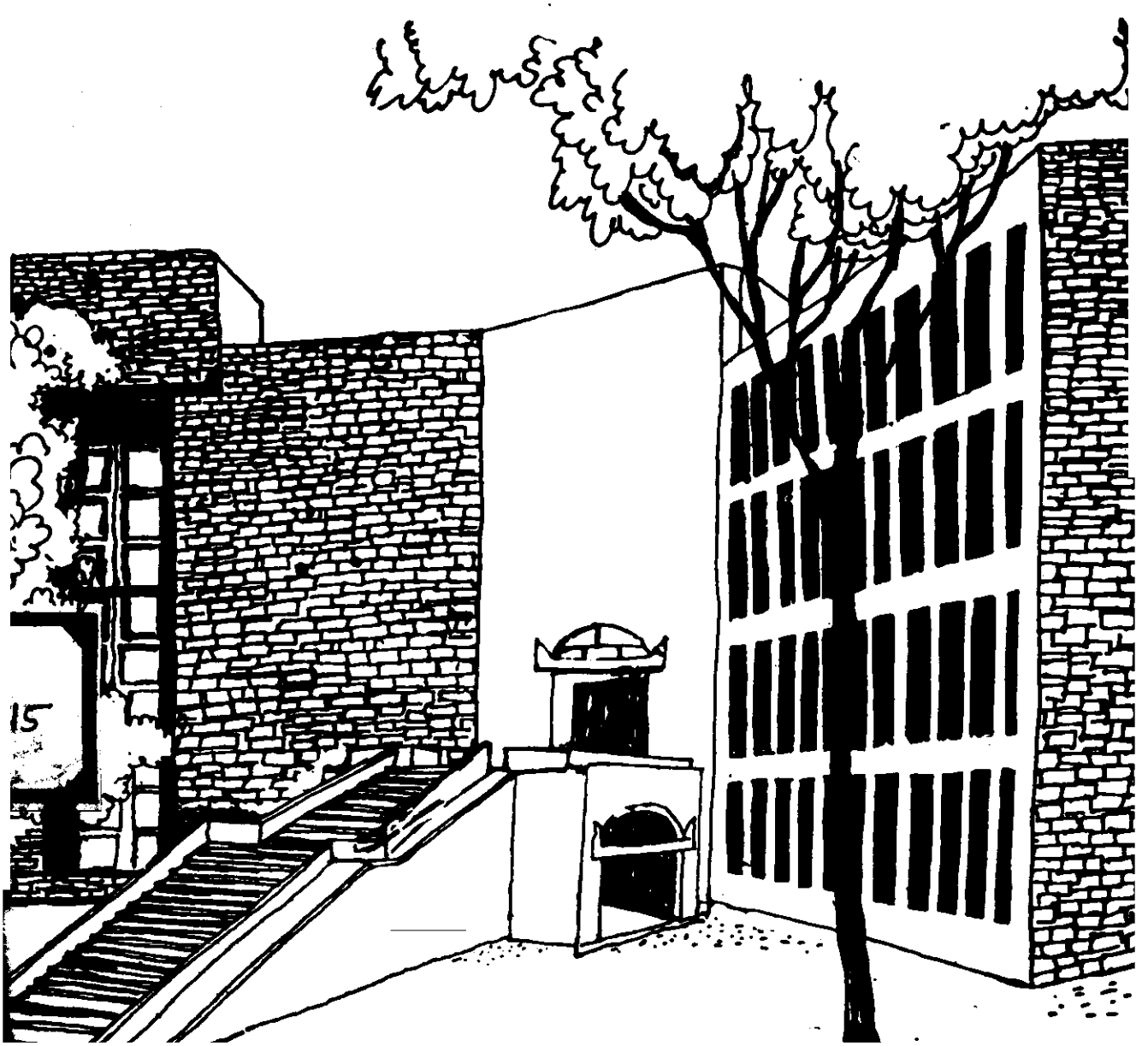
IIM
AHMEDABAD

W. P. 715

Working Paper



WAGE ELASTICITY OF LABOUR SUPPLY FOR MALES AND FEMALES

By

Ravindra H. Dholakia

W P No. 715

November, 1987

INDIAN INSTITUTE OF MANAGEMENT
AHMEDABAD-380015
INDIA

WAGE ELASTICITY OF LABOUR SUPPLY FOR MALES AND FEMALES

- Ravindra H. Dholakia
IIM, Ahmedabad

ABSTRACT

Male-female wage differential in the Indian economy can be explained satisfactorily by the model of wage discriminating monopsony provided that the wage elasticities of supply of male and female labour are significantly different. In the present paper individual labour supply functions are derived by optimizing the family utility function. The corresponding elasticity functions are then examined for their implications. It is shown that infinite elasticity of labour supply implies unrealistic assumptions about the marginal utilities of money income and leisure. It is also argued that under the prevalent family system in India, the wage elasticity of labour supply for males is likely to be higher than the one for females. The observed phenomenon of female workers being paid a lower wage rate than male workers of equal skill, qualification and experience can, therefore, be explained by the model of wage discriminating monopsony in the labour market.

WAGE ELASTICITY OF LABOUR SUPPLY FOR MALES AND FEMALES

- Ravindra H. Dholakia
IIM, Ahmedabad

1. Background

Persistence of male-female wage differential is a great cause of concern and has become a serious issue for ensuring equity between the two sexes. Status of the women, their role in the society and their well-being are systematically linked with such a differential. Extending the models of Becker (1957), Arrow (1972) and Alexi (1973), it is argued that females are being discriminated against in the labour market. It is also believed that there are prejudices and preferences against employing females on the part of employers so much so that they are prepared to sacrifice some of their profits to uphold their prejudices. Thus, male-female wage differential gets explained through sex discrimination. All these models are based on explicit or implicit assumption of perfectly competitive labour market and would, therefore, imply deviation from the profit-maximizing behaviour on the part of the entrepreneur.

With perfect competition, if the labour units are homogeneous in the sense that skill, qualification and experience of the male and female workers are the same, the difference between their wages can arise either due to the relative disutilities associated with the jobs they are doing or due to the prejudices and preferences of the employers. The other explanation available for persistant wage differential between sexes is the job discrimination hypothesis (Bermann and Adelman, 1973). Such an explanation, however, implies differences in the marginal product of male and female workers, once we assume perfect competition. The male-female wage differentials are, therefore, widely used for measuring changes in quality of labour to take care of the changing sex-ratio of the labour force (see, Denison, 1985 and Dholakia B.H., 1974). It is, however, found that the marginal productivity at aggregate level is not significantly different for male and female workers in India (Dholakia R.H., 1986). The job-discrimination hypothesis is, therefore, not a major explanation of the existing male-female wage differential in India.

As an alternative to the sexdiscrimination hypothesis which implies an implausible objective function for the employer it is suggested that the model of wage discriminating monopsony can provide a reasonably good explanation for the casually

observable phenomenon in the Indian labour market (Dholakia R.H., 1987). It is argued that the employer treats the men and women workers, who are homogeneous in all respects except supply characteristics, as distinct groups. Their cross-memberships are naturally ruled out. The monopsony power enjoyed by the employer permits him, therefore, to exploit the differing supply characteristics of these two groups to his advantage. In other words, his profit-maximizing behaviour would lead him to pay a lower wage rate to the group whose wage elasticity of supply is lower than the other group. In the present paper we make an attempt to derive the wage elasticity functions for male and female workers and examine the implications of their relative magnitudes.

2. Labour Supply Functions

In order to derive the wage elasticity of supply equation for male and female workers, let us first of all consider their labour supply functions. The decision to supply labour in the market, whether by a man and/or a woman, is a family decision taken jointly so as to maximize the welfare of the family. Let us consider the family utility (U_H) function with only three arguments for the sake of simplicity in exposition. These arguments could be the leisure time for the male (L_1), the leisure time for the female (L_2) and the money income of the family (M). Let us further assume that the money income of the family is

derived only out of the wages. Let W_1 be the wage rate for males and W_2 be the wage rate for the females. The supply of labour for the male (S_1) or the female (S_2) can be derived as the difference between the effective total time available for outside employment (T_1 for the male and T_2 for the female) and the actual time consumed for leisure. Thus,

$$U_H = f(M, L_1, L_2) \quad \ldots\ldots \quad (1)$$

$$S_1 = T_1 - L_1 \text{ and } S_2 = T_2 - L_2 \quad \ldots. \quad (2)$$

The budget constraint is given by

$$M = W_1 S_1 + W_2 S_2$$

i.e. $$M = W_1 T_1 + W_2 T_2 - W_1 L_1 - W_2 L_2 \quad \ldots\ldots \quad (3)$$

Assuming that the household maximizes its utility as a single entity subject to the budget constraint given in equation (3), we can derive the demand functions for leisure both for the male and the female. Let us take the Cobb-Douglas function to represent U_H for simplicity in exposition. Thus,

$$\text{Max. } U_H = \Phi(M, L_1, L_2) = A.M^{a} L_1^{a_1} L_2^{a_2}$$

$$\text{Subject to } M = W_1 T_1 + W_2 T_2 - W_1 L_1 - W_2 L_2$$

Using Lagrange's Multiplier, we can write

$$\text{Max. } V = A.M^{a} L_1^{a_1} L_2^{a_2} + \lambda (M - W_1 T_1 - W_2 T_2 + W_1 L_1 + W_2 L_2).$$

Differentiating V with respect to M, L_1, L_2 and λ, we get

$$\frac{\partial V}{\partial M} = a\,(V/M) + \lambda \qquad \ldots\ldots \qquad (4)$$

$$\frac{\partial V}{\partial L_1} = a_1(V/L_1) + \lambda\, W_1 \qquad \ldots\ldots \qquad (5)$$

$$\frac{\partial V}{\partial L_2} = a_2(V/L_2) + \lambda\, W_2 \qquad \ldots\ldots \qquad (6)$$

$$\frac{\partial V}{\partial \lambda} = M - W_1T_1 - W_2T_2 + W_1L_1 + W_2L_2 \qquad \ldots\ldots \qquad (7)$$

In order to find values of L_1, L_2 and M which would maximize the value of V, we must equate equations (4) to (7) to zero and solve them simultaneously. Assuming that the second order conditions for obtaining the maxima are fulfilled, we can find the solution for L_1 and L_2 which would maximize the household utility function subject to the given budget constraint.

For maxima, we equate equations (4) to (7) to zero :

$$a(V/M) + \lambda = 0 \qquad \ldots\ldots \qquad (8)$$

$$a_1(V/L_1) + \lambda W_1 = 0 \qquad \ldots\ldots \qquad (9)$$

$$a_2(V/L_2) + \lambda W_2 = 0 \qquad \ldots\ldots \qquad (10)$$

$$\text{and, } M = W_1T_1 + W_2T_2 - W_1L_1 - W_2L_2 \qquad \ldots\ldots \qquad (11)$$

From (8) and (9), we get,

$$\frac{a}{a_1} \cdot \frac{L_1}{M} = \frac{1}{W_1}$$

$$\text{i.e. } \frac{a.W_1L_1}{a_1} = M \qquad \ldots\ldots \qquad (12)$$

Similarly from (8) and (10), we get,

$$\frac{a}{a_2} \cdot \frac{L_2}{M} = \frac{1}{W_2}$$

i.e. $\frac{a.W_2L_2}{a_2} = M$ ..... (13)

From (12) and (11), we get,

$$\frac{aW_1L_1}{a_1} = W_1T_1 + W_2T_2 - W_1L_1 - W_2L_2$$

$$\therefore aW_1L_1 = a_1W_1T_1 + a_1W_2T_2 - a_1W_1L_1 - a_1W_2L_2$$

$$\therefore (a+a_1)\, W_1L_1 = a_1W_1T_1 + a_1W_2T_2 - a_1W_2L_2 \quad ..... \quad (14)$$

Similarly, from (13) and (11), we get,

$$(a + a_2)\, W_2L_2 = a_2W_1T_1 + a_2W_2T_2 - a_2W_2L_2 \quad ..... \quad (15)$$

Solving (14) and (15) simultaneously, we get the leisure demand functions for L_1 and L_2 :

$$L_1 = \frac{a_1(W_1T_1 + W_2T_2)}{W_1(a + a_1 + a_2)} = \frac{a_1}{b}\left(T_1 + \frac{W_2}{W_1}T_2\right) \quad ... \quad (16)$$

$$\text{and } L_2 = \frac{a_2(W_1T_1 + W_2T_2)}{W_2(a+a_1+a_2)} = \frac{a_2}{b}\left(\frac{W_1}{W_2}T_1 + T_2\right) \quad ... \quad (17)$$

where, $a + a_1 + a_2 = b$ is the degree of homogenity of the household utility function.

Leisure demand equations (16) and (17) can be used with equations (2) to get the labour supply functions for the male and female :

$$S_1 = T_1 - L_1 = \frac{a + a_2}{b}T_1 - \frac{a_1}{b}\cdot\frac{W_2}{W_1}\cdot T_2 \quad ... \quad (18)$$

$$\text{and } S_2 = T_2 - L_2 = \frac{a + a_1}{b} T_2 - \frac{a_2}{b} \cdot \frac{W_1}{W_2} \cdot T_1 \quad \ldots\ldots(19)$$

In these labour supply functions, a, a_1, a_2 and b are the parameters from the family utility functions. So long as the taste and preferences of the household regarding the leisure of the male and the female and the money income remain the same, these parameters can be taken as constants. T_1 and T_2 can be considered as parameters if they are thought to be independent of the wage levels. The two supply functions derived in equations (18) and (19) indicate that the labour supply is directly related to the own wage rate and inversely related to the wage rate of the spouse. Thus, higher wage rate offered to the male in the family would lead to a decline in the female labour supply other things remaining the same.

3. Wage Elasticity Functions

Wage elasticity of supply of labour for the male (e_1) and the female (e_2) can be defined as :

$$e_1 = \frac{\partial S_1}{\partial W_1} \cdot \frac{W_1}{S_1} \quad \text{and } e_2 = \frac{\partial S_2}{\partial W_2} \cdot \frac{W_2}{S_2} \cdot$$

From the labour supply functions in (18) and (19), we get

$$e_1 = \frac{1}{\frac{W_1}{W_2} \cdot \frac{a + a_2}{a_1} \cdot \frac{T_1}{T_2} - 1} \quad \ldots\ldots \quad (20)$$

$$\text{and } e_2 = \frac{1}{\frac{W_2}{W_1} \cdot \frac{a+a_1}{a_2} \cdot \frac{T_2}{T_1} - 1} \qquad \ldots\ldots\ldots \quad (21)$$

As can be readily observed from the equations (20) and (21), the wage elasticities of labour supply for male and female are not constant with respect to the own wage rate. Rather they are decreasing functions of own wage rate. On the other hand, the wage rate of spouse is directly related with the wage elasticity of labour supply for male and female. Thus, higher is the wage rate for male, lower is the wage elasticity of male labour supply and higher is the wage elasticity of female labour supply. If the wage rate of the male is lower, the wage elasticity of female labour supply would also be lower but the one for male labour supply would be higher.

On the basis of equations (20) and (21), moreover, it is interesting to examine the implications of various possibilities. Simplistic models of dualistic development assume that the labour supply curve is infinitely elastic for the economy as a whole. This can happen if and only if all individual supply curves are infinitely elastic at a given wage rate. Imposing this type of restriction on (20) and (21), we get

$$\frac{a + a_1}{a_2} = \frac{a_1}{a + a_2}$$

$$\therefore \quad a^2 + aa_1 + aa_2 + a_1a_2 = a_1a_2$$

$$\therefore \quad a.b = 0 \qquad \ldots\ldots \qquad (22)$$

Thus, (22) which is implied by infinitely elastic labour supply curve necessitates that either a or b or both must be zero. Thus, either the marginal utility of money income must be zero to make a = 0 or the marginal utility of leisure of the male or female must be negative to make b = 0. Both these implications are unrealistic for any type of society. Thus, infinitely elastic labour supply curve is not a plausible assumption consistent with the utility maximizing behaviour of the individuals.

As already argued in section 1 above, the wage discriminating monopsony model can provide reasonably good explanation for the casually observed phenomenon of male-female wage differential provided that wage elasticity of male labour supply (e_1) is higher than the one for female labour supply (e_2) at a given wage rate. From (20) and (21), the implication of such an inequality is :

$$e_1 > e_2 \quad \text{iff}$$

$$\frac{W_1}{W_2} \cdot \frac{T_1}{T_2} \cdot \frac{a + a_2}{a_1} - 1 < \frac{W_2}{W_1} \cdot \frac{T_2}{T_1} \cdot \frac{a + a_1}{a_2} - 1.$$

$$\text{i.e.} \quad \frac{a_2(a + a_2)}{a_1(a + a_1)} < \frac{W_2^2}{W_1^2} \cdot \frac{T_2^2}{T_1^2}$$

Since we are comparing e_1 and e_2 at a given wage rate, $W_1 = W_2$. Usually the toil-time for female (T_2) is less than that for male (T_1) so that $T_2/T_1 \leq 1$.

$\therefore e_1 > e_2$ iff

$$\frac{a_2(a+a_2)}{a_1(a+a_1)} < \frac{T_2^2}{T_1^2} \leq 1.$$

i.e. $a_2 a + a_2^2 < a_1 a + a_1^2$

i.e. $a_2 a + a_2^2 - a_1 a - a_1^2 < 0$

i.e. $a(a_2 - a_1) + (a_2 + a_1)(a_2 - a_1) < 0$

i.e. $b(a_2 - a_1) < 0$ ..... (23)

Thus, $e_1 > e_2$ if and only if (23) holds. The implication of equation (23) holding is that either $b<0$ or $a_2 < a_1$. As we have already seen, it is unrealistic to assume that $b < 0$, since it implies negative marginal utility for any one or more of leisure of male and female or money income. Thus $e_1 > e_2$ iff $a_2 < a_1$. In other words, the monopsonist would find it profitable to pay a lower wage rate to the female workers than the male workers provided the male leisure elasticity of family welfare (a_1) is higher than the female leisure elasticity of family welfare (a_2) The socio-cultural values prevalent in the system are captured in our model by these leisure elasticities. In the male-dominant society, the family welfare functions are likely to be such that the elasticity condition stated here is fulfilled.

4. Variable Toil-Time and Wage Elasticities of Labour Supply

So far we have assumed that the toil time of male (T_1) and female (T_2) are independent of the wage rates they are getting. Since we have defined the toil time as the effective time available for outside employment, even these two parameters reflect the socio-cultural values prevailing in the system. If the female usually carries the major load of looking after the household and taking care of the other members of the household like children and elders, it is natural that the effective time available to her for outside employment would be considerably less than what is available to the male. Thus, the toil time for female (T_2) would in all probability be less than that for male (T_1) in the male dominating society. This by itself, however, does not have any negative impact on the wage elasticity of female labour supply. If at all, it tends to increase their labour elasticity.

More interesting question in regard to the toil time is whether it is independent of the wage rates. It is a matter of casual observation again to seek the answer. If wage rate increases considerably people do take decision of hiring maid-servants to help in carrying out the routine household work so as to be able to increase the effective time available for outside employment. The males also tend to stretch themselves and accept some part time job or do the overtime if the wage-rate is attractive. Thus, there is reason to expect that both T_1 and T_2 are not totally

independent of wage rates. They are, in fact, increasing functions of the own wage rates and perhaps decreasing functions of the wage rates of the spouse. If we introduce such functional relationships into the wage elasticity functions for male and female labour supply, they get modified as under:

$$e_1 = \frac{\partial S_1}{\partial W_1} \cdot \frac{W_1}{S_1}$$

$$= \left[\frac{a + a_1}{b} \cdot \frac{\partial T_1}{\partial W_1} - \frac{a_1 W_2}{b}\left(\frac{W_1 \partial T_2/\partial W_1 - T_2}{W_1^2}\right)\right] \cdot \frac{W_1}{\frac{a + a_2}{b} T_1 - \frac{a_1}{b} \cdot \frac{W_2}{W_1} \cdot T_2}$$

$$= \frac{(a + a_2) W_1^2 \partial T_1/\partial W_1 - a_1 W_2 W_1 \partial T_2/\partial W_1 + a_1 W_2 T_2}{(a + a_2) W_1 T_1 - a_1 W_2 T_2}$$

$$= \frac{(a + a_2) W_1 T_1 (W_1/T_1)(\partial T_1/\partial W_1) - a_1 W_2 T_2 (W_1/T_2 \cdot \partial T_2/\partial W_1 - 1)}{(a + a_2) W_1 T_1 - a_1 W_2 T_2}$$

$$\therefore e_1 = \frac{\frac{a + a_2}{a_1} \cdot \frac{W_1}{W_2} \cdot \frac{T_1}{T_2} (ET_1/EW_1) - (ET_2/EW_1) + 1}{\frac{a + a_2}{a_1} \cdot \frac{W_1}{W_2} \cdot \frac{T_1}{T_2} - 1} \quad .. (24)$$

Similarly,

$$e_2 = \frac{\frac{a + a_1}{a_2} \cdot \frac{W_2}{W_1} \cdot \frac{T_2}{T_1} (ET_2/EW_2) - (ET_1/EW_2) + 1}{\frac{a + a_1}{a_2} \cdot \frac{W_2}{W_1} \cdot \frac{T_2}{T_1} - 1} \quad .. (25)$$

Where ET_1/EW_1, ET_2/EW_1, ET_2/EW_2 and ET_1/EW_2 represent the wage elasticities of toil times for male and female. ET_1/EW_1 and ET_2/EW_2 are direct wage elasticities of toil-time which are likely to be positive; whereas ET_1/EW_2 and ET_2/EW_1 are cross elasticity of toil time which are likely to be negative. Thus, the elasticity functions as given in (20) and (21) above get modified to respectively (24) and (25) when we consider wage responsiveness of toil time for male and female.

As it can be observed, the denominator of (20) and (24), and (21) and (25) are the same. The effect of variable toil time for male and female workers is confined to the numerators alone. It is obvious from these equations that variability of toil time tends to increase the wage elasticity of labour supply for both male and female since the direct wage elasticities of the toil time are most likely to be positive and the cross wage elasticities of the toil time are most likely to be negative. The numerator of the wage elasticity of labour supply would be larger with variable toil time than otherwise.

It is worth noting here that between the two direct wage elasticities of toil time, the one for male is likely to be higher than the one for female in a male dominating society since wage incentive can induce the males to sacrifice marginally their involvement in the family matters. They in any case do not have the primary responsibility of looking after routine household matters

which consume a lot of time in the Indian society. They can, therefore, effectively adjust their toil time in response to wage rate changes. Females, on the other hand, do not enjoy the same extent of flexibility. Their toil time is more or less dictated by the requirements of looking after the routine household duties which are relatively more time consuming. Small changes in their wage rates, therefore, cannot evoke any remarkable response in their toil time. This has an effect of making the wage elasticity of female labour less than the one for male labour.

It is also important to note that, of the two cross wage elasticities of toil time, the one for male toil time with respect to the wage rate for females is likely to be much lower than the cross elasticity of female toil time with respect to the male wage rate. This is because, in the Indian society, the primary responsibility of earning bread for the family rests with the male and his efforts are considered invariant with respect to female's efforts to supplement the household income. On the other hand, the females are not expected to be the major bread winners in the Indian families if males are around. As a consequence of all this, again we find that the wage elasticity of labour supply is more for males than for females.

5. Concluding Remarks

Family system imposes certain constraints on the behaviour of its members since it implies joint utility maximization

rather than individual utility maximization. The norms and values on which the family is formed play a major role in determining the behaviour pattern of its members in several directions. Labour supply by its members is one such direction. The family system with all the norms and values can effectively determine the optimizing supply response of males and females with respect to their wage rates. The nature and type of the family system that prevails in India are most likely to result in a higher labour supply response to the wage-rate for males than for females. This, in turn, could be exploited by the employers to their advantage by paying lower wages to the females than the males for the same work when both are otherwise identical in all respects. Such a wage discriminating monopsonistic behaviour on the part of the employers in India is justified because the labour market in India is far from perfectly competitive. The persistent male-female wage differential in India may not necessarily be the symptom of sex-discrimination but it could be the result of labour market imperfection coupled with differing wage elasticities of labour supply for males and females.

References

Alexis M. (1973) : "A Theory of Labour Market Discrimination With Interdependent Utilities", American Economic Review, May.

Arrow K.J. (1972) : "Some Models of Racial Discrimination in the Labour Market", in Pascal (ed) : Racial Discrimination in Economic Life, Lexington.

Becker G.S. (1957) : The Economics of Discrimination, University of Chicago Press, Chicago.

Bergmann B.R. and I. Adelman (1973) : "The Economic Role of Women", American Economic Review, September.

Denison E.F. (1985) : Trends in American Economic Growth - 1929-82, The Brookings Institute, Washington D.C.

Dholakia, B.H. (1974) : The Sources of Economic Growth in India, Good Companions, Baroda.

Dholakia, R.H. (1986) : "On Estimating Women's Contribution to National Product," Manpower Journal, No. 3 (Forthcoming)

Also Working Paper No.594, Indian Institute of Management, Ahmedabad.

Dholakia, R.H. (1987) :"Wage Differential Between Sexes in India - An Explanation", Working Paper No.711 , Indian Institute of Management, Ahmedabad.