Dynamic Female Labor Supply: Applications in China*

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Abstract

Applying GMM, Logistic Regression and Bayes Logistic Regression on 10 waves of CHNS data, we found out that different from women from the U.S. (Eckstein and Wolpin, 1989), Chinese women gain positive utility from working. Their utility also increases as they work more in the past. There are other factors that decrease the chances of working for Chinese women. With the increase in their husband's income, their probability of working declined. However, the most significant factor that discourage Chinese women from working is the presence of children, regardless of their age.

Keywords: natural language processing, international relations, united nations

1. Introduction

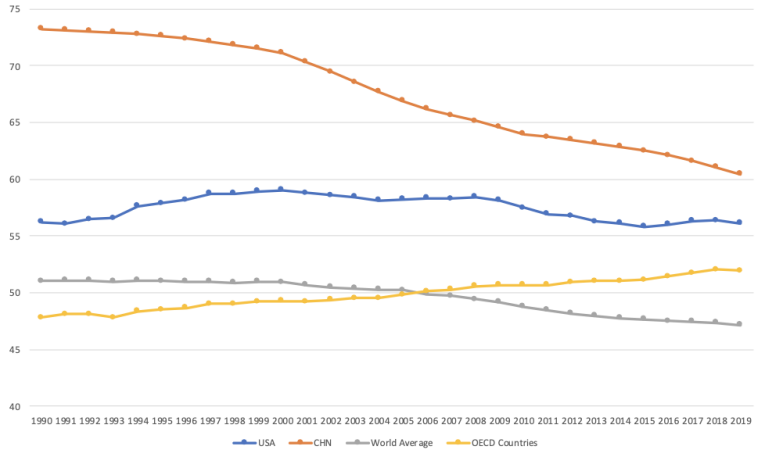
The last few decades of the 20th century has witnessed great enhancement in female rights. Based on the statistics of U.S. Bureau of Labor Statistics, female labor participation rate has almost doubled in 50 years, from below 35% during the post World War II period to approximately 60% in 2000. Along with the trend of increasing female labor engagement, there is also a global trend of declining fertility, higher female education level, as well as narrowed gender wage gap. All of these trends clearly illustrate an improvement in female rights in various aspects.

Similar with other countries, China has also experienced tremendous improvement in woman's rights during the last century just as many other western countries. Total rate of fertility has declined from around 2.6 in 1980s to 1.7 in 2018, after taking the effect of One Child Policy into consideration. Gender Parity Index measured by female primary and middle school enrollment rate has also grow from around 0.81 in 1980 to 1.014 in 2018, based on the data from the World Bank.

Even though sharing similar developing patterns of a variety female right statistics as western countries, Chinese women are participating less in the labor market than previous years.

*This is the course paper for MACSS perspective research class economics track. The course instructed by Prof. Richard Evans at the University of Chicago.

Figure 1: Labor market participation rate of China and other countries



As illustrated in Figure 1, China's female labor participation rate has declined from above 70% in 1990s to a little above 60% in current years, though the rate is also higher than the U.S., the average of OECD countries, as well as the world average.

Therefore, given the statistical and cultural context stated above, this paper will mainly devote in explaining the reversed female labor participation trend in China, with the help of dynamic life-cycle model which none of the Chinese literature has touched on before. Using 10 waves of CNHS (China Nutrition and Health Survey) data, we find out that, different from the results obtained from the U.S. data, Chinese women gain positive utility from labor participation and increased working experience, while taking care of children of all ages strongly discourage them from working.

The following sections will be organized as the following: the second section will discuss literature about the model and empirical results of related fields. Section III will present a detailed dynamic life cycle model employed in this paper. Section IV discusses the data, and section V presents the estimation results and the robustness of predicted value based on true value. Section VI concludes.

2. Literature Review

The idea of bringing life-cycle model to interpret human capital accumulation as well as life-time earnings and consumptions was first proposed by Weiss (1972) and Heckman (1976). The famous theoretical framework introduced by Heckman derives the life-cycle model of household earnings from dynamic human capital accumulation of individuals, regarding labor supply decisions as endogenous. Other family characteristics such as family size and age of children also enter interactively into the model. His theory provides an accurate prediction of married males' earnings in the 1960s, which marked the popularity of using life-cycle model in the field of labor economics.

After the fundamental work stated before, Heckman and Willis (1977) concentrate on the sequential discrete choice model of labor force participation of married women. In their simple reduced form model, married women decide on whether to participate in the labor market by comparing their marginal benefit (denoted by market wages) with the marginal cost (denoted by the shadow price of time). Therefore, the "net benefit" (or cost) of married women's labor participation decision can be regarded as a subtraction of the two terms. Since the market wage of women who stayed at home and the shadow price of those who worked cannot be fully observed, they further express the "net benefit" as a function of many other factors that may influence the two prices, such as the husband's wage rate, the prices of market goods, interest rates, assets, the number and age of children, and so on. The empirical study followed by this model mainly finds out that the distribution of labor participation probabilities is U-shaped, and unobserved population heterogeneity accounts for a large fraction of the behavior they observed.

However, Heckman and Willis's model has an inherent drawback as they view each period's labor participation decision as independent of the choices in the past and in the future, which is hardly the case. The studies of Weiss (1981) as well as Eckstein and Wolpin (1989) improve the former model by allowing labor market participation to affect future wages, the effect is then translated to the choice of future participation. Assuming people are forward-looking, Eckstein and Wolpin construct a dynamic life-cycle model for female labor participation: married women maximize their expected discounted lifetime utility given former experience, wage rates, and other relevant environmental factors such as schooling and children. The authors solve this utility optimization problem by a process of backward recursion. Selecting the mature women cohort (women age between 30 and 44) from National Longitudinal Survey of Labor Market Experience since 1967, they conclude that increase in schooling has the largest positive effect in explaining women's increase in labor participation, while an increase in the number of young children and in husband's wages will mostly discourage them from going to work.

Followed by Eckstein and Wolpin's study, a series of analysis have been made to explore the underlying factors that contribute to the increase in female labor participation, but their results vary. The most relevant one is done by Eckstein and Lifshitz (2011). Aiming at investigating the labor market participation of all females in working-age population, they extend the original model by letting women's marital status enter into the utility optimization problem. They also improve previous analysis by including a larger sample, using Current Population Survey (CPS) data from 1964 to 2007. Given the rich dataset with complete working information for women in the 1955 cohort (those who born between 1953 and 1957), they successfully obtain estimated parameters using simulated methods of moments (GMM). Their empirical results show a similar conclusion that the rise in female labor participation is mostly due to the increase

in schooling. Other factors, such as decreased fertility, increased divorce rates, and narrowed gender wage gap, can only account for about 20 percent of the rise in female employment. 40 percent remains unexplained by observed household characteristics. However, another study by Fernández and Wong (2014a) applies a similar life-cycle model on CPS dataset from 1962 to 2010, ending up in different conclusions. Choosing the 1935 cohort as the baseline to estimate key statistics, they find out that a higher divorce risk and a change in wage structure are the main contributors to the increased female labor participation for the 1955 cohort.

Enlighted by the rich empirical analysis evaluated with the U.S. data, many other authors have tried to explain female labor participation in their countries. The cross-country differences gradually become the new focus of many studies. Using a non-recursive five-variable Structural Vector Autoregressive (SVAR) model, Kinoshita and Guo (2015) utilize data from Japan, Korea, Norway, and Finland to study female labor participation in response to a variety of shocks. They pointed out that child cash allowance provided by the government discourage women from participating in full-time work. Large gender wage gap persisted in Asian countries also helps to explain why women there are more likely to engage in non-regular work rather than regular ones. Their study has strong policy indications, urging the government to adopt family-friendly policies and create jobs with flexible time arrangements, so as to encourage married women in participating more in regular full-time jobs. Cubas (2016) uses a modified version of life-cycle model based on Eckstein and Lifshitz's to look into female labor supply in developing countries. His results indicate that prices of household appliances and access to basic infrastructure are quantitatively important in explaining the cross-country differences in female labor participation in Latin America.Christiansen (2016) conduct a cross-country analysis based on the micro-data from European countries. Their analysis reveals that governmental policies play a crucial role in women's labor market choices. Creatively bringing women's attitudes towards working outside of household into prediction, the authors find out that women with more egalitarian gender opinions are more likely to engage in labor market activities. Other relevant studies include the one by Ismail and Sulaiman (2014) using data in Malaysia, and the one focusing on the labor supply in Israel Arabs by Yashiv and Kasir (2011).

Another fraction of literature has been dedicated into evaluating other exogenous effect on female labor participation. A few studies emphasize on the influence of the implementation of unilateral divorce laws on female labor supply choices. Fernández and Wong (2014b) implies that both the establishment of new divorce laws and decreased gender wage gap contribute to the rise in female labor participation. While Voena (2015) finds out that the introduction of unilateral divorce laws that impose equal division of property will distort women's preferences in a way that lower their labor participation.

Even though there are considerable amount of empirical analysis trying to unravel the factors behind country level female labor participation trend, few empirical studies have been

committed to the same purpose in China. The reason of the blank in Chinese literature might due to the lack of long-term longitudinal household survey data. Provided that female labor participation rate in China has followed a decreased trend different from the majority of countries in the world, the rationalities behind this reversed trend become more appealing and intriguing for economic analysis. Studies embedded in a Chinese context include the one by Shen et al. (2012). They employ the household survey data in 2002 and find out that a shift in family structure might contribute to the decrease in Chinese female labor supply. As the family sizes in China shrink, elderly parents of the household cannot offer sufficient childcare needed by the young couple, resulting in female leaving the labor market to take care of young children. Another study by Yao and Tan (2005) addresses the effect of household income on wife's labor supply. Their results reveal that the increase in husband's earnings can only account for a small fraction of female's decreased labor participation. The difficult employment situation faced by Chinese women is the main cause of their leaving the labor market.

Summarized from the above, though a wide range of studies has been carried out in discovering the reasons behind increased female labor participation, the blank in literature based on Chinses data still remains unfilled. Therefore, the aim of this study is trying to employ dynamic life-cycle model to tell the Chinese story of dynamic female labor supply. The study will contribute to current literature in the following three ways. First, it is the first study that attempt to apply a dynamic life-cycle model on Chinese micro-level longitudinal data. Its results will provide a new perspective in interpreting the reversed female labor participation trend in China. Second, the study modifies the classic life-cycle female labor supply model to fit into the Chinese context. Third, it yields comprehensive policy implications. For example, how to encourage Chinese married female in working full-time more effectively.

3. Methods

The models in this paper are mainly based on Eckstein and Wolpin (1989). This simplified model only takes the subsample of married women and considers their labor market participation decision in the post child-bearing period. After presenting the detailed specification of our model, a brief introduction of estimation methods is provided.

3.1. Simplified Model

In this section, we will consider the simplified model which only takes into account of married women and their labor market choices. In each discrete period t, the model supposes the household maximizes its expected utility over a finite total period T by choosing whether the wife works ($p_t = 1$) or not ($p_t = 0$) and whether to have an additional children (n_t). Under

such assumption, the household is targeted to maximize the following equation:

$$E_t\Big[\sum_{k=0}^{zt-t}\delta^j U(p_{t+k},\ N_{t+k,j},\ x_{t+k},\ K_{t+k-1},\ S)\Big] \tag{1}$$

where p_t is a dummy variable that indicates whether the women works or not at period t; K_t indicates the women's former experience which is measured by the number of periods the women has worked before; x_t denotes the consumption at that period; and $N_{t,j}$ indicates the number of children of age group j at period t. The total number of periods considered, T, is determined by a fixed retirement age, which is 50 for urban women in China.

Given the utility maximization problem above, the household faces the following budget constraint:

$$y_t^w p_t + y_t^H = x_t + \sum_{j=1}^{J} c_j N_{t,j} + b p_t \tag{2}$$

where the total income of the household at period t is equal to its total consumption. In equation (2), y_t^w and y_t^H denote the wife and husband's annual income at period t, respectively. The household consumption is consisted of three parts: commodity consumption x_t, the aggregate consumption spent on children (where c_j indicates the cost per child of age group j), and a fixed cost of women working b. By demonstrating the household budget constraint as the above, we are implicitly assuming that the wife's labor market decision is exogenous of her husband's income.

The wife's earnings at period t is subject to the standard Mincer earning function, which is given by

$$\ln y_t^w = \beta_1 + \beta_2 K_{t-1} + \beta_3 K_{t-1}^2 + \beta_4 S + \beta_5 R_t + \varepsilon_t \tag{3}$$

where R_t is an indicator of whether the women lives in rural or urban areas, which is an important factors that needed to be taken account of when considering individual income in China. All the other variables except ε_t in equation (3) are the same as previously defined. ε_t is the random effect of the wife's earning that is unaffected by the household decision process. It has a standard normal distribution with zero mean.

The number of children of age group j is determined by the following equation:

$$N_{t,j} = N_{t-1,j} + n_{t,j} - d_{t,j} \tag{4}$$

Equation (4) can be simply understood as the number of children of age group j at time period t is equal to the number of children of age group j at last period plus the number of kids who enter into this age group, $n_{t,j}$, subtracts the number of kids who leaves this age group, $d_{t,j}$.

One's working experience is written as a cumulative function of previous experience:

$$K_t = K_{t-1} + p_t \tag{5}$$

For simplicity, here we assume that the household utility for a single period t has taken a linear form, according to the general form given in equation (1),

$$U_t = \alpha_1 p_t + x_t + \alpha_2 p_t x_t + \alpha_3 p_t K_{t-1} + \sum_{j=1}^{J} \alpha_{4,j} N_{t,j} p_t + \alpha_5 p_t S + f(N_{t,i}) \tag{6}$$

Here $f(N_{t,i})$ is an unspecified term that illustrate how the utility of children enters into the total household utility function. As mentioned by Eckstein and Wolpin in their 1989 paper, there are a few coefficients in equation (6) that needs to be put special emphasis on. α_3 implies the marginal utility of leisure time, with $\alpha_3 < 0$ reflects diminishing marginal utility for non-market leisure time within the life cycle, and $\alpha_3 > 0$ reflects habit persistence that the women who work previously gain utility by continuing working in the current period. α_2 provides a test for wealth maximization. If we cannot reject the hypothesis that $\alpha_2 = 0$, then the individual will be better off with the capital market constraint.

We will use dynamic programming to solve this life-cycle utility maximization problem. Here we regard the maximum expected life-time utility given by equation (1) as $V_t(K_{t-1},\ \varepsilon_t,\ \Omega_t)$, where ε_t represents the random wage draw given by earnings equation (3), and Ω_t consists of all other factors, including schooling S, the age distribution of children $N_{t,j}$, and her husband's income $\bar{y}_t^H$. At any time period t, the woman makes a discrete choice between participating in the labor market and not participating, that is

$$V_t(K_{t-1},\ \varepsilon_t,\ \Omega_t) = \max\left[V_t^1(K_{t-1},\ \varepsilon_t,\ \Omega_t),\ V_t^0(K_{t-1},\ \varepsilon_t,\ \Omega_t)\right] \tag{7}$$

In equation (7), $V_t^1(\cdot)$ implies the household expected utility when the wife chooses to work at period t, and $V_t^0(\cdot)$ implies the expected utility when she decides not to. As a result, equation (7) simply means the household maximizes its expected life-time utility based on whether or not let the wife to work in the current period. Since we are solving this problem using backward induction, we consider the maximization problem at final period T. Given all the specifications above, we may write $V_t^0(\cdot)$ and $V_t^1(\cdot)$ as the following:

$$V_T^1(K_{T-1},\ \varepsilon_T,\ \Omega_T) = \alpha_1 + (a+\alpha_2)\Big(\exp\{\beta_1 + \beta_2 K_{T-1} + \beta_3 K_{T-1}^2 + \beta_4 S + \beta_5 R_t + \varepsilon_T\} + \overline{y_T^H} - \sum_{j=1}^{J} c^j N_{T,j} - b\Big)$$
$$+ \alpha_3 K_{T-1} + \sum j = 1^J \alpha_{4,j} N_{Tj} + \alpha_5 S + f(N_{T,j}) \tag{8}$$

$$V_T^0(K_{T-1},\ \varepsilon_T,\ \Omega_T) = \bar{y}_T^H - \sum_{j=1}^{J} c_j N_{T,j} + f(N_{T,j}) \tag{9}$$

If the utility the household can get when the wife works $V_T^1(\cdot)$ exceeds that of when she does not work $V_t^0(\cdot)$, then the wife would decide to participate in the labor market at period T. Therefore,

knowing her decision logistic, equation (8) and (9) can be simplified as:

$$p_T = 1 \iff \varepsilon_T \geq \ln\Big[-\alpha_1 - \alpha_2(\bar{y}_T^H - \sum_{j=1}^{J} c_j NT, j + b(1) + \alpha_2) - \alpha_3 K_{T-1} - \sum_{j=1}^{J} \alpha_{4,j} N_{T,j} - \alpha_5 S - (\beta_1 + \beta_2 + \beta_3 K_{T-1}^2 + \beta_4 S + \beta_5 R_t)\Big] \tag{10}$$

$$p_T = 0 \quad otherwise \tag{11}$$

Similarly, for any period t in between, the wife's utility giving the two choices can be written as:

$$V_t^1(K_{t-1},\ \varepsilon_t,\ \Omega_t) = \alpha_1 + (a + \alpha_2)\Big(\exp\{\beta_1 + \beta_2 K_{t-1} + \beta_3 K_{t-1}^2 + \beta_4 S + \beta_5 R_t + \varepsilon_t\} + \overline{y_t^H} - \sum_{j=1}^{J} c^j N_{t,j} - b\Big) + \alpha_3 K_{t-1} + \sum_{j=1}^{J} \alpha_{4,j} N_{t,j} + \alpha_5 S + f(N_{t,j}) + \delta EV_{t-1}(K_t = K_{t-1} + p_t) \tag{12}$$

$$V_T^0(K_{t-1},\ \varepsilon_t,\ \Omega_t) = \bar{y}_T^H t - \sum_{j=1}^{J} c_j N_{t,j} + f(N_{t,j}) + \delta EV_{t-1}(K_t = K_{t-1}) \tag{13}$$

which can be simply understood as the estimated utility at current period t add the expected utility the household might get for the future periods if she makes that decision. Given the utility value functions above, we may construct the decision function as below:

$$p_t = 1 \iff \varepsilon_t \geq \ln\Big[-\alpha_1 - \alpha_2(\bar{y}_t^H - \sum_{j=1}^{J} c_j N_{t,j} + b(1 + \alpha_2) - \alpha_3 K_{t-1} - \sum_{j=1}^{J} \alpha_{4,j} N_{t,j} - \alpha_5 S + \delta(EV_{t+1}(K_{t-1}) - EV_{t+1}(K_{t-1} + p_t)\Big] - (\beta_1 + \beta_2 + \beta_3 K_{t-1}^2 + \beta_4 S + \beta_5 R_t) \tag{14}$$

$$p_t = 0 \quad otherwise \tag{15}$$

Here, we have listed all the equations needed for estimation.

3.2. Estimation Methods

As long as we have stated all the methods and provide a brief introduction of data in the previous sections, now we came to present the methods for estimation. Since the Mincer earning equation (3) of the wife's income does not involve decision at the current period, we may easily obtain the wage parameters $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$, and the random effect ε_t for each individual. Also, for simplicity, using the data in the final period T, other parameters of interest, α_2, α_3, α_5, $\alpha_1 + b(1 + \alpha_2)$, and $\alpha_2 c_j - \alpha_{4,j}$ $(j = 1, ..., J)$ can be further identified. Since the parameters in the budget constraint, b and c_j cannot be directly estimated and is implicitly expressed in the parameters of utility maximization, we will here assume $b = 0$ and $c_j = 0$ without loss of generality.

Generalized Method of Moments (GMM) is employed in all estimations in this analysis.

4. Data

In this paper, we utilize 10 waves of data from China Health and Nutrition Survey (CHNS) in 1989, 1991, 1993, 1997, 2000, 2004, 2006, 2009, 2011, and 2015. CHNS dataset is the longest longitudinal survey that contains detailed household and individual data in China. Its baseline survey in 1989 covers 15,907 indivuduals within about 3,795 households. The number of participated households increases to over 7,000 in 2015. In all, there are 11,130 households and 42,829 individuals who ever participated in CHNS survey. Individual-level data of our interest includes information about the interviewee's current working status, marital status, annual income, and education level. Household-level data of interest includes how many children and their ages the household has and its living area (urban or rural). The reason why we choose this dataset is rather simple direct, since it is the only household-level survey dataset that contains longitudinal data for more than 10 years (The population census data conducted by Chinese government are not available for public academic use). Also, its sampling communities ranges across 15 provinces in China, making the dataset rich in regional context for analysis. Last but not least, CHNS dataset has an unique "ever-married women" dataset that includes all participated women that have ever been married. Using this dataset as the basis, we are able to link each mother to her children as well as the child's basic information.

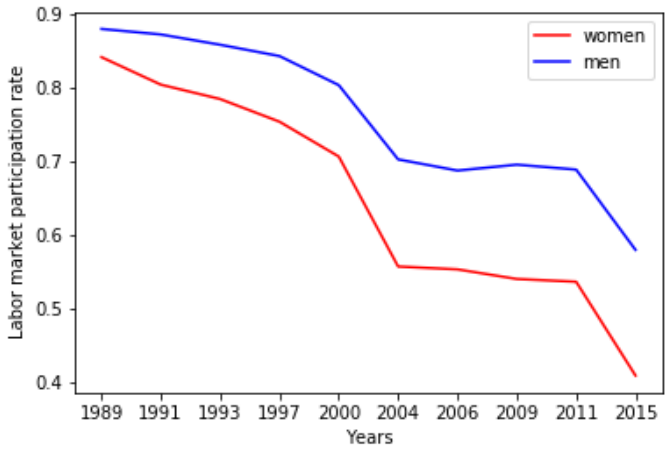
However, CHNS dataset also has it inherent drawbacks. Firstly, The survey is not conducted at an annual level, which implies we cannot obtain an accurate year-based working experience data of women. Also, the survey asks about the participant's current working status as "*Are you presently working?*". The survey question does not touch on the participant's employment status during the survey interval. As a result, we can only impute the experience variable in the following way, if the interviewee reports that she is currently working and she has worked before, then we will treat all the years during the gap of surveys as her "experience". If she reports not working currently but has work in the previous survey, we will assign half of the survey gap as her experience. If she does not report working for two consecutive surveys, then no experience gained. Secondly, the survey does not record individual schooling in a cumulative way, which means the survey in all does not have a continuous variable that represents the individual's years of schooling. Therefore, the schooling variable S using our data takes the form of categorical variable: no education, graduated from primary school, graduated from junior high school, graduated from senior high school, technical or vocational degree, college degree and above.

In the following two subsections, we shall first present sample selection and descriptive statistics for the data, then a brief introduction for estimation strategies is followed.

4.1. Sample Selection and Descriptive Statistics

Using 10 waves of CHNS data as introduced above, we first calculate the labor market participation rate for all married adults.

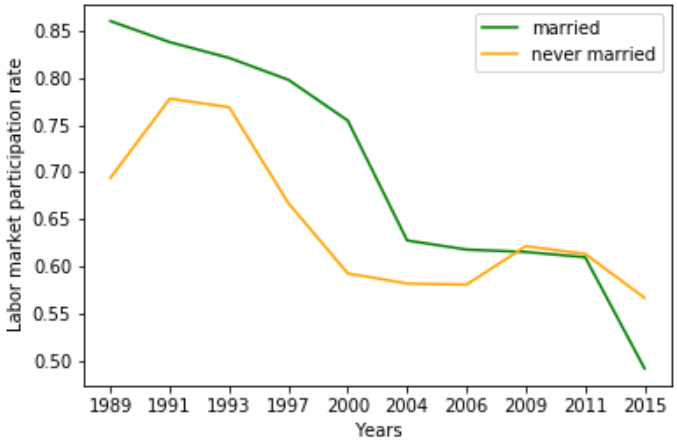
Figure 2: Labor market participation rate for married participants



As we can see from Figure 2, the labor market participation rate for both married men and women has declined significantly from 1989 to 2015. The labor market participation rate of married women has decreased from over 80% in 1989 to a little above 40% in 2015. The overall trend corresponds to what we have seen in introduction part using data from the World Bank, but the decline is larger in magnitude using CHNS data.

Moreover, if we emphasize on the labor market participation rates for women of different marital status, we may generate similar trends as follows: As illustrated in Figure 3, even

Figure 3: Labor market participation rate for women of different marital status



though the labor market participation rate of never married women and married women demonstrate overall trend of declining, the rate of married women has decreased more drastically than

that of never married women. What have shown in the two figures above has accentuated the importance of our analysis, as we are aiming at using dynamic programming to unmask the reason behind decreasing female labor participation in China, especially for married women.

The paper of Eckstein and Wolpin (1989) selects a subsample of 318 women who age between 39 to 44 (post child-bearing) in 1967 and have at least 4 consecutive year of employment information. The horizon T is set to 60. In our sample, since we have longer time range, and the usual retirement age for female workers in China is 50. Thus our sample selection criterion is listed as follows: we include ever-married women who age between 35 to 40 in any sample year expect 2009, 2011, and 2015 with at least 3 waves of consecutive information about their employment status and income information. If a women has not participated one of the surveys in between, her survey data after the gap will be taken into account. The selecting criterion also makes sure that any new survey interviewees who meet the standard will also be included in the sample. Also, given the unique urban-rural stratification in China, [1], we set the fixed retirement age (when a final decision about whether to work or not has to be made) as 55 for all sample, and 60 for the subsample of rural women. The distribution of our data is listed as in Table 1.

Table 1: Distribution of participants by number of consecutive surveys participated

Number of surveys participated	3	4	5	6	7	8	9	10
Number of participants	352	293	220	122	102	35	47	38
Cumulative proportion of participants (%)	28.95	53.04	71.13	81.17	89.56	92.43	96.30	100.00

As we can see, there are in all 1216 female participants that meet our sample selection criterion in CHNS dataset, which constitutes of 5861 observations in all. The sample size is far more larger than that of Eckstein and Wolpin (1989), which only has a sample size of 318 women and 3020 observations. Of all the qualified participants, approximately half of them has consecutive employment and income data for more than 5 surveys. Also, 38 participants have engaged in all 10 waves of surveys. Table 2 presents the descriptive statistics for all the observations. The descriptive statistics are obtained from the 5861 observations. For most of our variables of interest, there exist significant difference between rural women and urban women. Generally speaking, women in rural areas works more often, thus have more working experience than urban women. However, their income, including their own annual income and husbands' income, are significantly lower than those of urban women. Also, from the data

[1] Female workers in urban China conform to strict policies of retirement at age 50 or 55 (based on their position at work), while rural women in China usually engage in agricultural work in their household's own land until very late in life.

Table 2: Descriptive Statistics

	Variable name	Sample Mean	Standard deviation	Sample mean for rural areas	Sample mean for urban areas	t-statistics
0	Experience	5.74	5.37	5.90	5.31	3.66***
1	Age	43.18	6.07	43.27	42.94	1.83*
2	Husband Income	12243.04	18224.16	11457.95	14477.17	-5.55***
3	Degree	1.35	1.31	1.15	1.92	NaN
4	Number of Children under 6	0.12	0.41	0.13	0.09	3.56***
5	Number of Children from 6 to 18	1.05	1.02	1.10	0.93	5.50***
6	Annual Income	9219.29	13228.88	8583.70	11028.02	-6.20***

regarding to children we can see that, urban women give birth to children relatively later than rural women, thus making them have more children age under 6 years old and less children age between 6 to 18 years old. Most of the women have a degree of junior high school.

5. Results

5.1. Parameter Estimation Results

Table 3: Generalized Method of Moments Estimation Results

Parameters	Logistic Regression (1)	Bayes Logistic Regression (2)
α_1	1.266×10^{15}	1.058×10^{15}
α_2	-3.896×10^{8}	-3.065×10^{9}
α_3	2.154×10^{13}	2.777×10^{13}
α_{41}	-1.305×10^{13}	3.764×10^{14}
α_{42}	-3.980×10^{14}	-9.879×10^{13}
α_5	3.871×10^{13}	-3.730×10^{13}
β_1	8.758	-
β_2	-0.004	-
β_3	0.001	-
β_4	0.083	-
β_5	0.013	-

Parameter estimation results are presented in Table 3. The relative number of these estimated parameters are not of our interest and also do not have explicit meanings, especially for those parameters in logistic model. We mainly focus on interpreting the signs of parameters in the table above. The t-tests that the α parameters are equal to zero are all rejected at 1% level.

Looking at the first column – logistic regression – of the table above, $\alpha_1 > 0$, which implies in China, labor market participation actually increases women's utility. The result is different from conclusions obtained from American data, where women gain disutility from the labor market. $\alpha_2 < 0$ indicates that the increase in husband's income (or household total consumption) generally discourage women from participating in the labor market. Then we have $\alpha_3 > 0$,

another variable that is distinct from American data. Chinese woman's utility in working rises when she has more previous experience. Having children, regardless of their age, generally reduces mother's utility from work as $\alpha_{41} < 0$ and $\alpha_{42} < 0$. From the result we also have $\alpha_5 > 0$, woman with higher education are more willing to work, which correspond to the basic understanding.

While using R to gain these estimation results, we have encountered a problem that the data somewhat suffers perfect separation issues. We try to alleviate this problem by using Bayes logistic regression, the results are presented in column (2) of Table 3. For consistency in explanation, we will still use parameters obtained in column (1) for goodness of fit test as well as simulations.

5.2. Goodness of Fit Test for Estimation Results

In this section we present a goodness of fit test for the estimation parameters. Given the

Table 4: Actual and predicted labor participation rate by age group and experience

Experience	All ages		39-45		46-50		50+		$\chi^2(row)$
	A	P	A	P	A	P	A	P	
0-5	0.847	0.804	0.863	0.800	0.434	1.000	0.571	1.000	1.06
6-10	0.870	0.811	0.967	0.737	0.794	0.920	0.312	1.000	1.60
11-15	0.862	0.949	-	-	0.960	0.931	0.710	0.977	0.083
15+	0.768	0.983	-	-	-	-	0.768	0.983	-

results in Table 4, the method of dynamic life-cycle modeling generally does not provide a good prediction of labor market participation of different age groups and experience, even though the χ^2 test does not reject the hypothesis that the actual rates and predicted rates are the same.

If taken a closer look at predicted data, we can see that the prediction results are the worst when the women is beyond 50 years old, since there are few data that lies within this age group. And the actual labor market participation in China for elder women experienced a non-linear trend – it declines as the experience increases from 0-5 years to 6-8 years, and increases as experience further goes up to over 10 years. We anticipate that it might be the reason that the linear household utility model in this dataset cannot well capture the features in Chinese data. The prediction results are the best when the woman is between 39-45 years old with 0-5 years of experience, and when she is 46-50 years old with 11-15 years of experience. The following section will mainly use these two subsamples to obtain simulation results.

6. Conclusions

Applying GMM, Logistic Regression and Bayes Logistic Regression on 10 waves of CHNS data, we found out that different from women from the U.S. (Eckstein and Wolpin, 1989), Chi-

nese women gain positive utility from working. Their utility also increases as they work more in the past. There are other factors that decrease the chances of working for Chinese women. With the increase in their husband's income, their probability of working declined. However, the most significant factor that discourage Chinese women from working is the presence of children, regardless of their age. Therefore, the policy implications contains in this paper is that, the Chinese government should put a special emphasis on alleviating the childcare burden of women so as to encourage them to engage in the labor market.

Aside from the results and policy implications, the paper also have its inherent drawbacks. The CHNS data has strong limitations. For example, it is not a standard annual labor market survey, so some of the key statistics needs approximation and imputation, which might lead to the inaccuracy in predicted results. The paper also has a lot of room for future improvement, for example, a more careful evaluation and data cleaning might be needed.

References

Christiansen, L.E., 2016. Individual choice or policies? Drivers of female employment in Europe. International Monetary Fund.

Cubas, G., 2016. Distortions, infrastructure, and female labor supply in developing countries. European Economic Review 87, 194–215.

Eckstein, Z., Lifshitz, O., 2011. Dynamic female labor supply. Econometrica 79, 1675–1726.

Eckstein, Z., Wolpin, K.I., 1989. Dynamic labour force participation of married women and endogenous work experience. The Review of Economic Studies 56, 375–390.

Fernández, R., Wong, J., 2014a. Unilateral divorce, the decreasing gender gap, and married women's labor force participation. American Economic Review 104, 342–47.

Fernández, R., Wong, J.C., 2014b. Divorce risk, wages and working wives: A quantitative life-cycle analysis of female labour force participation. The Economic Journal 124, 319–358.

Heckman, J.J., 1976. A life-cycle model of earnings, learning, and consumption. Journal of political economy 84, S9–S44.

Heckman, J.J., Willis, R.J., 1977. A beta-logistic model for the analysis of sequential labor force participation by married women. Journal of Political Economy 85, 27–58.

Ismail, R., Sulaiman, N., 2014. Married women labor supply decision in malaysia. Asian Social Science 10, 221.

Kinoshita, Y., Guo, F., 2015. What can boost female labor force participation in Asia? 15-56, International Monetary Fund.

Shen, K., Zhang, Y., Yan, P., 2012. Family structure and female labor force participation in china. Population Research 36, 15–27.

Voena, A., 2015. Yours, mine, and ours: Do divorce laws affect the intertemporal behavior of married couples? American Economic Review 105, 2295–2332.

Weiss, Y., 1972. On the optimal lifetime pattern of labour supply. The Economic Journal 82, 1293–1315.

Weiss, Y., 1981. Expected interruptions in labor force participation and sex related differences in earnings growth. Technical Report. National Bureau of Economic Research.

Yao, X., Tan, L., 2005. Family income and labor force participation of married women in urban china. Economic Research Journal 5, 18–27.

Yashiv, E., Kasir, N., 2011. Patterns of labor force participation among israeli arabs. Israel Economic Review 9.