Technological Change, Skill Demand and Wage Inequality in Rural India

Arindam Banik, Ph.D (Delhi School of Economics)
Professor and Director
International Management Institute, Kolkata;
Editor: Global Business Review, Sage Publications
2/4C, Judges Court Road
Alipore
Kolkata 700027
INDIA
Mobile:+918420031823
Fax:+91 33 66529618;Email:arindambanik@imi.edu

Pradip K Bhaumik, B.Tech (IIT-Delhi), FPM (IIM Ahmedabad)
Professor
International Management Institute, New Delhi
B10, Qutab Institutional Area
New Delhi 110016
INDIA
Email:pkbhaumik@imi.edu

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Abstract

Most newer technologies entering the market through newer products and processes are skill-biased in the sense that they use skilled workers more intensively than the older technology. Economists have found that adoption of new technology is affected by the relative supply of skilled workers in the region — regions having a higher supply are likely to be quicker in new technology adoption. Also , while the real wages of skilled workers are expected to increase as new skill-biased technology is adopted, the wages of unskilled workers may either remain unaffected or even fall. The issue of supply of skilled labour has, therefore, become an area of immense interest largely because of the rising inequality in the relative wages of skilled and unskilled labour.

In this paper we examine the relationship between the supply of skilled labor (artisans) with improved toolkits, changes in rural economic activities, and the relative incomes. Our study of rural artisans data in Indian lends support to the view that supply of skilled artisans with improved toolkits is associated with high and accelerating income. The estimate of the logit regression reveals that the artisans as a broad social group were more likely to have benefited from the programme. Also the importance of 'use of toolkits' appears to be more significant factor in enhancing the income of artisans' households as compare to educational level of the artisan. The small, though significant, negative estimated coefficient of the 'number of other assets' variable shows that the artisan having more assets is less likely to have income increases. (JEL classification codes:I31,I32,I38,O10,15,O17)

1. Introduction

The issue of supply of skilled labor have been the subject of research for more than a decade, largely due to the rising inequality in the relative wages of skilled and unskilled labor. Studies on supply of skilled labor can broadly be divided into two groups: those that assume that skill-biased technological change is exogenous versus those that are based on the assumption that the adoption of skill-biased or unskilled-biased technologies is endogenous. The overwhelming majority of papers belong to the first group and have argued that skill-biased technological change have played a central role on the increased inequality in the incomes of skilled workers as well as countering the slowdown in productivity. Central to this argument is the assumption that skill-biased technological change is exogenous (Bound and Johnson 1992, 1995; Katz and Murphy 1992; Mincer 1993, 1995; Greenwood 1996; Greenwood and Yorukoglu 1996; Kahn and Lim 1997; and Egger and Grossmann 2001; Mcgrattan and Prescot 2009). Endogenous analysis of supply of skilled labor and skill-biased technologies has been carried out in a number of papers (Barro and Sala-I-Martin 1995; and Acemoglu 1996) but only recently has this phenomenon been given special treatment (Kiley 1997). Kiley concentrates on the endogenous growth model and argues that an increase in the supply of skilled labor leads to temporary stagnation in the wages of skilled and unskilled workers. Further an increase in the supply of skilled labor accelerates skill-biased technological change and under plausible conditions, lowers output growth, at least temporarily.

In this paper we examine the relationship between the supply of skilled labor (artisans) with improved toolkits, changes in rural economic activities, and the relative incomes. The improved toolkits were provided to poor, rural artisans by the government of India at a 90 percent subsidy under its SITRA (Supply of Improved Toolkits to Rural Artisans) programme. In accounting for the role of improved toolkits in both production activities of the artisans and rural economic activities, we hypothesize the following: First, the decision to supply improved toolkits affects the rural areas in two principal ways – by way of direct and indirect benefits. Second, an increase in the supply of skilled labor with improved toolkits fosters organizational change and raises the employment share of artisans within the rural economy, without lowering relative incomes. Third, the improved toolkits raise income inequality by affecting the organization of production (Eggar and Grossmann 2001; Parro 2013; Kurukawa 2011).

This paper is organized as follows. Section 2 discusses the theoretical model. In section 3 we present the empirical model. In section 4, the methods of data collection are explained. Section 5 examines the rural households based on select parameters. Section 6 presents the results of the empirical analysis. Section 7 concludes.

2. The model

2.1. Decision to Supply Improved Toolkits

We begin with the following assumptions: (i) the economic conditions of the rural artisans in the developing country are stark enough during the period [0, T]; (ii) At any given time t, the economic conditions have reached a certain position x(t) and (iii) for fixed t there is nothing the government can do to change this position.

Consider now that the decision of the government to supply improved toolkits over a small time interval [t, t+dt] provide an opportunity for the rural artisans to change their economic condition by a small amount, say dx. This change in position or decision, dx can affect the benefits accruing to the artisans in two ways:

The first is the direct effect, which will be

$$U(t, x, dx/dt)\,.dx \tag{1}$$

where U(t, x, dx/dt) is the social utility per unit of transfer at x(t), which is regarded as independent of the amount of transfer as dx is small.

In order to determine the indirect effect, the entire stream of marginal benefit generated by the small change in position dx must be known, i.e.

$$U_x(\tau, x, dx/d\tau),\ \ \tau \in [t, T] \tag{2}$$

where $U_x(\tau, x, dx/d\tau)$ is the present value of the future social utility per unit of transfer made at time t from the indirect benefit generated at time τ.

Let trajectory or extremal along which the rural economy moves be denoted by $\mathcal{E}$. Thus the present value of the stream of benefits generated by the decision dx is given by:

$$\left[\oint_{\mathcal{E}\,t}^{T} U_x(\tau, x, dx/d\tau).\partial\tau\right].dx = \sum_{j=1}^{J}\sum_{i=1}^{n_j}\left[\left(\oint_{\mathcal{E}\,t}^{T} U_{x_{ij}}^{j}(\tau, x_{ij}, dx_{ij}/d\tau).\partial\tau\right).dx_{ij}\right] \tag{3}$$

where the subscript ij refers to the i^{th} person in the j^{th} social group, both for the social utility function and the change in the economic position. The social utility functions for backward classes and castes may be different – for example under the SITRA programme, 50 percent of the beneficiary artisans were to be from the Scheduled Castes (SC) and Scheduled Tribes (ST) communities.

The total indirect benefit (present value) can be further separated into current and future indirect benefits. This gives

$$\left[\int_{t}^{t+dt} U_x(\tau, x, dx/d\tau).\partial\tau\right].dx + \left[\oint_{\mathcal{E}\,t+dt}^{T} U_x(\tau, x, dx/d\tau).\partial\tau\right].dx \tag{4}$$

Since the future indirect benefits are of major importance, the total benefit accruing to the rural economy during time interval [t, T] as a result of the decision to supply improved toolkits is then the sum of (1) and (4).

2.2. Toolkits Technology

The rural economy consists of three categories of labor (i) skilled labor with toolkit (L^{st}); (ii) skilled labor without toolkit (L^{s}) and (iii) unskilled labor (L^{u}). We define the toolkit as a labor-augmenting technical progress that enhances the value of skilled labor to more than that of skilled labor without toolkits and unskilled labor respectively. This is due to the assumption that skilled labor with toolkits are more productive than skilled labor without toolkits and unskilled labor.

Consider now n identical artisans who produce a homogeneous good. Let the artisans differ in toolkits technology, such that there will be a segmented labor market and inelastic supply of L^{st} and L^{s} respectively. We assume that L^{s} complements either L^{st} or L^{u} , not both. L^{s} complements L^{st} by selling services and work as per customer's need. We shall treat skilled labor without toolkits as supporting labor. Production with L^{s} and L^{st} is a perfect substitute for production with L^{st}. Kiley(1997) has argued that the assumption of perfect substitution reflects the idea that there are different ways to produce a good, and that the choice of the mix of production processes is endogenous. Given these assumptions, the output Y_i of artisan i is given by the linear homogeneous production function F:

$$Y_i = F(\mathcal{U}_i, \mathcal{V}_i) \equiv \mathcal{U}_i . f(\kappa_i), \qquad (6)$$

where $\mathcal{U}_i(\mathrm{L}_i^s)$ and $\mathcal{V}_i(\mathrm{L}_i^{st})$ are the efficiency units of artisan labor without and with improved toolkits respectively, $\kappa_i \equiv \mathcal{V}_i / \mathcal{U}_i$ represents the skill-intensity in production of the i[th] artisan while $f(\kappa_i)$, as an indicatrix, is a strictly increasing and strictly concave function. In the economic enterprise of a rural artisan, the only relevant factor of production is labor. There is virtually no capital or land or any other factor of production committed to the artisanal economic enterprise.

The efficiency units of labor in production depends on the artisans without improved toolkits and those with toolkits. Although artisans without improved toolkits enter the production function as productivity-augmenting through the expansion of say N (the goods available for production with skilled labor), they are employed at the same intensity level as those artisans with improved toolkits. By implication, production is linear in $\mathcal{U}_i$ and $\mathcal{V}_i$ respectively. The constant returns to production mix imply that expansion of N goods allows for endogenous technological progress, as in the well known "AK" model of endogenous growth (see Kiley, 1997;Barro and Sala-I-Martin, 1995). However, we are differentiating between categories of skilled labor in terms of tools or technology.

Consider now where additional units of improved toolkits greatly improve the artisans' productivity. Then the efficiency units of artisans without improved toolkits and artisans with toolkits are given as:

$$\mathcal{U}_i = \mathcal{U}_i^1 + \alpha \mathcal{U}_i^2 \quad \text{and} \quad \mathcal{V}_i = \mathcal{V}_i^1 + \beta \mathcal{V}_i^2 \qquad (7)$$

where α and β are relative efficiencies and both are assumed to be greater than 1 implying a productivity gain – i.e. additional supply of improved toolkits to artisans leads to higher productivity of both artisans without toolkits and those with the same. It should be noted that $\mathcal{U}_i^1$ and $\mathcal{V}_i^2$ are the additional units of labor in production by artisans without and with toolkits respectively, after the additional toolkits are supplied and do not imply the physical continuation of previous labor and an add-on to the same.

Following Nadiri (1987) it can be argued that the supply of additional toolkits will lead to a joint production function. Let m represent the additional toolkit which can be used to produce outputs by artisans not having a toolkit earlier or those having a toolkit earlier. The physical units of labor supplied by the ith artisan are $\mathcal{U}_i^1$ and $\mathcal{V}_i^2$ respectively, whereas the efficiency units of labor would be $\alpha\mathcal{U}_i^1$ and $\beta\mathcal{V}_i^2$. Then,

$$m_i = \omega.G(\alpha\mathcal{U}_i^2, \beta\mathcal{V}_i^2) \equiv \omega.\mathcal{U}_i^2.g(\chi_i) \qquad (8)$$

G is a linear homogeneous function; $\chi_i \equiv \mathcal{V}_i^2 / \mathcal{U}_i^2$ represents skill-intensity in production due to the additional improved toolkits, ω is the fraction of production or shift in efficiency parameter due to the additional toolkit, and $g(\chi_i)$ is assumed to be strictly increasing and strictly concave.

The implication of (8) is that every additional improved toolkit supplied creates an effect on skilled artisans in two ways: First, if it is used by an artisan without a toolkit, $m_i = \omega.G(\alpha\mathcal{U}_i^2)$ and second, if it is used by an artisan with toolkit then $m_i = \omega.G(\beta\mathcal{V}_i^2)$.It may be noted that a maximum of one improved toolkit is supplied by the government under SITRA but artisans can purchase additional unsubsidized toolkits from the market.

Next consider the wages and profit structures in the rural economy. Let final goods output produced by different artisans be identical. There are no market imperfections i.e. sales of final product does not depend on whether it was produced with subsidized toolkit or not. To maximize profits artisans take all wages ($w^1_{\mathcal{U}}, w^2_{\mathcal{U}}, w^1_{\mathcal{V}}, w^2_{\mathcal{V}}$ and w_m) paid to $\mathcal{U}^1_i, \mathcal{U}^2_i, \mathcal{V}^1_i, \mathcal{V}^2_i$ and m_i as a datum. We can write the decision facing a given artisan as,

$$\underset{\mathcal{U}^1_i \geq 0, \mathcal{U}^2_i \geq 0, \mathcal{V}^1_i \geq 0, \mathcal{V}^2_i \geq 0}{\text{Max}} F(\mathcal{U}^1_i + \alpha \mathcal{U}^2_i, \mathcal{V}^1_i + \alpha \mathcal{V}^2_i) - w^1_{\mathcal{U}} \mathcal{U}^1_i - w^2_{\mathcal{U}} \mathcal{U}^2_i - w^1_{\mathcal{V}} \mathcal{V}^1_i - w^2_{\mathcal{V}} \mathcal{V}^2_i - w_m . m_i \qquad (9)$$

Let $\kappa_i = \kappa$ and $\chi_i = \chi$ for all i given that all artisans are identical. The first –order conditions for the profit- maximizing employment levels are:

$$f'(\kappa) \leq w^1_{\mathcal{U}} \qquad (10)$$

$$\alpha f'(\kappa) \leq w^2_{\mathcal{U}} + w_m \omega g'(\chi) \qquad (11)$$

$$f(\kappa) - \kappa f'(\kappa) \leq w^1_{\mathcal{V}} \qquad (12)$$

$$\beta(f(\kappa) - \kappa f'(\kappa)) \leq w^2_{\mathcal{V}} + w_m \omega(g'(\chi) - \chi g'(\chi)) \qquad (13)$$

Conditions (10) – (13) respectively show the marginal product of labor on the left-hand; and the marginal costs on the right-hand. The marginal costs for labor after additional improved toolkits are supplied $\mathcal{U}^1_i$ and $\mathcal{V}^2_i$ equal the sum of their wage rate ($w^2_{\mathcal{U}}$ and $w^2_{\mathcal{V}}$ respectively) and marginal wage costs for the skilled labor without toolkits.

2.3. Wages and Skill –biased Technology Change

In this study, we treat improved toolkits of all types as skill-biased technology. Since in our model we are distinguishing between different categories of skilled labor in terms of tools or technology, it has endogenous and exogenous implications for relative wages. First, our model implies that more improved toolkits for the artisans raise the skill wage premium for both artisans with and without improved toolkits. This is due to the endogenous development of more toolkits for skilled labor. The endogenous development arises from our assumption that skilled artisans without improved toolkits can sell services or work as per customer's need. In effect, more investment in improved toolkits will shift the demand for artisans and lead to higher share of artisans' labor in the rural economy. Second, our model also implies an exogenous change in the share of the artisans on the growth of each type of improved toolkit and the relative wages of both artisans with or without toolkits. The relative supply of toolkits is expected to rise dramatically due to government's support for improved toolkits. For example, to suit the needs of the artisans from varying trades, many different toolkits have been developed by the research & development (R&D) organizations of the government of India and also the state governments. About 22 types of toolkits have already been developed since 1992. Also, the artisans can directly purchase the improved toolkits from the market and this provides another possible exogenous change. This then leads to the research question: will exogenous skill-biased technology lead to relative high wages of artisans with or without improved toolkits? Following Egger and Grossmann (2001) and the model developed above, this would depend on whether the efficiency units of labor of artisans with toolkits relative to that of artisans without toolkits result in (i) increasing α, (ii) increasing β, (iii) decreasing ω, (iv) does not depend on $\mathcal{U}_i$ and $\mathcal{V}_i$.

If α increases, the relative demand for artisans without toolkits and thus wage dispersion will increase. An increase in β, means that the relative demand for artisans with toolkits become more attractive. As a result, equilibrium wage inequality increases. An increase in ω implies that cost of buying toolkit is rising and supporting skilled labor without toolkits becomes more expensive. Thus the wage dispersion declines. Finally, the effect of both increase in $\mathcal{U}_i$ and decline in $\mathcal{V}_i$ cancel out in equilibrium due to the linear homogeneity of $G(\alpha\mathcal{U}_i^2, \beta\mathcal{V}_i^2)$.

3 Empirical analysis

The hypotheses generated in the previous section are tested in this study on field data collected in India during 2000. The SITRA (Supply of Improved Toolkits to Rural Artisans) programme was launched by the government of India in 1992 under which the beneficiary artisans received improved toolkits related to their trade at a heavy subsidy of 90 percent. This programme has since been merged with the Swarnjayanti Gram Swarozgar Yojana (SGSY) programme with effect from 1 April 1999. We examine some characteristics of the beneficiary artisans based on our earlier discussion and attempt to find if any of these have contributed to a significant income effect.

The econometric analysis adopted is probabilistic. The model used is a binomial logit model. The dependent variable is a binary variable which measures if there has been an increase in income or not. The probability of the event occurring is determined by:

$$\Pr ob\left(Y_i = 1\right) = F(\alpha + \beta X_i)$$

$$= \frac{exp(\alpha + \beta X_i)}{1 + exp(\alpha + \beta X_i)}$$

For the logit model the interpretation of the coefficient is transparent, considering the log odds ratio. The logit model can be written as,

$$\log_e \left[\Pr ob\left(Y_i = 1\right)/1 - \Pr ob\left(Y_i = 1\right)\right] = \alpha + \beta X_i$$

The effect of a unit change in X on the log odds ratio of the event occurring is given by the beta coefficient. Taking the log odds ratio into consideration is very useful since the interpretation of the coefficient is immediate.

As logit models are not linear in the parameters, they are estimated by using maximum likelihood techniques.

Definition of Variables

Dependent Variable

INCEFF Income effect on beneficiary artisan household's income from craftsmanship

$$= \begin{cases} 1, & \text{if income from craftsmanship after receiving toolkits is greater than the} \\ & \text{corresponding income before receiving the toolkit,} \\ 0, & \text{otherwise} \end{cases}$$

Independent Variables

SCLGRP Social Group of the artisan beneficiary

$$= \begin{cases} 1, & \text{if beneficiary artisan belongs to SC, ST or OBC} \\ 0, & \text{otherwise} \end{cases}$$

EXPCR Experience in craftsmanship

$$= \begin{cases} 1, & \text{0 - 5 years} \\ 2, & \text{6 - 10 years} \\ 3, & \text{11 - 15 years} \\ 4, & \text{more than 15 years} \end{cases}$$

HEDUC Highest education completed

$$= \begin{cases} 1, & \text{cannot read / write} \\ 2, & \text{can read / write} \\ 3, & \text{some schooling (upto 4 years)} \\ 4, & \text{SSC/HSC} \\ 5, & \text{Technical training (formal / informal)} \end{cases}$$

LDOWD Land Owned (in hectares)

ASSOD Assets or Durables Owned

$$= \begin{cases} \text{Number of asset categories owned by the household among eight categories specified} \\ \text{namely Tractor, Power Tiller, Combined thresher /harvester, Refrigerator, Television set,} \\ \text{Ceiling fan, Three - wheeler and Motor cycle/ scooter} \end{cases}$$

TYPPR Typical products produced or services sold

$$= \begin{cases} 0, & \text{standard product produced and kept for sale} \\ 1, & \text{sell the service/ work as per customer's needs} \\ 2, & \text{custom produce on order} \end{cases}$$

UTOOL Use of Tool Kits: extent of use

$$= \begin{cases} 0, & \text{using none} \\ 1, & \text{using some} \\ 2, & \text{using most} \\ 3, & \text{using all} \end{cases}$$

The dependent variable INCEFF is binary with Y_i having a value 1, if the i^{th} beneficiary artisan has had an increase in income and 0 otherwise. Although this may look to be a crude nominal measurement, it reduces the measurement errors inherent in income measurements of poor and quite often illiterate artisans without any regular source of income.

The independent variable SCLGRP categorises all beneficiary artisans into two categories *viz.* the relatively backward social groups – Scheduled Caste (SC), Scheduled Tribe (ST) and Other Backward Castes (OBC) – are assigned the value of 1, while all others get 0. While the backward social groups are preferred while selecting beneficiaries, social utility will actually increase only if they can successfully use the improved toolkits and raise their income levels.

The next two variables (EXPCR and HEDUC) measure the human capital represented by the beneficiary artisan. If the number of years in craftsmanship (EXPCR) is found significant, then this could perhaps be inferred to affect the skill and productivity of the artisan. Both these variables could also affect the way an artisan adopts and adapts the new technology represented by the improved toolkits. These variables could lead to a higher or lower wage inequality depending on the sign of the coefficient.

Similarly, ASSOD and LDOWD represent the asset holdings (other assets and land respectively) of the beneficiary artisan and as proxy of other factors of production – say capital and land, are expected to explain if the production function of the artisans should include variables other than labor.

The variable TYPPR measures an interesting characteristic of an artisan – how exactly is the labor offered in the market. If this variable is found significant, then skilled artisan labour may not be homogenous and supply of improved toolkits might actually raise wage inequality.

Finally UTOOL measures the utility of the toolkit received to the artisan. It is expected that only relevant and useful toolkits would enhance labour productivity and raise income level. An insignificant coefficient would imply income rises unrelated to the use of improved toolkits and should lead to search of other unknown variables.

4. Field data

Sample Frame, Method of Collection and Data Structure

The field survey was conducted from January 2000 to July 2000. The data collection was based on information gathered from three main sources, namely the implementing agency (DRDA), the gram panchayat and the individual artisans from the target group – both beneficiaries and non-beneficiaries. The beneficiaries got the benefit during 1996-1997, 1997-1998 or 1998-1999. In this paper we have analyzed beneficiary artisans only.

The number of districts for the study was fixed at 20 per cent of the total number of districts subject to a minimum of two districts in each state. The districts were selected through purposive sampling to ensure that these districts were adequately representative of the state with respect to geographical distribution and special conditions of the state, if any. The sample of districts was further refined to ensure that at least one district (if available) was included under the implementation of watershed programmes, namely, Desert Development Programme (DDP), Draught Prone Area Programme (DPAP) and Integrated Wasteland Development Programme (IWDP).

The sample districts were grouped into two strata, one stratum comprising districts where no watershed projects under DDP, DPAP or IWDP had been implemented, and the other stratum comprising the districts where at least one of these programmes had been implemented. In each of the non-watershed districts, 30 per cent of the blocks (rounded upward) were selected through circular systematic sampling using the Directory of Blocks as the frame of reference. In each of the watershed districts, the blocks were grouped into two main strata, one consisting of blocks where none of the schemes had been implemented (non-watershed blocks) and the other stratum comprising blocks where at least one of these schemes existed (watershed blocks). The sample size of the watershed blocks was also fixed at 30 per cent (rounded upward). The sample blocks in each district were selected through random sampling with preference given to those blocks where the maximum numbers of programmes (DDP, DPAP, IWDP) were in existence.

We selected 129 districts as sample districts across states, excluding North Cachar Hills and Karbi Anglong in Assam. The scheme did not cover the Munger and Gumla districts of Bihar. Likewise it did not cover the Samanda, Ranikor, Mawkyrwat and Nongstain blocks of Meghalaya. In Sangsax block, the survey could not be undertaken due to heavy rainfall. Hence a total of 123 districts were considered as sample districts for the study.

It is to be mentioned here that a gram panchayat is the lowest administrative unit. In some cases a single gram panchayat may consist of only one village, while in others it may have a number of villages, hamlets or *padas*. Data on village indicators were available for a gram panchayat rather than for a village. The field-level agencies, which actually carried out the data collection work, therefore found it convenient to collect information from the gram panchayat office. The schedule for collecting such information was appropriately called the gram panchayat schedule. The field-level agencies carried out the selection of villages/gram panchayats carefully, so that these would properly represent the implementation of the SITRA programme in the blocks. Individual artisans were the final sampling units. However, two types of respondents were covered namely BPL artisans who were beneficiaries under SITRA and below poverty level (BPL) artisans who were non-beneficiaries.

The Government of India enumerated BPL households in two censuses, in 1992 and 1997. The list of BPL households in each village was obtained from the DRDA, with due care being taken to identify the reference year. Wherever available, the BPL household list from the 1997 BPL census was used. In all other cases the 1992 BPL census list was used. From this list of BPL households, a frame of artisans (individuals not households) was prepared and beneficiaries and non-beneficiaries under SITRA were identified.

From the frame of BPL artisans, five beneficiaries (selected randomly) or all of the beneficiaries in case there were less than five were selected as beneficiary respondents and the schedule for beneficiaries filled up for each of them. Similarly, one non-beneficiary artisan from this frame of BPL artisans was chosen as a sample for the non-beneficiary artisan category.

5. Rural Artisans in India - A close look

This section summarizes those characteristics of rural artisans which have been measured and analyzed. This would also present a profile of rural artisans of India. Although data from 30 states and Union territories (UTs) have been used in the econometric study, those for seventeen major states are given in the tables below, while the All India figures relate to the complete sample size of 6788 beneficiaries. The sample sizes for the same state may vary somewhat in different tables because of missing data.

The income distribution of beneficiary artisan households in the major states of India – both before and after receiving the improved toolkits is shown in Table 1. The divergence in incomes among rural artisans in different states can be seen quite clearly. While Kerala had a relatively high income level of its beneficiary rural artisans, the same was quite low in West Bengal and Bihar. On the other hand, the reported increase in income level appeared to be significant in most states.

Type Table 1 somewhere here

Table 2

Income effect of SITRA on beneficiary artisan households' income: Major states (2000)

Major state	Total No. of HH in sample	HH with incr in income	HH with no incr in income
Andhra Pradesh	**310**	88.1	11.9
Assam	**66**	89.4	10.6
Bihar	**858**	83.1	16.9
Gujarat	**189**	93.1	6.9
Haryana	**131**	91.6	8.4
Himachal Pradesh	**16**	75.0	25.0
Jammu & Kashmir	**125**	87.2	12.8
Karnataka	**242**	69.4	30.6
Kerala	**301**	71.4	28.6
Madhya Pradesh	**701**	62.1	37.9
Maharashtra	**352**	93.2	6.8
Orissa	**521**	79.7	20.3
Punjab	**173**	82.7	17.3
Rajasthan	**153**	86.3	13.7
Tamil Nadu	**249**	92.4	7.6
Uttar Pradesh	**1127**	81.4	18.6
West Bengal	**344**	79.9	20.1
All India	**6788**	**79.5**	**20.5**

Total No. refers to the total number of beneficiary artisans for the major state.
All other figures refer to the percentage of artisans belonging to the corresponding income-effect group.

Table 2 presents the impact of SITRA on beneficiary households' income from craftsmanship. At all India level 80 per cent of the total sample artisans were able to raise their income after receiving the toolkits. The largest percentage of artisans who raised their income has been reported in Maharashtra, Gujarat and Tamil Nadu (between 90 and 93 percent). About 36 per cent artisans were unable to raise their income in Madhya Pradesh – the highest in this category.

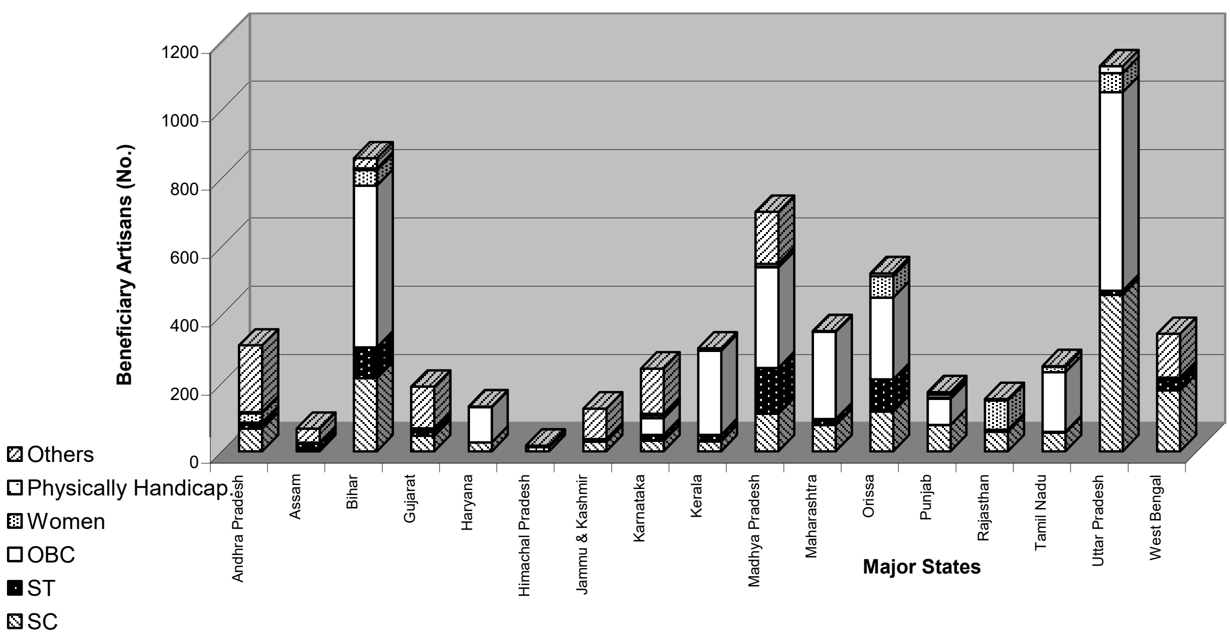
Table 3

Artisan beneficiaries under different social groups: Major states (2000)

Major State	Total No.	Percentage artisan beneficiaries from					
		SC	ST	OBC	Women	Physically Handicap.	Others
Andhra Pradesh	**310**	21.3	5.8	0.0	8.7	1.0	63.2
Assam	**66**	10.6	22.7	0.0	0.0	4.5	62.1
Bihar	**858**	24.9	10.5	55.2	5.2	0.6	3.5
Gujarat	**189**	23.8	6.3	3.2	0.5	1.6	64.6
Haryana	**131**	19.8	0.0	78.6	0.0	1.5	0.0
Himachal Pradesh	**16**	75.0	0.0	25.0	0.0	0.0	0.0
Jammu & Kashmir	**125**	22.4	5.6	0.0	0.8	0.0	71.2
Karnataka	**242**	12.4	7.4	20.2	3.3	2.1	54.5
Kerala	**301**	9.6	6.3	81.7	1.3	1.0	0.0
Madhya Pradesh	**701**	15.7	19.1	41.9	0.4	1.1	21.7
Maharashtra	**352**	21.9	4.8	72.4	0.6	0.3	0.0
Orissa	**521**	22.3	18.0	46.1	11.9	1.7	0.0
Punjab	**173**	44.5	0.0	44.5	1.7	5.2	4.0
Rajasthan	**153**	37.3	3.9	0.0	55.6	3.3	0.0
Tamil Nadu	**249**	21.7	1.2	69.9	6.4	0.8	0.0
Uttar Pradesh	**1127**	40.6	1.1	51.6	5.0	1.8	0.0
West Bengal	**344**	51.7	8.7	0.0	1.2	1.2	37.2
All India	**6788**	**24.0**	**15.7**	**38.4**	**4.8**	**1.5**	**15.6**

Total No. refers to the total number of beneficiary artisans for the major state.

All other figures refer to the percentage of artisans belonging to the corresponding social group.



The distribution of artisan beneficiaries under various social groups in the sample are presented in Table 3. It is evident that the percentage of beneficiaries under other backward castes (OBC) category at all India level dominates the total sample (about 38 per cent) followed by the social group SC (24 per cent). However, this trend varies substantially across states. The highest percentage of OBC beneficiaries was from Kerala (about 82 percent), while the lowest was from Gujarat (only about 3 per cent). In contrast, SC artisans formed the highest percentage in rural West Bengal (about 52 per cent) and the lowest in Kerala (about 10 per cent). Variations could also be observed among artisans under women, physically handicapped and ‘others’ categories.

Table 4 reveals the beneficiary artisan’s experience in craftsmanship among the major states of India. At all India level young artisans having up to 10 years of experience formed about 62 per cent of the total respondent artisans. However, there were wide differences from the all India averages. While states like Maharashtra, Andhra Pradesh, Kerala and Orissa had artisans with longer experience in craftsmanship, it was shorter in states like Madhya Pradesh, West Bengal and Himachal Pradesh.

The level of education and technical training of the beneficiary artisans are shown in Table 5. The rate of illiteracy (can not read or write) at all India level was reported to be 29 per cent among the artisan beneficiaries. Interestingly, while the rate of illiteracy among artisan beneficiaries was the lowest in Kerala (about 3 per cent), the state also had a large percentage of rural artisans with formal education up to SSC/HSC level but with no technical training either formal or informal. The role of formal or informal technical training appears to be an insignificant factor implying that the artisans are in the present profession by inheritance.

Table 4

Beneficiary artisans' experience in craftsmanship: Major states (2000)

Major State	Total No.	Percentage artisans with an experience of 0 - 5 years	6-10 years	11-15 years	> 15 years
Andhra Pradesh	**308**	23.7	18.5	21.8	36.0
Assam	**66**	37.9	31.8	10.6	19.7
Bihar	**772**	32.4	37.4	10.1	20.1
Gujarat	**186**	32.8	26.3	12.4	28.5
Haryana	**131**	22.1	22.1	16.0	39.7
Himachal Pradesh	**16**	43.8	31.3	12.5	12.5
Jammu & Kashmir	**120**	24.2	20.0	10.8	45.0
Karnataka	**241**	18.7	34.9	19.9	26.6
Kerala	**301**	16.9	24.6	21.6	36.9
Madhya Pradesh	**531**	44.6	40.5	9.2	5.6
Maharashtra	**351**	7.4	20.8	30.2	41.6
Orissa	**495**	20.4	21.8	18.4	39.4
Punjab	**173**	15.6	42.2	21.4	20.8
Rajasthan	**144**	42.4	27.1	8.3	22.2
Tamil Nadu	**249**	8.4	43.0	28.5	20.1
Uttar Pradesh	**1095**	37.1	26.6	14.3	22.0
West Bengal	**339**	45.7	33.9	11.5	8.8
All India	**6427**	**31.5**	**30.6**	**15.2**	**22.7**

Total No. refers to the total number of beneficiary artisans for the major state.
All other figures refer to the percentage of artisans belonging to the corresponding experience group.

While land owned by the beneficiary artisans is shown in Table 7, the other assets or durables owned by them are presented in Table 6. It appears that ceiling fans and three-wheeler cycles dominate the other assets or durables owned by the artisans. In states like Punjab and Haryana, the number of motorized two wheelers (motor cycle/scooters) owned by artisans appears to be much higher than in most other states.

Table 5

Level of education of beneficiary artisans: Major states (2000)

Major States	Total No.	Percentage beneficiary artisans who can/ have had: cannot read or write	can read or write	some schooling (up to 4 years)	5-9 years of school	SSC/HSC	Technical Training (formal/ informal)
A & N Islands	**105**	14.3	29.5	1.9	38.1	15.2	1.0
Andhra Pradesh	**310**	45.8	6.8	4.5	25.5	15.5	1.9
Assam	**66**	18.2	15.2	7.6	15.2	43.9	0.0
Bihar	**858**	37.1	35.2	7.3	8.4	11.5	0.5
Gujarat	**189**	28.6	10.6	16.4	34.4	10.1	0.0
Haryana	**131**	22.1	37.4	4.6	22.9	10.7	2.3
Himachal Pradesh	**16**	25.0	12.5	6.3	25.0	31.3	0.0
Jammu & Kashmir	**125**	61.6	8.8	4.0	17.6	7.2	0.8
Karnataka	**242**	24.0	7.9	27.7	28.5	11.2	0.8
Kerala	**301**	2.7	9.6	15.6	29.6	39.9	2.7
Madhya Pradesh	**701**	38.9	16.3	9.7	25.4	9.7	0.0
Maharashtra	**352**	20.2	15.6	17.0	27.8	18.8	0.6
Orissa	**521**	39.2	16.9	15.9	22.3	5.6	0.2
Punjab	**173**	27.2	24.3	5.2	26.0	16.2	1.2
Rajasthan	**153**	32.7	22.9	11.8	28.1	4.6	0.0
Tamil Nadu	**249**	13.7	43.8	13.7	23.3	5.2	0.4
Uttar Pradesh	**1127**	29.6	15.0	9.9	27.3	17.7	0.4
West Bengal	**344**	12.2	43.9	19.8	20.3	3.2	0.6
All India	**6788**	**28.9**	**21.9**	**12.6**	**23.4**	**12.5**	**0.6**

Total No. refers to the total number of beneficiary artisans for the major state.

All other figures refer to the percentage of artisans belonging to the corresponding education group.

Table 6

Beneficiary artisan households' ownership of other assets: Major states (2000)

		Percentage beneficiary artisan households that own							
Major State	**Total No.**	**Trac tor**	**Power Tiller**	**Thre/ Harv. Comb**	**Refri gera tor**	**Ceil. Fan**	**M. Cycle/ Scoot**	**TV**	**Three Whlr**
Andhra Pradesh	**310**	0.3	0.3	0.0	0.3	35.5	1.3	16.1	9.4
Assam	**66**	0.0	0.0	0.0	0.0	3.0	0.0	3.0	3.0
Bihar	**858**	0.3	0.1	0.1	0.2	1.7	0.5	4.1	5.8
Gujarat	**189**	0.5	0.0	0.0	1.6	52.9	2.6	18.0	16.4
Haryana	**131**	0.8	0.8	0.8	1.5	68.7	5.3	29.8	50.4
Himachal Pradesh	**16**	0.0	0.0	0.0	0.0	18.8	0.0	43.8	37.5
Jammu & Kashmir	**125**	0.0	0.0	0.0	4.0	52.8	0.0	16.0	7.2
Karnataka	**242**	0.4	0.0	0.0	0.8	14.9	2.5	21.9	38.0
Kerala	**301**	0.3	0.0	0.0	0.3	35.5	1.0	21.6	15.6
Madhya Pradesh	**701**	0.9	0.1	0.1	0.6	18.7	0.6	16.7	5.1
Maharashtra	**352**	0.0	0.0	0.0	0.3	12.5	1.7	21.6	18.8
Orissa	**521**	0.0	0.0	0.4	0.2	8.8	0.8	5.8	12.9
Punjab	**173**	2.3	3.5	3.5	16.2	84.4	14.5	43.9	34.1
Rajasthan	**153**	1.3	2.0	0.0	1.3	7.8	0.0	7.2	27.5
Tamil Nadu	**249**	0.8	0.4	0.4	0.4	47.4	3.2	13.3	8.0
Uttar Pradesh	**1127**	0.4	0.4	0.2	0.2	7.0	0.9	9.4	27.7
West Bengal	**344**	0.3	0.3	0.3	0.3	3.2	0.3	1.5	4.4
All India	**6788**	0.4	0.3	0.3	1.0	17.5	1.6	12.3	15.0

Total No. refers to the total number of beneficiary artisans for the major state.
All other figures refer to the percentage of artisans having the corresponding asset.

Table 7 presents the land owned and the typical products produced and sold by the beneficiary artisans. The percentage of artisans reporting to sell their service/work as per the customer’s needs seems to dominate at both all India and state levels. Indeed, the figure is as high as 88 percent in Tamil Nadu and Himachal Pradesh and Kerala. In contrast, majority of the artisans in Rajasthan and Andhra Pradesh produce only custom products produced on order. Finally, the artisans who sell standard products to be sold in the market appear to constitute 31 percent of all beneficiary artisans in Bihar and 36 percent in Orissa.

Table 7

Land owned and typical products produced and sold by beneficiary artisans: Major states (2000)

Major State	Average land owned (ha)	Total No.	Percentage artisans who sell: Standard Products produced and kept for sale	Service/Work as per the customer's needs	Custom Products produced on order
Andhra Pradesh	**0.282**	**218**	6.4	39.0	54.6
Assam	**0.429**	**66**	0.0	93.9	6.1
Bihar	**0.308**	**773**	31.4	62.9	5.7
Gujarat	**0.189**	**183**	6.0	68.9	25.1
Haryana	**0.095**	**125**	10.4	80.8	8.8
Himachal Pradesh	**0.457**	**16**	0.0	87.5	12.5
Jammu & Kashmir	**1.136**	**121**	9.1	43.8	47.1
Karnataka	**0.532**	**241**	5.4	63.1	31.5
Kerala	**0.138**	**293**	5.8	87.4	6.8
Madhya Pradesh	**0.650**	**529**	2.1	69.6	28.4
Maharashtra	**0.232**	**344**	7.3	64.5	28.2
Orissa	**0.387**	**492**	36.4	36.6	27.0
Punjab	**0.017**	**171**	6.4	73.1	20.5
Rajasthan	**0.707**	**134**	14.9	20.1	64.9
Tamil Nadu	**0.037**	**248**	4.8	88.3	6.9
Uttar Pradesh	**1.412**	**1030**	11.7	57.5	30.8
West Bengal	**0.239**	**342**	12.0	64.6	23.4
All India	**0.597**	**6144**	**14.1**	**59.4**	**26.5**

Average land owned by beneficiary artisan is in hectares.
Total No. refers to the total number of beneficiary artisans for the major state.
All other figures refer to the percentage of artisans belonging to the corresponding selling group.

The extent of use of the improved toolkits provided to the beneficiary artisans is captured in Table 8. About 36 percent of all beneficiary artisans report to be using all the tools in the toolkit, while another 32.5 percent use some of the tools. As many as 19.5 percent of the beneficiary artisans in Karnataka and 13.9 percent in Orissa do not use any of the tools. On the other hand, in Gujarat, Haryana, Jammu and Kashmir and Tamil Nadu more than 50 percent of all beneficiary artisans use all the tools received.

Table 8
Beneficiary artisans' use of toolkits: Major states (2000)

Major State	Total No.	No/ Using none	Using some	Using Most	Using All
Andhra Pradesh	**310**	7.7	39.7	48.1	4.5
Assam	**66**	4.5	40.9	9.1	45.5
Bihar	**770**	0.3	47.8	22.5	29.5
Gujarat	**186**	0.0	8.1	21.0	71.0
Haryana	**131**	1.5	26.0	12.2	60.3
Himachal Pradesh	**16**	6.3	37.5	25.0	31.3
Jammu & Kashmir	**124**	0.0	0.8	33.1	66.1
Karnataka	**241**	19.5	41.1	21.2	18.3
Kerala	**295**	9.2	14.6	16.6	59.7
Madhya Pradesh	**533**	5.1	46.7	22.0	26.3
Maharashtra	**345**	8.4	42.9	15.7	33.0
Orissa	**512**	13.9	47.5	19.5	19.1
Punjab	**171**	9.4	68.4	8.2	14.0
Rajasthan	**139**	4.3	23.0	55.4	17.3
Tamil Nadu	**248**	4.0	16.5	21.4	58.1
Uttar Pradesh	**1102**	5.3	25.7	27.1	41.9
West Bengal	**342**	0.6	21.3	42.1	36.0
All India	**6449**	**5.8**	**32.5**	**25.7**	**36.1**

Total No. refers to the total number of beneficiary artisans for the major state.
All other figures refer to the percentage of artisans belonging to the corresponding selling group.

6. Estimation Results

Table 9 presents the parameter estimates of the logit regression of the binary dependent variable (INCEFF) denoting that a beneficiary artisan's increase in income after receiving the toolkits as 1, or 0 otherwise, on a selection of the artisan's social group (SCLGRP), experience in craftsmanship (EXPCR), highest education (HEDUC), land owned (LDOWD), other assets owned (ASSOD), typical products produced (TYPPR) and use of toolkits (UTOOL). The list of variables used, their definitions and measurements have already been detailed in Section 4 above. The estimation, using the SPSS software package, was performed on the dataset consisting of 6788 observations (beneficiary artisans). We had to delete 910 observations because of missing data. Thus we considered 5878 observations for the purpose of logit analysis.

Table 9

Logit Estimates of *Beneficiary Artisans' Increase in Household Income from Craftsmanship* on Select Variables

Variable	Coefficient Estimate
Constant	.6131**
	(0.1922)
SCLGRP	.4604**
	(0.1083)
EXPCR	-0.0431
	(0.0316)
HEDUC	-.1200**
	(0.0234)
LDOWD	0.0005
	(0.0024)
ASSOD	-.0878*
	(0.0441)
TYPPR	.1788*
	(0.0583)
UTOOL	.3166**
	(0.0366)
Total Number of observations (A)	6788
Number rejected because of missing data	910
Number of cases included in the analysis (B)	5878
% B/A	86.59
Log Likelihood for Logistic	5278.5178
Chi –square value	140.115

Notes:
Standard errors are in parentheses
*** Significant at 1 per cent level*
** Significant at 5 per cent level*

The estimated coefficient for SCLGRP, i.e. 'social group' (SC, ST and OBC) is positive and significant implying that artisans from the relatively backward social groups as a whole are more likely to increase their income. Among these groups, the results are expected to be varied, further investigation of which we have planned for. It also confirms our earlier remark that the income tends to rise among artisan beneficiary households. In other words, with everything else held constant, rural artisans from backward social groups are more likely to have additional increments of income by using toolkits.

This is a very significant finding of this study. In India, the backward social groups are generally backward in almost all respects – economic, cultural, educational, etc. Special provisions exist for the protection of the socially underprivileged – for example even under the SITRA programme, a minimum 50 percent of the beneficiary artisans are mandated to be from the SC and ST categories – implying a higher social utility from benefits accruing to the socially backward compared to similar benefits accruing to the non-backward. A statistically significant positive co-efficient implies a reduced income inequality as a consequence of the benefits from SITRA.

It is more difficult to hypothesize possible reasons for this positive co-efficient. It would seem that the disadvantaged status of these rural artisans pushes them harder to exploit the technology made available to them, work harder and more productively and consequently gain income increases. The greater the initial handicap, the stronger the motivation to do better.

The variable EXPCR representing ‘experience in craftsmanship’ exerts a negative but insignificant impact on increase in income earned under the beneficiary category. Other things being equal a young and enterprising artisan will be more prone to be innovative and hardworking, and thus be able to gain more from the improved toolkit. However, this impact is not found to be statistically significant.

The variable HEDUC, i.e. 'highest education completed' by the artisan reveals an interesting negative coefficient. *Ceteris paribus*, lower general education of artisans is more likely to contribute to increases in their household income. It is to be noted that a small and negligible percentage (only 0.5%) of sample beneficiaries had any technical training – either formal or informal.

Both education and experience seem to have a negative relationship with income increases. Again, we find that the more disadvantaged an artisan, the greater the resolve to use the new technology effectively and the greater the likelihood of an income increase. Although the basic logic is the same, the strength of the argument is stronger for education with a statistically very significant negative coefficient and not-so-strong for experience with a statistically insignificant negative coefficient. This suggests that lack of experience is perhaps not as much of a handicap as lack of education.

'Land owned' represented by variable LDOWD shows insignificant but positive coefficient. On the other hand, the variable ASSOD representing 'other assets or durables owned' significantly affects artisan household's increase in income from craftsmanship. In other words households owning more categories of assets are less likely to experience increase in income. This, again corroborates the general argument that the more under-privileged and disadvantaged end up gaining more from the facility provided through improved toolkits.

The importance of 'typical products produced or services sold' on income, i.e. variable TYPPR, is reflected in the positive and significant coefficient. This implies that artisans are more likely to raise their income when they service/work as per the customer's needs or produce customized products on order than if they produce standard products and offer the same for sale. As it is, the income level of artisans producing standard products and keeping the same for sale is expected to be lower than the ones who sell service/work as per the customer's needs or produce customized products on order. The new technology would then result in higher income inequality.

Finally, the variable UTOOL, i.e. 'Use of Toolkits: extent of use' may be considered as a proxy of quality of toolkits. The artisans do not always receive high quality toolkits due to transaction cost, wrong selection of toolkits, etc. The positive and significant coefficient implies that when artisans receive toolkits of high quality they are more likely to use all of them and experience increase in income from craftsmanship. This is intuitive and calls for proper choice, design and development of the improved toolkits so that the improved toolkits are used extensively and actually contribute to increasing the artisans' income from craftsmanship.

7. Conclusions

In this article, we have developed a theoretical model in explaining how exogenous technological change may cause wage inequality in rural areas. The artisans may be benefited due to skill and supply of tool kits. The existing poverty reduction programmes may have overlooked this aspect, as they are short run specific and accordingly deviate from the actual situation. Sometimes, effective government interventions can make the situation different(for various studies addressing this issue, see Basu1981;Knack and Keefer,1997; Granovetter,1995;Rodrik,1998;Narayan,1997;Krishna,2001;Grootaert and

Narayan,1999;North,1990; Bird,Graham, and Sabot,1998 ; Stiglitz,2000;,1998 and Lucas 1998; Esquisvel and Rodriguez-Lopez 2003;Gervais et al 2015). There are two categories of skill population in the rural areas; one with toolkits and the others are with out toolkits. The underlying forces of demand and supply of skill labours may explain by the toolkits technology supplied to them. In such a situation the relative demand for artisans with toolkits become more attractive. As a consequence, equilibrium wage inequality increases. This may be considered as an equilibrium outcome in the skill category in a rural market setting. The inequality may disperse as more and more poor take advantage of the intervention.

The model was verified with the help of a fairly large number of samples of rural artisans in India. The backward class with skill is the real beneficiary due to the ownership of toolkits. The ownership of other assets appears to be less significant which shows that assets are less likely to benefit them. Surprisingly, the beneficiaries are under-privileged and disadvantaged artisans. The development of skills and supply of toolkits are strongly related. The result may serve certain interests in both academic and policy circles.

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