WP 2002-15
June 2002

Working Paper

Department of Applied Economics and Management
Cornell University, Ithaca, New York 14853-7801 USA

MALE WAGES AND FEMALE WELFARE: PRIVATE MARKETS, PUBLIC GOODS, AND INTRAHOUSEHOLD INEQUALITY

Suman Ghosh
Ravi Kanbur

Male Wages and Female Welfare: Private Markets, Public Goods, and Intrahousehold Inequality

Suman Ghosh
ITAM Business School

and

Ravi Kanbur
Cornell University

May 2002

Contents

Abstract

Can an increase in male wages make the woman in the family, or even the whole family, worse off? On the face of it, this seems paradoxical, since the overall resources of the household are improved by the wage increase. This paper shows that the chain reactions set in motion by such a wage increase in labor markets can end up by making not only the woman but the whole family worse off because of the interactions between intrahousehold public goods, extrahousehold public goods, and the outcomes in conventional labor markets. The key is specialization of males and females in different activities, the public goods characteristics of some of these activities, and the effects of the outside options defined by these activities on intrahousehold bargaining.

We thank Indraneel Dasgupta for his comments, and The Pew Charitable Trusts for financial support .

1. Introduction

Can an increase in male wages make the woman in the family, or even the whole family, worse off? On a conventional household model, this seems paradoxical. The overall resources of the household have been improved. A unitary household, one which acts as though it were maximizing a single utility function, would only respond to such a wage increase if it were made better off.[1] But evidence is increasingly bringing into question the standard unitary model (see Alderman et al. (1995)), and there has been vigorous development of both non-cooperative and cooperative bargaining models of household decision making and resource allocation at theoretical and empirical levels (see for Kooreman and Kapteyn (1990,1992), Haddad and Kanbur (1990,1992,1993), Bourguignon and Chiappori (1992), Browning and Chiappori (1998), Manser and Brown (1980)). In these types of models, some intrahousehold public good defines the household, but decisions on the supply of this public good are what take the model out of the unitary realm.

At the same time, there is considerable evidence, especially in developing countries, that standard household models, of the type put forward for example in Singh, Squire and Strauss (1986), do not capture the male-female specialization of activities that is commonly observed both inside and outside the household. Women typically contribute more to household activities than do males. Outside the household, men work in activities that link more directly to private markets. Thus men work in labor markets or on cash crops, women work on food crops to feed the household, or in activities with other women which have strong public goods and common property features (example

[1] See Becker (1981) for models on the unitary household framework.

Dasgupta (1993), Jodha (1990), Hart (1980), Tinker (1976), Chambers, Saxena and Shah (1989)).

When these real world characteristics are brought together, an increase in male wages can set off a chain reaction which can immiserize not only the woman in the family, but the man as well. The object of this paper is to develop a model that captures intrahousehold bargaining, intrahousehold and extrahousehold public goods, and activity specialization by males and females. As argued above, these are all features of any realistic description of households, particularly in poor rural communities. In such a setting, we investigate the impact of labor market improvements on the wellbeing of the woman and the man in a household, and find paradoxical, immiserizing effects of an increase in male wages.[2]

The plan of the paper is as follows. Section 2 sets up the basic model that will be the workhorse of the analysis in this paper. Section 3 considers the consequences of an increase in male wages on female and on family welfare when bargaining power is held constant. Section 4 endogenizes the sharing rule by relating it to outside options. Section 5 concludes with a discussion of areas for further research.

[2] Thus the issues studied in this paper relate to a small but growing literature on the effect of interhousehold inequality on the provision of public goods. See Bardhan and Dayton-Johnson (1999) and Bardhan, Ghatak and Karaivanov (2000).

2. Model

We consider a village of n identical households. Each household i has two members, m_i and f_i. Each agent k_i, ($k_i \in \{m_i, f_i\}$), allocates time to the production of a domestic public good x_{ki}. In addition, the male allocates his time to the labor market (y_{mi}), and the female to the community public good (y_{fi}). We normalize the time endowment of each agent as 1 unit. Thus $x_{mi} + y_{mi}=1$ and $x_{fi} + y_{fi} =1$.

The domestic public good is produced with the production function $H(x_{mi}+x_{fi})$ where $H'>0$ and $H''<0$. The male works in a competitive labor market at a wage rate w but does not contribute to the community public good. Thus the total income generated from the labor market by the male member is given by wy_{mi}. The female devotes her time to an activity which has common property characteristics. The output of the common property activity depends on the contribution of all females in the village according to the production function G(Y), where $Y=\sum_{i=1}^{n} y_{fi}$, and $G'>0$, $G''<0$. Here Y is the sum of contributions of all the female individuals in the village, y_{fi} is i's contribution and Y_{-i} is the sum of all female individuals except i.

When the male works x_{mi} in the household and y_{mi} in the private sector labor market outside the household, and the female works x_{fi} in the household and y_{fi} in the common pool activity outside the household, total household income is given by:

$Z_i = H(x_{mi} + x_{fi}) + G(y_{fi} + Y_{-i}) + wy_{mi}$.

The first component is the output of the intrahousehold public good, the second is the output of the extrahousehold public good, and the third is the private return from the labor market.

We assume that total domestic consumption is divided in the proportions s^m to the male and s^f =1- s^m to the female. These proportions are initially assumed to be given exogenously, and then it is relaxed subsequently. With this allocation rule, and given the behavior of other agents, the male and the female decide on their allocation of time between intrahousehold activity and extrahousehold activity to maximize a standard utility function.

The individual optimization problems and first order conditions are then given as follows.

Male

$$\pi_M = \underset{x_{mi}}{Max}\, s^m \{H(x_{mi} + x_{fi}) + G(y_{fi} + Y_{-i}) + w(1 - x_{mi})\}] \tag{A}$$

FOC:

$$x_{mi} : H'(x_{mi} + x_{fi}) = w \tag{1}$$

Female

$$\pi_F = \underset{y_{fi}}{Max}(1 - s^m)\{H(x_{mi} + 1 - y_{fi}) + G(y_{fi} + Y_{-i}) + wy_{mi}\} \tag{B}$$

FOC:

$$y_{fi} : G'(y_{fi} + Y_{-i}) = H'(x_{mi} + x_{fi}) = w \tag{2}$$

$x^*_{mi}(w,n), x^*_{fi}(w,n), y^*_{mi}(w,n), y^*_{fi}(w,n)$ are the labor supply functions.

Within a household, there is interdependency because of the intrahousehold public good- the optimal choices of the male are a function of the choices of the female, and vice versa. We take the non-cooperative route to finding a household equilibrium in time allocations. Thus equations (1) and (2) solve jointly for the Nash Equilibrium values of x_{mi}, y_{mi}, x_{fi}, y_{fi}, for a typical household in the village. We assume that a Nash Equilibrium exists, which it will since our assumptions on tastes and technology guarantee that the best response functions are continuous. Notice that these are also the first order conditions for joint maximization of total household income. Our focus is on what happens to time allocation and welfare when labor market conditions improve. The next section takes up this story.

3. Male Wages and Family Welfare

In this section we study some comparative static properties of the equilibrium derived. Specifically, we study the effects of an exogenous increase of the wage rate on the allocation decisions of the household and ultimately on welfare. In this section s_m and s_f are assumed to be given exogenously- thus individual welfare and family welfare moves in the same direction. Moreover we choose $s_m = s_f = 1/2$. Initially we take the contributions of the other female members in the village, i.e Y_{-i}, as fixed. Then as a next step we endogenize Y_{-i}.

For analytical simplicity we write equations (1) and (2) in the following fashion.

$$x_{mi} : (x_{mi} + x_{fi}) = h(w) \tag{3}$$

$$y_{fi} : (y_{fi} + Y_{-i}) = g(w) \tag{4}$$

where h(.) and g(.) are the inverse functions of H´(.) and G´(.) respectively.

From our specifications so far, we get the following result which is stated in the Proposition below.

<u>Proposition 1</u> : *An exogenous increase in the male wage rate has the following consequences for household i, holding Y_{-i} constant.*

(i) *Total time contribution to the domestic public good declines.*

(ii) *Each female devotes less time to the common pool resource.*

(iii) *There is a welfare improvement for both the male and the female.*

Proof: (i) This can be seen from (3) above. Basically, the total time devoted to the domestic public good is $(x_{mi} + x_{fi})$. And $h'(w) = 1/H''$. Since we know that H''<0, it follows that $h'(w)$ <0. Thus it is clear that the total contribution to the domestic public good declines.

(ii) This result is obtained from (4) above. As in (i), we get that $g'(w) = 1/G''$, and similarly $g'(w)$<0. Now since Y_{-i} is fixed, the female's contribution to the commons decreases for an exogenous wage increase.

(iii) From the expressions (A) and (B), we get that

$$p_F = p_M = \frac{1}{2}p = \frac{1}{2}[H(h(w)) + G(g(w)) + w[2 - h(w) - g(w) + Y_{-i}]]$$

By differentiating with respect to w we get,

$$\frac{1}{2}\frac{\partial p}{\partial w} = \frac{1}{2}[2 - h(w) - g(w) + Y_{-i}] > 0. \ \#$$

Next we endogenize Y_{-i} to find the effect on each individual household that is generated by the other households in the village. We consider symmetric Nash-Cournot equilibria in the common pool game. Hence $y_{fi} = \frac{Y}{n} = \frac{y_{fi} + Y_{-i}}{n}$, or $y_{fi} = \frac{Y_{-i}}{(n-1)}$. From

(4) we get $ny_{fi} = g(w)$. Thus $Y_{-i} = \frac{n-1}{n} g(w)$. Now we calculate the resultant welfare effect of a wage increase on the female and the male agent due to this transformation. The indirect utility functions for the agents becomes $\frac{1}{2}\boldsymbol{p}$, where

$$\boldsymbol{p} = H(h(w)) + G(g(w)) + w[2 - h(w) - g(w) + \frac{n-1}{n} g(w)] \tag{5}$$

Differentiating (5) with respect to w,

$$\frac{1}{2}\frac{\partial \boldsymbol{p}}{\partial w} = \frac{1}{2}[-g(w)\{(e_g)(\frac{n-1}{n}) + \frac{1}{n}\} + 2 - h(w)] \tag{6}$$

where, $$e_g = \frac{-wg'}{g} \tag{7}$$

is the elasticity of the female's common property labor contribution to changes in the male private sector wage.

Further differentiating (6) with respect to 'n' we get:

$$\frac{1}{2}\frac{\partial^2 \boldsymbol{p}}{\partial w \partial n} = \frac{1}{2}\frac{g(w)(1-e_g)}{n^2} \tag{8}$$

Hence, $\frac{1}{2}\frac{\partial^2 \boldsymbol{p}}{\partial w \partial n}$ <0 if e_g >1, and there exists a critical value of n, which we denote as n', such that $\frac{\partial \boldsymbol{p}}{\partial w} > (<) 0$ for $n <(>)\ n'$, (9)

which leads to our second Proposition.

Proposition 2 **:** *If the male wage elasticity of female common property labor contribution is greater than 1, and if the number of households in the village is large enough, an increase in the male wage makes each household worse off.*

The reasoning behind the seemingly paradoxical outcome, that an increase in wages makes households worse off, is the following. The household takes the strategy of the other individuals in the village as given in the Nash Equilibrium. But the nature of the common pool resource is such that it is dependent on the contribution of the other (n-1) households in the village. The cost to each household of the decreased time in the common property resource is increasing in n. Hence for n sufficiently large the negative impact from the common property resource will offset the benefits from the wage increase. The condition $e_g>1$ in the Proposition ensures that the labor supply for the female is responsive enough for this to happen.

4. Endogenous Sharing Rule

In the previous section, the analysis assumed that the share of each household member was given exogenously. In this section, we consider the case where the power within the household is determined by the outside options of each member.[3] The utility derived by each member by breaking off from the household and operating individually gives the outside option. So the male outside option is just the outside wage that they earn and the female outside option is the outcome from the commons property resource which is received if the female devotes her time entirely to that activity assuming other females in the village to maintain their current labor supply. Hence denoting the outside options as $\overline{V_M}$ and $\overline{V_F}$ for the male and the female respectively we can therefore write,

$$\overline{V_M} = w \qquad (10)$$

[3] For a recent paper on an attempt to endogenize power relations within the household see (Basu 2001).

and $$\overline{V_F} = G(1 + \frac{n-1}{n} g(w)) \tag{11}$$

Applying the standard outcome of Nash Bargaining over π with outside options $\overline{V_M}$ and $\overline{V_F}$ gives the outcomes

$$V_F = \frac{1}{2}[\boldsymbol{p} - \Delta] \tag{12}$$

$$V_M = \frac{1}{2}[\boldsymbol{p} + \Delta] \tag{13}$$

where, $$\Delta = \overline{V_M} - \overline{V_F} = \quad w - \mathrm{G}(1 + \frac{\mathrm{n}\text{ -}1}{\mathrm{n}}.g(w)) \tag{14}$$

Hence,

$$\frac{\partial V_F}{\partial w} = \frac{1}{2}[\frac{\partial \boldsymbol{p}}{\partial w} - \frac{\partial \Delta}{\partial w}] \tag{15}$$

and $$\frac{\partial V_M}{\partial w} = \frac{1}{2}[\frac{\partial \boldsymbol{p}}{\partial w} + \frac{\partial \Delta}{\partial w}] \tag{16}$$

where, $$\frac{\partial \Delta}{\partial w} = 1 - \mathrm{G}'.\frac{\mathrm{n}\text{ -}1}{\mathrm{n}}.g'(w) > 0 \tag{17}$$

Thus, $$\frac{\partial V_F}{\partial w} < \frac{1}{2}\frac{\partial \boldsymbol{p}}{\partial w} < \frac{\partial V_M}{\partial w} \tag{18}$$

And the male always gains more and the female always gains less relative to the case where the sharing rule is exogenous. But can the disparity be so great that $\frac{\partial V_F}{\partial w}$ <0 and $\frac{\partial V_M}{\partial w}$ >0? The answer is yes. To see this, notice first of all that

$$\frac{\partial^2 \Delta}{\partial w \partial n} = \frac{(\mathrm{e_g}\text{ -}1)}{\mathrm{n}^2}.g(w) \tag{19}$$

which is positive if $e_g > 1$, as assumed in Proposition 2. With this assumption,

$$\frac{\partial^2 V_F}{\partial w \partial n} < \frac{1}{2}\frac{\partial^2 \boldsymbol{p}}{\partial w \partial n} < \frac{\partial^2 V_M}{\partial w \partial n} \tag{20}$$

Thus, $\frac{\partial V_F}{\partial w}$ falls faster than $\frac{1}{2}\frac{\partial \boldsymbol{p}}{\partial w}$ as n increases. Hence the value of 'n' at which $\frac{\partial V_F}{\partial w}$ turns negative, n_f, is less than n´ and the value at which $\frac{\partial V_M}{\partial w}$ turns negative, n_m, is greater than n´. The shapes of the curves are illustrated in Figure 1.

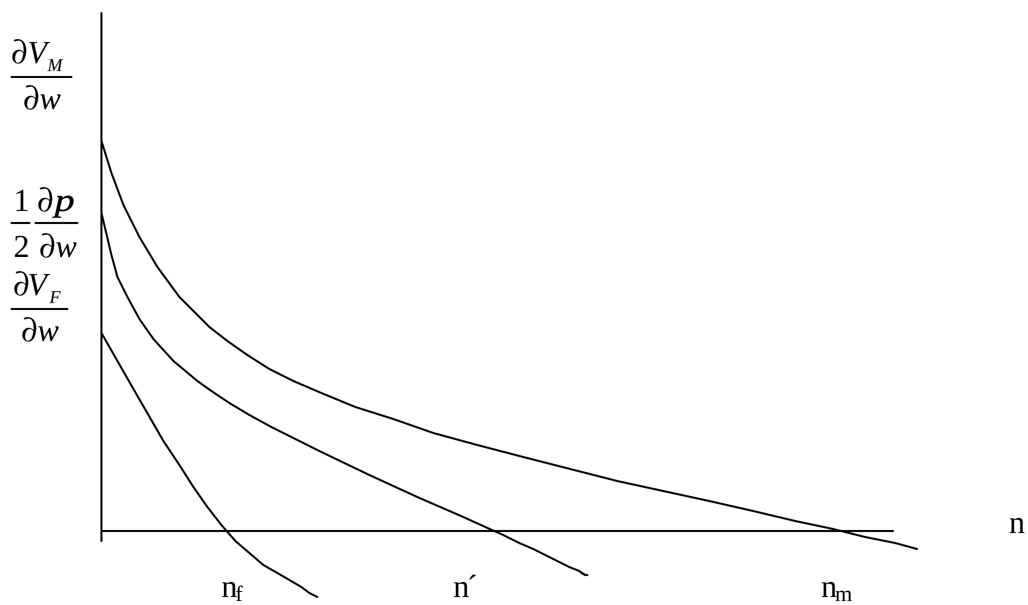

Figure 1: Welfare Effects of Wage Changes

There it is seen that when $n>n_m$ both the male and the female lose and when $n<n_f$ both gain. Moreover, in the range $n_f < n < n_m$ the male gains but the female loses in absolute terms. This argument is summarized in our third Proposition.

Proposition 3: *With an endogenous sharing rule, if the village size is neither too big ($n<n_m$) nor too small ($n>n_f$) then an increase in private sector wages will make the male better off and the female worse off, provided $e_g>1$.*

5. Conclusion

The potential impact of the effect of common property resources on intrahousehold distribution of resources is a neglected area in the literature. Case studies that have been done in this respect, clearly indicate that in many developing countries, the women in the community are involved in the exploitation of common pool resources. We show how this fact might effect the allocation of resources within the household. Apparently welfare improving phenomena (such as a rise in wages of the male member) can in fact worsen the situation of the household. When we do the analysis for a more endogenous formulation of the sharing rule for the household by taking into account the fact that the utility derived by the individuals when they operate alone effects the intrahousehold allocation, we show that the effects can be such that the male is better off while the female is worse off.

Apart from making a theoretical point about the effect of common pool resources on intrahousehold distribution of resources, this paper has some policy implications. It suggests that the process of privatization in such villages where common pool resource exploitation exists, should be done in a more planned manner since there can be severe adverse consequences associated with it on intrahousehold distribution. The exact procedure which should be followed in such cases is a matter of future research.

There are also some other fruitful directions in which this paper can be extended. We have considered a very simple formulation of the common pool game. One might think of other variants, such as, best-shot, weakest link or average aggregator functions for the technology. It would be interesting to see how this might change or add to the insights in this paper. And also as mentioned before, there is a small but growing literature on the effect of interhousehold inequality on the provision of public goods. Since this paper highlights the intrahousehold aspect, one might think of formulating richer models where there is an interaction of these two effects, and study the results in such a framework.

References

Alderman, H, P.A. Chiappori, L. Haddad, J. Hoddinott and R. Kanbur. 1995. "Unitary versus Collective Models of the Household: Is it time to shift the burden of proof?", *World Bank Research Observer* 10:1-19.

Bardhan, P and J. Dayton Johnson. 1999. "Inequality and Conservation on the Local Commons: A Theoretical Exercise." Mimeo University of California at Berkeley.

Bardhan, P, M.Ghatak and A. Karaivanov. 2000. "Inequality, Collective Action and Economic Performance." Mimeo University of Chicago.

Basu, K. 2001. "Gender and Say: An Intrahousehold Model of Household Behavior." CAE Working Paper, Cornell University.

Becker G. 1981. *A Treatise on the Family*. Cambridge Mass., USA: Harvard University Press.

Bourguignon, F and P.A. Chiappori. 1992. "Collective Models of Household Behavior: An Introduction." *European Economic Review* 36:355-364.

Browning M. and P.A. Chiappori. 1998. "Efficient Intra-Household Allocation: A General Characterization and Empirical Tests" (with M. Browning), *Econometrica*, 66:(6)1241-78.

Chambers, R, N.C Saxena and T. Shah. 1989. *To the Hands of the Poor.* Intermediate Technology Publications, London.

Dasgupta, P. 1993. *An Inquiry into Well-being and Destitution.* Cambridge University Press, Cambridge.

Haddad, L. and R. Kanbur. 1990. "How Serious is the Neglect of Intrahousehold Inequality?" *Economic Journal* 100 (402):866-881.

Haddad, L. and R. Kanbur. 1992. "Intrahousehold Inequality and the Theory of Targeting." *European Economic Review* 36(2):372-378.

Haddad, L. and R. Kanbur. 1993. "The Value of Intrahousehold Survey Data for Age-based Nutritional Targeting." *Annales d'Economie et de Statistique* 29:65-81.

Hart, G. 1980. "Patterns of Household Labor Allocation in a Javanese Village." In *Rural household studies in Asia*, ed. H.P. Binswanger, R.E. Evenson, C.A. Florencio and B.N.F. White. Singapore: Singapore University Press.

Jodha N.S. 1990. "Common property resources-contributions and crises." *Economic and Political Weekly*, June 30, A65-A78.

Kapteyn, A, and P. Kooreman. 1992. "Household Labor Supply: What kind of Data can tell us how many Decisionmakers there are?" *European Economic Review* 36:379-390.

Kooreman, P, and A. Kapteyn. 1990. "On the Empirical Implementation of some Game Theoretic Models of Household Labor Supply." *Journal of Human Resources* 25(4):584-598.

Manser, M and M. Brown. 1980. "Marriage and Household Decisionmaking: A Bargaining Analysis." *International Economic Review* 21(1):31-44.

Singh, I.J, L. Squire and J. Strauss. 1986. *Agriculture Household Models: Extensions, Applications and Policy*. Baltimore: Johns Hopkins University Press.

Tinker, I. 1976. "The Adverse Impact of Development on Women." In *Women and World Development*, ed. I. Tinker and M. Bramsen. Washington, D.C: Oversees Development Council.