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An Economic Analysis of Fertility, Market Participation and Marriage Behaviour in Recent Japan

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An economic analysis of fertility, market participation and marriage behaviour in recent Japan

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In a recent article, Butz and Ward (1979) demonstrated that both men's and women's wages have opposite but asymmetric effects on the fertility movements in the United States. The main criticism of the Butz and Ward single equation model is that women's fertility, market work and marital status are interrelated. In response to this criticism, a non-linear-in-variable simultaneous equation model was used by Winegarden (1984) to capture the endogeneity of these variables.

In this paper, similar methodology has been applied to post-war Japanese data. This is the first attempt in modelling fertility, labour force participation and marriage rate using Japanese data. Although the estimates obtained by Full Information Maximum Likelihood (FIML) and Three Stage Least Squares (3SLS) of the model are statistically significant, some of the signs of the estimates are not consistent to *a priori* predictions. We offer explanations in the light of recent Japanese economic and labour market development, but we warn that the small-sample bias may be large and suggest that either a larger data set or panel data be used for future research.

I. INTRODUCTION

There has been considerable interest in recent years to investigate the relationship of fertility, male and female wages. The reasons being that there have been an unprecedented increase of married women in the labour force and a precipitous fall in the fertility rates in many developed countries. These phenomena are especially interesting in the context of the United States and post-war Japan. A number of empirical studies have been done in this area recently to examine the relationship between women's labour supply and fertility, and the results are generally not conclusive as conflicting evidence is produced (e.g. see Butz and Ward (1979), Cain and Dooley (1976), Fleisher and Rhodes (1979), Hoffman (1985), Hotz and Miller (1988), Link and Settle (1981), Long and Jones (1980) and Schultz (1976) on the United States, and Yamada and Yamada (1985, 1986), Ogawa and Mason (1986) on Japan; see also Hill (1984), Shimada and Higuchi (1985) on the study of female labour force participation).

Most of these research studies are based on the work of Becker (1960) and Mincer (1963) who have long been recognized as the pioneers in 'New Home Economics'. The characteristic of these models of human behaviour is the assignment of value to time in the decision-making process. The theoretical settings of these models will provide a useful basis for empirical work. In particular, Butz and Ward (1979) in their effort to explain the different effects of male and female wages on the fertility rates, were able to derive a tractable form for empirical implementation. Since then, many advanced econometric methods have been used to examine the relations between fertility and labour participation of married women by a number of researchers.

In this paper, Butz and Ward's model is used and extended to a simultaneous equation system as in the case of Winegarden (1984). Although there are a number of studies which model fertility and labour force participation as a joint system, this is a first attempt to model fertility, participation rate and marriage rate as a simultaneous equation system for Japan. The simultaneous equation system consists of three equations and will be used to examine the relationships among fertility rates, wages, female labour participation and marriage rates in Japan. The plan of this paper is as followed. Section II describes the recent demographic and economic development in post-war Japan. The model is presented in Section III. The sources of data used in our empirical work are described in Section IV, the results are presented in Section V and finally, the conclusion is presented in Section VI.

II. DEMOGRAPHIC AND ECONOMIC DEVELOPMENT IN POST-WAR JAPAN

Subsequent to the post-war baby boom (1947–49), Japan underwent an unprecedented decline in fertility. Over the period 1947–57, the total fertility rate (TFR) fell by over half from 4.54 to 2.04 children per woman. There was little change until after the first oil crisis of 1973, when TFR began to fall again. The downward trend continued into the early 1980s and TFR reached a value as low as 1.74 in 1981. In recent years, however, TFR has risen slightly, reaching a level of 1.81 in 1984.

Parallel to these changes in fertility, Japan has undergone rapid economic transformation which has affected the labour market significantly. The Japanese economy suffered severely in the 1970s due to the two oil crises. Large increase in wages and decrease in productivity during the first oil crisis squeezed corporate profits. Many firms were suffering from deficits and workers, especially temporary and women workers, were threatened by the fear of dismissal. The rampant inflation in the first oil crisis also witnessed a tremendous rise in the prices of housing and education. In the midst of these uncertainties, it is difficult to imagine that the fertility rate will increase.

However, the effects of the second oil crisis in 1979 were not as severe as the previous one. In spite of the inflation rate at 7.5%, negotiated wages in 1980 rose by less than 6.8%. Consequently, the decline in real wages was only 1.6%. Perhaps it may be worth mentioning that over the twenty years from 1960 to 1980, there was a 280% increase in male real wages and 340% increase in female real wages. Over the corresponding period, the proportion of female paid employees in the population aged 15 and above rose from 21 to 29.5%. Despite the drastic changes in the female labour force participation and wages, marriage pattern and fertility rate have only changed marginally. This suggests that the relationships of fertility with wages and participation rate and other demographic variables may not be a simple one.

We propose a non-linear-in-variables simultaneous model in the next section in the hope of capturing some of these salient features of the Japanese data.

III. THE MODEL

For the benefits of those readers who are not familiar with 'New Home Economics' on fertility and the Butz and Ward (1979) model, some of the models are presented here. The simplest static model is first introduced. This is then extended to more sophisticated ones.

First consider a static model of household maximizing behaviour, in which the utility function consists of only consumption good X, leisure L and child services S.

$$U = U(X, L, S)$$

It is assumed that husband time is not an important input in the production of child services while children are intensive users of the time of the wife. Therefore, the wife's time t and consumption good X are the two inputs required for the production of child services.

$$S = f(X, t)$$

Since family income consists of both male and female wages, an increase of either will increase family income. However, there will be asymmetric effects from an increase in the male and female wages. This stems from the assumption that the production of child services requires only time input from the wife and not the husband. In other words, while the increase in the husband's wages increases the family income and therefore the demand for children, an increase of the wife's wages has two effects: the increase in the wife's wages will of course increase the family income, but it will also increase the opportunity cost of child bearing and rearing.

Consider an extension of the model above and take into account that not all the wives are participants in the labour force. So a distinction is made between families with employed and unemployed wives. Let us assume that both husband's and wife's time input (t_h and t_w) to the production of child services are gross substitutes.

$$S = S(X, t_h, t_w)$$

In other words, an increase in the wage of one will cause the other to substitute away from market work. Then, in a family with employed wife, an increase in the husband's wage will reduce her hours of market work (but not her shadow price of time) and increase fertility. While in a family with unemployed wife, an increase in husband's wage will increase her shadow price of time since there is no way that she can reduce her hours of work as in the case of an employed wife. This will increase the shadow price of children, thus leading to a smaller increase in fertility. The overall effect of an increase in the husband's wage is therefore an increase in the demand for children.

Since the unemployed wife will only participate in the labour force if the market wage is above her reservation wage, an increase in the market wage not sufficient to induce her to participate will have no effect on the demand for children.

This suggests that the probability of a couple having a child in a given year should be different for families with employed wives and families with unemployed wives as in the case

of Butz and Ward (1979). More specifically, we can assume that the probability of having a child for the families with employed wife is a function of the husband's income, the wife's market wage (the opportunity cost of time) and other factors which we have not specified. Similarly, the probability of having a child for the families with unemployed wife should be a function of the husband's income, the wife's opportunity cost of time and other factors affecting this probability. For the families with an employed wife, the opportunity cost can be taken to be her market wage rate, however, for the families with an unemployed wife, we will have to assume that the opportunity cost depends on the husband's income. By making this assumption, we can get rid of the unobservable opportunity cost, i.e.

$$P_e = P_e(Y, W, Z) \qquad \text{for families with an employed wife.}$$
$$P_u = P_u(Y, W^*(Y), Z) \qquad \text{for families with an unemployed wife.}$$
$$= P_u(Y, Z)$$

where P = the probability that a couple will have a child in a given year; Y = the husband's income; W = market wage rate of employed wife; W^* = opportunity cost of time for unemployed wife; Z = other factors affecting the probability P.

So, the probability that a couple will have a child in a given year (P), can simply be written as a function of husband's income, the wife's wage rate and other factors:

$$P = P(Y, W, Z)$$

and it should have the properties:

$$\partial P/\partial W < 0 \text{ and } \partial P/\partial Y > 0$$

The inequalities simply state that changes in the market wage rate of employed wife and husband's income will have opposite effects on the birth probability. By some simple mathematical arguments, a simple regression model emerges (see Butz and Ward (1979) for more details). Butz and Ward estimated a regression model of the form using instrumental variable estimation technique:

$$\ln P_t = \beta_0 + \beta_1 K_t \cdot \ln Y_t + \beta_2 K_t \cdot \ln W_t + \beta_3 \ln Y_t + \varepsilon_t$$

where K = fraction of families with an employed wife.

Several researchers have estimated other modifications of this model (e.g. Ogawa and Mason, 1986). Winegarden (1984) argued that it did not capture the endogeneity of market work, marital status and other demographic variables. He proposed that the Butz and Ward model be extended to a simulataneous equation system. The model can be extended to distinguish between married and unmarried women as well as married women living or not living with husband by introducing an endogenous variable M, i.e. the marriage rate. The following model is proposed to capture the endogeneity of market work and marital status:

$$TFR_t = a_0 + a_1 L_t \cdot W_t + a_2 M_t \cdot Y_t + \varepsilon_{1t} \tag{1}$$
$$L_t = b_0 + b_1 M_t \cdot W_t + b_2 TFR_t \cdot Y_t + b_3 S_t + \varepsilon_{2t} \tag{2}$$
$$M_t = c_0 + c_1 L_t \cdot W_t + c_2 TFR_t \cdot Y_t + c_3 X_t + \varepsilon_{3t} \tag{3}$$

where TFR_t, total fertility rate at time t; L_t, proportion of women in the wage and salary labour force at time t; M_t, proportion of women married and living with husband at time t;

Y_t, average monthly wages of men employed in manufacturing (in '000 yen) in 1980 prices at time t; W_t, average monthly wages of women employed in manufacturing (in '000 yen) in 1980 prices at time t; S_t, proportion of the labour force in service and related sectors at time t; X_t, sex-ratio of the population aged 15–44.

In the model, the exogenous variables W and Y are weighted by one of the endogenous variables L, M or TFR. These interaction terms are used to capture the conditioning effects of the responses in each individual equation to other demographic variables. There are altogether six interaction terms. The coefficients of these terms have the same interpretations as those of Winegarden (1984) with the exception of b_1 which should be of the opposite sign. The six interaction terms are as follows:

(i) $a_1(L \cdot W)$, $a_1 < 0$

First, it should be emphasized that the model takes into account the distinction between married and unmarried women. The married women, can be broken down further into two groups as assumed in many previous studies. The first group are those not employed in the labour force and the changes in W not large enough to induce participation will at most affect the shadow price of children. The second group are those employed in the labour force and if substitution effect outweighs income effect, fertility varies inversely with their opportunity cost of child bearing and rearing, W. Hence, the negative effect on fertility brought about by an increase in W is proportion to L.

(ii) $a_2(M \cdot Y)$, $a_2 > 0$

The distinction between married and unmarried women is important. For those women who are not married, an increase in men's wages should perhaps not have a noticeable effect on their fertility rate due to the low propensity of child service. The effect of an increase in the husband's wage rate is an income effect and thus affects fertility of married women. The positive effect of increased men's wage rate is weighted by this proportion of married women.

(iii) $b_1(M \cdot W)$, $b_1 > 0$

As the distinction has been made between married and unmarried women, their elasticities of labour supply with own wage for the two groups should also differ. Since married women can either supply their labour on the market or for household production, their elasticity of labour supply should be expected to be more elastic than that of the unmarried women who have little alternative but market work. So a larger proportion of married women should give a larger response to the change in own wage.

(iv) $b_2(TFR \cdot Y)$, $b_2 < 0$

For unmarried women, the increase in men's wage rate should have little effect on their labour supply. However, for married women, the increase in the husband's wage rate will indicate a higher opportunity cost for time. If the fertility rate increases, the women's marginal utility of leisure will be lower and a larger proportion of Y will be used to purchase leisure for the wives.

(v) $c_1(L \cdot W)$, $c_1 < 0$

For women who are unemployed, changes in W should have little effect on their marital status. The effect of W on marital status should be expected to be negative as the increase in the wage rate W should increase the proportion of women whose W exceeds the reservation

wage of 'non-marriage'. The higher the proportion of labour participation, the larger the effect of W on marital status.

(vi) $c_2(F \cdot Y)$, $c_2 > 0$

It is assumed that there is a positive association between women's gains from marriage and men's wage rate. The arguments presented above regarding the reduction of consumption of leisure by child-bearing can be applied here. Thus, the positive effect of men's wage is weighted by the fertility rate.

Also included are the proportion of the labour force in service and related sectors (S) in Equation 2 and sex-ratio of the population aged 15–44 (i.e. X) in Equation 3 to capture any effects which have not been picked up by the interaction terms. This system of equations will be referred to as model I. In model II, both the coefficients of S and X are constrained to be zero. Excluding variables S and X leaves the model with only the interaction terms as explanatory variables.

IV. SOURCES OF DATA

The raw data are time series collected from various sources of Japanese official publication from 1960 to 1984. Before 1970, only 1960 and 1965 data were used as some observations for the TFR were not available. The missing data could have been constructed but this was not done as such techniques suffer from certain defects. Therefore, 17 observations were available for estimations. The data set is available from the author upon request.

One of the primary sources of data is the Basic Survey of Wage Structure (BSWS) which is conducted on a yearly basis by the Ministry of Labour. It should be noted that BSWS does not collect information on the agriculture and Government sectors and that yearly data on service industry are not available. The wage data of average regular monthly earnings in the manufacturing industry were therefore used. Both male and female wages (W and Y) are measured in real terms, using 1980 consumer price index deflator excluding bonuses and overtime pay.

The other principal source of data is the Labour Force Survey (LFS). Data on labour force participation rates of male and female workers on a nationwide basis are collected annually. The data on the proportion of employed wives (L) and the proportion of the labour force in service and related sectors (S) were taken from the LFS.

For sex ratio (X), fertility and marriage (TFR and M) data were obtained from vital statistics compiled by the Ministry for Health and Welfare and the Population Census.

V. ESTIMATION AND RESULTS

Two models were estimated: model I consisted of Equations 1, 2 and 3, and model II with both a_3 and b_3 constrained to zero. The models are estimated using both Full Information Maximum Likelihood (FIML) and Three Stage Least Squares (3SLS). The instruments used to obtain the 3SLS estimates are the exogenous variables of the system. The results are reported in Table 1.

In column two the signs of the FIML estimates for the full model are consistent with *a priori* beliefs, but none of the coefficients in Equation 2 and Equation 3 are statistically

Table 1. *FIML and 3SLS estimates for Model I and Model II.*

Variable	Model I		Model II	
	FIML	3SLS	FIML	3SLS
Equation 1				
a_0	2.059*	2.040*	2.052*	2.092*
	(9.56)	(24.72)	(5.84)	(24.67)
a_1	−0.388*	−0.394*	−0.378*	−0.350*
	(−3.72)	(−6.88)	(−7.10)	(−5.70)
a_2	0.761	0.804*	0.747	0.619*
	(1.36)	(3.76)	(1.35)	(2.70)
Equation 2				
b_0	−0.084	−0.225*	−0.159	−0.194
	(−0.33)	(−2.85)	(−0.51)	(−0.78)
b_1	0.906	−0.004	−1.210*	−1.223
	(1.59)	(−0.02)	(−2.59)	(−1.13)
b_2	−0.127	0.028	0.329*	0.338
	(−1.02)	(0.48)	(6.71)	(1.75)
b_3	4.295	4.303*	—	—
	(2.05)	(5.30)	—	—
Equation 3				
c_0	−0.556	0.080	0.343*	0.311
	(−0.36)	(0.07)	(3.50)	(2.02)
c_1	−0.206	−0.220	−0.400*	−0.429
	(−1.43)	(−1.49)	(−8.00)	(−1.99)
c_2	0.040	0.055	0.119*	0.123*
	(0.53)	(1.58)	(4.91)	(1.96)
c_3	0.011	0.004	—	—
	(0.66)	(0.33)	—	—

Figures in parentheses are t-ratios.
* indicates that the coefficient is significant at the 5% level.

significant at the 5% level. The variable S, i.e. the proportion of the labour force in service and related sectors, has the highest probability value in Equation 2. This is not surprising as most of the women in the wage and salary labour force are in the service sector.

The 3SLS estimates for the full model are reported in column three. 3SLS estimates are more robust to misspecification of the error terms; in other words, if the underlying distribution of the disturbance terms is not multivariate normal, the estimates are still consistent. Of course, when the model is correctly specified, FIML is more efficient than 3SLS (see Amemiya, 1977). However, our small sample does not warrant any asymptotic results to be applicable and the bias of the estimates may be fairly large in our case. Nevertheless, the estimates from both FIML and 3SLS are fairly similar except for Equation 2. In column two, the 3SLS estimates for Equation 2 are incorrectly signed. If Equation 2 is misspecified, then all the estimates may not even be consistent. Columns four and five will be examined before any explanations are offered.

In column four, most of the FIML estimates are significant at the 5% level of significance. Although the 3SLS estimates are very similar to those from FIML, they are not statistically significant except for Equation 1. Furthermore, the results for Equation 1 are fully in accord with theoretical predictions. The response of the fertility with respect to men's wage rate (a_2) is significantly positive whereas the effect of women's wage rate (a_1) is negative. The evidence

that fertility declines with increase in W indicates the dominance of the substitution effect over the income effect with respect to women's wage.

As for Equation 2, both FIML and 3SLS estimates for b_1 and b_2 are incorrectly signed according to our *a priori* beliefs. This can be explained as follows. First, the negative-signed b_1 implies that the proportion of married women (aged 15–44) participating in wages and salary labour force responded negatively to increases in W. Assuming the estimates are reliable, then this contradiction of the *a priori* belief may be explained by the unique Japanese employment practices and cultural factors. The comments of Cook and Hayashi (1980) offer some insight into this aspect of female labour force participation in Japan: 'Japanese husbands often put wives under considerable pressure to quit work and remain at home because they think it does not look well for them if they permit their wives to work . . .'

In addition, the 'customary' practice whereby married women were asked to 'retire early' voluntarily is still widely practised by work rules, by collective agreement or by employer's 'hinting' to his married female employees that she is no longer useful to the company and had better go. According to a Ministry of Labour study in 1978, 36.7% of pregnant women or women who had given birth to a child retired.

Second, the positive-signed b_2 implies that a proportion of married women in the wage and salary labour force responded positively to men's wage rate. This again contradicts the expected sign. But this is not too difficult to explain, in view of the dramatic rise in the cost of living, particularly in the costs of housing and education, and the uncertainty during the oil crisis periods, all of which had made additional income from wives a necessity despite the increase in male real wages.

However, there is a danger of explaining away from the problem. The most likely explanation perhaps can be found by examining the models, techniques and data that have been used. Equation 2 describing the proportion of women participating in the wage and salary labour force may be misspecified. But, estimations have been made using different functional form and different instruments for 3SLS and the results are fairly similar. First, each equation was estimated using ols as well as maximum likelihood with AR(1) error correction whenever there is indication of first order serial correlation. The estimates (not reported) obtained for Equations 1 and 3 are fairly similar to those obtained by treating the three equations as a system. But for Equation 2, estimates very similar to those in column two (which are consistent with *a priori* predictions) were obtained, thus indicating that Equation 2 may be misspecified or the small-sample bias is large. To see if other specifications would perform better, the model was also estimated using a semi-log version, i.e. using log W and log Y leaving other variables in level. The signs of the estimates did not change but the t ratios deteriorated. It is suspected that the estimates for Equation 2, and indeed Equations 1 and 3, resported in Table 1, suffer from small-sample bias. The estimates, especially for Equation 2 should therefore not be taken too seriously.

Nevertheless, the remaining equation, i.e. Equation 3, will be examined briefly. It can be observed that the proportion of women married and living with husband (M) decreases with an increase in W and increases with an increase in Y. The results are consistent with theoretical predictions. In Japan, the transfer of employees to new locations accompanying promotion and increase in wages is quite a common practice. Moreover, the economic restructuring of firms that took place during the 1970s also brought about considerable changes in re-organization and transfer of employees. The increase in Japanese direct investment abroad in that period witnessed a large number of Japanese employees being sent abroad. Consequently, physical separation of wives from husbands was by no means

uncommon. In the case of an increase in male earnings, married women are more likely to be asked to quit their jobs and remain at home, indicating the dominance of income effect over substitution effect with respect to husband's wages as predicted.

VI. CONCLUSION

This paper has followed Winegarden's approach of extending the Butz and Ward model to a three equation simultaneous equation system and estimated the parameters by FIML and 3SLS using Japanese data. The FIML estimates of model I are of the correct signs but statistically insignificant. We have also estimated model II with explanatory terms made up entirely of interaction terms. The estimate from FIML and 3SLS for model II are statistically significant but the *a priori* predictions that b_2 and b_3 should be positive and negative respectively are contradicted. We offered possible explanations for the incorrect signs in the light of the Japanese labour market development but we believe that it is likely that our small-sample bias is too large to warrant any confidence in the magnitude of the estimates.

The crux of the model is that an increase in the wages of men has an unambiguous positive effect on fertility, whereas an increase in wages of women may not lead to higher fertility due to the dominance of substitution effect. But, the issue of whether there is discriminatory employment practices and cultural pressures on the participation of women in the labour force, raised by the results that we have obtained, can only be answered using a larger set of data or with the help of panel data.

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