# THE UNIVERSITY OF CHICAGO

DATE 3/4 19 91

GRACE REN-JUEI TSIANG — 7/12/58
Author — Birth Date

MARRIED FEMALE LABOR SUPPLY IN MALAYSIA; IMPLICATION OF FLEXIBLE EMPLOYMENT ARRANGEMENTS
Title of Dissertation

ECONOMICS — PhD — MARCH 1991
Department or School — Degree — Convocation



Grace R. Tsiang
Signature of writer



5-3-91
Date filmed

Number of pages

NOTE:

TSIANG–MARRIED FEMALE LABOR SUPPLY IN MALAYSIA

THE UNIVERSITY OF CHICAGO

# MARRIED FEMALE LABOR SUPPLY IN MALAYSIA; IMPLICATIONS OF FLEXIBLE EMPLOYMENT ARRANGEMENTS

A DISSERTATION SUBMITTED TO
THE FACULTY OF THE DIVISION OF THE SOCIAL SCIENCES
IN CANDIDACY FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

DEPARTMENT OF ECONOMICS

BY

GRACE REN-JUEI TSIANG

CHICAGO, ILLINOIS

MARCH, 1991

## ACKNOWLEDGEMENTS

Thanks to members of my thesis committee, Gary Becker, James Heckman, and Thomas Mroz for their comments on previous drafts of this work, and to numerous other faculty and students at the University of Chicago, NORC and Stanford for their helpful suggestions. Financial assistance from C.I.C. and the Hewlett Foundation is also gratefully acknowledged. Special thanks to my husband, Lars Peter Hansen, for all his moral support throughout this project and to my parents Sho-Chieh Tsiang and Hsi-Tsin Ma, my first and best-loved teachers.

TABLE OF CONTENTS

## LIST OF ILLUSTRATIONS

LIST OF TABLES

## INTRODUCTION

In female labor supply studies beginning with the works of Mincer [1962] and Becker [1965], economists have incorporated a higher value of time at home for married women realizing that in in many cultures women have primary responsibility for child-rearing. This paper studies implications of a high value of alternative uses of married women's time in a rapidly developing country in which the labor markets offer a wide range of choices regarding flexibility of employment, far wider than is available in the United States today. In many Southeast Asian countries, small family-run enterprises account for a large portion of employment. Jobs range from working in industrial assembly lines to harvesting vegetables in a home garden. In such a country it is unreasonable to summarize women's choices as binary; the standard approach in studies of female labor supply in the United States takes *working* and *non-working* to be the two possible employment states. (See Heckman [1979], Mroz [1987].) Instead, this paper studies self-selection into types of work which differ according to flexibility of substituting between wage work and home time.

Previous empirical work on female labor supply in Asian market economies has pursued the question of whether women self-select in choosing their form of employment. (Hill [1983], Liu [1988], Wong [1987], for example.) The empirical studies usually pose the question in the form of a discrete-choice model of two categories of job status: *full-time versus part-time*, or alternatively, *formal versus informal* employment, with the third possible state being *not working*. This paper examines the reasons for augmenting the usual binary characterization of employment states when jobs vary in the ease a working mother may transfer her time between wage-earning tasks and household production. The degree of flexibility on the job reduces the effort expended by women in switching her attention back to home. My findings of sorting by occupation (in addition to employment status) and wage premia for married women (but not men) who commute longer distances from their home lend support to the hypothesis that women value this alternative margin.

The theory of hedonic pricing applies to the determination of wages when the employment contract consists not only of wages and hours, but also the tied amenity of some flexibility to engage in alternate activities (see Rosen [1974]). Women may be willing to accept lower wages in order to have the right to switch readily between activities. Presumably, the occasional absence or divided attention of a worker is less productive to the employer; hence employers who require rigid hours will tend to hire workers who place lower value on flexibility. One might expect that employers' costs of "bending" rigid rules on standardized work hours depends on production technologies, ease of monitoring, and incentive compatibilities. I discuss briefly how these factors might play a role in explaining observed wage differentials by work status.

After a brief theoretical discussion in chapter 1, the Malaysian Family Life Survey (1976) is examined for self-selection, wage differentials, commuting cost premia, and patterns of childbearing which are consistent with the notion that employment contracts are heterogeneous with respect to the degree of flexibility implicit in the form of employment. Although the hedonic wage function is a useful theoretical construct, its empirical usefulness is limited where the levels of the tied amenity are unobserved. Instead, indirect measures are used to test whether those women who would reasonably be expected to value the amenity are employed to test whether self-sorting occurs by levels of the tied amenity. First, I estimate a three-state discrete choice model of self-selection by measured individual characteristics into non-work and the two categories of work discussed above, *formal* and *family* work. As in the model estimated by Hill for Japanese women, the presence of young children, the mother's age and her educational attainment all are found to affect the conditional probability of choosing a given employment category. The results are used to construct simulated profiles showing the sensitivity of the two types of labor force participation to age, education, and the presence of young children. Second, the question of whether commuting-distance wage premia exist for women and the results are compared to husbands' wages. The women's wage functions are corrected for self-selection into the formal sector. Here, I find that wages are sensitive to commuting distance for Chinese women and not for the sample of Malay women.

Much of the theoretical work on female labor supply models participation as a binary variable. This approach was been used by Mincer [1962] and Ben Porath [1967] as well as in more recent empirical work, such as Heckman and MaCurdy [1974] and Jakubson [1988]. My findings that women sort on the basis of complementarity of jobs with household tasks suggest generalizing this binary concept of work. In addition, this cross-section study indicates that there are substantial differences between the two ethnic groups with regard to the timing of family formation and work. Part of the observed wage differential between Chinese and Malay women is a result of differing degrees of specialization over the life-cycle between wage work and family formation.

# CHAPTER 1

## EMPLOYMENT PATTERNS AND MEASURES OF JOB FLEXIBILITY

I focus on the observable effects of heterogeneity of jobs with respect to flexibility between home and wage-earning tasks throughout a *work-period*, where the division between exactly what hours are *work* and *leisure* are blurred. The hypothesis underlying this study is that women with small children may value not only the total number of hours of leisure time, but the ability to substitute into household production at any point of time during a day. The broad range of working conditions present in countries in the process of modernization such as Malaysia offer an interesting window on this alternative to hours of work as a margin for adjusting employment.

Findings of wage differentials across sometimes arbitrary groupings according to establishment size, industry categories, *etcetera*, must take into account self-selection. Empirical studies on wage differentials in developing countries have been been rightly criticized many for both lack of motivation for the empirical categorizations chosen and for inattention to selectivity bias. The following summaries of differentials between husbands and wives' wages, participation rates, educational attainment, and occupational distribution are therefore provided merely as a starting point.

## Sources of Ethnic Differentials in Married Women's Wages

The MFLS survey sample exhibits clear wage differentials both by sex and by ethnic groups. The information on earnings is taken from the employment histories: the method for converting information on job spell and earnings per unit time to an average weekly wage in 1975 Malay dollars is given in the data appendix. The lowest average weekly earnings are reported by Malay women, the next lowest by Chinese women, followed by Malay men and Chinese men. Table 1 shows this ordering holds for both workers who report their work status as either *full time*, *part time*, or *employer of others*, which I categorize as the *formal* work force, as opposed to *family* workers, which consist of those who are self-described as *family business worker*, *self-employed*, or *engaged in home production*. Note that the composition of women in these subcategories of employment affects the average wage by ethnicity. That is, if one were to assign the Malay women to formal and family work in the proportions that Chinese assume these types of work, Malay average wage would rise from from 16.14 to 21.22. Alternatively, assigning Chinese to formal and family work in Malay proportions lowers that average from 28.9 to 25.3.

Married women's participation rates are given in Table 2. Nearly half of the Malay and slightly over half of the Chinese women work. Note however that I have included all women who work a positive number of hours for pay (instead of the usual criterion of working more than twenty hours a week) because of the focus of this study on flexible work arrangements. Among women there is a higher incidence of working less than twenty hours of week

Table 1. Average weekly wages of married men and women by work status.[a]

| | Family workers | | Formal workers | | All workers | |
|---|---|---|---|---|---|---|
| | Mean | s.d. | Mean | s.d. | Mean | s.d. |
| Wages | | | | | | |
| **Women** | | | | | | |
| **Chinese** | 17.9 | 31.3 | 38.3 | 33.9 | 28.1 | 34.3 |
| **Malay** | 5.3 | 11.7 | 34.8 | 45.9 | 16.1 | 32.4 |
| **Men** | | | | | | |
| **Chinese** | 81.4 | 123.6 | 107.5 | 169.7 | 97.7 | 157.0 |
| **Malay** | 29.8 | 32.7 | 50.6 | 47.8 | 43.5 | 44.3 |
| Composition | | | | | | |
| **Women** | | | | | | |
| **Chinese** | **46%** | | **54%** | | | |
| **Malay** | **63%** | | **37%** | | | |
| **Men** | | | | | | |
| **Chinese** | **23%** | | **77%** | | | |
| **Malay** | **34%** | | **66%** | | | |

[a] Wages in 1975 Malaysian dollars.

Table 2. Married men and women's labor force participation[a]

| | Women | | Men | |
|---|---|---|---|---|
| Year | Chinese | Malay | Chinese | Malay |
| 1960 | **52.1** | **41.7** | **86.6** | **81.8** |
| | 278 | 242 | 262 | 292 |
| 1965 | **52.8** | **39.3** | **88.4** | **85.7** |
| | 367 | 330 | 329 | 357 |
| 1970 | **54.8** | **39.8** | **96.5** | **89.2** |
| | 434 | 412 | 345 | 400 |
| 1975 | **51.5** | **41.8** | **95.1** | **92.1** |
| | 446 | 461 | 347 | 406 |

[a] **Means in bold type,** frequencies below.
*In the labor force* if paid for > 0 hours if female, for > 20 hours if male.

than for married men. The married men (husbands of the married female respondents of the MFLS) are nearly all employed throughout the period covered. These samples have a higher mean ages as the year approaches the sample date due to the retrospective survey design; however no clear conclusions regarding women's age-participation profiles should be drawn from this table alone. Instead, by combining the married women's fertility histories with employment data, Table 3 suggests that the timing of switches in work status do vary by age and that they are linked to the presence of young children at home.

In pooled cross-section time-series data set of yearly observations for 1955–1976 there are 404 instances of Chinese women changing job status over the 21 year period from 1955 to 1976, but only 261 such events occur among the Malay women: Malay women are more likely to remain in a given job status for long periods of time. The average age of all the employment switching Malay women is 24.1, Chinese switchers average 24.2. Chinese women tend to switch into formal employment at younger ages than other types of employment shifts: the mean age is 20 for entering, compared to an average age of 25 for those leaving formal employment for not-working, and even older for those leaving formal employment for family work. There is less of a difference in the mean ages of moving in and out of family employment.

Table 3 below asks what proportion of these same women also experienced an increase or decrease in the number of children less than 6 years of age in the same year in which they changed employment states. The differences between those entering and leaving formal employment are the most striking. The upper right corner contains information on those moving from not-working

Table 3. Percent of women changing work status with {increase/ decrease} in # of children less than 6 yrs old

**Chinese**

| Source: \ Destination: | Not Working | Family work | Formal work |
|---|---|---|---|
| Not Working | — | 18.6/ 14.6 | 3.8/ 0.9 |
| Family work | 19.4/ 13.9 | — | 9.1/ 5.4 |
| Formal work | 18.8/ 3.9 | 19.7/ 13.1 | — |

**Malay**

| Source: \ Destination: | Not Working | Family work | Formal work |
|---|---|---|---|
| Not Working | — | 15.6/ 10.4 | 6.8/ 5.5 |
| Family work | 20.0/ 2.2 | — | NA[a] |
| Formal work | 11.8/ 2.9 | NA[a] | — |

[a] Cell size less than 20.

Table 4. Married men and women's educational attainment: Proportion reaching high school, MFLS 1976

| | Women | | Men | |
|---|---|---|---|---|
| Cohort | Chinese | Malay | Chinese | Malay |
| -1925 | --- | --- | 0.27 | 0.11 |
| | --- | --- | 37 | 54 |
| -1935 | 0.03 | 0 | 0.29 | 0.19 |
| | 108 | 85 | 98 | 93 |
| -1945 | 0.13 | 0.03 | 0.44 | 0.22 |
| | 171 | 155 | 127 | 146 |
| -1955 | 0.22 | 0.16 | 0.58 | 0.41 |
| | 154 | 169 | 85 | 113 |
| -1965 | 0.14 | 0.17 | --- | --- |
| | 14 | 53 | --- | --- |

to formal work; the lower left corner on those leaving formal work for not-working. Clearly, very few women chose to shift from not-working to formal employment in the same year in which they had an additional child: 3.8% of Chinese and 6.8% of the Malay. On the other hand, higher percentages of the more women shifting out of formal employment to non-working did have additional young children: 18.8% and 11.8% for Chinese and Malay women. Tests of statistically significant differences reject the null that the the mean number of increases and decreases of young children are equal, for all transition in and out of formal employment. Differences between women entering and leaving family employment are less striking. As one might expect, the increase or decrease of young children would matter less to an activity which is fundamentally more compatible with child-rearing.

Having observed that life-cycle participation patterns differ by race, one might ask whether there is also an obvious differential investment in schooling. Table 4 shows educational attainment as measured by high school attainment. Investment in education differs by sex: this is in keeping with the notion that the payoffs to higher education are greater for full-time and career participants in the labor market. The Chinese women are more likely to live in urban locales in Malaysia than the ethnic Malays and appear to have higher educational attainments (except for the youngest cohort, for which there is a small sample problem.) Trend shifts have taken place over the decades in which these women obtained schooling. Public education initiatives have increased the proportion of the entire population acquiring at least six years of schooling, but gender differences are still quite marked in 1976 when measured by high school attainment.

Table 5. Detailed work status and average weekly work hours

| | Percent of population | | Average weekly hours of work | |
|---|---|---|---|---|
| **Married Women:** | N = 464 Chinese | N = 448 Malay | Chinese | Malay |
| pd full | 24.3% | 16.2% | 36.69 | 38.48 |
| pd part | 4.7% | 3.0% | 26.57 | 33.85 |
| emplyer | 1.3% | 0.6% | 42.66 | 34.66 |
| fmly bus | 16.1% | 21.5% | 42.61 | 37.52 |
| selfemp | 4.5% | 6.7% | 34.35 | 35.35 |
| home pr | 4.0% | 5.2% | 24.55 | 22.37 |
| EMPLOYED | 54.9% | 53.2% | 34.57 | 33.70 |
| NOT EMPL. | 45.1% | 46.8% | --- | --- |
| **Married Men:** | N = 350 Chinese | N = 406 Malay | Chinese | Malay |
| pd full | 56.3% | 58.6% | 48.55 | 47.18 |
| pd part | 1.7% | 3.0% | 46.16 | 30.33 |
| emplyer | 15.7% | 3.0% | 61.29 | 49.16 |
| fmly bus | 19.1% | 30.0% | 56.10 | 49.28 |
| selfemp | 4.0% | 1.5% | 58.21 | 47.66 |
| home pr | 0.6% | 1.5% | 50.00 | 53.00 |
| EMPLOYED | 97.4% | 97.6% | 52.46 | 47.47 |
| NOT EMPL. | 2.6% | 2.4% | --- | --- |

In Table 5, the following differences are apparent between married men and women in their job states and in average weekly hours worked. Only slightly more than half of the women have a job. A higher proportion of women who work choose family business employment than men: where 73% and 64% of Chinese and Malay men, respectively have *formal* employment, only 30% and 19% of the Chinese and Malay women do. The majority of working women are either full-time employees or workers in family businesses, with proportionately more Malay than Chinese women taking such jobs. Third, women average about 34 hours a week, less than the men's average of about 50 hours per week. Finally, the survey shows that the incidence of holding more than one job is higher for men than women: roughly 17% for men and only about 8% for women. Double job holding is more common in rural areas than in urban; the largest category in the secondary job columns for men and women is in agricultural labor. The occupational distributions given in Table 6 and Table 7 show that cumulatively, agricultural labor, sales, and industrial labor account for most of the primary jobs of both men and women. There is some evidence of occupational specialization by gender: more men hold jobs as industrial laborers, and more women work in service and sales jobs than men.

These summary tables show there are ethnic differences in investment in education and work status chosen by the married women in the MFLS. Nearly half of women do not work. Of those who do work, the proportions choosing family or formal employment differ considerably by ethnicity. Correcting labor supply functions for the self-selection of heterogeneous women into the labor force, as introduced by Heckman [1979] is a well-accepted

Table 6. Occupational distribution by primary and secondary jobs

**Married Women:**

| Category | PRIMARY JOB: Chinese | PRIMARY JOB: Malay | SECONDARY JOB: Chinese | SECONDARY JOB: Malay |
|---|---|---|---|---|
| prof/tec | 6.55 | 6.64 | --- | 0.22 |
| adm/man | 0.87 | 0.00 | --- | --- |
| clerical | 5.24 | 2.90 | --- | --- |
| sales | 23.58 | 13.28 | 0.22 | 0.65 |
| service | 9.61 | 1.66 | 0.45 | 0.22 |
| ag.labo | 38.43 | 63.49 | 2.01 | 9.91 |
| student | 0.44 | 1.66 | --- | --- |
| ind.labo | 15.28 | 10.37 | 0.67 | 0.43 |
| | 100.00 | 100.00 | 3.35 | 11.43 |

**Married Men:**

| Category | PRIMARY JOB: Chinese | PRIMARY JOB: Malay | SECONDARY JOB: Chinese | SECONDARY JOB: Malay |
|---|---|---|---|---|
| prof/tec | 8.79 | 7.41 | 1.14 | 0.25 |
| adm/man | 2.12 | 1.06 | 0.29 | 0.95 |
| clerical | 8.18 | 3.44 | 0.29 | 0.25 |
| sales | 24.24 | 5.82 | 3.14 | 3.45 |
| service | 2.42 | 3.70 | --- | 2.96 |
| ag.labo | 17.27 | 48.41 | 6.29 | 15.76 |
| student | 2.12 | 11.64 | --- | 0.25 |
| ind.labo | 31.52 | 16.93 | 1.71 | 2.46 |
| other | 3.33 | 1.59 | | |
| Employed | 100.00 | 100.00 | 12.86 | 25.37 |

Table 7. Occupational distribution of married women by work status

| Category | Family workers: Chinese | Family workers: Malay | Formal workers: Chinese | Formal workers: Malay |
|---|---|---|---|---|
| prof/tec | 0.00 | 0.00 | 11.03 | 17.58 |
| adm/man | 0.00 | 0.0 | 1.47 | 0.00 |
| clerical | 2.73 | 0.00 | 6.62 | 7.69 |
| sales | 45.45 | 19.23 | 3.68 | 2.20 |
| service | 2.73 | 0.00 | 13.97 | 4.40 |
| ag.labo | 33.64 | 69.87 | 38.24 | 48.35 |
| student | 0.00 | 0.00 | 0.74 | 4.40 |
| ind.labo | 15.45 | 10.90 | 13.97 | 8.79 |
| other | 0.00 | 0.00 | 10.29 | 6.59 |

empirical model for the United States. Next, we examine the applicability of such models to the Malaysian data.

## Complementarity of Wage Work and Household Activities

Researchers working on data from other countries, specifically the rapidly modernizing Pacific Rim nations, have found that substantial self-selection occurs across three categories: *not working* and two categories of employment. One such study makes a distinction between formal sector employment and working for a family business (often termed *informal* employment) because of the increased complementarity of family business jobs with household tasks: Hill [1983] analysed a discrete choice logit model of employment sector type by Japanese women, and found self-selection by number of small children and different experience payoffs across these two sectors.

I plan to examine a discrete choice logit model as Hill estimated, but also to extend the discussion of the reasons underlying these observed patterns in choice by employment status. I will focus upon the notion of a poorly measured job-related attribute of "flexibility" and implications for estimated wage functions if the market equilibrium wage incorporates implicit prices for this tied attribute. This discussion is benefited by the richer descriptive information available in the MFLS than the Japanese data set that Hill analysed.

To a working mother with primary responsibility for child care, the privilege of flexibility may be characterized as a time-augmenting amenity: the enforced specialization on wage-earning tasks by other bosses imposes a constraint on her labor time across tasks. A most compelling picture of the different costs of working across job classifications is given by Table 8. It summarizes the reported average number of hours of child care help obtained demanded per week (the data collected do not distinguish between paid and unpaid help). Although a higher proportion of Chinese women report receiving help with child care, one similarity emerges across both groups: those who work for an unrelated boss demand significantly more hours of help with child care than the others. Although one cannot entirely rule out income effects accounting for the difference across non-working women and working women, the similarity between non-working women and family workers would seem to support the hypothesis that family work meshes better with household activities. This is not a substitutability which may be measured only by the difference in reported average hours worked per week. The hours reported by family workers are roughly equivalent to those worked by formal employees.

Family workers also tend to enjoy shorter commuting distances to work. Table 9 shows that women who work for family tend to travel shorter distances to work. Commuting distance is easily measured, but the time involved in covering such distances will vary depending on the quality of roads and transport services. The table therefore distinguishes between rural and urban communities. In general, formal employees travel farther than family workers. Husbands tend to commute farther than wives in both rural and urban settings, but it appears that family workers work closer to home in urban areas (homes may be located directly over family shops, for example) than they do in rural areas (where the typical village is surrounded by outlying cultivated land.)

Table 8. Total child care help by work status

| | Mothers' work: avg hrs per wk | avg miles commute | Child care help: avg hrs per wk | % mothers w/ child < 6 getting help |
|---|---|---|---|---|
| **CHINESE** | | | | |
| Formal | 31.7 | 1.8 | 57 | 64% |
| Family | 35.4 | 0.9 | 34 | 49% |
| Nonworkers | -- | -- | 33 | 38% |
| **MALAY** | | | | |
| Formal | 39.5 | 1.8 | 55 | 32% |
| Family | 35.4 | 1.1 | 24 | 30% |
| Nonworkers | -- | -- | 24 | 25% |

Table 9. Commuting distance to primary jobs

| Residence | Women Chinese | Women Malay | Men Chinese | Men Malay |
|---|---|---|---|---|
| **URBAN** | | | | |
| % Urban | 59% | 28% | 59% | 28% |
| % Employed | 45% | 27% | 97% | 98% |
| **Avg miles to job:** | | | | |
| All Workers | 1.4 | 1.5 | 1.8 | 1.9 |
| Formal employees | 1.8 | 1.7 | 1.9 | 2.3† |
| Family workers | 1.0 | 1.1 | 1.3 | 1.9 |
| % who commute*: | | | | |
| 0-1 mile | 33 | 27 | 15 | 3 |
| 1-2 miles | 15 | 27 | 23 | 34 |
| 2-3 miles | 26 | 15 | 24 | 25 |
| 3 + miles | 26 | 30 | 38 | 38 |
| **RURAL** | | | | |
| % Rural | 41% | 73% | 41% | 72% |
| % Employed | 54% | 59% | 99% | 98% |
| **Avg miles to job:** | | | | |
| All Workers | 1.3 | 1.2 | 1.7 | 1.6 |
| Formal employees | 1.8 | 1.8 | 1.8 | 1.9 |
| Family workers | 0.8 | 1.0 | 1.6 | 1.4 |
| % who commute*: | | | | |
| 0-1 mile | 33 | 14 | 17 | 6 |
| 1-2 miles | 23 | 53 | 29 | 47 |
| 2-3 miles | 25 | 22 | 17 | 24 |
| 3 + miles | 18 | 10 | 37 | 22 |

[a] Cell size less than 10.
[b] Columns may not sum to 100% due to rounding error.

## Labor Demand and Employers' Costs of Providing Flexibility

In related work to Hill, some research has examined self-selection into full- and part-time work. One such study using data from Taiwan is by Liu [1988]. Theoretically, a distinction should be made between the *full-time/part-time* choice and the so-called *formal/informal* studies. Define hours flexibility as giving the employee the option to leave off working in order to attend to any alternative pressing demands on her time. Part-time hours, like other formal employment may actually require quite rigid hours. Two apparently similar workers may report 20 hours of work in an average week: the part-time employee working between 8 a.m. and noon each of five days, the other worker taking breaks at random points during any working spell and making up the time later. Clearly, these employees are not equivalent to most prospective employers. Under what conditions will an employer be amenable to allowing flexible hours in a labor contract?

Let $Q = f(L)$ be a production function in which L is the labor effort of a single worker. Optimal work effort defined by profit maximizing behavior by some manager can be obtained by paying the worker her value of marginal product. If L is unobserved but output Q is observed, simple inversion of the production function yields a reliable measure of L. Say the amount of effort $L = \rho C$, where C is the clock time worked and $\rho$ is a fraction of that time, $0<\rho<1$. Monitoring inputs by outputs, as for piece-rate compensated jobs, one can infer:

$$L = \rho\ C = f^{-1}(Q)$$

making hours flexibility costless to provide.

Coordination problems may arise where K is a vector of other inputs and production of $Q = f(L,K)$, whether these K inputs are complements or substitutes to L. If $K_i$ is some fixed or quasi-fixed input, clock time matters if that input is left idle for $(1-\rho)C$ hours. A separate cost to the firm arises if the flexible working hours extend beyond the standard working week and the firm does not have enough such workers to actually run a second shift. The employer can't exploit usual gains from cooperative efforts with other workers who are complementary to L. In the case of substitutes, one would expect that the more complex the activities of one worker, the more costly for to swap a worker into another's work role. One might consider transaction costs related to the number of partitions of any given time period into actual productive time. If labor effort is broken up into n partitions (separated either by departures from the workplace or attention devoted to activities non-productive to the firm) then each job ought to be thought of as a sum:

$$L = \sum_{i=1}^{n} L_i ,$$

accompanied by a transaction cost which varies directly with the number of partitions n. Alternatively, it could be an output reducing component of the production function: $Q = F(L, K, n)$. An example might be a fixed amount of time an exiting worker spends communicating to a substitute worker the status of tasks left to be done.

In summary then, flexible-time workers may actually have lower marginal product per unit clock time than other workers due to the lack of coordination with other inputs. The wages employers are willing to pay then are most likely decreasing in n and S, where

1) n the number of average partitions of labor effort per hour

2) S the number of hours of work performed at non-standard hours of the work week (late night or weekend).

Finally, these costs of coordination ought to vary with the degree of complexity of the production technology.

If flexible employment arrangements have no other cost to employers besides the increasing the incentive to shirk, then family members ought to be found working across the economy, wherever there are family-owned businesses. Instead, the detailed occupational categories of the MFLS suggest that the difference in work status may also be founded in the technology of production. The range of occupational categories is quite broad for the *formal* workers but *family* workers are mostly agricultural workers, sales clerks, and to a lesser extent, industrial workers. This type of work can be easily monitored: effort of agricultural workers can be measured by bushels harvested or rows planted. Sales clerk's performance is easily metered by receipts. One commonly sees piece-rate compensation in for tasks such as harvesting or processing grains, fruits and vegetables. Although information about the compensation schemes is missing, the occupational breakdown is, at least, suggestive that the technology of production matters. A drawback is that the largest category "agricultural laborer" may mix field workers with food processing workers who may work in quite capital-intensive plants where coordination of inputs is quite important.

The naming convention adopted here by calling the second group *family workers* should therefore be seen as a simplification: the degree of flexibility across jobs may vary continuously as a function of both kinship ties and technology of production. Grouping workers into *family* and *formal* workers is a first step towards identifying labor supply functions free from self-selection and the implicit pricing of flexible working conditions.

The primary indicator to be used for measuring how much value women place on their non-wage-earning time is the presence of small children. Of the MFLS Malay women whose primary employment is in agriculture, 61% have children less than six years of age, compared to 52% for all working Malay women. Of the Chinese women in agricultural employment, 71% have small children compared with 63% of all working Chinese women. It should be noted that consideration of the added amenity of flexibility should apply not only to women with children but to men with a high value to time spent in alternate activities. Smith [1983] has documented age-specific employment patterns of husbands in this survey, finding that the youngest and oldest men are more likely to be working in a family business: the young may need time off for school and study, the older men may be consuming more leisure time as they reach retirement age.

## Commuting & Wages

If the hypothesis that married women with children value the flexibility to shift between work and home (or even the option to do so) during the work day, then *within* the category of formal workers, women's wages may be higher for those for those women who have to commute long distances to work. That is, if one used employment status as a discrete-valued indicator of employment flexibility, commuting distance would be a continuous measure of job flexibility. The same hedonic pricing argument would apply: women who value flexibility the most choose employment closer to home. Presumably, by limiting the scope of their search for a job to a certain distance from home, these women thereby on average collect lower pay. Given that such a search is more likely to encounter a broader range of possible employment opportunities in an urban than a rural setting, one would also expect that commuting distance would serve to explain more of the variation in urban than in rural wages. The market equilibrium wages will reflect not only the local distribution of women according to their tastes for flexible work, but also the distribution of employers and their relative costs of offering such work.

Consider an urban setting in which some centrally located business district is surrounded by residential neighborhoods, sometimes referred to as a "circular city" model. Goldner [1955] initially proposed that firms may need to pay a premium to induce residents of distant suburbs to commute long distances to work. Commuting distances are usually insignificant in explaining *husband's* wages but have been found to be significant in explaining variation in women's wages in the U.S. In a study of the Chicago labor market as surveyed in 1963, Rees and Schultz [1970], asked whether some employers paid wage premia to attract workers from distant homes for specific occupations. At the 5% level of significance, they could not reject the hypothesis that distance to work was important for keypunch operators (all women). Distance to work was significant at the 10% level for typists (also female). Only one out of eight of their predominantly male occupations (accountants) revealed statistically significant commuting distance wage premia.

Rees and Schultz discuss the gender difference in their findings briefly, focusing upon the problem of jointly determined residential location and job choice: if most families weight husbands' and wives' convenience to work according to income earned, then the intermittent and part-time participation patterns of women would lead them to consider the husband's job location, not the wife's, as more important in deciding where to live. The capitalization of convenience to work would then mitigate the commuting distance wage premia more for women than for men. They do not mention that women's heterogeneous preferences for proximity to home would lead women to self-sort across such jobs, whereas this affect would be much weaker for men. In equilibrium, the commuting distance wage premia (which also may be thought of as the price of convenience to work) ought to be a more significant part of women's wages than men's, in keeping with their higher valuation of complementarity to home production.

Thus, several classifications, such as employment status (family or non-family), occupation, and even commuting distance to work, all provide some information on the degree of flexibility inherent in employment. The empirical portion of this study approaches the problem with two indirect measures of flexibility which are part of the MFLS instrument: employment status, as it reflects the amount of freedom in allocating one's time through the day, and commuting distance to work.

## Modelling Flexibility as a Tied Job Attribute

The aspect of job heterogeneity one would like to incorporate into labor supply of married women is some notion of compatibility with household tasks. Consider the time-augmenting aspect of flexibility in the context of the familiar one-period utility maximizing model with household production. Let the parameter $\alpha$ be a characteristic of a particular job, representing the complementarity of that job with household tasks important to the working woman. This characteristic may be thought of as increasing the household productivity of such a woman in producing Becker's household commodities, or more simply as entering the utility function directly. Thus, any particular job must be evaluated on the basis of the hours H, compatibility with home production $\alpha$, and wages $W(\alpha)$. In a utility-maximizing framework, one could model the woman's choice as follows, abstracting from the joint labor decisions of husband and wife, treating husband's decisions exogenously. Leisure (non-wage-earning time) L, consumption of goods G, and the job attribute of flexibility $\alpha$, are chosen to maximize utility U:

$$\max_{L,\, G,\, \alpha} \quad U(L, G, \alpha)$$

$$\text{subject to:} \qquad L + H = T\ , \quad \text{and}$$

$$PG + W(\alpha)\, L \;=\; A + W(\alpha) \quad T$$

The wage function $W(\alpha)$ is determined by market forces affected by the distribution of firms with varying costs of offering levels of $\alpha$ as well as the distribution of laborers (both women and men) according to their relative valuation of $\alpha$. The first order conditions on such a maximization problem given the usual concavity restrictions on the utility function are:

$$U_L = \lambda \quad W(\alpha)$$

$$U_G = \lambda\ P$$

$$U_\alpha = -\lambda\ H\ W'(\alpha)$$

These conditions simply reflect equating the marginal value of leisure, goods, and flexibility to their respective marginal costs. The marginal cost of the attribute $\alpha$ is given in terms of earnings foregone; this presuming that the costliness of supplying flexibility is not overborne by the excessive amounts of laborers requiring flexibility and that $W'(\alpha) < 0$. Clearly, the equilibrium wage function depends on labor supply, so this individual's maximization problem may be taken as only a partial statement of the market equilibrium.

Alternatively one could focus upon the effect of flexibility on the time constraint: jobs with higher levels of $\rho$ actually increase the net amount of the time endowment. This expansion of the time budget by some proportion of hours for each hour worked was suggested by Heckman [1980] in a discussion of the lower costs of part-time work to women because of access to low-cost child care for a limited number of hours each day. Heckman's modification of the standard hours constraint L + H = T is:

$$L + H = T + \rho H,$$

where $\rho = 0$ for formal workers, and $0 < \rho < 1$ for family workers up to some level $H_m$. (Some proportion of hours H spent at work are actually also available to be spent on household activities: thus, the total time endowment is expanded by $\rho$ H.) The woman solves the utility maximization problem with household production and subject to a full income constraint. Utility increases with home/leisure time L and household end-consumption commodities Z which are themselves produced from inputs of home time and purchased goods G. In this case, the maximization problem may be written as:

$$\max_{L,\, Z,\, \rho} \quad U(L, Z)$$

$$\text{subject to:} \qquad Z = F(L,G)) \,,$$

$$L + H = T + \rho H \text{ ,and}$$

$$PG + [W(\rho)/(1-\rho)] L = A + [W(\rho) /(1-\rho)] T$$

where $W(\rho)$ is a predetermined market wage function indexed by the degree of flexibility offered in a job, P is the market price of purchased goods, A is unearned income, and T is the total time endowment available for work (H) or leisure/home-production (L) activities. The marginal conditions for an optimum encompass this opportunity cost "wedge" between observed wages and the marginal value of leisure time:

$$\partial U/\partial L + \partial U/\partial Z \quad \partial F/\partial L = (1/\mu)\ W(\rho)\ /(1-\rho)$$

$U_2$ is the derivative with respect to the second argument and $\mu$ is the marginal value of full income.

Whether the attribute is modeled as a utility-bearing attribute or a direct limitation on the time endowment, the presence of the hedonic wage function, poses the usual difficulty in recovering other determinants of wages: one would like to estimate payoffs to experience, education, and other individual characteristics without bias, but the presence of this additional margin of choice must be addressed. The empirical methodology of correcting errors in wage equations for the conditioning information contained in a binary participation equation addresses this issue when all jobs are identically restrictive. If there are exactly two types of jobs, with $\rho = 0$ (formal) and $\rho = 1/2$ (e.g. family) then the use of the method developed by Hay [1980] and implemented in Dubin & McFadden [1984] incorporate conditioning information by using a multinomial logit model of choice of "$\rho$".

The parameter quantifying the degree of flexibility is not directly observable. Conceivably, a survey might ask questions which pertain to flexibility: *Are children allowed at the workplace?* or *How often during your working hours do you return home?*, but such responses would be indirect indications of flexibility. Even detailed time budgets may not capture between two employment situations which differ only in the availability in the *option* to leave work.

It is also possible that three employment states are insufficient to incorporate all possible gradations in job flexibility. To test this notion, the distance travelled to work will be used as an instrument for flexibility: if there is a premium paid to female workers willing travel farther from home, this may indicate even within the category of formal workers, hedonic pricing of a variety of levels of job flexibility is implicit in the wage. This is not inconsistent with the observation that job flexibility varies by occupation: the choice of occupation may affect the distance travelled to work. However, given the strong indications that flexibility of employment matters to married women, the occupation-specific requirements for commuting may be an important component in women's occupational choice.

# CHAPTER 2

## ESTIMATING WAGES GIVEN SELF-SELECTION BY JOB FLEXIBILITY

This chapter examines self-selection by women into different types of employment using the premise that women differ in the relative value of time spent in household activities as compared to wage-earning activities. The measures of the value of time of women include the number of children under age six at home, the number of older children, and whether there are grandparents living in who may be able to assist in child care. Instruments for the potential wages the individual could earn in market work are schooling, job experience, and regional and primary crop indicators. Regional differences in wages have been shown to be significant in Malaysia (see Kusnic and DaVanzo [1980]), and area-specific dummy variables are used to capture local variations in labor market opportunities. All data is from the sample year of the MFLS: 1976.

## Data Description

This study uses data from the Malaysian Family Life Survey selected 1262 households that each contained one ever-married women under age 50 in 1976, households located in one of 52 geographic sampling areas randomly selected in Peninsular Malaysia. It covers fertility histories of the women and employment histories of both the wife and husband (if the woman is still married). The fertility histories begin with marriage or the date of the first pregnancy. Employment histories begin at age 15. The fertility histories were used to construct the variable describing the number of children less than 6 (Young Children) and between 6 and 15 (Older Children) for the years 1955-1976, taking into account births, deaths, and aging of these children. Only households with Malay or Chinese primary respondents (the married women) are retained.

| | |
|---|---|
| Number of households, MFLS 76 | 1262 |
| Deleted cases | 353 |
| Remaining cases | |
| Chinese | 448 |
| Malay | 461 |

Earnings numbers available in this survey are gross receipts from paid labor. The survey takes a wide definition of "employment" and these figures are reported for employers of others, self-employed, and workers in family businesses, as well as for paid full- & part-time employees. For the retrospective employment histories, job characteristics are updated for

Table 10. Variable definitions

Employment

**Y** denotes work status, as described in Chapter 1. It distinguishes between those who work as employers of others, full- or part-time employees from those who are self-employed, family business workers, or engaged in home production.

**Wages** are average weekly compensation for work in 1975 Malay dollars, whether paid in currency or in kind. Entrepreneurial "residuals" are not included. Respondents provided information on the monetary value of in kind payments. One-time payments posed the problem of attribution to an unknown time period and were omitted. The price deflator was taken from the International Financial Statistics consumer price index, 1975 = 1. The average wages of the husband, computed in analogous fashion, are used as an approximation of **non-wife income.**

**Distance to work** is the number of miles the worker travels to her (or his) primary job.

Descriptive variables:

**Educational attainment** is recorded directly in the survey.

**Potential experience** is computed using the formula "age-schooling-6" (in years). Actual job tenure and total years of work experience is known, but not used due to simultaneity.

Regional indicators:

**North, south, central, east** are indicators grouping households by residence in 1976. One state is omitted to avoid colinearity.

**north**= Kedah, Penang/Province Wellesley, Perak, Perlis
**south**= Johore
**central**= Negri Sembilan, Pahang
**east**= Kelantan, Trengannu
**Omitted**= Selangor

**Urban** denotes residence in 1976 in one of the largest cities: Kuala Lumpur, Ipoh, or Penang.

**Rice** and **rubber** are also indicator variables describing the residence communities' major crops.

Household descriptors:

**Grandparents** is an indicates whether there are grandparents in residence.

**Young children** is a count of the number of children less than 6 years of age in the home.

**Older children** is a count of the number of children between ages 6 and 15.

spells exceeding 5 years in length: interviewers are instructed to probe for intermediate values at 3 year intervals. Thus, it is unlikely that these data will reveal interesting time series information at frequencies of less than three year intervals. Although the nominal weekly earnings series is not updated yearly, the information used in the male and female regressions does have variation in each year due to the deflator, a consumer price index (1975 = 100) obtained from International Financial Statistics.

This survey is confined to ever-married women: note, however, that marriage is quite prevalent in both ethnic groups. The Malaysian Family and Fertility Survey First Country Report (part of the World Fertility Surveys), and summarizes the proportion of women ever married and currently married by ages and 1974 and three preceding Census years. On the whole, high proportions of women are married (98% of women aged 35 and older have been married at least once) and the most significant shift seems to be the upward shift over time of the mean age of women at their first marriagefor the whole population. The mean age at first marriage of Chinese women has historically higher than that of Malayan women (19.6 and 16.6, respectively in 1974).

The empirical work weighs the relative importance of these measured characteristics on selection of employment status. The restrictions made in estimation are in parameterizing the distribution of the random errors and in the categorization of employment chosen. The use of probit or logit is shown to be of little significance in the binary selection estimates; the categorization of employment status is found to alter the estimates substantially. Malay and Chinese subgroups are analysed separately.

## Two models of self-selection

If substantial sorting is found across employment states as defined in Chapter 1: *formal*, *family*, and *non-working*, the payoffs to the usual education and experience measures will be biased unless wage errors are corrected for selection bias. The first model which was estimated was the binary choice model of participation (e.g. Heckman [1976]), the second is a logit model allowing for differing types of individuals to select family and formal employment (Hill, 1980). Subsequent estimation of wages for the selected samples incorporates the appropriate bias correction.

The probit probability model is estimated and the results examined for signs of specification error. The empirical specifications may be written as an indicator function $I$, depending on characteristics of the individual and the household and a normally distributed error component e. The indicator variable d indicates whether the individual participates in the labor market or not.

$$I_i = X_i\beta + e_i \qquad \text{for } i = 1 ,\ldots\ldots,N \text{ individuals, with}$$

$$d_i = \begin{cases} 1 \text{ if } I_i > 0 \\ 0 \text{ if } I_i \leq 0 \end{cases}$$

$$e_i \sim N\ (0,\ \sigma^2).$$

Wages are specified as

$$W_i = Z_i\gamma + E(u_i \mid d_i = 1) + u_i$$

$$E(u_i \mid d_i=1) = \phi(X_i\beta) \,/\, \Phi(X_i\beta)$$

with the conditional expectation of wage errors given choice of participation being a function of the probability density $\phi$ and cumulative density $\Phi$ of the normal distribution.

Variables such as number of young children can be expected to increase the value of time at home, and thus reduce the conditional probability of work. Instruments for marketable skills (education and experience) ought to lower the relative value of time at home and thuse increase the conditional probability of work. Husband's income effects on the conditional probability of work ought to be negative as long as leisure is not an inferior good, although a better measure of household wealth ought to include asset income. Wages are estimated with the correction for the bias imparted by non-zero conditional expectation of the errors given $d_i$=1.

In shifting to estimating three-state models of the conditional probabilities of work, I have chosen to switch to a logit specification for computational ease. Instead, the errors associated with the conditional probability of choosing *formal*, *family*, or *not working* is assumed to follow the log Weibull distribution. In this "conditional logit" framework the estimated coefficients represent the differences in the effect of the explanatory variables between two states.

The conditional probability that an individual with characteristics $X_i$

chooses state j is estimated as a function of the observed variables. The coefficients on the non-working state are normalized to be equal to zero, leaving the coefficients on the probability of choosing formal and family employment to be estimated. Let the nonworking state be j = 0, family employment be state j = 1 and formal employment be state j = 2. Substituting the indicator function $\delta(j)$ which equals one if j is chosen for the binary indicator $d_i$ used above, we are interested in estimating the choice probabilities given by:

$$\mathrm{Prob}(\delta(j)=1) = \exp\left( X_{ij}\,\beta_j\right)\left[1 + \sum_k \exp\left( X_{ik}\,\beta_k\right)\right]^{-1}, \quad k = 1,2.$$

In order to estimate wages consistently based on a sample of individuals who have chosen employment state j, I use the method which Hay [1980] and Dubin and MacFadden [1984] propose. Let wages in the two employed states j = 1,2 be a function of observed characteristics Z and errors $\varepsilon_j$.

$$E\left[\, W_j \mid \delta(j) = 1)\right] = Z_j\alpha_j + E[\, \varepsilon_j \mid \delta(j)=1]$$

In their approach, the distribution of $\varepsilon_j$ conditioned on $v_k$ for $k \in J$ where J is the set of employment states {k: 0,1,2}, is assumed to have mean $\sqrt{2}\ \sigma/\lambda \sum_i R_i v_i$ and variance $\sigma^2(1-\sum_i R_i^2)$ where $R_j$ is the correlation of $\varepsilon_j$ and $v_j$. The expected value of $v_k$ conditional on the choice of sector j, derived from the log Weibull distribution is:

$$E(v_k \mid \delta(j) = 1) = \begin{cases} -\ln P_j \lambda \sqrt{3} / \pi & , \text{ if } k = j \\ \dfrac{P_k}{1 - P_k} \ln P_k \ \lambda \sqrt{3} / \pi & , \text{ if } k \neq j. \end{cases}$$

The conditional expectation of wage errors in each sector take the form of weighted sums of the expected errors within each employment category.

$$E(\varepsilon_1 \mid \delta(1) = 1) = \frac{\sqrt{6}\ \sigma}{\pi} \left\{ R_0 \frac{P_0}{1 - P_0} \ln P_0 + R_2 \frac{P_2}{1 - P_2} \ln P_2 - R_1 \ln P_1 \right\}$$

$$E(\varepsilon_2 \mid \delta(2) = 1) = \frac{\sqrt{6}\ \sigma}{\pi} \left\{ R_0 \frac{P_0}{1 - P_0} \ln P_0 + R_1 \frac{P_1}{1 - P_1} \ln P_1 - R_2 \ln P_2 \right\}$$

These conditional expectations are used for correcting selection bias in wage estimates given the choice to work in the formal sector.

## Comparing estimates of self-selection

The shortcomings of trying to restrict three employment states into a binary classification quickly become evident in Table 11. In the first column of the table contains estimates when *formal* and *family* workers are pooled together ($\delta_1(2) = 1$ or $\delta_1(1) = 1$) and distinguished from *non-working* ($\delta_1(0) = 1$) individuals. In the second column are estimates obtained by

Table 11. Two Alternative Probit Models:[a]
I. All workers/non-workers II. Formal workers/all other

| **Chinese:** Sample size=448 | I. | | II. | |
|---|---|---|---|---|
| Parameter | Estimate | s.e | Estimate | s.e. |
| Constant | 1.3183 | 1.279 | 1.710 | 1.448 |
| Education | -0.1086 | 0.054* | -0.252 | 0.062* |
| -squared | 0.0119 | 0.004* | 0.028 | 0.005* |
| Experience | 0.0382 | 0.036 | 0.072 | 0.041** |
| -squared | -0.0008 | 0.001 | -0.002 | 0.001** |
| Region dummies: | | | | |
| North | -0.0687 | 0.414 | — | — |
| Central | 0.1828 | 0.156 | -0.001 | 0.168 |
| East | -0.3687 | 0.468 | -0.254 | 0.515 |
| South | -0.1252 | 0.253 | -0.068 | 0.266 |
| Urban | -0.1557 | 0.226 | -0.466 | 0.268** |
| Rice | -0.1818 | 0.354 | -0.611 | 0.243* |
| Rubber | 0.1711 | 0.154 | 0.346 | 0.166* |
| Grandparents | 0.2066 | 0.133 | 0.061 | 0.148 |
| Young children | -0.0701 | 0.065 | -0.163 | 0.076* |
| Older children | 0.0430 | 0.036 | -0.029 | 0.040 |
| Non-wife inc. | -0.2615 | 0.213 | -0.424 | 0.243** |
| **-Log likelihood** | **-299.655** | | **-226.707** | |
| **Chi-sq (d.f.)** | **20.46 (15)** | | **56.92 (15)** | |

| **Malay:** Sample size=461 | I. | | II. | |
|---|---|---|---|---|
| Parameter | Estimate | s.e | Estimate | s.e. |
| Constant | 0.969 | 1.372 | -0.706 | 1.556 |
| Education | -0.111 | 0.061** | -0.185 | 0.068* |
| -squared | 0.021 | 0.006* | 0.028 | 0.006* |
| Experience | 0.114 | 0.035* | 0.137 | 0.041* |
| -squared | -0.002 | 0.001* | -0.003 | 0.001* |
| Region dummies: | | | | |
| North | 0.678 | 0.227* | -0.202 | 0.240 |
| Central | 0.000 | 0.209 | -0.243 | 0.237 |
| East | -0.404 | 0.221** | -0.524 | 0.253* |
| South | -0.358 | 0.246 | -0.734 | 0.311* |
| Urban | 0.346 | 0.265 | -0.264 | 0.296 |
| Rice | 0.817 | 0.158* | -0.099 | 0.181 |
| Rubber | -0.112 | 0.150 | 0.331 | 0.168** |
| Grandparents | 0.179 | 0.177 | -0.008 | 0.201 |
| Young children | -0.122 | 0.071** | -0.238 | 0.083* |
| Older children | -0.040 | 0.037 | -0.005 | 0.043 |
| Non-wife inc. | -0.471 | 0.246* | -0.211 | 0.281 |
| **-Log likelihood** | **-252.408** | | **-189.222** | |
| **Chi-sq (d.f.)** | **134.09 (15)** | | **62.65 (15)** | |

[a]{*,**} denote non-zero estimates at {5,10}% level of significance.

comparing only *formal* workers to the rest of the sample.

The heterogeneity of working conditions would lead us to believe that not distinguishing in some fashion between *formal* and family employment is a fundamental specification error. Table 11 does serve to show that not only do the characteristics of women vary across these employment categories, but also that the parameters governing the self-selection differ for the two ethnic groups.

Table 12 shows that using a logit specification does not qualitatively change the estimates. In order to compare the coefficient estimates to those of probit specification reported in Table 11, I have rescaled the logit estimates by .625, a compromise suggested by Amemiya to account for the mean $\sqrt{3}\,/\,\pi \cong 0.55$ as well as the difference in the variance from the normal distribution.

Note that when comparing all Chinese workers to non-workers, we fail to reject the joint hypothesis that *all* the coefficients are zero. The relevant $\chi^2$ test statistic for this grouping is insignificantly different from zero at the 5% and 10% levels. That is, these explanatory variables do not serve to distinguish the group of all working women from women who do not work. On the other hand, the second column confirms that these variables, considered jointly, are significant in distinguishing Chinese *formal* workers from the pool of non-workers and family workers. The lower half of Table 11 suggests a different form of sorting for Malay women: there is more explanatory power of the observed characteristics in the model separating all working Malay women from non-workers than formal workers from all others.

Table 12. Two Alternative Logit Models:[a]
I. All workers/non-workers II. Formal workers/all other

| **Chinese:** Sample size=448 | **I.** | | **II.** | |
|---|---|---|---|---|
| Parameter | Estimate | s.e | Estimate | s.e. |
| Constant | 1.318 | 1.288 | 2.178 | 1.592 |
| Education | -0.108 | 0.055** | -0.272 | 0.067* |
| -squared | 0.012 | 0.004* | 0.030 | 0.006* |
| Experience | 0.039 | 0.036 | 0.076 | 0.044** |
| -squared | -0.001 | 0.001 | -0.002 | 0.001** |
| Region dummies: | | | | |
| North | -0.061 | 0.419 | — | — |
| Central | 0.182 | 0.157 | 0.022 | 0.178 |
| East | -0.377 | 0.479 | -0.258 | 0.547 |
| South | -0.124 | 0.256 | -0.064 | 0.280 |
| Urban | -0.159 | 0.228 | -0.537 | 0.301** |
| Rice | -0.190 | 0.359 | -0.742 | 0.289* |
| Rubber | 0.170 | 0.155 | 0.396 | 0.179* |
| Grandparents | 0.207 | 0.134 | 0.054 | 0.160 |
| Young children | -0.069 | 0.065 | -0.173 | 0.082* |
| Older children | 0.043 | 0.036 | -0.036 | 0.043 |
| Non-wife inc. | -0.263 | 0.215 | -0.508 | 0.269** |
| **-Log likelihood** | **-299.71** | | **-225.945** | |
| **Chi-sq (d.f.)** | **20.35 (15)** | | **58.45 (15)** | |

| **Malay:** Sample size=461 | **I.** | | **II.** | |
|---|---|---|---|---|
| Parameter | Estimate | s.e | Estimate | s.e. |
| Constant | 0.829 | 1.455 | -1.067 | 1.695 |
| Education | -0.121 | 0.064** | -0.199 | 0.076* |
| -squared | 0.022 | 0.006* | 0.030 | 0.007* |
| Experience | 0.119 | 0.037* | 0.152 | 0.046* |
| -squared | -0.002 | 0.001* | -0.003 | 0.001* |
| Region dummies: | | | | |
| North | 0.744 | 0.246* | -0.174 | 0.264 |
| Central | 0.025 | 0.217 | -0.228 | 0.262 |
| East | -0.396 | 0.229** | -0.608 | 0.291* |
| South | -0.372 | 0.262 | -0.875 | 0.379* |
| Urban | 0.375 | 0.273 | -0.253 | 0.318 |
| Rice | 0.853 | 0.165* | -0.111 | 0.206 |
| Rubber | -0.107 | 0.159 | 0.369 | 0.189 |
| Grandparents | 0.207 | 0.187 | -0.060 | 0.226 |
| Young children | -0.133 | 0.076** | -0.294 | 0.101* |
| Older children | -0.044 | 0.039 | -0.006 | 0.049 |
| Non-wife inc. | -0.457 | 0.261** | -0.171 | 0.305 |
| **-Log likelihood** | **-252.147** | | **-188.420** | |
| **Chi-sq (d.f.)** | **134.61 (15)** | | **64.26 (15)** | |

[a]Coefficients and s.e.'s have been rescaled by 0.625.
{*,**} denote non-zero estimates at {5,10}% level of significance.

These binary estimates also suggest the following generalizations by ethnicity: women of both ethnic groups seem to self-sort by educational attainment. Potential experience (age-schooling-6 years of age) is significant for Malays but not for Chinese. Taking the regional and community crop variables together, one cannot reject the influence of these instruments for labor market demand on the choice to work in a given category. In keeping with higher observed demand for childcare of *formal* workers, the deterring effect of young children on choice of formal work appears greater than when pooling all workers.

Investigation of the residuals from the binary probit and logit models in the manner of the Breusch-Pagan tests for heteroskedasticity show that the influence of the young children is significant when interacted with work status. This would suggest the usefulness in examining a three-state model of work status choice.

The estimates of a multinomial logit model distinguishing between *formal-*, *family-*, and *non-employed* women are given in Table 13 below. The logit results for the Chinese sample show education to be a distinguishing feature of the Chinese *formal* workers. Sorting by job experience does not appear statistically significant. The local primary crop being rice seems to make it more likely that the Chinese woman chooses *formal* employment, as does the urban indicator. The presence of young children is clearly negative on *formal* work, and indistinguishable from zero for family workers. Unlike the Malay groups, husband's income is not significantly different from zero for either employment group, but the value of the estimated

Table 13. A Three-state Logit Model: formal, family or not working

**Chinese:** Sample size=448 -Log likelihood= -409.184

| Parameter | Formal empl. Estimate | s.e | Family work Estimate | s.e. |
|---|---|---|---|---|
| Constant | -1.059 | 1.070 | -1.307 | 1.081 |
| Education | -0.383 | 0.115* | 0.076 | 0.119 |
| -squared | 0.046 | 0.010* | -0.003 | 0.011 |
| Experience | 0.130 | 0.074 | 0.020 | 0.076 |
| -squared | -0.002 | 0.001 | -0.000 | 0.001 |
| Region dummies: | | | | |
| North | 0.130 | 0.4070 | -0.043 | 0.371 |
| Central | 0.717 | 0.692 | -0.521 | 0.831 |
| East | -0.974 | 0.959 | -0.891 | 1.177 |
| South | -0.950 | 0.573 | -1.523 | 0.620* |
| Urban | -1.265 | 0.376* | -0.224 | 0.350 |
| Rice | -1.351 | 0.475* | -0.235 | 0.370 |
| Rubber | 0.369 | 0.343 | 0.068 | 0.340 |
| Grandparents | 0.274 | 0.275 | 0.485 | 0.269 |
| Young children | -0.352 | 0.141* | -0.002 | 0.132 |
| Older children | -0.033 | 0.075 | 0.179 | 0.073* |
| Non-wife inc. | -0.000 | 0.000 | -0.001 | 0.001 |

**Malay:** Sample size=461 -Log likelihood=-370.84

| Parameter | Formal work Estimate | s.e | Family Work Estimate | s.e. |
|---|---|---|---|---|
| Constant | -3.834 | 1.183* | -0.881 | 1.066 |
| Education | -0.403 | 0.134* | -0.205 | 0.130 |
| -squared | 0.057 | 0.012* | 0.019 | 0.015 |
| Experience | 0.296 | 0.079* | 0.151 | 0.070* |
| -squared | -0.006 | 0.001* | -0.002 | 0.001 |
| Region dummies: | | | | |
| North | 0.824 | 0.570 | -0.101 | 0.505 |
| Central | 0.277 | 0.765 | -0.989 | 0.775 |
| East | -0.499 | 0.628 | -1.390 | 0.552* |
| South | -0.328 | 0.700 | -0.547 | 0.563 |
| Urban | -0.373 | 0.558 | -0.679 | 0.645 |
| Rice | 0.583 | 0.347 | 1.717 | 0.314* |
| Rubber | 0.335 | 0.387 | -0.402 | 0.316 |
| Grandparents | 0.130 | 0.396 | 0.656 | 0.336 |
| Young children | -0.589 | 0.172* | -0.258 | 0.140 |
| Older children | -0.052 | 0.083 | -0.047 | 0.070 |
| Non-wife inc. | -0.000 | 0.001 | -0.003 | 0.002* |

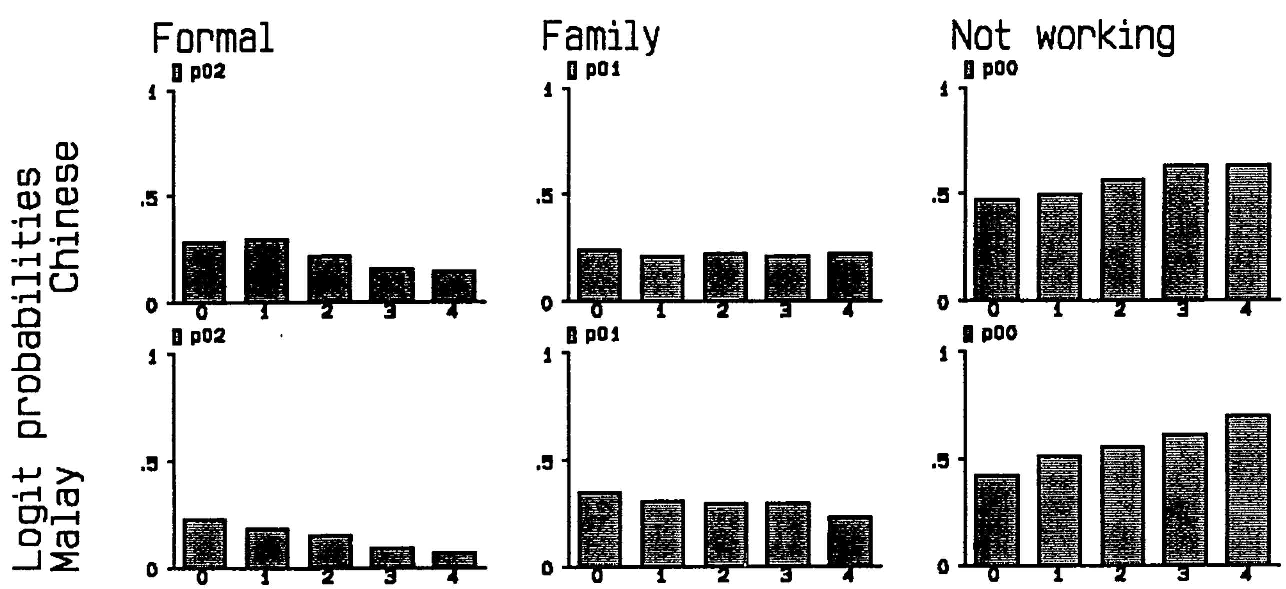
* Estimate is significantly different from zero at the 5% level.
Apparent discrepancies are due to rounding error.

coefficient is negative.

The estimated logit coefficients for the Malay sample imply that education and experience variables are significant in distinguishing between *formal* workers and non-workers. Quadratic terms in both appear significant, for experience: older women appear to be more likely to be family workers. Region indicator variables drop out except for one. (Recall that in these estimates, twice as many parameters are being estimated.) Again, the number of young children has a significantly negative effect only on *formal* work, and husband's income has a negative effect only on *family* work.

Figure 1 shows the effects of altering the number of young children on the mean logit probability estimated for each ethnic group and work status. The predicted probability of *formal* employment is definitely lower for women the greater the number of young children at home for both ethnic groups. The predicted probability of family work appears relatively insensitive to the presence of young children. This is consistent with the hypothesis *family* workers find that child care responsibilities are not incompatible with employment.

A corresponding graph of predicted probability of choosing a given work status for the various levels of educational attainment is shown in Figure 2. We find that there is a very strong positive effect on employment in the *formal* sector with higher levels of education. Note, the mean level is only between 4 and 5 years for these two populations so that there are very few women reaching high school. There is no corresponding strong effect on family employment. The strong upward trend in educational attainment in recent decades affecting this sample documented in Table 3 would lead to a




Children < 6 years old

Figure 1. Work choice by number of children

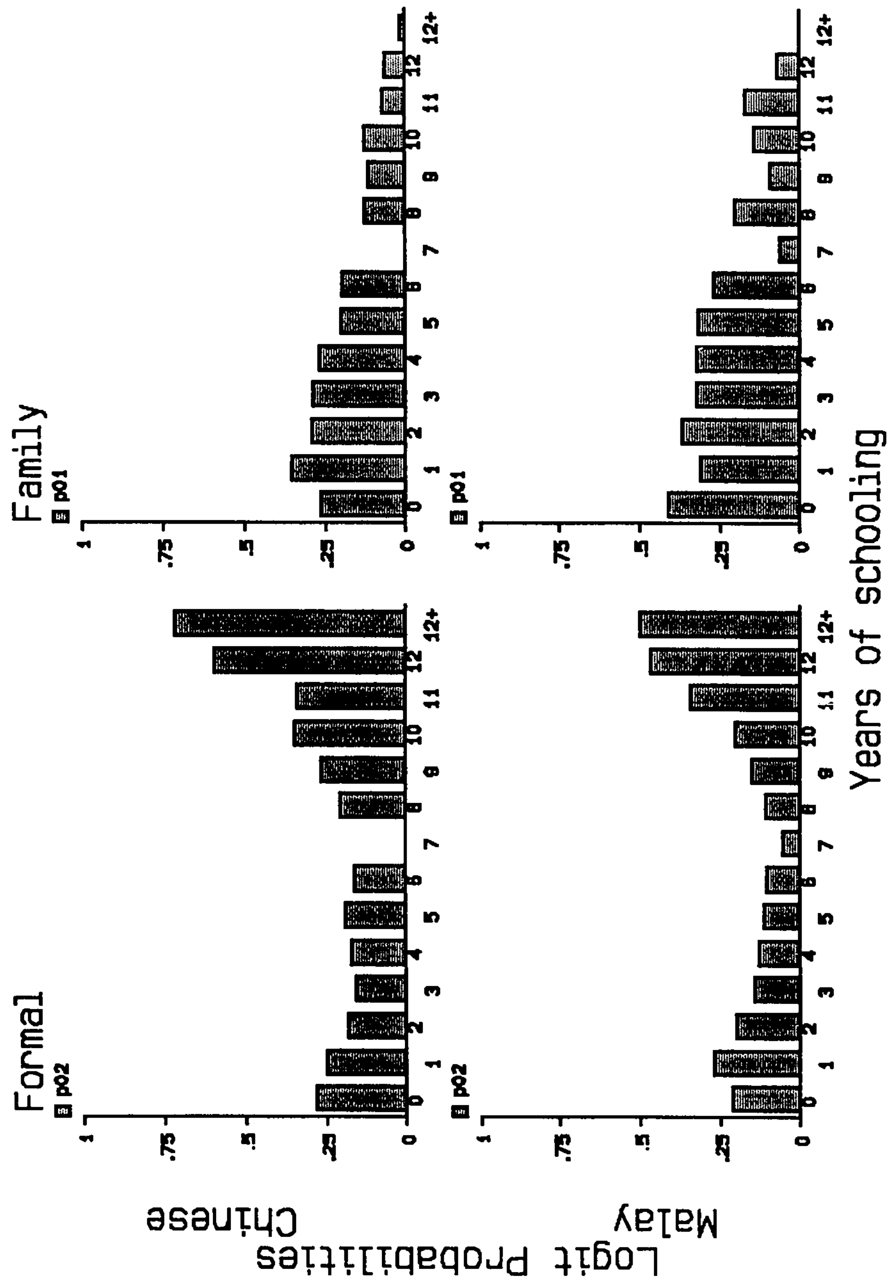



Figure 2. Work choice by educational attainment

different work/age profile than the simulation which alters ages without accounting for these trend shifts. The age profiles in Figure 2 adjusted for the changing composition in educational attainment would would tend to be flatter due to the increasing educational attainment by younger cohorts.

A standard concern when using the computationally convenient logit formulation for estimated multinomial probability models is the imposition of the independence of irrelevant alternatives which is an implication of the underlying extreme value distribution. A Rao test, also known as a Lagrange-multiplier test, based on a generalization of this distribution, addresses this question. Where the denominator in each logit probability specification is not

$$G(Y_0, Y_1, Y_2) = Y_0 + Y_1 + Y_2,$$

as in the multinomial logit formulation, but instead

$$G^*(Y_0, Y_1, Y_2) = Y_0 + ( Y_1^{1/(1-s)} + Y_2^{1/(1-s)})^s,$$

where each $Y_k = \exp(-v_k)$, this test asks whether the generalizing parameter is zero: $H_0$: $s = 0$ is not rejected at the 5% level. The value of the test statistic, distributed $\chi^2(1)$ is .178 for the Chinese sample and 1.007 for the Malay sample. See Maddala [1987].

## Wage estimates by work status

In a sense, a single wage function no longer exists if the presence of an unobserved dimension of working conditions is part of the labor contract. Instead, the locus of wages and individual characteristics pools unlike contracts: the purpose here is to document how much the education effects (for example) are distorted by pooling by using the categorical indicator to control for the underlying heterogeneity. In addition, the hypothesis that *family* workers enjoy more flexibility might lead one to believe that they sacrifice premia to experience and education due to limitations to occupations in which it is least costly for employers to provide flexibility.

The following comparisons of education and experience effects on wages show that the heterogeneity of job types can bias estimates. The amount of the bias depends upon range of variation of the unobserved work characteristic across employment types. The concentration of the population in urban areas increases the "extent of the market" which Adam Smith succintly stated limits the degree of labor specialization. The range of employment types might be expected to be greater in areas of such a country in which agricultural activities and non-farm employment coexist: these would be the areas counted as "urban" in Malaysia in 1976.

For the Chinese women who tend to be urban dwellers, the range of employment includes shopkeepers in family stores to clerical and industrial workers. Pooling across the different groups of women who choose *formal versus family* jobs overstates the within-group wage premium to characteristics Z such as education. The wage estimates in Table 14 and the illustrative Figure 3 show that the education effect on Chinese women's wages is significantly positive when the selected group of formal workers is distinguished from all others, and when the self-selection is taken into account, but insignificant for the pooled group of workers. On the other hand, the premium to age appears less steep in the selected sample of formal workers in Figure 3. The estimates of age effects are not statistically significant at the 5% or 10% for either the pooled or formal Chinese women. Chinese women tend to work more intermittently over their life-cycle: estimated experience effects may indeed be negligible for a population that works in short spells. In addition, they tend to work in the formal sector before their child-bearing years: the pattern of dropping out of the most intensive jobs as the women get older results in pooling across types of workers may explain why pooling has the opposite effect on estimated age effects as it does on education. Given the data, it is impossible to sort out both the increase in earnings from younger cohorts from age effects, but such a cohort effect may actually mean that a "premium" to youth (confounded with cohort) is estimated and this premium effect is magnified by focusing upon the formal workers. The sign on the correction term is negative, as one would expect: the conditional expectation of the error component for those who choose not to work in *formal* employment is negative.

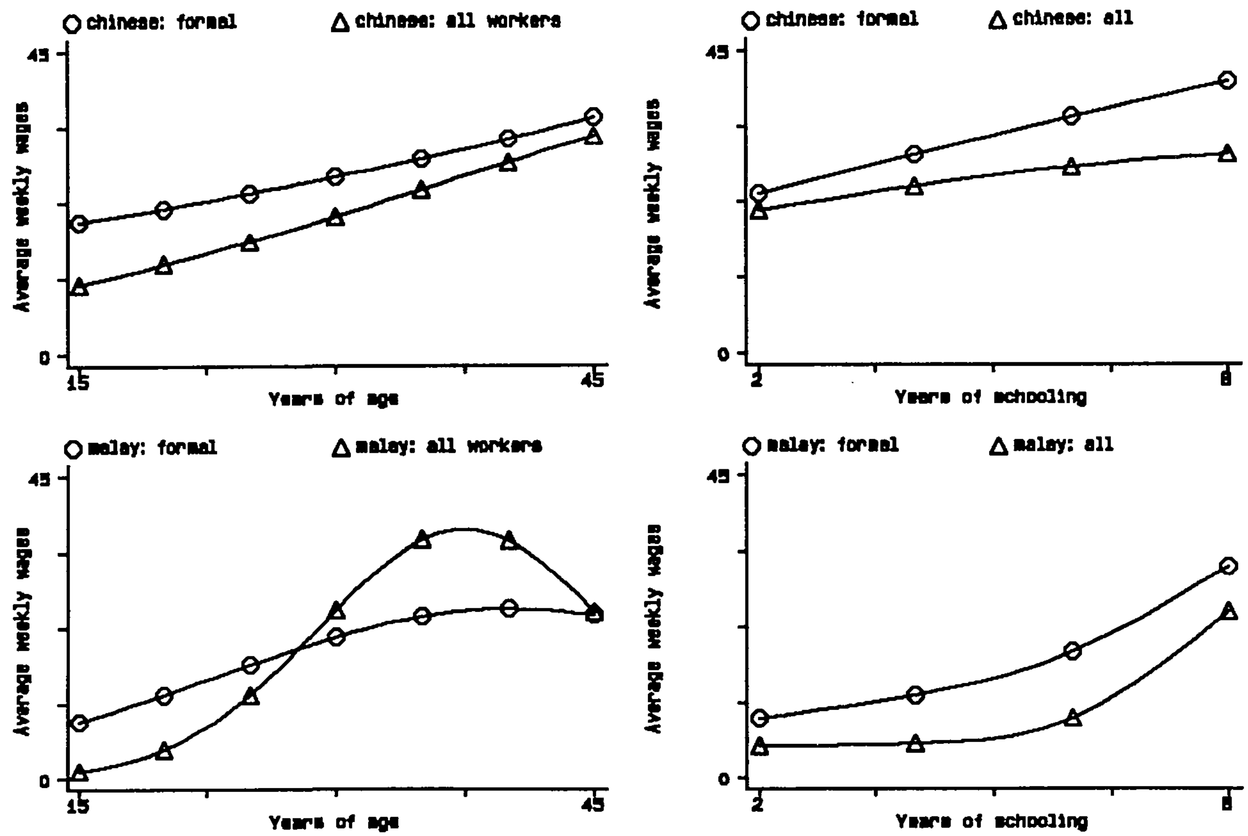
The results of distinguishing between formal and pooled workers in wage regressions are qualitatively different for the Malays. Most notably, on

Table 14. Estimates of formal sector log wages of married women[a]

| **Chinese Women:** Parameter | **Formal workers only** Estimate | s.e. | **All workers** Estimate | s.e. |
|---|---|---|---|---|
| Constant | 5.988 | .754* | 6.659 | 1.811* |
| Education | .135 | .073** | .109 | .103 |
| -squared | -.006 | .007 | -.005 | .013 |
| Experience | .019 | .041 | .058 | .052 |
| -squared | .000 | .001 | -.000 | .001 |
| Region dummies: | | | | |
| North | -.365 | .177* | -.193 | .186 |
| Central | -.868 | .274* | -.308 | .383 |
| East | .530 | .450 | 1.740 | .768* |
| South | -.000 | .299 | 1.515 | .922 |
| Urban | .356 | .290 | .612 | .625 |
| Rice | .382 | .368 | .828 | .790 |
| Rubber | .222 | .172 | -.330 | .267 |
| Grandparents | -.213 | .119** | -.541 | .303** |
| Young children | .068 | .099 | .117 | .155 |
| Older children | -.004 | .037 | -.143 | .063* |
| Non-wife inc. | .000 | .000 | .000 | .000 |
| Correction (logit) | -.665 | .256* | -2.93 | 1.772** |
| **Adjusted R-sq.** | .5568 | | .3492 | |
| **Observations** | 114 | | 179 | |

| **Malay Women:** Parameter | **Formal workers** Estimate | s.e. | **All workers** Estimate | s.e. |
|---|---|---|---|---|
| Constant | 2.169 | 1.697 | -7.113 | 4.027** |
| Education | .085 | .099 | -.312 | .141* |
| -squared | .012 | .009 | .059 | .018* |
| Experience | .101 | .077 | .386 | .125* |
| -squared | -.002 | .001 | -.007 | .002* |
| Region dummies: | | | | |
| North | -.097 | .442 | 1.640 | .737* |
| Central | -.574 | .525 | .501 | .559 |
| East | -.746 | .487 | -.703 | .409** |
| South | -.680 | .540 | -.752 | .504 |
| Urban | -.328 | .439 | -.469 | .392 |
| Rice | .458 | .246** | 3.278 | 1.239* |
| Rubber | -.029 | .309 | -.147 | .237 |
| Grandparents | -.018 | .316 | .611 | .337** |
| Young children | .007 | .179 | -.465 | .236** |
| Older children | .038 | .066 | -.023 | .055 |
| Non-wife inc. | .001 | .000* | .002 | .000* |
| Correction | .300 | .381 | 5.150 | 1.982* |
| **Adjusted R-sq.** | 0.503 | | 0.513 | |
| **Observations** | 83 | | 122 | |

[a]Reported errors are unadjusted for estimated bias correction.




Formal and pooled selection criteria

Figure 3. Age & schooling effects on wages

the relatively small sample of Malay women in formal employment, the only variables which are individually significant are husband's income (significant at the 5% level) and whether the community's major crop was rice (significant at the 10% level). This community variable may reflect the institutional adaptations to the highly labor-intensive cultivation of rice: more work for other landholders is performed in these regions, but such work does not necessarily entail any major differences in premia to education (for example) than similar agricultural tasks performed for a family-owned farm.

For Malays, the age patterns of work are not as pronounced as for the Chinese women: they tend to work a greater portion of their lives: the estimated experience effects (both in levels and squared-experience) on pooled workers is significant for the pooled sample of all workers. There was a smaller proportion of Malay than Chinese women who reported wages in a useful form: for example, women who reported one-time payments rather than a rate of compensation per unit time were dropped from the sample at this stage.

In contrast to the Chinese women, the sign on this correction term is *positive* for Malay women: those women who aren't working actually have a positive conditional expectation of wage errors. This may not be such a surprising finding, given the much lower income levels of the Malay population than the Chinese. Malay women are more likely to be working to "make ends meet" (a corner solution) and the previous probits show the husband's income effect is more strongly negative on these women's work decisions than for Chinese women.

In rural communities, it may be that married women choose not to work when their husbands earn sufficient income to support the household: the value of leisure exceeds the possible wage opportunities from market work. The mean income of husbands of wives who work is significantly lower (assuming equal variances) from that of husbands of non-working wives for Malays: $t(460)=-3.06$. For Chinese households there is no significant difference in mean incomes of husbands of non-working vs. working wives: $t(443) = -0.98$. The income elasticity of the demand for leisure may differ across the range over which these two ethnic groups are being compared.

The histograms of the actual and fitted wage densities are given in Figures 4 and 5. For both Malay and Chinese women in formal employment, there is apparently less mass in the left tail of the observed log wage density. An interesting feature is the bimodality of the Chinese formal worker's wages. The upper tail may exhibit the phenomenon of right-truncation: if these women indeed work only until their child-bearing years, it is possible that they quit even as they reach higher wage-earning potential. The family employee's wages are more diffusely distributed over the range of observed wages, which is at least consistent with the underlying hypothesis of the heterogeneity of such jobs with respect to the tied attribute of flexibility. The fitted wage distributions do not capture the degree of variation in these data: there is a higher degree of unexplained variation in the family sector.

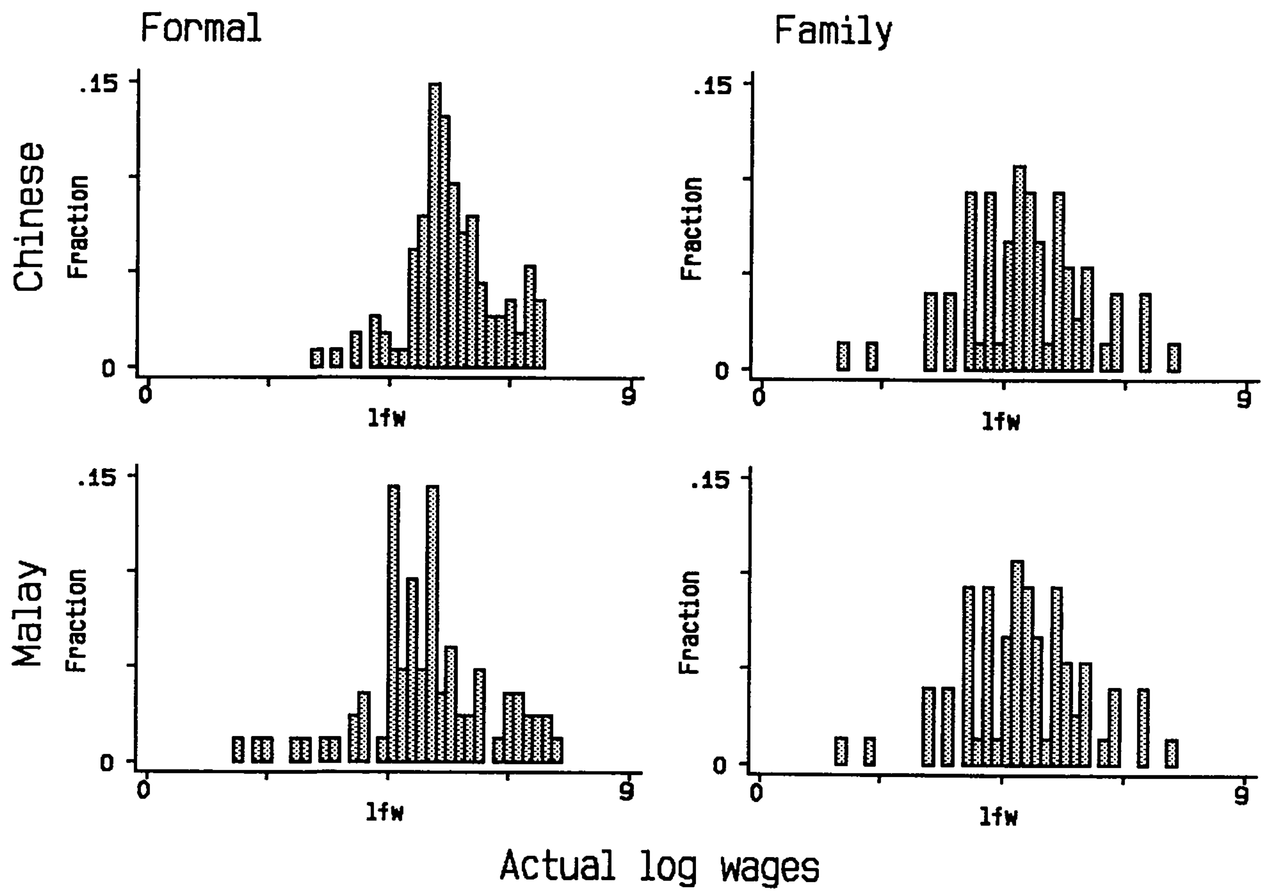



Figure 4. Wage Distribution

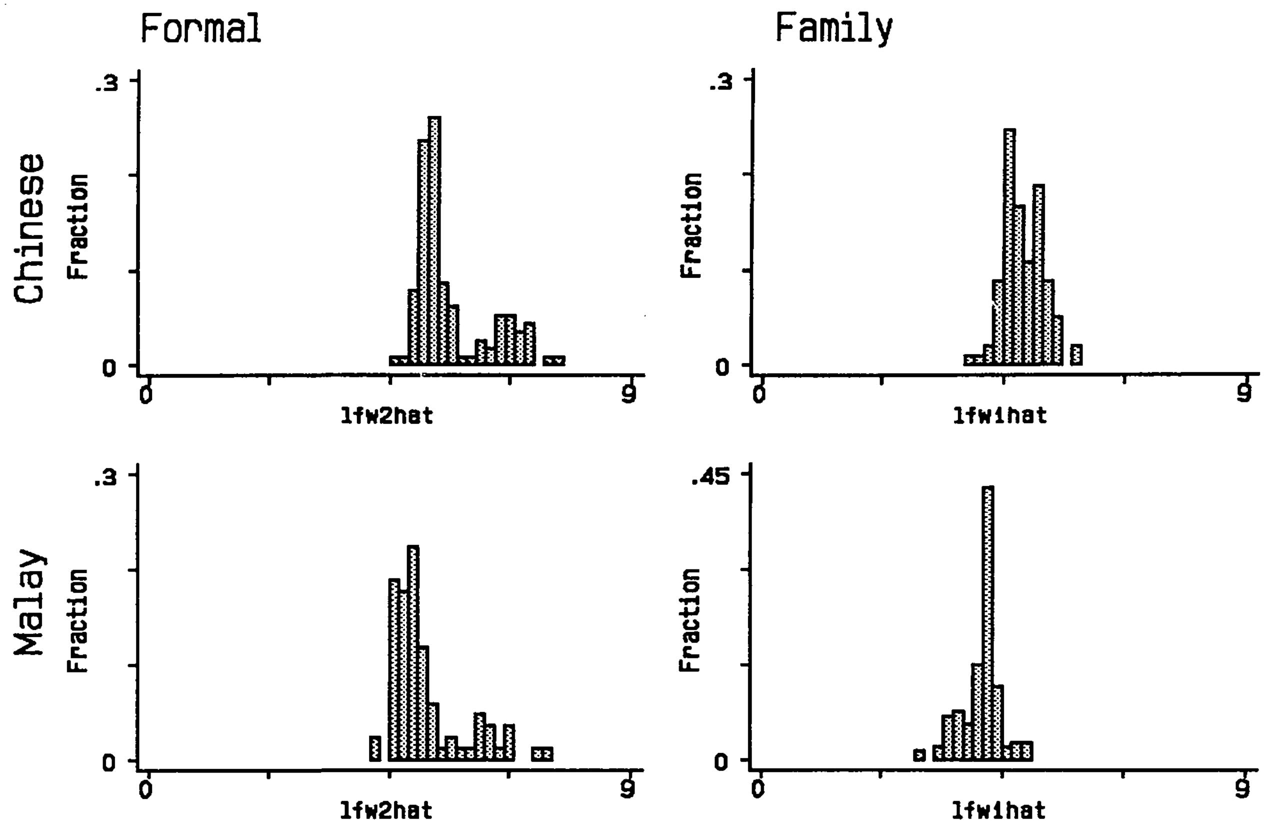



Figure 5. Predicted Wage Distribution

## Commuting distance to work;

## Comparing the effect on men and women's wages

Figure 6 gives the average of wages earned by women and men who commute 0 to 4 miles to their primary workplace. Women's wages appear to increase in distance travelled while men's wages do not. The discussion of chapter 1 suggests that commuting distance ought to be useful as an alternative measure of the flexibility to substitute between work and home responsibilities. I now investigate whether the classification of workers which distinguishes between formal and family workers is sufficient to capture all of the variation in job flexibility.

Controlling for selection into formal employment, the wages of urban (residents of the four largest cities) Chinese men and women in this sample are examined next: the subsample of women shows discernible wage variation by distance to work, the subsample of Chinese men does not. Wage regression estimates given in Table 15 show that the net effect commuting distance is significantly different from zero at the level of 5% in the married women's log wage model, and yet is not in the married men's log wage model. The two models differ in that no selection correction is included for the urban Chinese men, given their high proportion of labor force participation. The region-indicators are excluded from these regressions due to the interest in the smaller sample of urban Chinese.

The commuting distance premium implies a 20% increase in wages for

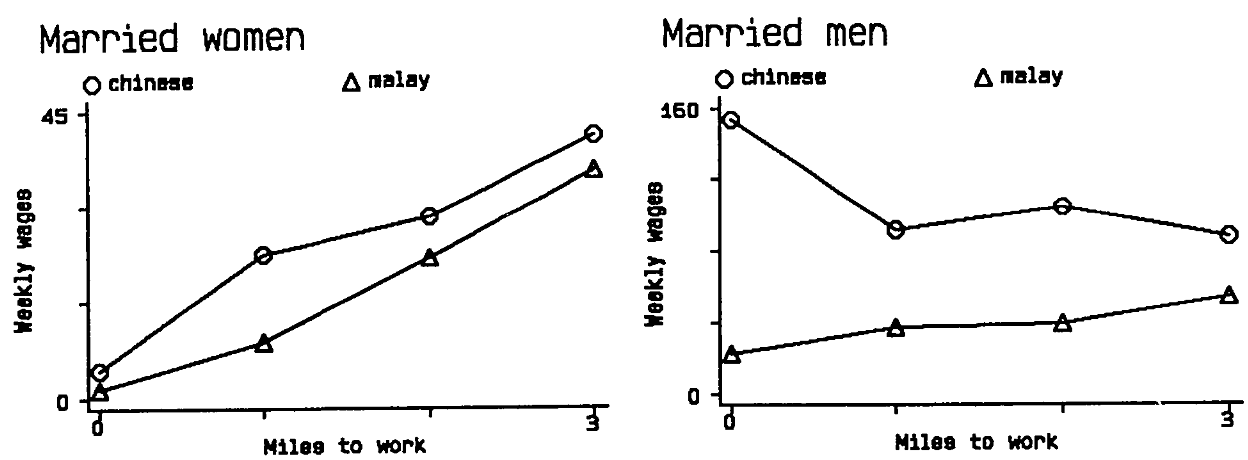



Figure 6. Wages by commuting distance

Table 15. Log Wages of Urban Chinese Women and Men[a]

| Parameter | Chinese Women: Estimate | s.e. | Chinese Men: Estimate | s.e. |
|---|---|---|---|---|
| Constant | 4.070 | .531* | 5.038 | .395* |
| Education | -.046 | .060 | -.028 | .043 |
| -squared | .012 | .005* | .008 | .003* |
| Experience | .103 | .037* | .109 | .025* |
| -squared | -.002 | .001* | -.002 | .000* |
| Grandparents | -.342 | .135* | -.076 | .110 |
| Young children | -.101 | .083 | -.060 | .050 |
| Older children | -.025 | .045 | -.063 | .029* |
| Non-wife inc. | .000 | .000 | | |
| Correction (logit) | .148 | .126 | | |
| Distance to work | .203 | .064* | -.011 | .048 |
| **Adjusted R-sq.** | .70 | | .190 | |
| **Observations** | 69 | | 176 | |

[a]An * denotes an estimate significantly different from zero at the 5% level.

every additional mile travelled to work. This may seem to be an excessively large number, but it is not directly comparable to the coefficients in the non-linear specification estimated by Rees and Schultz. First, their estimates are run within narrowly defined occupations, and second, they regress wages (in levels) on the logarithm of number of blocks to work. For keypunch operators traveling one miles to work, the marginal effect was found to be approximatedly 4¢. In Table 15, occupation is not held constant. Many occupations are pooled in the regression reported. The small sample size precludes running comparable within-occupation regressions for these data.

A joint test on whether the squared education and both experience coefficients are (individually) equal to zero in the men and women's log wage regressions can be rejected at the 5% significance level. The payoffs for higher education and experience to urban working women are comparable to those of men. While the presence of young children does not appear significant in either regression, the other household variables, the presence of grandparents and older children are significant in the women's and men's regressions, respectively. (These household composition characteristics may be correlated with the age of the worker in question.) The selection correction is not statistically significant, but omitting distance traveled from this regression results in regression estimates in which the correction term for selection are significantly different from zero. That these two variables show some statistical correlation is not inconsistent with the discussion in Chapter 1.

## CONCLUSION

This research suggests that the dimension of compatibility of work with family formation is an important one. The wage differential that exists between Malay and Chinese women is partially explained by the differing composition of the labor force across formal and family employment. The categorization used in this study, similar to that used by Hill, was found to be useful in understanding the form of job heterogeneity.

Having young children is found to be less deterring to taking a *family* job than a *formal* one. The child care demands of *family* workers are lower, and the logit estimates show that women with more young children are less likely to assume *formal* employment. This changes the age composition within the different categories of work. The logit study shows that higher education levels are indeed important factors in choosing *formal* employment.

Estimates of wages explain a greater portion of the observed variation in the wages of *formal* sector workers than of *family* workers. The are several non-mutually exclusive reasons why this is true: higher valuation of formal education by unrelated employers, greater standardization of work effort by *formal* workers, and simply a more homogeneous pool of workers in *formal* employment. The experience payoffs estimated are less steep when only formal workers are examined: considering the pattern of dropping out of the formal work force after marriage, this may be merely a result of self-selection.

The discrete-choice model is of course an oversimplification of the available tradeoffs between time spent in the market and at home. Some flexibility in allocation of time between work and home may be obtained by choosing a job in close proximity to home. A commuting distance premium is found only for the women in regressions examining the wages of urban Chinese men and women. For these women, access to the higher productivity jobs is not a problem in the urban environment: nonetheless, they earn less than married men, on average, in part due to the value they place on household time. The source of this observed wage premium is an interesting example of hedonic pricing of a tied attribute. The size of the premium, a 20% premium to each mile travelled to work, is striking. It most likely represents the combined effect of self-sorting of women by their valuation of home time and the locational decisions of firms in central business districts. It should be noted that similar examination of rural-dwelling men and women did not yield any statistically significant estimates of commuting distance wage premia. Unfortunately, the Chinese sample is concentrated in urban areas, so that a direct comparison within a given ethnic group was not possible.

In sum, this study of married female labor supply has modified the usual binary model of labor force participation for applicability to an Asian market economy. The range of employment choices is far greater than would be available in the United States. The results of the study support the hypothesis that women value household time, and respond to economic costs affecting their ability to transfer their time between the two spheres of home and the workplace.

## WORKS CITED


Becker, Gary. (1965) "A Theory of the Allocation of Time," *Journal of Political Economy*, 75: 493–517.

Ben Porath, Yoram. (1967) "The Production of Human Capital and the Life Cycle of Earnings," *Journal of Political Economy*, 85:352–365.

————. (1973) "Labor Force Participation Rates and the Supply of Labor," *Journal of Political Economy*, 81:697–704.

Blau, David. (1985) "Self-Employment and Self-Selection in Developing Country Labor Markets," *Southern Economic Journal*, 52: 351–363.

Chamberlain, Gary. (1984) "Panel Data." In *Handbook of Econometrics*, Edited by Z. Griliches and M.D. Intrilligator. 2 vols. Amsterdam: North Holland.

Dagsvik, J. K. and S. Strøm. (1989) "A Labor Supply Model for Married Couples with Nonconvex Budget Sets and Latent Rationing." Discussion Paper. Oslo: Central Bureau of Statistics.

Dubin, Jeffrey A. and Daniel L. McFadden. (1984) "An Econometric Analysis of Residential Electric Appliance Holdings and Consumption." *Econometrica*, 52:345–362.

Fain, Terry and Tan Poh Kheong. (1982) *The Malaysian Family Life Survey: Appendix E, Master Codebook.* Rand Corporation, R-2351/5-AID. Santa Monica.

Gronau, R. (1976) "The Allocation of Time of Israeli Women," *Journal of Political Economy*, 84, Part 2:201–220.

Hay, J.W. (1980) "Occupational Choice and Occupational Earnings: Selectivity Bias in a Simultaneous Logit-OLS Model," Unpublished Ph.D. dissertation, Yale University.

Heckman, James J. (1974) "Shadow Prices, Market Wages, and Labor Supply." *Econometrica*, 42:679–94.

Heckman, James J. (1978) "A Partial Survey of Recent Research on Female Labor Supply." *American Economic Review*, 68: 200-207.

————. (1979) "Sample Selection Bias as a Specification Error." *Econometrica*, 47:153-61.

————. (1979a). "Sample Selection Bias as a Specification Error with an Application to the Estimation of Labor Supply Functions," In *Female Labor Supply; Theory and Estimation*. Edited by J. Smith. Princeton: Princeton University Press. 206-239.

Heckman, James J. and Thomas E. MaCurdy. (1980) "A Life Cycle Model of Female Labor Supply." *Review of Economic Studies*, 47:47-74.

————.(1982) "Corrigendum on a Life Cycle Model of Female Labor Supply." *Review of Economic Studies*, 49:659-660.

Heckman, James J. and Jose Scheinkman (1987) "The Importance of Bundling in a Gorman-Lancaster Model of Earnings," *Review of Economic Studies*, 54:243-255.

Hill, Anne. (1983) "Female Labor Force Participation in Developing and Developed Countries—Consideration of the Informal Sector." *Review of Economics & Statistics*, 65:459-468.

————. (1984) "Female Labor Force Participation in Japan." *Journal of Human Resources*, 19:280-287.

Jakubson, George. (1988) "The Sensitivity of Labor-Supply Parameter Estimates to Unobserved Individual Effects: Fixed- and Random-Effects Estimates in a Nonlinear Model Using Panel Data." *Journal of Labor Economics*, 6:302-329.

Kusnic Michael W. and Julie DaVanzo (1980). *Income Inequality and the Definition of Income; the Case of Malaysia*. Rand Corporation, R-2416-AID. Santa Monica.

Lee, Lung-Fei. (1978) "Unionism and Wage Rates: A Simultaneous Equation Model with Qualitative and Limited Dependent Variables." *International Economic Review*, 19:415-433.

————. (1979) "Identification and Estimation in Binary Choice Models with Limited (Censored) Dependent Variables." *Econometrica*, 47:977-96.

Liu, Ying-chuan. (1988) "A Multinomial Choice Model for Married Women's Labor Force Participation." *Taiwan Economic Review*, 16:133-147. (in Chinese).

Maddala, G. S. (1987) *Limited Dependent Variables and Qualitative Variables in Econometrics*. New York: Cambridge University Press.

Malaysia, Department of Statistics, (1977) *Malaysian Fertility and Family Survey-1974, First Country Report.*

Mincer, Jacob. (1962) "Labor Force Participation of Married Women." In *Aspects of Labor Economics*. Edited by H. Gregg Lewis, Princeton: Princeton University Press.

———. (1974) *Schooling, Experience and Earnings*. New York: Columbia Press.

Mroz, Thomas A. (1987). "The Sensitivity of An Empirical Model of Married Women's Hours of Work to Economic and Statistical Assumptions," *Econometrica*, 55:765-799.

Rees, Albert & George P. Schultz (1970). *Workers and Wages in an Urban Labor Market*. Chicago: University of Chicago Press.

Rosen, Sherwin. (1974) "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition," *Journal of Political Economy*, 82:34-55.

Smith, James (1983). *Income and Growth in Malaysia*, Rand Corporation, R2941-AID.

Wong, Y.K. (1987). "Three essays on the open economy." Unpublished Ph.D. dissertation. University of Chicago.