Fertility and its Consequence on Family Labor Supply and Income

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(comments welcome)

Abstract

While a large body of literature focuses on how the fertility affects female labor market participation, there are relatively few studies that examine the effect of fertility on male labor market participation. Even if the burden of child care falls mainly on women, an exogenous increase in fertility is likely to change the optimal allocation of time, therefore, the labor supply decision of both female and male in a household. This paper examines how an exogenous increase in fertility affects labor market participation of a woman and a man in a household. The finding is that women reduce their working hours in response to the higher fecundity. On the other hand, the higher fecundity does not lead to men's increasing or decreasing their working hours. Further, there is found no evidence that fertility affects female or male earnings. The results suggest a few characteristics of Indonesian labor market and household structure.

Keywords: Fertility, Labor Market Supply, Labor Income, Poverty.
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1 Introduction

In many developing countries we observe that fertility declines often come along with increased household income. Indonesia is perhaps the most striking example of this pattern. From being a poor country with high fertility levels, Indonesia has over the last four decades experienced unprecedented economic growth together with a dramatic fertility decline. Table 1 shows that 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 economists and policy makers alike.

In this paper we analyze the relationship between fertility and household income. As the main part of household income consists of labor earnings, we examine specifically to what extent fertility may impact husband and wife's labor supply decision and their labor earnings. The majority of work concerning consequences of fertility tends to focus on female labor market participation and her earnings. Much less emphasis has been put on how fertility affects household income through male labor supply. Though the burden of child care tends to fall on women, an increase in fertility is likely to change the optimal time allocation within the household, and therefore influence the labor supply decision - and their labor earnings - of both husband and wife. Though the assumption of exogenous male labor supply (with respect to fertility) is a common one, one can easily imagine scenarios of imperfect capital markets or household time allocation settings in which this assumption is unlikely to hold. For instance, a husband may increase the hours of working in response to having additional children due to higher marginal utility of other consumption goods, or, a husband may decrease the hours of working if he enjoys his leisure more with children than without them.

Table 1: Total Fertility Rate and GDP per capital 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.

Examining the role of fertility on household income through men and women's labor supply decisions is important for several reasons. Since labor earnings is the major part of household income, the determinants for labor supply decisions also become important determinants for poverty. By examining men and women's labor supply separately enables us to identify to what extent changes in household income are driven by a possible fall in women's labor income (as a result of fertility), and possibly alleviated through a compensation of the husbands's labor supply and labor income. The approach provides an important advantage over traditional poverty analysis normally based on regression techniques using poverty status as the dependent variable, where labor supply are assumed exogenous regressors. But men and women's labor supply are themselves choice variables suitable for economic analysis. Higher labor supply, and therefore higher labor income, is associated with lower poverty, whereas the number of children is normally associated with higher poverty. The issue of male labor supply is also important for poverty predictions, since this is normally the main income source for most households. Traditional poverty analysis does not provide such insights since poverty itself is normally based on total household income. The traditional approach to poverty analysis is unfortunate, since poverty itself cannot be considered as a household choice

variable, and as such do not lend themselves easily to economic theory. Here we investigate the effect of labor supply and childbearing decisions on household earnings, but rather than treating these variables as regressors in an income equation, we discuss these processes directly, and then analyze the implications for poverty. As such the approach is similar to the one taken in Aassve et al. (2005).

The modeling strategy invokes many well known issues from the labor economics literature. The most crucial issue concerns the endogeneity issue of fertility. Clearly women's labor supply, and possibly labor supply of the husband, is a decision made jointly with fertility decisions. Consequently a central theme of any analysis of fertility on labor supply and household income is to account for the likely endogeneity bias. Here we follow the approach taken by Rosenzweig and Schultz (1985). By considering a dynamic model of fertility control and labor supply, they show that the effect of an exogenous increase in fertility on female labor market participation combines two opposing effects. One is the increase in the marginal utility of consumption good due to the higher fertility, which leads to an incentive to work more. The other is the increase in returns to being at home if a child good and leisure are complements in utility. When a male labor supply is considered additionally, the theoretical prediction requires a number of assumptions on the complementarity of female and male leisure and the production function of child good (Angrist and Evans 1996). Given the theoretical discussion on allocation of time in the theoretical development in the literature, we focus on the empirical question on the consequences of fertility on family labor supply.

From an empirical perspective the main challenge is to construct an exogenous measure of fertility as a means to analyze the impact on labor supply. There are two approaches to estimate the effect of exogenous variation of fecundity. One approach is to employ instrumental variables estimation. The proposed instrumental variables include twins as in Rosenzweig and Wolpin (1980)

and the sex composition of the first two children as in Angrist and Evans (1998). The number of twins in our sample is not large enough for any statistical inference, and the analysis of third birth also restricts the sample substantially. The other approach, which is pursued here, involves estimation of a reproduction function taking into account endogenous contraceptive choice. This approach, first presented by Rosenzweig and Schultz (1985), provides an exogenous measure of fertility, or fecundity, which is used as a regressor in the labor supply functions for women. However, we extend their analysis by investigating the effect of male labor supply and, thereby, family labor supply.

Our finding is that women reduce their working hours in response to the higher fecundity. On the other hand, the higher fecundity does not lead to men's increasing nor decreasing their working hours. The results remain the same when female and male labor supply are estimated jointly allowing for the marriage market selection. Hence, it is suggested that the two opposing effects of fertility on male labor supply offset each other. It is also found that neither female or male earning changes significantly with an increase in fecundity. Therefore, again, the two opposing effects of fertility on male labor productivity seem to offset each other. Although the overall finding of the paper is a negative one, we believe that the contribution of the paper is the empirical investigation into the characteristics of Indonesian labor market and household structure given the complexity of the theoretical prediction on fertility and family labor supply.

The paper is organized as follows. Section 2 provides a theoretical background. Section 3 describes the data. Section 4 presents the empirical specification and the results. The final section presents a discussion and further extensions.

2 Theoretical Background

Economic theory argues that fertility will have two different effects on family labor supply. First, given that the responsibility of child care falls mainly on women in a household, the framework of allocation of time and efforts by Becker (1985) predicts that an increase in fertility will lead to women spending more energy and time on child care due to the increase in its effort intensity (per unit of time) in child care. Men are likely to spend more time and energy in a market activity in response to an increase in fertility if a consumption good and a child good are complementary. This effect is often referred to as a specialization effect.

Second, when there are more children, the value of parents' time as inputs in the production of a child good may increase. In this case both the woman and the man will reduce their labor supply in terms of time and energy, an effect Lundberg and Rose (2002) refer to as the home-intensity effect.

Both hypotheses predict that the female labor supply and earning will decrease in response to an increase in fertility. However, the male labor supply and earning may increase or decrease depending on which of the two effects (specialization and home-intensity) dominates the other.

Recent studies on fertility and family labor supply provide mixed results. Using the sex composition of the first two children as instrumental variables for fertility, Angrist and Evans (1998) found that fertility reduces female labor supply significantly but that there is no significant change in male labor supply in the U.S. On the other hand, in their individual fixed-effect estimation, Lundberg and Rose (2002) found that the presence of children significantly increases male labor supply in the U.S.[1] By estimating the allocation of time, the value of non-market time, job tenure, market wages, and fertility for married couple in the PSID sample, Millimet (2000) found that

[1]Of course, the fixed-effect estimation leaves a potential endogeneity issue that the male labor supply at the previous period may affect both labor supply and fertility at the current period.

fertility reduces male and female labor supply and that it does not have a significant impact on male and female wages.

The separate estimation of female or male labor supply employed by these two studies may induce a bias due to a selection in the marriage market. For example, if more fertile women have a higher preference for household activity (like child care), then they are more likely to marry a man who prefers market activity. Therefore, we take both separate and joint estimation of female and male labor supply in order to assess this possibility.

3 Data

The data used in this study are from the Indonesian Family Life Survey (IFLS), which was collected in 1993, 1997, and 2000. The IFLS has an extensive questionnaires concerning fertility, labor market participation, migration and health, to mention a few. Importantly for this study, it also collects detailed information on contraceptive behavior. It also has a detailed information on infrastructure, health institutions and schools at the community level. The first wave has 7,224 households, and the split-off households as well as original households were interviewed in the subsequent surveys. The response rates for the second and third wave are over 90%.

The subsequent analysis utilizes the first wave of IFLS, but we plan to extend the analysis in order to take advantage of the panel structure of the data. There is a total of 4,890 women for whom detailed information on birth history, marriage and contraception is available in the IFLS1. The analysis is restricted to women married for at least five years and whose spouse is identified in the IFLS sample. The final sample include 3,287 women with no missing values for the relevant variables.

The summary statistics is presented in Table 2. On average, women are 34.5 years old, and have 5.0 completed years of schooling. Half of the women have a job in 1993, and the mean hours

of working is 16.4 hours per week. They had 3.3 children by 1989, and had 0.6 births between 1989 and 1992. Their spouses are six years older, and have one more year of schooling on average. The spouses' average weekly hours of working is 37.9 hours.

The dependent variable in the reproduction function is the conception rate, which is measured by the number of conceptions per month at risk of pregnancy over the five years prior to the time of survey. The Measure of contraception efforts is the proportion of the number of months of using a certain method out of total months at risk of pregnancy. The methods include pills, IUD, injection, implant, diaphragm/condom, female/male sterilization, and other less effective methods like withdrawal, rhythm, and so on. On average, the conception rate is 2 percent, and the number of months at the risk of pregnancy is 52 months. The proportion of months using contraceptive methods ranges from 3 percent to 13 percent. There exists a great deal of diversity in terms of government programs, infrastructure and prices of goods at the village level. The subsequent empirical analysis controls for those variation by removing the village fixed effect.

4 Empirical Analysis

Our empirical strategy is implemented in two stages. First, we estimate a reproduction function as a means to derive the natural variation of fertility (i.e. fecundity), which in turn is taken as an exogenous measure of fertility. Second, we estimate a series of regressions where we analyze the effect of fertility on female and male labor supply - estimated both separately and jointly, and on female and male earnings, in order to examine the effect of fecundity.

4.1 Estimation of the Reproduction Function

In order to generate an exogenous variation of fertility, we estimate a reproduction function following Rosenzweig and Schultz (1985). The main idea behind the approach is to consider the part of

Table 2: Summary Statistics ($N = 3,287$)

Variable	Mean	Std. Dev.	Min.	Max
Respondents' Characteristics				
Age	34.48	6.89	17.00	51.00
Completed years of schooling	4.95	3.97	0.00	18.00
Having a job	0.53	0.50	0.00	1.00
Number of hours of working per week	16.42	21.39	0.00	94.00
Year of marriage	1977.09	7.28	1955	1988
Muslim	0.87	0.34	0.00	1.00
Number of live births prior to 1989	3.32	2.39	0.00	18.00
Number of births between 1989 and 1992	0.57	0.72	0.00	5.00
Conception rate	0.02	0.03	0.00	0.33
Total months at risk of pregnancy	52.14	9.16	6.00	62.00
Proportion of months using:				
Pills	0.13	0.29	0.00	1.00
IUD	0.13	0.31	0.00	1.00
Injection/Impant/Diaphragm/Condom	0.13	0.27	0.00	1.00
Female/Male Sterilization	0.04	0.19	0.00	1.00
Ineffective Methods	0.03	0.16	0.00	1.00
Husband's Characteristics				
Husband's age	40.27	8.71	18.00	81.00
Husband's completed years of schooling	6.06	4.33	0.00	18.00
Husband having a job	1.00	0.00	1.00	1.00
Husband's number of hours of working per week	37.85	18.33	0.54	94.00

Notes: The data used are the 1993 Indonesian Family Life Survey.

realized fertility not explained by contraceptive efforts and women's observable biological characteristics as the variation of natural fertility. We refer to this measure as fecundity and we take the following linear approximation for the reproduction function.

$$N_{j,t} = \mu_j + \beta Z_{j,t} + \gamma X_{j,t} + \varepsilon_{j,t} \tag{1}$$

where $N_{j,t}$ is the conception rate of a woman j at period t, μ_j is a woman-specific fecundity, $Z_{j,t}$ is a vector of variables measuring couples' contraceptive behavior, and $X_{j,t}$ is a vector of observable biological characteristics of the woman. Thus the realized conception rate is considered as a function of fecundity, contraceptive efforts and observable biological characteristics of women, which includes age and the number of children prior to period t. The IFLS provides a monthly contraceptive calendar over the five years prior to the survey, from which we derive the conception rate and the measure of contraception. However, the estimation of equation (1) is problematic for two reasons. First, the choice of contraception and the methods will be correlated with fecundity if women are at least partly aware of their fecundity through their past experience. Second, woman-specific fecundity, μ will be correlated with past realized births. We deal with this endogeneity issue by instrumenting the choice of contraceptives and the number of children ever born prior to 1989, with a set of variables that affects the demand for children. The instruments include schooling, spouse's schooling, being Muslim, number of women of age above nine in a household, an index for living with parents, an index for living with parent-in-laws and community dummy variables.

Table 3 presents the results from the estimation of the reproduction function. The Ordinary Least Squares (OLS) estimation in column (1) states that the usage of various contraceptives are negative correlated with conception rate. The conception rate is lower for older women, and the effect of age seems to be linear. In the Instrumental Variables (IV) estimations the coefficients on contraceptive methods become larger in magnitude suggesting that more fecund women tend to use more contraceptives. The estimates also show that the effectiveness of pills is 40 percent

underestimated in the OLS estimation. The selection related to the choice of IUD, injection, implant, diaphragm and condom seems to be small because their effectiveness do not change much in the IV estimation. The effectiveness of sterilization is more than 30 percent underestimated in the OLS estimation. The Hausman test rejects the hypothesis that there is no correlation between contraception and fecundity at one percent level. The first stage estimation is reported in Table 8 in Appendix A.

The residual in the estimation of reproduction contains both permanent and random components of fecundity. The measure of natural fertility, the permanent component, is obtained by taking the average of the difference between the actual fertility and the fertility predicted by the reproduction function as follows.

$$\mu_j = \frac{\sum_{t=1}^{t=T} N_{j,t} - \widehat{N_{j,t}}}{T} \tag{2}$$

The random error in each period is calculated as the difference between residual in each period and the measure of individual specific fecundity ($\varepsilon_{j,t} = N_{j,t} - \widehat{N_{j,t}} - \mu_j$). We divide the 60 month-period into two periods in order to separate the permanent and temporary component of fecundity.

4.2 Fertility and Family Labor Supply

We consider a household in which two adults make a decision on their labor supply. We do not attempt to distinguish between a unitary model and a collective model in the decision making process. Rather, our primary interest is to look at how the allocation of time of two adults change in response to the natural variation of fertility. The usual conditional demand functions of female and male labor supply are considered.

$$H_M^* = h_M(W_M, W_F, X, \mu) \tag{3}$$

$$H_F^* = h_F(W_M, W_F, X, \mu) \tag{4}$$

Table 3: Determinants of Conception Rates

	(1) OLS	(2) IV
Pills	−0.0256	−0.0442
	(15.99)	(10.50)
IUD	−0.0227	−0.0219
	(14.49)	(6.27)
Injection, Implant, Diaphragm, Condom	−0.0234	−0.0236
	(13.86)	(4.72)
Female/Male Sterilization	−0.0187	−0.0280
	(7.53)	(3.88)
Ineffective Methods	−0.0164	−0.0019
	(5.79)	(0.23)
Number of live births up to 1988	0.0000	0.0019
	(0.20)	(4.04)
Age in 1988	−0.0020	−0.0021
	(5.17)	(4.90)
Age in 1988 sq.	0.0000	0.0000
	(0.89)	(0.19)
Constant	0.0822	0.0871
	(15.99)	(15.44)
No. of Observation	4,548	4,548
R-squared	0.26	0.21

Notes: The dependent variable is the conception rate defined as the number of months of conception out of the total months at risk of pregnancy. Absolute value of asymptotic t-ratios are in parentheses. The data used are the 1993 Indonesian Family Life Survey. The instruments in column (2) include schooling, spouse's schooling, being Muslim, community dummies.

which states that the hours of working for a man and a woman, H_M^* and H_F^*, are functions of the male and female wages, W_M and W_F, household characteristics, X, and the measure of fecundity, μ. We assume that men always work, whereas women may or may not work. Consequently, a woman's hours of working is observed to be zero if the latent demand is below zero.

$$H_M = H_M^* \tag{5}$$

$$H_F = \begin{cases} H_F^* & \text{if} \quad H_F^* > 0 \\ 0 & \text{if} \quad H_F^* \leq 0 \end{cases} \tag{6}$$

A linear specification for the conditional demand function for labor supply is taken as follows.

$$H_M^* = \alpha_1 W_M + \alpha_2 W_F + \alpha_3 X + \alpha_4 \mu + \epsilon_M \tag{7}$$

$$H_F^* = \beta_1 W_M + \beta_2 W_F + \beta_3 X + \beta_4 \mu + \epsilon_F \tag{8}$$

where the error terms are assumed to have a joint normal distribution.

$$\begin{pmatrix} \epsilon_M \\ \epsilon_F \end{pmatrix} | W_M, W_F, X, \mu \sim N \left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_M^2 & \sigma_{MF} \\ \sigma_{MF} & \sigma_F^2 \end{pmatrix} \right) \tag{9}$$

The likelihood is constructed taking into account the censoring of a woman's hours of working. We estimate first female and male labor supply separately assuming no correlation between unobservable individual characteristics, before we estimate them jointly.

The estimation of the effect of fertility on female and male labor supply is presented in Table 4. Because of the endogeneity of observed wages, we include instead the variables expected to determine wages directly in the labor supply regression. Prices of goods and government programs varies obviously across communities, and will be important both for labor supply and fertility. We control for such differences by incorporating community fixed-effects in the estimation. In total our sample consist of women from around 330 communities. In order to reduce the number of coefficients to be estimated, each explanatory variables in equation (7) and (8) is regressed on the

Table 4: Effects of Fertility on Female and Male Labor Supply

	(1)	(2)	(3)	(4)
	Separate Estimation		Joint Estimation	
Dependent Variable: Number of hours working of a wife				
Fecundity (μ)	−54.0307	-	−53.4686	-
	(1.65)		(1.64)	
Number of live births prior to 1989	-	−0.4536	-	−0.4605
		(1.11)		(1.14)
Number of births between 1989 and 1992	-	−2.2491	-	−2.2439
		(2.03)		(2.04)
Wife's age	3.7413	3.6174	3.7564	3.6241
	(3.42)	(3.32)	(3.48)	(3.36)
Wife's age squared	−0.0444	−0.0431	−0.0446	−0.0431
	(2.95)	(2.87)	(3.00)	(2.91)
Wife's schooling	0.6084	0.5518	0.5978	0.5451
	(2.21)	(2.00)	(2.18)	(1.98)
Husband's age	−0.2271	−0.1164	−0.2346	−0.1319
	(0.30)	(0.15)	(0.31)	(0.17)
Husband's age squared	0.0032	0.0021	0.0032	0.0023
	(0.38)	(0.25)	(0.39)	(0.27)
Husband's schooling	−0.3762	−0.3818	−0.3707	−0.3785
	(1.54)	(1.57)	(1.53)	(1.56)
Muslim	−4.6263	−4.4248	−4.5215	−4.3453
	(1.36)	(1.30)	(1.34)	(1.28)
Constant	3.9364	3.9366	4.0264	4.0244
	(5.54)	(5.55)	(5.67)	(5.67)
σ_F	34.9425	34.8714	34.7758	34.7673
	(47.00)	(47.00)	(46.81)	(46.66)
Dependent Variable: Number of hours working of a husband				
Fecundity (μ)	−2.0889	-	−2.0503	-
	(0.14)		(0.14)	
Number of live births prior to 1989	-	0.0482	-	0.0476
		(0.25)		(0.25)
Number of births between 1989 and 1992	-	0.1974	-	0.1892
		(0.37)		(0.35)
Wife's age	−0.7222	−0.7302	−0.7252	−0.7316
	(1.36)	(1.38)	(1.38)	(1.39)
Wife's age squared	0.0081	0.0082	0.0082	0.0082
	(1.10)	(1.11)	(1.12)	(1.12)
Wife's schooling	−0.1410	−0.1370	−0.1418	−0.1375
	(1.10)	(1.07)	(1.10)	(1.06)
Husband's age	0.7108	0.7054	0.7099	0.7070
	(2.03)	(2.00)	(2.04)	(2.01)
Husband's age squared	−0.0083	−0.0083	−0.0083	−0.0083
	(2.18)	(2.14)	(2.19)	(2.16)
Husband's schooling	−0.1702	−0.1692	−0.1692	−0.1713
	(1.48)	(1.47)	(1.47)	(1.49)
Muslim	−1.6219	−1.6525	−1.6269	−1.6565
	(1.03)	(1.04)	(1.04)	(1.05)
Constant	37.8389	37.8522	37.8549	37.8448
	(114.26)	(114.37)	(114.47)	(114.20)
σ_M	18.2821	18.2718	18.2768	18.2863
	(75.15)	(75.10)	(75.19)	(74.98)
ρ_{MF}	-	-	0.0710	0.0708
			(3.75)	(3.72)
Number of observations	3,287	3,287	3,287	3,287

Notes: Absolute value of asymptotic t-ratios are in parentheses. The data used are the 1993 Indonesian Family Life Survey. Each explanatory variable is regressed on a full set of community dummies, and the residual of the regression is used as an explanatory variable in the estimation in order to remove community fixed effects.

full set of village dummy variables, and the residuals of these regressions are used as an explanatory variable - thereby controlling for the community effects.

The separate estimation of female labor supply reported in columns (1) and (2) suggests that both the measure of fecundity and the number of births over the previous five years have a negative impact on the number of hours working of a woman. Since the fecundity is measured in terms of monthly conception rate and the increase in the expected birth by one over the 60-month period is roughly translated into 1/51, the result in column (1) implies that an increase in expected birth by one reduces female labor supply by 1.0 hours per week. According to the result in column (2), a woman's hours of working decreases by 2.2 hours per week in response to an actual birth. Thus, using actual births as a measure of fertility exaggerates the consequence of fertility with respect to female labor supply, which is a result consistent with the prediction by Rosenzweig and Schultz (1985). The woman's age and its square term suggest age exhibits a nonlinear impact on female labor supply being positive before 40 years and negative afterwards. Highly educated women tend to work more. The husbands' education has a negative impact on female labor supply, but the estimate is not precisely estimated. About 85 percent of Indonesian population are Muslim. The Muslim women in the sample tend to work less than the women of all the religion, but the estimate is imprecisely estimated.

The corresponding estimation of male labor supply are presented in the bottom panel of Table 4. The first two columns suggest that the effect of fecundity and actual births on male labor supply are small. Although the effect of an actual birth is larger than that of a comparable change in fecundity, the imprecise estimates suggest that men do not respond much to the variation of fertility. Men's labor supply also do not seem to be affected by their wives' characteristics such as their age and education. The effect of own age on men's hours of working is nonlinear as is the case for women, but the magnitude is smaller for men. Men's schooling does not have a positive impact

on their labor supply. The Muslim men also work less than the men of other religious background, but again the estimates are not precisely estimated.

The results of the joint estimation of female and male labor supply presented in column (3) and (4) of Table 4 are almost identical to those from the separate estimation. The correlation coefficient of the two error terms are 0.07 in each specification, and they are precisely estimated. This suggests that the women with higher preference for home activity tend to be matched with men of similar characteristics. This is the opposite to our expectation, but the degree of the selection is small, and as a result the selection in the marriage market does not seem to bias the consequence of fertility on female and male labor supply obtained in the separate estimation.

Taken together, the results of estimations of female and male labor supply suggest that fertility has a significant impact on women's labor market participation but not on the men's in a household.

4.3 Fertility and Labor Earnings

Now we turn to the effect of fertility on female and male earnings. A simple form of earnings equation is taken, which includes age, age squared and years of schooling as explanatory variables. Since the measure of earnings indicates wage, net profit or gross income, the dummy variable for each category is included. In order to control for the regional variation in the labor productivity, the community fixed effects are removed in all specifications below. Since the correlation between female and male preference through marriage market select is not found to change the result on fertility and working hours significantly, female and male earnings are estimated separately. The true female earnings, Y_F^*, is assumed to be a linear function of explanatory variables, X_F, described above.

$$Y_F^* = \alpha X_F + \eta_F \tag{10}$$

Because the measure of earning is available only for the working women, the information on the observed earnings for working women, Y_F, decision to work, D, and observable characteristics, X_F, are described as follows.

$$D = 1(\gamma Z_F + \theta_F > 0) \tag{11}$$

$$Y_F = DY_F^* \tag{12}$$

where η_F and θ_F have a joint normal distribution.

$$\begin{pmatrix} \eta_F \\ \theta_F \end{pmatrix} | X_F, Z_F \sim N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_\eta^2 & \rho\sigma_\eta \\ \rho\sigma_\eta & 1 \end{pmatrix} \right) \tag{13}$$

Given that the choice of working reflects the difference between the actual wage and the reservation wage, the identifying assumption is that husband's characteristics affects a woman's reservation wage but not her actual wage directly. Therefore, Z_F includes husband's age, age squared and schooling in addition to X_F. We first estimate the effect of fertility on female earnings ignoring the sample selection bias, and then compare it with the two step estimator from Heckman (1979).

Table 5 presents the estimated effects of fertility on log of female monthly earnings. The effects of age and schooling are stable across different specifications. Although the coefficients on age and its square term are imprecisely estimated, earnings generally increase with age but at a smaller rate as a woman gets older. One additional year of schooling increases earnings by around 11 percent. According to column (2) and (3) of Table 5, the number of live births is significantly negatively associated with female monthly earnings, while the measure of fecundity does not have a significant impact. This result implies the correlation that more fertile women tend to accumulate lower human capital. This result is the opposite to the finding of Rosenzweig and Schultz (1985) that use of number of children ever born underestimates the effect of fertility on female earnings. When the sample selection bias is corrected using Heckman two step estimation, the results remain

Table 5: Effects of Fertility on Female Monthly Earnings

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS			Two Step Estimation		
Dependent Variable: Log of Female Monthly Wage						
Permanent component of Fecundity (μ)	-	1.6544	-	-	2.0493	-
		(1.11)			(1.31)	
Number of live births	-	-	−0.0415	-	-	−0.0438
			(1.82)			(1.95)
Age	0.0648	0.0603	0.0743	0.0477	0.0201	0.0936
	(1.05)	(0.98)	(1.20)	(0.46)	(0.20)	(0.89)
Age squared	−0.0009	−0.0008	−0.0009	−0.0007	−0.0003	−0.0011
	(1.02)	(0.95)	(1.05)	(0.50)	(0.24)	(0.85)
Schooling	0.1192	0.1186	0.1149	0.1144	0.1075	0.1199
	(9.93)	(9.87)	(9.41)	(4.33)	(4.13)	(4.66)
Index for net profit	−0.1221	−0.1270	−0.1106	−0.1206	−0.1231	−0.1121
	(1.27)	(1.32)	(1.15)	(1.45)	(1.47)	(1.34)
Index for gross income	0.7044	0.7119	0.7166	0.7070	0.7182	0.7141
	(4.74)	(4.78)	(4.82)	(5.47)	(5.55)	(5.53)
Muslim	−0.1539	−0.1624	−0.1369	−0.1611	−0.1794	−0.1279
	(0.79)	(0.84)	(0.70)	(0.93)	(1.03)	(0.74)
Constant	2.2626	2.3592	2.1190	1.0196	2.0079	−0.4822
	(2.04)	(2.12)	(1.91)	(0.29)	(0.59)	(0.14)
λ	-	-	-	−0.1702	−0.3929	0.1868
				(0.20)	(0.47)	(0.21)
First Step Estimation of Selection into Working						
Permanent component of fecundity (μ)	-	-	-	-	−1.7443	-
					(1.87)	
Number of live births	-	-	-	-	-	−0.0200
						(1.38)
Age	-	-	-	0.1779	0.1834	0.1800
				(4.27)	(4.39)	(4.31)
Age squared	-	-	-	−0.0021	−0.0022	−0.0021
				(3.70)	(3.81)	(3.68)
Schooling	-	-	-	0.0464	0.0466	0.0447
				(4.74)	(4.77)	(4.54)
Muslim	-	-	-	0.0835	0.0878	0.0952
				(0.68)	(0.71)	(0.77)
Husband's age	-	-	-	−0.0205	−0.0230	−0.0155
				(0.73)	(0.82)	(0.55)
Husband's age squared	-	-	-	0.0001	0.0002	0.0001
				(0.44)	(0.52)	(0.27)
Husband's schooling	-	-	-	−0.0029	−0.0025	−0.0030
				(0.32)	(0.27)	(0.34)
Constant	-	-	-	−4.2377	−4.3016	−4.3486
				(4.92)	(4.97)	(5.01)
Distribution of Error Terms						
ρ	-	-	-	−0.1576	−0.3526	0.1730
σ_η	-	-	-	1.0805	1.1144	1.0802
λ	-	-	-	−0.1702	−0.3929	0.1868
Number of observations	1,181	1,181	1,181	3,287	3,287	3,287
Censored observations	-	-	-	2,106	2,106	2,106
Uncensored observations	-	-	-	1,181	1,181	1,181
Number of communities	291	291	291	291	291	291
R-square	0.13	0.14	0.14	-	-	-

Notes: Absolute value of t statistics in parentheses. Village fixed-effects are removed from all the specifications.

qualitatively the same. In fact, the estimates in column (4), (5) and (6) suggests that the hypothesis of no selection could not be rejected.

When the log of female hourly earnings are used as a dependent variable as shown in Table 6, again column (4), (5) and (6) suggests that the sample selection bias is not significant. Neither the coefficient on the number of live births or that on fecundity are significant. Therefore, there is no evidence that the female hourly earnings are affected by fertility. This result does not show the theoretical prediction, but is consistent with the finding of Millimet (2000). The effect of age and schooling exhibits the same pattern as that in the case of monthly earnings. One year of schooling increases the hourly earning by around 4 percent.

The effect of fertility on male earnings takes the same form as that used for the female earnings. Since the final sample includes the households with husbands working, there is no sample selection issue in the estimation.

$$Y_M = \alpha X_M + \eta_M \tag{14}$$

Table 7 presents the estimated effects of fertility on male earnings. For both monthly and hourly earnings, there is found no significant effect of fecundity. The association between number of live births and earnings is not significant either. Therefore, the results suggests that the two opposing effect of fertility on male market productivity offset each other. The findings from other studies are mixed. For example, Millimet (2000) found the positive effect of fertility on male market wage for older sample, but no effect for younger sample in the 1976 wave of PSID. Like female earnings, male earnings tend to increase with age, but at a smaller rate as a man becomes older. One year of schooling increases monthly earnings by about 9 percent and hourly earnings by about 4 percent.

Table 6: Effects of Fertility on Female Hourly Earnings

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS			Two Step Estimation		
Dependent Variable: Log of Female Hourly Wage						
Permanent component of Fecundity (μ)	-	0.0150	-	-	0.2250	-
		(0.03)			(0.37)	
Number of live births	-	-	−0.0054	-	-	−0.0041
			(0.62)			(0.47)
Age	0.0134	0.0133	0.0146	−0.0045	−0.0080	0.0030
	(0.57)	(0.57)	(0.62)	(0.11)	(0.21)	(0.07)
Age squared	−0.0002	−0.0002	−0.0002	0.0000	0.0001	0.0000
	(0.57)	(0.57)	(0.58)	(0.08)	(0.16)	(0.09)
Schooling	0.0453	0.0453	0.0447	0.0403	0.0394	0.0417
	(9.93)	(9.91)	(9.62)	(3.94)	(3.92)	(4.24)
Index for net profit	−0.0185	−0.0185	−0.0170	−0.0169	−0.0165	−0.0161
	(0.51)	(0.51)	(0.46)	(0.53)	(0.52)	(0.51)
Index for gross income	0.2469	0.2469	0.2485	0.2497	0.2503	0.2500
	(4.37)	(4.37)	(4.39)	(5.08)	(5.09)	(5.09)
Muslim	−0.0978	−0.0978	−0.0955	−0.1053	−0.1069	−0.1010
	(1.32)	(1.32)	(1.29)	(1.58)	(1.59)	(1.52)
Constant	0.0948	0.0956	0.0760	0.2378	0.3591	−0.0228
	(0.22)	(0.23)	(0.18)	(0.18)	(0.27)	(0.02)
λ	-	-	-	−0.1777	−0.2090	−0.1127
				(0.53)	(0.65)	(0.34)
First Step Estimation of Selection into Working						
Permanent component of fecundity (μ)	-	-	-	-	−1.7443	-
					(1.87)	
Number of live births	-	-	-	-	-	−0.0200
						(1.38)
Age	-	-	-	0.1779	0.1834	0.1800
				(4.27)	(4.39)	(4.31)
Age squared	-	-	-	−0.0021	−0.0022	−0.0021
				(3.70)	(3.81)	(3.68)
Schooling	-	-	-	0.0464	0.0466	0.0447
				(4.74)	(4.77)	(4.54)
Muslim	-	-	-	0.0835	0.0878	0.0952
				(0.68)	(0.71)	(0.77)
Husband's age	-	-	-	−0.0205	−0.0230	−0.0155
				(0.73)	(0.82)	(0.55)
Husband's age squared	-	-	-	0.0001	0.0002	0.0001
				(0.44)	(0.52)	(0.27)
Husband's schooling	-	-	-	−0.0029	−0.0025	−0.0030
				(0.32)	(0.27)	(0.34)
Constant	-	-	-	−4.2377	−4.3016	−4.3486
				(4.92)	(4.97)	(5.01)
Distribution of Error Terms						
ρ	-	-	-	−0.4131	−0.4764	−0.2705
σ_η	-	-	-	0.4302	0.4386	0.4166
λ	-	-	-	−0.1777	−0.2090	−0.1127
Number of observations	1,181	1,181	1,181	3,287	3,287	3,287
Censored observations	-	-	-	2,106	2,106	2,106
Uncensored observations	-	-	-	1,181	1,181	1,181
Number of communities	291	291	291	291	291	291
R-square	0.13	0.13	0.13	-	-	-

Notes: Absolute value of t statistics in parentheses. Village fixed-effects are removed from all the specifications.

Table 7: Effects of Fertility on Male Earnings

Dependent Variable	(1)	(2)	(3)	(4)	(5)	(6)
	Log of Monthly Earnings			Log of Hourly Earnings		
Permanent component of Fecundity (μ)	-	0.5751	-	-	−0.1063	-
		(0.66)			(0.36)	
Number of live births	-	-	−0.0080	-	-	−0.0073
			(0.57)			(1.54)
Age	0.0574	0.0574	0.0611	0.0227	0.0227	0.0260
	(2.52)	(2.52)	(2.58)	(2.94)	(2.94)	(3.25)
Age squared	−0.0007	−0.0007	−0.0008	−0.0002	−0.0002	−0.0003
	(2.77)	(2.76)	(2.82)	(2.65)	(2.65)	(2.91)
Schooling	0.0926	0.0924	0.0922	0.0410	0.0411	0.0407
	(12.06)	(12.03)	(11.97)	(15.79)	(15.79)	(15.60)
Index for net profit	−0.6252	−0.6253	−0.6236	−0.0512	−0.0512	−0.0498
	(9.56)	(9.56)	(9.52)	(2.31)	(2.31)	(2.25)
Index for gross income	−0.0310	−0.0306	−0.0310	0.0391	0.0390	0.0392
	(0.34)	(0.33)	(0.33)	(1.25)	(1.25)	(1.25)
Muslim	−0.1527	−0.1536	−0.1479	−0.1074	−0.1072	−0.1030
	(1.17)	(1.18)	(1.13)	(2.44)	(2.43)	(2.33)
Constant	2.8313	2.8294	2.7663	−0.1113	−0.1110	−0.1706
	(5.65)	(5.65)	(5.38)	(0.66)	(0.65)	(0.98)
Number of observations	3,114	3,114	3,114	3,114	3,114	3,114
Number of communities	311	311	311	311	311	311
R-square	0.11	0.11	0.11	0.10	0.10	0.10

Notes: Absolute value of t statistics in parentheses. Village fixed-effects are removed from all the specifications. Husband's earnings are not available for 173 households in the final sample.

5 Discussion

This paper focuses on the consequence of fertility on both male and female labor market participation. Two dimensions are considered: labor supply and earnings. The theoretical consideration encompasses both a unitary and a collective model of family labor supply and fertility. Although further assumptions need to be made concerning the functional form of utility in order to derive predictions of the model, one empirical question is whether an exogenous increase in fertility will reinforce or lesson the degree of household division of labor. In addition, this paper raises a question on how fertility would affect the allocation of efforts, which can be measured by the earning per hour.

Taking the unobserved natural variation of fertility as a measure of fecundity, the empirical analysis suggests that women reduces their working hours in response to a higher fecundity but that men do not respond to such a change. The results still hold when the correlation of female

and male preference through matching in the marriage market is controlled for. The findings on female labor supply is consistent with theoretical prediction, but those on male labor supply imply that the two opposing effects of fertility tend to be canceled off. Regarding the earnings, neither female or male earning seems to change significantly when fecundity increases.

The finding of no significant impact of fertility on male labor supply suggests a few characteristics of households in Indonesia and raises further questions. First, one explanation is that men may play a dominant role in the household decision making process. More than 85 percent of Indonesian population are Muslim. It may be the case where men moves first in labor supply, and women follow according to the situation including the presence of children. It will be worthwhile investigating the unitary versus collective model in the decision of family labor supply model. Second, men may face inflexible labor market conditions. This can be checked by examining the effect of fertility by occupation. Third, the opportunity for women in the labor market may be limited. A considerable portion of women are engaged in unpaid family business in the sample. Therefore, it may be the case that women face more flexible labor supply. This can be also checked by comparing women in different occupations. Fourth, it is possible that Indonesian households may have grandparents or older siblings of a young child as potential take-carer. Therefore, the effect of fertility on male supply may be more moderate than that on female's. It will be interesting to investigate how the presence of other potential child-carer would affect the labor supply effect of fertility in Indonesian context. Lastly, the huge diversity of Indonesian population in terms of geography and socio-economic status suggests that the current analysis hide the variation in terms of the response of labor supply to fertility across different income groups. Hence, it seems to us as an interesting task to assess whether fertility may have different effects depending on where men and women are placed on the income distribution. We plan to undertake this analysis with help of a quantile regression.

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Appendix

A First Stage Estimation in the Two Stage Least Squares Estimation

Table 8: First Stage Ordinary Least Squares Estimation in Table 3

Dependent Variables	(1) No. of births prior to 1988	(2) Pills	(3) IUD	(4) Injection, Implant, Diaphragm, Condom	(5) Sterilization	(6) Ineffective methods
Age in 1988	0.1715	0.0193	0.0166	0.0199	−0.0004	0.0024
	(7.52)	(5.37)	(4.73)	(5.71)	(0.19)	(1.19)
Age in 1988 sq.	0.0004	−0.0003	−0.0002	−0.0004	0.0001	0.0000
	(0.96)	(5.48)	(4.01)	(6.67)	(1.38)	(0.60)
Schooling	−0.0927	0.0011	0.0045	−0.0005	0.0004	0.0019
	(10.01)	(0.73)	(3.16)	(0.37)	(0.45)	(2.28)
Husband's Schooling	−0.0016	−0.0017	0.0031	0.0022	0.0003	0.0019
	(0.18)	(1.30)	(2.37)	(1.70)	(0.35)	(2.51)
Muslim	0.4529	0.0406	−0.0079	0.0544	−0.0487	−0.0274
	(3.65)	(2.08)	(0.41)	(2.87)	(3.87)	(2.51)
Number of Women of age above nine	0.5285	0.0073	0.0111	−0.0006	0.0110	−0.0015
	(18.32)	(1.61)	(2.50)	(0.13)	(3.76)	(0.60)
Living w/ Parents	−0.7205	−0.0200	−0.0187	−0.0220	−0.0185	−0.0078
	(7.72)	(1.36)	(1.30)	(1.55)	(1.96)	(0.95)
Living w/ Parent-in-laws	−0.5913	−0.0004	−0.0187	0.0167	0.0015	0.0042
	(5.34)	(0.02)	(1.10)	(0.99)	(0.14)	(0.43)
Constant	−3.0653	−0.1813	−0.2111	−0.1583	0.0186	−0.0142
	(8.81)	(3.31)	(3.94)	(2.98)	(0.53)	(0.46)
No. of Observation	4,548	4,548	4,548	4,548	4,548	4,548
R-squared	0.55	0.01	0.02	0.02	0.03	0.01

Notes: Absolute value of asymptotic t-ratios are in parentheses. The data used are the 1993 Indonesian Family Life Survey. The number of observations exceed that in the summary statistics because this sample includes all the observations with non-missing values for the variables used in this table. Community fixed effects are removed in all the columns.