An Inverted U-shaped Relationship between Female Labor Supply and the Age of Children: A Case of Vietnam

Review of Integrative Business & Economics Research

Van Thi Nghiem
Graduate school of economics, Tokyo International University

ABSTRACT

This study analyzes the effect of the age of children on female labor supply in Vietnam. Two major contributions of this research to the literature are: (a) expanding AIDS Kooreman and Kapteyn (1985) model by adding savings variable as a new variable; (b) extending the age of children into 3 groups to measure its effect on female labor supply. The pooled time series and cross-sections of the Vietnam Household Living Standard Surveys of years 1998-2010 are used in this study. The result indicates that there exists an inverted U-shaped relationship between female labor supply and the age of children. Another result is that women are more sensitive with wage changes than men.

JEL Classification: J22, J13.
Keywords: labor supply, consumer behavior.

1. INTRODUCTION

Female labor supply is one of the important issues in economic studies. From a macroeconomics viewpoint, the findings from studies on female labor force are useful in explaining the role of women in economic development. For example, Goldin (1993) has proved the existence of a theoretical U-shaped relationship between female labor force and economic development. She explains that when income is very low, women often work with other household members on farm. Economic development increases education level of women, leading to a higher rate of participation by them. Empirically, Goldin (1986) concludes that a high female labor force will raise per capita income of a nation.

From a microeconomics viewpoint, it is necessary to study the patterns of female labor supply to explain many persistent problems such as female employment in low-wage sectors, gender wage gap, and the role of women in poverty reduction. Moreover, a full understanding of the behaviors of female labor supply could help to make effective implications for many

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

phenomena such as marriage, fertility, divorce, and family income distribution.

Female labor supply is affected by many factors such as wage offered, family income, fertility rate, child-bearing, number of children and their ages. Few existing studies have adequately addressed all aspects of the effects of children (particularly the age of children) on women's choice of work. The AIDS Kooreman and Kapteyn (1985) model gives a good estimate of the effects of the number of children on female labor supply. It does not mention, however, the effects of the age of children and other factors such as savings behavior on the supply of women's labor. This paper attempts to improve on these limitations.

This research adds to the existing literature in two ways: Firstly, we try to expand AIDS Kooreman and Kapteyn (1985) model by adding savings variable as a new variable. Secondly, to measure the effects of the age of children on female labor supply, we expand the categorization of children by age into 3 sub-groups: 0-3 years old; 4-10 years old; 11-17 years old. We label children aged 0-3 years old as infants; 4-10 years old as toddlers; 11-17 years old as teenagers.

We design the experiment by revising the AIDS Kooreman and Kapteyn model and calling it the revised AIDS Kooreman and Kapteyn model using data obtained in Vietnam. The Vietnamese labor market is appropriate to test the model because it has a high female labor participation rate compared to other Southeast Asian countries. Moreover, the Vietnamese labor market has many common characteristics shared by the developing countries. For instance, unemployment rate in Vietnam is very low but underemployment rate is very high; earning levels are low and uncertain despite long working hours; women are less advantaged than men; a great proportion of the workforce is in agriculture and informal sectors. Therefore, it is possible to generalize the model and arrive at general findings for labor market in developing countries from a study of the case of Vietnam.

This research has two objectives. The first objective is to measure the effects of the number of children and their ages on female labor supply in Vietnam. The second objective is to test the sensitivity of wage changes in male and female labor supply in Vietnam.

We begin our work by raising two research questions: what are the effects of the number of children and their ages on female labor supply in Vietnam? and who are more

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

sensitive to wage changes in Vietnam: men or women?.
To answer these questions, we propose two hypotheses:
The first hypothesis:
Null hypothesis: Younger children have a negative effect on female labor supply.
Alternative hypothesis: Younger children have a positive or no effect on female labor supply.

We will provide some theoretical views and empirical findings related to the first hypothesis. On one hand, younger children have higher time costs than older ones. This will raise reservation wage and then reduce female labor supply. On the other hand, children have a direct effect on female labor supply. It is partially due to the time needs of children if we assume that these needs are fixed. Moreover, it is noted that the participation rate of women increases with the age of children due to the elements such as cheap child care costs, improvement in contraceptive methods, a change of preferences for children, and a rise in divorce rate.

Becker (1985) proves that time spent with an infant is more tiring than the same number of hours spent with an older baby. Then, the effect of an extra hour spent with a child on marginal utility of leisure falls with children's age. Some other researchers have found a substantial negative correlation between the presence of young babies and female labor supply (for example Mincer 1962, Cain 1966, Bowen 1969, Lehrer et al. 1986, Nakamura 1992). Browning (1992) sees an almost universal finding that the female participation rate increases with the age of the youngest child. Furthermore, women's labor supply and children vary quite significantly between different groups such as across races (Cain 1966, Bell 1974, Lehrer 1991), ages (Schultz 1978), and education (Gronau 1973) in the same period.

The second hypothesis:
Null hypothesis: Female labor supply is more elastic than male labor supply.
Alternative hypothesis: Female labor supply is less elastic than male labor supply.

We hypothesize that wage levels, commodity prices and property income are the same for both women and men but they have different preference of working. This difference leads to different behaviors of providing labor supply. Moreover, according to the Le Chatelier principle, in general terms, an individual with more alternatives will have a more elastic supply (or demand) function in absolute value terms. We have recognized that women have more choices in terms of consuming time compared to men. Indeed, women can choose to work or have leisure time at home to relax or take care of their kids. Thus, we

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

presume that women will have a more elastic labor supply than men. Empirically, many researchers such as Ashenfelter and Heckman 1973, Boskin 1973, Hall 1973 conclude that women are more sensitive to wage increases than men in terms of gross wage elasticity, own-price elasticity, cross-price elasticity and property income elasticity. In other words, women have a more elastic labor supply than men.

This paper proceeds as follows: After the introduction section, section two will provide a literature review. Section three will specify the model used in this study. Section four will be devoted to the estimation technique and empirical results. Section five will be the conclusion.

2. LITERATURE REVIEW

There is a large number of papers on the supply of labor in the literature. Killingworths (1983) provides a comprehensive summary of a prominent body of analyses of labor supply during the 1960s-1980s. Among them are important studies such as Gronau (1974), Heckman (1979), Deaton and Muellbauer (1980a-b). Studies since the mid-1980s has been done by Killingsworth and Heckman (1986), Goldin (1994), Pencavel (1998), Mammen and Paxson (2000), Lee (2005), Attanasio, Harmish and Sanches-Marcos (2008), Mano and Yamamura (2011), Cortes and Tessada (2011), and Eckstein (2011).

In our research, we employ model of joint labor supply and commodity demands proposed by Kooreman and Kapteyn (1985). The model of joint labor supply and commodity demands is of interest to many researchers. The number of studies on jointly labor supply and commodity demand model has been growing since the mid-1970s such as by Abbott and Ashenfelter (1976), Phlips (1978), Barnet (1979), Atkinson and Stern (1980), Blundell and Walker (1982), Ray (1982), Kooreman and Kapteyn (1985). Ray (1982) tests the joint model of labor supply and commodity demands to the AIDS and LES functions. Some researchers make an effort to investigate a condition that labor supply and commodity demands can be separable. Others are more interested in analyzing the effect of rationed system or tax on labor supply and commodity demands.

Applying the joint model of labor supply and commodity demands is very fruitful. On one hand, it permits us to test a separability hypothesis between commodities and leisure time. This hypothesis allows us to estimate commodity demand systems and the Engel curve that excludes wage rate. Likewise, the estimation of the labor supply curve

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

without including relative price could produce biased labor supply elasticity (Blundell and Walker 1982). On the other hand, as Barnett (1979a) argues the joint model allows us to concern the efficiency and the allocated effects of wage and commodity tax. Any change in the allocation of consumption expenditure should be viewed as a "shift variable" in the labor supply model. The joint model also enables us to evaluate the effects of the shift from direct tax (personal income tax) to indirect tax (value added tax) on labor supply and commodity demands (Atkinson and Stern, 1980).

We have found a few studies on the issue of labor supply in Vietnam in the literature. The two outstanding studies are by Le (2009) and Nguyen (2009). Le investigates the effects of fertility on parental labor force participation in Vietnam. Using the gender of the first child and the same gender for the first two children as two instrumental variables, he finds fertility has a negative effect on female labor force participation and female labor supply and a positive effect on male labor force participation and male labor supply. This finding is similar to Nguyen (2009). Nguyen also examines the effects of fertility on female labor supply in Vietnam, primarily female labor force and working hours. She has concluded that fertility has a negative effect on female labor supply because the falling in female labor supply during the child-bearing period could make women have lower wage than men.

3. THE MODEL

Our approach follows that of Koreeman and Kapteyn (1985) and Howe (1975). In the AIDS Koreeman and Kapteyn model, wage rate as price of leisure is considered as one of many other commodities. This idea is first mentioned by Deaton and Muellbauer (1980a). Koreeman and Kapteyn (1985) allow the effects of children appearing in labor supply and commodity demands by employing the idea of equivalence scale proposed by Barten (1964). Accordingly, a child consumes some amounts compared to an adult.

We will adopt the AIDS Koreeman and Kapteyn model. However, we will add savings as a new variable and call it the revised AIDS Kooreeman and Kapteyn model. In the literature, Howe (1975) has included savings variable in his Extended Linear Expenditure System (ELES). He also considers savings as one commodity like many other commodities. The problem here is how to determine price of savings. In economics, the price of one commodity is defined as the opportunity cost of giving up consuming another one. If a consumer has some savings, he/she has to give up his/her

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

spending on other commodities. Therefore, we determine the price of savings to be inflation. Due to limitation in the availability of the Vietnam data, we will use the Consumer Price Index (CPI) as a proxy for inflation.

We set up some assumptions of the model: supply of male and female labor is not subject to the problem of money illusion; accretion of non-human and human wealth is ignored; family utility function is a twice differentiable quasi-concave; commodities with the same quality will have the same prices. However, we also need some other assumptions to fit our idea into the model well: total family expenditures per period must be equal to total family income; utility of the family head is considered as utility of family; wages of male and female workers, commodity prices, property income, the number of children and their ages are assumed to be exogenous variables.

3.1 The revised AIDS Kooreman and Kapteyn model

In general, the joint model of labor supply and commodity demands belongs to the complete demand system approach. It is to solve a basic economic problem of a rational consumer making the minimum expenditures on one good (say, good i) to reach the maximum utility level. The idea of putting the effects of the number of children and their ages in the model is that instead of considering labor supply and commodity demands in reality as usual, we use subjective labor supply and commodity demands. The subjective labor supply and commodity demands are imaginary functions that are defined as the ratio of labor supply and commodity demands in reality to the family structure.

In mathematical terms, the subjective labor supply and commodity demand functions are assumed to be

$$\frac{l_j}{n_j} = l_j^*, \quad \frac{q_i}{n_i} = q_i^* \quad \frac{q_{n+1}}{n_{n+1}} = q_{n+1}^*, \text{ j=m, f; i=1…n,n+1;} \qquad (1)$$

where l_j is leisure time in reality for member j; l_j^* is subjective leisure time for member j; q_i is a consumed quantity of commodities in reality for commodity i; q_i^* is a subjective quantity of commodity i; q_{i+1} is savings in reality and q_{i+1}^* is a subjective savings; n_j, n_i, n_{n+1} are the family parameters that depend on family structure. In the

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

literature, family parameters are also called specific equivalence scales.

The subjective price of leisure time, prices of commodities, and price of savings are assumed to be respectively

$$w_j^* = n_j w_j,\ p_i^* = n_i p_i,\ p_{n+1}^* = n_{n+1} p_{n+1},\ \text{j=m, f; i=1…n,n+1;} \tag{2}$$

All families are assumed to have the same direct utility function after scaling by labor supply and commodity demands with family parameters:

$$u = u\left(\frac{q_i}{n_i}, \frac{q_{n+1}}{n_{n+1}}, \frac{l_j}{n_j}\right) \tag{3}$$

The budget constraint is

$$Y = \sum_{i=1}^{n+1} p_i q_i = \sum_{i=1}^{n+1} n_i p_i \frac{q_i}{n_i} = \sum_{i=1}^{n+1} p_i^* q_i^* = \sum_{j=m.f} w_j^* h_j^* + v \tag{4.1}$$

We can also rewrite the budget constrant as

$$\sum_{i=1}^{n+1} p_i^* q_i^* + \sum_{j=m.f} w_j^* l_j^* = \sum_{j=m.f} w_j^* T_j^* + v \tag{4.2}$$

Applying Shephard Lemma as $q_i = \frac{\partial C}{\partial p_i}$, $l_j = \frac{\partial C}{\partial w_j}$, and using simple algebra, we get the share functions $\frac{\partial \log C}{\partial \log p_i} = S_i$; $\frac{\partial \log C}{\partial \log w_j} = S_j$; i=1…n,n+1; j=m,l. In other words, the share functions are in the following forms:

$$S_i^* = \frac{p_i^* q_i^*}{C} = \frac{p_i q_i}{C} = S_i = f\left(p_i, w_j, n_i, n_j, C\right) \text{ , i=1…n, n+1; j=m, f} \tag{5}$$

$$S_j^* = \frac{w_j^* h_j^*}{C} = \frac{w_j h_j}{C} = S_j = h\left(p_i, w_j, n_i, n_j, C\right), \quad \text{i=1…n, n+1; j=m, f} \tag{6}$$

In equations (5) and (6), the subjective budget shares are exactly equal to the budget shares in reality, ($S_i^* = S_i$; $S_j^* = S_j$).

3.2 Empirical model

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

We use data obtained from the Vietnam Household Living Standard Surveys of the years 1998-2010 for empirical analysis. We will divide all commodities into 5 specific groups: food, housing, equipment, other nonfood, and savings. We allow the effects of the number of children and their ages to appear in our revised AIDS Kooreman and Kapteyn model through the terms $n_m, n_f, n_d, n_h, n_e, n_n, n$ in the cost functions as of

$$C(u, w_m, w_f, p_d, p_h, p_e, p_n, P, n_m, n_f, n_d, n_h, n_e, n_n, n_s) = \exp(a + u.b) \quad (7)$$

$$\begin{aligned}
a = {} & \alpha_0 + \alpha_m \log(n_m w_m) + \alpha_f \log(n_f w_f) + \alpha_d \log(n_d p_d) + \alpha_h \log(n_h p_h) + \alpha_e \log(n_e p_e) \\
& + \alpha_n \log(n_n p_n) + \alpha_s \log(n_s P) + \frac{1}{2}\gamma_{mm} \log^2(n_m w_m) + \frac{1}{2}\gamma_{ff} \log^2(n_f w_f) + \frac{1}{2}\gamma_{dd} \log^2(n_d p_d) \\
& + \frac{1}{2}\gamma_{hh} \log^2(n_h p_h) + \frac{1}{2}\gamma_{ee} \log^2(n_e p_e) + \frac{1}{2}\gamma_{nn} \log^2(n_n p_n) + \frac{1}{2}\gamma_{ss} \log^2(n_s P) + \\
& \gamma_{mf} \log(n_m w_m)\log(n_f w_f) + \gamma_{md} \log(n_m w_m)\log(n_d p_d) + \gamma_{mh} \log(n_m w_m)\log(n_h p_h) \\
& + \gamma_{me} \log(n_m w_m)\log(n_e p_e) + \gamma_{mn} \log(n_m w_m)\log(n_n p_n) + \\
& \gamma_{ms} \log(n_m w_m)\log(n_s P) + \gamma_{fd} \log(n_f w_f)\log(n_d p_d) + \gamma_{fh} \log(n_f w_f)\log(n_h p_h) \\
& + \gamma_{fe} \log(n_f w_f)\log(n_e p_e) + \gamma_{fn} \log(n_f w_f)\log(n_n p_n) + \\
& \gamma_{fs} \log(n_f w_f)\log(n_s P) + \gamma_{dh} \log(n_d p_d)\log(n_h p_h) + \gamma_{de} \log(n_d p_d)\log(n_e p_e) \\
& + \gamma_{dn} \log(n_d p_d)\log(n_n p_n) + \gamma_{ds} \log(n_d p_d)\log(n_s P) + \\
& \gamma_{he} \log(n_h p_h)\log(n_e p_e) + \gamma_{hn} \log(n_h p_h)\log(n_n p_n) + \gamma_{hs} \log(n_h p_h)\log(n_s P) \\
& + \gamma_{en} \log(n_e p_e)\log(n_n p_n) + \gamma_{es} \log(n_e p_e)\log(n_s P) + \\
& \gamma_{ns} \log(n_n p_n)(n_s P)
\end{aligned} \quad (8)$$

$$b = (n_m w_m)^{\beta_m} (n_f w_f)^{\beta_f} (n_d p_d)^{\beta_d} (n_h p_h)^{\beta_h} (n_e p_e)^{\beta_e} (n_n p_n)^{\beta_n} (n_s P)^{\beta_s} \quad (9)$$

where w_m and w_f are respectively male and female wage rates; p_d, p_h, p_e, p_n,P are respectively prices of food, housing, equipments, other nonfood and consumer price index (CPI); $n_m, n_f, n_d, n_h, n_e, n_n, n_s$ are respectively equivalence scales of male, female leisure and specific commodity groups of food, housing, equipments, other nonfood and savings.

The family parameters are assumed to be under the form as of

$$n_d = 1 + \delta_{d1} N_1 + \delta_{d2} N_2 + \delta_{d3} N_3 \quad (10.1)$$

$$n_h = 1 + \delta_{h1} N_1 + \delta_{h2} N_2 + \delta_{h3} N_3 \quad (10.2)$$

$$n_e = 1 + \delta_{e1} N_1 + \delta_{e2} N_2 + \delta_{e3} N_3 \quad (10.3)$$

$$n_n = 1 + \delta_{n1} N_1 + \delta_{n2} N_2 + \delta_{n3} N_3 \quad (10.4)$$

$$n_s = 1 + \delta_{s1} N_1 + \delta_{s2} N_2 + \delta_{s3} N_3 \quad (10.5)$$

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

$$n_m = 1 + \delta_{m1} N_1 + \delta_{m2} N_2 + \delta_{m3} N_3 \quad (10.6)$$

$$n_f = 1 + \delta_{f1} N_1 + \delta_{f2} N_2 + \delta_{f3} N_3 \quad (10.7)$$

where N_1 is the number of children aged 0-3; N_2 is the number of children aged 4-10; N_3 is the number of children aged 11-17.

The indirect utility can be derived from equation (7) as follows:

$$u = \frac{\log C - a}{b} \quad (11)$$

The restrictions on parameters of the revised AIDS Kooreman and Kapteyn cost function:

$$\alpha_m + \alpha_f + \alpha_d + \alpha_h + \alpha_e + \alpha_n + \alpha_s = 1 \quad (12.1)$$

$$\beta_m + \beta_f + \beta_d + \beta_h + \beta_e + \beta_n + \beta_s = 1 \quad (12.2)$$

$$\gamma_{mm} + \gamma_{mf} + \gamma_{md} + \gamma_{mh} + \gamma_{me} + \gamma_{mn} + \gamma_{ms} = 0 \quad (12.3)$$

$$\gamma_{ff} + \gamma_{fm} + \gamma_{fd} + \gamma_{fh} + \gamma_{fe} + \gamma_{fn} + \gamma_{fs} = 0 \quad (12.4)$$

$$\gamma_{dd} + \gamma_{md} + \gamma_{fd} + \gamma_{dh} + \gamma_{de} + \gamma_{dn} + \gamma_{ds} = 0 \quad (12.5)$$

$$\gamma_{hh} + \gamma_{mh} + \gamma_{fh} + \gamma_{dh} + \gamma_{he} + \gamma_{hn} + \gamma_{hs} = 0 \quad (12.6)$$

$$\gamma_{ee} + \gamma_{me} + \gamma_{fe} + \gamma_{de} + \gamma_{he} + \gamma_{en} + \gamma_{es} = 0 \quad (12.7)$$

$$\gamma_{nn} + \gamma_{mn} + \gamma_{fn} + \gamma_{dn} + \gamma_{hn} + \gamma_{en} + \gamma_{ns} = 0 \quad (12.8)$$

$$\gamma_{ss} + \gamma_{ms} + \gamma_{fs} + \gamma_{ds} + \gamma_{hs} + \gamma_{es} + \gamma_{ns} = 0 \quad (12.9)$$

The full income function now becomes

$$w_m^* T^* + w_f^* T^* + v = w_m T + w_f T + v \equiv Y = C = exp(a + ub) \quad (13)$$

The share functions after applying Shephard's Lemma:

$$S_d = \frac{q_d p_d}{C} = \alpha_d + \gamma_{dd} \log(n_d p_d) + \gamma_{md} \log(n_m w_m) + \gamma_{fd} \log(n_f w_f) + \gamma_{dh} \log(n_h p_h) + \gamma_{de} \log(n_e p_e) + \gamma_{dn} \log(n_n p_n) + \gamma_{ds} \log(n_s P) + \beta_d (\log C - a) \quad (14.1)$$

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

$$S_h = \frac{q_h p_h}{C} = \alpha_h + \gamma_{hh}\log(n_h p_h) + \gamma_{mh}\log(n_m w_m) + \gamma_{fh}\log(n_f w_f) + \gamma_{dh}\log(n_d p_d) + \gamma_{he}\log(n_e p_e) + \gamma_{hn}\log(n_n p_n) + \gamma_{hs}\log(n_s P) + \beta_h(\log C - a) \quad (14.2)$$

$$S_e = \frac{q_e p_e}{C} = \alpha_e + \gamma_{ee}\log(n_e p_e) + \gamma_{me}\log(n_m w_m) + \gamma_{fe}\log(n_f w_f) + \gamma_{de}\log(n_d p_d) + \gamma_{he}\log(n_h p_h) + \gamma_{en}\log(n_n p_n) + \gamma_{es}\log(n_s P) + \beta_e(\log C - a) \quad (14.3)$$

$$S_n = \frac{q_n p_n}{C} = \alpha_n + \gamma_{nn}\log(n_n p_n) + \gamma_{mn}\log(n_m w_m) + \gamma_{fn}\log(n_f w_f) + \gamma_{dn}\log(n_d p_d) + \gamma_{hn}\log(n_h p_h) + \gamma_{en}\log(n_e p_e) + \gamma_{ns}\log(n_s P) + \beta_n(\log C - a) \quad (14.4)$$

$$S_s = \frac{q_s p_s}{C} = \alpha_s + \gamma_{ss}\log(n_s P) + \gamma_{ms}\log(n_m w_m) + \gamma_{fs}\log(n_f w_f) + \gamma_{ds}\log(n_d p_d) + \gamma_{hs}\log(n_h p_h) + \gamma_{es}\log(n_e p_e) + \gamma_{ns}\log(n_n p_n) + \beta_s(\log C - a) \quad (14.5)$$

$$S_m = \frac{l_m w_m}{C} = \alpha_m + \gamma_{mm}\log(n_m w_m) + \gamma_{mf}\log(n_f w_f) + \gamma_{md}\log(n_d p_d) + \gamma_{mh}\log(n_h p_h) + \gamma_{me}\log(n_e p_e) + \gamma_{mn}\log(n_n p_n) + \gamma_{ms}\log(n_s P) + \beta_m(\log C - a) \quad (14.6)$$

$$S_f = \frac{l_f w_f}{C} = \alpha_f + \gamma_{ff}\log(n_f w_f) + \gamma_{mf}\log(n_m w_m) + \gamma_{fd}\log(n_d p_d) + \gamma_{fh}\log(n_h p_h) + \gamma_{fe}\log(n_e p_e) + \gamma_{fn}\log(n_n p_n) + \gamma_{fs}\log(n_s P) + \beta_f(\log C - a) \quad (14.7)$$

Due to adding-up restriction, the share functions must satisfy a condition that $S_d + S_h + S_e + S_n + S_s + S_m + S_f = 1$. Since the system satisfies a usual adding-up restriction, we can delete one equation from the system without losing information. These shares functions are estimable by using data from household surveys.

4. Data, estimation technique and empirical results

4.1 Data

Our data is a sample of nuclear families[1] that consist of husband and wife with or without children aged 0-17 years drawn from the pooled time series and cross sections of the Vietnam Household Living Standard Surveys (VHLSS) of the years 1998 to 2010.

[1] A nuclear family is a family in which spouses live separately from their parents after getting married. In our research, we define a family and a household differently. A family is an assembly of people who have close relationship through blood ties or marriage and live together in one house. Meanwhile, a household is often defined as an assembly of people living together in one house and sharing the same kitchen.

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

The husbands in all selected nuclear families work, but the wives may or may not work in the labor market. Our sample contains 4,429 nuclear families from 72,496 households in the whole pooled times series and cross sections sample of the VHLSSs of the year 1998-2010.

4.2 Estimation technique

The problem of non-working female labors exists during the estimation process of female labor supply because of observation of females' wages. In fact, non-working female workers may supply some working hours if they find appropriate works in the labor market. If we run the model by using OLS method that excludes non-working female workers from the sample, we may suffer a problem of sample selection bias. To solve this problem, some researchers have applied some techniques such as Heckman (1979), Blundell and Walker (1982), Koorenman and Kapteyn (1986). For example, Heckman (1979) suggests a method to correct the problem of sample selection bias; Kooreman and Kapteyn (1986) put on the rationing theory for the non-working female workers by setting the rationed working hours at zero. We argue that the technique offered by Kooreman and Kapteyn (1986) is a special case rather than a general one. Moreover, we have not seen maximization behavior in this rationed model. In our research, we will adopt Heckman's two-stage process to correct for the problem of sample selection bias. This method is a general method used by many researchers recently. We will use the sample of both working and non-working female workers. The sample of working female labors is for interior solution. The sample of non-working female labor is for corner solution. For the non-working female labors, we will apply the shadow prices, calculate the probability of participation rate and then adjust for imputed wage.

Using Heckman's two stage process to correct for the problem of sample selection bias, we first run a Probit model explaining the probability of the participation rate of female workers. Then we calculate Mill's inverse ratio. We continue to run female wage equation to get the predicted female wage by using sub-sample of families with both husband and wife working.

In the first step, we run 8 predictors which are log-total family expenditures, log-wage of husband, age of wife, square of age of wife, number of years of schooling of wife, numbers of infants, number of toddlers, numbers of teenagers to estimate the probability

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

of female participation in the labor force. The detail results of this estimation process can be provided upon request. All of these predictors are statistically significant at 5 percent confidence interval, except number of toddlers and log-expenditure variables, which are significant at 10 percent confidence interval. The signs of all predictors show reasonable economic meanings. That is, the number of years of schooling, the age of female workers, and the total family expenditures have positive influences on probability of participation in the labor force. In contrast, the number of infants, toddlers, teenagers, age square of female, and husband's wage have negative effects on probability of participation. Among 3 children groups, infants have the biggest probability of reducing participation followed by teenagers and toddlers. Geometrically, this result reveals an inverted U-shaped relationship between the female participation rate and the age of children in Vietnam.

In the second step, we estimate the function of women's wage. All parameters are statistically significant at 5 percent confidence interval. Only two variables, the number of years of schooling and the woman's age have positive effects on female workers' wage. Other variables like the number of infants, toddlers, teenagers, the square of the age of woman show negative signs. Overall, variables with negative effects have a larger impact than those with positive effects in terms of absolute magnitude. Interestingly, the results argue that teenagers reduce females' wage more than toddlers, but less than infants. After correcting for the sample selection bias problem, we get the predicted wages of female workers and start estimating the share equations labeled "14.1-14.7" in subsection "3.2 Empirical model".

4.3 Empirical results

We now turn to a discussion of the effects of the age of children on commodity demands, saving demand and supply of male and female. Due to limitation of space, we will not present regression results for the revised AIDS Kooreman and Kapteyn model in this section. However, the result can be provided upon request. Instead, we will show the estimated results of the age of children. The parameters of female labor supply by the age of children are -0.081, -0.045, -0.076, corresponding to children respectively aged 0-3 (labeled as infants), 4-10 (labeled as toddlers) and 11-17 (labeled as teenagers). This estimation result shows that a woman supplies less labor if she bears children. Nevertheless, the amount of female labor supply is differentiated by the age of children. A female having a child 0-3 years old decreases her labor supply sharply. A female with

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

a child 4-10 years old also decreases her labor supply but at a lesser rate. However, a female with a child 11-17 years old decreases her labor supply at a higher rate compared to a female with a child aged 4-10 years old. This may be because a female with a child aged 11-17 years old is usually older than a female with a young child. This inverted U-shaped relationship is similar to the inverted U-shaped relationship between female participation rate and the age of female, which has been observed in many countries including Vietnam. The parameters of male labor supply by the age of children respectively are: children aged 0-3 years old 0.029; children aged 4-10 years old 0.052; children aged 11-17 years old 0.027. The number indicates a fact that children have a positive effect on male labor supply.

Figures 1 shows a common inverted U-shaped relationship between the supply of female and male workers and the age of children. It is worth mentioning that though males and females show a similar inverted U-shaped, children have polar opposite effects on female and male labor supply. That is, children have a positive effect on male labor supply but they cause a negative effect on female labor supply.

We now look at the result of elasticity. Table 1 shows the cross-price elasticity and own-price elasticity of males and females. As can be seen, the females have much larger cross-price elasticity than males. In panel 1 of table 1, total cross-elasticity of female is -0.6, which is much larger than the number of -0.29 for male. The decomposition of total cross-price elasticity into cross-price substitution and income elasticity also confirm this result. For instance, for male, cross-price substitution is 0.01 and income elasticity is -0.3; for female, cross-price substitution is 0.65 and income elasticity is -1.25.

In panel 2 of table 1, the total own-price elasticity of male is more modest than female. The total own-price elasticity of male is -0.16 and that of female is -0.41. However, own-price substitution for male is larger than for female, though income elasticity shows an opposite position.

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

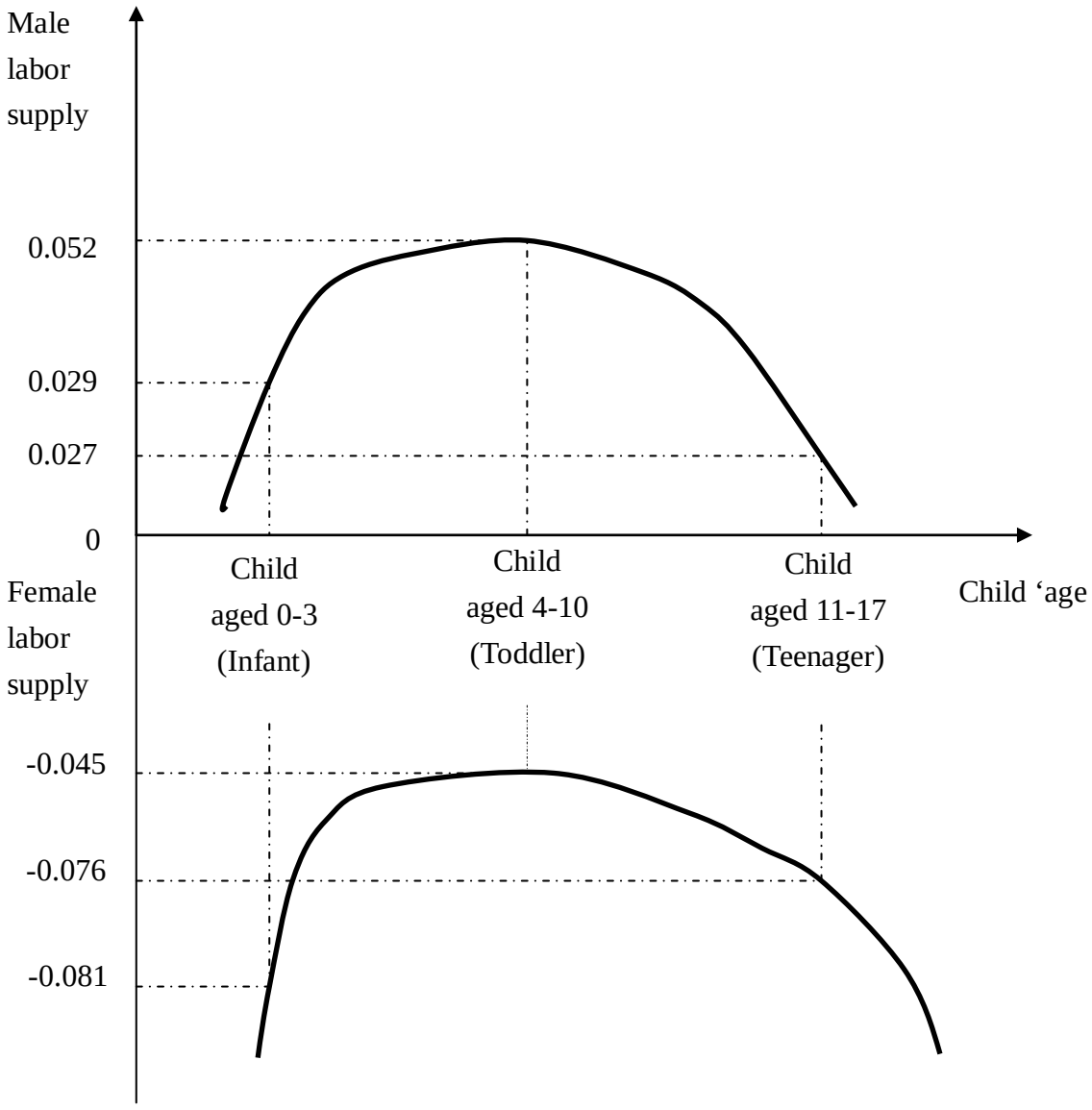

Figure 1: Inverted U-shaped relationship between male labor supply and female labor supply and the age of children

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

Table 1: Cross-price elasticity; own-price elasticity and income elasticity

Panel 1	**Total**	**Cross-price elasticity**	**Income elasticity**
Male	-0.29	0.01	-0.30
Female	-0.60	0.65	-1.25
Panel 2	**Total**	**Own-price elasticity**	**Income elasticity**
Male	-0.16	0.45	-0.61
Female	-0.41	0.26	-0.67

Source: Author's calculation

5. CONCLUSIONS

We do not reject the first hypothesis that younger children have a negative effect on female labor supply. The outcomes show that all 3 groups of children have negative effects on female labor supply but of different magnitudes. It is true that the youngest children have the highest effect on female labor supply. Children at the age of 4-10 years old have the lowest effect on female labor supply. It is interesting that children at the age of 11-17 years old have a higher effect on female labor supply than ones at the age of 4-10 years old.

We do not reject the second hypothesis that the Vietnamese female labor supply is more elastic than male labor supply. The estimation results show that the elasticity of female labor supply is larger than the elasticity of male labor supply in all terms of gross elasticity, cross-price elasticity, own-price elasticity and income elasticity. This implies that the Vietnamese female workers are more sensitive with wage changes than male workers. Accordingly, if wage decreases by one unit, female workers will reduce their labor supply by a greater degree than male workers.

From these results, we can conclude that there exists an inverted U-shaped relationship between female labor supply and the age of children. This inverted U-shaped is totally different from the upward sloping curve which is found in the literature. We can explain why infants have a lower effect on female labor supply than toddlers in a simple way. According to many researchers, younger children have higher time costs. This raises the reservation wage and reduces female labor supply. Therefore, it is reasonable to

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

understand that a woman will quickly reduce her labor supply if she has an infant. Some might argue that cheap care costs will be a factor in keeping a woman from decreasing her labor supply. However, we think that other factors such as the time needs of children, other costs will have a larger effect than cheap care costs.

The finding that teenagers reduce female labor supply larger than toddlers surprised us. This finding is opposite with the one that participation rate of women increases along with the age of children due to elements such as cheap care costs, improvement in contraceptive methods, a change in preference for children, and a rise in divorce rate. In addition, in his research, Browning (1992) sees an almost universal finding that female participation rate goes up with the age of the youngest child. However, we argue that though those findings are true, they are not in a position to explain the exact relationship between female labor supply and the age of children. We can imagine a case where female participation rate is high but female labor supply is low. Moreover, we observe that women with teenage children are usually aged more than 45 years. At this age, women tend to reduce their labor supply and increase their time to relax. Another reason is that teenagers need smaller amounts of food, housing, equipment, and other commodities than toddlers. Some other factors such as the imminent onset of old age, stable financial supports, and others might support this finding as well.

We also see an inverted U-shaped relationship between the demands for items such as food, housing, equipment, and other commodities and saving. The commodity demands and saving demand are low for the very young child, but gradually increases as the child becomes toddler and start reducing when the child is a teenager. It is understandable that the expenses for infants are smaller than for toddlers. This statement is also consistent with a finding by Nghiem (2013). On the other hand, toddlers have larger consumption demands than teenagers. This is new finding from our analysis. It is likely that the factors such as educational costs make this difference. We presume that toddlers require greater expenditures on education than teenagers. This is because toddlers may need extra classes or tutorials, while teenagers study as independent students. Moreover, we have found that teenagers require items other than food, such as equipment and other commodities much lower than toddlers. Furthermore, the greater capacity teenagers to do some housework compared to toddlers can help their parent cut down service costs. The last aspect is that teenagers can work and get some income to supplement to their demands.

Children have a negative effect on female labor supply, but a positive effect on male

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

labor supply. This finding is consistent with other results in literature. Normally, male worker is a primary-income earner in a household rather than female worker.

REFERENCES

[1] Abbott , M. and O. Ashenfelter and (1976) “Labour supply, commodity demand and the allocation of time” *The Review of Economic Studies* 43, 389-411.

[2] Ashenfelter, O. and J. J. Heckman (1973) “Estimating labor supply functions” in Cain and Watts, eds. (1973b), 265-78.

[3] Atkinson, A. B and N. H. Stern (1980) “On the switch from direct to indirect taxation” *Journal of Public Economics* 14:195-224.

[4] Attanasio O, L. Hamish and V. S. Marcos (2008) “Explaining changes in female labor supply in a life-cycle model” *American Economic Review* 98(4):1517-1552.

[5] Barten, A. (1964) “Family composition, prices, and expenditure patterns”, in P. Hart, G. Mills and J. Whitaker (eds), *Economic Analysis for National Economic Planning*, Butterworth: London.

[6] Barnet, W. A. (1979a) “The joint allocation of leisure and goods expenditure” *Econometrica* 47:539-604.

[7] Becker, G. S. (1985) “Human capital, effort, and the sexual division of labor” *Journal of Labor Economics* 3(1): 533-58.

[8] Bell, D. J. (1974) “Why participation rates of black and white wives differ” *Journal of Human Resources* 9(4): 465-79.

[9] Blundell, R. W. and I. Walker (1982) “Modelling the joint determination of household labour supplies and commodity demands” *Economic Journal* 92:351-64.

[10] Boskin, M. J. (1973) “ The economics of labor supply” in Cain and Watts, ed. (1973b), 163-81.

[11] Bowen, W. G (1969) *The economics of labor force participation*. Princeton, N. J. Princeton University Press.

[12] Browning, M. (1992) “Children and household economic behavior” *Journal of Economic Literature* 30: 1434-1475.

[13] Cain, G. G (1966) *Married women in the labor force, an economic analysis*, Chicago: University of Chicago Press.

[14] Cortes P. and J. Tessada (2011) “Low-skilled immigration and the labor supply of highly skilled women” *American Economic Journal: Applied Economic*

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

3(3):88-123.

[15] Deaton and Muellbauer (1980a) *Economics and consumer behavior* Cambridge: Cambridge University Press.

[16] Deaton and Muellbauer (1980b) "An almost ideal demand system" *The American Economic Review* 70(3):312-326.

[17] Eckstein, Z. (2011) "Dynamic female labor supply" *Econometrica* 79(6):1675-1726. Goldin, C. (1986)

[18] Goldin, C. (1986) "The female labor force and American economic growth, 1890-1980" in Stanley L. Engerman and Robert E. Gallman, eds, *Long-Term Factors in American Economic Growth*, University of Chicago Press

[19] Goldin, C. (1993) "The U-shaped female labor force function in economic development and economic history" in T. Paul Schultz, ed., *Investment in Women's Human Capital*, Chicago" The University of Chicago Press, 61-90.

[20] Gronau, R. (1973) "The effect of children on the housewife's value of time" *Journal of Political Economics* 81(2) 168-99.

[21] Gronau, R. (1974) "Wage comparisons – A selectivity bias" *Journal of Political Economy* 82:1119-43.

[22] Heckman, J. J (1979) "Sample selection bias as a specification error" *Econometrica* 47:153-62.

[23] Howe, H. (1975) "Development of the extended linear expenditure system from simple saving assumption" *European Economic Review* 6: 305-310.

[24] Killingsworth M. R. (1983) *Labor supply.* Cambridge: Cambridge University Press.

[25] Killingsworth M. R. and J. J Heckman (1986) "Female labor supply: A survey" in *Handbook of Labor Economics*, Vol. 1, Nethelands: Elsevier Science Publisher.

[26] Kooreman P. and A. Kapteyn (1985) "The systems approach to household labor supply in the Netherlands" *De Economists* 133:21-42.

[27] Kooreman P. and A. Kapteyn (1986) "Estimation of rationed and unrationed household labour supply functions using flexible functional forms" *The Economic Journal* 96:398-412.

[28] Le, C. Q. (2009) "Three essays in spatial econometrics and labor economics" PhD Dissertation, Kansas State University.

[29] Lee, J. (2005) "Marriage, female labor supply, and Asian zodiacs" *Economics Letters* 87:427-432.

[30] Lehrer, E. L. (1991) "The impact of children on married women's labor supply:

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

black-white differentials revisited" mimeo Univeristy of Illinois.

[31] Lehrer, E. L and M. Nerlove, (1986) "Female labor force behavior and fertility in the United States" *Annual Review of Sociology* 12: 191-204.

[32] Mammen K. and C. Paxson (2000) "Women's work and economic development" *Journal of Economic Perspectives* 14(4):141-164.

[33] Mano, Y. and E. Yamamura (2011) "Effects of husband's education and family structure on labor force participation and married Japanese women's earnings" *Japanese Economy* 38(3):71-91.

[34] Mincer, J. (1962) "Labor force participation of married women: A study of labor supply" in National Bureau of Economic Research, *Aspects of Labor Economics*, pp. 63-97, Princeton, N. J.: Princeton University Press.

[35] Muellebauer, J. (1977) "Testing the Barten model of household composition effects and the costs of children" *The economic Journal* 87:460-487.

[36] Nakamura, A. and M. Nakamura (1992) " The econometrics of female labor supply and children" *Econometric Reviews* 11(1): 1-71.

[37] Nghiem, T. V. (2013) "A quantitative measurement of child costs in Vietnam during high inflation period" *Vietnam Socio-economic Development Journal*, Vol. 75:61-80.

[38] Nguyen, T. T. H. (2009) "The effect of fertility on female labor supply", Master Thesis, Kansas State University.

[39] Pencavel J. (1998) "The market work behavior and wages of women" *The Journal of Human Resources* 33(4):771-804.

[40] Phlips, L. (1978) "The demand for leisure and money" *Econometrica* 46:1025-43.

[41] Ray, R. (1982) "Estimating utility consistent labor supply functions" *Economics Letters* 9:389-395.

[42] Schultz, T. P. (1978) "The influence of fertility on labor supply of married women: silmultaneous equation estimates" in *Research in Labor Economics*, eds: Ronald G. Ehrenberg, Greenwich, CT:JAI Press, 273-351.

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)