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Estimating the Endogenously Determined Intrahousehold Balance of Power and Its Impact on Expenditure Pattern

Evidence from Nepal

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Abstract

The collective approach to household behavior relaxes the restrictive features of the unitary model by specifying household welfare as a weighted combination of the individuals' utilities. But the weights are assumed fixed or exogenous to the analysis. Koolwal and Ray extend the collective approach by proposing and estimating a framework where the weights are determined and simultaneously estimated with the household outcomes.

The authors present Nepalese evidence that suggests that a woman's share of household earnings understates her "power" in making household decisions. An increase in the woman's educational experience leads to a rise in her bargaining power. The results also reveal some interesting nonmonotonic relationships between a woman's "power" and the household's expenditure outcomes.

This paper—a product of the Office of the Senior Vice President, Development Economics—is part of a larger effort in the Bank to understand how gender affects development outcomes and to identify the causes of poverty. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Narin Jameson, room MC4-333, telephone 202-473-0677, fax 202-522-1158, email address njameson@worldbank.org. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The authors may be contacted at gbk5@cornell.edu or ranjan.ray@utas.edu.au. March 2002. (15 pages)

Estimating the Endogenously Determined Intra Household Balance of Power and its Impact on Expenditure Pattern: Evidence from Nepal*

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1. Introduction

Empirical analysis of household expenditure has, traditionally, been based on the unitary model that assumes that family members maximise a single utility function. The assumption of common preference ordering among family members can be traced to Samuelson (1956) and Becker (1981). The unitary model has been increasingly challenged in recent years through attempts at modelling individual utility to incorporate the divergent and conflicting preferences of different family members. Examples include the cooperative bargaining models [Manser and Brown (1980), McElroy and Horney (1981), Moehling (1995)], the non cooperative bargaining models [Kanbur and Haddad (1994), Lundberg and Pollak (1994)], and the "sharing rule" approach based on a Pareto efficient sharing role between household members [Chiappori (1988), Browning and Chiappori (1998)]. Crucial to the non unitary models is the relative "power" of individual members in the household [see Pollak (1994)].

As Basu (2001a) has recently pointed out, a distinctive, perhaps limiting, characteristic of the literature on non unitary models is that the welfare weights assigned to the individual household members are fixed and exogenous to household decision making. To our knowledge, Basu (2001a) is the first attempt at endogenising the welfare weight[1] in a model of intra household behaviour. The present study extends Basu (2001a) in several ways: (i) Basu's framework is generalised to allow a simple test of his assumption that the female's share of adult wage earnings is a correct measure of her bargaining power, (ii) the woman's welfare weight is allowed to depend on the relative educational experience of the woman vis a vis the man, (iii) empirical evidence is presented on the endogenously determined welfare weight, on its variation with female education, and on its impact on household expenditure patterns[2]. The results are particularly significant since

[1] See, also, Pollak (1994) for a similar argument. In this paper, we treat the terms "welfare weight" and "power" synonymously.

[2] See Moehling (1995) for evidence on the impact of the child's work status, used as a proxy for her bargaining power, on the distribution of household resources.

there exists little empirical evidence on household behaviour in an intra household model where the welfare weights are endogenously determined and simultaneously estimated with the other behavioural parameters. The significance of the impact of female "power" on expenditure allocation, conditional on all other household characteristics including aggregate household expenditure remaining constant, constitutes a test of the income pooling hypothesis underlying the unitary model [see Maitra and Ray (2000) for an alternative test].

The plan of this paper is as follows. Section 2 presents the model and describes the estimation. The results are presented and discussed in Section 3. The paper concludes with Section 4.

2. The Intra Household Model with Endogenous Welfare Weights

Let us consider a household with a woman, man and a child. We shall denote these individuals as 1, 2, 3 respectively. Following the "collective approach", the household welfare function is:

$$W = \theta(z)u_1(x) + (1-\theta(z))u_2(x) \tag{1}$$

where u_1 and u_2 denote, respectively, the individual utilities of the woman and the man, specified as a function of goods and leisure, x. The balance of power in the household, $\theta \in [0, 1]$, is dependent on a set of household characteristics, z. As θ increases, the 'power' of the woman increases, and vice versa. The "collective approach" either considers θ to be fixed, or specifies the z variables to be exogenous to the analysis so that θ is also exogenous. The unitary model imposes the restriction of common preferences on (1), i.e., $u_1(x) = u_2(x) = \bar{u}(x)$.

Following Basu (2001a, Section 2), we endogenise θ by allowing the z vector to include choice variables that are also contained in x. To simplify the exposition, let us specify the individual utilities to be functions of leisure hours, i.e. l_1, l_2, l_3 which are, respectively, the leisure hours of the

man, woman and the child. The individual utilities are specified as $u_1(l_1, l_3), u_2(l_2, l_3)$. The assumption made here is that, while the woman and the man do not care for each other's leisure, they both care for the "leisure" of their child (l_3) which includes time spent on her/his schooling.

The household's welfare maximisation problem can, therefore, be written as:

$$\underset{(\text{w.r.t. } l_1, l_2, l_3)}{\text{MAX}} \; \theta(z)u_1(l_1, l_3) + (1 - \theta(z))u_2(l_2, l_3) \tag{2}$$

$$\text{subject to } w_1 l_1 + w_2 l_2 + w_3 l_3 + \tilde{x} \leq Y \tag{3}$$

where w_1, w_2, w_3 are the market wage rates of men, women and children (considered exogenous in this analysis), $\tilde{x}$ is aggregate household expenditure and Y is unearned income. If we recognise leisure hours as, simply, the negative of labour hours (namely, e_1, e_2, e_3)[3], then the welfare function can be re-expressed as:

$$\theta(z)u_1(e_1, e_3) + (1 - \theta(z))u_2(e_2, e_3) \tag{4}$$

Note that the utilities are decreasing in labour hours.

We specify the female power variable as follows:

$$\theta(z_1, z_2, ed_1, ed_2) = \left(\frac{z_1}{z_1 + z_2}\right)^{\phi} \tag{5}$$

$$\text{with } \phi = \phi_0 + \phi_1\left(\frac{ed_1}{ed_2}\right) \tag{5a}$$

where $z_i = w_i e_i$ is adult earnings (i = 1, 2) and ed_1, ed_2 denote, respectively, the years of schooling of the most educated adult female and male members of the household. Eqn (5) allows, via $\phi < 1$, for the female's share of adult earnings to be an understatement of her true "power" in the household, and for an overstatement if $\phi > 1$. Eqn (5a) allows, via ϕ_1, the female power parameter, ϕ, to depend on the relative educational experiences of the woman and the man. Note, therefore,

[3] Since the focus of this paper is on the adult welfare weights, child labour (e_3) enters the analysis quite tangentially via the adult utilities, u_1, u_2. For more complex models of child labour, see Basu and Van (1998), Ray (2000) and Basu (2001b).

that a test of $\phi_0 = 1$, $\phi_1 = 0$ constitutes a test of Basu (2001a)'s assumption that the female's share of adult earnings is a correct measure of her bargaining power.

Let us choose the following simple functional forms for u_1, u_2:

$$u_1(e_1, e_3) = e_1^{-\rho_1} e_3^{-\rho_3} \qquad (6a)$$

$$\rho_1 > 0, \rho_3 > 0$$

$$u_2(e_2, e_3) = e_2^{-\rho_2} e_3^{-\rho_3} \qquad (6b)$$

$$\rho_2 > 0, \rho_3 > 0$$

After routine manipulation, the welfare maximisation exercise yields the following estimable female and male earnings equations, expressed as a share of total household earnings, $E = (w_1e_1 + w_2e_2 + w_3e_3)$:

$$s_1 \equiv \frac{w_1 e_1}{E} = \frac{e_1\left\{\rho_1 \theta e_1^{-\rho_1 - 1} - \theta_1\left(e_1^{-\rho_1} - e_2^{-\rho_2}\right)\right\}}{(\rho_1 + \rho_3)\theta e_1^{-\rho_1} + (\rho_2 + \rho_3)(1-\theta)e_2^{-\rho_2}} \qquad (7a)$$

$$s_2 \equiv \frac{w_2 e_2}{E} = \frac{(1-\theta)\rho_2 e_2^{-\rho_3} - \theta_2 e_2\left(e_1^{-\rho_1} - e_2^{-\rho_2}\right)}{(\rho_1 + \rho_3)\theta e_1^{-\rho_1} + (\rho_2 + \rho_3)(1-\theta)e_2^{-\rho_2}} \qquad (7b)$$

where $\theta_1 = \frac{\partial \theta}{\partial e_1} > 0$, $\theta_2 = \frac{\partial \theta}{\partial e_2} < 0$ denote the responsiveness of the female's bargaining power to female and male labour hours, respectively. In conventional treatments of the "collective" model, $\theta_1 = \theta_2 = 0$.

The empirical exercise employs a two stage estimation procedure. In the first stage, we estimate the female power function parameters (ϕ_0, ϕ_1), along with utility function parameters (ρ_1, ρ_2) by applying nonlinear SUR on equations (7a, 7b). Using the estimated values of ϕ_0 and ϕ_1, we then generate via eqns. (5, 5a) the female power variable, θ. The second stage involves estimating, using 3SLS, the following set of simultaneous equations — the (N – 1) independent budget share equations (bs_i, N being the number of items), the total per capita expenditure (tpc) equation, and the

female power (θ) equation, with bs_i ($i = 1,\ldots, N-1$), tpc and θ being treated as jointly endogenous. Note in particular that we have allowed for the dependence of the "female power" variable, θ, on, among others, the household's aggregate expenditure variable, tpc. Note also the joint and mutual dependence of commodity demand (bs_i), aggregate expenditure (tpc) and female power (θ), via (8a) – (8c) in the empirical exercise.

$$bs_i = f_i\left(w_1, w_2, w_3, tpc, tpc^2, \theta, \theta^2, n\right) \qquad (8a)$$
$$i = 1,\ldots N\text{-}1$$

$$tpc = f_N\left(w_1, w_2, w_3, \theta, \theta^2, d, r, n\right) \qquad (8b)$$

$$\theta = f_{N+1}\left(w_1, w_2 w_3, tpc, d, r, ed_1, ed_2, n\right) \qquad (8c)$$

where n denotes the vector of household compositional variables, and d, r denote the characteristics of the household's region of residence. To simplify estimation, we assume linear functional forms in eqns. (8a) – (8c).

3. Data and Results

The data on child labour comes from the Nepal Living Standards Survey (NLSS) conducted in June, 1995 by the Household Survey Unit of the Central Bureau of Statistics (CBS). The main objective of the NLSS is to collect data from Nepalese households and provide information to the government to monitor progress in national living standards and to evaluate the impact of various policies and programs on the living conditions of the population. The sample size for the NLSS is 3388 households. Further, this sample is divided into four strata based on the geographic regions of the country: mountains, urban hills, rural hills and terai. This study uses the following 7-item breakdown of total consumer expenditure: Tobacco, Food, Fuel, Housing, Education, Consumer Durables and Clothing.

Table 1 presents the results of estimating equations (7a, 7b). With the exception of ρ_3, all of the other parameter estimates are well determined and highly significant. The ρ_1, ρ_2 estimates show that the magnitude of the negative impact of male labour hours on his utility (ρ_2) is higher than that of female labour hours on her utility or welfare (ρ_1). The estimates of ϕ_0, ϕ_1 convincingly reject the joint hypothesis: $\phi_0 = 1$, $\phi_1 = 0$ ie., that the wage earnings distribution between the woman and the man is an accurate measure of their bargaining power. The ϕ_0 estimate of 0.889 suggests that the woman's share of adult wage earnings is an understatement of her true bargaining power, while the ϕ_1 estimate shows that the magnitude of this understatement increases with an increase in the woman's educational experience vis a vis that of the man.

Table 2 reports the results of the 3SLS estimates of the equation system (8a) – (8c). The ϕ parameter estimates used in the 3SLS estimation, reported in Table 2, assumes $\phi_1 = 0$ (see eqn. (5a)). The qualitative results are robust to the relaxation of this assumption (see footnote of Figure 1). The endogeneity of the female bargaining power variable, θ, is underlined by the significance of most of the household characteristics in the estimated equation (8c). Six features stand out, in particular: (i) the female's bargaining power (θ) is significantly and positively affected by the woman's wage rate and negatively by the man's; (ii) the child wage rate has little impact on θ; (iii) women in the rural areas of Nepal have, ceteris paribus, higher bargaining power than their urban counterpart; (iv) the female's bargaining power is highly sensitive to household composition — that is, ceteris paribus, females enjoy greater power in households with more women and older children but less power in households with more men and younger children; (v) a ceteris paribus increase in the female's educational experience leads to a significant increase in her bargaining power inside the household; and (vi) a similar increase in the male's educational experience has an opposite effect.

Of the other results in Table 2, the ones of particular interest relate to the impact of female power (θ) on the budget shares of the 7 items, and on the household's per capita aggregate expenditure. With the exception of consumer durables, all of the other budget share equations reject the principal testable implication of the unitary model, namely, that the θ, θ^2 variables are jointly insignificant in their impact on the individual budget shares. While θ is significant for aggregate household expenditure, the θ^2 term is not significant. The results also show that the relationship between budget share (bs_i) and the female's bargaining power (θ), while mostly non-linear, varies greatly between items. This is brought out clearly in Figure 1. Tobacco, for example, is an interesting example of a "private good" which is consumed (almost exclusively) by the adult male in the household. As female power increases, the share of tobacco falls continuously until it reaches a minimum ($\theta \simeq 0.7$) when it starts to rise again.

The sensitivity of the relation between the budget share and female power is seen more clearly in Figure 2, which involves a finer (14-good) disaggregation of the food items in a 3SLS re-estimation of equations (8a – 8c). The 3SLS estimates are available on request. These show [see footnote of Figure 2] that eggs and milk, cooking oil, and sweets (both of which are jointly consumed inside the household) do not reject the constancy of budget share with respect to θ and θ^2 which the unitary model implies. Baby milk, which, like tobacco, has the features of a private good in that it is consumed exclusively by a child member, exhibits significantly non-monotonic relationships with respect to θ. Generally, items which have features of a "public good" in that they are consumed by all members (i.e., flour and rice, eggs and milk, and meat) tend to show greater monotonicity than other "privately consumed" items (i.e., baby milk, alcohol, and tobacco). The graphs presented in Figures 1 and 2 do not provide much support to the picture of a horizontal straight line that is implied by the unitary model. The idea of income pooling, underlying the traditional unitary model, with the female weights or bargaining power having no impact on

expenditure pattern, has only limited support, mainly from items (eg., consumer durables in Table 2) which are jointly consumed inside the household.

4. Summary and Conclusions

In the unitary model, the identity of the income recipient within the household is irrelevant in traditional analysis of household expenditure. Also, an unequal balance of power between men and women in making household decisions has little consequence for household outcomes. Consequently, the "power" of individuals in making decisions has attracted little attention in studies of household behaviour. The "collective approach" departs from these restrictive features by expressing household welfare as a weighted sum of individual utilities. However, the weights are considered to be fixed or exogenous to the analysis. One therefore overlooks the possibility that the weights could be altered by the outcomes themselves.

This paper extends the collective approach by proposing and estimating a framework where the weights are endogenised and simultaneously determined with the household's expenditure and earnings decisions. Defining a female's "power" as her endogenously determined welfare weight, the study finds on Nepalese data that the woman's share of household earnings understates her true "power" in influencing household outcomes. Other interesting results include: (a) ceteris paribus, the rural woman enjoys greater power within the household than her urban counterpart, and (b) education plays an effective role in enhancing the power of women inside the household. The estimates of the "female power" equation provide considerable support to Basu (2001a)'s suggestion that the welfare weights should be estimated simultaneously with the household outcomes.

The statistical significance or otherwise of the impact of female power on an item's budget share provides a convenient test of the income pooling hypothesis underlying the unitary model. The results provide little evidence in support of income pooling, especially for items which have the

characteristics of a "private good" in being primarily consumed by particular household members. Note, however, that limited support for income pooling does exist for items that are collectively consumed inside the household. The results reveal some interesting non-monotonic relationships between "female power" and budget share that vary a good deal between items.

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Table 1: Non Linear SUR Estimates of Earnings Share Equation Parameters [Eqns. (7a, 7b)]

Parameter	Estimate[a]
ϕ_0	0.889 (0.024)
ϕ_1	-0.015 (0.004)
ρ_1	0.863 (.029)
ρ_2	1.118 (.012)
ρ_3	-5.11e-8 (5.15e-6)

[a] Standard Errors in Brackets

Table 2: 3SLS Estimates of Simultaneous Equations[a] [Eqns. (8a) – (8c)]

Variable	Coefficient Estimate[b]						
	Tobacco	**Food**	**Fuel**	**Housing**	**Education**	**Consumer Durables**	**Clothing**
Female Wage Rate	2.37e-4 (4.47e-5)	-0.002 (2.30e-4)	1.33e-4 (2.24e-5)	0.002 (1.74e-4)	-4.31e-4 (9.57e-5)	6.23e-5 (7.19e-5)	5.66e-4 (1.36e-4)
Male Wage Rate	-1.32e-5 (1.38e-5)	5.89e-4 (7.66e-5)	-5.07e-5 (7.05e-6)	-4.81e-4 (5.85e-5)	7.46e-5 (2.99e-5)	-7.17e-5 (2.17e-5)	-4.6e-5 (4.2e-5)
Child Wage Rate	-5.73e-5 (3.35e-5)	3.82e-4 (1.84e-4)	-2.04e-5 (1.7e-5)	-5.27e-5 (1.41e-4)	-1.73e-4 (7.23e-5)	1.09e-4 (5.27e-5)	-1.87e-4 (1.02e-4)
No. of Women	8.12e-4 (7.10e-4)	-0.026 (0.004)	0.002 (3.61e-4)	0.023 (0.003)	-0.004 (0.002)	0.005 (0.001)	-0.001 (0.002)
No. of Men	-0.004 (8.48e-4)	0.030 (0.005)	-0.003 (4.28e-4)	-0.021 (0.003)	0.009 (0.002)	0.003 (0.001)	-0.013 (0.003)
No. of Children (aged 10-15 years)	5.36e-5 (6.98e-4)	-0.011 (0.004)	3.7e-5 (3.56e-4)	0.002 (0.003)	0.015 (0.002)	-0.002 (0.001)	-0.004 (0.002)
No. of Children (aged less than 10 years)	-0.002 (3.88e-4)	-0.004 (0.002)	1.39e-4 (1.97e-4)	0.003 (0.002)	0.005 (8.38e-4)	0.004 (6.14e-4)	-0.006 (0.001)
Total Per Capita Consumption	-2.39e-6 (3.65e-7)	-1.61e-5 (1.80e-6)	3.98e-7 (1.81e-7)	9.21e-6 (1.36e-6)	9.56e-6 (7.79e-7)	6.60e-6 (5.96e-7)	-7.23e-6 (1.12e-6)
(Total Per capita Consumption)^2	1.46e-11 (2.77e-12)	1.06e-10 (1.36e-11)	-5.21e-12 (1.37e-12)	-5.13e-11 (1.02e-11)	-6.97e-11 (5.91e-12)	-3.73e-11 4.53e-12	4.31e-11 (8.48e-12)
Female Power	-0.132 (0.032)	1.361 (0.167)	-0.086 (0.016)	-1.111 (0.126)	0.321 (0.070)	-0.016 (0.052)	-0.338 (0.099)
(Female Power)^2	0.092 (0.027)	-0.939 (0.138)	0.057 (0.013)	0.780 (0.105)	-0.238 (0.058)	-0.002 (0.043)	0.250 (0.082)
Constant	0.069 (0.009)	0.537 (0.043)	0.036 (0.004)	0.279 (0.033)	-0.126 (0.018)	-0.036 (0.014)	0.24 (0.026)

Table 2: (Continued)

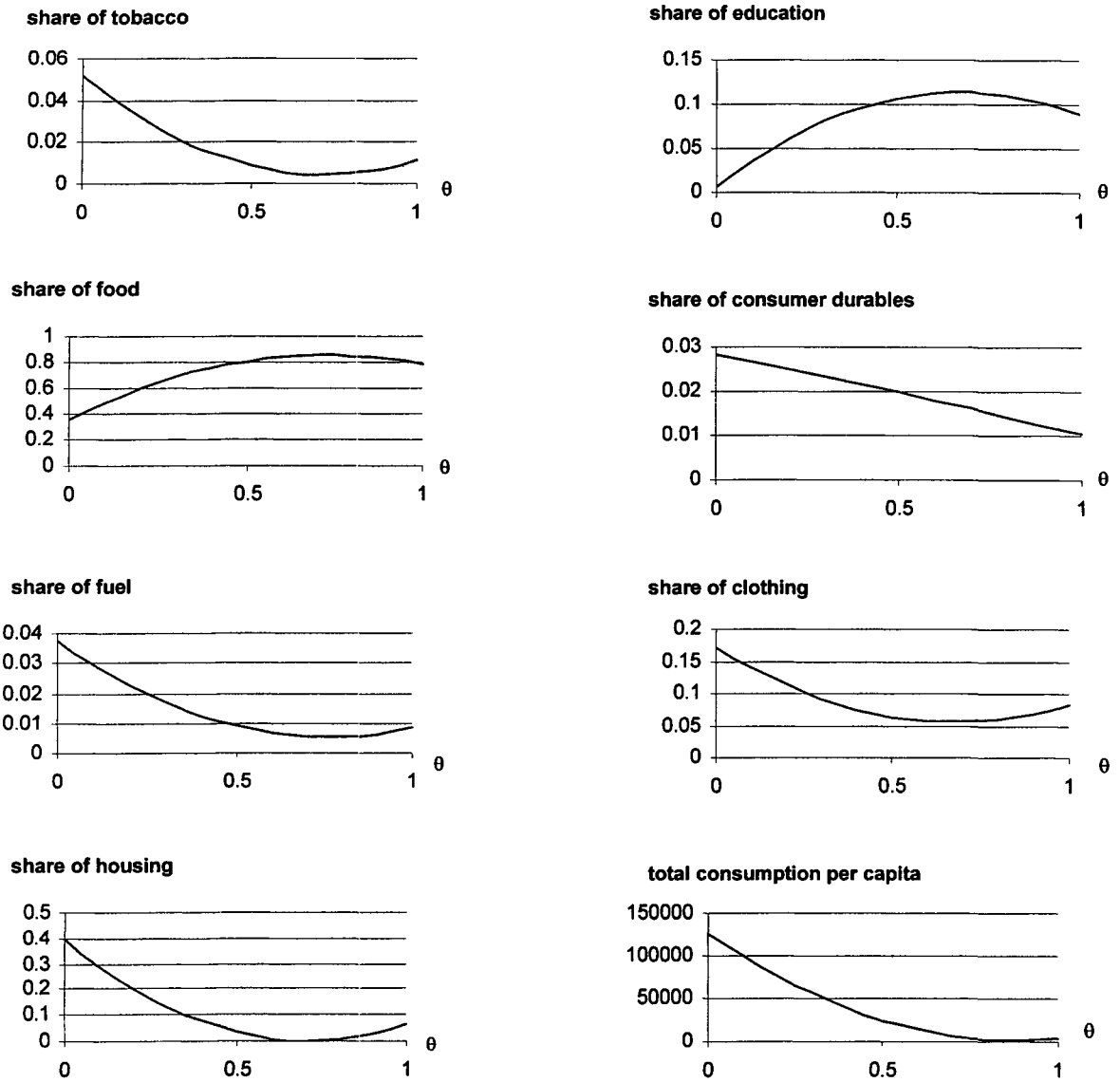
Per Capita Consumption (tpc)		Female Power (θ)	
Variable	**Coefficient Estimate[b]**	**Variable**	**Coefficient Estimate[b]**
Female Wage Rate	576.62 (216.54)	Female Wage Rate	0.003 (9.86e-5)
Male Wage Rate	-157.57 (52.27)	Male Wage Rate	-0.001 (6.74e-5)
Child Wage Rate	-36.90 (49.52)	Child Wage Rate	-2.71e-4 (2.16e-4)
No. of Women	7299.98 (1923.44)	No. of Women	0.057 (0.004)
No. of Men	-8536.68 (2868.99)	No. of Men	-0.053 (0.004)
No. of Children (aged 10 - 15 years)	1155.85 (1223.36)	No. of Children (aged 10 - 15 years)	0.006 (0.005)
No. of Children (aged less than 10 years)	-691.09 (867.35)	No. of Children (aged less than 10 years)	-0.007 (0.002)
DR[c] (Development Region)	-2911.86 (959.08)	DR[c] (Development Region)	0.001 (0.005)
RURURB (1 = rural, 0 = urban)	18174.34 (13333.37)	RURURB (1 = rural, 0 = urban)	0.105 (0.011)
Female Power	-285274.6 (154579)	Total Per Capita Consumption	-2.35e-7 (5.30e-7)
(Female Power)^2	163658 (126122.3)	ed1 (Years of Schooling of Most Educated Female Member)	0.004 (0.001)
Constant	67630.67 (19005.46)	ed2 (Years of Schooling of Most Educated Male Member)	-0.006 (0.001)
		Constant	0.314 (0.019)

[a] The Breusch Pagan test yields $\chi^2_{28} = 2277.954$, thus confirming the simultaneity of the nine equations.

[b] Standard errors in parentheses

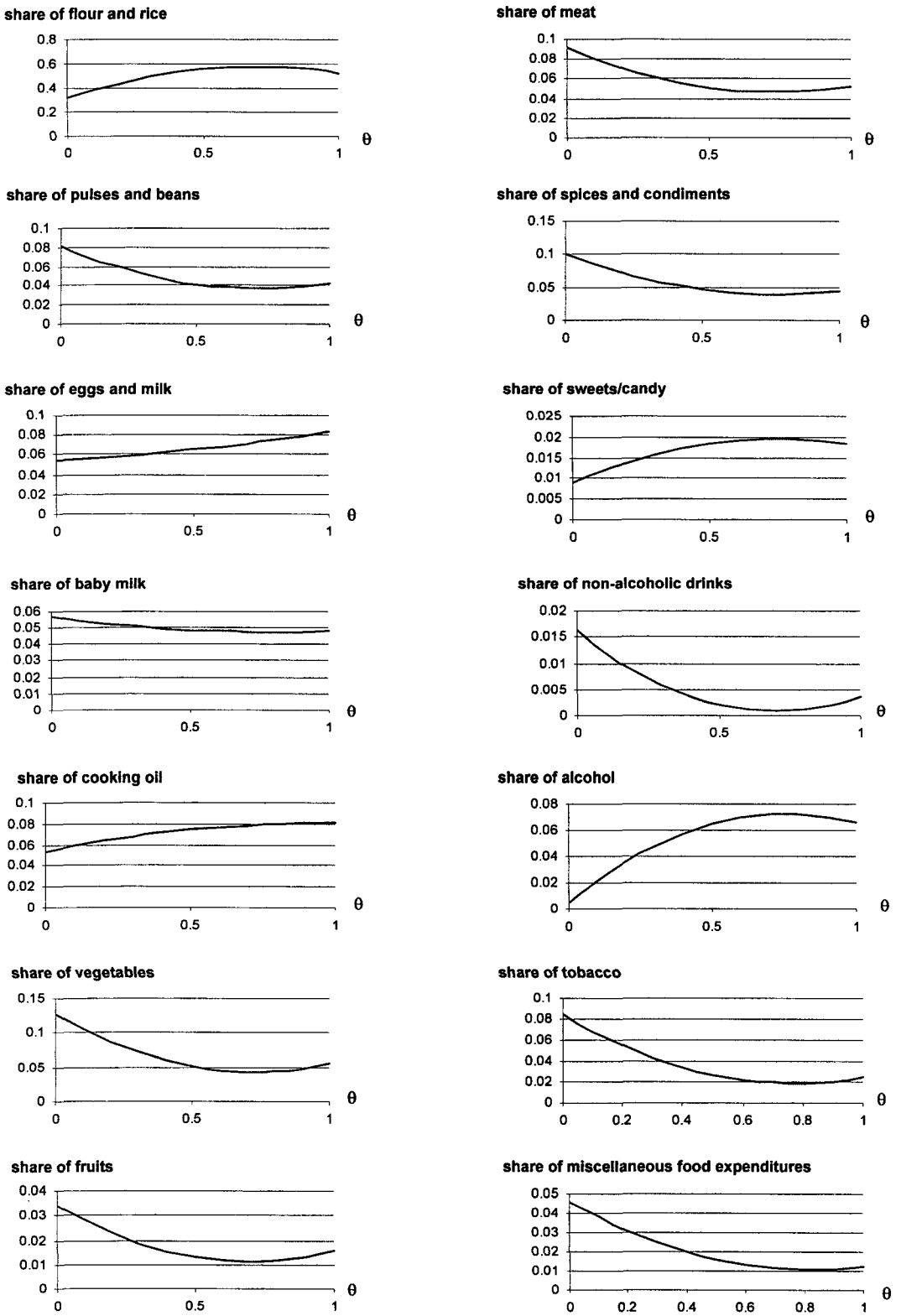
[c] DR = 1 for Eastern Nepal, 2 for Central Western, 3 for Mid Western/Far Western Nepal as the region of residence of the household.

Figure 1. Relationship Between Household Expenditure Shares and Female Power (θ)[1]



[1]Constant factors of 0.05 and 40,000 were added to the education expenditure share function and the total consumption per capita functions, respectively, to ensure nonnegative values at each level of female power. While results from the basic 3SLS model for θ (where ϕ is not dependent on anything) were used to produce the graphs, essentially the same graphs would have resulted from using the extended 3SLS model for θ (where $\phi = (\phi_0 + \phi_1$ (maxfemed/maxmaled)) since the output for both models was almost exactly the same. All figures were calculated at the mean values for all of the other variables in each equation. Results for consumer durables with respect to θ and θ^2 were not significant, and the coefficient for θ^2 in the total consumption per capita function was not significant.

Figure 2. Relationship Between Household Food Expenditure Shares and Female Power (θ)[1]



[1]Food expenditure shares were calculated as the share of purchased value of these goods relative to total food expenditure. Constant factors of 0.05 and 0.02 were added to the functions for baby milk and alcohol, respectively, in order to ensure nonnegative expenditure share values. All figures were calculated at the mean values for all of the other variables in each equation. Results for eggs and milk, cooking oil, and sweets were not significant in the 3SLS estimation with respect to θ and θ^2. Results for miscellaneous food expenditures were not significant with respect to θ^2.

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