Economic Modelling 29 (2012) 341–348

Contents lists available at SciVerse ScienceDirect

Economic Modelling

journal homepage: www.elsevier.com/locate/ecmod

Wage–productivity differentials and Indian economic efficiency

Amarendra Sahoo [a,*], Thijs ten Raa [b]

[a] Institute for Environmental Science (CML), Leiden University, P.O. Box 9518, 2300 RA, Leiden, The Netherlands
[b] Department of Economics, Tilburg University, P.O. Box 90153, 5000 LE Tilburg, The Netherlands

ARTICLE INFO

Article history:
Accepted 4 November 2011

JEL classification:
D24
D41
D57
D58
I20
J24
J31
O53

Keywords:
Competitive pressure
Wage and productivity inequality
Efficiency
Returns to education
Frontier-general equilibrium analysis
Multiplicative decomposition
Skill formation
Trade efficiency

ABSTRACT

A frontier-general equilibrium analysis with skill transformation evaluates the productivities of skilled and unskilled labor and potential of the Indian economy. We compare the wages of skilled and unskilled labor between 1994 and 2002 with their respective productivities over this period. Education is considered to be responsible for the skill formation over this period: the change in skilled labor supply is endogenous in the model. Compared to its productivity, skilled labor is underpaid in the initial period and overpaid in the second period. Unskilled labor is underpaid in both periods. A decomposition exercise shows that skilled labor gains from free trade, and stands to lose due to education and domestic competition in the second period. The annualized rate of return to education is between 7 and 10%. The economy operates below its potential in both periods, particularly in the second—due to trade limitations and the failure to capture the return to education. Service sectors are found to have potential to grow significantly.

1. Introduction

Do wage differentials follow productivity differentials and which economic inefficiencies cause distortions? For long, Indian industries were characterized by inefficiency, high costs and uneconomical means of production with pervasive government control. With a view to improving efficiency and global competitiveness, liberalization policy and economic reforms were introduced at the outset of 1990s. Post liberalization period is marked by much higher productivity growth and increased contributions from the service sector and the skilled-based manufacturing industries (Bosworth et al., 2007; Virmani, 2006), which have possibly increased the wage premium for higher education. It is believed that India still needs a higher pace of reforms towards competitive markets (Bajpai and Sachs, 1997; Fischer, 2002). The resulting competitive factor prices that reflect the factor productivities would determine the returns to education. Our study compares the wages of skilled and unskilled labor between 1994 and 2002, over the decade of strong reform, with the respective productivities and also measures the potential of the economy in these two periods. We conduct a decomposition exercise in order to track the factors responsible for the wage–productivity differentials and observed–potential gap in the economy. Our observations of the study can be indications for the performance of Indian economy in the later periods.

Tinbergen (1975) argued that opposing effects of technology (skilled labor demand) and education (skilled labor supply) determine the relative wage. Between 1987 and 1993, the returns to education in India increased significantly for middle and secondary levels, but not for primary and higher education (Bargain et al., 2006). The returns to middle and secondary level education fell over the next period 1993–2004, while the returns to higher education (college) grew (Asian Development Bank, 2007). Prior to 1993 (the pre-liberalization period) lack of demand for basic education could have been the reason for the high middle and secondary education premiums. Pradhan and Subramanian (2000), based on the MIMAP-India Survey (Pradhan and Roy, 2003) for 1994–95, argue that demand for education was low due to dim expected future

* Corresponding author at: Sabelhof 2, 5044 JR, Tilburg, The Netherlands. Tel.: +31 624187748.
E-mail addresses: amar_sahoo@hotmail.com (A. Sahoo), tenRaa@UvT.nl (T. ten Raa).

0264-9993/$ – see front matter © 2011 Elsevier B.V. All rights reserved.
doi:10.1016/j.econmod.2011.11.002

earnings. Incomplete markets for higher education depress returns to higher education during this period.

Sectoral skilled–unskilled wage differentials in India depict no clear pattern over time (see Table 1). The gap increased in 'agriculture', 'heavy industries', 'transports and storage', and 'wholesale and retailed trade', but decreased in the other sectors. From 1994 to 2002 the supply of skilled labor increased in all sectors relative to unskilled except in 'construction'. Supply and demand of 'education' increased over this period. The relative wage of skilled to unskilled labor declined marginally from 2.95 in 1994 to 2.91 in 2002. We compare the relative wage with the relative productivity. The relative productivity signals the potentials differential between skilled and unskilled labor.

The productivity and efficiency aspects of growth have attracted attention in the real business cycle (Kydland and Prescott, 1996 and Prescott, 1986) and endogenous growth (Lucas, 1988 and Romer, 1986) literatures. Our model is a dynamic extension of ten Raa and Mohnen's (2002), bringing in dynamic physical capital inefficiency and education inefficiencies. Following Negishi (1960), the efficiency frontier is determined subject to commodity, factor and trade constraints. The distance of the economy towards its frontier determines inefficiency. We make the frontier approach dynamic by incorporating human and physical capital formation. Education process in our model determines the returns to education, skill transformation and productivity of skilled labor. A dynamic framework seems a natural response to the inconclusive literature.

Trade liberalization increased the skilled–unskilled wage gap in Latin America (Hanson and Harrison, 1999), but reduced it in East Asia (Wood, 1994, 1999). Wage differentials between skilled and unskilled labor have been analyzed for both developed and developing countries (Katz and Autor, 1999; Williamson, 1999; Wood, 1999). The explanations include skilled-biased technological change, international trade, and supply–demand factors (Berman et al., 1998; Katz and Murphy, 1992; Kiley, 1999; Krusell et al., 1997; Learner, 1996; Machin, 2002). In the Indian context, studies have shown that trade openness has an exacerbating effect on the skilled–unskilled wage gap (Beladi and Chakraborty, 2004; Dutta, 2004; Marjit and Acharyya, 2003; Pradhan, 2002), but no clear picture has emerged as regards the effect of education on the skill premium during the period of liberalization. Pradhan (2002), with the help of a general equilibrium model, observed that even large increases in the access to education preserve the wage inequality, but an econometric study by Dutta (2005) found that despite the increase in the skill premium education helped reduce the wage gap.

Table 1
Skilled–unskilled wages and labor supply, real output and final demand between 1994 and 2002.
Sources: Pradhan et al. (1999) and Pradhan et al. (2006).

Sectors	Ratio of skill to unskilled wages		Ratio of skilled to unskilled labor		Ratio of 2002 to 1994	
	1994	2002	1994	2002	Real output	Real final demand
1. Agriculture and allied	1.30	1.58	0.19	0.39	1, 19	1, 12
2. Mining and quarrying	2.03	1.91	0.33	0.57	1, 52	3, 43
3. Light manufacturing	1.98	1.84	0.37	0.69	1, 67	2, 42
4. Heavy manufacturing	2.26	2.44	0.92	1.40	1, 94	1, 15
5. Construction	1.58	1.46	0.31	0.55	1, 79	2, 01
6. Electricity, gas and water	1.72	1.64	1.75	4.42	1, 46	1, 97
7. Transports, storage	1.69	1.84	0.81	1.40	1, 67	2, 40
8. Wholesale, ret. trade	1.78	1.83	0.81	1.31	1, 77	2, 07
9. Finance, insurance, real est	3.39	2.97	10.19	11.70	2, 60	2, 85
10. Services	3.70	2.92	1.17	2.18	2, 28	2, 19
11. Education	3.70	2.92	1.17	2.18	5, 65	5, 75
All sectors	2.95	2.91	0.38	0.64		

We will assess the contributions of various factors to the productivity–wage differentials. Productivity is determined at the frontier, which is beyond actual output due to four reasons: static inefficiency from domestic allocative inefficiency, i.e. domestic competition, static trade inefficiency, dynamic inefficiency from human capital formation and dynamic inefficiency from physical capital formation. The decomposition is based on an extended Fisher Index approach, to ensure path independence (which is an issue due to the non-linearity of our model). As the elasticity of substitution between skilled and unskilled labor is expected to influence wage differentials, we simulate with different values for this parameter.

The rest of the paper is divided into four sections. The theoretical model is presented in Section 2. Section 3 analyzes the basic data set and calibrates. The model results are discussed in Section 4, while Section 5 concludes.

2. The model

We determine the frontier of the economy by maximizing the vector of total final demand excluding the investment demand and net export (which will be endogenous) subject to commodity, factor and trade deficit constraints. There are three types of factors, viz. capital, skilled labor and unskilled labor. We consider a small open economy, where producers of tradable products take the world prices as given, with Leontief preferences. The endogenous pattern of trade is constrained by the observed deficit on the balance of payment. The model computes the economy's production frontier and the competitive factor and commodity prices. The gap between the frontier and the observed total final demands (observed total economic activities) measures inefficiency. The economy is classified into 11 economic activities including education sector (see Table 1).

Human and physical capital formations are modeled as forward-looking processes without adjustment costs. The initial supply of capital and education is fixed by past investments. Households are modeled by means of a forward-looking intertemporal utility-maximizing representative consumer. A commonly used additively separable intertemporal preference function is assumed, where the second period's utility is added with a discount factor, β $(0\leq\beta\leq1)$. The implicit discount rate is $\mu=(1-\beta)/\beta$. We maximize the additive intertemporal utility, $D^0+\beta D^1$, subject to constraints on demand, resources, trade, capital formation and education process. HereD^t is the value of aggregate final demand at the optimum for period t. This model is a finite horizon Ramsey model, where a fictitious planning authority splits production between consumption and capital accumulation.

The expansion factor is defined as $c^t=D^t/D_0^t$, where D_0^t is the observed value of aggregate final demand. The inverse of the expansion factor measures the efficiency of the economy in period t and the residual$1-1/c^t$ the inefficiency.

In each period producers face a nested production function. A Leontief production function of intermediate inputs and a factor-input aggregate forms the first rung of the nested structure. The aggregate is a Cobb–Douglas function of capital and a labor composite, a CES function of skilled and unskilled labor. Capital is sector specific, in the Ricardo–Viner spirit, but skilled and unskilled labor may move freely between sectors. We assume "downward mobility" of skilled labor, the ability to join the unskilled pool if unsuccessful in the skilled labor search.[1] Here is the model:

$$Max \quad D^0+\beta D^1 \quad w.r.t. D^t, X_i^t, T_i^t, I^0, K_i^t, L_{s_i}^t, L_{u_i}^t, \sigma^0, \Delta S\geq0 \quad t=0,1$$
$$s.t.$$

[1] This ensures that the competitive skilled wage is at least as big as the unskilled.

$$\sum_j a_{ij}^t X_i^t + f_i^t D^t + \tau_i^t I^t + T_i^t \le X_i^t (i,j = 1,\ldots,11; 11 = \text{education}) \quad (1)$$

$$X_i^t \le \theta_i^t \left(K_i^t\right)^{(1-\phi_i^t)} \left[\alpha_i^t \left(L_{s_i}^t\right)^{\rho_i} + \left(1-\alpha_i^t\right)\left(L_{u_i}^t\right)^{\rho_i}\right]^{\phi_i^t/\rho_i} \quad (2)$$

$$\sum_i L_{u_i}^t \le N^t - \sum_i L_{s_i}^t - \sigma^t \quad (3)$$

$$\sum_i L_{s_i}^0 \le S^0, \quad \sum_i L_{s_i}^1 \le S^0 + \Delta S \quad (4)$$

$$K_i^0 \le \overline{K_i^0}, \quad K_i^1 \le K_i^0 + \delta_i I^0 \quad (5)$$

$$-\sum_g \pi_g^t \mathrm{T}_g^t \le B^t \quad (6)$$

$$\Delta S = \xi\left(\sigma^0\right), \quad \sigma^0 = \lambda^0 X_{11}^0 \quad (7)$$

Endogenous variables:

D^t	Aggregate final demand excluding investment and net export in period t
I^0	Aggregate investment demand in the initial period
X_i^t	Output of *i*th sector in period *t*
T_i^t	Net exports of tradable sector in period t; $i \neq 5$, 6 and 10
ΔS	Addition to stock of skilled labor in the end period over the initial period
σ^0	Stock of unskilled labor force going for education in the initial period
${L_{u_i}}^t$	Demand for unskilled labor for period t respectively by *i*th sector
${L_{s_i}}^t$	Demand for skilled labor for period t respectively by *i*th sector
$\underline{K_i^t}$	Demand for capital in period *t* respectively by *i*th sector
K_i^1	Stock of capital in the end period.

Exogenous variables:

β	Inter-temporal time-discount factor, takes value between 0 and 1
a_{ij}^t	Intermediate demand in period t
f_i^t	Share of total demand for ith sector in period t
I^1	Aggregate investment demand in the end period
τ_i^t	Share of total investment demand coming from ith sector in period t
B^t	Observed trade deficient for period t
π_i^t	Terms of trade in period t
λ^t	Coefficients of unskilled labor joining education with respect to educational output in initial period
ξ	Coefficient of additional skilled labor stock in the end period with respect to labor joining education in the initial period
δ_i	Sector-wise rate of increase in investment in the end period, 1, over the initial period 0
σ^1	Stock of unskilled labor force going for education in the end period
$\overline{K_i^0}$	Stock of capital in the initial period
N^t	Total population of labor force in period t
S^t	Supply of skilled labor in period *t*
C_i^t	Supply of capital stock in period t
θ_i^t	Cobb–Douglas shift parameters for period t
ϕ_i^t	Cobb–Douglas share parameters for composite labor for period t
α_i^t	Share parameters of skilled and unskilled labor for period t
ρ_i	Substitution parameters between skilled labor and unskilled labor.[2]

The first constraint of each period is the commodity constraint, i.e. the material balance for the tradable and non-tradable products, while the second constraint represents the CES nested production function. The next three constraints are for unskilled and skilled labor, and capital, respectively. The skilled labor demand in the initial period is constrained by an exogenously given skilled labor supply, and in the second period by the number of initial period skilled labor plus the additional skill supplies; see constraint (4). In (3) N^1 is the given labor force in period 1. Part σ goes to school and the residual determines the supply of unskilled labor. Unemployed skilled labor may join the unskilled labor pool in both periods; see the second right hand side term of the unskilled constraints (3). Basically, competitive unskilled wages set the minimum wages for the skilled labor in constraint (3), while the shadow prices from constraints (4) are the competitive skill premiums; the competitive skilled wage will thus be the competitive unskilled wage plus the competitive skill premium. The capital demand constraints are (5). Constraint (6) states that net exports valued at world prices cannot exceed the existing trade deficit for each period. Shadow prices associated with each constraint, i.e. commodity, production function, unskilled labor, skilled labor, capital and trade, P_i^t, ${P_{v_i}}^t$, w_u^t, ${P_{S_i}}^t$, r_i^t and ε^t, represent the competitive prices of output, value added, unskilled wage, skill premium, rent to capital, and purchasing power parity for both periods.

Capital in the second period, 2002, depends on the initial period capital stock plus a fixed rate of increase in initial endogenous investment, δ_i; see constraint (5). Investment in the terminal period is exogenous. Constraint (7) captures the process of skill formation with the help of education. Every year of the eight years between 1994 and 2002, a portion of the potential work force joins the school or training. Education or training does not necessarily take one year to transform the unskilled to skilled labor. However, every year there is a net turnover of skilled labor. In the initial period (1994), number of unskilled labor that goes for education is proportional to educational output, λ^1. We assume that educational output grows at a fixed rate between 1994 and 2002, hence also the number of unskilled labor enrolled in education. Considering education sector's output as number of educated students, net of enrolments and dropouts, the change in the stock of skilled labor in the next sub-period is assumed to be proportional to the number of labor joining education in the previous period, ξ.[3] The shadow prices of constraint (7) determine the cost of skill formation between 1994 and 2002 (χ_c), as well as the opportunity cost of tending education (χ_e). In our fixed duration scenario, education stops playing any role in transforming the labor into skilled for periods afterward 2002. Hence we consider the amount of workforce (σ^2) going to education in the end period an exogenous 'reserve army' for the future.

The first order conditions of the model are reported in Appendix A. The shadow prices of the skilled labor constraint (A6) give the static and dynamic competitive premiums for 1994 and 2002 respectively: $P_s^0 = w_s^0 - w_u^0$ and $P_s^1 = w_s^1 - w_u^1$. Conditions (A9) and (A8) show the equivalence of the competitive skill premium in the second period with the cost of skill transformation, which is the competitive unskilled wage forgone by tending education plus the cost of education:

[2] ρ_i is substitution parameter between skilled and unskilled labor, which is defined as $(\delta-1)/\delta$, where δ is the elasticity of substitution.

[3] This is similar to a Poisson process where the distribution of intervals between successive occurrences is exponential, implying a fixed rate of occurrence.

$P_s^1 = \chi_c, \chi_c \xi = w_u^0 + \chi_e$. The competitive consumer price of education at the optimum consists not only the cost of producing it, but also the unskilled wage forgone in the first period net of the competitive skill premium the student expects (see Eqs. (A3), (A8) and (A9)): $P_{11}^0 = \sum_j A_{11,j}^0 P_{11}^0 + P_{v_{11}}^0 + w_u^0 - P_s^1 \xi$. The competitive skill premium also measures the premium on skill productivity. Returns to education are the benefit accrued to labor going for education to become skilled instead of remaining as unskilled, i.e. the ratio of the competitive premium to the competitive unskilled wage, P_s^1/w_u^1.

Conditions (A4) and (A5) show that the equilibrium rental price for capital is equal to its marginal product for each industry, and it also equilibrates the demand for capital with the stock. The price of the initial period capital is the sum of initial period value of the marginal product of capital and the second period price of capital with long run growth rate. In the dynamic equilibrium, the price of capital for each sector in the second period equals the price of investment in the initial period with a constant long run growth rate (see Eq. (A10)): $r_i^{t+1} = P_i^t(\tau_i^t/\delta_i)$.

Eq. (A1) establishes price normalization condition for the general equilibrium model and also implicitly establishes that equilibrium prices and wages are discounted value of the future prices and earnings: $\sum_i f_i^0 P_i^0 = 1, \sum_i f_i^1 P_i^1 = \beta$. We decompose the efficiency of the economy, i.e. performance of the economy relative to its potential, and the productivity over the wage ratio into the contributions of the following factors: (a) static allocative efficiency, (b) trade efficiency, (c) dynamic efficiency from physical capital formation, and (d) dynamic efficiency from human capital formation (education process). Due to nonlinearities, the sequence of the decomposition may influence the decomposition. Often in computable general equilibrium models (CGE) there is an interest to split the total effect of a package of shocks into individual or group effects. Harrison et al. (2000) propounded a method of decomposing the endogenous changes from a general equilibrium simulation into sources attributable to each of the exogenous shocks by using an arbitrarily accurate approximation to the linear path. Shorrocks (1999) proposed a decomposition method for sources and causes of poverty and inequality, based on the Shapley value; the contribution of any given source of income to overall change in indicator can be interpreted as the expected marginal impact of the factor when such an expectation is made over all possible sequences of elimination. The last two methodologies decompose additively, absolute differences. Since our outputs are analyzed in relative differences, e.g. productivity–wage ratios and efficiency, we follow the modification of Ang et al. (2004). They extend the Fisher index to an *n-factor* model by taking the geometric average of all the combinations of the Laspeyres and Paasche indices, which satisfies the factor reversal test as well the perfect decomposition. Suppose the model is $V = f(X_1, \ldots, X_n)$ and the set $N = \{1,2,3,4\}$. Aggregate value changes from V^0, the observed value to V^*, the optimum. The multiplicative decomposition is represented by $V^*/V^0 = D_T D_E D_I D_F$, where D_T, D_E, D_I and D_F represent the decomposed individual effect of trade efficiency, human capital formation, physical capital formation, and static allocative efficiency. Let us define the function $V(S) = f(X_{l \in S}^*, X_{m \in N/S}^0)$. Individual factor's contribution can be represented by $D_i = \prod_{S \subset N, i \in S} [V(S)/V(S/\{i\})]^{(s-1)!(n-s)!/n!}$ where S are subsets of N and s is the cardinality of S.[4] If the individual effect is less than one, then that factor is responsible for V^0 to exceed V^* (a negative impact), and if an individual effect is above one, then that factor is responsible for V^* to be above V^0 (a positive effect). In order to place a weight on individual impact we use a simple method. We take the log on both sides of the equation and normalize the impacts, in absolute term, to 100, expressing the weight of individual impact in percentage.

[4] The mathematical description is close to Ang et al. (2004). Appendix B gives detailed formulae for all the components.

3. Data and calibration

The data on inter-industry flows, final demand, investment, net-exports, output and value-added of capital and labor for the years 1994 and 2002 are based on the social accounting matrices (SAM) from Pradhan et al. (1999) and Pradhan et al. (2006). The economy is classified into 11 major production sectors, including education. The original SAMs do not categorize labor by type of education. The unskilled labor is defined as labor having primary education or less, while the skilled ones are above the primary level of education.[5] To calculate industry average wage rates and employment we used the National Sample Survey Organisation (NSSO) 50th employment survey for the year July 1993–June 1994, their 55th for the year 1999–2000 and the 58th for 2002. For the labor force we take the number of persons engaged for a longer time in work related economic activities (principal and subsidiary status). The working age of the labor force is cut off at age 14, following the Government of India. We admit that we overlook child labor. On the basis of the above-mentioned NSS data the total labor force is split into working population, attending school and seeking for job (unemployed).

The values of industry output, net exports, intermediate demand, final consumption, and investment demands net of indirect taxes are computed in real terms for 1994 and 2002 by using GDP price deflators calculated from information provided in the National Accounts Statistics (Government of India, 2004, 2006). The terms of trade reflect the value of Indian tradable commodities in the world market. We use the Global Trade Analysis Project (GTAP) database, which provides fairly detailed value of imports by industry at the levels of India and the world to get the terms of trade for the years 1995 and 2001; see www.gtap.agecon.purdue.edu/databases. Choosing a discount rate, for β, is a difficult issue, particularly for a developing country. We take the annualized real interest rate, using lending rates and wholesale price indices (WPI) to capture the real interest rate.[6] The real interest rate is lowest in 1994 (2.40) due to high inflation and highest in 1996 (10.14). It is stable until 2002. We use the geometric average of the real interest rates over the period between 1994 and 2002 for our time discount rate, 8.6%.[7] Applying this annualized rate over the years from 1994 till 2002, discount factor β becomes around 0.5.

To get parameter values for the CES production function, we calibrate as in applied general equilibrium modeling.[8] The elasticity of substitution parameters plays a crucial role in calibration exercises; usually these are acquired through estimation or with some estimates (prior knowledge or outside information). We vary the elasticity parameters between a low value of 0.5 and a high value of 2.5, across the industries, and assume that these parameters do not change over time.[9]

[5] Primary education is essential for good quality unskilled work in modern manufacturing and services, low levels of education in the labor force result in low quality of service and mass consumer goods while secondary education ensured that labor was gradually able to undertake the semi-skilled jobs that opened up as the economy moved to middle income level (Virmani, 2006).

[6] Morgan (2006) explains the reason for considering lending rate and WPI for the estimation.

[7] A study by Shanmugam (2006) on the rate of time preference in India estimated that real discount rate ranges from 7.6 to 9.7%.

[8] For details on calibration, see Shoven and Whalley (1984), Howitt (1995), Sims (1996), Hansen and Heckman (1996), Kydland and Prescott (1996) and Dawkins et al. (2001).

[9] The low elasticity of substitution between skilled and unskilled labor is a plausible assumption for a country like India. Jung and Thorbecke (2003) have taken similar number for some African countries.

The nested production function can be split into Cobb–Douglas function of capital and composite labor, and a CES labor composite of skilled and unskilled labor:

$$X_i^b = \theta_i \left(K_i^b\right)^{(1-\phi_i)} \left(L_i^b\right)^{\phi_i} \quad i = 1, \ldots, 11 \tag{8}$$

$$L_i^b = \left[\alpha_i \left(L_{s_i}^b\right)^{\rho_i} + (1-\alpha_i)\left(L_{u_i}^b\right)^{\rho_i}\right]^{\frac{1}{\rho_i}} \quad i = 1, \ldots, 11. \tag{9}$$

The profit maximizing behavior of the producer in a Cobb–Douglas production function yields the share parameters ϕ. Given the information on the sector-wise output, capital, total labor, skilled and unskilled labor, at the observed period, we calibrate parameters θ, and α for both the beginning and end years.

4. Results

We run two scenarios, with the elasticity of substitution between skilled and unskilled labor low or high. In case of a lower elasticity of substitution, the analysis shows that the Indian economy operated at 88 and 49% of its potential in the respective years of 1994 and 2002 (see Table 2). In case of a higher elasticity of substitution, the economy operated at 90 and 47% in 1994 and 2002, respectively. It is worth mentioning here that in our model 1994 is considered to be static efficiency and 2002 dynamic. Possibility of education and investment process creates substantial potential for the economy in 2002. Introduction of perfectly competitive market would push the economy to its potential by doubling the economic activities in the long run.

The competitive wages of skilled and unskilled labor determine their respective productivities. The competitive skill premium accounts for the cost of education including the wage forgone, all evaluated at competitive prices. We define the returns to education as the ratio of the competitive skill premium to the competitive unskilled wage, i.e. the premium over unskilled productivity. The annualized rate of returns to education between 1994 and 2002 are found to be 7.3 and 10% for the lower and the higher elasticity of substitutions respectively.[10] We report the wage (and productivity) differentials as skilled/unskilled wages (and productivities). Table 2 shows that skilled productivity is significantly higher than the unskilled and this differential declines in the end period. With a lower elasticity of substitution, the productivity differential remains as high as 6.93 in 1994 and drops significantly to 1.76 in 2002; it declines significantly in 1994 with the increase in the elasticity of substitution. Productivity differential remains above the wage differential in the initial period and below it in the end period irrespective in both the scenarios. We have already noticed from Table 1 that wage ratio between skilled and unskilled labor has already started declining, from 2.95 in 1994 to 2001 in 2002. Government of India (2010a)'s report on Employment and Unemployment Situation in India has indicated even a lower wage ratio in 2005–2006, 2.54.

Table 2 shows that in 1994 the skilled labor productivity is more than double the observed wage but it is below the wage in 2002. A higher elasticity of substitution between skilled and unskilled labor reduces the productivity–wage differential. The unskilled wage is below its productivity in either period. We notice that in case of lower elasticity of substitution between skilled and unskilled labor, unskilled labor is paid only marginally less than its productivity in the initial period and much lower than productivity in the second period. However, in case of higher elasticity of substitution, the unskilled wage lies substantially lower than its productivity in the initial period; this wage still lies below the productivity in second period, but not as much below as initial period. Under the lower elasticity of substitution scenario, the unskilled productivity lies much above the wage in the end period as compared to the initial and in case of higher elasticity of substitution, it is just the opposite. On the other hand, skilled productivity declines relative to wage in the end period in both scenarios.

Table 3 shows the that service sector in general, in which 'other services', 'wholesale, retail trade', 'finance, insurance, real estate' and 'education' in particular have more potential for growth, while potential levels of 'agriculture', 'light manufacturing', 'heavy manufacturing' (particularly in the first period, 1994), and 'transport and storage' sectors lie below their observed outputs. 'Other service' sector has the highest potential to grow, almost over seven times of the observed in the end period, 2002. It is worth mentioning here that information technology services, outsourcing and business services have been major contributors to the performance of the 'other services' these days.

A cursory look at the changes in the composition of sector-wise gross domestic products (GDP) and their growth rates from 2003 till 2009 clearly displays the growing importance of service sectors in the economy (see Table 4). The 'agriculture' sector has recently shown increasing growth rates; however, its share in GDP has been continuously declining. Share of 'manufacturing' sector in total GDP has also shown declining trend with almost stagnant growth rates. Government of India (2010b) rightly observes that the technological breakthrough in agriculture achieved in 1960s is gradually waning and there is need for a second green revolution. The Survey also claims that lack of capacity utilization in core sectors and infrastructure

Table 2
Efficiency, wages and productivities in 1994 and 2002.

	Elasticity of substitutions between skilled and unskilled: 0.5*		Elasticity of substitutions between skilled and unskilled: 2.5*	
	1994	2002	1994	2002
Efficiency	0.88	0.49	0.90	0.47
Productivity ratio	6.93	1.76	3.50	2.19
Productivity ratio/observed wage ratio	2.35	0.60	1.19	0.75
Skilled productivity/observed skilled wage	2.42	0.79	2.12	0.84
Unskilled productivity/observed unskilled wage	1.03	1.30	1.79	1.12

* Returns to education, $P_s^1/w_u^1 = w_s^1/w_u^1 - 1$, are 0.76 and 1.19 respectively for the low and high elasticity of substitutions respectively. Considering 8 periods of gap, the annualized returns turn out to be around 7.3% and 10% respectively.

Table 3
Sector-wise ratio of optimal to observed output.

	Elasticity of substitution between skilled and unskilled: 0.5		Elasticity of substitution between skilled and unskilled: 2.5	
	1994	2002	1994	2002
1. Agriculture and allied	0.45	0.14	0.37	0.17
2. Mining and quarrying	1.11	1.02	1.06	1.02
3. Light manufacturing	0.15	0.75	0.13	0.89
4. Heavy manufacturing	0.38	0.99	0.37	1.14
5. Construction	1.63	1.12	1.99	1.13
6. Electricity, gas and water	0.71	1.47	0.71	1.57
7. Transports, storage	0.71	0.54	0.74	0.61
8. Wholesale, retail trade	1.00	1.76	1.02	1.95
9. Finance, insurance, real est.	1.02	1.40	1.06	1.49
10. Other services	3.96	7.00	4.29	7.06
11. Education	2.58	2.03	2.60	2.14

[10] Asian Development Bank (2007) reported returns to education for 2004 based on Mincerian equation, which are 6.3 and 12.3 (middle level education) for mid-carrier and senior workers respectively.

Table 4
Sector-wise composition and growth rates of observed GDP at factor cost from 2002 to 2009.
Source: Government of India (2011).

	2002	2003	2004	2005	2006	2007	2008	2009
Percentage shares								
Agriculture	22.52	22.83	19.03	18.82	18.29	18.26	17.59	17.76
Mining	2.75	2.51	2.86	2.79	2.70	2.72	2.62	2.52
Manufacturing	15.60	15.59	15.25	15.39	16.06	15.99	15.45	14.76
Electricity, gas, water	2.21	2.15	2.11	2.04	1.93	1.83	1.59	1.51
Construction	6.20	6.18	7.70	7.93	8.16	8.49	8.55	8.18
Wholesale, retail trade	14.75	14.94	16.06	16.70	17.07	17.09	16.93	16.31
Transports, storage	7.69	8.02	8.43	8.25	8.17	8.00	7.84	7.78
Finance, insurance, real estate	13.75	13.50	14.71	14.55	14.84	15.09	16.08	16.75
Other services	14.52	14.27	13.84	13.55	12.78	12.52	13.34	14.44
Growth rates								
Agriculture		13.28	−1.71	12.79	13.36	15.70	11.05	17.26
Mining		2.00	34.20	11.10	13.05	16.88	11.09	11.27
Manufacturing		11.68	15.35	15.10	21.69	15.42	11.40	10.90
Electricity, gas, water		8.48	15.82	10.26	10.20	10.08	0.40	10.11
Construction		11.51	46.86	17.38	20.03	20.62	16.07	11.14
Wholesale, retail trade		13.20	26.77	18.62	19.15	16.03	14.28	11.84
Transports, storage		16.52	23.92	11.63	15.46	13.59	12.96	15.18
Finance, insurance, real estate		9.68	28.54	12.79	18.96	17.88	22.81	20.96
Other services		9.85	14.40	11.62	10.01	13.59	22.84	25.62

Table 5
Multiplicative decomposition of efficiency and productivity–wage ratios.

	Efficiency		Productivity of skilled labor/ skilled wage		Productivity of unskilled labor/ unskilled wages	
	1994	2002	1994	2002	1994	2002
Low elasticity of substitution						
Trade efficiency	0.83	0.61	3.11	1.65	0.63	0.82
	(59.34)	(63.34)	(78.48)	(40.31)	(48.59)	(15.94)
Human capital	1.03	0.84	1.03	0.67	1.17	2.13
	(9.41)	(22.34)	(2.04)	(32.24)	(16.51)	(60.75)
Physical capital	0.97	0.93	0.98	0.9	1.04	0.87
	(9.70)	(9.30)	(1.40)	(8.48)	(4.12)	(11.19)
Static allocative efficiency	1.07	1.04	0.77	0.79	1.34	0.86
	(21.55)	(5.03)	(18.08)	(18.97)	(30.78)	(12.12)
Total	0.89	0.49	2.42	0.79	1.03	1.30
High elasticity of substitution						
Trade efficiency	0.82	0.57	2.58	1.61	1.27	1.23
	(67.12)	(62.62)	(79.76)	(42.58)	(41.32)	(28.05)
Human capital	1.03	0.85	1.02	0.74	1.15	1.25
	(10.00)	(18.10)	(1.67)	(26.92)	(24.16)	(30.23)
Physical capital	1.00	0.90	0.99	0.90	1.11	0.98
	(0.00)	(11.74)	(0.85)	(9.42)	(18.04)	(2.74)
Static allocative efficiency	1.07	1.07	0.81	0.79	1.1	0.75
	(22.88)	(7.54)	(17.73)	(21.08)	(16.48)	(38.98)
Total	0.90	0.47	2.12	0.84	1.79	1.12

Note: figure in parenthesis indicates the absolute weight of the individual impact in percentage.

bottlenecks are responsible for the slow growth in manufacturing sectors. The challenges India faces to retain the already acclaimed competitiveness in the IT services and India is yet to tap its full potential in international market for its trade services, education, financial services and other business services.

Trade efficiency, human capital formation, physical capital formation, and static allocative efficiency are the four factors contributing to the performance of the economy and to the productivities of skilled and unskilled labor relative to their wages. We make decompositions for both the initial and the final period. In case of efficiency, factor that causes performance of the economy less than its potential indicates a decomposition value less than one (negative impact). It is other way around if the value is more than one. In case of productivity–wage ratio, if the factor causes productivity to be higher than the wage, decomposition value will be higher than one; it is the opposite if the value is less than one. The value in the bracket suggests the importance of a factor relative to the other in terms of percentage.

Main reasons for the Indian economy to perform under its potential are declining efficiency from free trade (see Table 5). It is the static allocative efficiency, which has contributed to the performance of the economy. However, the contribution of allocative efficiency is not strong enough to bring the economy to its potential. Lack of human capital formation is also responsible for decreasing the performance of the economy in the end period.

Table 5 clearly shows that trade efficiency is the main source of skilled productivity in both periods, 1994 and 2002. However, the contribution of free trade to the skilled productivity declines drastically in 2002. The principal cause of skilled productivity to be lower than the wage is due to lower human capital formation. Failure to capture the higher rate of returns to education has created a large number of undereducated labor force in 2002. Shortage of skilled labor in 2002 prompts excessive skilled wage relative to its productivity.

Contrary to skilled productivity, unskilled productivity is sensitive to the degree of elasticity of substitution assumed between skilled and unskilled labor. In case of lower elasticity of substitution, free trade is responsible in lowering the productivity of unskilled labor relative to its wage. Static allocative efficiency contributes significantly to the unskilled productivity in 1994. On other hand, human capital formation is the sole factor that has caused unskilled productivity to be much higher than the wage in 2002. In case of higher elasticity of substitution, free trade and the human capital formation contribute significantly to the increase in unskilled productivity above its wage.

5. Conclusion

Given earlier, the 1994 Indian economy operated at 90% of its potential. The performance in 2002 dropped to 50%, taking into account the missed investment and education opportunities. Service sectors including education have significant potential to achieve higher growth.

Both openness and education would push the productivity differential more than the observed wage differential in the first period and would reduce it in the end period. The intensity of the pressure would be greater under the low elasticity of substitution between skilled and unskilled labor. The data shows that the observed wage inequalities (skilled–unskilled wage ratio) for the two periods are 2.95 and 2.91. However, productivity inequalities (skilled–unskilled competitive wage ratio) are 6.93 and 1.76 in 1994 and 2002 respectively for the lower elasticity of substitution between skilled and unskilled labor, and 3.50 and 2.19 for the higher elasticity of substitution.

Compared to its productivity, skilled labor is significantly underpaid in the initial period and overpaid in the end period. However unskilled labor is underpaid in both periods compared to its productivity. This indicates the existence of still large pool of undereducated Indians. The pattern of change in productivity relative to the wage for unskilled labor is sensitive to degree of elasticity of substitution. Human capital formation through education process is an important component for productivity–wage disparity. The optimum returns to education are 7.3% and 10% for a lower and higher degree elasticity of substitutions respectively.

We conduct a decomposition exercise to capture the importance of various factors that influence the efficiency of the economy and the productivity–wage differential. Skilled labor benefits from free trade, but stands to lose from education and domestic competition. On the other hand, unskilled labor gains from domestic competition and human capital formation. However, wage–productivity differential for unskilled labor is sensitive to degree of elasticity of substitution. Unskilled labor loses from free trade under a lower elasticity of substitution, while gains in the case higher elasticity of substitution.

The static allocative efficiency, i.e. the domestic competition is the only factor that contributes to the efficiency gain of the Indian economy. However, the main reasons for India to under-perform are its deviation from free trade potential, followed by failure to capture returns to education (human capital formation) and investment potential (physical capital formation) in the end period. We have already observed that there exists a higher potential returns to education. Failure to capture it has led to shortage of skilled labor and excessive wage inequality in the economy.

Appendix A

$$D^t : \sum_i f_i^t P_i^t = (\beta)^t \quad t = 0, 1 \tag{A1}$$

$$X_i^t : P_i^t = \sum_j A_{ij}^t P_i^t + P_{v_i}^t \begin{cases} i = 1, \ldots, 10 & t = 0 \\ i = 1, \ldots, 11 & t = 1 \end{cases} \tag{A2}$$

$$X_{11}^0 : P_{11}^0 = \sum_j A_{11,j}^0 P_{11}^0 + P_{v_{11}}^0 - \chi_e \lambda^0 \tag{A3}$$

$$K_i^t : P_{v_i}^t \theta_i^t \left(1-\phi_i^t\right)\left(K_i^t\right)^{-\phi_i^t}\left[\alpha_i^t \left(L_{s_i}^t\right)^{\rho_i} + \left(1-\alpha_i^t\right)\left(L_{u_i}^t\right)^{\rho_i}\right]^{\frac{\phi_i^t}{\rho_i}} = r_i^t - r_i^{t+1}\left(\frac{1}{\delta_i}\right) t = 0 \tag{A4}$$

$$K_i^{t+1} : P_{v_i}^{t+1} \theta_i^{t+1} \left(1-\phi_i^{t+1}\right)\left(K_i^{t+1}\right)^{-\phi_i^{t+1}}\left[\alpha_i^{t+1} \left(L_{s_i}^{t+1}\right)^{\rho_i} + \left(1-\alpha_i^{t+1}\right)\left(L_{u_i}^{t+1}\right)^{\rho_i}\right]^{\frac{\phi_i^{t+1}}{\rho_i}} = r_i^{t+1}\left(\frac{1}{\delta_i}\right) \tag{A5}$$

$$L_{s_i}^t : P_{v_i}^t \theta_i^t \left(K_i^t\right)^{1-\phi_i^t} \phi_i^t \left[\alpha_i^t \left(L_{s_i}^t\right)^{\rho_i} + \left(1-\alpha_i^t\right)\left(L_{u_i}^t\right)^{\rho_i}\right]^{\frac{\phi_i^t}{\rho_i}-1} \alpha_i^t \left(L_{s_i}^t\right)^{\rho_i - 1} = w_u^t + P_s^t \tag{A6}$$

$$L_{u_i}^t : P_{v_i}^t \theta_i^t \left(K_i^t\right)^{1-\phi_i^t} \phi_i^t \left[\alpha_i^t \left(L_{s_i}^t\right)^{\rho_i} + \left(1-\alpha_i^t\right)\left(L_{u_i}^t\right)^{\rho_i}\right]^{\frac{\phi_i^t}{\rho_i}-1} \left(1-\alpha_i^t\right) \left(L_{u_i}^t\right)^{\rho_i - 1} = w_u^t \tag{A7}$$

$$\sigma^0 : \chi_c \xi = w_u^0 + \chi_e \tag{A8}$$

$$\Delta S : P_s^1 = \chi_c \tag{A9}$$

$$I^t : r_i^{t+1} = P_i^t \left(\frac{\mathcal{T}_i^t}{\delta_i}\right) \quad t = 0 \tag{A10}$$

$$T_i^t : \pi_i^t \varepsilon^t = P_i^t (\text{for tradables}) \tag{A11}$$

Appendix B

The multiplicative decomposition is written as $\frac{V^*}{V^0} = D_T D_E D_I D_F$.

$$D_T = \left[\frac{T^* E^0 I^0 F^0}{T^0 E^0 I^0 F^0}\right]^{\frac{1}{4}} \quad \text{when } S = \{1\}$$

$$\cdot \left[\frac{T^* E^* I^0 F^0}{T^0 E^* I^0 F^0}\right]^{\frac{1}{12}} \quad \text{when } S = \{1, 2\}$$

$$\cdot \left[\frac{T^* E^0 I^* F^0}{T^0 E^0 I^* F^0}\right]^{\frac{1}{12}} \quad \text{when } S = \{1, 3\}$$

$$\cdot \left[\frac{T^* E^0 I^0 F^*}{T^0 E^0 I^0 F^*}\right]^{\frac{1}{12}} \quad \text{when } S = \{1, 4\}$$

$$\cdot \left[\frac{T^* E^* I^* F^0}{T^0 E^* I^* F^0}\right]^{\frac{1}{12}} \quad \text{when } S = \{1, 2, 3\}$$

$$\cdot \left[\frac{T^* E^* I^0 F^*}{T^0 E^* I^0 F^*}\right]^{\frac{1}{12}} \quad \text{when } S = \{1, 2, 4\}$$

$$\cdot \left[\frac{T^* E^0 I^* F^*}{T^0 E^0 I^* F^*}\right]^{\frac{1}{12}} \quad \text{when } S = \{1, 3, 4\}$$

$$\cdot \left[\frac{T^* E^* I^* F^*}{T^0 E^* I^* F^*}\right]^{\frac{1}{4}} \quad \text{when } S = \{1, 2, 3, 4\}$$

Similarly, we can derive for D_E, D_I and D_F respectively.

$$D_E = \left[\frac{T^0 E^* I^0 F^0}{T^0 E^0 I^0 F^0}\right]^{\frac{1}{4}} \cdot \left[\frac{T^* E^* I^0 F^0}{T^* E^0 I^0 F^0} \cdot \frac{T^0 E^* I^* F^0}{T^0 E^0 I^* F^0} \cdot \frac{T^0 E^* I^0 F^*}{T^0 E^0 I^0 F^*}\right]^{\frac{1}{12}} \cdot \left[\frac{T^* E^* I^* F^0}{T^0 E^0 I^* F^*} \cdot \frac{T^0 E^* I^* F^*}{T^* E^0 I^0 F^*} \cdot \frac{T^* E^* I^0 F^*}{T^* E^0 I^* F^0}\right]^{\frac{1}{12}} \cdot \left[\frac{T^* E^* I^* F^0}{T^* E^0 I^* F^*}\right]^{\frac{1}{4}}$$

$$D_I = \left[\frac{T^0 E^0 I^* F^0}{T^0 E^0 I^0 F^0}\right]^{\frac{1}{4}} \cdot \left[\frac{T^* E^0 I^* F^0}{T^* E^0 I^0 F^0} \cdot \frac{T^0 E^* I^* F^0}{T^0 E^* I^0 F^0} \cdot \frac{T^0 E^0 I^* F^*}{T^0 E^0 I^0 F^*}\right]^{\frac{1}{12}} \cdot \left[\frac{T^* E^* I^* F^0}{T^* E^* I^0 F^0} \cdot \frac{T^0 E^* I^* F^*}{T^* E^0 I^0 F^*} \cdot \frac{T^* E^* I^0 F^*}{T^0 E^* I^0 F^*}\right]^{\frac{1}{12}} \cdot \left[\frac{T^* E^* I^* F^*}{T^* E^* I^0 F^*}\right]^{\frac{1}{4}}$$

$$D_F = \left[\frac{T^0 E^0 I^0 F^*}{T^0 E^0 I^0 F^0}\right]^{\frac{1}{4}} \cdot \left[\frac{T^* E^0 I^0 F^*}{T^* E^0 I^0 F^0} \cdot \frac{T^0 E^* I^0 F^*}{T^0 E^* I^0 F^0} \cdot \frac{T^0 E^0 I^* F^*}{T^0 E^0 I^* F^0}\right]^{\frac{1}{12}} \cdot \left[\frac{T^* E^* I^0 F^*}{T^* E^* I^0 F^0} \cdot \frac{T^0 E^* I^* F^*}{T^0 E^* I^* F^0} \cdot \frac{T^* E^0 I^* F^*}{T^* E^0 I^* F^0}\right]^{\frac{1}{12}} \cdot \left[\frac{T^* E^* I^* F^*}{T^* E^* I^* F^0}\right]^{\frac{1}{4}}$$

References

Ang, B.W., Liu, Hyun-Sik, Chung, F.L., 2004. A generalized Fisher index approach to energy decomposition analysis. Energy Economics 26, 757–763.

Asian Development Bank, 2007. Asian Development Outlook: growth amid changes. Asian development Bank, Printed in Hong Kong. ISBN: 978-971-561-619-5.

Bajpai, N., Sachs, J.D., 1997. India's economic reforms: some lessons from East Asia. Journal of International Trade and Economic Development 6 (2), 135–164.

Bargain, O., Bhaumik, Chakrabarty, S.K., Zhao, Z.M., 2006. Returns to education in Chinese and Indian formal sectors: implications for skill shortages. Employment and Development Conference. IZA and World Bank.

Beladi, H., Chakraborty, A., 2004. Trade, wage inequality in developing countries. Economic Enquiry 42 (2), 295–303.

Berman, E., Bound, J., Machin, S., 1998. Implications of skilled-biased technological change: international evidence. Quarterly Journal of Economics 1245–1279 (November).

Bosworth, Barry, Collins, Susan, M., Virmani, Arvind, 2007. Sources of growth in the Indian economy. NBER Working Paper No. 12901, National Bureau of Economic Research, Cambridge, Massachusetts.

Dawkins, C., Srinivasan, T.N., Whalley, J., 2001. Calibration. In: Heckman, J.J., Learner, E. (Eds.), Handbook of Econometrics, vol. 5. Elsevier, New York, pp. 3653–3703. Chapter 58.

Dutta, P.V., 2004. Trade protection and inter-industry wages in India. Working Paper No. 27, Poverty Research Unit at Sussex, Department of Economics, University of Sussex.

Dutta, P.V., 2005. Accounting for wage inequality in India. Working Paper No. 29 Poverty Research Unit at Sussex, Department of Economics, University of Sussex.

Fischer, S., 2002. Breaking out of the third world: India's economic imperative. A Speech Prepared for Delivery at the India Today Conclave, New Delhi, January 22.

Hansen, L.P., Heckman, J.J., 1996. The empirical foundations of calibration. Journal of Economic Perspectives 10, 87–89.

Hanson, G.H., Harrison, A., 1999. Trade liberalisation and wage inequality in Mexico. Industrial and labor Relations Review 52, 271–288.

Harrison, J., Horrdge, M., Pearson, K.R., 2000. Decomposing simulation results with respect to exogenous shocks. Computational Economics 15 (3), 227–249.

Howitt, R.A., 1995. Positive mathematical programming. American Journal of Agricultural Economics 77 (2), 329–342.

Government of India, 2004, 2006. National Accounts Statistics. Ministry of Statistics and Programme Implementation, New Delhi. .

Government of India, 2010a. NSSO Report No. 522: Employment and Unemployment Situation in India, July, 2005–June, 2006, National Sample Survey Office, Ministry of Statistics and Programme Implementation, New Delhi.

Government of India, 2010b. Economic Survey of India. Ministry of Statistics and Programme Implementation, New Delhi.

Government of India, 2011. National Accounts Statistics. Ministry of Statistics and Programme Implementation, New Delhi.

Jung, S.E., Thorbecke, E., 2003. The impact of public education expenditure on human capital, growth and poverty in Tanzania and Zambia: a general equilibrium approach. IMF Working Paper No. 01/106, August.

Katz, L.F., Autor, D., 1999. Changes in wage structure and earnings inequality. In: Ashenfelter, O., Card, D. (Eds.), Handbook of Labour Economics, Elsevier, North Holland Publishing Co., Amsterdam.

Katz, L.F., Murphy, Kevin M., 1992. Changes in relative wages, 1963–1987: supply and demand factors. Quarterly Journal of Economics 107 (1), 35–78.

Kiley, M.T., 1999. The supply of skilled-biased technological progress. The Economic Journal 109, 708–724.

Krusell, P., Ohanian, L.E., Rios-Rull, J., Violante, G.L., 1997. Capital-skill complementarities: a macroeconomic analysis. Federal Bank of Minneapolis Research Department Staff Report, No. 236.

Kydland, F.E., Prescott, E.C., 1996. The computational experiment: an econometric tool. Journal of Economic Perspectives 10, 69–71.

Learner, E.E., 1996. Wage inequality from international competition and technological change: theory and country evidence. American Economic Review, Papers & Proceedings 86 (2), 309–314.

Lucas, R.E.B., 1988. On the mechanics of economic development. Journal of Monetary Economics 22, 3–42.

Machin, S., 2002. Labour market inequality and change in the relative demand for skills. Paper Prepared for the Royal Statistical Society "Explanations of Rising Economic Inequality" Conference.

Marjit, S., Acharyya, R., 2003. International Trade, Wage Inequality and the Developing Economy: a General Equilibrium Approach. Physica-Verlag, Heidelberg; New York.

Morgan, J.P., 2006. India focus: real interest rates. Economics Research: India Focus. (September 7).

Negishi, T., 1960. Welfare economics and existence of an equilibrium for a competitive economy. Metrorconomica 12, 92–97.

Pradhan, B., 2002. The role of education in wage inequality change in India: 1988–97. DFID project paper, department for International Development, UK.

Pradhan, B.K., Sahoo, A., Saluja, M.R., 1999. A social accounting matrix for India, 1994–95. Economic and Political Weekly 34 (48), 3368–3378.

Pradhan, B.K., Roy, P.K., 2003. The Well-being of Indian Households: MIMAP-India Survey Report. Tata McGraw-Hill Publishing Company Limited, New Delhi.

Pradhan, B.K., Subramanian, A., 2000. Education, openness and the poor: analysis of an all-India sample of households. NCAER Discussion Paper No. 14, New Delhi.

Pradhan, B.K., Saluja, M.R., Sing, S., 2006. Social Accounting Matrix for India: Concepts, Construction and Applications. Sage Publications, New Delhi.

Prescott, E.C., 1986. Theory ahead of business-cycle measurement. Carnegie-Rochester Conference Series on Public Policy 25, 11–14.

Romer, P.M., 1986. Increasing returns and long-run growth. Journal of Political Economy 94 (5), 1002–1037.

Shanmugam, K.R., 2006. Rate of time preference and the quantity adjusted value of life in India. Environment and Development Economics 11, 569–583.

Shoven, J.B., Whalley, J., 1984. Applied general equilibrium models of taxation and international trade: an introduction and survey. Journal of Economic Literature 22, 1007–1051.

Shorrocks, A.F., 1999. Decomposition procedures for distributional analysis a unified framework based on the shapely value. University of Essex mimeo.

Sims, C.A., 1996. Macroeconomics and methodology. Journal of Economic Perspectives 10, 105–107.

ten Raa, T., Mohnen, P., 2002. Neoclassical growth accounting and frontier analysis: a synthesis. Journal of Productivity Analysis 18, 111–128.

Tinbergen, J., 1975. Income Distribution: Analysis and Policies. North Holland, Amsterdam.

Virmani, A., 2006. Sustaining employment and equitable growth: policies for structural transformation of the Indian economy. Working Paper, No. 3//2003 PC, Planning Commission, New Delhi.

Williamson, Jeffrey G., 1999. Real wages, inequality and globalization in latin america before 1940. Revista de Historia Económica (Second Series) 17, 101–142. doi:10.1017/S0212610900002287.

Wood, A., 1994. North–south Trade, Employment and Inequality, Changing Fortunes in Skill-driven World. Clarendon Press, Oxford.

Wood, A., 1999. Openness and wage inequality in developing countries: the Latin American challenge to East Asian conventional wisdom. In: Baldwin, R.E., et al. (Ed.), Market Integration, Regionalism and the Global Economy. Cambridge University Press.