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Research Article

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Abstract

This paper presents an empirical analysis of the relationship between fertility and poverty for Indonesia, a country which has experienced unprecedented economic growth and sharp fertility decline over recent decades. We illustrate the sensitivity of the effect of fertility on household consumption with respect to the equivalence scale in a unitary household framework. Using the propensity score matching method, the analysis suggests that a newborn child decreases household consumption per person by 20 percent within four years. When the estimates of equivalence scales implied by the Indonesian sample are applied, the effect of a child on household consumption is still negative, but the magnitudes are in the range of 20 to 65 percent of that found with the per-capita expenditure as a measure of consumption. Therefore, it is suggested that analysis based on the conventional measure of poverty is likely to exaggerate the effect of fertility on poverty at least because of neglect of the proper equivalence scale. Given that household preference for consumption of private goods such as children's education is negatively associated with fertility, the test for household bargaining supports the model of the unitary household as a valid assumption for examining the relationship between fertility and household consumption.

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1. Introduction

The causal relationship between population growth and standard of living has long been of interest to policymakers. While the estimates of the effect of fertility on poverty range from being significantly positive to insignificant, a growing body of literature suggests that the true relationship is likely to be more complicated than unidirectional (e.g. Birdsall et al. 2001). The relationship between poverty and fertility is not unidirectional but dependent on the stage of economic development (McNicoll 1997, Schoumaker and Tabutin 1999). While in most contemporary developing countries this relationship is positive, a negative relationship has been reported within the poorest countries. The latter results are associated with lower reproduction capability and higher rates of infertility among extremely poor households (Lipton 1998, Livi-Bacci and De Santis 1998). Clearly many factors that influence fertility also determine well-being. These include education, health services and family planning policies. In addition to *joint causation*, *reverse causation* may also take place. Among poor households, the demand for children is high since those households rely on their children's labor supply and often the child's support is critical when parents become old. Higher fertility in turn is associated with lower investment in education (i.e. demand for quantity rather than quality of children) and consequently lower earnings potential for children, which in turn fosters intergenerational transmission of poverty (Moav 2005).

The theoretical perspectives suggest various mechanisms linking fertility and poverty. Empirical studies that tried to identify the causal relationship between fertility and poverty have so far relied on aggregate level data and cross-sectional micro level data (cf. the review by Merrick 2001). With these data, it is difficult to provide robust causal information about fertility and well-being because fertility and household income are jointly determined. Recent longitudinal household surveys in developing countries that incorporate the timing of fertility together with information on consumption expenditure, income and other measures of well-being allow researchers to identify the dynamic relation between poverty and fertility. So far, these data sets have not been used to study the link between poverty and fertility, which is the goal of this paper. In particular, we examine the Indonesian experience for which we have excellent longitudinal information on both fertility and household expenditure, together with a range of other background information.

The most commonly used measure of poverty is a dichotomous variable that indicates whether a household's consumption expenditure is below a certain poverty threshold level. Although this poverty measure is useful in comparing the standard of living across countries or over time, its analysis cannot measure the magnitude of the effect of fertility on household consumption. Moreover, the thresholds are often set in an arbitrary way. Therefore, we examine the relationship between fertility and household consumption directly. It should be noted that the level of consumption is not the only measure

of household welfare. In addition, parents may enjoy having children and children may make the consumption of other goods more enjoyable. However, in light of the Millennium Development Goals, set out by the United Nations, the materialistic measure of welfare is clearly of interest.[5] As a result, we examine here whether and how much having an additional child decreases household consumption.

One difficulty in establishing a relationship between fertility and household consumption is related to the measure of consumption (Ravallion 1996). As argued in Lanjouw and Ravallion (1995) "Despite extensive work on welfare measurement in economics, there is still no preferred method for making inter-personal comparisons across households of different size and/or composition." For instance, a common measure of well-being at the household level is *expenditure per adult equivalent*. However, assigning equal weight to all household members and overlooking economy of scale with household size ignores the compositional and size effect of households on the measure of well-being. As shown in Lanjouw and Ravallion (1995) for Pakistan, the measure of poverty is sensitive to the economy of scale parameter that is assumed. In this paper we investigate whether the causal relation between fertility and household consumption is sensitive to two dimensions of equivalence scale frequently discussed in the literature: the weight of a child's consumption relative to an adult's and the economy of scale (Banks and Johnson 1994; Koulovatianos et al. 2005)

A further complication in verifying the relationship between fertility and poverty is the issue of measuring a variation of fertility that is exogenous with respect to the measures of well-being. Two approaches have been adopted in the existing literature. The first one is to use the context of a natural experiment such as samples of twins or the sex composition of the first two children as an instrumental variable for fertility (e.g. Rosenzweig and Wolpin 1980; Angrist and Evans 1998). Although these instruments are reasonably valid, Rosenzweig and Wolpin (2000) note that this approach requires restrictions on the utility function (e.g. the separability of leisure and consumption, etc.). The second approach is to use the residual from a fertility regression as a measure of unobserved fecundity (Rosenzweig and Schultz 1985). Measuring female fecundity is certainly a useful approach, but the result is less intuitive. As an alternative approach, we apply here a matching method in order to estimate the effect of an additional child on household consumption in the short run. This approach assumes that the event of childbearing is independent of household consumption given observable characteristics. However, our focus is on illustrating the extent to which the effect of fertility on poverty depends on the measure of equivalence scale under a reasonable estimation strategy, and we minimize any possible bias due to

[5] The first goal of the Millennium Development Goal is to eradicate extreme poverty and hunger by 2015. It has two specific objects. The first is to reduce by half the proportion of people living on less than a dollar a day, and the other is to reduce by half the proportion of people who suffer from hunger. The full description is available at http://www.un.org/millenniumgoals/.

unobservable characteristics by conditioning on an extensive set of observable characteristics.[6]

The sensitivity of the effect of fertility on household consumption suggests that the expenditure share of private good may affect fertility decision. Then, the share of private good in household expenditure may be determined by the intrahousehold bargaining process. Therefore, these possibilities are further investigated in order to find an empirical evidence that connects unitary and collective models of a household.

Our main finding is that households with a new born child between 1993 and 1997 experience about 20 percent reduction in consumption when per-capita consumption is used as a measure of household consumption. However, the effect of fertility on consumption is highly sensitive to the choice of the equivalence scale. When we apply the estimated equivalence scale parameters with further assumptions on household welfare, the magnitude of the effect of fertility on consumption is in the range 20 to 65 percent of that found with the per-capita consumption. Therefore, it is suggested that the analysis based on the conventional measure of poverty is likely to exaggerate the effect of fertility on poverty at least because of the neglect of the proper equivalence scale. On the other hand, the household preference for consumption of private goods such as children's education is found to be negatively correlated with fertility. Further, the results of the tests for the household bargaining process supports the framework of a unitary household model, which is a basic assumption for the analysis of equivalence scale.

The rest of the paper is organized as follows. Section 2 introduces the measure of household consumption and summarizes estimates of the equivalence scale implied by the data. The method of analysis is discussed in section 3. Section 4 describes the institutional background, data and variables used in our study. The results on whether and in which direction fertility causes household consumption are presented in section 5. We apply household consumption expenditure per person and investigate the sensitivity of the results depending on the way in which household size and household composition are taken care of. Section 6 examines the effect of private goods share of expenditure on fertility and the effect of bargaining power on the share of private goods in household expenditure. In section 7 we conclude.

2. Measuring household consumption

The most commonly used measure of welfare is *household expenditure per person*. A critical issue when considering the effect of a new born child on household consumption is the definition of the equivalence scale (Lanjouw and Ravallion 1995). One approach is to directly estimate the cost of a child in terms of an adult's consumption (e.g. Deaton

[6] See Mattei (2004) for a similar approach.

and Muellbauer 1986). A limitation of this approach is that the calculation is based on households of a specific demographic type. Therefore, the result is not directly applicable to households of various demographic types. Unlike developed countries where nuclear households are common, there are 67 different types of households in our sample with the numbers of children and adults ranging from zero to ten and from one to twelve, respectively. Although, in principle, it is correct to calculate the cost of a child for each household type separately, it seems more appropriate here to estimate the effect of a newborn child in an average household.

One way of estimating the equivalence scale is to use a complete demand system and to estimate the equivalence scale for a particular type of household compared to a baseline household (e.g. De Santis and Maltagliani 2003). Our approach is to estimate two parameters of equivalence scale in a functional form, which can be applied to all households with different demographic composition. It has the disadvantage of assuming a particular functional form for the equivalence scale, but, at the same time, has an important advantage since it allows us to evaluate the effect of a birth on individual household consumption, on average, under the equivalence scale implied by the data. The functional form is widely used, and in this sense we are in line with the majority of the previous literature.

There are two dimensions of the equivalence scale to be considered: 1) the weight assigned to children relative to adults, and 2) the economy of scale in household consumption. We adopt a simple form of a welfare measure incorporating these dimensions, as suggested by Banks and Johnson (1994).[7]

$$W = \frac{H}{(A + \alpha K)^{\theta}}, \tag{1}$$

where H denotes total household expenditure, and A and K denote the number of adults and the number of children respectively. A measure of household consumption per equivalence scale, W, is the measure of household consumption when the cost of each member is taken into account. Therefore, if two households of different demographic characteristics have the same level of W, then it can be argued that they have the same level of welfare. In equation (1), the weight for a child relative to an adult is α, and the economy of scale is reflected through the parameter θ. Both α and θ take values between zero and one. Using the expenditure per person as a measure of household consumption implies that a child consumes as much as an adult and that there is no economy of scale in consumption of goods ($\alpha = 1$, $\theta = 1$).

[7] We are aware that the functional form used in the paper is not the only one used, but this version is a frequently used specification in the literature (e.g. Banks and Johnson 1994; Koulovatianos et al. 2005).

Since estimating the equivalence scale requires a set of assumptions about the household preference structure, we first study the effect of a child on consumption expenditure for different values of the equivalence scale ($\alpha = 1/2, 1$; $\theta = 1/2, 1$), and then apply our estimates of equivalence scale to illustrate the range of the effect of a child on individual consumption.

One way to estimate α and θ in equation (1) is to use experimental data as in Koulovatianos et al. (2005). Given the lack of the data on direct compensation for an additional child or an adult, we take an alternative approach using the Engel curve estimation as in Deaton and Muellbauer (1986).[8] That is, under the assumption that the inverse of food share of expenditure correctly indicates the welfare of household members, we calculate the amount of consumption that is needed in order to compensate for the additional members of the household compared to the baseline household. A household with two adults is taken as the baseline, and the estimated equivalence scales for households with different demographic characteristics are presented in Table 1. The estimation procedure is described in Appendix A. The second row in Table 1 states that a household with two adults and a child needs 126 percent of the consumption of the reference household in order to have the same level of welfare, suggesting that a child costs 52 percent of an adult's consumption.[9]

It is notable that the estimation procedure taken in the paper considers food as having a private good aspect. This assumption is not against the finding by Deaton and Paxson (1998). They show that conditional on the per capita expenditure the food expenditure per person as a private good should increase as household size increases but that data suggest the opposite. Since food having a public good aspect did not prove to be a good explanation for their puzzle, our assumption seems to be reasonable with regard to their findings.

As Blundell and Lewbel (1991) pointed out, the conditional demand equation can be used to identify the cost of living indices for different household compositions but not the true equivalence scale. Restoring the equivalence scale requires an identifying assumption such as independence of base utility, or the assumption that unconditional preference orderings depend on demographics only through Barten scales. With this limitation, we use the relative magnitudes of the costs of additional household members in order to estimate the parameters of equivalence scale.

[8] The Engel curve refers to the demand for a good (food in this case) as a function of income when the prices are fixed.

[9] Using an Indonesian survey (Susenas) in 1978, Deaton and Muellbauer (1986) estimated that a child costs 90 percent of an adult's consumption using Engel's method.

Table 1: Equivalence scale for different household types

Scale(S)	Household type	No. adults (A)	No. children (K)
1.00	AA (baseline)	2	0
1.26	AAK	2	1
1.41	AAKK	2	2
1.48	AAKKK	2	3
1.16	AAA	3	0
1.30	AAAK	3	1
1.37	AAAKK	3	2
1.38	AAAKKK	3	3

Notes: 1) *Data source*: The 1993 Indonesian Family Life Survey.
2) A child is defined as a household member under age 15.
3) The estimation is conducted under the assumption that the inverse of food share of expenditure correctly indicates the welfare of household members.
4) The estimated scale indicates the amount of consumption (compared to that of the baseline household) needed to make the household as well-off as the baseline household.

Given that there is a wide variety of household types in the sample, we run the following non-linear regression to find a set of parameters of equivalence scale, using the equivalence scales for eight different household types as shown in Table 1. We do this instead of estimating the equivalence scale for every household type separately.

$$S = \delta(A + \alpha K)^{\theta} + \varepsilon, \tag{2}$$

where S represents the estimated total equivalence scale, and δ is an additional scale parameter. Because we have only eight observations for estimating the parameters of the equivalence scale function, the estimates are often out of the range implied by the theory. By introducing additional parameter of δ we search for the range of estimates of α and θ satisfying the theoretical prediction. Although δ is not identified, it should be noted that the parameter δ does not affect the comparison of two households of different demographic types. The purpose of our study is not to estimate the exact equivalence scale for a specific practical application (such as a tax policy) but to find a range of reasonable estimates of α and θ that is implied by the data. The estimation procedure is that the values of α and θ are estimated for a fixed value of δ. Then, we find a range of δ that produces the estimates of α and θ between zero and one as indicated in Table 2. In the following sections, we estimate the effect of a newly born child on household consumption per equivalence scale for the range of the estimates in Table 2.

Table 2: Estimated parameters of equivalence scale

δ	$\widehat{\alpha}$	**t-ratio** $(\widehat{\alpha})$	$\widehat{\theta}$	**t-ratio** $(\widehat{\theta})$	**Residual**	$\mathbf{R^2}$
0.1	0.475	(1.28)	1.990	(6.00)	1.609	0.882
0.2	0.525	(1.43)	1.454	(6.32)	0.901	0.934
0.3	0.581	(1.55)	1.132	(6.53)	0.547	0.960
0.4	0.654	(1.68)	0.898	(6.70)	0.336	0.975
0.5	0.757	(1.81)	0.712	(6.83)	0.203	0.985
0.6	0.916	(1.95)	0.556	(6.93)	0.118	0.991
0.7	1.192	(2.07)	0.420	(6.93)	0.064	0.995
0.8	1.780	(2.10)	0.298	(6.65)	0.032	0.998
0.9	3.527	(1.77)	0.188	(5.61)	0.016	0.999
1.0	10.343	(0.94)	0.102	(3.37)	0.015	0.999
1.1	53.709	(0.26)	0.047	(1.26)	0.033	0.998
1.2	4,702,439.000	.	0.008	(4.29)	0.072	0.566
1.3	−0.617	(7.28)	−0.078	(1.37)	0.094	0.993
1.4	−0.477	(5.06)	−0.153	(2.88)	0.099	0.993
1.5	−0.363	(3.39)	−0.227	(3.82)	0.121	0.991
1.6	−0.284	(2.38)	−0.294	(4.38)	0.149	0.989
1.7	−0.226	(1.76)	−0.356	(4.75)	0.181	0.987
1.8	−0.183	(1.34)	−0.415	(5.01)	0.215	0.984
1.9	−0.149	(1.05)	−0.470	(5.20)	0.250	0.982
2.0	−0.122	(0.83)	−0.523	(5.35)	0.288	0.979

Notes: 1) Data source: Table 1.
2) The estimation is conducted under the assumption that the inverse of food share of expenditure correctly indicates the welfare of household members.

3. Statistical methods

In order to estimate the causal effect of fertility on material wellbeing, we apply a matching approach based on the treatment effect literature following the counterfactual model of causal inference. This approach is based on the intuitively attractive idea of contrasting the outcomes of a treatment group, Y_1, with the outcomes of a 'comparable' control group, Y_0, conditional on a set of characteristics of individuals, X. The outcome in this study is the household consumption expenditure per equivalence scale in 1997, and the treatment is defined as the birth of a child between 1993 and 1997. The control variable, X, includes the observable characteristics of households in 1993. Differences in the outcomes between the two groups are consequently attributed to the treatment, D. Matching methods for estimating causal effects have several advantages. First, they make no assumptions about the functional form of the dependence between the outcome of interest and the control variables. Second, matching ensures that the control variables of interest in the treatment group are similar to those in the control group and, thus, only similar units are compared. Third, since fewer parameters are estimated than in a traditional regression model, matching may be more efficient. This can be especially important if samples are small.

The matching method is based on the identifying assumption that, conditional on X, the outcome of the control group Y_0 is independent of the treatment D. Using the notation of Dawid (1979), the assumption of *strongly ignorable treatment assignment*

$$Y_0 \perp\!\!\!\perp D \mid X, \tag{3}$$

is sufficient to identify the *mean effect of treatment on the treated*, or ATT (Rosenbaum and Rubin 1983):

$$ATT = E(Y_1 - Y_0 \mid D = 1) = E(Y_1 \mid D = 1) - E(Y_0 \mid D = 0). \tag{4}$$

Assumption (3) produces a comparison group that resembles the control group of an experiment in one key aspect: conditional on X, the distribution of Y_0 given $D = 1$ is the same as the distribution of Y_0 given $D = 0$:

$$E(Y_0 \mid X, D = 1) = E(Y_0 \mid X, D = 0) = E(Y_0 \mid X). \tag{5}$$

In general, the households that experience the event of childbearing are likely to be different from those who do not in many respects. Examples include educational achievement, working status, preference for having children, and so forth. Thus a simple tabulation of the treatment and controls will most likely yield biased estimates of the treatment effect. In other words, these differences are going to affect the total household consumption expenditure, which induces a bias of the estimate due to selection. By matching the households based on a set of control variables, ATT in equation (4) corrects for the selection bias due to the correlation between childbearing and the observable characteristics of households (Rosenbaum and Rubin 1983). Strictly speaking, the matching method does not resolve any selection bias due to the unobservable characteristics (Heckman and Robb 1985). However, in so far as the observed variables used for matching also capture outcomes due to unobserved heterogeneity, this bias will be reduced. Hence, the set of variables included in the matching should be as extensive as possible, including both exogenous and endogenous variables. To further refine our estimates, we consider the difference between outcome variables in 1993 and 1997.

$$\begin{aligned} ATT &= E((Y_{1,1997} - Y_{1,1993}) - (Y_{0,1997} - Y_{0,1993}) \mid D = 1) \\ &= E(Y_{1,1997} - Y_{1,1993} \mid D = 1) - E(Y_{0,1997} - Y_{0,1993} \mid D = 0) \\ &= E(\Delta Y_1 \mid D = 1) - E(\Delta Y_0 \mid D = 0). \end{aligned} \tag{6}$$

The ATT in equation (6) is the so-called *difference-in-difference* estimator, and corrects for the selection bias due to the fixed component of unobservable characteristics. That is, if the effect of the unobservable characteristics of a household such as the preference for childbearing on individual household consumption is present in both 1993 and 1997 and if its magnitudes are the same, it is removed in equation (6) as the change in the outcome variable is considered. It should be noted that the identifying assumption for ATT in equation (6) has a weaker form implying that the change in the outcome of the control group is independent of the treatment.

$$Y_{0,1997} - Y_{0,1993} \perp\!\!\!\perp D \mid X. \tag{7}$$

However, our analysis is still prone to selection bias due to the time-varying component of the unobservable characteristics.

For estimating the mean effect of treatment on the treated, many matching estimators have been proposed that exploit assumption (7) for alternative matching methods. For all matching methods, the average treatment effect for the treated in equation (6) can be written as (Heckman et al. 1998):

$$E(\Delta Y_1 - \Delta Y_0 \mid D = 1) = \sum_{i \in T} w_i \left[\Delta Y_{1i} - \sum_{j \in C} W_{i,j} \Delta Y_{0j} \right], \tag{8}$$

that is, the average (weighted by w_i) of the differences between the events, Y_{1i}, of the treatment group T and the events, Y_{0j}, of the control group C weighted by $W_{i,j}$. The different matching algorithms differ in the construction of the comparison weights, $W_{i,j}$.

Traditional matching methods pair the non-treated with the treated persons that are 'close' in terms of X using different metrics, e.g. caliper matching of different widths, Mahlanobis distance matching, or kernel-based matching. In practice (i.e. with samples of typical size) it is often difficult to match on high dimensional X. Instead it is easier to do the matching based on individuals' probability of treatment, or in other words the *propensity score* (Rosenbaum and Rubin 1983). We define $P(X)$ as the propensity score with $P(X) = P(T = 1 \mid X)$. If the *balancing property*

$$D \perp\!\!\!\perp X \mid P(X) \tag{9}$$

is satisfied, i.e. X and D are independent conditional on $P(X)$, observations with the same propensity score must have the same distribution of observable and unobservable characteristics independent of treatment status. In other words, for a given propensity score, exposure to treatment is random. A theorem of Rosenbaum and Rubin (1983) demonstrates that if assumption (7) is satisfied, then

$$Y_{0,1997} - Y_{0,1993} \perp\!\!\!\perp D \mid P(X), \tag{10}$$

provided $0 < P(X) < 1$, so that there is a positive probability that the events $D = 1$ and $D = 0$ occur. This insight shows that matching can be performed on $P(X)$ alone, provided that the balancing property (9) holds.

Propensity scores are implemented in the matching techniques by defining the closeness of propensity scores and the control variable X in different ways. Since estimates are sometimes sensitive to the choice of matching technique, we implement several approaches. In particular we apply nearest neighbor matching, radius matching, kernel matching, and stratification matching based on the propensity score (Becker and Ichino 2002). With nearest neighbor matching, each member of the treatment group is matched to a non-treated unit using the closest propensity score. With radius matching, the treated units are only matched with non-treated units within a pre-specified range around their propensity scores. With kernel matching, the propensity score of each treated unit is matched with the kernel-weighted average outcome of all non-treated units.

Finally, with stratification matching, the range of variation of the propensity score is divided into intervals such that within each interval, treated and control units have on average the same propensity score.

4. Institutional background and data

4.1 Background and data description

In many developing countries we observe that fertility declines often come along with reductions in poverty. Indonesia is perhaps the most striking example of this pattern. Over the last four decades, Indonesia has experienced unprecedented economic growth together with a dramatic fertility decline. Table 3 shows that the real GDP per person increased by more than three times over the period 1970 to 1995, and total fertility rate fell by around 50% over the same period. This dynamic nature of the socio-economic change combined with a large population and its vast geographical diversity has attracted considerable interest among demographers and policymakers alike. We focus on the period between 1993 and 1997, which is at the end of the fertility transition and before the Asian Financial Crisis.[10]

Table 3: Total fertility rate and GDP per capita in Indonesia

Period	TFR	GDP per capita
1965-1970	5.57	297.6
1970-1975	5.20	384.3
1975-1980	4.73	503.0
1980-1985	4.11	601.7
1985-1990	3.50	776.7
1990-1995	3.00	1,048.7

Notes: 1) Source of TFR: World Population Prospects: The 2000 Revision, Vol. I, United Nations Population Division (requoted from World Resources Institute)
2) Source of GDP per capita: World Development Indicators 2004, The World Bank.
3) GDP per capita is in constant 1995 US dollars, and indicates the value in the last year of each period.

[10] The field work of the second wave of the Indonesian Family Life Survey (IFLS2) was conducted between August and December of 1997. Although there had been a modest increase in the exchange rate for that period, the real financial crisis took off in January 1998. Frankenberg et al. (2003) also point out that the growth rate of prices and wages in Indonesia started to jump in January 1998. Therefore, it seems reasonable to assume that the IFLS2 was not severely affected by the financial crisis.

Our study is based on data from the Indonesian Family and Life Survey (IFLS). The IFLS consists of three waves in total, IFLS1 conducted in 1993/94, IFLS2 and IFLS2+ in 1997 and 1998, and IFLS3 in 2000. In 1997, the Indonesian economy was hit by the Asian financial crisis. The second wave of the IFLS was conducted shortly before the event. We do not use any of the waves after 1997 in order to prevent estimates from being driven by the financial crisis. The IFLS is of exceptional quality and is ideal for the purpose of constructing a quasi-experiment of the type implemented here, as the survey contains extensive questionnaires on a range of aspects of household economy covering a period of steady economic growth. The survey has been conducted by RAND Corporation in collaboration with UCLA and Lembaga Demografi, University of Indonesia (Frankenberg and Karoly 1995). The sample is representative of about 83% of the Indonesian population and contains over 30,000 individuals living in 13 of the 27 provinces in the country. IFLS1 has 7,224 households, and subsequent waves targeted all the split-off households as well as all the original households previously interviewed. The response rate for the IFLS2 was 94 percent of the original sample (Frankenberg and Thomas 2000). The survey contains a wealth of information collected at the individual and household levels, including multiple indicators of economic well-being such as consumption, income, and assets. It also includes information on education, migration, labor market outcomes, marriage, fertility, contraceptive use and health. Information on relationship among co-residents and non-co-resident family members and inter-generational mobility are included as well. Another outstanding feature of the IFLS is the quality of information provided at the community level. The panel has information concerning the physical and social environment, infrastructure, employment opportunities, food prices, access to health and educational facilities, and the quality and prices of services available at those facilities.

4.2 Control variables

Our unit of analysis is the household. 6,742 households were interviewed in both waves. After dropping observations that have missing values for relevant variables, the final sample consists of 4,852 households. Table 4 presents summary statistics of household characteristics. The proportion of households with urban residence is 44% in 1993 and remains almost the same in 1997. Average household size is 4.57 in 1993 and it decreases by 0.1 in 1997. The proportion of children within households decreases from 0.31 to 0.28 between waves. The average number of newly born children between waves is 0.31. Put differently, 27% of the households experienced at least one live birth. Only 15% of households are headed by a female, and the head's average age is 45.6 years in 1993 and 48.4 in 1997. Islam is the dominant religion, as 87% of household heads are Muslim. The proportion of household heads who worked in the previous year increases from 82% to 86% between waves.

The educational attainment of household heads increases from 4.7 years in 1993 to 5.3 years in 1997. The proportion of households with new household heads in the second wave is four percent. General educational attainment of household members increases between 1993 and 1997 as can be seen in Table 2. The average number of adult men who worked in the previous year increases by 0.05, but that for adult women decreases by 0.07 in the second wave. The prevalence of child labor is low in the sample, which is partly due to the fact that the question of whether an individual worked in the past year does not capture part-time workers or unpaid family workers. The proportion of households with at least one farmer decreases from 42% in 1993 to 37% in 1997. Real monthly expenditure per person is 39,106 Rupiah in 1993 (in 1986 Rupiah), and it slightly decreases to 38,808 in 1997 (in 1986 Rupiah).[11] The expenditure share of food is 61% in 1993, and it increases to 67% in 1997.

Table 4: Summary statistics of the balanced panel (N = 4,852)

	1993		1997	
Variable	**Mean**	**S. D.**	**Mean**	**S. D.**
Demographic variables				
Urban residence (index)	0.44	(0.50)	0.43	(0.50)
Household size	4.57	(2.07)	4.47	(2.01)
Proportion of children in household	0.31	(0.22)	0.28	(0.22)
Proportion of adults in household	0.69	(0.22)	0.72	(0.22)
No. of children	1.62	(1.41)	1.44	(1.32)
No. of adults	2.95	(1.39)	3.03	(1.43)
No. of head's own children	2.13	(1.66)	2.01	(1.56)
No. of head's own sons	1.11	(1.15)	1.05	(1.09)
No. of head's own daughters	1.02	(1.06)	0.96	(1.01)
No. of generations	2.09	(0.58)	2.16	(0.60)
No. of newly born children between waves			0.31	(0.55)

[11] The consumption expenditure includes expenditures on food, non-food and education. The questionnaire of the IFLS asks about food expenditure in the past week, non-food expenditure in the past month (for the non-durable) or in the past year (for the durable), and educational expenditure in the past year.

Table 4: (Continued)

Variable	1993 Mean	1993 S. D.	1997 Mean	1997 S. D.
Household head characteristics				
Head is female (index)	0.15	(0.36)	0.17	(0.38)
Head's age	45.57	(14.21)	48.38	(13.81)
Head is Muslim (index)	0.87	(0.34)	0.87	(0.34)
Head worked last year (index)	0.82	(0.38)	0.86	(0.35)
Head's years of schooling	4.74	(4.22)	5.34	(4.36)
Head is married (index)	0.85	(0.35)	0.83	(0.38)
Head has a spouse in HH (index)	0.81	(0.39)	0.79	(0.41)
Head is new in the second wave (index)			0.04	(0.19)
Educational attainment				
No. of adult men with more than primary education	0.55	(0.81)	0.63	(0.86)
No. of adult women with more than primary education	0.43	(0.72)	0.53	(0.79)
No. of adult men with only primary education	0.30	(0.56)	0.33	(0.56)
No. of adult women with only primary education	0.29	(0.51)	0.34	(0.54)
No. of adult men with less than primary education	0.57	(0.66)	0.47	(0.63)
No. of adult women with less than primary education	0.82	(0.71)	0.72	(0.68)
Working status				
No. of adult men who worked last year	1.01	(0.70)	1.06	(0.67)
No. of adult women who worked last year	0.69	(0.70)	0.62	(0.68)
No. of male children who worked last year	0.02	(0.16)	0.01	(0.09)
No. of female children who worked last year	0.02	(0.14)	0.00	(0.07)
Household with at least one farmer (index)	0.42	(0.49)	0.37	(0.48)
Measure of welfare				
Real monthly expenditure per person/100 (1986 Rupiah)	391.06	(324.99)	388.08	(308.12)
Expenditure share of food	0.61	(0.20)	0.67	(0.18)

Notes: 1) Data source: IFLS1 (1993) and IFLS2 (1997).
2) 21 observations are dropped due to missing expenditure share of food.
3) Only primary education (six years of schooling) was compulsory until 1994. Since then, junior high school became mandatory. However, the full enrollment of junior high school has not been achieved.
4) A child is defined as a household member who is less than 15 years old.
5) The sampling weight is not applied.

5. Household consumption expenditure and fertility

This section presents our estimates of the effect of a new born child on household consumption using the average treatment effect model. The estimation is conducted in two stages. The first stage involves estimating the probability of receiving the treatment, in this case, having a child born between two waves is estimated. In the second stage, the average treatment effect is estimated by comparing households with and without the treatment that have similar propensity scores.

Since the main purpose for probit estimation is to construct a set of variables that can be used as a basis for matching households, the specification includes an extensive set of variables representing a household's demographic characteristics, educational attainment and working status including the head's characteristics. However, there still remains an issue of unobservable characteristics such as cultural norms that might affect female labor force participation and fertility. The identifying assumption for the matching method is that the treatment (i.e. to have a newborn child between 1993 and 1997) is independent of the characteristics observed in 1993 including female working status and female education. This assumption is not testable, and it is true that in the presence of unobservable characteristics such as cultural norms, two households identical with respect of all the variables except the treatment assignment may be different in a way unobserved by a statistician. Therefore, we try to minimize the bias in matching households by including as many variables as possible, including endogenous variables, and by including quadratic terms and interaction terms of those variables.

Table 5 presents the results of estimating a probit model for having a child between 1993 and 1997 with a set of variables satisfying the balancing property. Among the demographic variables, the age of previous children is an important determinant in addition to the number of previous children to explain a further childbearing. The households that have more children under five face a higher likelihood of a new birth as the household head ages. When there are more children aged 10 to 14, a household is less likely to experience a birth and the tendency is mitigated as the number of children of 10 to 14 increases. When more generations live together, a household has higher chance of having a birth.

The household head's characteristics turn out to be an important predictor for new childbearing. As a household head becomes older, a household is more likely to have a newly born child, and this tendency becomes stronger as the head gets older. Muslim households are associated with a higher chance of having a birth, whereas those heads who worked in the previous year are associated with a lower chance. The educational level of household head is negatively correlated with childbearing only when the head is female.

Table 5: Probit estimation of having a new child between 1993 and 1997

	Explanatory variables	Coefficients		Std. Error
Dependent variable: Index for having a new-born child between 1993 and 1997				
Demographic characteristics	Urban	-0.035		(0.051)
	No. of children of ages 0-4	-0.084		(0.134)
	No. of children of ages 0-4 sq.	-0.013		(0.036)
	No. of children of ages 0-4 * Head's age	0.005	*	(0.002)
	No. of children of ages 5-9	0.012		(0.139)
	No. of children of ages 5-9 sq.	0.017		(0.037)
	No. of children of ages 5-9 * Head's age	-0.001		(0.003)
	No. of children of ages 10-14	-0.521	**	(0.125)
	No. of children of ages 10-14 sq.	0.101	**	(0.027)
	No. of children of ages 10-14 * Head's age	0.004		(0.002)
	No. of adults	-0.069		(0.047)
	No. of generations	0.173	**	(0.051)
Household head's characteristics	Head's age	-0.052	**	(0.011)
	Head's age sq./100	0.029	**	(0.010)
	Head being Muslim	0.309	**	(0.069)
	Head worked last year	-0.273	**	(0.087)
	Head worked last year * Head's female	0.167		(0.148)
	Head's years of schooling	-0.011		(0.009)
	Head's years of schooling * Head's female	-0.053	**	(0.018)
	Head's female	-0.060		(0.142)
Educational attainment	No. of adult men with more than compulsory education	-0.013		(0.063)
	No. of adult women with more than compulsory education	0.139	**	(0.048)
	No. of adult men with only compulsory education	-0.001		(0.074)
	No. of adult women with only compulsory education	0.079		(0.048)
	No. of adult men with less than compulsory education	-0.025		(0.081)
Working status	No. of adult men who worked last year	0.196	**	(0.055)
	No. of adult women who worked last year	-0.002		(0.035)
	No. of male children who worked last year	-0.110		(0.148)
	No. of female children who worked last year	-0.158		(0.161)
	Any member worked as a farmer last year	0.069		(0.050)
	Constant	0.621	*	(0.275)
	No. of observations	4,694		
	Log Likelihood	-2,406.96		

Notes: 1) Standard errors are in parentheses.
2) * significant at 5%; ** significant at 1%.
3) The unit of observation is a household.
4) All the explanatory variables denote the values in 1993.
5) 179 households with more than one newborn child were dropped.

Among a set of variables representing educational attainment of household members only the number of women with more than primary education exhibits a significant association with having a child. The fact that higher female education is correlated with childbearing suggests that female education reflects higher income in the context of Indonesia.

Regarding the working status of household members, the only significant variable is the number of men working, which is positively associated with a new birth. This again suggests an income effect where higher labor income leads to more children.[12]

Table 6 presents *the effect of a newly born child on expenditure* in a household using the matching method described in Section 4 for the whole sample. The outcome is the difference in the household real monthly expenditure per equivalence scale.[13] A child is defined as a household member of age below fifteen. When the expenditure per person is used as a measure of individual household income, as in the first column, a newly born child has a significant negative impact on expenditure per person. Using the nearest neighbor matching method, the households with a new born child between the two waves experienced a decrease in consumption per person by 7,600 Rupiah, or 20 percent of consumption per person in 1997. This implies a substantial impact of fertility on household economy. Other matching methods produce similar results in terms of magnitude.

When a child is counted as half of an adult, as in the second column, the ATT is significant and negative, and the magnitude is in the range of 4,200 to 4,800 Rupiah. This is around 40% less than the per-capita reduction in expenditure. Although this result is expected, the level of change is surprising. The cost of a child is calculated to be 52% of that of an adult based on the comparison of the baseline household and the household of two adults and one child in Table 1. Therefore, the assumption that the weight of a child's consumption is one half is not totally unrealistic. The point is that the effect of a new born child on the individual household consumption can decrease by 40% when a child consumes a half of what an adult consumes.

[12] Strictly speaking there is no theoretical justification for having the number of adults working rather than the proportion of them as an explanatory variable. In principle the number and the proportion convey the same information. However, we are careful in introducing nonlinear variables in the specification because those variables seem to be hard to interpret for the marginal effects. Moreover, the specifications with nonlinear variables tend to make the balancing property unsatisfied. Therefore, we stick to the linear specification.

[13] If a birth took place near the time of the survey in 1997, then the consumption expenditure might be measured before the birth (thereby measuring the outcome before the treatment). To address the issue, we conducted the following analysis dropping from the treatment group the households whose newly born child is measured as zero years of age in 1997. The qualitative result remains the same as presented in the Table 6.

Table 6: Effect of fertility on household expenditure per equivalence scale I

Equivalence scale			**Cons. per person**	**Case A**	**Case B**	**Case C**
α			1.00	0.50	1.00	0.50
θ			1.00	1.00	0.50	0.50
Matching method	*n(T)*	*n(C)*				
Nearest neighbor	1,135	853	$-76.169**$	$-50.339**$	-20.347	13.320
			(18.318)	(20.700)	(39.841)	(36.119)
Radius	1,135	3,546	$-76.025**$	$-42.159**$	-7.361	34.697
			(9.710)	(12.568)	(19.286)	(26.586)
Kernel	1,135	3,546	$-80.243**$	$-52.637**$	-17.531	18.202
			(9.888)	(13.543)	(20.718)	(20.501)
Stratification	1,135	3,546	$-82.023**$	$-56.011**$	-20.560	13.557
			(10.585)	(13.384)	(20.946)	(24.550)

Notes: 1) The dependent variable is the difference in real expenditure per equivalent scale between 1993 and 1997 (100 Rupiah).
2) Standard errors (S.E.) are computed using bootstrap.
3) 179 households with more than one newborn child were dropped.
4) Treatment is to have a newly born child between 1993 and 1997.
5) n(T) and n(C) denote the size of treatment group and controlled group, respectively.
6) * significant at 5%; ** significant at 1%.

Next, the role of economy of scale is examined. The third column in Table 6 deals with a case where the economy of scale parameter is one half with a child consuming as much as an adult. The ATT is still negative but not significant. The magnitude of the ATT is in the range of 1,000 to 1,300 Rupiah, which is only around 16% of the reduction in per-capita expenditure. That is, the effect of new childbearing on individual household consumption almost disappears when the parameter of economy of scale is one half. Under this assumption, the expenditure of a household with three adults increases by 32% compared to a household of two adults at the same level of utility.[14] The estimated equivalence scale in Table 1 suggests that the expenditure increases by 16% from a household of two adults to that of three adults. Therefore, the size of one half as a parameter of economy of scale is reasonable.

[14] The calculation is based on the comparison of $\sqrt{2}$ and $\sqrt{3}$.

When both the relative weight of a child and the economy of scale parameter are set to be one half as in column (4) of Table 6, the ATT becomes positive but insignificant. The result is well expected from columns (2) and (3), but it is still surprising that the individual household consumption can increase even after a new birth under a different equivalence scale. When the significance of the estimates in Table 6 is considered, the exercise at least suggests that the negative effect of a new birth on individual household consumption can disappear for some range of realistic values of the equivalence scale. [15] [16]

Next we estimate the effect of a child on household consumption applying the estimates of the equivalence scale obtained in Table 2. The results are presented in Table 7. The first column is the case where expenditure per person is used as a measure of household consumption. The effects of a newly born child on consumption per estimated equivalence scale in the other columns are all negative although the estimates in column (3) and (4) are not precisely estimated. The magnitudes of the ATT are in the range from 20 percent to 65 percent of that estimated when the per-capita expenditure is used as a measure of consumption. Since the estimates of both equivalence scale parameters in Table 2 are between 0.5 and 1, the ATT in column (4) of Table 6 serves as an upper bound of the effect of a birth on individual household consumption. On the other hand, when it is used as a measure of individual consumption, the expenditure per person is likely to exaggerate the effect of a new born child on individual household consumption at least by 35%.

[15] Given the huge geographical diversity in Indonesia, one might expect a systematic difference between rural and urban samples due to the differences in relative prices or in the child care cost. However, it is found that the patterns of estimates with different equivalence scales in rural and urban samples are similar to that from the total sample.

[16] One observation is notable. The average treatment effect estimated using nearest neighbor matching method tends to be greater than the other estimates in both sub-samples. Further, the estimates seem to be ranked in the order of nearest neighbor matching, radius matching, kernel matching, and stratification matching. However, to our knowledge, no studies are able to verify that there is a systematic difference in the magnitudes of the average treatment effect from different matching methods.

Table 7: Effect of fertility on household expenditure per equivalence scale II

Equivalence scale (ES)			Cons. per person	Implied ES 1	Implied ES 2	Implied ES 3
α			1.00	0.65	0.76	0.92
θ			1.00	0.90	0.71	0.56
Matching method	*n(T)*	*n(C)*				
Nearest neighbor	1,135	853	$-76.169**$	$-54.287**$	-42.877	-27.683
			(18.318)	(20.914)	(25.913)	(32.502)
Radius	1,135	3,546	$-76.025**$	$-47.248**$	$-33.178*$	-15.625
			(9.710)	(11.270)	(16.115)	(19.355)
Kernel	1,135	3,546	$-80.243**$	$-56.250**$	$-42.872**$	-25.685
			(9.888)	(14.446)	(15.829)	(19.121)
Stratification	1,135	3,546	$-82.023**$	$-59.196**$	$-45.903**$	-28.721
			(10.585)	(14.164)	(15.759)	(20.025)

Notes: 1) The dependent variable is the difference in real expenditure per equivalent scale between 1993 and 1997 (100 Rupiah).
2) Standard errors (S.E.) are computed using bootstrap.
3) 179 households with more than one newborn child were dropped.
4) Treatment is to have a newly born child between 1993 and 1997.
5) n(T) and n(C) denote the size of treatment group and controlled group, respectively.
6) * significant at 5%; ** significant at 1%.

6. Private expenditure on child and intra-household bargaining

The finding of the previous section has implications on the relationship between fertility and the expenditure on private-public goods. Our results indicate that fertility affects household consumption differently depending on the assumption about the economy of scale and the relative weight of a child consumption to that of an adult (see Table 6). These findings in turn, imply that the characteristics of household consumption is likely to affect fertility.[17] In particular, the composition of the expenditure on private and public goods may reflect the price of having a child. For example, the share of private goods such as children's education in household expenditure can be interpreted as indicating a

[17] We owe this section to two anonymous referees, who suggested adding the discussion on fertility, the consumption of public-private goods and the intra-household bargaining.

household's preference for quality of a child. The larger share of educational expenditure a household has, the less likely it is to give birth. We test this hypothesis using a probit model as used in Table 5. As a measure of the expenditure on private goods, three variables are used: share of educational expenditure, educational expenditure per person and educational expenditure per child.[18]

The results are displayed in Table 8. The basic specification in column (1) shows the result similar to that of Table 5. Most variables representing household characteristics and provinces are abbreviated in order to keep the focus on educational expenditure. Total household expenditure per capita does not exhibit any significant impact on fertility in the sample of all the households, whereas a positive income effect is found for the group of households with any child in column (4).

Table 8: The effect of educational expenditure on fertility (Probit Model)

Dependent variable: Index for having a newly-born child between 1993 and 1997	**(1) All**	**(2) All**	**(3) All**	**(4) HH with children**
Share of educational expenditure	-	$-0.864**$	-	-
		(0.199)		
log Educational expenditure per person	-	-	$-0.084**$	-
			(0.015)	
log Educational expenditure per child	-	-	-	$-0.072**$
				(0.015)
log Total household expenditure per person	-0.003	0.012	0.059	$0.083*$
	(0.035)	(0.035)	(0.036)	(0.042)
No. of observations	$4,694$	$4,694$	$4,694$	$3,480$
Log Likelihood	$-2,421.43$	$-2,411.55$	$-2,405.13$	$-1,880.73$

Notes: 1) Standard errors are in parentheses.
2) * significant at 5%; ** significant at 1%.
3) The unit of observation is a household.
4) All the explanatory variables denote the values in 1993.
5) 179 households with more than one newborn child were dropped.
6) Household characteristics and province dummies are included in all specifications.

[18] The educational expenditure as a part of the information on consumption expenditure is measured at the household level, and it is not separated for adults' education and children's. Therefore, both results with the educational expenditure scaled in terms of per capita and per child are presented below.

Column (2) of Table 8 indicates that a household spending more on education is less likely to give birth as expected. The implied marginal effect suggests that one percent change in educational share of expenditure is associated with a quarter percent change in the probability of giving birth between 1993 and 1997. The absolute level of educational expenditure per person also has a negative effect on the likelihood of having a new child as in column (3). Using the educational expenditure per child as a measure of the educational expenditure generates the similar result, where only households with any child are considered (column (4)). The changes in probability of giving birth associated with one percent change in educational expenditure per person and per child are 0.25 percent and 0.23 percent, respectively. Therefore, it may be inferred that those households with more expenditure on private goods like education are less likely to give birth.

In examining the relationship between fertility and household consumption so far, we have assumed that a household makes a decision the same way as an individual does. If a household behaves collectively through a bargaining process among its members, the specification for equivalence scale needs to be modified accordingly as suggested by Browning et al. (2006). Therefore, it would be informative to investigate whether the framework of a unitary household is supported by the same data.

In understanding the relationship between household preference and fertility, the demand for private goods may be determined by household members with different preference and bargaining power (Browning and Chiappori 1998). Specifically, the expenditure on children's education may be determined by the husband and wife's collective decision. It is a common conjecture that mothers tend to care more about children's education, or that mothers at least have different preference from fathers. Therefore, we focus on investigating the differences in preferences of husband and wife with regard to children's education in the context of Indonesia. Using the first wave of the IFLS, the effect of the bargaining power on the educational share of expenditure is examined.

One measure of bargaining power suggested in the literature is nonlabor income (Lundberg et al. 1997; Duflo 2003; Park 2007). In the IFLS, the nonlabor income is constructed by combining income from pension, scholarship, insurance claim, lottery or gift from family, friends and charity. One limitation is that the percentage of the households with positive nonlabor income is relatively small (17% for husband's nonlabor income, 22% for wife's at household level). Another measure indicating bargaining power is premarital assets (Quisumbing and Maluccio 2003; Park 2007). The IFLS has the information on premarital assets, but there is a substantial attrition (48%) due to the availability of premarital assets and the relevant price indices.

In addition, we consider the share of the current asset as a measure of bargaining power assuming that the individual shares of current assets are exogenously given. Three kinds of assets are used: farm business, non-farm business and house. Because the recorded values of assets are not reliable, the relative ownership of an asset is taken as

a measure of bargaining power. That is, the sum of shares of ownership between husband and wife is set to be one. A husband's share of one asset, for example, farm business should be interpreted to be valid among households with farm business since it is, in fact, the interaction term between farm business owner dummy and the husband's share.

As discussed in the literature, we test for unitary versus collective household decision process by investigating whether the individual resources of husband and wife have the same effect on educational expenditure. Also we examine whether husband's share of assets have any impact on the expenditure on education.[19]

Regarding the dependent variable, there are two sources for educational expenditure in the IFLS. The first is the information on educational expenditure as a part of the household consumption expenditure. The educational expenditure for a household includes the expenditure on adults' education as well as children's education. The second is the educational expenditure for a particular child. The IFLS has a special section on children under age 14, which was conducted for two randomly chosen children per household. The educational expenditure on a child was collected only for those attending school. We use both pieces of information. First, the household educational expenditure per person is used as a measure of educational expenditure with the assumption that the expenditure on adults' education is negligible. Second, the results using the expenditure on a school child as a measure of educational expenditure in a sample of children are presented.

The results using the data at the household level are presented in Table 9. According to column (1), households with non-farm business tend to spend less on education, whereas households with farm business or house do not exhibit any difference. Husband's share of three assets does not have any impact on educational spending. Households with larger total household expenditure per person tend to spend more on education. One percent increase in per capita household expenditure is associated with 2.5 percent increase in share of the expenditure on education. This magnitude is roughly consistent in column (2) and (3). In column (2) the husband's and wife's premarital assets have an impact on educational spending with different direction, but the result does not reject the hypothesis that they have the same impacts at the conventional level of significance. Husband's and wife's nonlabor income does not show any effects significantly different from each other as in column (3). When the log of educational expenditure per person is used as a dependent variable in column (4) to (6), the results remain qualitatively the same.

[19] Under the null hypothesis that the resources of a husband and a wife have the same effects, the husband's share should have no effect on educational expenditure.

Table 9: Household bargaining and educational spending I

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)
	Share of educational expenditure			log Educational expenditure per person		
Farm business owner	0.003	-	-	0.040	-	-
	(0.004)			(0.052)		
Farm business husband's share	−0.006	-	-	−0.080	-	-
	(0.009)			(0.111)		
Non-farm business owner	−0.009∗	-	-	−0.037	-	-
	(0.004)			(0.046)		
Non-farm business husband's share	0.003	-	-	0.022	-	-
	(0.008)			(0.097)		
House owner	−0.002	-	-	0.019	-	-
	(0.005)			(0.064)		
House husband's share	0.009	-	-	0.052	-	-
	(0.009)			(0.107)		
log Husband's premarital asset(α_1)	-	−0.001	-	-	−0.002	-
		(0.001)			(0.009)	
log Wife's premarital asset(α_2)	-	0.002	-	-	0.011	-
		(0.001)			(0.012)	
log Husband's nonlabor income(α_3)	-	-	−0.0004	-	-	−0.003
			(0.0010)			(0.013)
log Wife's nonlabor income(α_4)	-	-	−0.0001	-	-	0.020
			(0.0009)			(0.012)
log Total household expenditure per person	0.025∗∗	0.018∗∗	0.023∗∗	0.806∗∗	0.800∗∗	0.802∗∗
	(0.004)	(0.005)	(0.004)	(0.039)	(0.051)	(0.039)
No. of observations	4,595	2,412	4,466	4,595	2,412	4,466
R^2	0.19	0.21	0.19	0.44	0.47	0.44
p-value for:						
$H_0 : \alpha_1 = \alpha_2$	-	0.08	-	-	0.38	-
$H_0 : \alpha_3 = \alpha_4$	-	-	0.80	-	-	0.21

Notes: 1) White heteroscedasticity-corrected standard errors are in parentheses.
2) * significant at 5%; ** significant at 1%.
3) The unit of observation is a household.
4) All the explanatory variables denote the values in 1993.
5) 179 households with more than one newborn child were dropped.
6) Household characteristics and province dummies are included in all specifications.

The results from the child level data are shown in Table 10. In column (1), households with non-farm business tend to spend more on children's education in contrast to column (1) in Table 9. The difference is likely to be due to the selection of samples. Households with other assets do not spend on education any differently. Husband's share of the three assets do not have any significant effects on children's educational spending. In column (2) the premarital assets of a husband and a wife do not have any significant impact on education nor are their effects different from each other. Nonlabor income of a husband and a wife in column (3) is associated with a larger spending on education, but the result does not reject the hypothesis that their effects are of the same magnitude.

One limitation of the analysis is that the size of samples vary over the specifications due to the availability of data. However, data at both household and child level produce results in favor of a unitary household model. The results are consistent with Park (2007), who did not find a clear evidence that a parental household bargaining plays an important role in the decision of expenditure on children's education using the third wave of IFLS.[20] Therefore, the framework of a unitary household seems to be valid at least in understanding the relationship between fertility and household consumption.

Table 10: Household bargaining and educational spending II

	(1)	**(2)**	**(3)**
Dependent variable: log Educational expenditure for a child			
Farm business owner	-0.087	-	-
	(0.051)		
Farm business husband's share	0.097	-	-
	(0.106)		
Non-farm business owner	$0.125**$	-	-
	(0.041)		
Non-farm business husband's share	0.043	-	-
	(0.087)		
House owner	-0.073	-	-
	(0.061)		
House husband's share	-0.166	-	-
	(0.099)		

[20] Park (2007) also found a consistent evidence in favor of a collective household model examining the children's nutritional status, and suggested that the decision process may differ depending on the type of decision.

Table 10: (Continued)

Dependent variable: log Educational expenditure for a child	(1)	(2)	(3)
log Husband's premarital assets (α_1)	-	0.010	-
		(0.008)	
log Wife's premarital assets (α_2)	-	−0.008	-
		(0.009)	
log Husband's nonlabor income (α_3)	-	-	0.019
			(0.010)
log Wife's nonlabor income (α_4)	-	-	0.015
			(0.010)
log Total household expenditure	0.376**	0.351**	0.395**
per person	(0.036)	(0.046)	(0.037)
Female	0.021	0.032	0.026
	(0.034)	(0.042)	(0.034)
Age	0.113**	0.122**	0.109**
	(0.009)	(0.011)	(0.010)
No. of observations	2,665	1,716	2,612
R^2	0.34	0.35	0.34
p-value for:			
$H_0 : \alpha_1 = \alpha_2$	-	0.14	-
$H_0 : \alpha_3 = \alpha_4$	-	-	0.81

Notes: 1) White heteroscedasticity-corrected standard errors are in parentheses.
2) * significant at 5%; ** significant at 1%.
3) The correlation between children from the same household is allowed when the standard errors are calculated.
4) The unit of observation is a child.
5) All the explanatory variables denote the values in 1993.
6) 179 households with more than one newborn child were dropped.
7) Household characteristics and province dummies are included in all specifications.

7. Conclusion

This paper describes the causal effect of fertility on household consumption in Indonesia at the end of a fertility transition in a unitary household framework. Using the nonparametric propensity score matching method, it is found that a newly-born child leads to a reduction of consumption by 20 percent within four years, when consumption expenditure per person is used as a measure of household consumption. This effect, however, is extremely sensitive to the choice of equivalence scale. Using the estimates of equivalence scale based on the assumption that food share inversely indicates the level of household welfare, it is shown that the effect of a child on household consumption is still negative but the magnitude is in the range from 20 to 65 percent of that obtained when per-capita consumption is used as a measure of household consumption. Hence, the results suggest that the analysis based on the conventional measure of poverty is likely to exaggerate the effect of fertility on poverty at least because the equivalence scale is not properly taken into account (e.g. Mason and Lee 2004).

The prevalence of poverty measure based on consumption per person is mainly due to its practical convenience and the strong assumptions required for alternative measures. Our analysis presents a reasonable and practical way of estimating the equivalence scale and applying it to the question on the relationship between fertility and poverty. The increasing quality of survey data in recent years enables one to incorporate the equivalence scale in the poverty analysis in demographic research at least within a certain country.

The sensitivity of the effect of fertility on household consumption with respect to the equivalence scale generates two theoretical implications. First, it illustrates the importance of separating public from private consumption. The expenditure on private goods such as children's education reflects the price of having a child. Second, our analysis provides an empirical bridge between unitary and collective models of the household. The results suggest that the expenditure share of private goods can be used to test for a collective decision making process in a household. Although the data are limited, our finding is that the demand for children's education does not seem to be affected by the parental bargaining process.

There are a couple of directions suggested for future research. First, since the choice of welfare indicator may make a considerable difference in the estimation as Anand and Harris (1994) suggested, it is worthwhile to extend the analysis in the paper by using other measures of household welfare including income or body mass index. Secondly, because poverty is measured as an aggregate variable in a household in this study, it is not clear how fertility is going to affect total household income. Therefore, estimating the effect of fertility on the elements of household income, such as the working hours or earnings per hour of household members in a structural model, will be a fruitful way of investigating the causal relationship between fertility and household welfare.

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Appendix: Estimating Equivalence Scale using Engel method

Calculating the equivalence scale requires an assumption on the measure of welfare. Two methods of constructing a proxy of welfare are widely used in the literature. The Engel method assumes that the food share of expenditure inversely indicates the level of household welfare. The Rothbarth method assumes that the consumption of adult goods correctly indicates the level of adults' welfare in a household. With the limitation on the detail of consumption measure in the IFLS, we take the Engel method in estimating equivalence scale.

The food share of expenditure is considered as a simple linear function of the household expenditure per person and the demographic characteristics as in Deaton and Muellbauer (1986).

$$w_f = \alpha + \beta \ln(\frac{x}{n}) + \sum_{j=1}^{J} \gamma_j n_j + \varepsilon \tag{11}$$

where w_f is the food share of household, x is the total household expenditure, n denotes the number of household members, n_j is a set of the variables indicating the demographic structure of a household, and ε represents a residual. The results are presented in Table 11. The ordinary least squared (OLS) estimation suggests that ten percent increase in expenditure per person is associated with a decrease of 0.013 in the food share. Controlling for the expenditure per person, an additional adult or child are associated with a lower food share, and the magnitude of the change is larger for an adult. Since there exists a huge geographic diversity in Indonesia, we run the community fixed-effects estimation in order to control for the variation in prices or infrastructure at the community level. The results, shown in column (2), are similar to those from the OLS estimation.

With the estimates of the Engel curve, we calculate the equivalence scale by comparing two households with different demographic structures (i.e. household composition). We denote the total expenditure and the demographic characteristics of the baseline household of two adults by x_0 and n_0, respectively. We are interested in the amount of expenditure, x_c, that would give the same level of food share to a household with a demographic structure, n_c, as that of the baseline household.

$$\alpha + \beta \ln(\frac{x^c}{n}) + \sum_{j=1}^{J} \gamma_j n_j^c = \alpha + \beta \ln(\frac{x^0}{n}) + \sum_{j=1}^{J} \gamma_j n_j^0 \tag{12}$$

The ratio of x_c to x_0, or the equivalence scale, $E(c,0)$, is obtained by solving equation (12) for $\frac{x_c}{x_0}$.

$$E(c,0) = \frac{x^c}{x^0} = \frac{n^c}{n^0} / exp\left(\sum_{j=1}^{J} (\frac{\gamma_j}{\beta})(n_j^c - n_j^0) \right) \tag{13}$$

Table 11: Engel Curve Estimation

	(1) OLS	**(2) Comm FE**
Dependent variable: Food share of expenditure		
$\log \frac{x}{n}$	$-0.127**$	$-0.119**$
	(0.003)	(0.004)
No. of adults	$-0.032**$	$-0.027**$
	(0.002)	(0.002)
No. of children	$-0.022**$	$-0.026**$
	(0.002)	(0.002)
Constant	$1.462**$	$1.407**$
	(0.021)	(0.024)
No. of observations	4,852	4,852
No. of communities		311
R^2	0.27	0.21

Notes: 1) Standard errors in parentheses.
2) * significant at 5%; ** significant at 1%.