less skilled employment in developing economies empirical evidences suggest a globally pervasive skill bias in the earnings and employment composition (Berman and Machin 2000, Acemoglu 1998). Many economies, both from the developed and developing world, experience a rise in skill demand expressed as skill bias in the earnings and employment (Berman et al, 1998).

Prominent studies about the developed economies argued that technological change in the production and distribution processes have led to a rising demand, and hence rising relative wages for skilled workers. The phenomenon being termed as Skill Biased Technological Change (SBTC) (Berman, Bound and Griliches, 1994., Autor,Katz and Krueger, 1998., Berman, Bound and Machin, 1998). One of the major arguments for this SBTC revolves around the changes in production process and organizational changes stimulated by the adoption and use of new Information and Communications Technologies (ICT) (Acemoglu, 1998; Autor, Katz and Krueger 1998; Card, Kramarz, .Lemeieux 1997; Doms, Dunne and Troske 1997). Studies report that the steady decline in the rental price of computers had led to rapid substitution of this equipment for other inputs in the US economy. The substitution was, by and large, skill biased, i.e. ,IT acted as a substitute for unskilled labour and a complement to the skilled labour (Card, Kramarz and Lemieux 1997; Doms, Dunne and Trotske 1997; Berman 2000; Autor, Katz and Krueger 1998).

The rising demand for skilled workers also started showing up on the wages as well. The wage differential between the skilled and the less skilled was high and increasing. Based on the Current Population Survey of the U.S. for 1984 and 1989, Krueger (1993) relates the relation between computer use and wages. His study showed that computer users received a premium of approximately 20 per cent, which was also found increasing over time. Cross-sectional studies done by Doms, Dunne and Troske (1997) also report that plants that use a large number of technologies paid higher wages. Autor, Katz and Krueger (1998) again provide evidence to the argument that the use of computer has led to higher wage levels. Using four digit datasets of NBER productivity database the authors have argued that the within-industry wage differentials between computer users and non-users have widened. Investment in computer alone would seem to account for between one quarter to one half of the within industry move away from production labour that occurred during 80s. They conclude their study as

> "*…Skill-biased technological and organisational changes that accompanied the computer revolution appear to have contributed to faster growth in relative skill demand within detailed industries starting in the 1970s. Although the strong observed conditional correlations of computer measures and the growth in the relative utilisation of highly educated workers may not just reflect causal relationships, it seems clear that whatever is driving the rapid rate of within industry skill upgrading over the past few decades is concentrated in the most computer-intensive sectors of the U. S. economy*."

In the developing economies, however it is argued that endogenous technological change is feeble. On the other hand, it is argued that technological change gets transmitted through the import of technology embodied capital and intermediate goods by the developing economies. Pavcnik (2002) and Attanasio et al (2004) provide evidence for skill upgradation due to imported technology adoption and trade in Chile and Columbia respectively. Berman et al (2005) also argue that technology embodied within capital is a major source of skill biased wage inequality in India. Since the liberalization of the economy the trade openness may have attracted greater imports of technology embodied capital. However, they do find that international trade per se has no effect on the phenomenon. Ramaswamy (2008) also argues that in the case of India capital skill complementarities are becoming strong since trade liberalization in the economy. He posits that probably technology embodied within imported capital is the causal factor for this phenomenon. But while the Berman et.al (2005) paper argues that there are sectoral differences in skill bias between U.S and Middle Income countries and India and the Ramaswamy (2008) invokes the increasing trend in capital imports as a probable reason for skill bias, both these studies do not put forward a direct measure of technology, to support their argument.

This paper specifically contributes to the literature on Skill Biased Technological Change (SBTC) in India by utilizing a direct measure of technology, in this case that of Information Technology. Given that IT diffusion in the organized manufacturing sector has been rising at a fast pace in India (Joseph and Abraham, 2005) it would be appropriate to look into its effect on rising wage inequality. The results of the study show that intensity in IT use explains a substantial share of the change in wage inequality. Further, capital skill complimentarity becomes very weak once the effect of IT is separated out.

The second section provides the analytical back ground to the study. Section three gives the Data Sources and Scope of the Study. An exercise on wage inequality decomposition is described in Section four. The trends and patterns in skill intensity, wage differentials and trends in IT adoption and use in India are discussed in Section Five. The following section analyses the empirical relation between wage differentials and the adoption and use of Information Technology in India. Finally, the conclusions are presented in the last section.

II. Analytical Background

The increase in aggregate wage shares of skilled workers can be analytically conceived to have two parts: one, the sector-specific increase in total wage payment that normally have a high share of skilled worker wages and two; a skill-specific increase in the wage share within industries. The approach as suggested by Berman, Bound and Grilichez (1994) is to decompose the change in the share of the wage bill share of the skilled workers into 'between' industry share and 'within' industry share, as expressed in equation (1). The 'between' industry would account for 'sector biasness' and within industry would account for 'skill biasness'. The decomposition equation is as follows:

$$\Delta Sn = \sum_{i=1}^{N} \Delta Sn_i \overline{P_i} + \sum_{i=1}^{N} \Delta P_i \overline{Sn_i} \qquad (1)$$

Where Sn is the wage bill share of industry i… The within industry component of skill upgrading is represented by the first term in the RHS. P *bar* is a weight of the relative size of the industry, averaged across time, in this case the size of employment. The second term in RHS estimates contribution of 'between' industry shifts, wherein the changes in the size of the industry's employment, P , over time , keeping the 'within' industry skill component averaged over time is estimated. A markedly higher share of contribution of the second term, the 'within' industry component would qualify the rise in wage inequality to be skill biased.

Further, this 'within' industry changes in skilled worker wage share is analysed to explore the relation attributable to technological change that affects the production process. A framework for the analysis of factors that these changes in skilled worker wage share as suggested by Berman, Bound and Grilichez (1994) is based on a quasi fixed cost function of labour demand.

Consider the quasi fixed cost function:

$$C= f(K, Ws, Wu, Q) \tag{2}$$

where Ws and Wu are the prices of variable inputs: skilled and unskilled labour, Q is output and K is capital which is fixed.

The above cost function is used to derive equations for shares of skilled and unskilled labour payment in total factor payments for all variable factors assuming that some of the inputs are fixed and quantities of variable inputs are chosen to minimize costs.

Assuming the above cost function takes the Translog form the first order condition gives the cost share equation for each factor. After imposing the symmetry and homogeneity restrictions only one of the equations need to be estimated. By taking the first difference of the resulting equation we arrive at the following change in skilled-workers wage bill share equation

$$\Delta Sn_{it} = \alpha + \beta\Delta log(K_{it}/Q_{it}) + \gamma\Delta log(Q_{it}) + \delta\Delta log(W_s/W_u)_{it} \tag{3}$$

Where Sn = share of wage of skilled workers, subscript i. represent the i^{th} industry and t represent t^{th} time period.

Capital – skill complimentarity implies $\beta > 0$.The technology embodied capital raises the demand for skill, which gets reflected in skilled worker wage share. α represents the cross industry average bias in technological change. Constant returns to scale imply $\gamma = 0$, though $\gamma > 0$ denotes short term cyclical fluctuations in skilled wage share. The effect of relative wages on share of skilled wage share is captured by δ. However, given that the ratio of wage rates may be endogenous to the equation this term is dropped. The changes in wage rate are confounded by skill upgrading and quality improvements. On the assumption that the ratio of price of quality adjusted production and non-production labour is constant, leaving the term from the system will not affect the quality of the other coefficients, except for the constant (Berman, Bound and Griliches, 1994).

The above equation, while captures the capital complimentarity of share of skilled worker wages the argument of technological change being an important factor for this skill bias is brought in indirectly, through the assumption of technology embodied capital. A direct measure warrants that indicators of technological change are plugged in along with the above equation. Studies conducted previously provide evidence that IT explained a large share of skill bias in the developed economies (see Section 1). Taking cue from the literature on developed economies we extend the equation to add a term, ITPW, as an indicator for IT to test for the skill bias nature of IT. We use two alternate indicators, IT adoption rate and the IT investment per worker. While IT adoption rate captures the incidence of IT use, IT investment per worker indicates the intensity of IT use. $\Phi > 0$ indicates that indicators of IT have a positive effect on share of skilled worker wage.

Since the data takes a panel structure year dummies are added to control for time specific shocks and industry dummies are added to control for unobserved heterogeneity across observations. These additions make the estimating equation (4) as follows.

$$\Delta Sn_{it} = \alpha + \beta \Delta log(K/Q)_{it} + \gamma \Delta log(Q_{it}) + \Phi \Delta log(ITPW)_{it} + \psi Y_t + \eta IND_i + \xi_{it} \quad (4)$$

Where ITPW indicates IT investment per worker, and alternatively IT adoption rate, measured as the proportion of operating units using IT. The variable Y is the year dummy, IND is the industry dummy, and ψ and η are their coefficients respectively . ξ is the error term.

Following the literature on Skill enhancing trade hypothesis (Robbins, 1996; Pavcnik 2002, Attanasio et al 2004) we augment the above equation with two trade variables, namely export intensity and import intensity. The import of technology endowed capital that is skill biased can enhance wage inequality due to rise in demand for skilled labour. Since developing economies are 'technology followers', the import of technology endowed capital by developing economies could cause widening skill based wage inequality, to the extent that such import occurs within industry rather than being sector specific. Export could also be skill enhancing in nature due to the re-export, from developing economies, of 'outsourced' intermediate goods from developed economies (Feenstra and Hanson, 1996, 2001). Typically the lower technology, low value added and labour intensive part of the value chain is outsourced to developing economies for further processing. However, even these low ends of the value chain maintain a higher technology level than the domestic levels, thus creating the skill bias. Moreover, the threat of import competition and export competitiveness brings in greater use of technology and the related skill bias. Thus it is expected that both the trade coefficients ρ for import intensity and ω for export intensity would bear positive signs.

Finally, the effect of labour market rigidity in Indian manufacturing sector is also expected to have a positive effect on skill bias. Labour market rigidity has prompted subcontracting of work (Ramaswamy,1998) in the manufacturing sector. The sub contracted parts of the value chain, as mentioned earlier, are low end while the higher end of the value chain, which are more technology intensive remain within the firm. This is another source of skill bias. Thus we expect υ, the coefficient for the indicator for labour market rigidity to have a positive sign.

Thus, the augmented estimating equation is as follows

$$\begin{aligned}\Delta Sn_{it} = \alpha + \beta\Delta log(K/Q)_{it} + \gamma\Delta log(Q_{it}) + +\Phi\Delta log(ITPW)_{it} + \rho\Delta log(I/Q)_{it} \\ +\omega\Delta log(X/Q)_{it} + \upsilon\Delta log(LABREG)_{it} + \psi Y_t + \eta IND_i + \xi_{it}\end{aligned} \quad (5)$$

where I/Q is import intensity measured as total imports as a ratio of gross value added; X/Q is export intensity measured as total exports as a ratio of gross value added; LABREG is an indicator for labour market rigidity measured as the number of mandays lost due to strikes and lock outs per worker; ρ, ω and ν are coefficients to be estimated.

The analysis is done at three digit level aggregation for the period 1998-99 to 2004-05. The choice of period has been constrained by the availability of data for IT investment. The estimations are based on OLS regressions, reporting panel corrected standard errors. All estimations are weighted by the share of wages of the i'th industry in total manufacturing sector. These weights would give greater importance to industries with larger wage payment, and lesser importance to industries with lesser wage payment.

III. Data Sources and Scope of the Study

The Annual Survey of Industries (ASI) conducted by Central Statistical Organisation of India (CSO) publishes data for all important characteristics of manufacturing sector at three digit level of National Industrial Classification, which includes measures of output, capital, wages to production and non-production workers and number of production and non-production workers. This is the main source of data used in the present study. The ASI reports the figures in current prices. The Wholesale Price Index (WPI) has been utilized to deflate the values to constant prices at 1993-94 prices[3]. We have deflated the prices by using the appropriate commodity price index at the three digit NIC (NIC 1998) classification of industries to arrive at the constant prices. There is no appropriate commodity classification for NIC classification number 371, 372. Hence we have used the WPI for total manufacturing sector in these two industries. Gross Value Added as reported in ASI, deflated using the Wholesale Price Index at 93-494 prices is taken to be the Output. Fixed assets as reported in ASI deflated using the WPI for plant and machinery is the indicator for capital. The nominal wages reported in the ASI is deflated using the Consumer Price Index for Industrial Workers for the respective years to arrive at real wages.

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3 The WPI series for commodities is available at www. eaindustry.nic.in.

The ASI has added a query on IT since 1998-99, viz., the total amount of investment in computer hardware and software by the firms. Though this data is not available in the published reports of CSO this is available on request. The data thus obtained was merged with the readily available other variables from ASI at three digit levels. Since the IT data is available only from 1998-99 the analysis in the paper is limited to the period 1998-99 to 2004-05, the latest period for which ASI data has been published. Computer investment was deflated using the WPI index at 1993-94 prices to arrive at constant prices.

The data for imports and exports were obtained from the World Integrated Trade System (WITS) database of UNCTAD. Both of these variables were deflated using the WPI at 93-94 prices. Mandays lost due to disputes were obtained from the 'Pocketbook of Labour Statisitics" published by Labour Bureau, Shimla of the Government of India.

IV. Wage Inequality Decomposition

The percent annual change in the share of wages to the skilled workers in total emoluments had been increasing since liberalization of the Indian economy in 1990s. While the increase during the period 1990-98 was at 0.37 percent per annum during the period 1998-99 to 2004-05 was even higher at 0.49 percent per annum, indicating that not only is there wage inequality, but also there is an acceleration in its pace. On the other hand during the pre liberalisation period 1984-89 there was a decline in the share of wages to skilled workers declining annually at -0.23 percent. Thus skill biased wage inequality had become a noticeable phenomenon during the post liberalization period while the period before liberalisation had reduced such inequalities. This wage inequality measure is further supplemented by another measure of wage inequality, percent change in the ratio of wages per skilled worker to wages per less skilled worker. The change in this ratio also had continuously increased from 0.26 to 1.07 to 1.69 during the three periods mentioned above.

The decomposition of the wage share of skilled workers according to equation (1) yields the result in row 2 of Table 1. It shows that in all the three periods an overwhelming majority of the annual change was 'within' industries while only a small minority occurred 'between' industries. During 1990-98, 90 percent of the changes in wage share was within industries, while during 98-99 to 2004-05 , 97 percent of the changes was within industries. This decomposition brings out the 'within' industry skilled biased changes in wage share allowing us to follow the hypotheses of technological change and capital skill complementarities within industries.

Table 1: Decomposition of Employment and Wage share "Within" Industries.

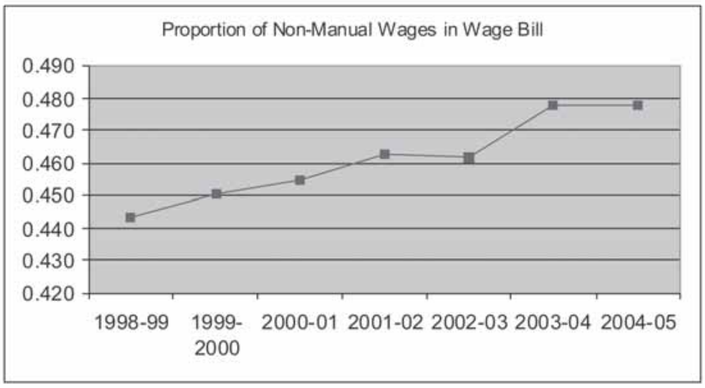
	1984-89	1990-98	98-99 to 04-05
% annual change in share of wages to the skilled workers in total emoluments	-0.230	0.370	0.490
% of within Industry in annual change in share of wages to the skilled workers in total emoluments	175.310	89.450	96.55
Ratio of wages per skilled worker to wages per less skilled worker	0.260	1.070	1.687

Note : The figures for 1984-89 and 1990-98 are taken from Berman, Somanathan and Tan (2005) The figures for period 98-99 to 04-05 are own calculations

V. Trends and patterns of IT adoption and use, Skill Intensity and Wage Differentials

Skill Intensity and Wage Inequality: The average annual employment in the organized manufacturing sector of India had declined at the rate of 0.23 Lakh employees per annum during the period 1998-99 to 2004-05. The declining trend in employment is also visible in the standardized measure, employment per unit of output which declined at the rate of -0.008 employees during the period. Skill intensity, measured as the ratio of managerial and supervisory employees to total employees, had in fact declined from 28.3 percent to 25.7 percent during this period[4]. Yet the ratio of unskilled worker to skilled worker cost, a measure of the wage differential, had decreased from 47 percent to 37 percent, at the rate of -0.015 units(See Fig 1, Table 2), implying widening wage differentials between the skilled workers and the less skilled workers. It is also to be noted that the annual average change in inter-industry coefficient of variation had been negative for both skill intensity and relative less skilled worker to skilled worker cost, implying that the skill based changes in employment and wages are increasingly becoming 'within' industry phenomenon rather than 'between' industry phenomenon.

Figure 1 : Share of Skilled Worker Wages in Total Wage Bill



4 It is true the number of skilled workers also declined. But, the share of wages in total emoluments has increased. This in effect points to a rise in overall demand for skilled workers. Surely, some frictional displacement is bound to happen at all levels due to technological change. But then as a category the skilled workers overall demand is higher. It is possible that due to the technological change even some skilled workers unequipped to work with new technologies may become redundant, but the replacement may be a more skilled worker, who may be not only replacing floor workers alone, but also some skill-inflexible non-production workers as well.

Table 2: Trends in Employment, Skill and Wage Differentials

	1998-99 to 2004-05 Average Level	Change per annum
Average		
Total Persons Engaged (in Lakhs)	70.471	-0.229
Average Employment per Lakh Rs. Output	0.157	-0.008
Skill Intensity	0.270	-0.004
Relative Worker to Skilled-worker Cost	0.412	-0.015
Coefficient of Variation		
Total Persons Engaged (in Lakhs)	1.410	-0.016
Average Employment per Lakh Rs Output	0.836	0.031
Skill Intensity	0.317	-0.006
Relative Unskilled-Worker Skilled-worker Cost	0.249	-0.024

Information Technology Adoption and use in the Manufacturing sector: The share of firms in the organised manufacturing sector that reported any investment in IT was 33 percent in 1998-99 (Table 3) the first year for which the data is available. From 1998-99, there has been a steady increase in the per cent of firms reporting IT investment and by 2004-05 their share increased to 52.3 per cent increasing at an annual rate of 2.74 percent points. This represents an approximately 20 percent point increase in a short period of seven years. The observed diffusion rate during the last seven years emerges as impressive when considered against the fact that the first commercial computer installation was in 1961 by ESSO Standard Eastern Inc an eastern affiliate of the American multinational oil company Exxon (Subramanian, 1992)[5]. While rate of diffusion increased by 34 percent during the first 36 years since the first point of diffusion, the terminal seven years recorded a much higher

5 The first computer installation in India was at Indian Statistical Institute, Calcutta in 1955.

diffusion rate of 20 per cent. The IT investment per worker also increased from Rs. 2681 in 1998-99 to Rs. 5475 increasing annually at Rs. 399 per worker. Inter-industry variation in IT adoption does exist but the variation has been continuously declining over years as is evident from the estimated values of the coefficient of variation (CV), from 0.41 in 1998-99 to 0.27 in 2004-05 declining annually by -0.020. This trend, along with the rise in average IT adoption rates, points to the fact the IT adoption is increasing over the years and the inter industry variations are declining. However the inter industry variation in IT investment per worker was increasing, albeit gradually.

Table 3: Indicators of IT Diffusion in Indian Manufacturing Sector

	1998-99 Level	1998-99 to 2004-05 Average	1998-05 change per annum
IT Adoption Rate (%)	33.10	43.18	2.74
Inter-industry CV in IT Adoption	0.41	0.32	-0.020
IT investment per Worker (in Rs)	2680.68	4418.83	399.11
Inter-industry CV in IT per Worker	1.205	1.253	0.011

IT, Skill Intensity and Wage Inequality: The relation between IT adoption, skill intensity and wage differentials is expressed in Table 4. As is evident from the table below, the skill intensity levels marks a secular increase along with the increase in adoption rates, from 18 percent at the lowest class of adoption to 36 percent at the highest class. The average salary share of skilled workers, an indicator for wage inequality, increased from 33 percent to 58 percent. The ratio of average wage of less skilled worker per less skilled worker, another indicator for wage inequality, declined from 44 percent to 40 percent as the level of IT adoption increased. Results are very similar when we take up IT investment per worker as the classificatory variable instead of IT adoption (Table 5). Here too we find that there is a linear relation for IT investment per worker with skill intensity, wage share of skilled workers, though there are some mixed trends for proportion of less skilled worker wages to skilled worker wages. These results do tend to suggest an association between skill biasness and IT use in the manufacturing sector.

Table 4: IT Adoption, Skill Intensity and Wage Inequality

IT Adoption Rate (in per cent)	Skill Intensity Levels	Average Salary share of skilled workers	Less skilled worker to Skilled worker wage ratio
Less than 20	0.180	0.33	0.440
20-40	0.231	0.41	0.432
40-60	0.258	0.45	0.422
60-80	0.303	0.53	0.387
above 80	0.357	0.58	0.401

Table 5: IT Investment per Employee, Skill Intensity and Wage Inequality

IT investment per employee	Skill Intensity Levels	Average Salary share of skilled workers	Less skilled worker to Skilled worker wage ratio
Less than Rs 1500	0.206	0.38	0.416
1500 to 3000	0.255	0.45	0.425
3000 to 4500	0.303	0.50	0.426
4500 to 6000	0.313	0.53	0.395
above 6000	0.348	0.58	0.384

VI. Empirical Estimation Results

Long period time differenced OLS regression estimates are reported in Table 6. From Column 2 of Table 6 the positive and highly significant constant denotes the positive change in the share of skilled worker wages. The size of the constant, after converting to percent, 0.39 is nearly 80 percent of the total annual change in skilled wage share, at 0.49 percent (see Table 1 on wage difference decomposition). Thus while the sector is experiencing a rise in wage share of skilled workers , only 20 percent of this change get explained away due to changes in output and capital output ratio, the two prominent culprits in skill biased changes in wage share. Even this 20 percent change may not speak of much as both these variables are not statistically significant. However, the addition of the technology variable, namely, the IT investment per employee, adds a lot to the explanation of Skill biased changes. The variable is added in the model expressed in column (3). The change in IT investment per employee has a positive and significant effect on change in the share of skilled worker wages. In this estimation the size of the constant declined from 0.39 percent to 0.08 percent. Now, the constant consisted of only 16 percent of the total change in share of skilled worker wages. On the other hand, the addition of the IT investment per worker accounted for 63 percent ((0.39-0.08)/0.49) of the change in the share of skilled worker wage share. The R-square also improves from 3 percent to 15 percent in the equation. Adding the alternative indicator of the same technology variable namely IT adoption rate, however, does not turn out to be significant though the sign is positive. One could interpret this as that mere adoption of IT need not create the noticed skill biasness, but what matters is the intensity of IT use, which is expressed in IT investment per employee.

The column (5) gives the estimated coefficients of Equation 5. The perceived effect of trade are not visible in this study. Both the variables on import intensity and export intensity are not statistically different from zero. The other important variable suspected to have an impact on skill bias, namely labour market rigidities also does not show any significant effect on skill biasness.

Time differencing techniques was applied to two shorter periods and their pooled data as well. The data was analyzed for the two periods 1998-99 to 2001-02 and 2002-03 to 2004-05 (See Table 7). Such a classification has two purposes. One, it would allow to look into inter-

Table 6: Long Time Differencing – 2005-1998

	(1)	(2)	(3)	(4)	(5)
Δ log GVA	0.0140(0.91)	0.0247(1.10)	0.0235(1.24)	0.0276(1.24)	0.0196(0.84)
Δ log capital GVA ratio		0.0150(0.72)	0.0238(1.20)	0.0154(0.76)	0.0208(1.01)
Δ log IT investment per employee			0.0351** (2.36)		0.0401** (2.44)
Δ log import intensity					-0.0066(0.83)
Δ log export intensity					0.0027(0.25)
Δ log IT adoption rate				0.0270(0.85)	
Δ log labour rigidity					0.0008(0.28)
Constant	0.0039*** (3.91)	0.0039*** (3.68)	0.0008 (0.45)	0.0020 (0.88)	0.0009 (0.31)
Observations	58	58	58	58	53
R-squared	0.02	0.03	0.16	0.04	0.20
R -squared	0.0191	0.0304	0.1582	0.0395	0.2012
F test	0.8241	0.6233	2.5868	0.7073	1.5300
prob>F	0.3679	0.5399	0.0625	0.5518	0.1897

Robust t statistics in parentheses
*significant at 10%; ** significant at 5%; *** significant at 1%

temporal variations in the impact of these variables on skilled worker wage share. Secondly, it also allows one to capture the effect of the Information Technology Agreement (ITA) of the WTO, of which India is a signatory. The ITA came into effect in 2000 and since then India had been steadily reducing its import tariffs on IT goods. It can be expected that the cheaper importation of IT goods would increase the adoption and use of IT. Expecting a structural break in the impact of IT use with a time lag of two years, we analyse the data for both the periods. Then we pool the data along with a year dummy for structural break in the data.

The technology variable, IT per worker continues to be positive and highly significant. As expected, IT investment per employee has a statistically significant positive coefficient, implying that IT investment per employee does play a significant role in wage inequality in the manufacturing sector.

The addition of year dummy in the pooled estimation in the first estimation (column (7)) shows that the change in the share of skilled worker wages after controlling for the three variables, Real GVA, KY ratio and IT per worker, was equal in both the periods at 0.17 percent per annum. Thus the combined explanatory power of these three variables was not different between the two periods. The size of the constant and year dummy together was 0.34 percent. The addition of the variable IT adoption rate in Column(8) showed that the effect of the year dummy was higher in the second period, rejecting the argument that ITA had enhanced the effect of IT use and adoption on skill biasness. Both specifications in column(7) and (8) shows that real GVA , capital output ratio and IT are statistically significant and positive.

Both the trade variables, Import intensity and Export intensity takes negative values in all specifications, though only export intensity is statistically significant. This is understandable, given that exports from developing economies have their comparative advantage in labour intensive low technology based goods. The presence of these variables reduces the size and significance levels of both the variables on output and capital output ratio.

The positive and significant coefficient of change in capital output ratio in both the periods Column (1) of Table below shows the existence of capital skill complimentarity. However, when one compares between the two periods the estimation of Equation 5 in the first period explains a much larger share of change in the skilled worker wage share than in the second period. This is observable from the constants for the two estimations in columns (1) and (4), wherein much of the change in skilled worker remain unexplained and get accounted in the constant in the second period (.0042), in the first period the constant is much smaller (.0007) suggesting larger portion of the explanation by the explanatory variables. In the second period IT investment per employee does not turn out to be a significant variable though the sign remain positive. Moreover, in the specification with IT adoption rate as independent variable instead of IT investment this variable turns to be significant.

To test the robustness of the results obtained from the time differencing techniques we further analysed the same data using fixed effects model(Table 8). Instead of long time differencing, we employ year to year changes for the analysis. In the model year dummies are added. Column (1) and (2) reports results from Fixed effects model. Over all the fixed effects model has statistically significant levels of F statistic. In the estimated fixed effects model both change in IT adoption rate and change in IT investment intensity, along with change in gross value added had a positive effect on wage inequality. This gives further credence to the skill biasing properties of the IT use in the manufacturing sector. Size of the industry also turns out significant and positive across all models.

Table 7: Short Time Differencing Regressions

	1998-2002			2003-2005			Pooled 1998-2002/2003-2005		
(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Δ log GVA	0.0321 (1.63)	0.0218 (0.98)	0.0133 (0.54)	0.0268 (0.94)	0.0406 (1.49)	0.0154 (0.50)	0.0259** (2.10)	0.0286** (2.42)	0.0131 (0.90)
Δ log capital GVA ratio	0.0460* (1.82)	0.0426 (1.59)	0.0389 (1.36)	0.0401* (1.93)	0.0354* (1.81)	0.0449* (1.73)	0.0437** (2.43)	0.0383** (2.01)	0.0402 (1.35)
Δ log IT investment per employee	0.0248** (2.15)		0.0248** (2.14)	0.0055 (0.43)		0.0101 (0.76)	0.0174*** (3.39)		0.0187*** (5.98)
Δ log IT adoption rate		0.0247 (0.84)			0.0888* (1.87)			0.0473** (2.00)	
Δ log export intensity			-0.0165 (1.59)			-0.0110** (2.16)			0.0134*** -(6.55)
Δ log import intensity			-0.0018 (1.45)			-0.0113 (1.44)			0.0015 -(0.67)
Δ log labour rigidity			0.0025 (0.87)			-0.0046 (1.26)			0.0006 -(0.40)
Constant	0.0007 (0.36)	0.0026 (1.05)	0.0029 (1.18)	0.0042** (2.19)	0.0006 (0.27)	0.0062*** (2.95)	0.0017** (2.46)	0.0011 (0.67)	0.0035*** (10.46)
Year dummy							0.0017** (2.38)	0.0018 (1.14)	0.0009*** (2.79)
Observations	58	58	52	58	58	55	116	116	107
R –squared	0.1639	0.0644	0.1882	0.0499	0.1081	0.1574	0.0976	0.0725	0.1240
F test	4.1120	1.0304	2.5159	1.5084	2.0977	2.8596	31.9540	16.2629	39.3548
prob>F	0.0106	0.3865	0.0348	0.2228	0.1113	0.0184	0.0000	0.0010	0.0000

Robust t statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 8: Wage Inequality: Fixed Effects Estimations

	Fixed Effects	
	(1)	(2)
∆ log GVA	0.0365*** (3.75)	0.0438*** (4.54)
∆ log capital GVA ratio	0.0079 (0.88)	0.0136 (1.52)
∆ log IT investment per employee	0.0143*** (3.79)	
∆ log IT adoption rate		0.0319** (2.04)
∆ log import intensity	0.0004 (0.31)	0.0004 (0.30)
∆ log export intensity	0.0035 (0.71)	0.0042 (0.84)
∆ log labour rigidity	0.0015 (0.86)	0.0026 (1.41)
Year Dummy	Yes	Yes
Constant	-0.0070 (1.27)	-0.0045 (0.80)
Observations	322	270
Number of NIC	54	54
R –squared	0.1688	0.1363
F test	7.4043	5.5183
prob>F	0.0000	0.0000

Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

VII Conclusion

The rise in the proportion of skilled workers and their wages in the Indian manufacturing in the nineties has been a matter of concern, which reflected the world wide patterns. The two main suspects in such changes usually are change in demand structure and change in production technology. The first one brings about a sectoral shift between industries and the second one brings a skill biased shift within industries.

The case of Indian manufacturing sector, coinciding with investment and trade liberalization had raised the apprehension that sectoral shifts in trade composition of India, post liberalisation, had created sector biased demand for skilled workers. The other route to affect skill mix was through technological change within industries, which could be through importation of technology embodied foreign capital or use of such capital locally purchased. A decomposition of the change in wage share of skilled workers showed that sector bias explained very little of the changes in the share of skilled worker wages. In fact more than 85 percent of the changes occurred within industries, giving support to the argument of changing skill mix within industries, rather than between industries.

The analysis brings out the importance of biased technological change in explaining the increase in skilled worker wage share in the Indian manufacturing. While scale effect and capital skill complementarities do tend to suggest explanations for the increasing share of skilled worker wage share, the most consistent and quantitatively large explanation seem to appear from Information Technology, whatever the specifications be. However there is no evidence for an enhanced effect of IT on wage shares since the signing of the ITA agreement and the probably increased import of IT goods. Neither there is any evidence that capital goods have had an impact on the changes in skill biased wage share, once the effect of IT is controlled for. Thus while IT does seem to explain skill biased factor demand and ensuing wage inequality, the role of trade either as an exogenous factor or as a technology transmitting agent is negligible.

Labour market rigidities have little to contribute towards explaining the skill biased wage share, while export intensity seem to also contribute towards the phenomenon of skill biased wage share changes. The negative signs of the trade variables in the estimation support the H-O hypothesis of negative effect of trade on skill enhancing in trade by developing economies.

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Appendix

Table 1: Employment and Wage of Non-production Workers

Year	Share of non-production workers in total employment	Share of non-production workers wages in total wage bill	Average Annual wage of non-production worker (Rs. lakh)	Average Annual wage of production worker (Rs. lakh)	Ratio of wage of non-production worker to production worker
1981-82	21.72	35.17	0.14	0.07	1.98
1982-83	23.34	36.02	0.17	0.08	2.09
1983-84	22.30	35.77	0.20	0.10	2.06
1984-85	22.90	36.61	0.22	0.11	1.98
1985-86	21.91	36.00	0.24	0.12	1.98
1986-87	23.04	36.17	0.27	0.14	2.01
1987-88	22.86	36.56	0.30	0.15	2.03
1988-89	22.87	34.56	0.32	0.17	1.85
1989-90	23.00	35.92	0.36	0.19	1.95
1990-91	23.32	35.92	0.40	0.21	1.91
1991-92	24.31	35.23	0.38	0.22	1.77
1992-93	24.85	38.93	0.52	0.25	2.06
1993-94	24.99	38.56	0.53	0.27	2.01
1994-95	24.23	37.70	0.62	0.32	1.98
1995-96	25.11	38.00	0.71	0.37	1.94
1996-97	24.16	42.77	0.89	0.37	2.40
1997-98	-	43.13	0.96	0.39	2.47
1998-99	-	44.37	0.89	0.39	2.28
1999-00	23.31	45.02	1.08	0.42	2.57
2000-01	22.93	45.44	1.29	0.45	2.87
2001-02	22.82	46.26	1.37	0.46	2.97
2002-03	22.00	46.17	1.49	0.48	3.09
2003-04	22.28	47.76	1.62	0.50	3.24
2004-05	21.59	47.78	1.72	0.51	3.38

Table 2: Inter Industry Variations in Skill Intensity and Wage Differentials

	NIC 2 DIGIT 1998	Skill Intensity	Worker_ skilled worker Wage Ratio
Food Products and Beverages	15	0.257	0.413
Tobacco Products	16	0.053	0.212
Textiles	17	0.174	0.392
Wearing Apparel Dressing and Dyeing of Fur	18	0.151	0.331
Tanning and Dressing of Leather Luggage	19	0.179	0.344
Wood and Products of Wood	20	0.237	0.551
Paper and Paper Products	21	0.222	0.408
Publishing, Printing and Reproduction etc	22	0.392	0.429
Coke, Petroleum Products and Nuclear Fuel	23	0.260	0.494
Chemicals and Products	24	0.294	0.388
Rubber and Plastic Products	25	0.258	0.388
Other Non-Metallic Mineral Products	26	0.198	0.345
Basic Metals	27	0.253	0.457
Fabricated Metal Products, Except Machinery	28	0.263	0.395
Machinery and Equipments N.E.C	29	0.339	0.481
Office, Accounting and Computing Machinery	30	0.420	0.286
Electrical Machinery and Apparatus N.E.C.	31	0.298	0.408
Radio, TV & Communication Eqpts & Apparatus	32	0.355	0.336
Medical & Optical Instr's, Watches and Clocks	33	0.317	0.370
Motor Vehicles, Trailers and Semi-Trailers	34	0.253	0.436
Other Transport Equipment	35	0.290	0.476
Furniture; Manufacturing N.E.C.	36	0.247	0.486
Total		0.270	0.411

Table 3: IT Diffusion as 2 digit level of aggregation

NIC 2 digit	IT Adoption Rate	IT investment Per Worker (Rs.)
Wood and Products of Wood	16.8	574.9
Tobacco Products	16.6	309.8
Tanning and Dressing of Leather Luggage	44.9	923.6
Textiles	41.1	1296.3
Fabricated Metal Products, Except Machinery	45.3	2369.3
Food Products and Beverages	25.2	1204.4
Paper and Paper Products	51.5	1960.4
Rubber and Plastic Products	51.4	2245.7
Wearing Apparel Dressing and Dyeing of Fur	62.1	1322.7
Other Non-Metallic Mineral Products	18.7	1847.9
Furniture; Manufacturing N.E.C.	50.1	3340.4
Machinery and Equipments N.E.C	58.2	4431.5
Basic Metals	49.2	2819.9
Electrical Machinery and Apparatus N.E.C.	65.1	3947
Other Transport Equipment	60.9	3354
Medical & Optical Instr's, Watches and Clocks	66	8335.2
Chemicals and Products	56	3995.6
Publishing, Printing and Reproduction etc	53.7	10294.7
Coke, Petroleum Products and Nuclear Fuel	49.1	7637.1
Radio, TV & Communication Eqpts & Apparatus	71.1	9560.9
Office, Accounting and Computing Machinery	74	17276.8
Motor Vehicles, Trailers and Semi-Trailers	63.1	10299.7
Total	42.1	4418.8

References

Acemoglu, Daren (1998) "Why Do New Technologies Complement Skills? Directed Technical Change and Wage Inequality", *Quarterly Journal of Economics*, Vol. CXIII, No.4,1054-1089.

Acemogulu,D.(2003) "Patterns of Skill Premia," *Review of Economic Studies*, Vol.70, No.2, 199-230.

Attanasio, O., P. Goldberg, P., and N. Pavcnik. (2004) "Trade Reforms and Wage Inequality in Colombia," *Journal of Development Economics* 74, 331– 366.

Autor, David, H., Lawrence F. Katz and Alan B. Krueger (1998) "Computing Inequality: Have Computers Changed the Labour Market?" *Quarterly Journal of Economics*; Vol. CXIII, No.4, 1170-1213.

Berman, Eli & Somanathan, Rohini & Tan, Hong W.(2005) 'Is Skill-biased Technological change here yet ? Evidence from Indian Manufacturing in the 1990,' Policy Research Working Paper Series 3761, The World Bank.

Berman, Eli (2000) 'Does Factor-Biased Technological Change Stifle International Convergence? Evidence from Manufacturing,' Working Paper, Boston University.

Berman, Eli and Stephen Machin (2000) "Skill-Biased Technology Transfer around the World," *Oxford Review of Economic Policy*, 16(3).

Berman, Eli, John Bound and Stephen Machin (1998) "Implications of Skill-Biased Technological Change: International Evidence," *Quarterly Journal of Economics,* 113(4), 1245-1280.

Berman, Eli, John Bound and Zvi Griliches (1994) "Changes in the Demand for Skilled Labour within U.S.Manufacturing Industries: Evidence from the Annual Survey of Manufacturing," *Quarterly Journal of Economics,* CIX, 367-398.

Besley, Timothy and Robin Burgess (2002) 'Can Labour Regulation Hinder Economic Performance? Evidence from India,' CEPR Discussion Paper 3260.

Card, D., Kramarz, and T.Lemeieux (1997) 'Changes in the Relative Structure of Wages and Employment : A Comparison of the United States, Canada and France,' NBER Working Paper 5487.

Card, F. Kramarz, T. Lemieux (1999) "Changes in the Relative Structure of Wages and Employment: A Comparison of the United States, Canada and France," *Canadian Journal of Economics*, 32, 4, 843-877.

Doms, Mark, Timothy Dunne and Kenneth R. Troske (1997) "Workers, Wages and Technology", *Quarterly Journal of Economics*; Vol. CXII, pp. 254-290.

Ghose, A.K. (2000) 'Trade Liberalisation and Manufacturing Employment,' Employment Paper No. 2000/3, International Labour Organisation, Geneva.

Joseph K.J. and Vinoj Abraham, (2007) 'Information Technology and Productivity : Evidence from India's Manufacturing Sector,' Working Paper No:389, Centre for Development Studies, Trivandrum, Kerala, September.

K.V. Ramaswamy,(2008) 'Wage Inequality in Indian Manufacturing: Is it Trade, Technology or Labour Regulations?' WP-2008-021 Indira Gandhi Institute of Development Research, Mumbai, November.

Machin and Van Raneen (1998), "Technology and Changes in Skill Structure: Evidence from Seven OECD Countries," *Quarterly-Journal-of-Economics.* November,113(4): 1215-44.

Nagaraj, R. (2000) "Organised Manufacturing Employment," *Economic and Political Weekly,* September 16.

Robbins, D.J. (1996) 'Evidence on Trade and Wages in the Developing World,' Working Paper 119, OECD Development Centre.

Subramanian, C R (1992) *India and the Computer: A Study of Planned Development,* Oxford University Press, New Delhi.

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