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A COMPARISON OF ECONOMIC MODELS AND EMPIRICAL RESULTS FOR FEMALE LABOR FORCE PARTICIPATION IN JAPAN AND THE UNITED STATES

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This paper examines the economic models that have been developed to analyze a woman's decision to enter the labor force and the empirical results obtained from these models estimated for Japan and the United States. To place labor force decisions of women in these two countries in the appropriate context, the first section of this paper discusses the aggregate labor force trends in Japan and the U.S. The second section reviews several economic models that have been developed to treat labor force participation. The third section presents a model used to estimate female labor force participation in Japan with aggregate prefectural data. The final section compares empirical results for the U.S. and Japan from models using both aggregate and household level data.

I. Aggregate Trends

The steady increase in the labor force participation of married women in the United States during the period following World War II has stimulated considerable interest in and research on the economic analysis of a woman's decision to work. As this body of research has grown, the economic models developed within it have been applied and extended to analyze the labor force behavior of women in other countries. However, there is no consistent international pattern in the behavioral trends of the female labor force.

The composition of the labor force by employment status is one aspect of the female labor force in which, at any point in time, there is significant variation across countries and within a country, significant variation across time. Economies in which there are a large agricultural sector and numerous cottage industries generally are characterized by a labor force that consists primarily of self-employed and family workers. With economic development, we observe a relative shift of resources and workers away from the agricultural sector and from small family-run businesses to more highly industrialized activities. With this transition, the composition of the labor force by employment status also changes as more and more individuals work as "employees" rather than as self-employed or family workers.

This transition in the composition of the male labor force in Japan is depicted in Table 1 and Figure 1. Between 1948 and 1979 the percentage of all working men in Japan who were either family workers or self-employed declined from 55.4 percent to 23.5 percent, while the percentage who were employees increased from 44.6 percent to 76.5 percent. However, in spite of the dramatic change in employment status in Japan, the overall labor force participation rates for men in Japan and for men in the U.S. remained remarkably similar. In both countries the proportion of all men over 15 years of age who are in the labor force has declined rather gradually. In Japan, 83.9 percent of all men over fifteen years of age participated in the labor force in 1948, while 80.2 percent participated in the labor force in 1979. Similarly, in the U.S., participation rates for men declined from 87.0 percent in 1948 to 78.7 percent in 1979.

In marked contrast to the similarities between the overall labor

Table 1 Male Labor Force Participation Rates and the Distribution of the Labor Force by Employment Status--Japan and the U.S.[1]

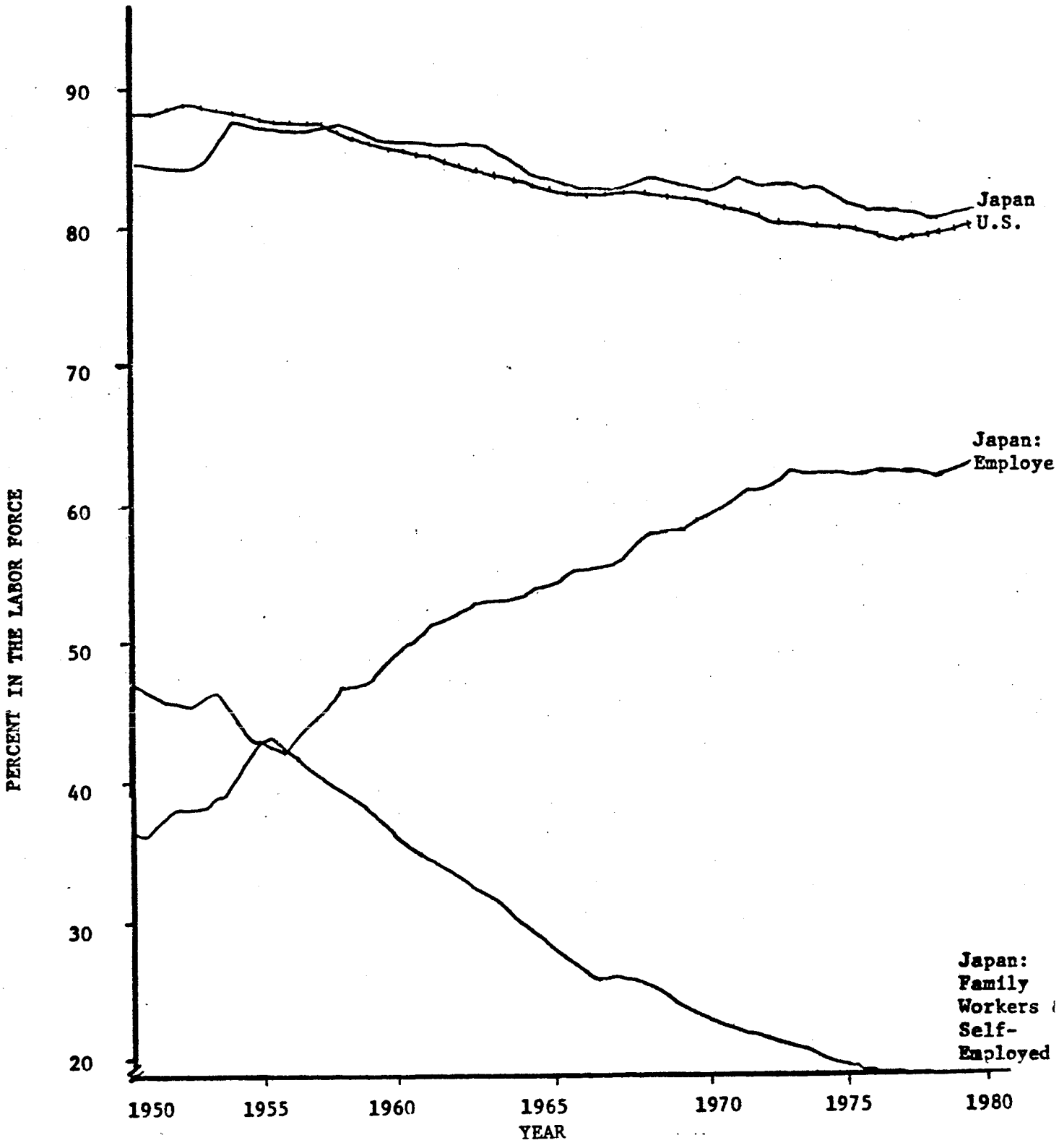
Year	Japan				United States			
	Labor Force Participation Rate	Percent Distribution			Labor Force Participation Rate	Percent Distribution		
		Employees	Self-Employed	Family Workers		Employees	Self-Employed	Family Workers
1950	83.2	43.8	36.9	19.3	86.8	77.0	21.3	1.7
1955	85.9	49.7	32.9	17.4	86.2	79.3	19.4	1.3
1960	84.8	59.6	28.7	11.7	84.0	81.5	17.3	1.2
1965	81.7	66.7	24.6	8.7	81.5	84.4	14.8	0.8
1970	81.8	71.5	22.4	6.0	80.6	88.0	11.5	0.5
1975	81.1	75.8	20.2	3.9	78.5	88.6	11.1	0.4
1976	81.2	76.2	19.9	3.8	78.1	88.8	10.9	0.3
1977	80.6	76.2	20.0	3.8	78.3	88.9	10.8	0.3
1978	80.3	75.9	20.4	3.7	78.4	89.0	10.8	0.2
1979	80.2	76.5	20.0	3.5	78.7	-	-	-

[1]In Japan, the labor force participation rate is defined as the number of persons over 15 who are in the labor force divided by the total population over 15 and expressed as a percentage. In 1950 the age cutoff for Japan was 14. The relevant age for the U.S. is 16.

Source: Japan Statistical Yearbook, various issues. Statistical Abstract of the U.S., various issues.

Figure 1

MALE LABOR FORCE PARTICIPATION RATES IN JAPAN AND THE U.S.



Source: Japan Statistical Yearbook, various issues, U.S. Handbook of Labor Statistics, 1973 and 1977, and the Statistical Abstract of the U.S., various issues.

force participation rates for men in Japan and the U.S., a comparison of these rates for women in the two countries points out striking differences. Historically, a higher proportion of all women in Japan have participated in the labor force than have women in the U.S. However, between 1948 and 1979 the overall labor force participation rate for Japanese women experienced only a slight increase from 47.4 percent to 47.6 percent. This rate reached a peak of 56.7 percent in 1955. During the same period, the overall labor force participation rate for women in the U.S. steadily increased from 32.7 percent to 50.8 percent and rose above the rate for women in Japan in 1974. (Table 2 presents female labor force participation rates for Japan and the U.S.)

Table 2 also includes information on the distribution of the employed labor force among three types of workers: employees, self-employed, and family workers. In the U.S., the majority of working men and women are employees. In Japan, self-employed and family workers remain much more significant components of the labor force. In 1950, 62.5 percent of all employed Japanese females were engaged in family enterprises. An additional 15.0 percent were self-employed, with only 22.5 percent working as employees. The twenty-nine year period between 1950 and 1979 saw a dramatic shift in the composition of the female labor force as the proportion of women working in family enterprises declined to 24.1 percent and the proportion of paid employees increased to 62.0 percent. By 1950, 85.8 percent of all working women in the U.S. were employees. During the post-World War II period, this proportion increased to 93.4 percent.

Figure 2 depicts these trends for Japan and the U.S. As shown

Table 2 Female Labor Force Participation Rates and the Distribution of the Labor Force by Employment Status--Japan and the U.S.[1]

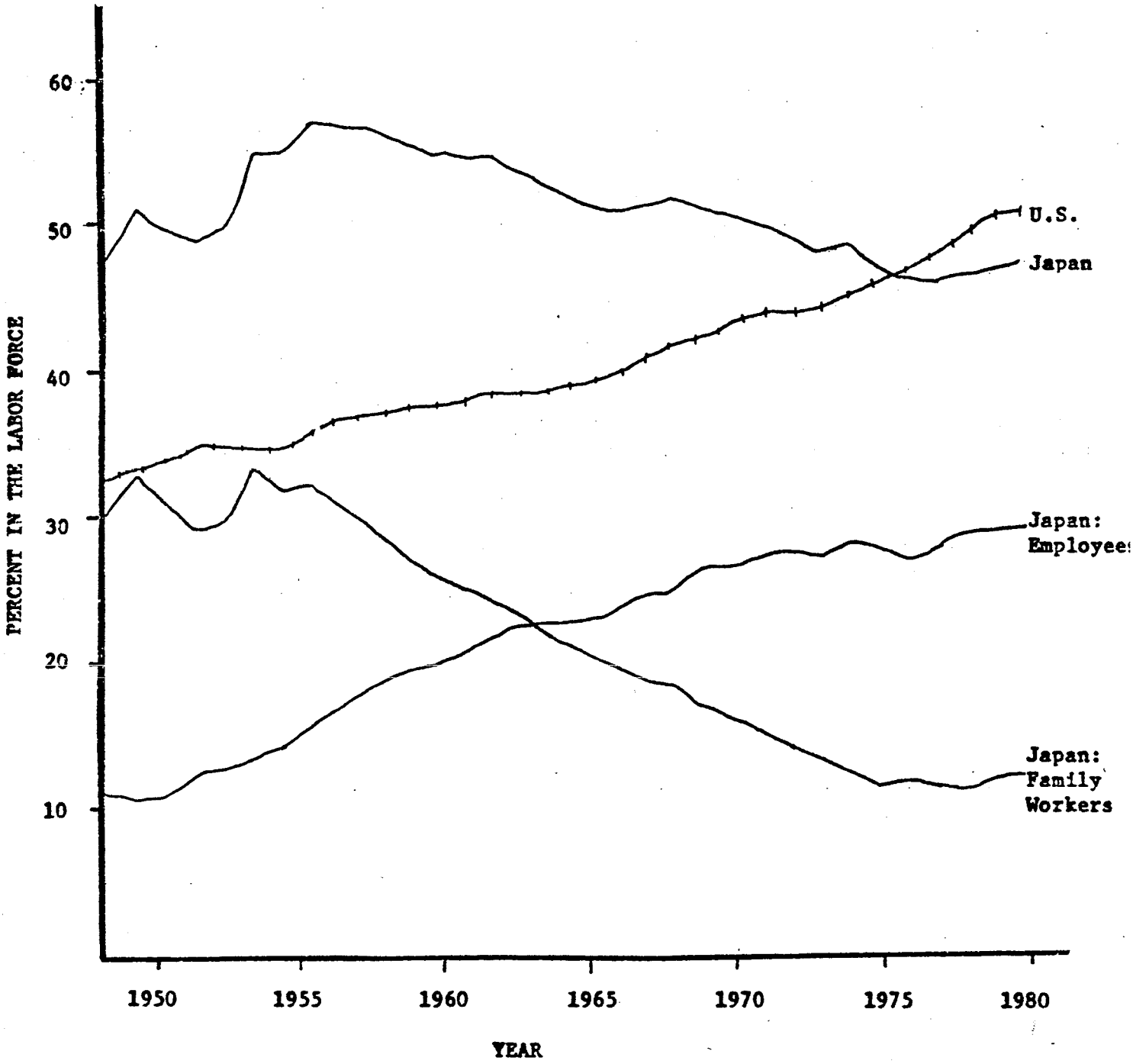
Year	Japan				United States			
	Labor Force Participation Rate	Percent Distribution			Labor Force Participation Rate	Percent Distribution		
		Employees	Self-Employed	Family Workers		Employees	Self-Employed	Family Workers
1950	49.4	22.5	15.0	62.5	33.9	85.8	8.0	6.2
1955	56.7	28.9	14.4	56.7	35.7	87.4	6.2	6.4
1960	54.5	38.4	15.1	46.5	37.8	88.3	6.6	5.2
1965	50.6	46.4	14.1	39.5	39.3	89.8	6.2	4.0
1970	49.9	54.7	14.2	30.9	43.4	92.7	4.6	2.7
1975	45.8	59.8	14.3	25.9	46.4	93.3	4.7	2.0
1976	45.8	60.9	14.1	24.9	47.4	93.5	4.7	1.8
1977	46.6	61.7	13.8	24.5	48.5	93.3	4.8	1.8
1978	47.4	61.6	13.8	24.6	50.1	93.4	5.0	1.7
1979	47.6	62.0	13.9	24.1	50.8	-	-	-

[1]In Japan, the labor force participation rate is defined as the number of persons over 15 who are in the labor force divided by the total population over 15 and expressed as a percentage. In 1950 the age cutoff for Japan was 14. The relevant age for the U.S. is 16.

Source: Japan Statistical Yearbook, various issues. Statistical Abstract of the U.S., various issues.

Figure 2

FEMALE LABOR FORCE PARTICIPATION RATES IN JAPAN AND THE U.S.



Source: Japan Statistical Yearbook, various issues, U.S. Handbook of Labor Statistics, 1973 and 1977, and the Statistical Abstract of the U.S., various issues.

in this figure, the trend of increasing participation of Japanese women as "employees" roughly parallels the post-war trend of overall labor force participation in the U.S. Between 1948 and 1979, the participation rate of Japanese women as employees nearly tripled, increasing from 11.4 percent to 29.5 percent. A simple linear regression of the overall participation rate in the U.S. and the participation rate as an employee in Japan yields:

$$\text{Participation Rate, U.S.} = 31.11 + 0.54\ \text{Year}.$$

$$\text{Participation Rate, Japan (Employees)} = 11.35 + 0.63\ \text{Year}.$$

These simple regressions confirm the picture in Figure 2. Although the level of female participation as employees in Japan is lower than in the U.S., the rate of increase during the postwar period has been at least as rapid.

The economic transition and concurrent change in employment opportunities in Japan during the post-World War II period have had very different impacts on the overall labor force participation rates of Japanese men and women. From this cursory examination of the aggregate trends it appears that as relative opportunities for gainful employment as a self-employed or a family worker declined, Japanese men shifted fairly steadily into working as "employees". For Japanese women, however, the picture is somewhat different. This difference is not surprising as the job characteristics that distinguish family work and self-employment from working as an employee may be more important for women than for men. In particular, working as an employee (unlike family work or self-employment) is not especially compatible with household activities such as child care. As a result, women who would otherwise be active in the labor force may choose not to work if the only employment available to them involves leaving the home.

These changing employment opportunities may have significant implications for the economic models that we develop to analyze female labor force participation and for the manner in which we interpret the empirical results. In particular, if the behavioral response of women to the returns from working as a family worker differs substantially from the response to the returns from working as an employee, then economic models which treat these responses as identical may obscure the underlying individual behavior. The following section reviews economic models that have been developed to treat these labor force decisions.

II. Review of the Literature

The basic model applied in most studies of female labor force participation is one in which the choice to work or not to work is the outcome of maximizing household welfare subject to economic constraints. Generally, household preferences are described by a utility function of the following sort:

$$(1) \quad U = U(L_f, L_m, X; \varepsilon),$$

where L_f is the leisure (or home) time of the wife, L_m is the leisure time of the husband, X is the Hicksian composite commodity (or aggregate expenditure on all other goods), and ε is a randomly distributed stochastic term representing unmeasured household characteristics. The utility function U(.) is assumed to be twice differentiable and strictly concave. Time and income constraints may be written:

$$(2) \quad T = L_f + H_f$$

$$T = L_m + H_m$$

$$(3) \quad W_f H_f + W_m H_m + V = P_x X$$

where H_f and H_m are the market hours of work of the wife and the husband, respectively, V is the household's non-earnings or asset income, and P_x is the price of X. X is taken as the numeraire with P_x, the price index, set equal to one. P_x may be treated also as a price index which differs across geographic areas or over time.

In the context of this household model, the labor force participation decision has been treated in three different ways. The first type of analysis treats labor force participation as a measure of permanent labor supply which is an "interior" solution to maximizing the household's lifetime utility. The second type of analysis treats the decision to enter the labor force as a discrete (0,1) choice or "corner" solution resulting from maximizing a short-period model. The third type of analysis treats the decision to work as a discrete, short-period choice made in the context of maximizing a dynamic, life-cycle utility function.

As Heckman (1978) clearly illustrates, studies such as those of Mincer, Cain, Bowen and Finegan and Ashenfelter and Heckman (1974) for the U.S. and Obuchi, Umetani, Hamilton, Nagano, and Shimada for Japan implicitly assume that labor force participation status, which may be represented as a dichotomous variable for the individual or as a rate for the population, is a measure of permanent labor supply that is interchangeable with lifetime hours worked. In this context, we may solve the utility maximization problem to yield the optimal household demand for lifetime hours worked:

$$(4) \quad H_f = H_f(W_f, W_m, P_x, V; \varepsilon).$$

The endowment of time T can be thought of as lifetime hours and H_f can be

treated as the fraction of the lifetime working:

$$(5) \quad H_f^* = (T - L_f)/T, \text{ where } H_f^* \equiv H_f/T.$$

We can take partial derivatives of H_f^* with respect to W_f and V, yielding the uncompensated Hicks-Slutsky substitution effect of permanent wages on labor supply ($\partial H_f^*/\partial W_f$) and the income effect ($\partial H_f^*/\partial V$). These substitution and income effects may then be estimated with either aggregate data (using the participation rate) or household level data (using a dummy variable which equals 1 if the individual is working and 0 otherwise). If data are available for the husband's wage rate, the cross substitution effect of the husband's wage on the wife's labor supply may also be estimated.

The econometric specification of this model may take the form

$$(6) \quad H_f^* = B'Z + \epsilon^*$$

where Z is a vector of independent variables including wages and income and ϵ^* is some transformation of ϵ.

There are several econometric problems associated with estimating (6). If (6) is estimated using aggregate data, the dependent variable (the participation rate) is limited, ranging between 0 and 1. For individuals H_f^* is dichotomous. For aggregate models, (6) may be transformed using some cumulative statistical distribution. At an individual level, the model may be estimated with P, as the dependent variable, where P is the probability of participating in the labor force, and representing the probablity that

H_f^* is equal to 1 conditional on the observed variables (Z). Assuming an appropriate distribution for ε^* (6) may be estimated as a linear probability model (uniform error), logit model (logistic error), or a probit model (normal error).

This first method of treating female labor force participation incorporates several crucial assumptions. First, it assumes that non-market time at any one age is a perfect substitute for non-market time at any other age. That is, the likelihood of participating in the labor force at a point in time measures life time labor supplied to the market. Second, this modelling assumes that the participation decision is an interior solution for the maximization problem, meaning that everyone works at some point in their lives. That is, for all women $H_f^* > 0$. It should be noted again that this model can be estimated using either household level or aggregated data.

If we assume that the participation rate and hours of work are both measures of lifetime labor supply, we would expect to find similar empirical results from estimating hours of work and participation regressions. However, the estimates are generally quite different. In sorting out the apparent differences in these estimates, Gregg Lewis began to examine the relationship between hours of work and labor force participation. At the same time Obi (1968) began working on this problem. In the U.S., Lewis (1968) and later Ben-Porath (1973) illuminated the distinction between labor supply as a measure of the permanent labor supply itself and as a discrete choice that is one step in the process of choosing the optimal labor supply. These papers stimulated work by Gronau (1973), Heckman (1974a, 1980),

and Cogan (1975, 1978) among many others. The models developed in these papers assume that an individual will enter the labor force if and only if the wage offered in the market place exceeds the value of time in the household at zero hours of market work (the reservation wage).

In each of these models there are two dimensions of labor supply: labor force participation status (whether working or not) and the optimal hours of work given working. The likelihood of working is related to the difference between the value of time in the home and the value of time in the market. If the market wage exceeds the value of time in the home at zero hours of market work (or at some critical level of hours if there are costs of working), the individual will supply labor to the market until the marginal value of time is equal in each activity.

These models usually consist of two equations which may be represented in general as:

$$(7)\quad D = \begin{cases} 1 & \text{if } U_w^* > U_{nw}^* \\ 0 & \text{if } U_w^* \leq U_{nw}^* \end{cases}$$

$$(8)\quad H_f = \begin{cases} H_f^* & \text{if } D = 1 \\ 0 & \text{if } D = 0 \end{cases}$$

where D is a measure of participation status, U_w^* is the maximum utility attainable if working, U_{nw}^* is the maximum utility attainable if not working, and H_f^* are the optimal hours of work. U_w^* and U_{nw}^* represent household utility evaluated at the optimal consumer demands (the indirect utility) and, with H_f^* (as in (4)), are functions of prices, wages, non-wage income, the

endowment of time, and a stochastic term:

$$U_w^* = \psi\ (w_f,\ w_m,\ P_x,\ V,\ \epsilon)$$

$$U_{nw}^* = \psi\ (w_m,\ P_x,\ V,\ T;\ \epsilon)$$

The information contained in (7) also may be represented in terms of the market wage W_o and the reservation wage W_r which is defined as the value of the marginal rate of substitution between L_f and X when all time is spent in the home. We can rewrite (7):

$$(7') \quad D = \begin{cases} 1 & \text{if } W_o > W_r \\ 0 & \text{if } W_o \leq W_r \end{cases}$$

The econometric procedure used to estimate (7) and (8) depends in part upon the specification of the underlying error structure of the model. If we assume that the stochastic components of (7) have uniform distributions, (7) is a linear probability model. Alternatively, normal distributions lead to a probit model and Weibull distributions result in a logit model. The estimation of (7) and (8) is complicated by the fact that we do not observe H_f for women who do not work. These models admit corner solutions and their authors have developed the tools with which to address the econometric problems associated with corner solutions. Alternative procedures include (a) recognizing that (8) is a limited dependent variable and using Tobit analysis (Schultz (1975)); (b) estimating (7) and (8) simultaneously using Heckman's Tobit-type procedure (Heckman (1974)); and (c) recognizing that sample data for H_f and for W_o are not representative of the underlying

population as they are drawn from choice-based samples. That is, an individual's choice "to work or not to work" determines whether the sample data will include observations on H_f and W_o for that individual. A literature treating this "sample selection bias" includes work by Heckman (1980), Olsen (1979), and Hay (1980), who develop corrections appropriate for models with normal errors, uniform errors, and Weibull errors, respectively.

Generally, the parameters of the participation function (7) are not interpreted as Hicks-Slutsky income and substitution effects, but in some cases may be related systematically to the income and substitution effects of the hours of work function (see Cogan (1975) for details).

These second generation models have been expanded to analyze the effects on labor supply of fixed money and time costs of working, income taxes, and social programs (such as a negative income tax) that may give rise to either kinked or nonconvex budget constraints. Also, Lewis (1968) and Obi (1968) have examined the implications of institutionally fixed (or minimum) hours of work. Jones and Long (1980) distinguished between the decision to work part-time and full-time and estimated a multinomial probit model of labor force participation.

There are several problems with this second type of model. First it ignores substitution possibilities of time across different ages. The utility function is defined for a particular age and the model abstracts from the relationship between the choice this period and the choice in any other period. Second, the econometric complexity of these models has discouraged the joint estimation of female labor supply and male labor supply. As a consequence, either male earnings are treated as "non-earnings income" for the

female, or the male wage may be included to measure the cross substitution effect without taking advantage of the cross-equations restrictions implied by the symmetry of the matrix of compensated price effects. Finally, these models are generally nonlinear at the individual level, ruling out linear aggregation and thereby hindering estimation with aggregate data.

A growing body of work models the two dimensions of labor supply most appropriately in a dynamic life-cycle context. Initial work was done by Heckman (1974b, 1976) and Ghez and Becker (1975). Notable recent examples are Heckman and Willis (1977), Heckman and MaCurdy (1980) and MaCurdy (1980). While these dynamic models can be estimated for the U.S. using the wealth of individual panel data available for public use, in Japan, as in most countries, such data are not available.

While the theoretical models and statistical techniques have been refined considerably, the coefficients estimated with U.S. data have in general provided empirical support for the underlying theoretical predictions. Also, there is reasonable agreement among the household level and aggregate level results for women. These results indicate in particular a strong positive relationship between the probability of entering the labor force and a woman's wage (and usually her level of schooling) and a significant negative relationship between other family income and a woman's propensity to work. (For a detailed comparison of these results see Heckman, Killingsworth, and MaCurdy (1981).)

In contrast, the straightforward application of a standard labor force participation model to aggregate Japanese data has produced somewhat anomalous results. Umetani (1972) and Hamilton (1979) relate the overall

labor force participation rate to socioeconomic variables, including male earnings, female earnings, numbers of children and a measure of the regional predominance of agriculture. While most of the coefficients fall within an expected range, the estimated own wage effect is negative.

However, there are several problems associated with performing this sort of analysis using Japanese prefectural data. Unlike Standard Metropolitan Statistical Areas (SMSA's) in the U.S., prefectures are not very homogenous. They range from being highly urban to highly agricultural. If prefectures with high wages also have low overall participation rates due to the limited opportunities for agricultural employment, then it is not surprising to find this negative relationship between wages and overall labor force participation. Recognizing this problem Umetani reestimated his model using only fifteen prefectures for which agricultural employment comprised less than 30 percent of the labor force. The results still showed a negative wage effect. Nishikawa (1970) argued that the high degree of correlation between male wages and female wages may have reduced precision with which their coefficients could be estimated.

Nishikawa and Higuchi (1979) analyze determinants of female labor force participation using prefectural data. However, they exclude the female wage rate as an explanatory variable and treat the proportion of females who are either self-employed or unpaid family workers as an independent rather than a dependent variable.

Shimada uses household level data for All Japan to estimate labor force participation functions for household members. He relates the dichotomous decision (to work or not to work) to socioeconomic variables including

the own wage rate. Although some of his estimated wage effects are positive, many are negative or insignificant.

If individuals in Japan regard the decision to enter the labor force as an "employee" as being distinct from the decision to enter the labor force as a "family worker", then their responses to socioeconomic variables, especially the prevailing wage, may differ significantly by sector. There are theoretical reasons why the simple dichotomous labor force participation model may not adequately capture the underlying labor supply decisions in countries like Japan that are characterized by large segments of the labor force engaged in agriculture or in small family run businesses. Three particularly important economic characteristics differentiate the employment statuses--"employee" and "family worker." First, commuting away from the home to work may involve both monetary costs (of child care, uniforms, etc.) and time costs (in commuting). Working in the family business may allow comparatively costless substitution between time at home and time at work. Furthermore, mothers may also be able simultaneously to care for their children and to work in the family business or on the farm. Second, treatment of the labor supply of family workers must consider the production technology of the family firm. In particular, while employees may face a wage rate that is independent of their hours of work, family workers may receive the value of their marginal product, which may not be independent of their hours of work. Finally, the wife's time in the family business may be complementary with the husband's time. This complementarity, combined with potential discrimination encountered by married women in the Japanese labor force, may result in higher family income than if husband and wife worked apart.

The most general labor force participation model developed for Japan (and other countries in which there is a large informal sector) should recognize that the decision to work as an employee may differ from the

decision to work as a family worker and also should incorporate those characteristics that differentiate the two sectors.

Hill (1981) develops a model that treats the two decisions as distinct. Using a trichotomous dependent variable (working as an employee, working as a family worker, and not working) and household level data for the Tokyo Metropolitan Area, the author shows this distinction to be fairly important. The theoretical model bases the labor force participation decision on a comparison of the maximum utility attainable given each participation status (as in (7) above) allowing the indirect utility to differ by participation status:

$$(9)\quad \begin{aligned} D_p &= \begin{cases} 1 \text{ if } U_p^* > U_j^*,\ j = f \text{ and } nw \\ 0 \text{ else} \end{cases} \\ D_f &= \begin{cases} 1 \text{ if } U_f^* > U_j^*,\ j = p \text{ and } nw \\ 0 \text{ else} \end{cases} \\ D_{nw} &= \begin{cases} 1 \text{ if } U_{nw}^* > U_j^*,\ j = f \text{ and } p \\ 0 \text{ else} \end{cases} \end{aligned}$$

where p denotes "employee," f denotes "family worker" and nw denotes "not working." Again, U_j^* will be a function of prices, wages, non-wage income, the endowment of time, and a stochastic term:

$$(10)\quad \begin{aligned} U_p^* &= \psi(w_{f_p}, w_m, p_x, V; \varepsilon) \\ U_f^* &= \psi(w_{f_f}, w_m, p_x, V; \varepsilon) \\ U_{nw}^* &= \psi(w_m, P_x, V, T; \varepsilon) \end{aligned}$$

where w_{fp} is the female wage as an employee, and w_{f_f} is her wage as a family worker. This model is estimated using a multinomial logit technique which

assumes that the stochastic terms for the indirect utility for each participation status are independently distributed. The estimated responses of employees in Japan appear to be reasonably similar to the responses of women in the U.S. while the responses of family workers differ substantially. In particular, the wage response for employees is positive and significant while the response for family workers is negative and significant. This model has several shortcomings however. Neither the production technology of the family firm nor the money and time costs of participating in the formal sector of the labor force are incorporated into the model. Consequently, the source of the differences between the estimated coefficients for the two sectors cannot be identified. As Hanoch (1980) has indicated, failure to account for the effects of fixed costs may bias the estimated wage effect for employees.

This model can be generalized by incorporating the family firm's (or farm's) production technology and the differential costs associated with leaving the home to work. In this case the indirect utilities would be:

$$
\begin{aligned}
U_p^* &= \psi(w_{f_p}, w_m, P_x, T\text{-}Lc, V\text{-}Xc; \varepsilon) \\
U_f^* &= \psi(w_{f_f}^*, w_{m_f}^*, P_x, V; \varepsilon) \qquad (11) \\
U_{nw}^* &= \psi(w_m, P_x, V, T; \varepsilon)
\end{aligned}
$$

where Lc and Xc are time and monetary costs of working as an employee, $w_{f_f}^*$ and $w_{m_f}^*$ are the optimal shadow prices of the wife's and husband's hours of work in the family business, and the remaining variables are defined as above.

III. An Aggregate Model of Labor Force Participation

In light of the similarity between the behavioral responses of employees in Japan and all workers in the U.S., this section develops an alternative simplified model for estimating female labor force participation using prefectural data for all Japan. This model differs in three respects from previous aggregate models. First, the dependent variable is the participation rate for employees. That is, the decision to work is treated as the decision to participate in "paid " employment. Hence, the model combines together family workers and the self-employed with nonworkers. This procedure incorporates an aggregation bias unless self-employment, family work, and non-participation are similar choices from the decision maker's viewpoint. (Unfortunately in this context, we may neither measure nor correct this bias.) Second, as the dependent variable is limited between 0 and 1, it is transformed using the cumulative logistic distribution. Third, hourly wages for males and females are calculated and used as independent variables in place of monthly earnings.

The model is specified:

$$(12) \quad \log_e \left(\frac{P_K}{1 - P_K}\right) = BX_K$$

where K = 1,...,46 prefectures (excluding Okinawa), P_K is the probability of working in paid employment and X_K is a vector of independent variables. Since we do not observe P_K, the observed relative frequency (θ_K) of the choice to work as an employee is used instead. This observed participation rate is defined for prefecture K:

$$(13) \quad \theta_K = PE_K/TP_K$$

where PE_K = Number of Female Paid Employees in prefecture K

TP_K = Total Number of Females Over age 15 in prefecture K.

The econometric model is:

$$(14) \quad \ell n \left(\frac{\theta_K}{1 - \theta_K}\right) = BX_K + \varepsilon_K$$

where ε_K is asymptotically normally distributed as the population in prefecture K increases:

$$\varepsilon_K \rightarrow N\left(0, \frac{I}{TP_K . P_K . (1 - P_K)}\right) \text{ as } TP_K \rightarrow \infty$$

equation (4) must be estimated using generalized least squares (GLS) as ε_K is heteroscedastic. The appropriate weight for prefecture K is:

$$(15) \quad w_K = \sqrt{TP_K . \theta_K . (1 - \theta_K)}$$

Each variable including the intercept is multiplied by (15), before OLS estimates are calculated, therefore, the traditional R^2 is then invalid; an F-test is consequently performed and these test statistics are reported.

Table 3 presents the mean values for the dependent and independent variables used in this analysis. These variables include male and female hourly wage rates, monthly non-wage income, the average number of children under five per married woman, and an agriculture variable. Measures of educational attainment for men and women and the average age in the prefectures are also included as proxies for their potential wages.

Table 4 presents the estimates for four specifications of the participation model. The first includes female and male hourly wage rates along with non-wage income, children under 5, and the agriculture variable. In this case, the female wage has the expected positive sign, the male wage effect is negative, and non-wage income has the expected negative effect. The second specification includes male and female education and age as proxies for the potential wage. The third specification includes only male and female education as proxy. In both specifications, these variables have the opposite effect compared to that expected. Female education and age reduce the likelihood of women working while male education and age increase the likelihood of working.

Table 3

Variable Definitions, Mean Values, and Sources

VARIABLE	MEAN	SOURCE
Participation Rate (Fraction of all females over 15 whose employment status is "Employee")	0.2746	1970 Census
Female Hourly Wage Rate, yen per hour (Total earnings per month/total hours worked per month)	221.52	1970 data from the Yearbook of the Monthly Labor Survey, 1976
Male Hourly Wage Rate, yen per hour (Total earnings per month/total hours worked per month)	413.14	1970 Data from the Yearbook of the Monthly Labor Survey, 1976
Female Education (Fraction of females not attending school who have attained at least Middle school, Senior High School, Old or Youth Training School)	0.4437	1970 Census
Male Education (Fraction of males not attending school who have attained at least Middle School, Senior High School, Old or Youth Training School)	0.4830	1970 Census
Female Age (Average of women over 15)	35.67	Calculated from 1970 Census
Male Age (Average of men over 15)	34.88	Calculated from 1970 Census
Non-Wage Income (Yen per month, excluding social security payments and income-in-kind)	2,394.7	1969 survey of Family Income and Expenditures
Children under five (Number of children 0 to 4 years old per married woman)	0.3604	1970 Census
Agriculture (Fraction of the total labor force employed in agriculture)	0.1787	1970 Census

Table 4

Empirical Results for Female, Labor Force Participation
(Employees Only)

Prefectural Data, 1970[a,b,c]

Independent Variables	Specifications (1)	(2)	(3)	(4)
Intercept	1.30 (0.76)	1.84 (1.30)	0.85 (0.34)	-7.24 (-6.30)
Female Wage Rate	0.60** (1.98)	-	-	0.42 (1.11)
Male Wage Rate	-0.71* (-1.75)	-	-	0.68 (1.46)
Female Education	-	-1.68** (-2.04)	-1.59** (-2.04)	-
Female Age	-	-0.11* (-1.74)	-	-
Male Education	-	2.17** (2.18)	1.81** (2.04)	-
Male Age	-	0.06 (1.10)	-	-
Non-Wage Income	-0.69* (-2.00)	-0.54 (-1.39)	-0.49 (-1.26)	-0.69 (-1.48)
Children Under 5	-2.06*** (-4.39)	-2.88*** (-4.34)	-2.25*** (4.41)	-
Agriculture	-1.89*** (-6.11)	-1.52*** (-4.86)	-1.77** (-6.61)	-
F-statistic	28.51	21.67	28.75	18.45

[a] Logit coefficients reported. To recover partial derivatives at the sample mean, multiply by .1992.

[b] t-statistics in parentheses

[c] ***1%, **5%, *10% level of statistical significance.

In each of these three specifications, children under 5 and agriculture have the expected strong, negative effects. These variables, however, may themselves be subject to economic choice and their inclusion in these regressions may lead to simultaneous equations bias. For comparison, the fourth specification does not include these variables. Although the overall explanatory power of the equation is much lower, the female wage rate still has the expected positive effect and the effect of nonearnings income is still negative. However, the sign of the male wage effect becomes positive. If the male wage effect is viewed as being a substitution effect rather than as an income effect, there is no a priori expectation for the sign of this effect. A positive sign indicates that male and female time spent in activities other than paid employment (L_m and L_f) are likely complements.

IV. Comparison of Empirical Results for Japan and the U.S.

Table 5 presents a comparison of empirical results from estimating many models of female labor force participation for Japan and the U.S. In each country, these models are estimated using both aggregate and household level data. Although the models in general include variables such as number of children, health status, asset or non-wage income, for simplicity the estimated effects of only three variables are included in this table: female wages (or earnings), female schooling, and male wages (or earnings). Generally, the partial derivatives for these variables are reported; if an elasticity is available it is reported as well. The estimated coefficients from logit and probit models are converted to partial derivatives and are evaluated at the sample mean. The econometric technique used to estimate

Table 5

Comparison of Coefficients of Female Wages, Female Schooling, and Male Wages Estimated Using Aggregate and Household Data for the United States and Japan[a]

UNITED STATES	Female Wage (or Earnings)	Schooling	Male Wage (or Earnings)	Method of Estimation
Aggregate Data				
O'Neill, 1948-1978 time series data, All women 25-34	0.37*	-	-0.43*	(OLS)
35-44	0.42*	-	-0.29*	
45-54	0.50*	-	-0.15*	
Cain, 1950 Northern SMSA's, Married women	1.48*	0.95*	-0.84*	(OLS)
	(1.49)		(-1.31)	
Fleisher and Kniesner, 1970 SMSA's, Married women	0.39*	0.31*	-0.17*	(OLS)
	(0.43)		(-0.34)	
Fields, SMSA's, Married Women				
1940	1.16*	0.18	-1.45*	(OLS)
1950	1.11*	1.52*	-0.65*	
1960	0.40*	1.36*	-0.25*	
1970	0.27*	1.95*	-0.11*	
Ashenfelter and Heckman, 1960 SMSA's Married women	1.23*	-	0.13*	(3SLS)
Cain and Dooley, 1970 SMSA's Married women	1.60*	-4.6	-0.52*	(3SLS)
	(2.81)	(-1.30)	(-1.28)	
Household Data				
Schultz, 1967 Survey of Economic Opportunity, White married women, 25-34	0.17*	-	-0.13*	(LOGIT)
	(1.01)	-	(-1.25)	
35-44	0.04	-	-0.12*	
	(0.18)		(-0.97)	
45-54	0.17*	-	-0.07*	
	(0.75)		(-0.95)	
Heckman (1980), 1966 National Longitudinal Survey, Married women, 30-44	-	0.32*	-0.07*	(PROBIT)
		(1.90)	(-0.10)	
Hanoch (1980), 1967 Survey of Economic Opportunity, Married women	(2.02)*	-	(-0.74)*	(PROBIT)
Jones and Long, 1967 National Longitudinal Survey, Married, Full-Week	0.41*	-0.03*	-0.003*	(TRICHOTO-MOUS PROB
	(1.94)		(-0.52)	
Part-Week	0.03*	-0.002*	-0.0002*	
	(0.25)		(-0.07)	

Table 5 (continued)

JAPAN	Female Wage (or Earnings)	Schooling	Male Wage (or Earnings)	Method of Estimation
Aggregate Data				
Umetani, 1965 Prefectures, Married Women,				
All Japan, Arithmetic	-1.00*	-3.33	-0.31*	(OLS)
Logarithmic	(-0.54)*	(-0.84)	(-0.25)*	
15 Nonagricultural Prefectures,				
Arithmetic	-3.25*	-0.58*	0.15	
Logarithmic	(-1.69)	(-0.99)*	(0.06)	
Hamilton, 1960 Prefectures, All women,				
except in Agriculture, 30-34	-2.54	1.99	0.89	(3SLS)
	-	-0.16	-0.52*	(GLS)
Nagano, Employment Status Survey,				
1971, Prefectures, 30-34	-	-14.73*	-0.58*	(OLS)
		(-3.11)	(-0.92)	
40-44	-	-7.37*	-0.44*	
		(-1.12)	(-0.91)	
50-54	-	-2.96	-0.47*	
		(-0.49)	(-0.63)	
1977, Prefectures, 30-34	-	-9.08*	-0.19*	
		(-1.99)	(-0.72)	
40-44	-	-4.26	-0.16*	
		(-0.69)	(-0.48)	
50-54	-	-3.29	-0.14*	
		(-0.53)	(-0.38)	
Hill, 1970 Prefectures, All Women,				
Participation as Employee Only				
Partial Derivatives, (1)	0.12*	-	-0.14*	(GLS)
Calculated from	(0.44)		(-0.52)	
Table 4 (3)	-	-0.32*	-	
		(-0.51)		
(4)	0.08	-	0.14	
	(0.30)		(0.49)	
Household Data				
Hill, (1981), 1975 Tokyo Metropolitan				
Area, Married Women				
Employees only	0.95*	-0.08*	-0.38*	(TRICHOTO-
Family workers only	-0.94*	0.17	0.68*	MOUS LOGIT
Shimada, Employment Status Survey				
1974 25-34	-0.14×10^{-4}	-	-0.36×10^{-3}*	(LOGIT)
	(-0.033)		(-0.28)	
35-49	0.23×10^{-4}*	-	-0.30×10^{-3}*	
	(0.037)		(-0.16)	
50+	0.45×10^{-4}*	-	-0.40×10^{-4}*	
	(0.075)		(-0.02)	
1977 25-34	-0.29×10^{-4}*	-	-0.32×10^{-3}*	
	(-0.08)		(-0.31)	
35-49	0.07×10^{-4}		-0.27×10^{-3}*	
	(0.01)		(-0.18)	
50+	0.46×10^{-4}	-	-0.23×10^{-4}*	
	(0.01)		(-0.02)	

[a]Elasticities, where reported are in parentheses. * = 10% or greater level of statistical significance.

these models varies and is included in Table 5.

The results of six studies using aggregate U.S. data are reported. O'Neill (1981) uses 1948-1978 time series data for all women and the remaining studies use data from a cross section of married women in Standard Metropolitan Statistical Areas in the U.S. The results for female earnings are fairly consistent. Each of the coefficients is positive and significant at at least a 10 percent level. The value of these effects ranges from 0.27 (Fields (1976), 1970 data) to 1.60 (Cain and Dooley (1976), 1970 data). Apart from the Cain and Dooley estimates, the effect of female wages on the likelihood of working appears to be weakening over time. Years of schooling appears to have a fairly strong positive effect on female labor force participation. Although Cain and Dooley estimate a negative effect, the coefficient is not statistically significant. Male earnings or wage rate have, in each case, a strong and significant negative effect although the effect appears to be weakening over time.

Table 5 presents the results for four studies using household level data for the U.S. Each of these studies restricts the estimation sample to include only married women with husband present. Schultz and Hanoch use data from the 1967 Survey of Economic Opportunity while Heckman and Jones and Long use data from the National Longitudinal Survey for 1966 and 1967 respectively. The estimated effect of the female wage rate is in each case positive. The wage elasticities range from 0.18 (Schultz, women 33-44) to 2.02 (Hanoch). Only two of these studies include schooling as a regressor. Heckman finds a positive effect of schooling while Jones and Long find negative effects for both full-week and part-week work. The effect of the husband's income is consistently negative and significant, with elasticities ranging from -0.07 to -1.25.

Although the body of evidence for Japanese female labor force participation is admittedly much smaller than that for women in the U.S., the results appear to be far less consistent with the theoretical predictions. In many cases female earnings appear to decrease rather than increase the likelihood of working. Also, the level of schooling appears to decrease the propensity to work.

The results for four studies using aggregate prefectural data are reported. Umetani uses 1965 data for married women for all Japan and a reduced sample including only fifteen nonagricultural prefectures. Each estimated equation yields a negative effect of female earnings. Hamilton also estimates a negative though insignificant wage effect. Nagano uses Employment Status Survey data for 1971 and 1977 (among other years), but he does not include a female earnings variable, and his estimated effect of schooling is negative, representing in part the omitted wage effect that is correlated with schooling. The model presented in Section III of this paper,which treats the labor force participation decision as the decision to work as an employee, yields only positive own wage elasticities, estimated at 0.44 and 0.30.

The effect of male earnings on female labor force participation appears somewhat more consistent across these studies. With few exceptions, this variable has the expected negative effect with elasticities ranging from -0.25 to -0.92.

Few studies have used household level data for Japan. Estimates for two are presented in Table 5. The first uses 1975 data for married women in the Tokyo Metropolitan Area. This study treats the labor force participation decision as a three-way choice, distinguishing between participation as a family worker and participation as an employee. The estimation sample excludes self-employed women. This study uses a multinomial logit technique to estimate the parameters of the participation function. (See Hill (1981)

for a more complete description of the estimation procedure and the empirical results.) This procedure yields a significant positive wage effect on the decision to work as an employee and a significant negative wage effect on the decision to work as a family worker. The husband's income has the expected negative effect on work as an employee but not for the decision to engage in family work.

Shimada uses household level data for all Japan from the Employment Status Surveys for 1974 and 1977. In both years he estimates a negative wage effect for women in the youngest age group and a positive wage effect for women in the two older age groups. Shimada does not include a variable for the wife's schooling. The estimated effects for the husband's income each have the expected negative sign and are statistically significant.

In comparing the results for Japan with those for the U.S., the first conclusion is that much more work needs to be done using household level data for All Japan. The second conclusion is that, as women in Japan have significantly different employment opportunities available to them, (as against women in the U.S.), economic analysis must deal with the manner in which these differences influence the labor force participation decision. In the U.S. there are few opportunities for women to perform home handicraft work or family work and only limited opportunities for self-employment. Also, the agricultural labor force is relatively small and primarily male. As a result, "labor force participation" usually implies in the U.S. that a woman leaves the home to work for someone else. In Japan this is not the case. In 1979, twenty-three percent of all female workers were either self-employed

or family workers. There are significant differences in the responses to socioeconomic variables between the decisions to work as a family worker and the decision to work as an employee evidenced by analysis of both household level and aggregate prefectural data. Especially, when the decision to work in the labor force as an employee is treated separately, the results for female labor force participation in Japan appear more consistent with both the theoretical predictions and empirical results for the U.S. Further analysis of these decisions would be greatly facilitated by the public availability of household level data from Japan.

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