# Stuck at a Crossroad: A Microeconometric Analysis of Fertility and Married Female Labor Force Supply in the Philippines

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# Stuck at a Crossroad: A Microeconometric Analysis of Fertility and Married Female Labor Force Supply in the Philippines

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## Abstract

This study investigated the link between fertility and married female labor supply of Filipino women using instrumental variable (IV) probit regression using microeconomic data from the National Demographic and Health Survey (NDHS) published in 2013 with 7,628 married women respondents. The first stage regression results showed that couple's age has a direct relationship on fertility. On the other hand, variables such as secondary education of married female's husband as compared to non-educated husband, household wealth of all classes relative to the poorest household, and age of female at first marriage has an inverse relationship with the number of children. Second-stage regression results showed that fertility increases the probability of a married female to look for employment. Married female's age, higher educational attainment relative to non-educated married female, and household wealth as opposed to the household class with the least wealth have direct relationship with married female employment. Lastly, marginal effects showed that additional children will increase the likelihood of a married female to participate in the labor force by 3 percentage points. Increase in married female's age also increases her probability of getting employed by 0.9 percent. The chances of having labor market activity is higher by 13 percentage points if a married female attains higher education as compared to a married female that has no formal education. If a married female belongs to a household belonging to the highest wealth quintile among all classes in terms of wealth, she has the greatest chance to be employed by 16 percentage points relative to a married female who is a member of a household belonging to the lowest wealth quintile.

JEL Classification: D13, J13, J21, J22
Keywords: Fertility, Married Female Labor Supply, Endogeneity, IV Probit

## I. Introduction

It is of withstanding interest to some labor economists to identify how a woman's decision on the number of children she will have is connected to her labor force participation decisions. Today, a woman has various roles and responsibilities. Aside from taking care of her children and managing the household, she also works and earns money to support the family's finances. At times, a woman is stuck on a crossroad, facing two paths: whether to prioritize motherhood and take care of her children, while possibly foregoing her career, or to prioritize her career, to earn for her family and help pay for basic needs and luxuries.

Globally, the female labor force participation increased from around 1.20 billion to 1.32 billion from 2004-2014 although its participation rates decreases over time from 51.8 percent to 49.6 percent during the same time period (Key Indicators of the Labor Market 9th Edition, Labor Force Participation Rate, ILO, 2016). Several factors were mentioned for the gradual decrease of female labor participation rates such as urbanization (World Bank, 2009), increased attendance in education and higher household income levels (Kapsos, et. al., 2014) and other factors such as barriers to entry due to cultural restrictions particularly in the case of Northern Africa, Middle East and Southern Asia (Elder and Kring, 2016). However, it was not mentioned that the number of children might play a significant role in the labor force participation of women. During 2004-2014, fertility rate decreases from 2.58 to 2.45 births per woman (World Bank Development Indicators, 2016). Therefore, macroeconomic data suggests that on a global scale suggests that there are positive correlation between fertility and female labor supply indicated by female labor force participation rates. But if we look in the case of OECD countries, female labor force participation increased from almost 234 million to 259 million translating to 59.9 percent to 62.8 percent participation rate from 2004 to 2014 (OECD Stat, 2016) while there is little increase in fertility rate from 1.65 to 1.68 percent from 2000-2014 (OECD Data 2016). Also suggesting positive correlation between fertility and female labor supply. Lastly, in the case of the Philippines from 2000-2014, the female labor force to almost 13 million to more than 16 million Key Indicators of the Labor Market 9th Edition, Labor Force Participation Rate, ILO, 2016) while on the same period, fertility rate decreases from 3.57 to 2.98 births per women, indicating a negative relationship between female labor supply and fertility based on macroeconomic data (World Bank Development Indicators, 2016).

Therefore, the relationship between having children and working can go two ways. First, it can be argued that a mother with relatively many children will likely quit her current job to take care of them, at the expense of possibly earning more income, used to provide for the family's basic needs and for the children's education. On the other hand, she could work to provide additional funds in the household but she will need to forgo the time spent in caring for her kids. Hence, there is no *a priori* direction of causality to bridge fertility and labor force participation.

This paper shall explore the link between fertility and married female labor supply in the case of the Philippines based on microeconomic data from the 2013 National Demographic and Health Survey (NDHS) using instrumental variables (IV) approach which is a two-step regression based on maximum likelihood estimation. The relationship between fertility and married female labor supply is based on a simple model in which number of children influences a mother's decision to participate in the labor market.

## II. Literature Review

### *Theoretical Literature Review*

Several theories have been established to link fertility and labor force participation: (1) Neoclassical theory of labor supply; (2) Labor-fertility trade-off; (3) Theory of allocation of time; (4) Demographic transition; (5) Microeconomic theory of fertility, and; (6) Economic approaches of fertility, particularly Easterlin and Crimmins model (1985) and Rosenzweig and Schultz (1985).

Neoclassical theory of labor supply is one of the concepts that establishes the connection between fertility and female labor force supply. This theory was discussed by Jacobsen (1999), wherein the increasing labor demand, increase in labor supply as women tend to acquire more education, changing technology for non-market production, decreasing household work, and changes in family composition over time are explained by neoclassical theory of labor supply. This concept discussed how an individual is constrained by time and must decide between work and leisure as well as factors such as wage, sources of non-work income, and household assets. The two underlying assumptions are: (1) Time is only allocated to labor and leisure; and (2) Each individual chooses the amount hours of work and leisure that maximizes their utility (Cahuc and Zylberberg, 2004). The utility function based on this concept is extended to couples. Myck and Reed (2005) noted that types of goods must be defined clearly, couples' preferences should be outlined separately, and lastly, co-operative games between couples in long-term partnership would arrive at Pareto efficiency in which one party will be better off while the other will be at worse off.

The connection between fertility and female labor supply can either be direct or inverse. Younger (2006) noted that women can allocate between their fertility (having children) and participation in the labor market considering various factors. This is by constructing a simple utility function of consumption, number of children, (constrained by time spent in raising children and other purchased inputs), and budget constraint allocated to expenditures on consumption and other inputs equivalent to wages plus unearned income. These constraints on utility of females show the trade-off because limited time must be allocated between work and raising children. According to Furtado and Hock (2008), rearing children implies that females will face labor supply-fertility trade-off because their traditional responsibility is to perform household work that may be forgone through the number of hours allocated for work among those who are employed. On the other hand, having more children that need constant and intensive care may persuade women to forego work in the labor force, having a trade-off between being part of the labor force and taking care of children (Forgha and Mbella, 2016).

Since time is a limited resource, it should be allocated in productive and important activities to maximize its use. Becker (1965) proposed the theory of allocation of time by individuals between various activities. It is assumed that: (1) Households are both producers and consumers; (2) Households combine two inputs (time and goods) to produce commodities; (3) Commodities are produced in terms of quantities, and; (4) Resources are measureable through full income (sum of money income and foregone income) by using goods and time to achieve utility. Moreover, Leibowitz (1975) said that if a woman has high educational attainment, she tends to substitute her time less because the available substitutes cannot provide the same high-quality child care. In contrast, if the price of time of better-schooled females is high, this would lead to greater participation in the labor market. Becker's (1965) framework is extended by Wolff and Makino (2012) by taking continuous time blocks into account and therefore same level of utility is derived regardless whether it is done continuously or divided into multiple periods.

Female labor supply and fertility can be explained by shifts in social and demographic characteristics. Thompson (1929) as cited in Kirk (1996), Todaro and Smith (2011) classified three stages of population growth. The first stage (Group A) were described as falling fertility rates and decline in population despite low mortality rates. Second stage (Group B) is where fertility and mortality rates are decreasing but the latter decreased earlier than the former. This thus leads to rapid increase in population until such time that mortality rates would stabilize that would ultimately bring population to a downward trend. Finally, the third stage (Group C) is where both fertility and mortality rates cannot be controlled. This is also classified as "Malthusian" in which population inevitably increases when the means for survival increases. Other views of demographic transition were also studied. Lam and Marteleto (2008) described Stage 1 as declining mortality, which thus increases family size and birth groups, Stage 2 when fertility decreases more than mortality, thus decreasing family size but with continuous population growth based on birth cohorts, and Stage 3, where fertility continues to fall and overtake growth in birth cohorts, thereby decreasing overall population growth.

Highlighting the importance microeconomic analysis in understanding fertility and female labor supply can be traced back in the study of Leibenstein (1957) and Becker (1960) in which the decision on the number of children to have is affected by several characteristics in the household. Schultz (1997) noted that every additional child entails cost of childcare and it is affected by the foregone time of mothers. Moreover, female's wages and educational level have more negative effect on fertility than male's wages. Other factors such as changing income between labor and nonhuman capital and productivity are important determinants of fertility. On the other hand, Todaro and Smith (2011) noted that this concept considers children as a special good and thus, an additional choice that determines family's demand for children relative to other goods. It is assumed that demand for children has income and substitution effects and it is positively related to household income and prices of all other goods. On the other hand, it is negatively related to price of raising children and taste for other goods (Todaro and Smith, 2011).

There are empirical studies addressing endogenous factors related to child and mother's health such as contraceptive use. Easterlin and Crimmins (1985) cited in Arroyo (1993) identified three categories that determine fertility control: (1) supply of children measured by the number of children in the absence of using birth controls; (2) couple's ideal number of children if there are no regulation costs associated in controlling birth tthat proxies demand for children; and (3) regulation costs is the psychic cost associated with learning and using contraceptive methods. Rosenzweig and Schultz (1985) formed a reproduction function to determine the effects of changes in the supply of births, birth control methods chosen by couples, life-cycle labor supply, and income of married women. It is assumed in their model that a mother maximizes the expected present value of her lifetime utility flows that is affected by number of children, consumption, and leisure that is subjected to income constraint that comprises of couple's income, time, cost of fertility control and cost of rearing children per period.

### *Empirical Literature Review*

Empirical studies forming an association between fertility and female labor supply is complicated in nature because of the caveats that are attached to it. The common obstacle is that the observed association could be attributed to having children that cause women to either join or more out of labor activities. Contrastingly, it might be the female labor supply decision that actually affects her preference of having children and henceforth, may be a reverse causality. The other problem could be the other determinants that significantly drive both number of children and female labor supply and thus, seemingly have an established association but in fact, has no causality among them.

Using data from Luxembourg Income Study (LIS), Brusentsev (2000) studied the variation in the labor force participation in Australia, Canada, and United States and found that number of children below 18 years old is associated with lower chances of entry in the labor market. Carrasco (2001) used family sex composition as instrument for fertility and the results estimated that there is negative causal effect of fertility and female labor force participation. Bloom et.al. (2007) estimated the cross-country effect on female labor force using abortion legislation as instrument to account for the endogeneity of fertility and their results suggested large negative impact of fertility rate on female labor force participation, particularly with women aged 20-39 years old. Meanwhile, two-staged least squared (2SLS) and other instrumental variable (IV) regression methods suggest negative relationship between fertility and female labor supply due to education, expensive cost of childcare relative to other goods, quality instead of quantity of children, more employment opportunities available for women, and increasing support for women to have paid work and technological change via introduction of birth control methods (Nguyen, 2009). On the other hand, Dayıoğlu and Kırdar (2010) described the main features of women's labor force participation in Turkey and noted that fertility behavior of women is also an important factor aside from demographic and economic factors. Using 1993 and 2003 DHS data, younger women have lower probability to have children and women with children have lower participation rates, implying a negative relationship between number of children and labor force participation. Moreover, OLS estimates showed a negative relationship between fertility and female labor supply and utilized instrumental variables such as sex composition of children and more than two children. Negative causal effect was also found if only married women are considered because the indirect causality fails if all women were included in the regression estimation (Tortarolo, 2014).

While the preceding paragraph cited inverse relationship between fertility and female labor supply, there are other studies that showed positive relationship. For instance, Sundstrom and Stafford (1991) showed that for 20 OECD countries, fertility and female labor force participation rates are directly related especially those countries that have highest female labor force participation rates have the highest fertility rates and argued against studies that showed an inverse finding. In Italy, using 1993 Survey of Household Income and Wealth of the Bank of Italy, it was found that higher fertility is associated to women with higher education that is currently participating in the labor force because they can afford the more quantities of children and its corresponding childcare cost (Bratti, 2003). Moreover, Da Rocha and Fuster (2006) found that fertility and employment are directly related across OECD countries and this is explained by the low probability of finding work or low employment ratio. Therefore, friction in labor market is important in establishing the relationship between fertility and female labor supply. On the other hand, the positive link between fertility and female labor supply is due to endowment of resources in raising children. For instance, mothers could allocate more hours in the labor market to provide additional funds to compensate the investment needed in having a child (Caceres-Delpiano, 2008). The impact of fertility along with health status on female labor force participation in urban Cameroon based on 2,096 women respondents aged 18 to 64 were conducted by Tsafack-Nanfosso and Zamo-Akono (2010) and their estimates showed that number of children increases the probability of female labor force participation in public sector by 2.4%, formal private sector by 1.7%, and in informal sector by 7.5%. Lastly, Kinoshita and Guo (2015) examined the factors that affect Japan and South Korea's female labor force participation using time-series model and applying structural vector autoregressive (SVAR) model. They also used Norway and Finland as benchmark comparison and found that most of female employed on a regular basis is associated with higher fertility.

### *Endogeneity Problem*

Studying the relationship between fertility and female labor causes endogeneity problem in which the explanatory variable is correlated with the error term and therefore, employing Ordinary Least Squares (OLS) would generate biased results. There are various literatures that cited reasons why is there a problem of endogeneity between fertility and female labor supply and its implications in establishing the relationship of the two if this problem is not accounted.

Willis (1974) noted that the estimates of the effect of number of children on female labor supply would be biased down because female's preferences for work are correlated with their fertility preferences or if time spent on work has an impact of having a children. Therefore indicating that number of children affects labor supply. If endogeneity of fertility to female labor supply is not accounted, this would result to exaggerated estimates of the impact of children on labor supply and may lead to biased estimates, not only of the coefficient of fertility but, also to other coefficients that are correlated to it (Iacovou, 2001). Aside from these, there could be an endogeneity if there is an important determinant that was omitted in the model. For instance, Aguero and Marks (2008) acknowledged that estimating fertility and female labor supply simultaneously is due to omitted variable bias that are hard to measure or to find proxy variable for it such as ambition or talent. Posel and van der Stoep (2008) noted that because of the endogeneity of fertility, it is difficult to identify the its causality in which the decision to have children per se is a consequence of female labor supply and aside from this, there are unobserved factors that are correlated to both fertility and female labor market activity. Moreover, as previously cited in Willis (1974) in which fertility has an impact on female labor supply, there are instances that female labor supply explains fertility. In developing countries, fertility is determined through a collective bargaining process in work at the household level; and it was observed that if individuals have more bargaining power in their work, it increases its influence over the number of children (Rasul, 2008). Lastly, it is noted by Wagner (2013) that the exact relationship between labor market decisions and fertility is difficult because decisions on having children as well as economic decisions in the household are most likely to be jointly determined and therefore, there is difficulty whether fertility affects female labor supply or vice versa.

## III. Theoretical Framework: Fertility Choice and Married Female Labor Force Supply

Based on the neoclassical theory of labor supply, we will show how a married female spends her limited time in various activities (e.g. work, leisure, and childcare).

We made a simple static model by considering a well-behaved married female's utility that is derived from consumption of goods ($X$) and leisure ($V$):

$$U = u(X, V) \tag{1}$$

We assumed that a married female's leisure is affected by the number of children she has ($N$):

$$V = v(N) \tag{2}$$

Therefore, the utility of married female originally specified in Equation (1) will be re-expressed as:

$$U = u[X, V(N)] \tag{3}$$

We assume that labor hours increase with wages.

$$\frac{\partial L}{\partial w} > 0 \tag{4}$$

Following backward-bending labor-supply models, we also assume that women work less when they receive higher wages so that:

$$\frac{\partial L}{\partial w} < 0 \tag{5}$$

Like any individual, we assume that the representative married female undertakes different activities and uses all and allocates her total available time ($\bar{T}$) between labor ($L$) and leisure ($V$). Thus, the married female's time constraint is expressed as:

$$\bar{T} = L + V \tag{6}$$

Aside from the time constraint in Equation (6) there is also a constraint that shows expenditures and income of a married female. These expenditures are primarily are spent on consumption of goods, while the sources of income came from the wage that a married female earns from her job. Hence, the budget constraint that a married female faces can be expressed as:

$$pX = wL \tag{7}$$
$$pX = w(\bar{T} - V) \tag{8}$$
$$pX + wV(N) = w\bar{T} \tag{9}$$

We can now solve for a married female's optimal consumption level ($X$) and leisure ($V$) through selecting the optimal number of children ($N$):

$$\max U[X, V(N)] \tag{10}$$

subject to budget constraint in Equation (9):

$$pX + wV(N) = w\bar{T} \tag{11}$$

Solving for the utility maximization problem, we will get the optimal levels of consumption $X^*$ and leisure $V^*$ through the optimal number of children $N^*$.The reduced form functions are expressed in Equations (12) to (14) as:

$$X^* = x(p, w, \bar{T}) \tag{12}$$
$$N^* = n(p, w, \bar{T}) \tag{13}$$
$$V^*(N^*) = v(p, w, \bar{T}) \tag{14}$$

Since optimal leisure time is affected by $N^*$, optimal work hours must also be determined by $N^*$, implying that a woman's decision to work must also depend on her choice of number of children. This is denoted by Equation (15). The details of the comparative statics of this equation and the ambiguous impact (either positive or negative) of number of children on married female's work-leisure decision is explained in Appendix A.

$$L^* = l(N^*, p, w, \bar{T}) = \bar{T} - V^*(N^*) \quad (15)$$

## IV. Empirical implementation

### *The model*

Based on Equation (16), the structural equation for a married woman's decision to work is denoted by:

$$L = \alpha + \rho N^* + \boldsymbol{\beta w} + \boldsymbol{\gamma p} + \boldsymbol{\delta \bar{T}} + \varepsilon \quad (16)$$

where: $L$ = married female employment status
$N^*$ = cumulative fertility from the first-stage regression
$w$ = vector of wage-related characteristics
$p$ = vector of price-related measures
$\bar{T}$ = vector of time-related indicators

$\alpha$, $\rho$, $\beta, \gamma$, and $\delta$, are the parameters to be estimated and $\varepsilon$ is the error term. Since $N^*$ is endogeneous, running OLS on Equation (16) may lead to inconsistent estimates. We will discuss how to address this issue in the succeeding part of this section.

Married women's wage is a vital factor for her decision on the number of children she will have and her decision to enter the labor market. However, since wage is not directly observable, educational attainment and age were used as an alternative for wage ($w$). The educational attainment and wage of the husband also plays a role in the number of children and his wife's decision to enter paid activities and hence, will also be used as an alternative variable for wage. Age measures labor market or work experience in which the wage increases as the worker gains experience (Gorry, 2013). Mincer (1975) stated that increases in earnings increase with age and experience. In terms of justifying the use of educational attainment as proxy for wage, Mincer (1975) noted that the increases in the change in earnings is due to the level of schooling since there is a direct correlation in schooling subgroups and earnings distribution. We also use the square root of the age of couples to capture non-linear effects, as done by Sackey (2005).

On the other hand, to capture the effect of the price of consumption goods ($p$), we used the wealth index of households constructed based on the information provided by the respondents that represent their respective households. This household index represents the wealth of the household as evaluated in the 2013 NDHS. The basis and method for the calculation of wealth index was developed and tested in numerous countries to determine the social stratification of every household in terms of income, access of health services, and health outcomes (Rutstein and Johnson, 2004). Hence, it can be an appropriate measure to proxy for expenditure and / or income levels. We used geographical area to proxy for the total time variable because variations in geographical areas could have an implicit effect on a married woman's time allocated for her work and time for caring her children. This affects her leisure time, and thus, affects the total time ($\bar{T}$) available for married woman.

The choice of instrumental variable (IV) is critical in studying the relation between fertility and female labor supply since the instrument should explain fertility but not female labor supply.[1] In

[1] Rosenzweig and Schultz (1980) used unplanned births as an IV. Rosenzweig and Wolpin (1980) pioneered twin births as an instrument. Angrist and Evans (1998) used sibling sex composition as an instrument for fertility in the case of the United States. Xia (2010) used first woman's pregnancy that ended

this study, we used the age of the married female at first marriage as an instrument ($Z$) to account for the endogeneity of the number of children. This proxy satisfies the condition of an instrumental variable because it is correlated to the number of children because age at first marriage is linked to the biological fertility lifespan of a woman.[2] Since the age at first marriage is connected to the number of children that she has (as it is biologically more difficult for a woman to bear children as she gets older), it is not directly correlated to the choice of a married woman to enter the labor force. Hence, this variable is qualified to be used as an instrument in our regression method.

Total children ever born by a married female (number of children born alive) is used to measure cumulative fertility (the number of children she has). Current employment status of the married woman is characterized into two: (1) employed (includes regularly employed, employed in the past 12 months because she is working either occasionally or seasonally, and has a current job but on leave in the last 7 days) and (2) not employed. Educational attainment of married female and her husband are categorized into four: (1) no education, (2) primary, (3) secondary, and (4) higher. Age is measured as the actual age of the married woman and her husband/partner. Household wealth is measured by wealth index categorized into quintiles: (1) poorest, (2) poor, (3) middle, (4) richer, and (5) richest. Geographical area is defined as the de facto type of resident of a married female which has two categories: (1) urban or (2) rural area. Lastly, the instrumental variable which is the age of female at first marriage is defined as the actual age of the mother when she got first married. The detailed description on the list of the variables we used in this study can be seen in Table 1. The method that will be used in this survey is the instrumental variable (IV) probit that will be discuss afterwards.

**Table 1. List of Variables**

| Variable | Proxy | Description |
|---|---|---|
| Cumulative Fertility | $N$ | Total children ever born by a married female |
| Married Female Employment Status | $L$ | Dummy Variable:<br>=1 if currently employed in the last 12 months (includes currently employed, employed in the past year, and have a job, but currently on leave in the last 7 days) or =0 otherwise |
| Married Female's Age | $w$ | Actual age of the married female at the time the survey was conducted |
| Married Female's Age Squared | $w$ | Squared of the actual age of the married female at the time the survey was conducted |
| Husband's Age | $w$ | Actual age of the husband of the married female at the time the survey was conducted |
| Husband's Age Squared | $w$ | Squared of the actual age of the husband of the married female at the time the survey was conducted |
| Married Female's Educational Attainment: | $w$ | Dummy Variable:<br>=1 if no educational attainment or =0 otherwise |

in a miscarriage in China. Lundborg, et. al. (2014) proposed a novel instrument in which they used in-vitro fertilization success on treated women in Denmark to assess the effect of having children on female labor force supply. Trako (2015) also exploited the use of IV and utilizing parental preference of having sons to address the endogeneity of fertility to female labor force supply.

[2] Simple regression analysis was done and it was identified that age at first marriage is significantly correlated to the number of children. We also tried to use twin births by Rosenzweig and Wolpin (1980) and sex sibling composition by Angrist and Evans (1998) as instrument, however it was revealed by the simple regression results that both instruments are not correlated. For the details of the regression results of the age of married female at first marriage and number of children, see Appendix B.

| | | |
|---|---|---|
| No Education | | |
| Married Female's Educational Attainment: Primary | $w$ | Dummy Variable: =1 if primary or =0 otherwise |
| Married Female's Educational Attainment: Secondary | $w$ | Dummy Variable: =1 if secondary or =0 otherwise |
| Married Female's Educational Attainment: Higher | $w$ | Dummy Variable: =1 if higher or =0 otherwise |
| Husband's Educational Attainment: No Education | $w$ | Dummy Variable: =1 if no education or =0 otherwise |
| Husband's Educational Attainment: Primary | $w$ | Dummy Variable: =1 if primary or =0 otherwise |
| Husband's Educational Attainment: Secondary | $w$ | Dummy Variable: =1 if secondary or =0 otherwise |
| Husband's Educational Attainment: Higher | $w$ | Dummy Variable: =1 if higher or =0 otherwise |
| Wealth Index: Poorest | $p$ | Dummy Variable: =1 if poorest or =0 otherwise |
| Wealth Index: Poorer | $p$ | Dummy Variable: =1 if poorer or =0 otherwise |
| Wealth Index: Middle | $p$ | Dummy Variable: =1 if middle or =0 otherwise |
| Wealth Index: Richer | $p$ | Dummy Variable: =1 if richer or =0 otherwise |
| Wealth Index: Richest | $p$ | Dummy Variable: =1 if richest or =0 otherwise |
| Geographical Area: Urban | $\bar{T}$ | Dummy Variable: =1 if urban or =0 if rural |
| Geographical Area: Rural | $\bar{T}$ | Dummy Variable: =1 if rural or =0 if urban |
| Age of Married Female at First Marriage (Instrumental Variable) | $Z$ | Actual age of married female when she first entered marital union |

***IV Probit regression***

In Equation (16) it is noticeable that we used predicted values of the number of children after it has been estimated instead of its actual values. This is to avoid having a problem of endogeneity. Therefore, the empirical model has the case where one of the exogenous variables is correlated with the error term. Consider the following models represented in Equations (17) to (19):

$$y_1^* = z_1\delta_1 + \alpha_1 y_2 + \mu_1 \quad (17)$$
$$y_2 = z\delta_2 + v_2 \quad (18)$$
$$y_1 = 1[y_1^* > 0], \quad (19)$$

Equations (17) and (19) is the structural equation while Equation (18) is the reduced form equation of $y_2$, which is endogenous when $\mu_1$ and $v_2$ are correlated. In this study, the equations are applicable because $y_2$ is correlated with $\mu_1$. Causality exists between the dependent and independent variables (Wooldridge, 2010).

Rivers and Vuong (1988) devised a two-step approach to test for endogeneity of $y_2$. Assuming the joint normality of $\mu_1$ and $v_2$ or N($\mu_1$, $v_2$) with Var($\mu_1$)=1, $\mu_1$ can be expressed as:

$$\mu_1 = \theta_1 v_2 + e_1 \tag{20}$$

where $\theta_1 = \eta_1/\tau_2^2$, $\eta_1 = Cov(v_2, u_1)$, $\eta_1 = Var(v_2)$, and $e_1$ is independent of z and $v_2$ (in other words, $y_2$). Because N($\mu_1$, $v_2$) and N($e_1$), $y_1^*$ can be expressed as:

$$y_1^* = z_1\delta_1 + \alpha_1 y_2 + \theta_1 v_2 + e_1 \tag{21}$$

where $y_1^*$ now has three parameters, $\delta_1, \alpha_1$, and $\theta_1$ to be estimated. However, since the parameter $\delta_2$ is not yet known, OLS regression is used to estimate $y_2$ on z to get the residuals $v_2$. Afterwards, we run probit estimation to $y_1$ on $z_1$, $y_2$, and $v_2$ to get consistent estimators of the scaled coefficients of $\delta_{\rho 1}, \alpha_{\rho 1}$ and $\theta_{\rho 1}$ (Rivers and Vuong, 1988; Wooldridge, 2010).

The log-likelihood estimation for observation $i$ of the models that have continuous explanatory variables are given as:

$$y_{il} = \log \Phi(w_i) + (1 - y_{il}) \log[1 - \Phi(w_i)] - \frac{1}{2}\log(\tau_2^2) - \frac{1}{2}(y_{i2} - z_i\delta_2)^2/\tau_2^2 \tag{22}$$

where $w_i$ depends on the parameters ($\delta_1$, $\alpha_1$, $\rho_1$, $\delta_2, \tau_2$) and is expressed as:

$$w_i \equiv \frac{[z_{il}\delta_1 + \alpha_1 y_{i2} + (\rho_1/\tau_2)(y_{i2} - z_i\delta_2)]}{(1 - \rho_1^2)^{1/2}} \tag{23}$$

Equation (22) is maximized with respect to all parameters and produces the maximum likelihood estimators of $\delta_1$, $\alpha_1$, $\rho_1$, $\delta_2$, and $\tau_2^2$. Using estimated Hessian, the expected estimated Hessian, or the outer product of the score, standard errors can be calculated. The MLE applied to this model is called instrumental variables probit, or IV probit (Wooldridge, 2010).

### *Data and Descriptive Statistics*

In the 2013 NDHS used in this study, there were 16,155 women respondents and 7,645 of them were married at the time of survey. In the NDHS survey, the age of women interviewed was between 15-49 years old. The responses given by these married females are used to determine the link between fertility and female labor force participation. We excluded those responses that are coded inconsistent, lack of information, and / or those married female that replied “don’t know” to some of the variables that we included. The summary of descriptive statistics of the variables used can be found in Table 2.

The average number of children is around three (3) per married female 63 percent of the married females are employed. The married females’ average age in the sample is 36 years old while the husbands’ average age is 39 years old. Married females attained at least secondary education

while their partners have roughly finished the same level of education. At an average, married females belong to middle class based on their household wealth. 60 percent of the married females are located in rural areas and the rest are currently residing in urban areas. Lastly, females included in the sample are typically married at the age of 21 years old.

**Table 2. Descriptive Statistics: 2013 National Demographics and Health Survey (NDHS)***

| Variable | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| Cumulative Fertility | 3.20 | 2.22 | 0 | 18 |
| Married Female Employment Status | 0.63 | 0.48 | 0 | 1 |
| Married Female's Age | 35.96 | 7.88 | 15 | 49 |
| Husband's Age | 39.07 | 8.80 | 15 | 86 |
| Married Female's Educational Attainment | 2.05 | 0.79 | 0 | 3 |
| Husband's Educational Attainment | 1.97 | 0.83 | 0 | 3 |
| Wealth Index | 2.88 | 1.44 | 1 | 5 |
| Geographical Area | 1.60 | 0.49 | 1 | 2 |
| Age of Married Female at First Marriage | 21.24 | 4.61 | 9 | 47 |

*Source: Authors' calculations based from Philippine National Demographic Health Survey (PNDHS) 2013.*
**Note: The observations of the variables vary because some of the respondent's answer are excluded because of inconsistency, lack of information, and / or those that replied "don't know".*

## V. Results

We estimated Equation (16) using IV probit and we first showed how our instrumental variable first affects the choice of having children, which is deemed endogenous. Table 3 reports the first stage regression in which the number of children is the dependent variable. Age is associated with higher number of children but this effect decreases as the couples get older. This implies that as the couple gets older, husband and wife accumulate more work experience and thus, their ability to raise children increases because they can bear the cost of childcare through their increasing wages. Further, as noted by Mincer (1975), earnings or income are directly correlated to age an experience.

Moreover, there is no difference between an educated and non-educated female on deciding about the limitation of having children implying as the results showed indirect but insignificant impact. It could imply that educational system and school policies should be strengthened regarding fertility preferences and timing of births in order for women to increase their knowledge about the consequences of having a children. Husbands who finished at least secondary level has a decreasing effect on number of children; however, this effect is not seen for husbands who have attained a higher educational level.

**Table 3. First-Stage Instrumental Variable Probit Regression: Fertility**

| Explanatory Variables | NDHS 2013 |
|---|---|
| Married Female's Age | 0.40*** |
| | (0.03) |
| Married Female's Age Squared | -0.003*** |
| | (0.0004) |
| Husband's Age | 0.02* |
| | (0.01) |
| Husband's Age Squared | -0.0004** |
| | (0.0002) |

| | |
|---|---|
| Married Female's Educational Attainment (Base = No education) | |
| Primary | -0.002 |
| | (0.20) |
| Secondary | -0.28 |
| | (0.22) |
| Higher | -0.30 |
| | (0.24) |
| Husband's Educational Attainment (Base = No education) | |
| Primary | -0.20 |
| | (0.19) |
| Secondary | -0.41** |
| | (0.21) |
| Higher | -0.32 |
| | (0.20) |
| Wealth Index (Base = Poorest) | |
| Poorer | -0.49*** |
| | (0.07) |
| Middle | -0.94*** |
| | (0.08) |
| Richer | -1.29*** |
| | (0.10) |
| Richest | -1.51*** |
| | (0.10) |
| Geographical Area (Base = Urban) | |
| Rural | -0.07 |
| | (0.06) |
| Age of Married Female at Marriage | -0.19*** |
| | (0.008) |
| Constant | -1.54*** |
| | (0.60) |
| Observations | 7,628 |
| Wald Chi-squared(16) | 85679.81*** |
| Log Pseudolikelihood | -19063.77 |

*Source: Authors' calculation based from 2013 National Demographic and Health Survey (NDHS)*
****Indicates significance at 1%; **Indicates significance at 5%;*Indicates significance at 10%.*
*Note: Robust standard errors adjusted for region clusters are in parentheses.*

Higher household wealth significantly decreases the likelihood of having more children. This could be attributed to higher opportunity cost of having more children and hence, married female tends to limit bearing more children and instead acquire assets for the household.

Geographical location (i.e., whether the married female lives in urban or rural area) appears to have no bearing on number of children. The probable reason is that the variations in the resources between urban and rural area doesn't affect married women's time in caring for her children and / or its decisions to limit or desire additional number of children because there are available substitute resources in the rural areas that are comparable to the more-endowed urban areas in terms of childcare. Rural areas now have easier access to resources and needs for childcare,

such as food, water, and medicine. Thus, married female's residing in the urban or rural area has no significant difference in the number of children that she will decide to have since the availability of resources in both urban and rural areas are substitutes there is no variations or differences when it comes to the total time devoted by married female in economic activities and child raising.

Lastly, married females that have entered marriage at a later age are less likely to have children. The rationale is that if a married female engaged in a union at a relatively early age, her fertility lifespan is longer; hence they have the capacity to bear more children. On the other hand, this is the opposite case for a married female who cohabitate in later years because her fertility lifespan is shorter and therefore, the capacity to bear children is less likely.

Table 4 displays the results from the second-stage of IV probit regression. After controlling for female's individual characteristics and circumstances, we see that cumulative number of children increases the probability of entering the labor force. This implies that having more children increases the married female's propensity to work more given the increasing number of children to support. This positive relationship was also consistent those of Sundstorm and Stafford (1991), Bratti (2003), Da Rocha and Fuster (2006), Caceres-Delpiano (2008), Tsafack Nanfosso and Zamo-Akono (2010) and Kinoshita and Guo (2015).

**Table 4. Second-Stage Instrumental Variable Probit Regression: Married Female Labor Supply**

| Explanatory Variables | NDHS 2013 |
|---|---|
| Cumulative Fertility | 0.07*** |
| | (0.03) |
| Married Female's Age | 0.07*** |
| | (0.02) |
| Married Female's Age Squared | -0.0007*** |
| | (0.0003) |
| Husband's Age | 0.003 |
| | (0.01) |
| Husband's Age Squared | -0.00007 |
| | (0.0001) |
| Married Female's Educational Attainment (Base = No education) | |
| Primary | -0.09 |
| | (0.12) |
| Secondary | 0.003 |
| | (0.13) |
| Higher | 0.36*** |
| | (0.11) |
| Husband's Educational Attainment (Base = No education) | |
| Primary | 0.12 |
| | (0.12) |
| Secondary | -0.03 |
| | (0.13) |
| Higher | -0.09 |
| | (0.14) |
| Wealth Index (Base = Poorest) | |

| | |
|---|---|
| Poorer | 0.16** |
| | (0.07) |
| Middle | 0.25** |
| | (0.11) |
| Richer | 0.34*** |
| | (0.11) |
| Richest | 0.46*** |
| | (0.11) |
| Geographical Area (Base = Urban) | |
| Rural | 0.12 |
| | (0.09) |
| Constant | -1.96*** |
| | (0.37) |
| Instrument: Age of Female at First Marriage | |
| Observations | 7,628 |
| Wald Chi-squared(16) | 85679.81*** |
| Log Pseudolikelihood | -19063.77 |
| /atrho | -0.17 |
| /lnsigma | 0.46 |
| Rho | -0.16 |
| Sigma | 1.58 |
| Wald test of exogeneity: Chi-squared (1) | 16.88*** |

*Source: Authors' calculation based from 2013 National Demographic and Health Survey (NDHS)*
****Indicates significance at 1%; **Indicates significance at 5%;*Indicates significance at 1%.*
*Note: Robust standard errors adjusted for region clusters are in parentheses.*

Age has a positive impact on a married female's employment opportunities but this impact diminishes as she becomes older and approaches retirement age. One possible reason is that additional productivity or output at work decreases as the married female gets older. In contrast, the husband's age has no impact on the married female's decision to enter labor force. The intuition behind this is that married females have their own stand in making decisions to pursue their personal (career) goals, while at the same time, contribute for the overall welfare of the household. For example, a married female currently has work because she wants to develop her skills, practice her field of specialization, to achieve her personal goals, and to earn income for her family. There are also instances where a married female decides not to find a job because she wants to devote all of her time in caring for her children. This implies that the husband is not involved in making these decisions. Hence, husband's labor market experience as proxied by age does not influence his wife's choices in pursuing labor activities. It could also be a manifestation that women empowers herself through her self-made decisions in life that cannot be highly influenced by external factors that she cannot entirely control.

The results showed that there is no significant difference between non-educated married female and educated married female (finished primary and secondary education) in entering productive employment. However, the chances of employment are higher for married females who finished higher education as compared to non-educated married females. It can be implied that women should invest time in attaining more human capital through attaining higher education to gain

competitive edge in the labor market. On the other hand, there is no significant difference in the husband's education attainment when it comes to female's decision to be employed. As discussed, a married female bases her choices based on her own capabilities and personal preferences. Therefore, external factors such as her husband's educational attainment do not affect her decisions regarding employment status.

Moreover, higher possession of household wealth (from poorer to richest) as compared to household that has the least possession (poorest) is associated with higher likelihood for the married female to find employment. As more wealth is acquired, one has higher disposable income, and may purchase more expensive goods and services, thus leading to an increase in household expenditures. This will incline the married female to be more proactive in finding better and higher paid employment to cover these expenses.

Lastly, geographic area (whether the respondent lives in a rural or urban area) is not significant in affecting female's choice whether to be employed or not. The reason could be that this external factor, given the differences when it comes to the availability of jobs doesn't affect a married woman's choice in entering labor market because there are available resources that they can utilize their time efficiently (e.g. resources for leisure such as caring for children) and therefore, doesn't provide significant role in determining married female employment decisions. Another possible reason could be that there is no difference in the time devoted in economic activities between urban and rural area since the resources available in those areas that have an impact on labor market decisions (proximity of work, transportation, and skill needed in particular work) are close substitutes or practically almost the same.

Wald test of exogeneity statistic shows that there is an endogeneity between fertility and married female labor supply. Therefore, the IV approach is necessary and the use of age of female at first marriage as an instrument is empirically valid since the statistic shown by the Wald test rejects exogeneity at 1 percent level.

Table 5 presents the marginal effects of the explanatory variables based from the second-stage IV probit regression calculating the changes in probability of a married female's decision to enter the labor market. An additional child will increase the probability that a married female will join labor force by 3 percent. The results suggests that married female will be more inclined to decide to look for a job since an additional member was added in the household.

**Table 5. Marginal Effects: Second-Stage Instrumental Variable Probit Regression (Explained Variable = Married Female Labor Supply)**

| Explanatory Variables | Coefficients |
|---|---|
| Cumulative Fertility | 0.03*** |
| | (0.01) |
| Married Female's Age | 0.009*** |
| | (0.002) |
| Husband's Age | -0.0009 |
| | (0.001) |
| Married Female's Educational Attainment (Base = No education) | |
| Primary | -0.03 |
| | (0.04) |
| Secondary | 0.001 |
| | (0.05) |

| | |
|---|---|
| Higher | 0.13*** |
| | (0.04) |
| Husband's Educational Attainment (Base = No education) | |
| Primary | 0.04 |
| | (0.04) |
| Secondary | -0.01 |
| | (0.05) |
| Higher | -0.03 |
| | (0.05) |
| Wealth Index (Base = Poorest) | |
| Poorer | 0.06** |
| | (0.03) |
| Middle | 0.09** |
| | (0.04) |
| Richer | 0.12*** |
| | (0.04) |
| Richest | 0.16*** |
| | (0.04) |
| Geographical Area (Base = Urban) | |
| Rural | 0.04 |
| | (0.03) |
| Instrument: Age of Female at First Marriage | |
| Observations | 7,628 |

*Source: Authors' calculation based from 2013 National Demographic and Health Survey (NDHS)*
****Indicates significance at 1%; **Indicates significance at 5%;*Indicates significance at 1%.*
*Note: Standard errors are in parentheses.*

As observed, the likelihood of employment increases by 0.9 percent as the married female gets a year older. This output is aligned with the results of the effect of age on the positive outcome that women will get employed. Since age is typically used as a proxy for job experience, we can infer that additional experience gain by a married female will increase her chances of employment in any kind of occupation. However, the husband's age has no impact on its probability in joining workforce. Again, this in aligned with the inference that characteristics not exclusive for a married female do not affect her probability of either looking for a job or fully utilize her time to her children.

In the case of married female's educational attainment, there is no change in the probability of a married female of getting employed whether she finishes primary and secondary education as opposed to a non-educated married female. Only married females that attained higher education has an impact because has higher chances of getting a job by 13 percentage points as compared to married females that has no educational attainment. The output suggests that a married female should have attained higher education to have higher chances of getting hired in the labor market. Meanwhile, husband's educational attainment has no effect on his wife's decision to join the labor force. It is also parallel to the results on the husband's age; further implying that social characteristics that are not directly associated to a married female does not affect the outcome whether the married female decides to get employed or otherwise.

Reflecting the positive effect of wealth on labor participation, we observe an increasing probability of becoming employed as the woman climbs up the wealth quintile. As compared to those

households categorized under “poorest,” those Q2 (categorized as “poor”) households see a 6-percent improvement in chances of employment. There will be a 9-percent improvement in probability points if married female belongs to a middle class household, while there will be a 12-percent improvement in probability if she belongs to a household categorized under “richer.” Asset ownership entails household expenses and based on our theoretical framework, income and expenditures are equated and wages are sources of income to cover expenses. Hence, as the household possesses many physical assets, the tendency for a married female to stay employed increases as opposed to a married female whose household is characterized as poorest in terms of household wealth.

On the other hand, there is no significant difference in terms of the probability of getting a job for a married female if she is currently located in rural areas as compared to urban areas. It can be inferred that married female’s current employment status is based on her capacity and abilities, and she will adjust according to the location of her job. For instance, if a married female has interest and expertise in agricultural-related activities, but lives in an urban area, she may work in a rural area where facilities and equipment related to her discipline are more abundant. If a married female who lives in a rural area is interested and skilled in finance, she is willing to move to the urban area where there are many employers from these markets that are looking for the abilities that she possesses. Thus, regardless of the type of geographical area married female can find employment or chooses to care for her children.

## VI. Conclusion

The objective of this paper is to explore the link between fertility and married female labor supply in the case of the Philippines using instrumental variables (IV) approach. We used a two-step regression based on maximum likelihood estimation. We made a simple model that connects fertility and married female labor supply in which having children influences a mother’s decision to participate in the labor market.

In the first stage regression, we find that the couple’s age has a direct impact on fertility. On the other hand, secondary education of married female’s husband as compared to non-educated husband, household wealth relative to the poorest household, and age of female at first marriage have a tendency to limit the number of children.

Accounting for the endogeneity of fertility with the married female labor supply in the second-stage regression, we used age of female at first marriage as an instrument while predicted values of fertility was used as an explanatory variable. The results showed that fertility increases the probability of a married female to look for employment. The married female’s age, higher educational attainment relative to non-educated married female, and household wealth as opposed to the household class with the least wealth have direct relationship with married female employment.

Marginal effects of the second-stage regression were also conducted and we estimated that additional children will increase the likelihood of a married female to participate in the labor force by 3 percentage points. Increase in married female’s age also increases her probability of getting employed by 0.9 percent. The chances of having labor market activity is higher by 13 percentage points if a married female attains higher education as compared to a married female that has no formal education. If a married female belongs to a household belonging to the highest wealth quintile (categorized as “highest”) among all classes in terms of wealth, she has the greatest chance to be employed by 16 percentage points relative to a married female who is a member of a household belonging to the lowest wealth quintile (categorized as “poorest”).

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## Appendix

### A. Comparative Statics of Married Female Labor Supply Model

Solving for Equation (15), we get the impact of number of children ($N^*$) to married women labor force supply ($L^*$) and leisure ($V^*$):

$$\frac{\partial L^*}{\partial N^*} = -\frac{\partial V^*}{\partial N^*} \tag{24}$$

When there is marginal change occurred in wages ($w$), the effect on married women labor supply ($L^*$) is shown as:

$$\frac{\partial L^*}{\partial w} = -\frac{\partial V^*}{\partial N^*}\frac{\partial N^*}{\partial w} \tag{25}$$

Isolating $\frac{\partial V}{\partial N^*}$, we get:

$$\frac{\partial V^*}{\partial N^*} = \frac{-(\partial L^*/\partial w)}{(\partial N^*/\partial w)} \tag{26}$$

In Equation (26), $\frac{\partial V^*}{\partial N^*}$ measures the effect of the number of children ($N$) on leisure ($V$), $\frac{\partial L^*}{\partial w}$ determines the impact of wages ($w$) on married women labor supply ($L^*$), and $\frac{\partial N^*}{\partial w}$ is the response of number of children ($N$) on wages ($w$). It should be noted, however that $\frac{\partial N^*}{\partial w}$ is ambiguous because it depends on how the married female perceives the effect of wages on facilitating more or discouraging additional children that would in turn, affects her work-leisure decision. Hence, there are two possible scenarios:

(1) If $\frac{\partial N^*}{\partial w} > 0$ implying that higher wages allow more children, since the married female has more money and time to afford raising children, then $\frac{\partial V^*}{\partial N^*} < 0$ which means leisure ($V^*$) decreases with number of children ($N^*$), and thus, $\frac{\partial L^*}{\partial N^*} > 0$ which means married female labor supply ($L^*$) increases with number of children ($N^*$) and;

(2) If $\frac{\partial N^*}{\partial w} < 0$ suggesting that more wages deter having children, as the married female decides to focus on her career, then $\frac{\partial V^*}{\partial N^*} > 0$ which means leisure ($V^*$) increases with number of children ($N^*$), and thus, $\frac{\partial L^*}{\partial N^*} < 0$ which means married female labor supply ($L^*$) decreases with number of children ($N^*$). In other words, the determining factor is the number of children ($N^*$) that could either give positive or negative impact married woman labor supply ($L^*$).

### B. Validity of Instrumental Variable to the Endogeneity of Fertility: Age of Married Female at First Marriage

**Table 5. Simple OLS Regression Results**

| Explanatory Variables | NDHS 2013 |
|---|---|
| Age of Married Female at First Marriage | -0.16*** |

| | |
|---|---|
| | (0.01) |
| Constant | 6.69*** |
| | (0.11) |
| Observations | 7,645 |
| $R^2$ | 0.12 |
| Adj. $R^2$ | 0.12 |
| F-Stat (1, 7643) | 1010.91*** |

*Source: Authors' calculation based from 2013 National Demographic and Health Survey (NDHS)*
****Indicates significance at 1%; **Indicates significance at 5%;*Indicates significance at 1%.*
*Note: Standard errors are in parentheses.*

We employed simple regression analysis on the IV, age of married female at marriage to the fertility as proxied by the number of children. The results showed that IV is negatively correlated to the number of children at 1% level of significance. Thus, age of married female at first marriage can be used as an instrument for the endogeneity of fertility on married female labor supply.