Resource Sharing in Households with Children. A Generalized Model and Empirical Evidence from the U.K.

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Introduction: Evaluating the cost of children in the literature

... a long tradition in empirical microeconomics with various methods: Engel, Rothbarth, Houthakker, Barten, Gorman,...

$\longrightarrow$ useful to measure poverty or implement economic policies/

The Rothbarth method consists in imputing the same level of welfare to parents in different households that have the same level of expenditure on some adult-specific goods.

References: Lazear and Michael (1988), Deaton, Ruiz-Castillo and Thomas (1989), Gronau (1991) and Tsakloglou (1991).

Introduction: Our approach

We propose a generalization of the Rothbarth approach which is consistent with (i) parental bargaining and (ii) economies of scale.

(i) Parental bargaining

- Each individual (including children) has specific preferences over an adult-specific good and a general aggregate good.
- The outcome of the decision process is Pareto efficient. $\longrightarrow$ Collective framework

(ii) Economies of scale

Economies of scale are represented by an implicit price (that depend on all the exogenous variables) for the aggregate good.

Introduction: Identifying assumption

Identifying assumptions are the following:

(a) the condition that individual preferences do not depend on the demographic structure (identification based on singles and couples)

(b) the observation of the demand for two adult goods and one aggregate good

(c) a condition on the implicit prices

(d) a simple, rather weak condition on how the adults' share and the implicit price are affected by the presence of children.

Introduction: Related literature

The model merges and slightly generalizes three ideas included in Rothbarth (1943), Barten (1964) and Chiappori (1988).

In particular, the contribution differs from:

> Bargain and Donni (EER, 2012) and Bargain et al. (JDE, 2014) who consider a collective model with economies of scale and intra-household bargaining but economies of scale are represented by a simple Independent-of-the-Base translation of total expenditure.
>
> Browning et al. (RES, 2013) who consider a collective model with economies of scale and intra-household bargaining with a general representation of scale economies using a price transformation à la Barten but children are ignored (and the price transformation is a constant).

Here we consider a price transformation depending on the exogenous variables, and we focus on the cost of children.

Introduction: Our empirical application

We exploit the U.K. Family Expenditure Survey over the period 1978-2007, and suppose that household expenditures on some male and female clothing can be seen as adult-specific.

Empirical results show that the share for one child is equal to about 19% of the household total expenditure, and it increases up to 39% for three children.

Theoretical Framework

The main idea is to merge information on singles and on couples. Thus we need:

- A model for the behavior of singles
- A model for the behavior of couples (with and without children)

Theoretical Framework: The Model of Singles' Behavior (1)

Each household member i $(= m$ or $w)$ has a well-behaved direct utility function as

$$U_i = U_i(x_i, X)$$

The purchases of each good by individual i are denoted by z_i and Z, respectively, and the budget constraint is

$$z_i p_i + Z = y_i$$

If we focus on nondurable goods, then

$z_i = x_i$ and $Z = X$.

Theoretical Framework: The Model of Singles' Behavior (2)

Individual i then faces the following optimization program:

$$\max U_i\left(x_i, X\right)$$

subject to

$$z_i p_i + Z = y_i$$

and

$$z_i = x_i \text{ and } Z = X.$$

The solution is:

$$\omega_i = \frac{p_i x_i}{y_i} = g_i(p_i, y_i)$$

Theoretical Framework: The Couple Decision Process (1)

Each adult is endowed with a well-behaved utility function (with altruism toward children),

$$U_w(x_w, X_w) + \delta_w(n)U_c(X_c),$$

$$U_m(x_m, X_m) + \delta_m(n)U_c(X_c),$$

with $\delta_i(n) = 0$ if $n = 0$, while the children are represented by a single utility function,

$$U_c(x_c, X_c) = U_c(X_c).$$

The household budget constraint is:

$$z_w p_w + z_m p_m + Z = y,$$

Theoretical Framework: The Couple Decision Process (2)

A general consumption technology based on the following two conditions:

(i) Exclusive goods are purely private:

$$z_w = x_w, \quad z_m = x_m,$$

(ii) Aggregate goods have a public component:

$$Z = \sum_{i=w,m} A_i(p_w, p_m, y, n) X_i + X_c,$$

where $A_i \leq 1$ (in principle).

Theoretical Framework: The Couple Decision Process (3)

Thus:

$$x_w p_w + x_m p_m + \sum_i A_i(p_w, p_m, y, n) X_i + X_c = y$$

i.e., $A_i(p_w, p_m, y, n)$ plays the role of a shadow (not necessarily Lindahl) price.

Assumption 1. The outcome of the decision process is Pareto efficient. In particular, (x_i, X_i) for $i = w, m$ is the solution of

$$\max U_i(x_i, X_i)$$

$$\text{subject to } x_i p_i + A_i(y, p_w, p_m, n) X_i = y \cdot \phi_i(y, p_w, p_m, n)$$

for some function $\phi_i(y, p_w, p_m, n)$ such that $\sum_{i=w,m} \phi_i(y, p_w, p_m, n) \leq 1$ and

$$\sum_{i=w,m} \phi_i(y, p_w, p_m, n) = 1,$$

if $n = 0$.

Theoretical Framework: The Couple Decision Process (4)

The solution is:

$$
\begin{aligned}
\frac{\omega_i}{\phi_i(p_w, p_m, n, y)} &= \frac{p_i x_i / y}{\phi_i(p_w, p_m, n, y)} \\
&= g_i\left(\frac{p_i}{A_i(p_w, p_m, n)}, \frac{y\phi_i(p_w, p_m, n, y)}{A_i(p_w, p_m, n)}\right)
\end{aligned}
$$

because of homogeneity, where g_i is independent of the family composition.

Identification (1)

Identification relies on two additional assumptions:

Assumptions 2. For $n = 0$, and any (y, p_w, p_m),

a. The technology is of the BCL form, i.e.,

$$A_w(y, p_w, p_m, n) = A_m(y, p_w, p_m, n);$$

or

b. The technology is of the Pseudo-Lindahl form, i.e.,

$$A_w(y, p_w, p_m, n) + A_m(y, p_w, p_m, n) = 1.$$

Identification (2)

Assumptions 3. For any (y, p_w, p_m, n),

1. Individual price functions are separable and defined as:

$$A_i(y, p_w, p_m, n) = a_i(y, p_w, p_m) \cdot b_i(p_w, p_m, n),$$

for $i = w, m$, for some functions a_i and b_i, with $b_i = 1$ if $n = 0$, and

2. Individual share functions are separable and defined as:

$$\phi_i(y, p_w, p_m, n) = \sigma_i(y, p_w, p_m) \cdot \kappa_i(p_w, p_m, n),$$

for $i = m, w$, for some functions σ_i and κ_i, with $\kappa_i = 1$ if $n = 0$.

Identification (3)

Proposition. *If A1-A3 and some regularity conditions are satisfied, then individual shares of total expenditure* $\{\phi_w, \phi_m\}$ *and shadow prices* $\{A_w, A_m\}$ *can be exactly recovered for any* n.

Then:

$$\phi_c = 1 - \sum_{i=w,m} \phi_i \left(y, p_w, p_m, n \right),$$

Identification (4)

The budget share fonction is identified from singles. Thus:

$$\omega_i = \phi_i g_i \left(\frac{p_i}{A_i}, \frac{\phi_i y}{A_i} \right) = g_i^* \left(\frac{p_i}{A_i}, \frac{y}{A_i}, \phi_i \right),$$

If

$$\frac{\partial g_i^*}{\partial \phi_i} \neq 0,$$

then

$$\phi_i = G_i \left(\frac{p_i}{A_i}, \frac{y}{A_i}, \omega_i \right).$$

The adults'share are identified up to a function A_i.

Identification (5)

If $n = 0$, the functions $A_w(p_w, p_m, y, n)$ and $A_m(p_w, p_m, y, n)$ can generically be identified by the following equation:

$$G_w\left(\frac{p_w}{A_w(\overline{p}_w, \overline{p}_m, y, 0)}, \frac{y}{A_w(\overline{p}_w, \overline{p}_m, y, 0)}, \omega_w\right) + G_m\left(\frac{p_m}{A_m(\overline{p}_w, \overline{p}_m, y, 0)}, \frac{y}{A_m(\overline{p}_w, \overline{p}_m, y, 0)}, \omega_m\right) = 1$$

and

$$A_w(\overline{p}_w, \overline{p}_m, y, 0) = A_m(\overline{p}_w, \overline{p}_m, y, 0)$$

or

$$A_w(\overline{p}_w, \overline{p}_m, y, 0) + A_m(\overline{p}_w, \overline{p}_m, y, 0) = 1$$

thanks to Assumption 1.

Identification (6)

If $n > 0$, and each parent contributes to children's cost proportionately to the share of total expenditure they would obtain without children, then

$$G_i\left(\frac{p_i}{a_i(y,\overline{p}_w,\overline{p}_m,y)b_i(\overline{p}_w,\overline{p}_m,\overline{n})},\frac{y}{a_i(y,\overline{p}_w,\overline{p}_m,y)b_i(\overline{p}_w,\overline{p}_m,\overline{n})},\omega_i\right)$$
$$=\sigma_i(\overline{p}_w,\overline{p}_m,y)\kappa_i(\overline{p}_w,\overline{p}_m,\overline{n})$$

The children's individual share is then given by

$$\phi_c = 1 - G_m\left(\frac{p_m}{A_m(\overline{p}_w,\overline{p}_m,y,\overline{n})},\frac{y}{A_m(\overline{p}_w,\overline{p}_m,y,\overline{n})},\omega_m\right)$$
$$-G_w\left(\frac{p_w}{A_w(\overline{p}_w,\overline{p}_m,,y,\overline{n}_c)},\frac{y}{A_w(\overline{p}_w,\overline{p}_m,,y,\overline{n}_c)},\omega_w\right).$$

Empirical Implementation (1)

The following QUAIDS-type form for the basic budget share equation is adopted:

$$\omega_i = \alpha_i + \beta_i \log p_i + \gamma_i \log y + \delta_i (\log y)^2 + \epsilon_i$$

Thus:

(i) If $M = 0$,

$$\epsilon_i = \omega_i - \alpha_i - \beta_i \log p_i - \gamma_i \log y - \delta_i (\log y)^2$$

(ii) If $M = 1$,

$$\epsilon_i = \frac{\omega_i}{\phi_i} - \alpha_i - \beta_i \log\left(\frac{p_i}{A_i}\right) - \gamma_i \log\left(\frac{\phi_i y}{A_i}\right) - \delta_i \left(\log\left(\frac{\phi_i y}{A_i}\right)\right)^2 .$$

Empirical Implementation (2)

Moreover

$$\log \phi_w = \log\left(\frac{1}{2}\right) + \frac{1}{2}(\sigma_o + \sigma_y \log y) + \sum_k \kappa_{w,n_k} n_k$$

and

$$\log \phi_m = \log\left(\frac{1}{2}\right) - \frac{1}{2}(\sigma_o + \sigma_y \log y) + \sum_k \kappa_{m,n_k} n_k,$$

which is a linear approximation of a logistic function,

$$\log A_w = a_o + a_y \log y + b_\delta \delta(n > 0)$$

and

$$\log A_m = a_o + a_y \log y + b_\delta \delta(n > 0)$$

The data

Family Expenditure Survey between 1978 and 2007.

Selection of:

- Singles without children + Couples with 0-3 children – no other member in the family

- Children are less than 16 years and adults are between 22 and 55.

- Observations without missing values.

The final sample contains 7,549 single women, 6,883 single men, 14,680 couples without children, 9,599 couples with one child, 15,058 couples with two children and 4,315 couples with three children.

The estimation method

The model is estimated by the Three Stage Least Square Method.

Household total expenditure is supposed to be potentially endogenous and is instrumented by household income.

The equations to estimate can be written as:

$$\epsilon_i = \omega_i - \alpha_i - \beta_i \log p_i - \gamma_i \log y - \eta_i (\log y)^2 + M_i Q_i$$

where

$$Q_i = \omega_i \frac{1-\phi_i}{\phi_i} - \beta_i \log\left(\frac{1}{A_i}\right) - \log\left(\frac{\phi_i}{A_i}\right)\left(\gamma_i + \eta_i \log\left(\frac{y^2\phi_i}{A_i}\right)\right).$$

		Single women	Single men	Couples with			
				0 child	1 child	2 children	3 children
Expenditure data							
Female clothing	Weekly expenditure (in £)	9.2	-	10.4	7.1	6.2	5.6
	Percentage of zeros	0.4	-	0.3	0.3	0.3	0.3
Male clothing	Weekly expenditure (in £)	-	5.5	5.3	3.8	3.2	3.1
	Percentage of zeros	-	0.7	0.6	0.7	0.7	0.7
Total weekly expenditure (in Θ)		105.1	129.5	210.1	189.2	201.0	206.6
Individual and household characteristics							
Men's labor force participation		-	1.00	1.00	1.00	1.00	1.00
Women's labor force participation		0.74	-	0.85	0.61	0.60	0.52
Men's education (in years)		-	12.7	12.2	12.1	11.9	11.9
Women's education (in years)		12.4	-	12.2	12.1	11.9	11.8
Men's age (in years)		-	37.2	38.9	35.8	36.6	36.6
Women's age (in years)		39.8	-	37.1	33.6	34.3	34.2
House owner (0/1)		0.57	0.65	0.83	0.81	0.81	0.72
Number of children		0	0	0	1	2	3
Average age of children		-	-	-	5.3	13.9	22.2
Proportion of boys		-	-	-	0.51	0.51	0.51
Number of observations		7,549	6,883	14,680	9,599	15,058	4,315

Test	Stat.	DF	Pr > Khi-2
Over-identifying restrictions	39.03	35	0.29
No log total expenditure terms in women's equation	93.04	2	0.00
No log total expenditure terms in men's equation	56.14	2	0.00
Cubic term in log total expenditure	34.44	2	0.10
Trend terms in adults' shares	38.84	1	0.66
Trend terms in children's shares	35.49	2	0.17
No scale economies	72.71	6	0.00
Pseudo-Lindahl specification	56.69	0	-

Note: The statistics are computed with the same weighting matrix.

	Women's budget equation		Men's budget equation	
Parameters	Est. value	Std. Err.	Est. value	Std. Err.
Intercept	0.1824	(0.0266)	0.0269	(0.0603)
Education in years	-0.0013	(0.0004)	0.0002	(0.0003)
Age in years	-0.0043	(0.0009)	-0.0036	(0.0007)
Age in years^2	0.0042	(0.0011)	0.0040	(0.0009)
Year	0.0097	(0.0039)	0.0181	(0.0038)
Year^2	-0.0023	(0.0009)	-0.0014	(0.0009)
House owner Dummy	0.0048	(0.0018)	0.0004	(0.0020)
Labor force participation	0.0021	(0.0025)	0.0000	(0.0000)
Regional Dummy: Northern	-0.0043	(0.0041)	-0.0039	(0.0040)
Regional Dummy: York and Humberside	-0.0069	(0.0038)	-0.0038	(0.0038)
Regional Dummy: East Midlands	-0.0093	(0.0039)	-0.0092	(0.0038)
Regional Dummy: East Anglia	-0.0098	(0.0041)	-0.0112	(0.0040)
Regional Dummy: Greater London	-0.0113	(0.0038)	-0.0037	(0.0039)
Regional Dummy: South East (except London)	-0.0109	(0.0035)	-0.0079	(0.0035)
Regional Dummy: South West	-0.0139	(0.0038)	-0.0116	(0.0038)
Regional Dummy: Wales	-0.0040	(0.0041)	-0.0073	(0.0041)
Regional Dummy: North West	-0.0066	(0.0038)	-0.0067	(0.0038)
Regional Dummy: West Midlands	-0.0046	(0.0037)	-0.0055	(0.0036)
Regional Dummy: Scotland	-0.0062	(0.0037)	-0.0040	(0.0037)
Log relative price	0.0031	(0.0062)	0.0298	(0.0092)
Log total expenditure share	-0.0498	(0.0180)	-0.1507	(0.0822)
Log total expenditure share^2	-0.0204	(0.0051)	-0.0514	(0.0266)

Recall:

$$\log \phi_w = \log \left(\frac{1}{2}\right) + \frac{1}{2}(\sigma_o + \sigma_y \log y) + \sum_k \kappa_{w,n_k} n_k$$

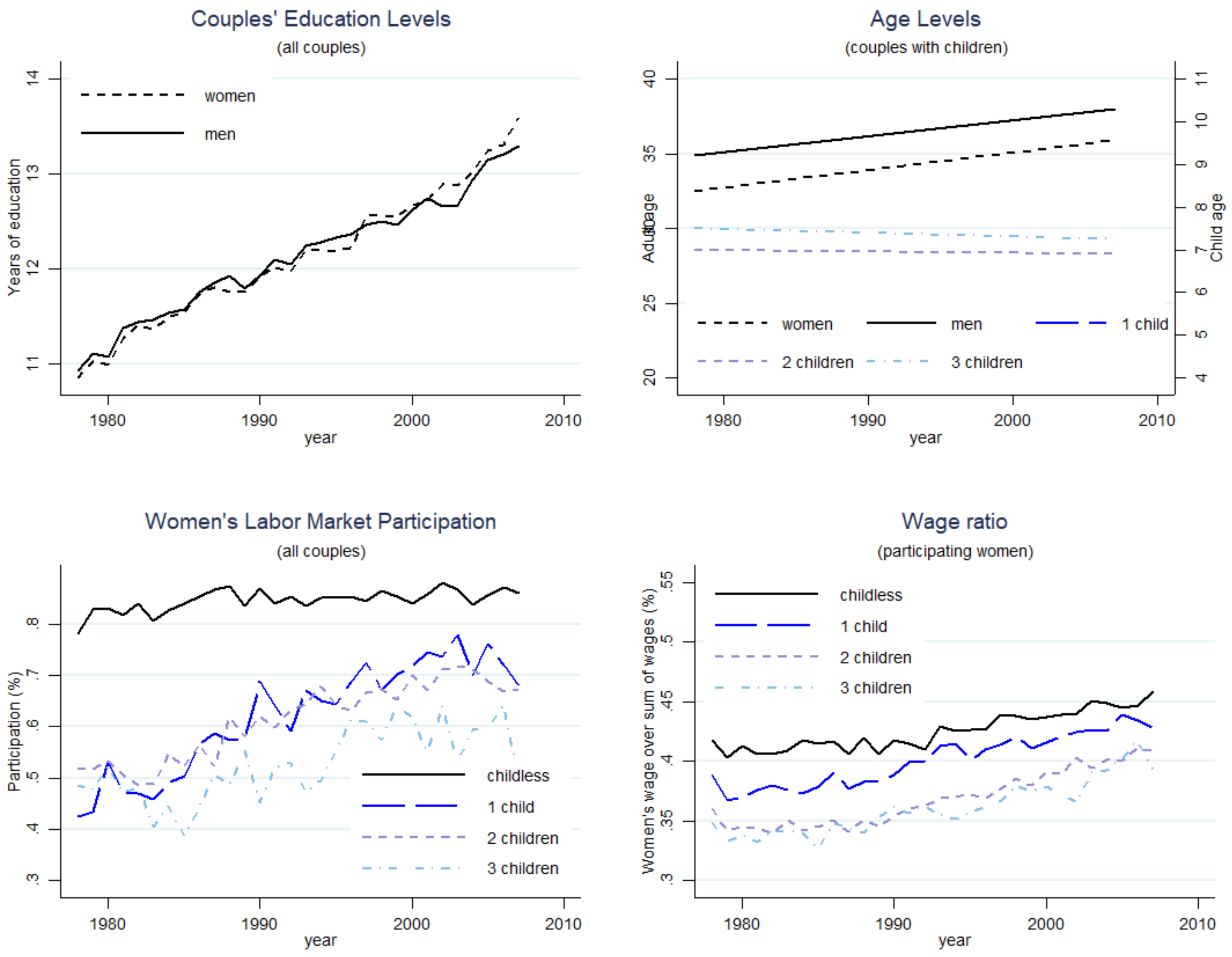
$$\log \phi_m = \log \left(\frac{1}{2}\right) - \frac{1}{2}(\sigma_o + \sigma_y \log y) + \sum_k \kappa_{m,n_k} n_k,$$

$$\log A_w = a_o + a_y \log y + b_\delta \delta(n > 0)$$

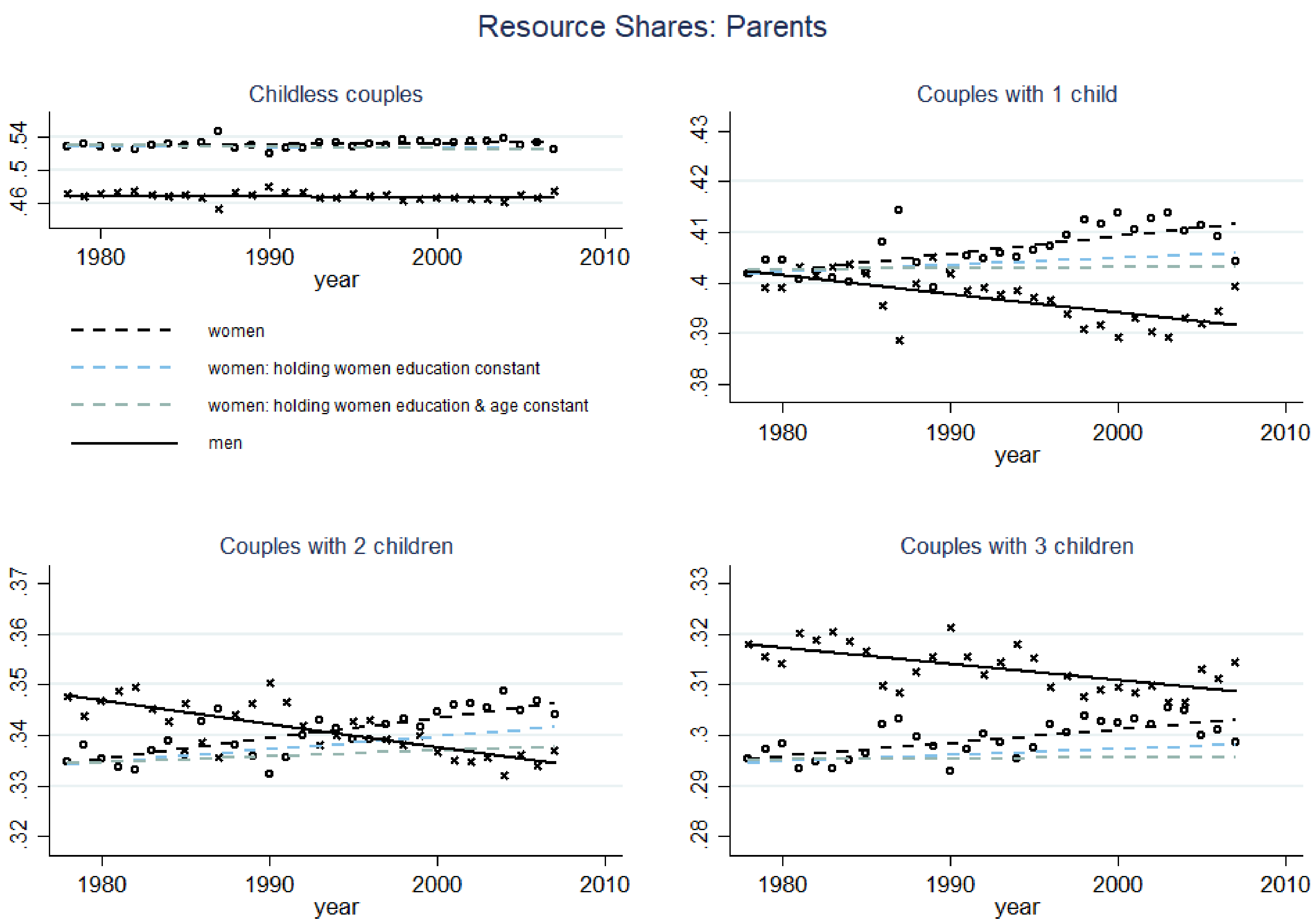
$$\log A_m = a_o + a_y \log y + b_\delta \delta(n > 0)$$

		Women's resource share and scale equation		Men's resource share and scale equation	
Parameters		Est. value	Std. Err.	Est. value	Std. Err.
σ	If woman out of labor market: Intercept	0.1464	(0.1862)	-0.1464	(0.1862)
	If woman on labor market: Intercept	0.0967	(0.1835)	-0.0967	(0.1835)
	If woman on labor market: Income ratio	0.1659	(0.0514)	-0.1659	(0.0514)
	Log total expenditure	0.3403	(0.0960)	-0.3403	(0.0960)
	Man's age	-0.0007	(0.0013)	0.0007	(0.0013)
	Woman's age	0.0063	(0.0017)	-0.0063	(0.0017)
	Man's education	-0.0019	(0.0028)	0.0019	(0.0028)
	Woman's education	0.0129	(0.0040)	-0.0129	(0.0040)
κ	Number of children	-0.2438	(0.0308)	-0.2180	(0.0756)
	Number of children^2	0.0340	(0.0083)	0.0280	(0.0167)
	Average age of children	-0.0054	(0.0013)	-0.0020	(0.0014)
	Proportion of boys	-0.0153	(0.0103)	0.0286	(0.0135)
A	Intercept	-1.2032	(0.3892)	-1.2032	(0.3892)
	Log total expenditure	-0.5553	(0.2302)	-0.5553	(0.2302)
	Children Dummy	0.2164	(0.1078)	0.2164	(0.1078)

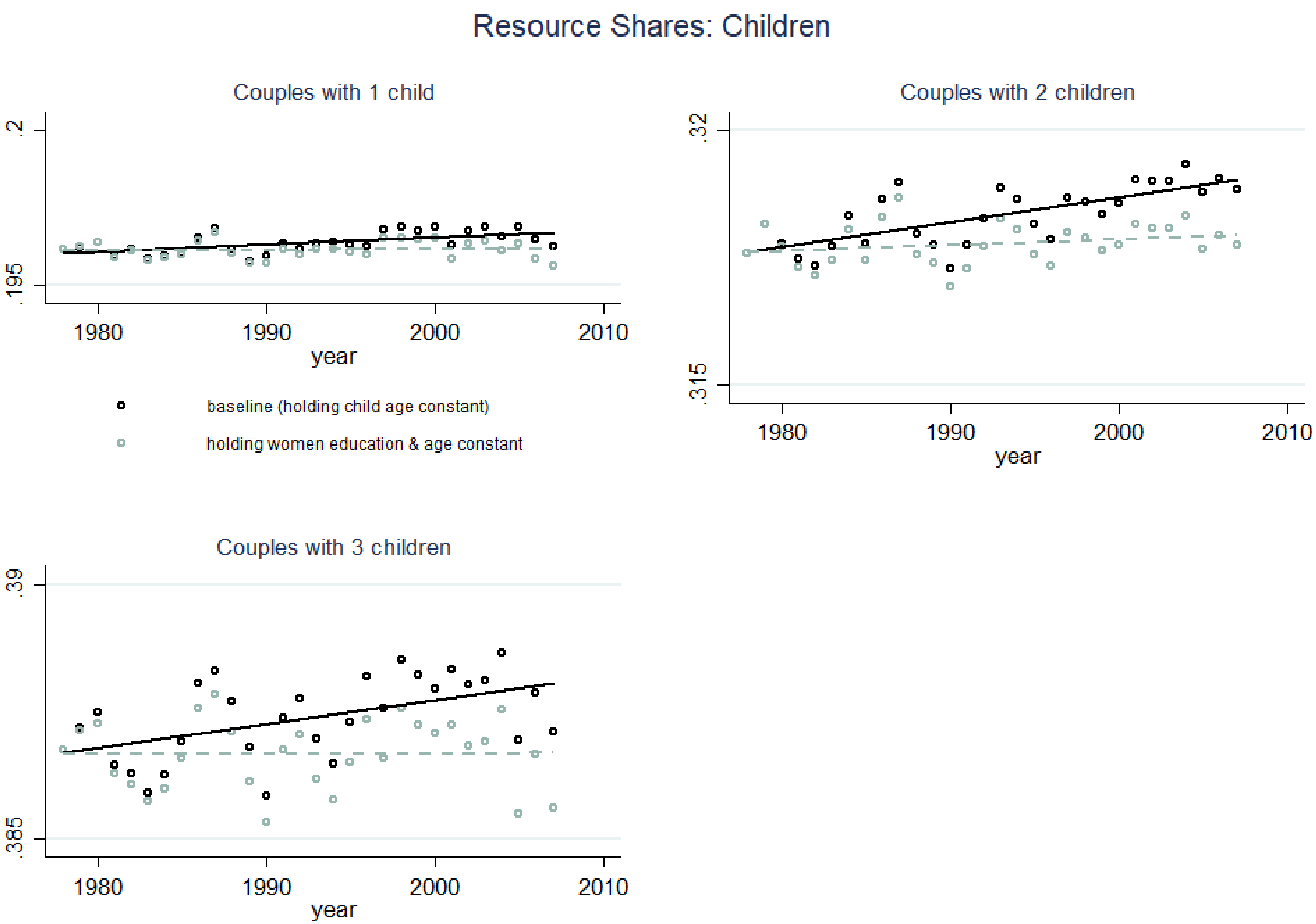
	Couple without child		Couple with one child		Couple with two children		Couple with three children	
	Est. Value	Std. Err.	Est. Value	Std. Err.	Est. Value	Std. Err.	Est. Value	Std. Err.
Women not on the labor market								
Women's share	0.5226	(0.0108)	0.4029	(0.0076)	0.3347	(0.0080)	0.2958	(0.0087)
Men's share	0.4774	(0.0108)	0.4095	(0.0228)	0.3495	(0.0292)	0.3199	(0.0284)
Children's share	-	-	0.1876	(0.0269)	0.3158	(0.0339)	0.3844	(0.0332)
Women on the labor market								
Women's share	0.5337	(0.0119)	0.4194	(0.0076)	0.3461	(0.0077)	0.3056	(0.0086)
Men's share	0.4663	(0.0119)	0.3922	(0.0226)	0.3368	(0.0284)	0.3083	(0.0274)
Children's share	-	-	0.1885	(0.0262)	0.3172	(0.0330)	0.3861	(0.0324)
Women's contribution to child cost	-	-	0.2083	(0.0184)	0.3540	(0.0222)	0.4328	(0.0226)
Men's contribution to child cost	-	-	0.1661	(0.0486)	0.2747	(0.0639)	0.3316	(0.0636)



Evolution of the Key Determinants of the Sharing Rule



Evolution of the Resource Shares



Evolution of the Resource Shares

Conclusion (1)

Main results

- A single child command about 19% of total expenditure and the resources accruing to children (the cost of children) increase with the number of children but at a decreasing rate.

- The cost of children tends to be mainly supported by mothers (their contribution is around one-third larger).

- Barten scales imply limited adult scale economies, due to the fact that our composite good ignores durables and housing costs.

- The sharing rule is relatively stable over the long period. Women's progress in education is the main driver of a (slight) increase of their resource share.

Conclusions (2)

Future research

- The fact that the per-child share of resources decreases as family size increases indicates the presence of scale economies among children. This has never been estimated and should be the focus of future work.

- Estimations are conducted on different household types and assume some stability on preferences for exclusive goods. Yet there is a likely selection into cohabitation/marriage or into the choice of having children. Because of the lack of good instruments, this potential endogeneity has not yet been addressed.