A Simple Model on Mothers' Autonomy, Health Inputs, and Child Health

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Abstract

Using traditional health capital model of Grossman (1972) and Wagstaff (1986[a]) this paper attempts to fill in the theoretical missing link between mothers' autonomy and household consumption behavior, particularly focusing on the consumption of child health inputs. It has been shown in this analysis that working mothers' children should be of better health status. Further independent of working status of the mother, the autonomy parameter always induces consumption of more health inputs for the children. However, when autonomy is linked with mothers' income, the basic results of the model are further strengthened. In fact, income induced autonomy may result in redefining the composite consumption good for the family as an inferior one.

Key words: mothers' autonomy, child health, health demand, behavioral factors

JEL classification: D1,I12, I18, D11.

Introduction

The importance of mothers' role in family decision-making that impacts the health, nutrition and overall wellbeing of their children is quite evident from the literature on gender and development studiesin developing countries (Caldwell (1986); Hossain et al. (2007); Brunson,Shell-Duncan&Steele (2009), World Bank (2003)).In the context of child health, such autonomy or empowerment of the mother translates to decisions regarding demand for diets, medical careand other health inputs which are primarily needed to improve or maintain the health stock of the child, increase life expectancy, decrease morbidity etc. Although the definition and measurement of female autonomy itself has been a debated issue,[1]many empirical studies- either directly or indirectly - have established the fact that women with more freedom to control household resources positively affect child health (Caldwell(1986); Hossain et al.(2007); World Bank (2003); Miles-Doan and Bisharat (1990); Brunson, Shell-Duncan, & Steele (2009)). The aim of this paper is to theoretically study the mechanism through which greater autonomy of the mother translates to better child health. Since the topics of gender equality, women's empowerment have been addressed largely in the context of developing countries, the objective and implications of our research are mostly applicable in the context of developing nations as well. For brevity, we employ a simple modeling methodology and abstain from any inherent bargaining mechanism between husband and wife that affects intra-household resource allocation in determining female autonomy, which has been a cornerstone of some theoretical studies (see for example, Anderson & Eswaran (2009);Doepke & Tertilt (2011)). Our model focuses on the inherent trade-off that a mother faces in redistributing limited family financial resources between child health-related inputs and other goods and services in the family budget.

This paper is along the lines of health capital models of Grossman (1972, 1999) and Wagstaff (1986[a], 1986[b]). Following this literature,we assert that a representative individual or family includes child health in addition to consumable goods and servicesin the utility function. But child health itself is a produced input, whereas other elements of utility can be directly

[1] Mason (1986), Dyson and Moore (1983) elucidate the conceptual underpinnings of female autonomy.

purchased from the market. We also assume that the mother's autonomy parameter takes away some finances from the family budget constraint in favor of child health inputs. Consequently, the effects of changes in the degree of autonomy and money income are explored under two different situations and for two different groups of mothers i.e. working and non-working mothers. We examine two different setups: (i)when autonomy is exogenous[2] andindependent of money income earned by the mother (in case of working mothers), and (ii)when mother's autonomy is endogenously determined by the income earned by her. The second situation obviously applies only to working mothers.[3]

In this backdrop we derive some basic results: earning mothers' children should have better health; autonomy always increases the consumption of child health inputs; incremental changes for health inputs due to increase in mother's autonomy are higher for working mothers; consumption of composite good may fall even after increase in mother'sincome when mother's autonomy depends on her income –composite good may become an inferior one.

Model Environment and the Basic Model

Irrespective of the type and nature of the representative individual or family, one derives satisfaction from two sources: child health and consumption of the composite good. Here consumption itself includes the health of the representative individual.[4] Following Grossman (1972) and Wagstaff (1986[a], 1986[b]) we slightly modify the utility function of the representative individual in such a way that child health, which itself is a produced input, enters into the utility function, since a healthy baby probably gives significant amount of satisfaction to the parents. We assume that children are endowed with some initial stock of health, although such health stockis exogenous to our analysis. Therefore, we have two different objective functions: one is

[2] This can be thought of as a situation when mother's autonomy in family decision making depends on her education level, social norms, her mobility outside the household etc. Such factors that impact the association between mother's autonomy and child health have been empirically corroborated by Chakrabarti (2012), Basu and Stephenson (2005), Miller & Rodgers (2009), Frost, Forste& Haas (2005), etc.

[3] Empirical research documenting links between female earning and female autonomy, mothers' income and child health, income-induced autonomy of mother on child health can be found in studies such as Mason (1986), Engle (1993), Kishor (1993), Rahman & Rao (2004), Anderson & Eswaran (2009).

[4] We use "individual" and "family" interchangeably to denote the same thing. We do this intentionally as the motto of the individual and family are identical, at least in our case.

the family utility function and the other one is the child health production function. The representative family or individual allocatesresources among different health inputs for child health and the composite good.

The utility function representing an individual's preferences is given by,

$$U = U\ (H_C, G) \quad (1)$$

U is increasing in both arguments and quasi-concave. H_C represents health status of the child, which is essentially a produced input that yields satisfaction to the individual and$G$ indicates a composite commodity including parents' own health. Therefore, the representative individual is faced with the problem of production of H_C and the consumption of$G$. Although the use of a single utility function representative of the whole family -following Becker (1981) - is not beyond criticism (see McElroy & Horney (1981); Chiappori (1988, 1992); Browning &Chiappori (1998)), this function is extremely popular for its applicability and elegance.

To ensure tractability, we represent the individual utility function using a Cobb-Douglas form as shown below.

$$U = H_C^{\gamma(\alpha)} G^{\delta(\alpha)} \quad (2)$$

We incorporate mothers' autonomy or the degree of empowerment in the utility function by making the parameters of the utility function dependent on mother's autonomy coefficient α such that $0 \leq \alpha < 1$.Specifically,$\gamma = \gamma(\alpha)$and$\delta = \delta(\alpha)$ where $0 < \gamma(\alpha) < 1$ and $0 < \delta(\alpha) < 1$ are the utility elasticities with respect to $H_C$and G, respectively.

<u>Assumption 1:</u> $\gamma'(\alpha) > 0$ and $\delta'(\alpha) < 0$

Although the mother derives utility from both child health and consumption of other goods and services, we assume that with an increase in autonomy power, the mother prioritizes child health over the composite good when faced with resource allocation trade-off between these two items at the margin.[5]

H_C is defined by the following health production function.

$$H_C = H_C(X); \frac{\partial H_C}{\partial X} > 0 \qquad (3)^6$$

X is the consumption of food, medical care and other things by the child. Price of X is given by P_X.[7] If the health production function is Cobb-Douglas type then we have,

$$H_C = X^\rho \qquad (4)$$

where $0 < \rho < 1$ is the elasticity of H_C with respect to X.

The representative individual is constrained by family income earned by both the father and mother together. Mother's income is denoted by M[8] and father's income is given by F.[9]

Assumption 2: $F > 0$ and $M \geq 0$.

$M \geq 0$ captures both working and non-working mothers in terms of their earnings.[10] Being a working mother does not guarantee that a significant part of family income, in general, and the

[5] Empirical studies such as Thomas (1990), Bruce, Lloyd & Leonard (1995), Blumberg (1991) suggest that families where women have a stronger say in decision making tend to devote a higher proportion of family resources to children compared to those where women play a less decisive role.

[6] We do not include the child's initial stock of health i.e. I_C in our health production function. In a more extensive version of the model i.e. $H_C = H_C(X, I_C)$ such initial stock of health I_C would be endogenous and will depend on several factors such as prenatal care, access to health facilities, food habit of the mother, genetic problems etc. We ignore all these factors for brevity.

[7] Although we implicitly assume that child care is included in the variable X, for a more complete representation one can explicitly include a child care variable Q in the health production function i.e. $H_C = H_C(X, Q)$. In that case some necessary level of child care Q_m might be provided by mother such that $Q > Q_m > 0$, while the rest can be purchased in the market. For our current paper this segregation of inputs does not change the basic results of the model. Also, note that for child care provided by the mother, the price of care P_Q then represents the imputed cost of care.

[8] M defines mother's income from working outside the home.

[9] Note that father's income can be thought of as being composed of two components: F_C and $F_{\bar{C}}$, where some part of father's income, F_C, is always spent on child health. This also ensures that in the extreme case if mother's autonomy parameter converges to zero, H_C does not fall to zero. $F_{\bar{C}}$ defines the remaining part of father's income which could be used either for G or H_C, depending on the value of α.

[10] We are aware that this assumption undermines the mothers who sacrifice their personal happiness, professional career, etc. for child rearing and doing household chores. One could have thought of imputing costs for such work, but we have refrained ourselves from delving into such issues.

mother's income, in particular, would be spent on H_C. This depends on the autonomy power of the mother. Non-zero but less than unitary value of α indicates the fraction of money from the family budget the mother can allocate or re-allocate for child's health. Even if $M = 0$, α may not be zero. This happens in many families where professionally qualified mothers opt not to work outside of home in order to take care of their children. Therefore, for any given value of $M \geq 0$, a low value of α indicates more consumption of G and less of H_C, and conversely.[11] So, the budget constraint becomes,

$$\mathrm{P}_X X + \mathrm{P}_G G = M + F \qquad (5)^{12}$$

The utility maximization problem of the representative family can be then written as,

$$\left.\begin{array}{r} \max_{X,G} U = H_C^{\gamma(\alpha)} G^{\delta(\alpha)} \\ \text{subject to } H_C = X^{\rho} \text{ and } P_X X + P_G G = M + F \end{array}\right\} \qquad (6)$$

Results

We solve for the equilibrium values of X and G for both working and non-working mothers using the Lagrangian method of constrained optimization. Employing the first order condition for maximizing H_C and G we get,

$$\left.\begin{array}{l} X^* = \frac{\rho\gamma(M+F)}{P_X(\delta+\rho\gamma)} \\ G^* = \frac{\delta(M+F)}{P_G(\delta+\rho\gamma)} \end{array}\right\} \qquad (7)$$

and,

[11] Since we do not focus on determining α, we assume it as given. α depends on lot of factors including bargaining power, education, social systems, religious beliefs, etc. So, in our analysis α takes the form of a composite index that is comprised of education, awareness, mobility, decision making power, etc. that helps the mother to control a larger pie of the household income.

[12] Note that the budget constraint can be alternatively re-arranged as $P_X X + P_G G = F_C + (F_{\bar{c}} + M)\alpha + (F_{\bar{c}} + M)(1 - \alpha)$. This clearly depicts how mother's autonomy parameter captures the distribution of family income between H_C and G. However, we are not using such a budget constraint in order to avoid any in-built distributional bias that might occur against the composite consumption good with an increasing value of α.

$$\left.\begin{aligned} X_N^* &= \frac{\rho\gamma F}{P_X(\delta+\rho\gamma)} \\ G_N^* &= \frac{\delta F}{P_G(\delta+\rho\gamma)} \end{aligned}\right\} \tag{8}$$

X^* and G^*denote the equilibrium values for working mothers and X_N^*, G_N^* stand for the same for non-working mothers - for whom $M = 0$.

Subtracting equation (8) from (7) we get,$[X^* - X_N^*] = \frac{\rho\gamma M}{P_X(\delta+\rho\gamma)} > 0$. This result is quite apparent since for working mothers the disposable income is higher vis-à-vis their non-working counterparts which leadsto more resource allocation towards child health inputs. Therefore, health status of children of working mothers must be better than those of non-working mothers. Thus the following proposition is immediate.

PROPOSITION I*: For given α, H_C for working mother is greater than that of non-working mother as$\frac{\partial H_C}{\partial X} > 0$.*

Proof: See discussion above. ■

Now, let us move to the changes in equilibrium value of Xowing to any change in $\alpha$and Min order to explore how changes in autonomy power and income of mother affect child health.

$$\left.\begin{aligned} \frac{\partial X^*}{\partial \alpha} &= \frac{(F+M)\rho(\gamma'\delta-\gamma\delta')}{P_X(\delta+\rho\gamma)^2} > 0 \\ \frac{\partial X^*}{\partial M} &= \frac{\rho\gamma}{P_X(\delta+\rho\gamma)} > 0 \end{aligned}\right\} \tag{9}$$

and,

$$\frac{\partial X_N^*}{\partial \alpha} = \frac{F\rho(\gamma'\delta-\gamma\delta')}{P_X(\delta+\rho\gamma)^2} > 0 \tag{10}$$

Thus, we propose that,

PROPOSITION II*: Irrespective of whether the mother is working or not, an increase in α raises H_C as$\frac{\partial X^*}{\partial \alpha}, \frac{\partial X_N^*}{\partial \alpha} > 0$.*

Proof: See equations (9) and (10) above. ■

Lemma II.1: *Incremental change in X due to an increase in α is higher for working mothers.*

Proof: $\left(\frac{\partial X^*}{\partial \alpha} - \frac{\partial X_N^*}{\partial \alpha}\right) = \frac{M\rho(\gamma'\delta - \gamma\delta')}{P_X(\delta+\rho\gamma)^2} > 0$, since $\delta'(\alpha) < 0$.

■

So far we have not attempted to examine the effects on G. Differentiating the expressions for G^* and G_N^* w.r.t. α and M, we get the following:

$$\left.\begin{aligned} \frac{\partial G^*}{\partial \alpha} &= \frac{(F+M)\rho(\gamma\delta' - \gamma'\delta)}{P_G(\delta+\rho\gamma)^2} < 0 \\ \frac{\partial G^*}{\partial M} &= \frac{\delta}{P_G(\delta+\rho\gamma)} > 0 \end{aligned}\right\} \tag{11}$$

and,

$$\frac{\partial G_N^*}{\partial \alpha} = \frac{F\rho(\gamma\delta' - \gamma'\delta)}{P_G(\delta+\rho\gamma)^2} < 0 \qquad (12)^{13}$$

So, we arrive at the following proposition.

PROPOSITION III: *A rise in autonomy, α, redistributes expenditure against G or in favor of H_C.*

Proof: See equations (11) and (12) above. ■

Extended Model

In this segment we modify the basic model described earlier in such a way that α is no longer exogenously given. In the previous section α was considered as a proxy for all variables controlled by the mother; here mothers' autonomy depends on her income. So, α is redefined as

$$\alpha = \alpha(M); \;\; 1 > \alpha' > 0 \tag{13}$$

α is a monotonically increasing function of M with the inequality condition of $0 \leq \alpha < 1$. A zero M implies zero autonomy power, i.e $\alpha = 0$ if $M = 0$. So, α solely depends on the amount

[13] α induces positive income effect for X only. But M does the same for all the goods. So, G may be regarded as an "inferior good" for any change in autonomy.

of money the mother earns. Therefore, this section, in a sense primarily focuses on the working mothers.

Maximization of utility subject to the health production function and budget constraint yields identical demand expressions for X and G, as in equation (8), except for the fact that all terms with α are now functions of M. Let us denote these new demand expressions as X^{**} and G^{**}.[14]

Differentiating X^{**} and G^{**} with respect to α again and comparing the values with that of (9) and (11) one can easily assert that the values of the marginal changes in the consumption of X and G, respectively due to changes in α are the same in the basic and extended models.[15] However, when M changes, we have different results:

$$\frac{\partial X^{**}}{\partial M} = \frac{\rho\gamma(\delta+\rho\gamma)+(F+M)\alpha'\rho(\gamma'\delta-\gamma\delta')}{P_X(\delta+\rho\gamma)^2} > 0 \tag{14}$$

Comparing (14) with similar expression in (9) we find:

$$\frac{\partial X^{**}}{\partial M} > \frac{\partial X^{*}}{\partial M} \quad as\ \delta'\big(\alpha(M)\big) < 0\ .$$

This leads us to the following proposition:

***PROPOSITION IV**: Marginal change in X due to an increase in M is higher when α depends on M*.

■

This further explains why H_C for working mother would be higher when α is determined by mothers' earnings.

Now, let us turn to the consumption of the composite good G. Differentiating G^{**} with respect to M, we have:

$$\frac{\partial G^{**}}{\partial M} = \frac{\delta(\delta+\rho\gamma)+(F+M)\alpha'\rho(\gamma\delta'-\gamma'\delta)}{P_G(\delta+\rho\gamma)^2} \tag{15}$$

[14] For details see Appendix.
[15] Refer to Appendix for details.

A careful scrutiny of the above expression reveals that $\frac{\partial G^{**}}{\partial M}$ may take any value, unlike $\frac{\partial G^{*}}{\partial M}$ in the basic model. In the basic model we had the standard income effect. Whereas, here, the income effect is not so straightforward as M helps redistributing budget more towards X both directly through $(F+M)$) and indirectly through $\alpha(M)$.

$$\frac{\partial G^{**}}{\partial M} \gtreqless 0 \; iff \; \frac{\delta(\delta+\rho\gamma)}{\alpha'\rho(\gamma'\delta-\gamma\delta')} \gtreqless (F+M) \qquad (16)$$

If $\bar{M}$ represents some threshold level of mother's income, then,

$$\left.\begin{array}{l} \text{At } M=\bar{M},\ \frac{\partial G^{**}}{\partial M}=0 \Leftrightarrow \frac{\delta(\delta+\rho\gamma)}{\alpha'\rho(\gamma'\delta-\gamma\delta')}=(F+M) \\ \text{For } M<\bar{M},\ \frac{\partial G^{**}}{\partial M}>0 \Leftrightarrow \frac{\delta(\delta+\rho\gamma)}{\alpha'\rho(\gamma'\delta-\gamma\delta')}>(F+M) \\ \text{For } M>\bar{M},\ \frac{\partial G^{**}}{\partial M}<0 \Leftrightarrow \frac{\delta(\delta+\rho\gamma)}{\alpha'\rho(\gamma'\delta-\gamma\delta')}<(F+M) \end{array}\right\} [16] \qquad (17)$$

Based on (17) we can see that for working mothers, a very high income can translate into high autonomy power, which, in turn,might result in family consumption of the composite good becoming an inferior one. The intuition here is that when M is very high, mother has very high autonomy power, $\alpha(M)$ being high too, to redistribute family consumption substantially more towards child health inputs and quite less towards G with increasing M. This makes δ' become so negative i.e. it crosses some threshold level to turn G into an inferior good. Family's overall utility from elevated child health overcompensates any disutility resulting from decreased consumption of G. Realistically, this situation can be imagined as one when a very high family income has already taken care of basic family needs and the family's net utility from cutting down some conspicuous consumption and redistributing resources towards child health inputs is positive. Note that δ' is always negative but in the basic model this threshold level is never reached when autonomy is independent of M. Also, when M is zero, this can be viewed as the limiting case of M being very small. We have already shown that $\frac{\partial G^{**}}{\partial M} > 0$ when M is very small

[16] When M is very high, α is very high since α is a monotonic increasing function of M. For such a case δ' is negative and large and γ' is positive and large. At the same time α' will be a high positive number as well. This makes the denominator $\alpha'\rho(\gamma'\delta-\gamma\delta')$ a very large positive number. So, the fraction in the above expression is a very low number and becomes less than (F+M), the latter being a large number because of M being very high. This makes $\frac{\partial G^{**}}{\partial M}$ negative. Similar reasoning holds for the case when M is very low and $\frac{\partial G^{**}}{\partial M}$ is positive.

or when M is close to zero which in the limit converges to the basic model.Thus, we have the following proposition:

PROPOSITION V*: Reallocation of expenditure due to change in* M *may transform* G *into an inferior good with* $\frac{\partial G^{**}}{\partial M} < 0$. ■

Conclusion and discussion

In this paper we have strived to fill in a caveat in the theoretical literature – the mechanism through which mothers' autonomy power translates into better child health, by setting up a model of utility maximization and health production following Grossman (1972) and Wagstaff (1986[a]). In doing so, we have established that working mothers are more likely to have a healthy child as their autonomy redistributes financial resources in favor of child health inputs. Autonomy always induces consumption of health inputs for children – this is independent of whether the mother works or not. We then extended the basic set up to check what happens if mothers' autonomy depends only on her income. We observed that the results of the basic model are further strengthened in the extended model.

Apart from providing with some empirically testable hypotheses, this model may be extended for a case where initial child health endowment is incorporated into the model.If such initial health stock differs across children, one can expect different levels of X for identical health outcomes for different children. This model can again be reshaped to incorporate the issue of distribution of total working hours of the mother between work and child care (for any given amount of time for leisure). We believe that this could be an extremely interesting exposition as, on the one side, money raises autonomy power and disposable income and, on the other hand, it reduces the time devoted for child care. That will possibly enable one to explain some empirical irregularities such as children of working mothers are not always of better health.[17]The model, we hope, would also be able to capture the phenomenon of a backward bending labor supply curve, and how beyond a threshold level of mother's wage and

[17] See Basu&Basu (1991), Desai & Jain (1994).

income a wage hike would increase child health, whereas for a wage rate less than that, child health may display a negative relationship with wage rate.

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Appendix

In the extended model the optimization problem is

Max U = $H_C^{\gamma[\propto(\mathrm{M})]} G^{\delta[\propto(\mathrm{M})]}$

subject to $H_C = X^{\rho}$ and $P_X X + P_G G = M + F$

Lagrange method yields the following optimal values

$$\left.\begin{aligned} X^{**} &= \frac{\rho\gamma[\propto(\mathrm{M})](M+F)}{P_X(\delta[\propto(\mathrm{M})] + \rho\gamma[\propto(\mathrm{M})])} \\ G^{**} &= \frac{\delta[\propto(\mathrm{M})](M+F)}{P_G(\delta[\propto(\mathrm{M})] + \rho\gamma[\propto(\mathrm{M})])} \end{aligned}\right\}$$

Differentiating X^{**} and G^{**} with respect to α yields

$$\frac{\partial X^{**}}{\partial\alpha} = \frac{(F+M)\rho(\gamma'[\propto(\mathrm{M})]\delta[\propto(\mathrm{M})] - \gamma[\propto(\mathrm{M})]\delta'[\propto(\mathrm{M})])}{P_X(\delta[\propto(\mathrm{M})] + \rho\gamma[\propto(\mathrm{M})])^2} > 0$$

$$\frac{\partial G^{**}}{\partial\alpha} = \frac{(F+M)\rho(\gamma[\propto(\mathrm{M})]\delta'[\propto(\mathrm{M})] - \gamma'[\propto(\mathrm{M})]\delta[\propto(\mathrm{M})])}{P_G(\delta[\propto(\mathrm{M})] + \rho\gamma[\propto(\mathrm{M})])^2} < 0$$