

UNIVERSITY OF BOMBAY  
DEPARTMENT OF ECONOMICS

WAGE INEQUALITY : THE ROLE OF TECHNICAL CHANGE

BY  
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## **Wage Inequality: The Role of Technical Change and Trade**

The post war boom effectively ended in the oil crisis of the early 1970's. Since then the growth in mean incomes has been sharply reduced in the U.S. and this has been accompanied by a marked increase in inequality. Between 1958 and 1973 median income (in 1988 dollars) for full-time, 45-54 year old male workers, adjusted for fringe benefits, grew from \$21,100 to \$34,100. In 1988 it stood at \$35,900 (Levy and Murnane, 1992, 1337). For the least skilled there have been falls in real wages so given the vigorous rise in earnings at the other extreme, an appreciable increase in the dispersion of earnings has occurred. The contrast with the fairly equitable growth of the previous period has stimulated much analysis and debate. ( See, for example, Burtless, 1990; Nelson, 1994; Kusters, 1994)

Many factors may have contributed to the situation - demographic change, including the progress of the post war baby boom, changes in household structure; the increase in part-time jobs and women's participation rate, the contraction of 'middle-class jobs', the decline of unionization and the limited upgrading of minimum wage legislation. However, cause and effect hard to disentangle among these developments and none of them seem capable of accounting for the radical departure that occurred in the 1980's. The two causal factors that have been most commonly blamed have been globalization, the opening of trade particularly among the developing countries, and biased technical change. Since Adam Smith the dominant view among economists has been support of free trade. However, should a consequence of it be greatly increased inequality then protection, with potentially serious repercussions for the world economy, commands greater political support. This is evident in the Perot candidacy in the 1992 election and the Buchanan bid in the current one.

Unfortunately technical change is generally accepted by default - if the other explanatory factors fail to establish the result then technical change is accepted as the residual. This paper seeks to examine the roles of trade and technical change within the two sector model popularized by Jones (1965). The objective is to determine the characteristics of technical change that could account for what happened in the 1980's rather than just labeling it as "biased". Restricting consideration to two sectors limits the analysis but has the considerable advantage of providing clarity. The intuition behind many of the contributions to the debate can be readily grasped despite the limitations.

The following section outlines the basic model and establishes the basic definitions of technical change. These are then applied to outline the properties of technical change that would generate the inequality of the 1980's. Rather than treat factor supplies as exogenous these are next made to respond to the changes in relative wages. In conclusion a coherent account of the period is presented.

### Jones' Simple General Equilibrium Model

The economy consists of two sectors, say Textiles (T) and Computers (C) which are produced using two inputs, Unskilled (U) and Skilled (S) labor, with wages  $W_i$ ,  $i=U,S$ . Limiting the model to two sectors and two factors has clear advantages as regards tractability and permits the issue of wage inequality to be kept in focus. However, Wood (1994) has argued cogently that total factor productivity in the model world is not the powerful constraint that it was previously. Developments in communications and capital markets have allowed firms to develop global production. The

real constraints thus are the availability of skilled labor and perhaps its infrastructural requirements.

Production functions are homogeneous of degree one and perfect competition exists in factor and product markets. (See Woodland, 1982, for a development of the standard model).

Allowing for technology by including a time parameter, consider the firm's optimization problem:

$$\begin{aligned} \text{Min} \quad & w_U U + w_S S \\ \text{ST} \quad & f_T(U, S; t) = 1 \end{aligned}$$

The solution to this is the unit cost function  $c_T(w_U, w_S; t)$ , so by Shepherd's Lemma we have the

air, the amount of the  $i^*$  factor required to produce a unit of textiles as  $a_{iT} = \frac{\partial c_T}{\partial w_i}$  for  $i = u, s$ .

Clearly

$$a_{iT} = a_{iT}(w_U, w_S; t) \quad (1)$$

As a consequence of perfect competition there are no supernormal profits in the product markets and so:

$$a_{Uj}w_U + a_{Sj}w_S = p_j \quad j = T, C \quad (2)$$

Similarly we have full employment in the factor markets

$$a_{iT}T + a_{iC}C = 1 \quad i = U, S \quad (3)$$

Changing the output level to  $1/p_j$  and thus the optimal inputs to  $\left[ \frac{a_{Uj}}{p_j}, \frac{a_{Sj}}{p_j} \right]$  allows the situation to be depicted graphically using the Lerner-Pearce diagram

To generate the dynamics of technical change we differentiate (3) with respect to time and generate:

$$\begin{aligned} \frac{da_y}{dt} / a_y &= \hat{a}_y = \frac{w_U}{a_{Uj}} \frac{\partial a_{Uj}}{\partial w_U} \hat{w}_U + \frac{w_S}{a_{Sj}} \frac{\partial a_{Sj}}{\partial w_S} \hat{w}_S + \frac{\partial a_{Uj}}{\partial t} / a_y \\ &= \hat{c}_{Uj} - \hat{b}_{Uj} \quad j = T, C \end{aligned} \quad (4)$$

where following Jones the proportion damage due to technology considered a positive quantity.

$\hat{c}_y$  is separate from technical change and captures the factor substitution in response to a change in factor prices. Defining  $\lambda_{UT} = \frac{a_{UT}T}{U}$ , the fraction of the unskilled labor force employed producing T, and  $\theta_{UT} = \frac{a_{UT}w_U}{p_T}$ , the share of the value of textile output received by unskilled

labor, etc., we assume that textiles are labor intensive and so  $|\lambda| = \lambda_{UT} - \lambda_{ST} > 0$  and

$$|\theta| = \theta_{UT} - \theta_{ST} > 0.$$

Now biased technical change has been advanced as a causal factor in wage inequality so it is worth establishing the measures of technical change that have been developed for the two sector model. The distinction between *industry* and *factor* is important. At the *industry* level the

rate of technical advance,  $\pi_j$ , is defined as the proportional reduction in the total cost of production, assuming relative factor prices are unaltered.

$$\pi_j = \theta_{Uj} \hat{b}_{Uj} + \theta_{Sj} \hat{b}_{Sj} \quad j = T, C \quad (5)$$

Mirroring the reduction in cost at the industry level is the reduction in demand for factors due to technical change, which will clearly be a function of the current relative employment between the two industries.

$$\pi_i = \lambda_{\pi} \bar{b}_{\pi} + \lambda_{\kappa} \bar{b}_{\kappa} \quad i = U, S \quad (6)$$

The  $\pi_i$  are naturally aggregate measures which permit two different notions of overall bias. If  $\pi_U > \pi_S$  then we have unskilled labor saving technical change, that is, it is biased against U. If  $\pi_T > \pi_C$  then technical change is biased toward Textiles.

Bias can be simply at the industry level.  $\beta_j = \hat{b}_{Uj} - \hat{b}_{Sj}$   $j = T, C$ , is the bias within each industry taken separately in the rate of technical change between the two factors.

$\beta_i = \hat{b}_{\pi} - \hat{b}_{\kappa}$   $i = U, S$ , is the bias between industries in the rate of technical progress for each factor. Thus  $\beta_i$  may be considered the interindustry and  $\beta_{ii}$  the intraindustry bias. Clearly

$$\beta_U - \beta_S = \beta_T - \beta_C \quad (7)$$

Defining  $Q_i = \lambda_{\kappa} \theta_{\pi} + \lambda_{\pi} \theta_{\kappa}$   $i = U, S$  ( $Q_i > 0, Q_U + Q_S < 1$ ), we have the following relationship between the aggregate measures of bias:

$$\pi_T - \pi_C = Q_U \beta_U + Q_S \beta_S + |\theta| (\pi_U - \pi_S) \quad (8)$$

and thus  $\pi_T > \pi_C$  does not necessarily imply that  $\pi_U > \pi_S$  (if this does hold, Jones, 1965, characterized the technical change as *regular*.)

The central behavioral equation in our analysis is obtained by differentiating (3) with respect to time.

$$\hat{w}_U - \hat{w}_S = \frac{1}{|\theta|} (\hat{p}_T - \hat{p}_C) + \frac{1}{|\theta|} (\pi_T - \pi_C) \quad (9)$$

This equation succinctly highlights the principal alternative explanations of the increase in wage inequality during the 1980's. The avenue of trade is through the relative price of the outputs,  $\hat{p}_T - \hat{p}_C$ , a point emphasized by trade theorists such as Deardorff (199??) and Bhagwati and Dehejia (1994). However, the Stolper-Samuelson result operates whatever the cause of the relative price change. To establish that international trade developments led to increased wage inequality requires two steps: first that the relative price change operated against the good that used unskilled labor intensively and second that such a price change was a consequence of the opening up of trade. If this was so, its origin was in the export policies of the East Asian and Latin American countries - the Reagan presidency was little different to his predecessors in terms of trade policy according to Deardorff (1991).

The role of relative prices is crucial to the trade argument. Deardorff and Hakura (1994, 86-90) give five examples of how the wages of skilled labor could rise with increases in the volume of trade - 'looking at trade and wages alone cannot be enough to identify what is going on'. (See also Richardson, 1995). For this reason we also exclude the factor content approach



developed extensively by Wood (1994) since they "take the increase in imports as an exogenous event for the receiving country" (Richardson, 1995, 27).

Equation (9) does not imply any causality; it could be that labor market developments lead to the fall in the unskilled wage. An example of this would be the abolition of minimum wage legislation or ignoring its violation. Then the relative price change would be a *consequence* rather than a *causal* factor. Technical change, on the other hand, has been modeled as an exogenous factor, and so  $\pi_T - \pi_C$  may be considered causal. This is just a consequence of the modeling strategy since it is of course possible to make the rate of technical change endogenous.

It is useful to trace out the adjustment process in, say the textile sector, in response to technical change as it spells out the nature of the simple general equilibrium model being employed. Technical change will alter the cost function and thus the unit factor requirements,  $a_{LT}$  and  $a_{ST}$ . The sign of  $\beta_T$  will indicate the direction of bias in factor saving. For clarity assume this is positive so unskilled labor is saved proportionally more than skilled. Irrespective of the bias, the system is now out of equilibrium since costs are now less than revenues given (3) and so existing textile firms are earning profits.

Since textiles are assumed to be intensive users of unskilled labor, a unit reduction in the output of computers will release proportionally less unskilled than required. Thus as resources are transferred from computers to textiles there will be an excess supply of skilled labor generated, this will put pressure on the relative wage of such labor. It is important to emphasize that although technical change disproportionately *saves* unskilled labor, this will tend to exert pressure for an *increase* in its wage.

Another avenue through which equilibrium may be restored is for, in addition to an increase in the output of textiles, for there to be an increase in its relative price. On the Lerner-Pearce diagram, neutral technical change cannot be distinguished from an increase in the price of the commodity - both will shift the unit value isoquant radially (because of constant returns to scale) towards the origin.

How price changes are determined will depend upon the model's structure. If it is closed, then the price changes will be endogenous and influenced by the elasticities of supply,  $\sigma_{SUP}$ , and demand,  $\sigma_D$ :

$$\hat{p}_T - \hat{p}_C = -\frac{|\lambda||\theta|\sigma_{SUP}}{\sigma}(\pi_T - \pi_C) - \frac{|\theta|}{\sigma}(\pi_U - \pi_S) \quad (10)$$

assuming that factor supplies are constant. Inserting this into (9) yields:

$$\hat{w}_U - \hat{w}_S = \frac{|\lambda|\sigma_D}{\sigma}(\pi_T - \pi_C) + \frac{1}{\sigma}(\pi_U - \pi_S) \quad (11)$$

This exercise emphasizes how causality is established by the structure of the model. In particular, the avenue for through which trade influences the model is by determining  $\hat{p}_T - \hat{p}_C$ ; for the model given by (2) and (3) this is exogenous and follows Woodland's (1982) comparative static approach. For that given by (10) and (11) we are in Jones' (1965) general equilibrium framework. The result of technical change will be seen in the trade balance. The model is one of the supply side so the composition of final demand is not determined. What is the empirical evidence concerning the relative prices of goods with respect to their skill intensity?

Lawrence and Slaughter (1993, 192-198) conclude that the relative price of nonproduction-labor-intensive products (their measure of skill intensity) fell slightly 1980-89 and so international trade would have tended to *reduce* wage inequality. This is challenged by Sachs and Shatz (1994, 38) whose regression evidence suggests that low skill sectors did experience a fall in relative price 1978-89. However the estimated equation includes a highly significant dummy for computer prices whose coefficient is *negative*. And computers, of course, played an important role in technical change in the 1980's and beyond. In 1977 personal computers represented 2.8% of manufacturing investment; by 1987 this had risen to 7.5% despite a 28% *annual* fall in their real price 1982-88 (Berman et al, 1994). There is a positive relationship between TFP growth and the prevalence of computers (Kreuger, 1993). The role of computers<sup>2</sup> and the difficulties in estimating their effective prices makes one reticent to consider the evidence of Sachs and Shatz as decisive. Perhaps the most reasonable conclusion is to say that the price evidence is muted. Let us next consider the role of technical change.

#### . Technical Change at the Industry and Factor Level

Two developments in the 1980's, the sharp increase in wage inequality and the increase in skill intensity in production form the focus of our inquiry. This section asks the question - what form of technical change can account for them? The issue of wage inequality is tackled first and then the further restrictions implied by increased skill intensity. This cannot be accounted for by Stolper-Samuelson since the increased wage of the skilled should stimulate substitution against that form of labor.

For clarity we assume that relative prices are unaltered and that the unskilled wage is unaltered. In terms of the Lerner-Pearce diagram produced in Figure 1 this implies that the unit

cost line rotates anti-clockwise about the horizontal intercept. (See also Findlay and Gilbert, 1959). Obviously if specialization is not complete, technical change must take production from the unit cost line AB to AC. Under our assumptions, differentiation of (2) gives

$$\hat{w}_s = \frac{\theta_{UT}}{\theta_{ST}} \hat{b}_{UT} + \hat{b}_{ST} = \frac{\theta_{UC}}{\theta_{SC}} \hat{b}_{UC} + \hat{b}_{SC} \quad (11)$$

This can be depicted on the Lerner-Pearce diagram for an arbitrary point  $(a_U, a_S)$ . As is clear from (11), there is a linear relationship between  $\hat{b}_U$  and  $\hat{b}_S$  that is consistent with the change in the unskilled wage. We will term this the *technical change frontier*. It can be drawn by establishing the two extremes,  $\hat{b}_U^{MAX}$  and  $\hat{b}_S^{MAX}$ . Given that there is no technical regression, these will be associated with the Horizontal and vertical distances between  $(a_U, a_S)$  and AC. To convert these absolute changes to proportions mark off  $a_U$  and  $a_S$  on the respective axes and join them to 1 on the opposite axis. For clarity on Figure 1 this is just done for the unskilled case. Drop a perpendicular from  $a_U$  - but to the horizontal axis and project the intercept with DE onto the vertical axis. This gives  $\hat{b}_U^{MAX}$  and the process can be repeated for  $\hat{b}_S^{MAX}$ .

It is clear from Figure 1 that as we move up AB skill intensity increases and  $\hat{b}_U^{MAX}$  does likewise since  $a_U$  falls but  $a_S$ , the horizontal distance to AC, increases. However, since  $a_S$  and  $\hat{b}_S^{MAX}$  increase in the same proportion as we move up AB,  $\hat{b}_S^{MAX}$  remains the same, at  $\hat{w}_s$ , as is clear from (11). The technical change frontiers for textiles and computers are drawn in Figure 2 which underlines the wide range of technical progress that can support an increase in wage inequality. It is, for instance, possible that the rate of saving of skilled labor is greater in textiles,

that is  $\beta_s > 0$ , provided that  $\frac{\theta_{LC}}{\theta_{SC}} \hat{b}_{LC} > \frac{\theta_{UT}}{\theta_{ST}} \hat{b}_{UT}$  which by assumption is more stringent than  $\beta_U < 0$ .

The technical change frontier for textiles must lie inside that of computers with the only common point that of  $\hat{b}_s^{max}$ . Take the arbitrary point A on the textile frontier. The wage inequality developments are consistent with technical change in computers at B,C and I) where respectively  $\beta_U < 0, \beta_s > 0; \beta_U < 0, \beta_s < 0$  and  $\beta_U > 0, \beta_s < 0$ . The only restriction placed upon technical change at the inter industry level is that  $\beta_U > 0, \beta_s > 0$  cannot hold simultaneously.

As noted above, (8), it is possible that technical change is more rapid in computers yeti still unskilled labor saving. Using (11) we have

$$\pi_U - \pi_S = \frac{A_U}{Y_S} \cdot \tilde{w}_S \quad (12^*)$$

where  $Y_S = \frac{Sw_s}{Sw_s + Uw_U}$ , the share of skilled labor in national income. Times the smaller  $Y_S$ , the

more likely technical change is to be irregular in the circumstances being analyzed. Consider points A and B on Figure 2; it is likely that even if  $Y_S$  was large that technical change would still be unskilled labor saving.

What further restrictions on technical change are placed by requiring Ing that skill intensity

also rises? Defining skill intensity as  $\gamma_j = \frac{a_{sj}}{a_{uj}}$  we have

$$\dot{\gamma}_j = (\hat{c}_{sj} - \hat{b}_{sj}) - (\hat{c}_{uj} - \hat{b}_{uj}) = -\hat{w}_s \sigma_j + \beta_j > 0 \quad j = T, C \quad (13)$$

by assumption. Thus the increase in skill intensity cannot be due to international trade since in the absence of technical change (13) indicates that skill intensity should fall. The adjustment process is straightforward: the fall in the relative wage of the unskilled leads to firms substituting unskilled for skilled labor and thus full employment is maintained. An increase in skill intensity in both industries thus requires that  $\hat{b}_{uj} > \hat{b}_{sj} \quad j = T, C$  and so technical change must occur on the frontier above the 45 degree line on Figure 2, which represents Hicks neutral change ( $\hat{b}_{uj} = \hat{b}_{sj}$ ). This halves the possibilities but does not fundamentally alter the inter industry picture. In particular the factor saving position is still ambiguous since

$$\pi_u - \pi_s = (\lambda_{uT} \hat{b}_{uT} - \lambda_{sT} \hat{b}_{sT}) + (\lambda_{uC} \hat{b}_{uC} - \lambda_{sC} \hat{b}_{sC}) \quad (14)$$

and though  $|\lambda| > 0$  ensures that the first term is positive it is possible that the second term could be negative if the computer industry absorbs a considerable proportion of the skilled labor force, despite  $\hat{b}_{uC} > \hat{b}_{sC}$ . Technical change being unskilled labor saving at the *industry* level does not necessarily imply it so at the *economy* level.

The above provides a useful framework with which to examine the empirical evidence concerning the influence of technical change on wage inequality. Lawrence and Slaughter (1993) compare the rates of total factor productivity (TFP) across industries at the three-digit SIC level. TFP is just Hicks neutral technical change though the authors in this case have, in addition to the two types of labor, have capital, energy and intermediate materials as inputs. Their finding is that "technological change has been concentrated in industries that use nonproduction labor

intensively' (p.201). This follows from weighting the rates of IFF by the respective  $\lambda_{ij}$  .

However, if change is Hicks neutral then  $\pi_j = \hat{h}_{ij}, j-T,C$  and

$$\pi_U - \pi_S = |\lambda|(\pi_T - \pi_C) \quad (15)$$

Thus what the authors have done is to estimate the factor saving bias in technical change but men conclude that this "helped raise the wages of skilled labour relative to unskilled labor (p. 20?)

Now this is not necessarily true in general as indicated b\ (8). On the other hand, the *assumption* of Hicks neutral change implies that technological change is regular and that the result will hold.

However, the assertion of Sachs and Shatz (1994, 40) that "*biased* technical change in the form of technical change that saves unskilled labor .... »was at work alongside neutral growth in total factor productivity" is meaningless. If change is biased it cannot be Hicks neutral; the two conditions are mutually exclusive. Hicks neutrality can support the relative wage change by having  $\pi_C > \pi_T$  but any change in the skill intensity would be in the opposite direction through (13) with the  $\beta_j = 0$  . The change in skill intensity cannot occur in the simple general equilibrium model due to trade induced changes in relative prices.

### Changes in Factor Supplies

Up to now we have only examined the dynamics of equation (2) and have ignored those involving the factor markets in (3). This is despite the share of aggregate hours worked in the US accounted for college .graduates having increased by over 15% in the period 1979-87 (Katz and Murphy, 1992, 49) while that of high school dropouts fell by over 40%. Differentiation of (3) gives:

$$\hat{T} - \hat{C} = \frac{1}{|\lambda|}(\hat{U} - \hat{S}) + \sigma_{SUP}(\pi_T - \pi_C) + \frac{1}{|\lambda|}(\pi_U - \pi_S) \quad (16)$$

Thus the rate of growth of sectors is determined by the structure of technical change and the relative change in factor supplies. To treat the latter as exogenous, as is done in much of the labor market analysis (such as Murphy and Welch, 1992) is clearly unsatisfactory. In the simple general equilibrium model, if factor supplies are endogenous then (16) clearly puts technical change in the driving seat.

Following Martin and Neary (1980), we assume that agents maximize utility,  $V$ , where

$$V = V(Z_i, T_i, C_i, y_i) \quad i=U, S \quad , \quad (17)$$

and  $Z$  is leisure and  $y$  unearned income (taken as zero for both types of worker). The solution to the constrained maximization for unskilled labor is  $U - U(w_U, p_T, p_C)$  which, when differentiated, yields

$$\hat{U} = e_{Uw_U}^* \hat{w}_U + e_{UT}^* \hat{p}_T + e_{UC}^* \hat{p}_C - m_{ZU} (\hat{w}_U - \alpha_{UT} \hat{p}_T - \alpha_{UC} \hat{p}_C) \quad (18)$$

where  $e_{Uw_U}^* = \left( \frac{w_U}{U} \frac{\partial U}{\partial w_U} \right)_{comp}$  is the compensated labor supply elasticity etc,  $\alpha_{UT} = \frac{p_U T_U}{w_U U}$  is the

share of unskilled labor income spent on textiles and  $m_{ZU} = w_U \frac{\partial Z_U}{\partial w_U}$  is the marginal propensity

of the unskilled to consume leisure. Using (9) to substitute out price changes gives

$$\hat{U} = E_{Uw_U} (\hat{w}_U - \hat{w}_S) + g_U \quad (19)$$



where  $E_{Uw_U} = \theta_{SC} e_{Uw_U}^* - |\theta| e_{UT}^* - m_{Z_U} (\alpha_{LT} \theta_{ST} + \alpha_{UC} \theta_{SC})$  and

$$g_U = - (e_{UT}^* + \alpha_{UT} m_{Z_U}) \pi_T + (e_{UT}^* + e_{Uw_U}^* - m_{Z_U} \alpha_{UC}) \pi_C$$

Assuming (19) is well behaved, the response to an increase in the relative wage of skilled labor will be for the supply of U to fall and that of S to rise. This is a considerable simplification of the process of demographic change, acquisition of education and earnings profiles. Several of the important issues in labor market analysis, such as the role of experience, gender, race are totally ignored.

## Conclusion

The growth in wage inequality in the 1980's has been modeled in this paper as the result of two exogenous factors - trade where the impact is through relative product prices and technical change. Given that the empirical evidence on relative prices suggests that their impact is not pronounced, the focus has been upon technical change. The central finding here is that it is the *industry* rate of change that drives the wage changes rather than the *factor* bias. In particular, the rate of change in computers has to exceed that of textiles. This will generate the inequality observed irrespective of whether it is skilled or unskilled labor saving.

The increase in skill intensity of production cannot be explained by relative price changes and technical change is the sole explanatory factor. At the firm level an increase in the relative wage of the skilled should stimulate substitution against the factor. Technical change can reverse this - though the forms that will permit this are still extensive.

The story suggested by the paper »s as follows: an innovation in computers occur\* which is major in the sense that it saves unskilled labor and thus draws disproportionately skilled labor from the textile sector which is experiencing similar but less pronounced change. As a result the skilled wage is bid up. This in turn leads to an increase in the supply of skilled workers and a drop in the unskilled. Thus the pattern supports the interpretation of a significant innovation dominating the developments of the 1980's.

Is there thus no role for trade? An unsatisfactory aspect of the above is that price changes are considered as exogenous and that effectively the US is being treated as a small open economy. This might be accepted for the textile sector, but not for the computer one. Moving from the model to history, computers in the 1980's experienced an incredible and consistent fall in price. If this was an important element in what happened the skill-intensive sector of the economy, which has been labeled "computers" in the paper then it is possible to distinguish two radically different modes of price formation. In the computer sector prices are dominated by technical change within the US - the economy is substantially closed. Technical change is strong and the upshot is pressure on prices. In contrast the textile sector has prices set internationally and thus has to take on board the export orientation of the developing world. Thus the relatively muted price evidence may actually be the result of two powerful forces working in opposite directions.

## REFERENCES

- BergstradL Jeffrey H.; Cosimano, Thomas F.; Houck, John, W and Sheehan, Richard G (ed), (1994), The Changing Distribution of Income in an Open U.S. Economy, Amsterdam, North-Holland.
- Berman, Eli; Bound, John and Griliches, Zvi (1994), "Changes in the Demand for Skilled Labor withk US. Manufacturing: Evidence from the Annual Survey of Manufactures", Quarterly Journal of Economics. 109, 2, 367-397
- Bhagwati, Jagdish and Kusters, Marvin H (1994) Trade and Wages: Leveling Wages Down? Washington DC. AEI Press
- Borjas, George J and Rainey, Valerie A (1994) "The Relationship between Wage Inequality and International Trade" in Bergstrand (ed)
- burtless, Gary (1990), A Future of Lousy Jobs?: The Changing Structure of U.S. Wages, Washington DC, The Brookings Institution
- Burtless, Gary (1995) "International Trade and the Rise in Earnings Inequality", Journal of Economic Literature.33. 2, 800-816
- Deardorff, Alan V. (19??) "Overview of the Stolper- Sammuelson Theorem", ir Deardorff, Alan V and Stem, Robert *id.* (ed), The Stolper-Sammuelson Theorem: A Golden Jubilee, Ann Arbor, University of Michigan Press.
- De?rdorff, Alan (1991) "Trade Policy of the Reagan Years" in Sahu, Anandi P and Tiacy, Ronald L (ed) The Economic Legacy of the Reagan Years: Euphoria or Chaos?, New York, Praeger.
- DeardorrL Alan V and Hakura, Dalia S (1994) "Trade and Wages - What are the Questions" in Bhagwati and Kusters (ed) Trade and Wages: Leveling Wages Down?
- Findlay, Ronald and Grubert, Harry (1959), "Factor Intensities, Technological Progress and the Terms of Trade". Oxford Economic Papers, 11, 1, 11-121
- Freeman, Richard, B. (1995) "Are Your Wages Set in Beijing?" Journal of Economic Perspectives 9, 3, 15-3?.
- Gregg, Paul and Maclin, Stephen (19??) "Is the UK Rise in Inequality Different?" in BarreU, Ray (ed), The UK Labour Market: Comparative Aspects and Institutional Developments, Cambridge, Cambridge University Press.
- Jones Ronald W (1965) "The Structure of Simple General Equilibrium Models JPE 73557-57 Juhn chinhui Murphny Kevin M and Pierce Brooke(1993) "Wage Inequality and the rise in return to skill JPE,101,31,410,442

Katz, Lawrence F and Murphy, Kevin M (1992) "Changes in Relative Wages, 196J-1987: Supply and Demand Factor" Quarterly Journal of Economics. 107. 1. 35-73.

Kosters, Marvin H (1994), "An Overview of Changing Wage Patterns in the Labour Market" in Bhagwati and Kosters (ed), *Trade and Wages: Leveling Down?*

Krueger, Alan B. (1993); "How Computers have changed the Wage Structure. Evidence from Microdata, 1984-1989". Quarterly Journal of Economics. 108, 1,33-60

Lawrence, Robert Z and Slaughter, Matthew J. (1993), "International Trade and American Wages in the 1980s: Giant Sucking Sound or Small Hiccup", Brookings Papers on Economic Activity. Microeconomics 2. 161-226

Levy, Frank and Murnane, Richard J. (1992), "US Earnings Levels and Earnings Inequality: A Review of Recent Trends and Proposed Explanation". Journal of Economic Literature, 30. 1333-1381

Martin, John P and Neary, J. Peter, (1980), "Variable Labour Supply and the Pure Theory of International Trade", Journal of International Economics. 10, 549-559

Mincer, Jacob (1993) "Human Capital, Technology, and the Wage Structure: What do Time Series Show?" in Mincer, Jacob, *Studies in Human Capital: Collected Essays of Jacob Mincer*, Aldershot, Edward Elgar.

Murphy, Kevin M and Welch, Finis (1992), "The Structure of Wages", Quarterly Journal of Economics 107, 1, 285-326

Murphy, Kevin and Welch, Finis (1991), "The Role of International Trade in Wage Differentials", in Kosters, Marvin H (ed), *Workers and Their Wages: Changing Patterns in the United States*, Washington DC. AEI Press

Nelson, Charles T. (1994) "Levels and Changes in the Distribution of U.S. Income", in Bergstrand (ed)

Richardson, J David (1995) "Income Inequality and Trade: How to think, what to Conclude", Journal of Economic Perspectives, 9, 3, 33-55.

Sachs, Jeffrey D. and Shatz, Howard J. (1994), "Trade and Jobs in U.S. Manufacturing", Brookings Papers on Economic Activity. 1, 1-84

Trefler, Daniel (1993) "Trade Liberalization and the Theory of Endogenous Protection: An Econometric Study of US Import Policy", Journal of Political Economy 101, 1, 138-160

Wood, Adrian (1995), "How Trade Hurt Unskilled Workers", Journal of Economic Perspectives. 9.3.57-80.

Wood, Adrian (1994), *North-South Trade, Employment and Inequality: Changing Fortunes in a Skill-Driven World*. World, Oxford, Clarendon Press.

Woodland, AD. (1982) International Trade and Resource Allocation, Amsterdam. North Holland.

The aggregate elasticity of substitution is given by  $\sigma = \lambda \theta (\sigma_{SF} + \sigma_D)$ , see Jones (1965).

Computers are being modeled in this paper as consumer **and not** investment goods. Again the objectives of clarity and realism contradict one **another**.

Figure 1  
The Determination of  $\hat{b}_U^{MAX}$

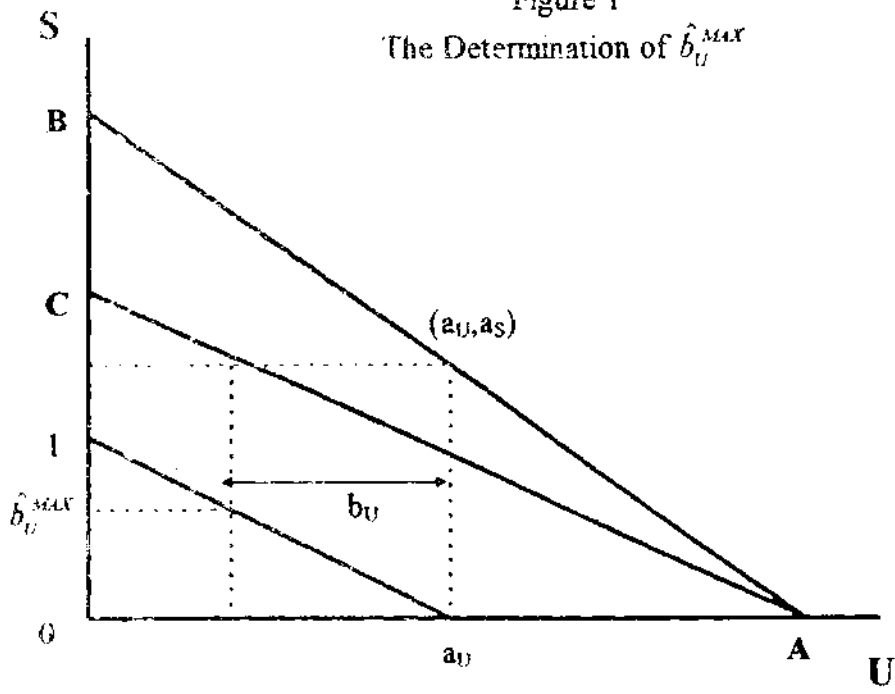


Figure 2  
The Technical Change Frontier

Hicks neutrality

