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MARRIAGE AND LABOR MARKET DISCRIMINATION IN JAPAN

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One determinant of lower population growth is a decrease in the total fertility rate. Fertility can be changed not only by reducing marital fertility at every age but also by changing the pattern of nuptiality. Lesthaeghe (1971) fit the "standard" nuptiality curve developed by Coale (1971) to Middle Eastern data and found that nuptiality changes produce the same effect on population growth as changes in marital fertility. He found, for example, that if the minimum age of marriage in Turkey is raised from 13.5 to 16 years, perhaps as the result of a government decree, fertility declines of 15 percent are expected. Similar results are derived from a simulation study by Menken and Bongaarts (1979) in which the total fertility rate declines from 9.31 to 7.85 if the age at marriage rises from 20 years to 20.3 years.

To determine under what conditions a change in the age at marriage can be expected, demographers and economists have analyzed household behavior. Demographic literature examines socioeconomic differentials in fertility without actually modelling behavior. Bumpass (1969), Hogan (1978), Dixon (1971), and others find significant differences in age at marriage by religion, area of residence (urban/rural), educational level, wealth, occupation, and family type.

Economic work on marriage by Keeley and Becker views marriage within the framework of choice. Keeley (1977, 1979) models the process of searching for a mate, emphasizing the costs of search. A single person must decide whether to enter the marriage market and, upon entering, how long to search. An optimal sequential search process is pursued if he enters the marriage market. The costs of search depend on the value of time and the prices of goods purchased during the search. From the model, women are expected to marry later if the female wage increases relative to the male wage, causing the net gain to marriage to fall. Empirical results support most of the model's predictions.

In Becker's (1973, 1974) theory of marriage, marriage occurs if the benefits from marriage exceed the costs. In other words, the individual's share of marital income must exceed the maximum output producible in a single household for marriage to occur. Gains to marriage depend on wage and non-wage income when married and single, the prices of purchased inputs used in the production of household commodities, and the efficiency of household production. If the husband and wife's time in home production are complementary or there are economies of scale in production in the married household, the gain to marriage increases relative to the cost. Becker does not empirically test his model, but Friedan (1974) does find some support for the importance of economic variables in determining the proportion of females married. If the difference in the male and female wage rates is large (indicating some complementarity between male and female household time), the proportion of women marrying increases. An increase in wealth or technological change in the home results in an increase in marriage.

The major problem with the economic household models of marriage is that no unambiguous predictions are readily derivable without placing some structure on the form of the home production functions. In addition, as Wallace (1974) points out, the models are deterministic, and implications concerning the "likelihood" of ever-marrying require a stochastic framework. The empirical estimation of marriage equations also requires improvement. In particular, separate measures of full labor and non-labor wealth are needed to adequately estimate the wealth and wage effects.

Our paper on marriage begins with the development of an economic model of the decision to marry based on Becker's model and placing some structure on the form of the production functions. In the second section, we present a stochastic model of the age at marriage derived from our marriage model. In the third section, by applying rationing theory, we demonstrate how outlawing a Japanese practice requiring married women to withdraw from the paid labor force affects the optimal age at marriage. Finally, our model of the age at marriage is tested in the last section using data from Japan.

1. THE DECISION TO MARRY

Our model of the decision to marry is derived from Becker (1973) and Wallace (1974). At some point in an individual's life, he makes the decision to marry or to remain single. In order to make this decision, he compares the maximum lifetime utility attainable in marriage with the maximum lifetime utility attainable in the single state and chooses to marry only if the utility expected in marriage is larger.

We are interested in the individual's decision to marry rather than the joint decision of two potential spouses, and we are abstracting from search for a mate. The individual begins with knowledge of his utility function as a single person, the characteristics of the potential spouse, and the objective function of the married household. Given this information, each individual can ascertain the optimal utility that he can achieve in the married household as well as the single household. The utility function is separable and composed of two commodities--N and Z--which are produced in the home. The commodity Z may be viewed as a group of commodities, the production of which is less costly in the single household. For example, Z may be privacy--its cost increases where a spouse contributes time to its production. N may be, for example, child services which are produced at lower cost in the married household. The difference between the two utility functions depends on differences in the production functions for Z and N and the budget constraints in each state.

In the single woman's household, Z and N are produced with inputs of her time and market goods. In the married household, Z and N are produced with her time, her husband's time, and market goods. If the production functions are linear homogeneous, then the shadow prices of Z and N are easily derived as weighted linear functions of the input prices--the value of the wife's time (W_W), the value of the husband's time (W_H), and the prices of goods used in production (P_{X_Z} and P_{X_N}).

The single woman's full income is the sum of her unearned income (V_W) and her full time (T) evaluated at her market wage ($W_W T$). Full income is spent on purchases of goods and time used in the production of Z and N. In the married household, full income is augmented by her husband's unearned income (V_H) and his full time evaluated at his market wage ($W_H T$). V_W and V_H include intergenerational transfers of wealth and human capital including inheritances.

To determine whether or not marriage is optimal, the single woman compares the optimal utility within marriage to the optimal utility in the single household. Utility in each state is maximized subject to the full income and production constraints. The optimal quantities of Z and N are derived as functions of wages, prices, and income. Optimal Z and N are then substituted back into the utility functions and the indirect utilities within marriage and the single state (U_M^* and U_S^*) are obtained. If U_M^* is greater than U_S^*, marriage is optimal. If U_S^* is greater than U_M^*, remaining single is optimal.

The indirect utilities are derived in Appendix A. From the model, the following implications are obtained. First, the higher the husband's nonearnings income, the higher the gain to marriage. Second, higher non-earnings income for the wife implies a lower gain to marriage if the weighted share of her wealth in a single household exceeds the weighted share of her wealth in a married household. Third, if the income elasticities of demand for N and Z exceed the elasticity of substitution between N and Z, then an increase in the wife's wage will likely result in a decrease in the gain from marriage. Finally, if the husband's time share in the production of Z is larger than his time share in the production of N in the married household, then an increase in the husband's wage will likely increase the gain to marriage.

This model examines the motivations of an individual woman who is considering marriage. It can be assumed that a single man's behavior is modelled identically. His optimal lifetime utility attainable within marriage is compared to his optimal utility as a single person. Marriage is optimal to him if the gain from marriage $(U^*_M - U^*_S)$ is positive. Marriage actually occurs when the gain for both prospective spouses is positive.

2. THE AGE AT MARRIAGE

From the model derived in the previous section, an individual marries at some point in his life if the optimal utility attainable from marriage exceeds the optimal utility attainable from remaining single. Suppose, that the utility function consists of a non-stochastic component (U^*) and some stochastic component (e) which measures individual tastes, for example:

(3a) $$U_M = U_M^* + \varepsilon_M, \text{ and}$$

(3b) $$U_S = U_S^* + \varepsilon_S$$

Then the probability of ever-marrying (P_{EM}) during the lifetime is positively related to the gain from marriage.

(4) $$P_{EM} = Pr(U_M^* - U_S^* > \varepsilon_S - \varepsilon_M) \ .$$

As the gains from marriage increase, the probability of ever-marrying and, therefore, the fraction of the lifetime married increases. The fraction of the lifetime married represents the probability of ever-marrying:

(5) $$P_{EM} = \frac{T - A}{T}$$

Rearranging, age at marriage is shown as a decreasing function of P_{EM}:

(6) $$A = (1 - P_{EM})T$$

Consequently, those variables that increase the gain from marriage and the probability of ever-marrying will systematically decrease the age at marriage.

This modelling requires several comments and caveats. First, we are abstracting from intertemporal variation in utility for both married and single households. The gain from production in a married household obviously changes with the value of time over the life-cycle. Second, this model allows no marital dissolution. While inappropriate for the U.S., this assumption appears reasonable given information for all Japan and our sample. In both our sample and all Japan, fewer than three percent of all women over thirty had ever divorced.[2]

3. THE SETTING IN JAPAN

Japan provides a very interesting setting for a study of the age at marriage. In 1947, with the American Occupation, the Civil Code was revised to assure women equal property rights, freedom of marriage, and equal grounds for divorce.[3] At the same time the Labor Standards Law guaranteed equal pay for equal work. The extent to which these rights were enforced is suspect. In 1965, a government survey of firms indicated that 9.4 percent had formal rules requiring retirement of women upon their marriage, with 7.5 percent of the firms admitting informal practice of compulsory retirement. In 27.9 percent of the surveyed firms, female employees were subject to different retirement age rules than male employees. In 1966, the District Court of Tokyo ruled that the compulsory retirement practiced by a Japanese cement company violated the provisions of the Civil Code.[4] This ruling reenforced the

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[2] Japan. Prime Ministers Office. Japan Statistical Yearbook (1975), and survey data.

[3] Lebra et al. (1976, p. 20).

[4] Cole (1971) p. 147.

freedom to marry, allowing greater flexibility in the age at marriage to women marrying after 1966.

The practice of compulsory retirement from the paid sector upon marriage can have differential effects on three groups of women. In the absence of this practice, these affected groups are:
(1) married women, (2) single women who are not working, and (3) single women who are paid labor force participants.

If there is no option of divorce, this practice is pro-natalist for the first group of women. Compulsory retirement from the paid labor force essentially rations hours of work in the paid sector. This practice reduces the "ration" of market time and increases the "ration" of time in other activities. This ration can be viewed symmetrically as a reduction in the wage married women can receive in the paid labor force. If discrimination is completely effective, this wage is literally driven to zero. As a result, the real value of time foregone in the market in order to raise children declines and the desired number of children increases.

The second group of women affected by this practice are single women who are not working. In this case, the value of their time in the home exceeds the market wage before the practice is established so that the most efficient use of their time is in home production. Upon marriage, the behavior of these women is the same (with or without the law) as long as the marginal product of their labor after marriage does not fall below their premarriage wage. The same result is expected for women who would withdraw from the labor force upon marriage in the absence of this practice. In this case, marginal product in the home increases with marriage to a point above the market wage; the optimal allocation of their time includes no time in paid employment.

The third group of affected women consists of working single women who would marry in the absence of compulsory retirement. These women have two choices. If they remain single, they can earn a market wage equal to the value of their time in the home by allocating time both to the market and to home production. If they marry, their actual market wage falls to zero which is less than their market wage if they did not marry. If all gains from marriage remain constant, this practice reduces the net benefit of marriage. Women choose to delay marriage beyond the age which is optimal without compulsory retirement. The effect on this group of women is anti-natalist since their period of potential childbearing is shortened.

Compulsory retirement upon marriage imposes a welfare loss on women in groups one and three. In the absence of the practice, time is efficiently allocated between home production and the paid labor force until the marginal product of time in the home is equal to the market wage. If market time is rationed so that the number of hours spent in the paid labor force is less than the number of unrationed hours, the marginal product of home time falls below the going market wage. This wedge driven between the wage and the value of home time results in a welfare loss to married women. For single working women contemplating marriage, this welfare loss is an additional cost of marriage and, consequently, reduces the net benefit to marriage.

We may express the effect of this market discrimination on age at marriage by first considering a result derived in Tobin and Houthakker (1958).[5] They show that the effect of an exogenous change in the quantity of the rationed commodity is equivalent to a compensated change in the wage:

$$dt_H^R = \eta^C_{H,W_W}\, dW_W \tag{7}$$

where t_H^R is the rationed time in the formal sector, η^C_{H,W_W} is the compensated own substitution effect, and dW_W is the change in the wage.

The effect of this ration on age at marriage then is

$$\frac{\partial A}{\partial t_H^R} = \left.\frac{\partial A}{\partial W_W}\right|_{comp} \cdot \frac{\partial W_W}{\partial t_H^R} = \left.\frac{\partial A}{\partial W_W}\right|_{comp} \cdot \frac{1}{\eta^C_{H,W_W}} \tag{8}$$

where $\partial A/\partial W_W|_{comp}$ is simply the compensated substitution effect of the wage on age at marriage. Unfortunately, we do not have information on the change in the ration of market time that resulted from the court ruling. We do know whether a marriage took place before or after the court ruling, so we construct a dummy variable (D) that equals one for these women married after 1966 and equals zero for women married during or before 1966. We consider the effect of D on age at marriage:

$$\frac{\partial A}{\partial D} = \frac{\partial A}{\partial t_H^R} \cdot \frac{\partial t_H^R}{\partial D} = \left.\frac{\partial A}{\partial W_W}\right|_{comp} \cdot \frac{1}{\eta^C_{H,W_W}} \cdot \frac{\partial t_H^R}{\partial D} \tag{9}$$

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[5]Their result generalizes readily when full income (I) is the appropriate income measure.

Given the sign of the estimated coefficient of the dummy variable D in our age at marriage equation, we may then sign the compensated effect of a change in the wage on age at marriage. We know from demand theory that $\eta^{C}_{W,H}$ is positive. Also, the effect of the dummy variable on rationed market hours ($\partial t^{R}_{W,H}/\partial D$) is positive. Since both terms are positive, the sign of $\partial A/\partial W\big|_{comp}$ will be the sign of the coefficient in the dummy variable; e.g., if $\partial A/\partial D$ is negative, that will indicate that the compensated effect of the wage on age at marriage is also negative.

4. DESCRIPTION OF THE DATA AND VARIABLES

The data set employed in this analysis draws from a 1975 survey of women 20 to 59 in the Tokyo metropolitan area. This survey includes information on family background and marital status as well as retrospective data on work experience and fertility.[6]

Our modelling suggests a regression analysis in which the age at first marriage depends on the wages of the husband and the wife, their non-wage income, and the ration of labor market time. The sample means and definitions of the variables used in our estimation are presented in Table 1. The mean age at marriage for this sample is 24 with a standard deviation of 3 years. Since we had no wage data for non-working women, we predicted their value of time by setting the wage equal to an instrumental variables prediction of the market wage if they were working in the paid labor force and equal to their predicted reservation wage if they were not working in the paid labor force.

[6] For a complete description of these data, see Hill (1979).

TABLE 1

Means and Standard Deviations of Variables Used in Empirical Work
(standard deviations in parentheses)

Age of Marriage	23.8 (3.06)
ln Wife's Hourly Wage[1] (yen per hour)	5.70 (0.21)
Wife's Schooling (years)	11.24 (2.27)
ln Husband's Income (yen per year)	14.27 (0.21)
Husband's Schooling (dummy variable - 1 if mother completed junior high school)	0.72 0.31
ln Father's Income (yen per year)	14.67 (0.24)
Year of Marriage	1961
Married after 1966 (yes = 1)	.35

[1]The 1975 exchange rate was 293.8 yen per dollar, hence the geometric mean wage is $1.20/hour.

While the husband's income was reported, his hours of work were not, so we have no wage measure for him. Also, income is reported for the husband only if he is the primary earner. We, therefore, use an instrumental measure of his income which unfortunately incorporates both wage and labor supply information. The mother's schooling and the father's predicted income proxy the woman's own non-wage income and transferred endowment of wealth and human capital. The wage and income predictions are presented in Appendix B. Any wage measure which is a function of the wife's age is predicted where the wife's age equals zero when included as a regressor.[7]

The year of marriage captures the secular trend in the age at first marriage of Japanese women. The mean year for the sample is 1961. A dummy variable equal to one if the woman married after 1966 is included to measure the response in age at marriage to the 1966 elimination of compulsory retirement from paid employment upon marriage. The regression sample was limited to those women who are currently married.[8]

Schooling of the husband and wife are included in regressions with and without estimates of the wage or market earnings. In many studies, schooling is used as a proxy for the value of time whenever information on wages is unavailable. However, education is closely associated with wealth accumulation, tastes, and efficiency in home production. Interpretation of the coefficient on schooling only as a wage effect requires restrictive assumptions concerning its other effects.

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[7]See DaVanzo, et al., (1976).

[8]Estimates excluding women married before the end of World War II resulted in little change in the values of the estimated coefficients and an overall decline in statistical significance.

TABLE 2

Empirical Results for Age at Marriage (1110 observations)[1]

Independent Variable	(1)	(2)	(3)	(4)
Intercept	-186.0621 (-6.35)	-160.0812 (-5.68)	-181.9962 (-6.11)	-169.50 (-5.94)
ln Wife's Hourly Wage	0.9131 (3.64)	0.7866 (1.37)	-	-
Wife's Schooling	-	-	0.0807 (1.65)	0.0961 (2.01)
ln Husband's Income	0.5892 (0.94)	-.5202 (-0.90)	0.8443 (1.47)	-
Husband's Schooling	-0.9384 (-3.64)	-	-0.9985 (-3.79)	-0.8052 (-3.53)
Mother's Schooling	0.3144 (1.49)	0.2854 (1.34)	0.2945 (1.38)	0.3342 (1.58)
ln Father's Income	0.8218 (2.10)	0.8275 (2.10)	0.8092 (2.06)	0.8769 (2.25)
Year of Marriage	0.0944 (6.65)	0.0891 (6.28)	0.0928 (6.47)	0.0919 (6.41)
Married After 1966	-0.9825 (-3.52)	-1.0522 (-3.75)	-0.9873 (-3.53)	-1.0307 (-3.71)
F-statistic	10.65	10.11	10.64	12.04

[1] t-statistics in parentheses.

6. EMPIRICAL RESULTS

Table 2 presents the empirical results of OLS regressions for age at marriage for four specifications of the model. The wife's and the husband's schooling alternate as measures of the value of time. First, the effect of a change in the wife's value of time, measured as her wage or schooling on age at marriage is positive and significant -- the elasticities evaluated at the mean are approximately .04 in each regression. This result implies that the income elasticities for N and Z outweigh the elasticity of substitution between N and Z.

Second, when the husband's schooling is included as a regressor, his income increases the age at marriage, though insignificantly. When his level of schooling is not held constant, his income reduces the age at marriage. This variable is not a predicted wage or value of time but predicted earnings and, therefore, includes an endogenous labor supply effect which cannot be separated from the wage effect. Although the husband's level of schooling incorporates these same effects, the effect of a change in his schooling on age at marriage is negative and significant. The elasticity evaluated at the mean is -.02. The husband's schooling variable probably captures an efficiency effect as well as the negative wealth effect. An increase in his level of schooling, will raise his efficiency in household production and unambiguously increase the gains to marriage.

Third, the proxies for the wife's transferred endowment -- father's income and mother's schooling -- are positive and significant determinants of the age of marriage; the elasticity of age with respect to mother's schooling and the elasticity of age with respect to father's income, evaluated at the sample means, are .005 and .035 respectively. These results are as predicted by the model,indicating that the share of unearned income in full single income is greater than the share of unearned income in full marital income.

Fourth, the year of marriage is a positive determinant of the age of marriage. The trend in age at marriage from 1947 to 1975 is significantly upwards if we control for individual variation in wages and wealth.

Finally, the court decision in 1966 forbidding discrimination in the employment of married women has a decidedly negative effect on age at marriage as expected. This result indicates that the practice of compulsory retirement reduced the overall welfare of married women in Japan. Recall that this coefficient is a function of the compensated wage effect on age at marriage, the compensated wage effect on hours, and the effect of the dummy variable on rationed hours. Since our estimated coefficient for $\partial A/\partial D$ is negative, the compensated wage effect must be negative. This result indicates that the effect of non-wage income on age must be positive, since our uncompensated wage effect (the sum of the compensated effect and the income effect) is positive. Overall, the estimated effect of the dummy variable confirms the predictions of the model.

The regression sample used in estimating the age at marriage equations includes only those women who are currently married. We obviously do not know the age of marriage for never-married women. The young women (20 to 30) who are currently married are not a random sample of their cohort. They have a higher probability of ever marrying than their counterparts; their inclusion in the sample may lead to selectivity bias in our results. Rather than exclude these women from the regression sample, we choose to test for selectivity bias by including the Mill's ratio correction in the estimated model.[9]

Inclusion of this correction for selectivity bias results in a slight

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[9]The correction was derived from a Logit estimation of the probability of ever-marrying. Details of the procedure are given in Hay (1979). Tables of the probability function and the corrected marriage regression are available upon request.

decrease in overall significance of the estimates (e.g., the F-statistic for the first specification in Table 2 drops from 10.65 to 9.35). The coefficient for the selection variable is itself insignificant, and the remaining coefficients change very little. Since there is virtually no evidence of selectivity bias, we choose to present the most significant empirical results -- those uncorrected for this bias.

7. CONCLUSIONS

We have derived a model of the decision to marry based on Becker's model of marriage. If the utility expected from marriage exceeds the utility from remaining single, the individual decides to marry at some point in his lifetime. This decision to marry is related to the probability of ever-marrying if the deterministic model is expanded to include stochastic variation in utility across individuals. In this case, the age at marriage becomes a negative function of the probability of ever marrying.

Few unambiguous predictions are possible from this model without assumptions about behavior before and after marriage. In general, we expect the wife's age at marriage to be a positive function of her wage and wealth and a negative function of her husband's wage and wealth. The predictions are supported empirically using Japanese data.

In addition to testing the home production model, we are interested in determining the effect of legal sexual discrimination in the labor market on the age at marriage. Applying rationing theory to explain the direction of effect of market discrimination on age at marriage, we predict that age at marriage declines if the legal constraint is removed. This prediction is supported by the data after adjusting for a positive secular trend in age at marriage in Japan. Further research from different cultural settings such as the United States is needed to support the hypothesis that market discrimination against married women is a deterrent to marriage.

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APPENDIX A

The utility function for the married household is an additive function of the utility of the wife within marriage and the utility of the husband within marriage. Marriage occurs whenever the difference between the wife's optimal utility when married and her optimal utility when single and the difference between the husband's optimal utility when married and his optimal utility when single are positive.

In a single woman's household, Z and N are produced with inputs of her time ($t^S_{W,Z}$ and $t^S_{W,N}$) and goods (X^S_Z and X^S_N). In the married household, Z and N are produced with inputs of the husband's time ($t_{H,Z}$ and $t_{H,N}$), the wife's time ($t^M_{W,Z}$ and $t^M_{W,N}$) and goods (X^M_Z and X^M_N). The production functions are assumed to be linear homogeneous. The shadow prices of Z and N are easily derived as functions of the input prices--the value of the wife's time (W_W), the value of the husband's time (W_H), and the prices of goods in production (P_{X_Z} and P_{X_W}) and are presented below.

(A.1) $$E\Pi^S_Z = \alpha^S_{t_N,Z}\ EW_W + \alpha^M_{X_Z}\ EP_{X_Z}$$

(A.2) $$E\Pi^M_Z = \alpha_{t_H,Z}\ EW_H + \alpha^M_{t_W,Z}\ EW_W + \alpha^M_{X_Z}\ EP_{X_Z}$$

(A.3) $$E\Pi^S_N = \alpha^S_{t_W,N}\ EW_W + \alpha^S_{X_N}\ EP_{X_N}$$

(A.4) $$E\Pi^M_N = \alpha_{t_H,N}\ EW_H + \alpha^M_{t_W,N}\ EW_W + \alpha^M_{X_N}\ EP_{X_N}$$

where:

$$\alpha^r_{t_{K,i}} = \frac{t^r_{K_i} W_K}{\Pi^r_i \, i}$$, the cost share of K = W or H in the production of commodity i = Z,N. $\Pi^r_i \cdot i$ is the total cost of production r = S, M.

Full income in the single household (I^S) and the married household (I^M) is the sum of unearned income and full wage income and is spent on time and market goods used in the production of Z and N. The time cost and the value of purchased goods form the shadow prices of Z and N (Π_Z and Π_N). The full income constraint is given in (A.5):

(A.5a) $$I^S = V_W + W_W T = \Pi^S_Z Z + \Pi^S_N Z$$

(A.5b) $$I^M = V_H + V_W + (W_H + W_W)T = \Pi_Z Z + \Pi_N N$$

The first order differentiation of the utility function in percentage change terms is:

(A.6) $$EU = \eta_{U,Z} EZ + \eta_{U,N} EN.$$

To compare the maximum utility attainable in the married household with the maximum utility for the single household, we must evaluate (A.6) at the optimal values of Z^S, N^S and Z^M, N^M. Then the gain from marriage is:

(A.7) $$E(U^M - U^S) + \eta_{U,Z} (\theta^M EZ^M - \theta^S EZ^S) + \eta_{U,N} (\theta^M EZ^M - \theta^S EZ^S)$$

where $\theta^M = \frac{U^M}{U^M - U^S}$ and $\theta^S = \frac{U^S}{U^M - U^S}$, both assumed to be positive. These optimal demands may in turn be expressed as functions of full income (I_s and I_m), and the shadow prices of their production (Π_N^S, Π_Z^S, Π_N^M, Π_Z^M). The form of these demands is independent of the marital state. If r indexes the marital state and equals S or M, then the optimal demands in percentage chages are:

$$\text{(A.8)}\quad EZ^r = \eta_Z EI_r - [K_Z^r \eta_Z + (1 - K_Z^r)\sigma] E\Pi_Z^r + (1 - K_Z^r)(\sigma - \eta_Z) E\Pi_N^r$$

$$\text{(A.9)}\quad EN^r = \eta_N EI_r - [(1 - K_Z^r)\eta_N + K_Z^r \sigma] E\Pi_N^r + K_Z (\sigma - \eta_Z) E\Pi_Z^r$$

The factor shares and elasticities in equations (A.8) and (A.9) are defined as:

σ = the elasticity of substitution between Z and N in consumption.

$\eta_i = \frac{Ei}{EI}$, the full income elasticity of demand for i = Z,N.

$K_i^r = \frac{\Pi_i^r \cdot i}{I_r}$, the budget share of commodity i=Z,N in full income I_r, r = S,μ.

The final expression for the gains from marriage may be derived by substituting (A.1) - (A.5) into (A.7). The final equation is:

$$\text{(A.10)}\quad E(U^M - U^S) = \eta_{U,Z}(\alpha_1 E_{W_H} + \alpha_2 E_{V_H} + \alpha_3 E_{W_W} + \alpha_4 E_{V_W})$$
$$+ \eta_{U,N}(\delta_1 E_{W_H} + \delta_2 E_{V_H} + \delta_3 E_{W_W} + \delta_4 E_{V_W})$$

where the α's and δ's are defined as follows:

$$\alpha_1 = \theta^M[\eta_Z\gamma_{W_H} - (K_Z^M \eta_Z + K_N^M \sigma)\alpha_{t_{H,}Z} + K_N^M(\sigma-\eta_Z)\alpha_{t_{H,}N}]$$

$$\alpha_2 = \theta^M[\eta_Z \gamma_{V_H}]$$

$$\alpha_3 = \theta^M[\eta_Z \gamma^M_{W_W} - (K_Z^M \eta_Z + K_N^M \sigma)\alpha^M_{t_{W,}Z} + K_N^M (\sigma-\eta_Z)\alpha^M_{t_{W,}N}]$$

$$- \theta^S[\eta_Z \gamma^S_{W_W} + (K_Z^S \eta_Z + K_N^S \sigma)\alpha^S_{t_{W,}Z} - K_N^S(\sigma-\eta_Z)\alpha^S_{t_{W,}N}]$$

$$\alpha_4 = \eta_Z(\theta^M\gamma^M_{V_W} - \theta^S\gamma^S_{V_W})$$

$$\delta_1 = \theta^M[\eta_N\gamma_{W_H} - (K_N^M \eta_N + K_Z^M \sigma)\alpha_{t_{H,}N} + K_Z^M(\sigma-\eta_N)\alpha_{t_{H,}Z}]$$

$$\delta_2 = \theta^M(\eta_N\gamma_{V_H})$$

$$\delta_3 = \theta^M[\eta_N\gamma^M_{W_W} - (K_N^M \eta_N + K_Z^M \sigma)\alpha^M_{t_{W,}N} + K_Z^M(\sigma-\eta_N)\alpha^M_{t_{W,}Z}]$$

$$- \theta^S[\eta_N\gamma^S_{W_W} + (K_N^S \eta_N + K_Z^S \sigma)\alpha^S_{t_{W,}N} - K_Z^S(\sigma-\eta_N)\alpha^S_{t_{N,}Z}]$$

$$\delta_4 = \eta_N[\theta^M\gamma^M_{V_W} - \theta^S\gamma^S_{V_W}]$$

where:

$\gamma^{r}_{W_K} = \frac{W_K T}{I_r}$, the share of full earnings of K = W,H in full income I_r where r = S,M.T is the endowment of time.

$\gamma^{r}_{V_K} = \frac{V_K}{I_r}$, the share of the non-earnings wealth of K = W,H in full income I_r, r = S,M.

In drawing implications from our model, we assume:

$K^M_N > K^S_N$: The budget share of N is greater in married households.

$K^M_Z < K^S_Z$: The budget share of Z is greater in single households.

$\gamma^M_{W_W} < \gamma^S_{W_W}$: The share of the wife's earnings in full income is lower in married than in single households.

$\alpha^M_{t_W, N} > \alpha^S_{t_W, N}$: The time share of the wife in producing N is higher in married households.

$\alpha^M_{t_W, Z} < \alpha^S_{t_W, Z}$: The time share of the wife in producing Z is higher in single households.

APPENDIX B

1. ESTIMATING WAGE AND INCOME VARIABLES

As discussed in the text, estimation of the marriage model requires measures of the value of the wife's time, the value of the husband's time and the female's transferred endowment as proxied by her father's income. The procedure for measuring the lifetime value of the female's time takes into consideration the censoring error of predicting a wage for all women based only on the working sub-sample.[1] Since income information was reported for the husband and the father only if they were the primary income earner, we use instrumental variables predictions for these two income measures. Each predicting equation is discussed in turn.

2. WIFE'S WAGE

The measured market wage may understate the true value of time for non-working women. Hence the predicted value of the female's time is set equal to an instrumental value of the market wage if they are working in the paid labor force and to their predicted reservation wage if they are not working in the paid labor force. This procedure is based on work by Cogan (1975). The lifetime offered wage W_o is a function of each woman's level of schooling and her labor market experience:

(B.1) $$W_o = f_o \text{ (schooling, experience).}$$

Following Mincer (1963), we define the experience variables as:

(B.2) $$\text{Experience} = \text{Age} - \text{Schooling} - 6.$$

[1]We do not correct for selectivity bias since there was little evidence of this bias in early work with these data. (See Hill (1979).)

The reservation wage is defined as:

(B.3) $$W_R = f_R \text{ (schooling, husband's income, family business, home ownership).}$$

The choice to participate in the paid labor force in the current period relies on a comparison of the reservation wage with the offered wage. In order to estimate the parameters of the participation and wage functions, we must first specify functional forms and stochastic structure:

(B.4) $$\ln W_o = \beta_{o1} + \beta_{o2} \text{ Schooling} + \beta_{o3} \text{ Experience} + \varepsilon_o$$

(B.5) $$\ln W_R = \beta_{R1} + \beta_{R2} \text{ Schooling} + \beta_{R3} \text{ husband's income} + \beta_{R4} \text{ family business} + \beta_{R5} \text{ home ownership} + \varepsilon_R$$

where ε_o and ε_R are independent and identically distributed Weibull errors. The probability of labor force participation (P_i) is then:

(B.6) $$P_i = \Pr(\ln W_o - \ln W_R > \varepsilon_R - \varepsilon_o) = \frac{1}{1 + e^{-(\beta_o X_o - \beta_R X_R)}}$$

The parameters of the participation function may now be estimated with a logit technique since $\varepsilon_R - \varepsilon_o$ has a logistic distribution (McFadden (1975)). Given the parameters of the market wage, estimated by OLS, we may then identify the reservation wage function. These estimates are presented in Table B.1.

TABLE B.1

ESTIMATED EQUATIONS FOR PREDICTING THE VALUE OF TIME

(t-STATISTICS IN PARENTHESES)

Independent Variable	Means	Labor Force Participation[1]	Market Wage	Reservation Wage
Intercept	--	13.5054 (2.20)	4.7038 (19.16)	2.9168
Years of Schooling	10.72	.01105 (.75)	.08528 (4.90)	.08250
Experience	19.60	.03092 (4.03)	.003835 (1.05)	--
Home Ownership Dummy	0.60	-.7538 (-4.39)	--	.09091
Family Business Dummy	0.22	-.7562 (-3.74)	--	.1291
ln Husband's Predicted Income	14.56	-1.05 (-2.47)	--	.1247
X_5^2	--	64.37	--	--
-log likelihood	--	474.53	--	--
F-statistic	--	--	13.60	--

[1] t-statistics are asymptotic

3. HUSBAND'S INCOME

The predicting equation for the husband's income is based on a linear model in which the dependent variable, the natural logarithm of annual earnings, is regressed on three dummy variables indicating the highest level of schooling which the husband completed, and a set of dummy variables describing the husband's occupation. Since the husband's age is not reported, the wife's age serves as a proxy. A dummy variable, equal to one if the husband has ever been unemployed represents disruption in work experience. Table B.2 presents the results.

TABLE B.2

ESTIMATES FOR PREDICTING THE HUSBAND'S INCOME

(918 OBSERVATIONS)

Independent Variables	Means	Coefficient	t-statistic
Intercept	--	13.9613	232.26
Ever unemployed (yes=1)	0.06	-0.1494	-2.91
High School	0.38	0.1558	4.88
Technical School or Junior College	0.11	0.2006	4.31
College	0.24	0.3291	7.76
Wife's Age	37.23	0.007744	5.59
Occupational Variables			
Self-employed	0.19	.3033	8.46
Professional	0.09	.1238	2.38
Manager	0.07	.4282	7.75
Salary man, large firm	0.16	.2125	5.09
Salary man, small firm	0.11	.1371	3.06
Blue Collar, large firm	0.09	.07063	1.51
F		29.34	

4. FATHER'S INCOME

The father's income is reported only for those women whose fathers are the primary income earner. Table B.3 presents the predicting equation based on the available sample information. The model for the father is similar to that for the husband. A variable equal to one if the father completed college represents the father's schooling. Dummy variables for seven occupational categories are also included.

TABLE B.3

ESTIMATES FOR PREDICTING THE FATHER'S INCOME

Independent Variable	Means	Coefficient	t
Intercept	--	14.9156	75.24
College	0.17	.1768	1.01
Farmer	0.14	-.5442	-2.25
Self-employed	0.24	-.09706	-0.45
Manager	0.07	-.1705	-0.63
Salary man, large firm	0.14	-.3225	-1.42
Salary man, small firm	0.07	-.1919	-0.69
Blue Collar, large firm	0.11	-.3936	-1.57
Blue Collar, small firm	0.15	-.6054	-2.55
F		2.66	

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