An economic analysis of retirement decisions in Taiwan

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Abstract

Over the last 20 years there has been a growth in the relative importance of labour economics as an area of economics, particularly for labour force participation, retirement, and labour force transition. However in Taiwan, due to a lack of suitable data, most of the work in this area has been cross-sectional and time-series data analyses. This thesis uses micro panel data to fill this gap.

The data is from the Survey of Health and Living Status of the Middle Aged and Elderly in Taiwan, a rich source of information on employment history from 1989 to 2003. The main econometric methods use the binary response models and continuous-time hazard models to analyse labour force participation, retirement, and labour force transition, paying particular to gender differences.

The main empirical results show that older workers, female workers, Mainlander workers, and workers with poor health have a lower probability of labour force participation and a higher hazard rate of retirement. In contrast, Hakka workers, workers with better educational attainment, married male workers, and rural workers have a higher probability of participation in work and a lower hazard rate of retirement. In particular, there is an interesting and conditional result for the Pension variable that for workers with less than 35 years employment duration, the survival curve for workers eligible for a pension lies above that of workers ineligible for a pension; and after 35 years, the results are expected to change, particularly for women. Furthermore, workers with higher predicted earnings have a lower hazard rate of retirement, and workers with higher predicted pension income have a higher hazard rate of retirement. Finally, in the case of labour force transitions, the duration models

incorporate time-varying covariate factors and show that being in poor health increases the hazard rate of retirement, other things being equal. In addition, as the models consider unobserved heterogeneity factors and find that most estimated coefficients on the regressors are lightly larger in magnitude than the corresponding coefficients in the reference model. Further, unobserved heterogeneity factors are also found to be less serious once time-varying covariates are included in the hazard model.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

BHPS: British Household Panel Survey

CEPD: Council for Economic Planning and Development

GSOEP: German Socio-Economic Panel (in German)

HRS: Health and Retirement Study

KMT: Kuomintang Party

LFP: Labour Force Participation

LFT: Labour Force Transition

LHRS: Longitudinal Health and Retirement Survey (in the US)

LSL: Labour Standards Law

MLE: Maximum Likelihood Estimation

NHI: National Health Insurance

NLS: National Longitudinal Survey (in the US)

OECD: Organisation for Economic Co-operation and Development

OLS: Ordinary Least Squares

PSFD: Panel Study of Family Dynamics (in Taiwan)

PSID: Panel Study of Income Dynamics (in the US)

RGEI: Retired Government Employee Insurance

RHS: Retirement History Longitudinal Survey (in the US)

MUS: Manpower Utilization Survey (in Taiwan)

RS: Retirement Survey (in the UK)

SFIE: Survey of Family Income and Expenditure (in Taiwan)

SHLS: Survey of Health and Living Status of the Middle Aged and Elderly in Taiwan

TPSFD: Taiwanese Panel Survey of Family Dynamics

TVCs: Time-Varying Covariates

UK: United Kingdom

UN: United Nations

US: United States

YMSS: Yearbook of Manpower Survey Statistics (in Taiwan)

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Chapter 1

Introduction

"Retirement is an event with profound personal, social and economic consequences. When workers withdraw from the labour force in old age, their earnings cease and must be replaced by some other sources of income."

- Burtless (1999, p.1)

1.1 Objectives of the Study

Retirement economics encompasses topics such as the labour force participation of older workers, social security and pensions, health, and job opportunities. At some level these topics are familiar to mainstream economists. However, most previous studies of retirement issues in Taiwan focused on living arrangements (Chen, 1994; Chang, 1999), the economic well being of the elderly (Hermalin, Roan and Chang, 1999), and the health status and health-care utilisation of the elderly (Chen, 1999); little is said about how older workers make their decision to continue working or to retire. Therefore, this thesis attempts to use the tools of economics to fill this gap.

This thesis has three related objectives. First, it aims to analyse the determinants of labour force participation of the middle-aged and elderly in Taiwan. In particular, how the health status of middle-aged and elderly men and women affects their labour force participation, and whether the national expansion in health insurance in 1995 encouraged earlier retirement in 1996. Influential papers by Chou and Staiger (2001), and Mete and Schultz (2002), argued that health insurance and health status played an

important role in labour force participation. However, Chou and Staiger (2001) only focused on married women and did not discuss age variables. Furthermore, Mete and Schultz (2002) focused on health status and did not discuss other factors, such as pensions and job opportunities, which also influence labour force participation. To the best of the author's knowledge no empirical study has looked at the decision to work among middle-aged and elderly people in Taiwan. This study aims to fill the knowledge gap by examining the determinants of labour force participation by these groups under various different assumptions.

The second objective of this study, using the concept of employment duration, is to clarify the determinants of retirement behaviour. In particular, due to the limitations of the Survey of Health and Living Status of the Middle Aged and Elderly in Taiwan (SHLS) and the different social security systems and specific retirement laws in Taiwan, previous retirement models such as the life cycle model (Gustman and Steinmeier, 1986); option value model (Stock and Wise, 1990); or stochastic dynamic programming model (Berkovec and Stern, 1991) which focused on retirement age to examine retirement decisions might not be suitable for analysing the Taiwanese case. Hence, this study uses the employment duration model to estimate the hazard rate of retirement. Influential papers in this area include Diamond and Hausman (1984), Antolin and Scarpetta (1998), and An, Christensen, and Gupta (1999). In particular, Diamond and Hausman (1984) were the first to employ the regression-type hazard model to examine the determinants of individual retirement and savings in the US. Antolin and Scarpetta (1998) used non-parametric and semi-parametric approaches to analyse the determinants of retirement decisions in Germany, and An et al. (1999) applied a semi-parametric proportional hazard model to analyse the retirement behaviour of married couples in the US. However, to the best of the author's

knowledge no empirical study has looked at retirement decision making in Taiwan using a duration model. Therefore, using the SHLS survey, this study aims to plug this gap by examining the determinants of retirement decisions in Taiwan.

The third objective of this study is to examine the determinants of labour force transitions, including work-to-retirement and retirement-to-work. The empirical work first merges two waves of the SHLS survey between 1996 and 1999. Second, it considers the time-varying covariates to estimate the hazard rate of retirement. Influential papers by Bound, Schoenbaum, Stinebrickner, and Waidmann (1999) and Disney, Emmerson, and Wakefield (2003) brought attention to the significant role of health in the labour force transition process. They argued that poor health and changes in health played an important role in influencing labour force transition. Unfortunately, data on labour force transition in Taiwan is scarce. In particular, no empirical study has looked at labour force transition in Taiwan using a duration model. This study can not only fill this gap in our understanding of labour force transition, but also allows us to put forward recommendations about retirement and public policies in Taiwan.

The rest of this introductory chapter proceeds as follows. The background to retirement is discussed in Section 1.2. The main factors include Taiwan's ageing population, the gender and ethnic composition of society, educational development, health, marital status, the pension system, and patterns of immigration in Taiwan. Section 1.3 outlines the structure of the study and the different approaches used, including the binary response model, duration model, and panel data analysis.

1.2 The Background to Retirement in Taiwan

1.2.1 Population Ageing

As a result of the Labour Standards Law in Taiwan, most people choose to retire at 55, 60, or 65.[1] As workers become older their productivity gradually declines and fewer job opportunities are available to them. More importantly perhaps, the marginal utility of leisure time may be an increasing function of age, so that, even if productivity and wage rates do not decline with age, individuals may be more likely to retire as they become older.

Government reports show that there have been significant changes in the population size and age structure, dependency ratio, and life expectancy in Taiwan.[2] Table 1.1 shows the actual (1996-2005) and predicted (2006-2051) population size and age structure in Taiwan. The proportion of the population aged 65 and older rose from 7.9% in 1996 to 9.7% in 2005, and it is predicted that the proportion aged 65 and older also will increase from 9.9% in 2006 to 37% in 2051. Further, Table 1.1 also presents the elderly dependency ratio[3]. The elderly dependency ratio rose from 11.4 in 1996 to 13.5 in 2005, and the ratio is expected to increase rapidly from 13.8 in 2006 to 67.0 in 2051. Moreover, Table 1.2 shows that life expectancy at birth for males has increased by 2.1 years from 72.4 in 1996 to 74.5 in 2005; and for females, by 2.7 years from 78.1 to 80.8 in the same period. Furthermore, in the period 2006 to 2051, the predicted life expectancy for males and females will further increase from 74.3 years to 81.5 years and from 80.7 years to 88.5 years respectively. These trends

[1] According to the Labour Standard Law (Chapter 6 Retirement, Article 53 and 54) in Taiwan, workers can choose their retirement ages at 55, 60 or 65.

[2] See, for example, Ministry of the Interior (2007), *Department of Statistics in Taiwan;* and Council for Economic Planning and Development (2006), *Population Projections for Taiwan Area 2006-2051.*

[3] The elderly dependency ratio is a measure showing the number of elderly dependents (over the age of 65) to the total population (aged 15-64). This indicator gives insight into the amount of people of non-working age compared to the number of those of working age. A high ratio means those of working age - and the overall economy - face a greater burden in supporting the ageing population.

clearly show that "population ageing" is occurring in Taiwanese society. Hence, the problem of population ageing may reduce the labour force participation rate, and place greater demands on the social security system, requiring more pension benefits for the elderly.

1.2.2 Gender

Gender is also an important factor for analysing the determinants of individual retirement behaviour. Given the tradition that females typically bear the greater share of the burden of household duties, this might imply that females place a higher valuation on the marginal utility of leisure than their male counterparts. Hence, the reservation wage of females is likely to be higher than that for males and thus faced with the same earnings opportunities in paid employment females may be more likely to retire than males. Further, Kuo (1997) noted that women have fewer opportunities to participate in society and in economic activity than men in Taiwan. Some of this is due to the traditional cultural position of women and disadvantages in education or training.

Table 1.2 shows that the gender balances of the Taiwanese population are predicted to change with the proportion of females expected to be greater than the proportion of males by 2016. In 1996, there were 105.8 males per 100 females. Further, the ratio is expected to fall to 100.8 males per 100 females by 2011, and 91.4 males per 100 females by 2051. This imbalance is due to differences in mortality and life expectancy, and has been a longstanding phenomenon.

Table 1.1 Population Size, Age Structure and Elderly Dependency Ratio

Year	Aged 0 to 14 (%)	Aged 15 to 64 (%)	Aged 65 and over (%)	Elderly Dependency Ratio
1996	23.1	69.0	7.9	11.4
1997	22.6	69.3	8.1	11.7
1998	22.0	69.7	8.3	11.9
1999	21.4	70.1	8.5	12.1
2000	21.1	70.3	8.6	12.2
2001	20.8	70.4	8.8	12.5
2002	20.4	70.6	9.0	12.7
2003	19.8	71.0	9.2	13.0
2004	19.3	71.2	9.5	13.3
2005	18.7	71.6	9.7	13.5
2006	*18.2*	*71.9*	*9.9*	*13.8*
2011	*15.3*	*74.0*	*10.7*	*14.5*
2016	*13.0*	*74.0*	*13.0*	*17.6*
2021	*12.0*	*71.3*	*16.6*	*23.3*
2026	*11.3*	*68.1*	*20.6*	*30.3*
2031	*10.4*	*65.0*	*24.6*	*37.9*
2036	*9.5*	*62.5*	*28.0*	*44.7*
2041	*8.7*	*60.4*	*30.9*	*51.3*
2046	*8.1*	*57.4*	*34.5*	*60.0*
2051	*7.8*	*55.2*	*37.0*	*67.0*

Note: The elderly dependency ratio is the number of people aged 65 years and over population per 100 aged 15-64.

Source:

1. Ministry of the Interior (2005). *Department of Statistics in Taiwan.* The website is from: http://www.moi.gov.tw/stat/english/index.asp

2. Council for Economic Planning and Development (2007). *Population Projections for Taiwan Area 2006-2051.* The website is from: http://www.cepd.gov.tw/encontent/m1.aspx?sNo=0002899&key=&ex=%20&ic=&cd

Table 1.2 Life Expectancy and Sex Ratio

Year	Male (Years)	Female (Years)	Sex Ratio
1996	72.4	78.1	105.8
1997	72.9	78.6	105.5
1998	73.1	78.9	105.2
1999	73.3	78.9	105.0
2000	73.8	79.6	104.7
2001	74.1	79.9	104.4
2002	74.6	80.2	104.1
2003	74.8	80.3	103.8
2004	74.7	80.7	103.5
2005	74.5	80.8	103.2
2006	*74.3*	*80.7*	*102.7*
2011	*76.2*	*82.8*	*100.8*
2016	*77.5*	*84.3*	*99.2*
2021	*78.3*	*85.2*	*97.9*
2026	*78.6*	*85.6*	*96.8*
2031	*79.2*	*86.2*	*95.7*
2036	*79.8*	*86.8*	*94.5*
2041	*80.4*	*87.3*	*93.2*
2046	*80.9*	*87.9*	*92.2*
2051	*81.5*	*88.5*	*91.4*

Note: Sex ratio is the number of males per 100 females.

Source: See Table 1.1.

1.2.3 Ethnic Groups

Due to the differences in cultural attitudes to work, family support arrangements, and the special political situation in Taiwan discussed below, ethnicity is also an important factor for examining the determinants of individual retirement behaviour. Traditionally, ethnicity in Taiwan distinguished between Indigenous and Han people. The former are known as Aboriginal, and the latter includes Fujianese (Holo), Hakka, and Mainlanders (immigrants arriving after 1949). Prior to 1949, Taiwan was controlled by the Japanese government for 50 years. The indigenous people possess diverse cultures and languages. They live on mountainous reservations, on land which cannot be sold to non-aborigines. Despite exposure to Han culture, Taiwan's indigenous groups have maintained much of their unique way of life. Below are some of the distinctive cultural traits of the 12 main indigenous peoples[4] in Taiwan; they now make up roughly two percent of the population.

The ancestors of the Fujianese and Hakka arrived in Taiwan from China's south-eastern provinces in the 17th century. Fujianese and Hakka workers are seen to be imbued with the characteristics of perseverance, diligence, and frugality. They have worked together to develop land, build irrigation systems, maintain social order, and construct temples dedicated to deities. Ethnic assimilation has also occurred as time passed. Some Hakka who settled in places where the Holo predominated were gradually assimilated by the Holo. Likewise, some Holo were assimilated by the Hakka, although this number was much smaller. The Fujianese and the Hakka together now constitute about 85 percent of Taiwan's population, the former outnumbering the latter by a 4:1 ratio.

[4] There are 12 main indigenous peoples in Taiwan: the Amis, Atayal, Bunun, Kavalan, Paiwan, Pinuyumayan, Rukai, Saisiyat, Thao, Truku, Tsou, and Yami.

The Mainlanders are also an immigrant population. Their immigration resulted from the Nationalist government's relocation to Taiwan in 1949, which brought about 1.2 million people from China, the majority of whom were in the military, the civil service, and education. Unlike earlier immigrants (such as Fujianese and Hakka), these people came from every province of China, and included not only Han Chinese but also minority peoples from Mongolia, Tibet, and south-western China. These immigrants brought to Taiwan their own customs and traditions, which are as distinctive and rich as those of the Fujianese, Hakka, and indigenous peoples. The cultural influence of these immigrants on Taiwan can be seen in art and literature, in forms such as Beijing opera and the literary works of the so-called residential military community. These immigrants also brought with them a diverse food culture. All major Chinese regional cuisines can be found in Taiwan. Another important cultural influence was the beginning of the widespread use of Mandarin.

According to a Taiwanese government survey,[5] the ethnic groups have different socioeconomic statuses. For instance, the Mainlanders are better educated, 49.9 percent of them have 13-17 years of schooling. So, they have more skills and the opportunity to earn a higher income. Table 1.3 shows that 17 percent of Mainlanders earn over NT$ 50,000 (about £ 963) per month, more than the other ethnic groups. The next best educated are the Fujianese people, 34.5 percent of whom have 13-17 years of schooling with 10.8 percent earning over NT$ 50,000 per month. Third are the Hakka, 33.3 percent of them have 13-17 years of schooling and 11.6 percent of them earn over NT$ 50,000 per month. Lastly, the Aboriginal peoples, of whom only

[5] See, Ministry of the Interior (2002). *The Survey of Living Status in the Taiwan and Fujian Areas in 2002*, Department of Statistics, Taiwan.

17.8 percent have 13-17 years of schooling and 1.8 percent earn over NT$ 50,000 per month. These figures also show the ethnic inequality in Taiwanese society. In particular, during the period 1949 to 1987 the Mainlanders represented only 13 percent of Taiwan's population, but they controlled Taiwan. Many educated Mainlanders returned to China to reconstruct the legal government. However, by the time the second President Chiang died,[6] Taiwanese society had undergone significant change. Mainlanders comprise a smaller proportion of the population, and can no longer control the whole of Taiwan. In addition, people are better educated, living standards have improved, and Taiwan enjoys a democratic political system. There has been demand for greater equality in public policy for each ethnic group, especially for social welfare and pension policy. Ethnicity was removed from identification cards in 1993, and replaced with birthplace on the new card. This could promote ethnic cooperation in Taiwan. Then, the race variable will become an implicit and important factor for influencing individual retirement behaviour.

[6] The first former President Chiang, Kai-Shek, who died on April 5, 1975; and the second former President Chiang, Ching-Kuo, who died on January 13, 1988. The relative information is from the website as follows: http://www.gio.gov.tw/taiwan-website/5-gp/yearbook/03history.html.

Table 1.3 Socioeconomic Status by Ethnic Groups

Unit: %

Variables	Fujianese	Hakka	Mainlander	Aboriginal	No Answer
Observations	76.9	10.9	10.0	1.4	0.8
Ages					
50 to 64	76.5	11.6	9.4	1.8	0.7
65 and over	70.0	10.7	18.3	0.8	0.2
Education					
0-6 years	21.7	19.3	8.2	30.4	5.7
7-12 years	43.8	47.4	41.9	51.8	37.2
13-17 years	34.5	33.3	49.9	17.8	57.1
Income					
0	30.3	32.4	29.8	42.9	38.2
1-29,999	35.9	34.2	25.9	44.7	11.8
30,000-49,999	21.1	20.3	25.6	10.8	17.6
50,000-69,999	6.7	6.1	9.1	0.0	11.7
70,000-99,999	2.0	3.2	4.9	0.0	8.8
100,000+	2.1	2.3	3.0	1.8	5.9
No Answer	1.8	1.6	1.7	0.0	5.9

Note:

1. The total sample has 4062 observations, including 3125 Fujianese, 441 Hakka, 405 Mainlander, 57 Aboriginal, and 34 observations where no response was given.
2. The rate of foreign exchange was about NT$51.907 equals £1 in 2002. The website is (in Chinese): http://investintaiwan.nat.gov.tw/zh-tw/env/stats/exchange_rates.html.

Source: Ministry of the Interior (2002). *The Survey of Living Status in the Taiwan and Fujian Areas in 2002*, Department of Statistics, Taiwan.

1.2.4 Educational Development

Education is an important factor in determining individual retirement behaviour. More education makes more (as well as more desirable) job opportunities available to people. Taiwan is an island with relatively few natural resources, so human resources are central to its economy. Since the Mainlanders were better educated, Taiwan's government was able to reform the education system relatively easily in 1968 and extended basic education from six to nine years. Table 1.4 shows that people aged 70 to 74 had the lowest levels of college education of all age groups in 2005. This implies three situations. First, since this age group was born and educated before the Second World War, when Taiwan was colonized by the Japanese government (from 1895 to 1945), fewer people received an education. Second, younger people have a higher standard of education than those aged 70 to 74. This reflects the success of Taiwan's educational reforms during the period 1968 to 2005. Third, the oldest people also have a higher level of education than those aged 70 to 74. This is because a larger part of the older population belongs to the Mainlander group. They are not only better educated, but they also have a higher social position and income, and as a result they have longer lives. Furthermore, the proportion of the population with only informal education is smaller for the younger age groups. It decreases from 36.7 % of those aged 80 and over to 4.4% of those aged 50 to 54. In contrast, the proportion of people with high school education increases from 14.4 % of those aged 70 to 74 to 44.2% of those aged 50 to 54.

Table 1.4 Educational Attainment by the Middle Aged and Elderly

Unit: %

Ages	Informal Education (0 year of schooling)	Primary School (1-6 years of schooling)	High School (7-12 years of schooling)	College (13-17 years of schooling)
50 to 54	4.4	28.1	44.2	23.3
55 to 59	7.6	40.3	32.8	19.3
60 to 64	16.1	44.8	27.6	11.5
65 to 69	30.0	43.2	18.1	8.7
70 to 74	28.6	50.2	14.4	6.8
75 to 79	27.8	44.1	20.9	7.2
80 and over	36.7	33.6	19.6	10.1

Source: Ministry of the Interior (2005). *The Summary Analysis for the Elderly Survey in the Taiwan and Fujian Areas in 2005*, Department of Statistics, Taiwan. The website is (in Chinese): http://www.moi.gov.tw/stat/index.asp.

1.2.5 Self-Assessed Health and Use of Hospital Medical Services

Health is a major factor in the determination of labour force participation and individual retirement behaviour. When workers' health becomes poor, they are less likely to remain in the labour force. Table 1.5 shows that the proportion of the population with not so good and poor health increased with increasing age from 12.3 % of the population aged 50 to 54 to 34.2% aged 80 and over in 2005. In contrast, the proportion with excellent and good health decreased with increasing age from 58.7 % aged 50 to 54 to 34% aged 80 and over. Furthermore, Table 1.6 shows that the proportion of people who spent time in hospital increased with age from 8.8 % aged 50 to 54 to 29.7% aged 80 and over. 71.7% of the 50 to 54 group only stayed in hospital once, 17.1% twice, and 11.2% three times and over in 2005. Therefore, the health-age results as expected that the relatively younger people seem to have better health than the older groups.

Table 1.5 Self-Assessed Health by the Middle Aged and Elderly

Unit: %

Ages	Excellent	Good	Average	Not So Good	Poor
50 to 54	24.2	34.5	29.0	10.1	2.2
55 to 59	17.3	34.1	33.2	11.9	3.5
60 to 64	13.6	27.3	35.7	19.9	3.5
65 to 69	15.2	22.7	36.0	20.3	5.8
70 to 74	9.9	21.4	40.5	22.3	5.9
75 to 79	10.1	18.6	38.3	26.2	6.8
80 and over	9.4	24.6	31.8	24.0	10.2

Source: See Table 1.4.

Table 1.6 Uses of Hospital Medical Services by the Middle Aged and Elderly

Unit: %

Ages	Spent time in hospital		Frequency		
	Never Used	Used	1 time	2 times	3 times and over
50 to 54	91.2	8.8	71.7	17.1	11.2
55 to 59	89.7	10.3	79.8	10.9	9.3
60 to 64	86.2	13.8	57.8	27.6	14.6
65 to 69	84.9	15.1	61.6	20.6	17.8
70 to 74	83.3	16.7	63.3	29.1	7.6
75 to 79	77.3	22.7	58.3	23.7	18.0
80 and over	70.3	29.7	58.1	24.7	17.2

Source: See Table 1.4.

1.2.6 Marital Status

Marital status and family circumstances also affect individual participation in work and retirement behaviour. For instance, once a man is married, he tends to have more opportunities to work, and perhaps an increased desire or need to work as he is likely to be the main earner for his family. In contrast, a married woman might do more housework and have a lower desire (less need or opportunity) to work. Table 1.7 shows that the proportion of the population who are married decreased with increasing age from 85.4 % aged 50 to 54 to 39.3% aged 80 and over. In contrast, the proportion whose spouse was deceased increased with age from 5.7 % aged 50 to 54 to 57.3% aged 80 and over in 2005. The proportion of the population divorced or separated decreased with increasing age from 6.2 % aged 50 to 54 to 1.6% aged 80 and over. In particular, for the Taiwanese traditional society, most people prefer to only marry once during their lives. Therefore, this study is interested to test some hypothesis of marital status and employment among the middle aged and elderly in Taiwan: for example, the unmarried people (including single, separated or divorced, spouse deceased) may have a lower labour force participation rate and the married may have a greater incentive or responsibility for their family to participate in work.

Table 1.7 Marital Status of the Middle Aged and Elderly (Unit: %)

Ages	Married	Spouse Deceased	Divorced or Separated	Single
50 to 54	85.4	5.7	6.2	2.7
55 to 59	82.9	9.0	6.1	2.0
60 to 64	77.9	15.9	5.1	1.1
65 to 69	69.5	26.6	3.1	0.8
70 to 74	62.3	33.3	3.1	1.3
75 to 79	50.0	45.9	1.5	2.6
80 and over	39.3	57.3	1.6	1.8

Source: See Table 1.4.

1.2.7 Pension System

According to the policy research report of the World Bank (1994), "Averting the Old Age Crisis: Policies to Protect the Old and Promote Growth", there are potentially three pillars of any pension system. The first pillar is an anti-poverty measure that is non-contributory and guarantees a minimum income in old age. The second pillar is a forced savings element that only provides benefits to contributors, and, in general, provides the most benefits to those who contribute most. The third pillar is a voluntary savings system, available to anyone who cares to supplement the retirement income provided by the first two pillars. Until now, the Taiwanese government has not provided a public pension. People have only had access to occupational pensions (the second-pillar pension) and personal or individual pensions (the third-pillar pension). However, Table 1.8 shows that people aged 50 to 54 have a higher proportion both in favour and against new pension programmes (with the lowest proportion of "don't know" response) than other older groups. This implies that the younger group seems to be the most aware of this new pension system. On the one hand, they concern how much they should pay for their contributions or taxes during their working period. On the other hand, they also worry how much they could receive their pension benefits as they retire in the future.

Furthermore, Articles 53 to 58 of the Labour Standards Law (LSL), state that no employee is eligible to receive a retirement pension until the employee has worked 25 years for the same employer or is over age 55 and has worked 15 years for the same employer. If eligible, the employee is entitled to receive upon retirement a lump-sum payment based on his or her monthly salary, capped at 45 months' wages. Employers are not required to make any payments or fulfil any obligations until an eligible employee retires. In Taiwan, most private sector businesses are small and medium

sized enterprises with an average life of about 12 years.[7] The employers do not provide occupational pensions for their employees. For the government sector, the occupational pension system also changed from defined benefit retirement plans to defined contribution plans in 1993 (Yu and Chang, 2004). The defined benefit retirement plans pay government employees a fixed sum per month or a fixed fraction of the retiree's earnings prior to retirement. These retirement benefits come from taxes or public budget expenditure. On the other hand, the defined contribution plans are ones in which the government promises to contribute a certain amount each year to a fund to which the employee has access upon retirement, and this is increased each year by the contributions of government and employees. The government allocates a large portion of this pool of money to specialist fund managers to manage these pension contributions. Any returns made from the investments generated by the managers belong to the retirees, so retirement benefits depend solely on the size of the fund at the age of retirement (Ehrenberg and Smith, 2000). In addition, most occupational pensions are paid as a single payment. Retirees from government sectors can deposit this pension lump sum in a designated financial institution and receive an interest rate as high as 18 percent. However, the social welfare system was inadequate. The government attempted to improve pension policy for workers by extending the occupational pension schemes to cover private sector employees. In particular, in 2005 the government planned to change the pension system gradually from non-portable to portable pension plans, and the funds from government to partially private management (Chiu, 2004). Changes in pension policy may be able to provide more opportunities and benefits for workers making their labour force participation or retirement decisions.

[7] CEPD. (2001). Report on the Revised Labour Law, the *Employment Division of Economic Development Advisory Conference*, Council for Economic Planning and Development, Executive Yuan, Republic of China, pp. 9-11 (in Chinese).

Table 1.8 Views of New Pension Programmes by the Middle Aged and Elderly

Unit: %

Ages	For	Against	Don't Know	No Answer
50 to 54	74.1	10.4	15.2	0.3
55 to 59	70.2	9.3	19.9	0.6
60 to 64	69.6	8.5	21.5	0.4
Gender				
Males	75.9	10.4	13.3	0.4
Females	68.0	8.8	22.8	0.4
Education				
Informal	52.1	8.5	38.0	1.4
Primary	65.2	11.1	23.2	0.5
High School	77.9	8.3	13.5	0.3
College	80.5	10.0	9.4	0.1
Marital Status				
Married	73.2	9.6	16.8	0.4
Spouse Deceased	64.7	9.0	26.0	0.3
Separated/Divorced	65.9	10.1	23.4	0.6
Single	67.2	12.5	20.3	-

Source: See Table 1.4.

1.2.8 Residence Status

Residence status may influence the determinants of labour force participation and individual retirement behaviour, including employment opportunities and living arrangements. For the opportunity of employment, people living in urban areas have more diverse employment opportunities than those in rural areas. One might therefore expect that states having a larger proportion of the population living in urban areas will have a higher participation rate. On the other hand, rural workers tend to help out by feeding livestock and poultry and doing other farm chores. Thus, they will be part of the labour force. This means that if a state has more rural areas, then labour force participation may be higher, resulting in a positive sign. The net effect can be

determined only empirically.

For the living arrangements, most people prefer to have three generations living together in the traditional agriculture society. However, this situation may be to change in the modern society. For example, Table 1.9 shows the preferred residence status of the middle aged and elderly in Taiwan. The proportion of them who would prefer to live with their spouse and children increased with age from 38.2 % aged 50 to 54 to 60.7% aged 80 and over. In contrast, the proportions that would prefer to live only with their spouse decreased with increasing ages from 32.4 % aged 50 to 54 to 13.6% aged 80 and over. Furthermore, the proportion that would prefer to live alone also increased with increasing age from 6.4 % aged 50 to 54 to 15.1% aged 80 and over. These trends imply that if the elderly are widowed or live alone, they are likely to need more help from the government and society. Hence, the government can provide more supported housing and other social assistance for their later lives.

Table 1.9 Views of Ideal Residence Status by the Middle Aged and Elderly

Unit: %

Ages	Living with spouse and children	Living with spouse only	Living alone	Living with others	No Answer
50 to 54	38.2	32.4	6.4	3.4	19.6
55 to 59	39.3	29.5	7.0	3.6	20.6
60 to 64	50.5	24.6	6.7	2.6	15.6
65 to 69	61.8	22.1	7.8	0.8	7.5
70 to 74	59.3	22.0	9.9	1.1	7.7
75 to 79	57.4	20.1	15.1	1.9	5.5
80 and over	60.7	13.6	15.1	4.3	6.3

Source: See Table 1.4.

The information presented above shows that population ageing, the ethnic composition of society and the pension system are important factors in the determinants of retirement behaviour. In particular, until recently Taiwan was a developing country with limited social welfare schemes. A large proportion of her budget resources were channelled into defence related sectors. Social welfare such as medical insurance was neglected.[8] For example, the Taiwan National Health Insurance (NHI) programmes were introduced as late as 1995. As a result, elderly civilians are currently receiving inadequate pension benefits or retirement payments and combinations of medical insurance when they retire. In addition, as traditional family structures have gradually changed from the extended family to the small nuclear family,[9] traditional social values have also changed correspondingly. To remedy these poor social welfare conditions, the Taiwanese government has set objectives to construct social security systems and improve public pensions and other social welfare for the elderly in the near future. Thus, knowing the factors that contribute to the patterns of retirement behaviour and labour force participation can greatly assist the government in drawing up optimal pension plans and retirement benefits without dislocating the labour force.

[8] See CEPD. (2000). "*Taiwan Statistical Data Book*", Council for Economic Planning and Development, Executive Yuan, Taiwan.

[9] A nuclear family denotes a married couple living with their biological children.

1.3 Scope and Organisation of the Study

This study investigates three main areas of labour economics in Taiwan: labour force participation, retirement, and labour force transition. First, binary response models are used to examine the determinants of labour force participation. These include probit analysis, which examines the choice of whether to work or not, and ordered probit and multinomial logit analyses, which not only examine the choice of participation but also whether a participant chooses to work full-time or part-time. These approaches are commonly seen in labour economic studies, such as that by Gunderson (1977), who used a logit model to analyse labour force participation of married women in Canada, and Nakamura and Nakamura (1981), who used a probit model to compare the labour force behaviour of married women in the United States and Canada. In this study, the SHLS data is a national random sample of 2462 individuals aged 50 to 70, which includes the current working situation of 1196 individuals, out of the labour force of 1266 individuals. The explanatory variables, similar to those used by Gunderson (1977) and Nakamura and Nakamura (1981), include age, gender, race, educational attainment, marital status, health status, pension, and residence status. These topics are further discussed in Chapter 3.

Second, duration models, also known as survival analysis or event history analysis, are used to examine the timing of events. This branch of statistical techniques has become a subject of increasing interest, especially in labour economics. Numerous empirical papers using this method have addressed issues such as unemployment duration (Lancaster, 1979); the effects of unemployment benefits on spells of unemployment (Meyer, 1990); absence duration (Barmby et al, 1991); turnover (Burdett et al, 1985); job search (Jovanovic, 1984; Cahuc and Zylberberg, 2004); occupational matching (McCall, 1990); and retirement (Diamond and

Hausman, 1984).[10] The duration approach is apt for the SHLS survey because this survey contains rich information about employment history, from which employment duration data suitable for investigating the determinants of retirement can be easily constructed. First, using a nonparametric approach produces some preliminary results of retirement decisions which are discussed in Chapter 2. Furthermore, in Chapters 4 and 5, a parametric approach and a semi-parametric approach are used to examine the determinants of retirement behaviour. For all these approaches, the dependent variable is employment duration, which includes the completed spell for retired observations and the right-censored spell for working observations. The independent variables, which are similar to those used by Diamond and Hausman (1984), include age, gender, race, educational attainment, health status, marital status, residence status, eligibility for a pension, predicted lifetime income (including predicted earnings and pension income). In particular, the effects of unobserved heterogeneity on retirement decision are also examined in Chapter 4.

Third, panel data analysis is used to examine transition effects on retirement in Chapter 5. This approach has advantages over the cross-sectional or pooled data analysis used in previous research as these analyses supposed the explanatory variables were constant so do not examine the transitions over the interval period. As explanatory variables are incorporated in a model for duration data, the values of such variables are those recorded at the time of the origin of the study. The multiple record data can be created by the STATA programmes. Transforming the data using a method called "episode splitting"[11] allows the construction of time-varying covariates, such as changes in health, marital, pension, and residence status at varying times. These

[10] See, for example, Klein and Moeschberger (1997) for a textbook treatment on survival analysis.
[11] A single observation is represented by multiple records, and linked by the case identifier and variables to mark the beginning and the end of the episode.

time-varying covariates can be incorporated into the exponential, Weibull and Cox hazard models, allowing a better retirement forecast. For instance, workers with poor health have a higher hazard rate of retirement, as workers being in poor health increase the hazard rates of retirement, other things being equal.

The structure of the study is as follows: Chapter 2 first describes in detail the SHLS data sets, including background data, the definition of retirement, employment duration and factors influencing retirement decision. It covers a preliminary analysis of the covariates using non-parametric duration methodology. Moving to the empirical analysis of this data, Chapter 3 focuses on single record data, the main observed periods are before 1996, and uses the binary probit model, ordered probit model, and multinomial logit model to analyse the determinants of labour force participation. Chapter 4 focuses on single record data with right censoring, the main observed periods are also before 1996, and uses continuous-time hazard models, including parametric and semi-parametric approaches, to analyse the determinants of retirement behaviour. Chapter 5 merges two data sets of SHLS to create a multiple record data. The main observed periods are between 1996 and 1999, and incorporate time-varying covariates into duration models. Time-varying covariates might provide a better forecast of retirement decision. Chapter 6 concludes and recommends some areas for future study, in particular using the new panel of 2003 SHLS data. The observed periods can be extended from 1996 to 2003 and to create a balanced or unbalanced panel dataset, which would be very useful for further research.

Chapter 2

Data

2.1 Introduction

One of the new tools that micro-econometricians have developed to analyse micro data since the Second World War is panel data analysis, which has become popular in social science research (Heckman, 2000). For instance, Baltagi (2001) noted that two well-known examples of panel data analysis in the US are the Panel Study of Income Dynamics (PSID) collected by the Institute for Social Research at the University of Michigan, and the National Longitudinal Surveys (NLS) of Labour Market Experience from the Centre for Human Resource Research at Ohio State University and the Census Bureau.

This thesis uses panel data collected from the Survey of Health and Living Status of the Middle Aged and Elderly in Taiwan (hereafter, SHLS) to analyse labour force participation and retirement issues. The SHLS is an important and unique survey in Taiwan, the first large-scale panel data set collected and produced by the Taiwan Provincial Institute of Family Planning (TPIFP)[1] and the Population Studies Centre in the University of Michigan (PSC, UM), and is available for the period from 1989 to 2003.[2] The project was initiated in 1989 with a survey of 4049 respondents aged 60 and above. These respondents were interviewed four times

[1] The Taiwan Provincial Institute of Family Planning was merged into the Bureau of Health Promotion, Department of Health in July 2001.

[2] The fifth wave of SHLS data had been reorganised and people were interviewed again between September 2003 and February 2004 by the Population and Health Centre in the Bureau of Health Promotion in Taiwan. However, this wave of SHLS data was not released for open research until 2006. See Table 2.1.

including a major follow-up interview in 1993. The SHLS survey was extended by a second panel of individuals aged 50 to 70 in 1996. The two 1996 questionnaires were very similar. The sample size for the first panel was 2669 individuals aged 67 and over, and the second panel had 2462 respondents aged 50 to 70. In 1999 the first panel comprised 2310 respondents aged 70 and over, and the second panel had 2130 respondents aged 53 to 73. In 2003 the first panel comprised 1743 respondents aged 74 and over, the second panel had 2035 respondents aged 57 to 77, and the SHLS survey was again extended by a third panel of individuals aged 50 to 56 as shown in Figure 2.1.

This study uses only the second panel of the SHLS conducted in 1996 and 1999. In Taiwan, voluntary retirement can be taken at age 50 if individuals have worked for 25 years, or reached age 55 and worked for more than 15 years. The first panel in 1989 did not cover those aged 50 to 60. For this reason the first panel has been discarded for this study, and instead this thesis uses the second panel. Furthermore, the third panel included people aged 50 to 56, but this data is not openly available for research as shown in Figure 2.1. This database of the second panel represents a national random sample, selected from a population of 2462 individuals aged 50 to 70, and their spouses, in 1996. The SHLS contained information on background, marital status, residence history, family structure, health status, social support, employment history, and economic status. It includes detailed questions regarding decisions on labour force participation and retirement, including reasons for working and for leaving their last job, pension plan availability and retirement incentives. About 90 percent of the 2462 individuals were interviewed again in 1999 (see Table 2.1).

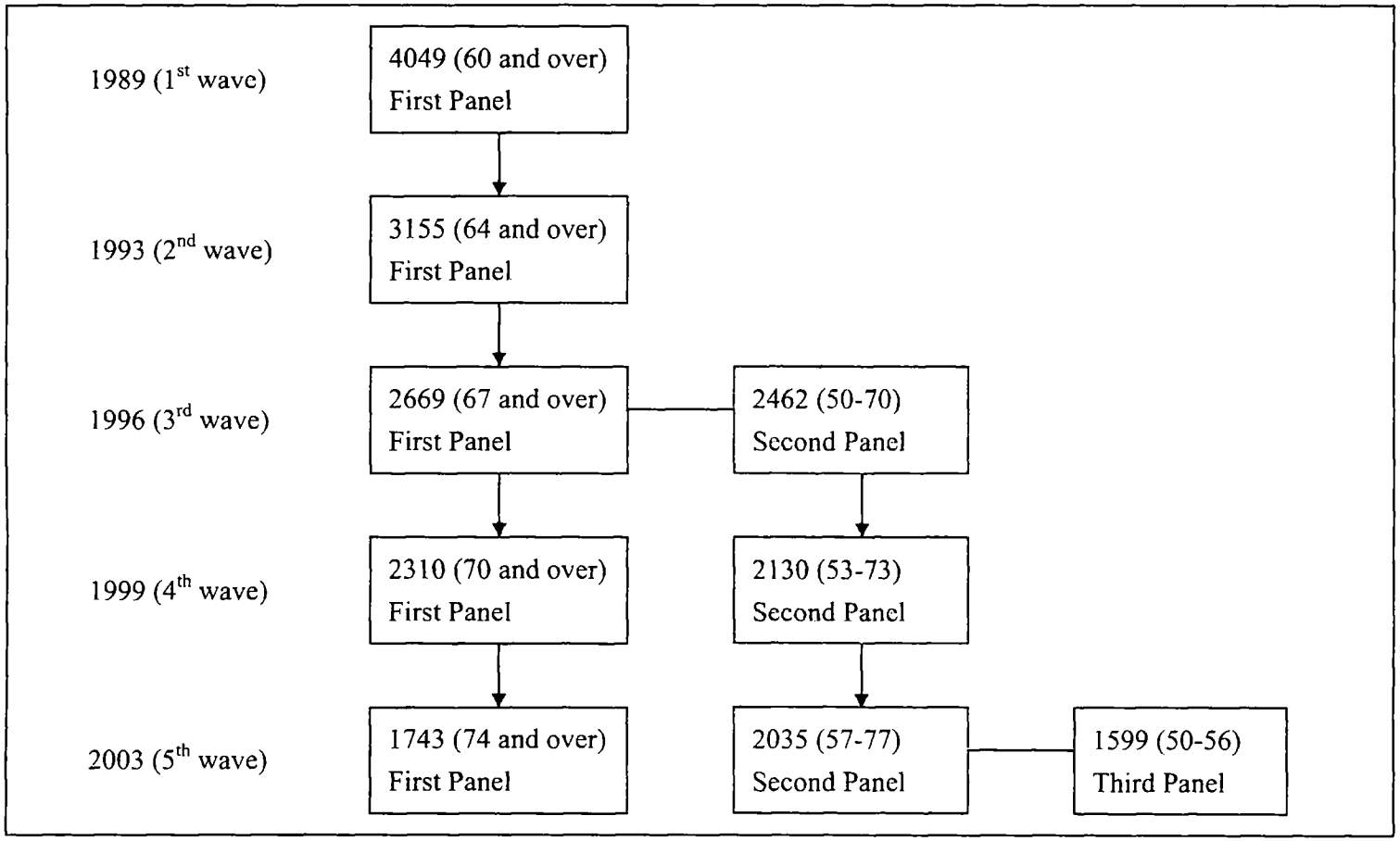


Figure 2.1 The SHLS Data in Taiwan

The SHLS survey questionnaire contained eight distinct sections. They were (A) Background information, marital and living situation; (B) Family structure, general circumstances, and living with kin; (C) Health, use of medical services and hygiene habits; (D) Social support and exchange of support; (E) Employment history; (F) Leisure activities and general attitudes; (G) Economic status; (H) Livelihood plans. The SHLS survey data is fairly comprehensive and thus allows for a detailed discussion of labour force participation, retirement, and labour force transition for older people in Taiwan.

In this chapter a nonparametric approach is used to present some preliminary results for retirement decisions in Taiwan. The nonparametric approach has the advantage of "letting the dataset speak for itself" without imposing a statistical distribution on the parameters' values.

The rest of this chapter is organised as follows. The background information on the data is described in Section 2.2, including the design of the cover of the questionnaire, sample size and panel attrition of the SHLS data. Section 2.3 presents the measures of labour force participation, retirement, and labour force transition. Section 2.4 shows the specific variables of retirement decisions using the duration model, including the dependent variable employment duration, and explanatory variables from the SHLS data. Section 2.5 presents some preliminary results relating to retirement. Section 2.6 concludes the chapter.

2.2 Data Background in Taiwan

2.2.1 The Cover of the SHLS Questionnaire

The cover of the SHLS questionnaire has an interesting and special design, which has an illustration of five bats and one Chinese character - ten thousand years - as shown in Figure 2.2. The five bats represent five lucky things, because the Chinese pronunciations of "bat" and "lucky" are similar. According to Chinese tradition successful people pursue these five things - long life, wealth, good health, good behaviour, and timely death - relentlessly throughout their whole life. The other Chinese character represents eternity. The survey considers the influence of factors such as age, economic status, health status, and social support systems on the determinants of labour force participation, retirement, and labour force transition.

Source: Author graphic using the 1996 SHLS survey.

Figure 2.2 Five Lucky Things in Traditional Chinese Culture

2.2.2 Sample Size and Panel Attrition of SHLS Data

The SHLS data has been collected in five waves and three panels by the Taiwan Provincial Institute of Family Planning and the Population Studies Centre, University of Michigan, from 1989 to 2003. The first panel sample in 1989 included 4049 individuals aged 60 and above. These individuals were then contacted again in 1993, 1996, 1999, and in 2003. In 1993, 3467 respondents were still living, and 91 percent of these persons were successfully re-interviewed. The rest of the survivors were re-interviewed as shown in Table 2.1. The SHLS repaired the panel attrition and extended the survey by launching a second panel of 2462 individuals aged 50 to 70, and their spouses, in 1996. The sample of the elderly is nationally representative: all elderly, including the institutionalised, were sampled;[3] these individuals were then contacted again in 1999, and in 2003. In 1999, 2352 respondents were still living, and 90.6 percent of these persons were successfully re-interviewed. In 2003, about 90.7 percent of the 2243 survivors were re-interviewed. A third panel sample in 2003 selected 1599 individuals aged 50 to 56, and their spouses.

The employment history section of the questionnaire is comprehensive enough to provide us with a variety of variables to assess the labour force participation and the reasons for retirement decisions. But these surveys have a number of limitations. One of these is the insufficient data collected on wage, assets, and pension income. The response rates to the income question were low, reflecting the reluctance of the elderly to reveal their retirement income. Consequently, the predicted earnings and predicted pension income variables have to be constructed into duration models to examine the retirement decisions discussed in Chapter 4.

[3] As described by the survey documentation, the elderly in Taiwan (whether institutionalised or not) are covered in the "household register". The survey adopted sampling designs that used a probability sample of all individuals in the age groups of interest in the household register.

Table 2.1 Sample Size and Panel Attrition of SHLS Data

Year	Cases Interviewed	Age	Cumulative Cases Deceased	Cumulative Cases Survived	Non-response	Response Rate* (%)
1989 I	4049	60+	-	4412	363	91.8
1993 I	3155	64+	582	3467	312	91.0
1996 I	2669	67+	1047	3002	333	88.9
II	2462	50+	-	3041	579	81.0
1999 I	2310	70+	1486	2563	253	90.1
II	2130	53+	110	2352	222	90.6
2003 I	1743	74+	1969	2080	337	83.8
II	2035	57+	219	2243	208	90.7
III	1599	50+	-	2030	431	78.8

Note: * Deceased cases were excluded from each denominator.

Source: Chuang, Yi-li (2006), "Introduction for the Survey of Health and Living Status of the Middle Aged and Elderly in Taiwan", at the Workshop for Panel Data Analysis, Central for Survey Research, Academia Sinica, Taipei, Taiwan, p.12 (in Chinese).

2.2.3 Comparisons with the Census data and Population Projections

Regarding demographic structure, the SHLS data can be compared with the Census data and population projections in this study. The samples of SHLS are aged 50 to 70 in 1996, that is consistent to the samples of Census data aged 65 and over in 2011 as shown in Table 1.1. The proportion of the elderly is 10.7% and the elderly dependency ratio is 14.5. This presents that Taiwan has become an ageing society. Furthermore, Table 1.2 shows the Population Projections for Taiwan Area 2006-2051 that male life expectancy is 76.2 years, females' is 82.8 years, and the sex ratio is 100.8 in 2011. This implies that women have a longer life expectancy than men. Therefore, the Taiwanese government may concern more social welfare and social security system for the elderly in the near future.

2.2.4 The SHLS Data Used in This Study

Each sample is analysed independently and the results are presented in Chapters 3, 4 and 5, though the data sets have some overlaps across chapters. Table 2.2 provides an overview of the sample data used in each chapter. For example, Chapter 3 uses the 1996 SHLS data to examine the determinants of labour force participation, the dependent variables including working or not, and working full-time or part-time. Chapter 4 uses the 1996 SHLS data to analyse retirement decisions; the dependent variable is employment duration. Chapter 5 uses the 1996 and 1999 SHLS data to estimate the probability of labour force transition; the dependent variables include work-to-retirement, retirement-to-work, and employment duration. The explanatory variables include personal characteristics, family factors, job opportunities, and economic factors in the probit and duration models.

Table 2.2 The SHLS Data Used in This Study

Chapter	Topic	Sample	Dependent Variables	Explanatory Variables
3	Labour Force Participation	1996 SHLS 2462 Observations	(1) Work or not (2) Work Full-time or Part-time	Personal Characteristics, Family Factors, and Economic Factors in 1996
4	Retirement Decisions	1996 SHLS 2462 Observations	Employment Duration	Personal Characteristics, Family Factors, and Economic Factors in 1996
5	Labour Force Transition	Merge the 1996 and 1999 SHLS data 2130 Observations	(1) Exit (2) Re-entry (3) Employment Duration	Personal Characteristics, Family Factors, and Economic Factors in 1996 and 1999

2.3 Measures

2.3.1 Labour Force Participation

In general, the definition of labour force includes all civilians who are aged 15 years or over and able to work.[4] This category could be further classified into the employed, the unemployed, and out of the labour force. To be employed, a worker must have been at a job with pay for at least 1 hour, or worked at least 15 hours on a non-paid job (such as the family farm). To be unemployed, a worker must either be on a temporary layoff from a job, or have no job but be actively looking for work in the four-week period prior to the reference week (Borjas, 2008). Finally, out of the labour force includes people who wish to work but have no employment, attend schools, do housework, become aged or disabled or retired, or have some other reasons for being unemployed (YMSS, 2002).

This study focuses on labour force participation for the middle-aged and elderly. According to the 1996 SHLS data, the total sample has 2462 observations, including 1442 observations in labour force and 1020 not in labour force. The former includes 1196 observations currently in employment (1072 persons working full-time and 124 persons working part-time) and 246 observations unemployed. The latter includes 610 workers who are retired and 410 people who have never worked. Table 2.3 shows some individual characteristics of current employment among the middle-aged and elderly in Taiwan. The proportion of all samples in full-time work is 43.5% and in part-time work is 5.0%. First, for full-time work, the participation rate of males is 70.2%, while only 29.8% of workers are female. For the race variable, most of the interviewees are Fujianese and Hakka, and small proportions are Mainlander and

[4] The Current Population Survey in the United States classifies all persons aged 16 or older into one of three categories: the employed, the unemployed, and the residual group that is said to be out of the labour force.

Aboriginal. The educational attainment is low for most people in this survey, as approximately two-thirds have less than six years of schooling. The participation rates of married workers are 88.2%; married workers tend to have greater family responsibilities. Furthermore, workers with poor health have a lower participation rate, e.g. 14.7% in Table 2.3. Only 24.5% of workers are eligible for an occupational pension, especially for the government employees and big companies' workers. Thus, as the Taiwanese government provided National Health Insurance programmes for people from 1995, most workers would be likely to participate in these programmes: the participation rates of NHI were 89.3% in 1996. Looking at residence status, 37.9% of workers lived in urban areas, 22.8% in towns, and 39.3% in rural areas.

Second, for part time work, most trends are different from full time work. For instance, Table 2.3 shows that older workers, female workers, Fujianese workers, workers with lower educational attainment, unmarried workers, and workers with poor health have a higher participation rate in part time work. In contrast, workers eligible for an occupational pension and rural workers have a lower participation rate in part time work. Chapter 3 extends the analysis using the binomial probit and multinomial response models to investigate the contributing factors that affect labour force participation of the middle-aged and elderly.

Table 2.3 Main Characteristics of Labour Force Participation

Unit: %

Variables	Full-time Work	Part-time Work
Age Groups		
Age1 (50-54)	40.0	32.5
Age2 (55-59)	34.3	35.0
Age3 (60-64)	19.9	26.7
Age4 (65-70)	5.8	5.8
Gender		
Female	29.8	37.5
Male	70.2	62.5
Race		
Fujianese	71.7	79.2
Hakka	19.8	14.2
Mainlander	6.9	5.8
Aboriginal	1.6	0.8
Education		
Informal	18.9	32.5
1-6 years	47.5	54.2
7-12 years	24.3	12.5
13-17 years	9.3	0.8
Marital Status		
Married	88.2	81.7
Single	2.3	2.5
Divorced	2.1	0.8
Separated	0.8	1.7
Widowed	6.6	13.3
Health Status		
Excellent	25.7	21.4
Good	28.6	14.5
Average	31.0	45.3
Not so good	14.0	16.2
Poor	0.7	2.6
Pension		
Eligible	24.5	5.0
Otherwise	75.5	75.0

NHI		
Eligible	89.3	89.2
Otherwise	10.7	10.8
Residence		
Urban	37.9	36.4
Town	22.8	24.6
Rural	39.3	39.0
Sample	1072	124

Note:

The NHI is National Health Insurance. According to the 1996 SHLS data, the sample of those in employment has 1196 observations, including 1072 working full time and 124 working part time.

2.3.2 Retirement

Diamond and Hausman (1984) identified three possible definitions of retirement, namely people who stop working full time, people unable to work, or those who were forced to retire. Most of their empirical works are based on the first definition. Lazear (1986) also provided some possible objective definitions of retirement, including (1) the individual is out of the labour force with the intention of remaining out permanently. (2) The individual has reduced their hours substantially and intends to maintain hours at or below the current level. (3) The individual receives some of their income as pension benefits. (4) The individual appears on some company's retirement roll. (5) The individual receives primary social security payments.

However, Shih (1999) pointed out some problems when applying these retirement definitions. First, looking at sudden reductions in hours worked or complete withdrawal from the labour force may not always adequately measure elderly employment. Moreover, a large number of the elderly are farmers, whose work hours are highly variable because of seasonality and the type of farm they work on, so the reduction in hours worked may not be related to retirement decisions. Second, using pension status alone to define retirement under-estimates the level of retirement in Taiwan because a substantial number of workers are self-employed or in family-owned businesses that have no pension coverage. Lastly, retirement regulations in Taiwan do not restrict pensioners from seeking new employment after retirement, so it is not unusual to find pensioners receiving income from new employment. Hence, to take into account the above issues, retirement is defined in this study to be: Workers who have stopped working full time or civilians in receipt of pension benefits.

According to the SHLS data, the reasons for stopping working at last job include (1) Reached retirement age, (2) Health problems, (3) Wanted to change work environment, (4) Company lay-offs or relocation, (5) Business failure, where profits were too low, (6) Wanted to earn more money, (7) Family factors: such as got married or had to take care of children. For empirical analysis, terms (3) to (6) can be referred to as unemployment, so only terms (1), (2), and (7)[5] are used to define retirement behaviour. The sample of stop working at last job has 856 observations, but there are only 610 observations classed as retired and another 246 observations unemployed.

Table 2.4 presents the main characteristics of individuals who stopped doing their last job and of retirement. The former includes unemployment situations, but most proportional trends of these are similar. For example, older workers, female workers, workers with lower educational attainment, and workers with poor health have higher proportion rates for leaving the labour market. Chapters 4 and 5 extend the analysis using a duration model to examine the contributing factors to retirement decisions of the middle-aged and elderly.

[5] Due to the factors influencing expected retirement age of the SHLS data, this study considers family factors, such as the category 7 to define the retirement behaviour for the middle aged and elderly in Taiwan.

Table 2.4 Main Characteristics of Stop Working at Last Job and Retirement

Unit: %

Variables	Stop Working at Last Job	Retirement
Age Groups		
Age1 (50-54)	16.8	15.8
Age2 (55-59)	29.8	27.2
Age3 (60-64)	33.6	34.9
Age4 (65-70)	19.7	22.1
Gender		
Female	53.6	55.6
Male	46.4	44.4
Race		
Fujianese	72.5	71.5
Hakka	14.4	14.9
Mainlander	11.3	11.8
Aboriginal	1.8	1.8
Education		
Informal	33.2	33.4
1-6 years	46.0	47.2
7-12 years	16.2	15.4
13-17 years	4.6	3.9
Marital Status		
Married	77.7	76.9
Single	3.3	3.8
Divorced	3.1	2.9
Separated	0.6	0.3
Widowed	15.3	16.1
Health Status		
Excellent	13.4	11.4
Good	17.6	14.7
Average	32.8	32.9
Not so good	30.2	33.7
Poor	6.0	7.3
Pension		
Eligible	23.6	24.1
Otherwise	76.4	75.9

NHI		
Eligible	89.4	90.0
Otherwise	10.6	10.0
Residence		
Urban	40.5	38.5
Town	24.8	25.4
Rural	34.7	36.1
Sample	856	610

Note:

According to the 1996 SHLS, the sample of those who have stopped working has 856 observations, with 610 observations retired and another 246 observations unemployed.

2.3.3 Labour Force Transition

The labour force transition by duration analysis combines two waves of the SHLS data to examine actual changes in labour economic behaviour, including continuing work, moving from work to retirement, and from work to unemployment between 1996 and 1999. Chapter 5 not only uses time-constant covariates, but also considers time-varying covariates to assess the determinants of labour force transition.

The preliminary characteristics of labour force transition in the SHLS data are shown in Table 2.5. First, for the variables of Age groups, the proportion of Age1 continuing work increased from 39.6% in 1996 to 44.6% in 1999, and the proportion of Age4 continuing work decreased from 5.5% in 1996 to 4.7% in 1999. It implies that older people gradually make their decisions to retire with their increasing age. However, the relatively younger group (Age1) also have a larger proportion of unemployment than others. Further, regarding the Gender variable, the proportion of females continuing work decreased from 29.8% in 1996 to 26.9% in 1999. This shows that female workers have an increasing trend of moving from work to retirement. But male workers have a higher proportion of unemployment than females. For the Race variable, the proportions of Fujianese and Hakka continuing work changed little from 72.9% in 1996 to 73.9% in 1999, and 18.8% in 1996 to 19.0% in 1999 respectively. This indicates that Fujianese and Hakka workers have an increasing trend for continuing work. They might have a larger proportion for living in the rural areas and doing some agricultural or self-employed jobs, so they prefer to retire later. In contrast, the proportion of Mainlanders continuing work decreased from 6.8% in 1996 to 5.6% in 1999. They might have better economic status and pension benefits, so they prefer and are able to retire earlier. For the Education variable, workers with informal education continuing work decreased from 20.3% in 1996 to 18.2% in 1999; in

contrast, workers with better educational attainment have an increasing trend of continuing work.

Moreover, considering time-varying covariates, for the Marital status variable, the proportion of married people continuing work changed little from 88.1% in 1996 to 86.8% in 1999; meanwhile, 85.0% moved from work to retirement between 1996 and 1999. This implies that married people still have a higher participation rate for continuing work. Furthermore, single people also have a second higher proportion of unemployment than others. Regarding the Health variable, the proportion of workers with poor health (including not so good and poor) continuing work changed from 15.0% in 1996 to 14.1% in 1999; in the meantime, 21.8% moved from work to retirement between 1996 and 1999. This demonstrates that people with poor health have a lower participation rate in work. Thus, a higher proportion moves from work to retirement. For the Pension variable, the proportion of workers eligible for a pension continuing work decreased from 28.2% in 1996 to 14.0% in 1999; in the meantime, 32.8% moved from work to retirement between 1996 and 1999. It implies that people with pension eligibility have a higher probability of retirement. In particular, the retirees might be able to receive a higher benefit from the interest rate payment of retirement system in Taiwan. Finally, for the Residence status variable, the proportion of workers living in urban areas continuing work decreased from 37.7% in 1996 to 35.8% in 1999, and in the rural areas those continuing work also decreased from 39.5% in 1996 to 31.2% in 1999, but the town areas increased from 22.8% in 1996 to 33.0% in 1999. Workers living in rural areas also have a lower proportion of unemployment than others.

Table 2.5 Main Characteristics of Labour Force Transition

Unit: %

Variables	Continuing Work in 1996	Continuing Work in 1999	From Work to Retirement in 1999	From Work to Unemployment in 1999
Age Groups				
Age1	39.6	44.6	24.9	46.1
Age2	34.5	33.7	37.9	30.8
Age3	20.4	17.0	28.9	17.9
Age4	5.5	4.7	8.3	5.1
Gender				
Female	29.8	26.9	36.8	7.7
Male	70.2	73.1	63.2	92.3
Race				
Fujianese	72.9	73.9	69.6	79.5
Hakka	18.8	19.0	19.8	10.3
Mainlander	6.8	5.6	9.4	7.7
Aboriginal	1.5	1.5	1.2	2.5
Education				
Informal	20.3	18.2	28.1	25.6
1-6 years	47.3	48.1	48.6	41.1
7-12 years	23.9	24.1	17.0	20.5
13-17 years	8.5	9.6	6.3	12.8
Marital Status				
Married	88.1	86.8	85.0	82.0
Single	2.1	2.1	2.8	10.3
Divorced	2.0	2.5	1.6	2.6
Separated	0.9	0.6	0.4	0
Widowed	6.9	8.0	10.2	5.1
Health Status				
Excellent	25.4	22.3	13.8	17.9
Good	27.1	32.7	26.5	28.2
Average	32.5	30.9	37.9	43.6
Not so good	14.1	13.3	17.8	7.7
Poor	0.9	0.8	4.0	2.6
Pension				
Eligible	28.2	14.0	32.8	41.0
Otherwise	71.8	86.0	67.2	59.0

NHI				
Eligible	89.0	97.6	98.0	95.0
Otherwise	11.0	2.4	2.0	5.0
Residence				
Urban	37.7	35.8	35.2	41.0
Town	22.8	33.0	30.8	38.5
Rural	39.5	31.2	34.0	20.5
Sample	1122	713	253	39

Note:

The right-censored sample of duration model had 1122 observations in the 1996 SHLS data. In 1999, the sample changed to 713 people continuing work, 253 retired, 39 unemployed, and 117 missing for moved, dead, or no answer.

2.4 Specific Variables of Retirement Decision Making

2.4.1 Dependent Variable: Employment Duration

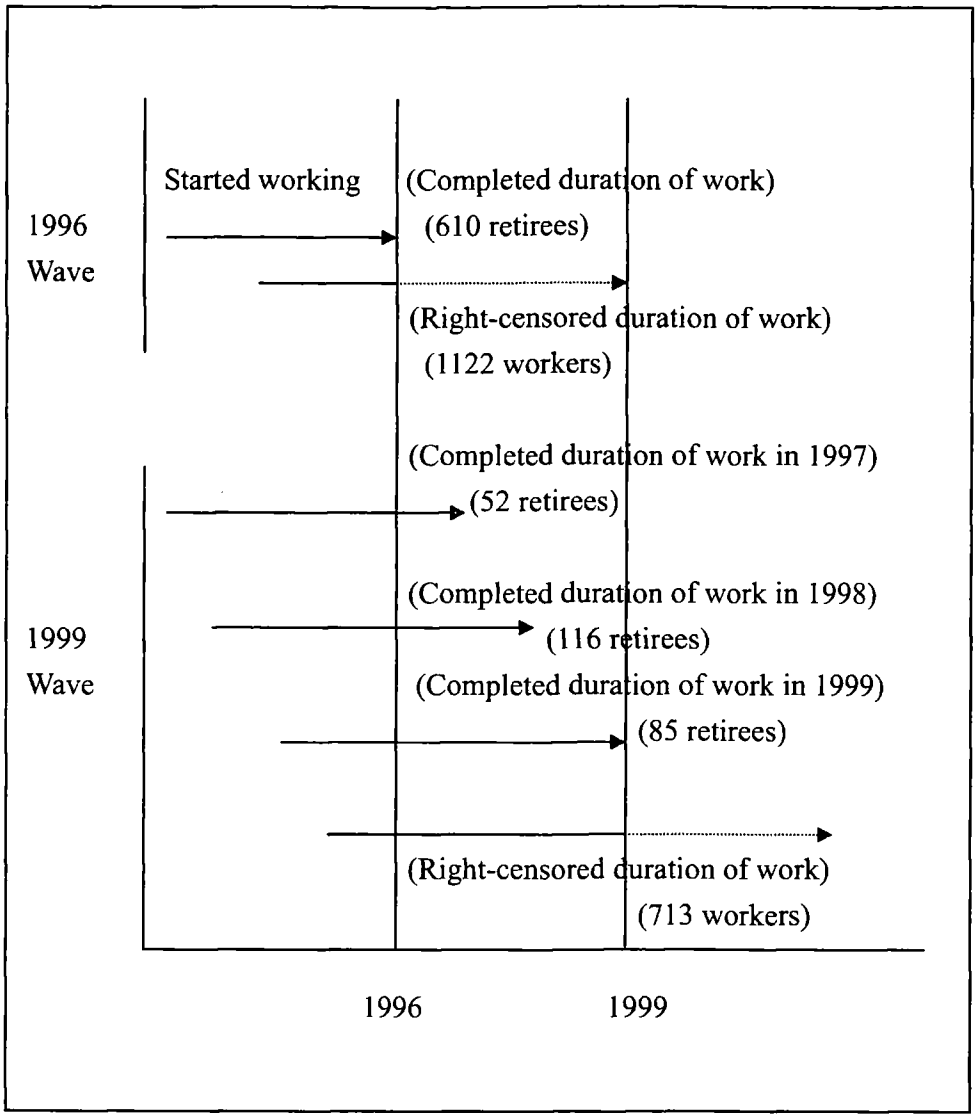
As previously mentioned, early studies of retirement decisions focused on the normal retirement age being a dependent variable (See e.g., Rust, 1989; Lumsdaine and Mitchell, 1999), but this variable might not be the sole reason behind the retirement decision. Since workers have a variable initial working period, reasons for retirement vary as does the age at which they decide to retire. Therefore, this study adopts the concept of duration of employment from Diamond and Hausman (1984), who used the time of duration in work instead of the retirement age to investigate the decision to retire.

Using the SHLS data set, the dates when individuals started their current job and when individuals retired, can be used to calculate the precise time of duration of work. This sample data consists of two groups of individuals, current workers and retirees. The former group do not retire during the sample period; this "right-censored" duration of work can be calculated from the SHLS questionnaires. For these people, the probability of survival function $S(t)$ is used, where t is the last time point, or age, at which the individual was observed. The latter group retires during the sample period and observations include the date on which an individual started their last job and the exact age at which they stopped. This observed duration of employment is taken as completed duration of work from the SHLS questionnaires.

The observed duration of employment can be identified from the two waves of SHLS as shown in Figure 2.3. The first wave includes 610 observations that had a completed duration of work, and 1122 observations which had a right-censored duration of work in 1996, and the second wave contains 253 observations which had a

completed duration of work and 713 observations which had a right-censored duration of work in 1999.

Finally, using the questionnaires from the 1996 SHLS, the time of duration in employment and survival rates are shown in Table 2.6. Column 1 contains the time of duration in employment when workers were observed to retire and were censored. Observations were made at yearly intervals from 1 to 55 years. Column 2 reports the number of individuals who retired. Column 3 shows the number of individuals who continued working. Column 4 presents the estimated survival rates. Column 5 shows the standard error of estimated survival rates. Columns 6 and 7 illustrate the 95% confidence intervals of estimated survival rates. In general, Table 2.6 shows that the duration distribution of those retired and currently in work are really remarkably lacking in a major peak, except the 5, 10, 15, 20, 25 and 30 years have a higher frequency than otherwise. This implies that the above years might be good for workers to consider their contributions and benefits from the Labour Standards Law and make their decisions to retire or participate in work. However, after 35 years, the duration of employment has gradually been lost these trends.



Note:

According to the 1996 and 1999 SHLS survey, the sample of duration model that covers the completed duration of employment for those who have retired has 610 observations, and the right-censored duration of employment for those who continued to work has 1122 observations in the 1996 SHLS. In 1999, the 1122 observations sample had changed to 253 people retired, 713 persons continuing work, 39 unemployed, and 117 missing for moved, dead, or no answer. See Table 2.5.

Figure 2.3 Duration of Employment for the SHLS Study

Table 2.6 Duration of Employment and Survival Rates

Time (Years)	Beg. Total	Retired	Work	Survival Rates	Standard Error	[95% Conf. Int.]	
1	1732	13	35	0.993	0.002	0.987	0.996
2	1684	21	32	0.980	0.003	0.972	0.986
3	1631	28	49	0.963	0.005	0.953	0.971
4	1554	14	31	0.955	0.005	0.944	0.964
5*	1509	20	45	0.942	0.006	0.930	0.952
6	1444	13	30	0.934	0.006	0.920	0.945
7	1401	15	33	0.924	0.007	0.909	0.936
8	1353	15	30	0.913	0.007	0.898	0.926
9	1308	11	13	0.906	0.007	0.890	0.919
10*	1284	25	45	0.888	0.008	0.871	0.903
11	1214	13	9	0.878	0.008	0.861	0.894
12	1192	12	26	0.870	0.009	0.852	0.886
13	1154	12	16	0.861	0.009	0.842	0.877
14	1126	12	19	0.851	0.009	0.832	0.869
15*	1095	21	33	0.835	0.010	0.815	0.853
16	1041	18	13	0.821	0.010	0.799	0.840
17	1010	12	11	0.811	0.010	0.789	0.830
18	987	8	21	0.804	0.011	0.783	0.824
19	958	7	15	0.798	0.011	0.776	0.819
20*	936	17	45	0.784	0.011	0.761	0.805
21	874	12	11	0.773	0.011	0.750	0.795
22	851	6	22	0.768	0.012	0.744	0.789
23	823	6	23	0.762	0.012	0.738	0.784
24	794	12	12	0.751	0.012	0.726	0.773
25*	770	16	30	0.735	0.012	0.710	0.758
26	724	15	16	0.720	0.013	0.694	0.744
27	693	14	23	0.705	0.013	0.679	0.730
28	656	8	12	0.697	0.013	0.670	0.722
29	636	6	13	0.690	0.013	0.663	0.715
30*	617	20	40	0.668	0.014	0.640	0.694
31	557	6	24	0.661	0.014	0.632	0.687
32	527	13	29	0.644	0.014	0.615	0.672
33	485	10	36	0.631	0.015	0.602	0.659

34	439	14	20	0.611	0.015	0.580	0.640
35	405	15	23	0.588	0.016	0.557	0.618
36	367	13	27	0.567	0.016	0.535	0.598
37	327	14	22	0.543	0.017	0.510	0.575
38	291	14	19	0.517	0.017	0.483	0.550
39	258	13	19	0.491	0.018	0.455	0.525
40	226	11	23	0.467	0.018	0.431	0.503
41	192	10	21	0.443	0.019	0.405	0.479
42	161	9	13	0.418	0.020	0.379	0.456
43	139	14	10	0.376	0.021	0.335	0.416
44	115	6	11	0.356	0.021	0.315	0.397
45	98	2	13	0.349	0.021	0.308	0.391
46	83	6	19	0.324	0.022	0.281	0.367
47	58	6	9	0.290	0.024	0.245	0.337
48	43	6	7	0.250	0.026	0.201	0.301
49	30	3	10	0.225	0.027	0.175	0.279
50	17	2	5	0.198	0.029	0.144	0.259
51	10	0	3	0.198	0.029	0.144	0.259
52	7	1	5	0.170	0.036	0.106	0.247
55	1	0	1	0.170	0.036	0.106	0.247

Note:

According to the 1996 SHLS data, the effective sample of duration model that has 1732 observations, including 610 people retired and 1122 continuing work. Number at risk represents the number of individuals n_i at risk for retirement at time t_i.

2.4.2 Explanatory Variables: Factors Influencing Retirement Decisions

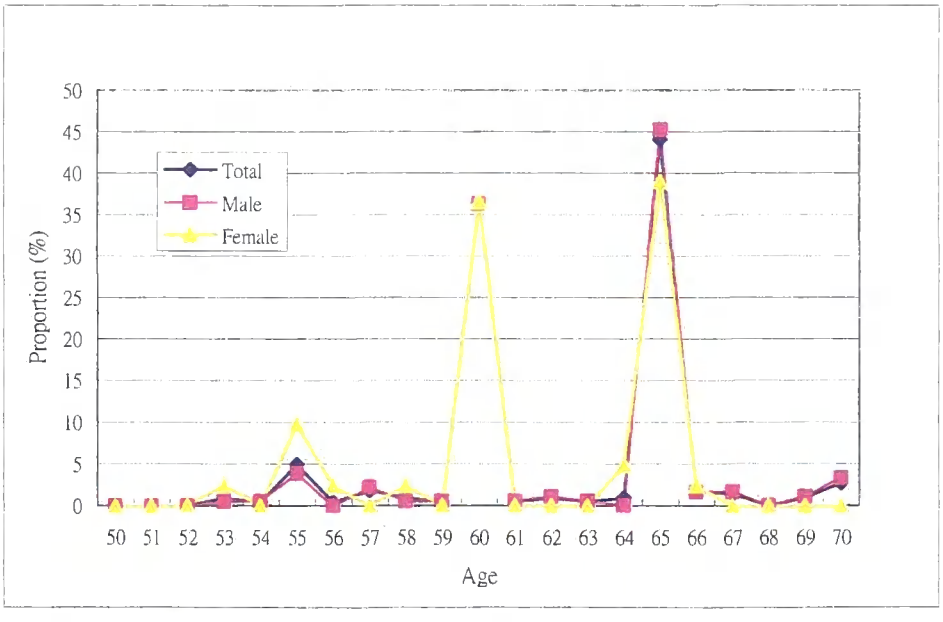
Previous studies have found that a number of factors influence retirement decisions, including age, gender, race, educational attainment, marital status, health, pension benefits, social security system, and economic status. For example, Uccello (1998, pp.2-4) noted that *"workers with eligible pension are more likely to retire than workers without, workers with poor health are more likely to retire, but workers who would lose health insurance coverage upon retirement are less likely to retire"*. Thus, this section presents some related literature together with characteristics of the sample obtained from the 1996 SHLS which could shed slight on the reasons behind retirement decisions.

2.4.2.1 Age

Previous research has either concluded that retirement is primarily induced by poor health (Quinn, 1977) or economic variables, such as pensions (Hall and Johnson, 1980). This conclusion is not universal (Lumsdaine and Mitchell, 1999). In fact, the age factor is the first determinant of retirement behaviour, if the retirement age is not a dependent variable. In addition, the expected retirement age is different from the actual retirement age. For example, Rust (1989) found two marked peaks in retirement ages in the US, showing that older workers retired either at age 65 when they were eligible for unreduced social security payments, or as early as they were permitted to retire, at age 62, when their benefits were reduced in recognition of the early leaving date (Lumsdaine and Mitchell, 1999).

Looking at the current work sample of the 1996 SHLS data, "E11: Are you planning to stop working completely once you have reached retirement age?" If yes, "E11a: what age is that?" we can find three marked peaks in the expected retirement

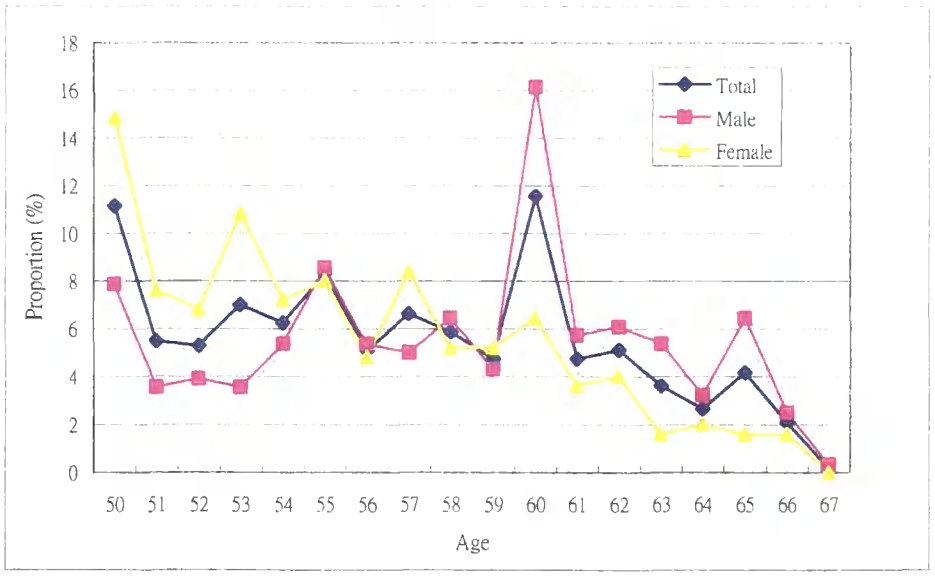
ages at 55, 60 and 65; and their proportion rates have 5%, 36% and 44%, respectively as shown in Figure 2.4. Female workers have a higher proportion at first peak in the expected retirement ages at 55 than males. The second peaks of both are similar at age 60, and the third peaks of males at aged 65 have a higher proportion than females. This implies that female workers prefer to retire earlier. The influencing factors of the expected retirement ages include health, family situation, finances, and other. 87.8% of people cite their health, 20.7% of them their family situations, 40.3% of workers focus on their finances, and 6.9% of people other factors.



Source: Author graphic using the 1996 SHLS survey.

Figure 2.4 Expected Retirement Age by Gender

Furthermore, for the retired sample of the SHLS survey, "E18: When did you stop doing your last job?" We can also find three marked peaks in the actual ages of stop doing last job.[6] Female workers stop doing their last job at aged 50, 53 and 57; and males at aged 55, 60 and 65 as shown in Figure 2.5. The rate of stop doing last job amongst females at each age is larger than male rates before aged 58 (until aged 57) but, after this age, the rates of stop doing last job amongst females are lower than their male counterparts. This implies that female workers may retire earlier than males.



Source: Author graphic using the 1996 SHLS survey.

Figure 2.5 Actual Age of Stop Doing Last Job by Gender

[6] This means the respondents who reached the retirement age and stopped working.

2.4.2.2 Gender and Educational Attainment

According to traditional Chinese culture, which is especially applicable to elderly Taiwanese, "a female without knowledge always has good morals".[7] It is widely believed that girls and women do not need to be educated. However, this situation has changed rapidly in the past few decades amongst the younger Taiwanese. A large number of women are now employed in various industries. Kuo (1997) noted that the emphasis on female education in Taiwan has already contributed to upgrading the social status of women, as can be seen in the increasing female participation rate, female employment, and female earnings. Better education is a critical factor for continuing improvement in the social status of women in the future.

Moving to the influence of education, Chang (1996) analysed a sample of 4049 observations of people aged 60 and over, using data from the 1989 SHLS survey. He indicated that educational status of the elderly is a crucial factor in determining their economic independence and health status. In general, elderly people with better educational attainments are more likely to be economically independent and healthy. In contrast, the elderly with lower educational attainments are unable to be economically independent and are reliant on financial support from their children.

Zimmer and Liu (1999) used an ordered probit model to compare the impact of education on functional limitations[8] across three countries: Taiwan, Thailand and the Philippines. In Taiwan, they used the 1989 SHLS data. They found a strong negative association between education and functional limitation. For example, 71% of those

[7] For example, a woman follows her father's decisions before she is married; and she follows her husband's ideas after she is married; finally, she has to follow her son's guidance after her husband's death.

[8] The meaning of functional limitations is that individuals were asked whether they have any problems walking 200 to 300 metres, shopping or bathing.

with no education report no limitations. This figure rises to about 85% of those with some primary education, and over 90% of those with seven years of education or more. At the same time, the proportion with limitations falls consistently when moving from none to primary to seven or more years of education. For instance, of those without education about 16% reported one limitation. For those who have one to six years of education around 9% reported one limitation, and of those with seven or more years of education only 5% reported a single limitation. However, this study did not examine specifically the intervening effects to analyse the mechanisms by which education influences health and retirement.

Using the 1996 SHLS data, Table 2.7 presents some preliminary results concerning gender and educational attainment. It is helpful in recognising factors influencing retirement behaviour. The proportion of women with educational attainments has been steadily increasing as shown in Table 2.7. For example, the proportion with informal educational attainments decreases from 54.2% amongst women aged 66 to 14.3% amongst those aged 50. Of the women aged 50, 53.1% are educated to primary school level, 26.5% to high school level, and only 6.1% to university or college level. In contrast, informal educational attainment for men has also decreased from 20.6% of those people aged 66 to 2.9% of those aged 50. Of the men aged 50, 46.4% are educated to primary school level, 36.2% to high school level, and 14.5% to university or college level.

Table 2.7 Gender and Educational Attainment by Age

Ages	Men					Women				
	Sample (people)	A (%)	B (%)	C (%)	D (%)	Sample (people)	A (%)	B (%)	C (%)	D (%)
50	69	2.9	46.4	36.2	14.5	49	14.3	53.1	26.5	6.1
51	56	7.1	55.4	25.0	12.5	49	20.4	59.2	16.3	4.1
52	80	3.8	47.5	36.2	12.5	53	34.0	45.3	20.7	0
53	65	4.6	66.1	20.0	9.3	57	43.9	29.8	19.3	7.0
54	88	4.6	45.4	36.4	13.6	48	39.6	41.7	18.7	0
55	86	17.4	50.0	22.1	10.5	57	40.4	50.8	7.0	1.8
56	84	15.5	53.6	21.4	9.5	71	62.0	23.9	9.9	4.2
57	85	16.4	58.8	16.4	8.4	54	63.0	29.6	3.7	3.7
58	64	17.2	46.9	25.0	10.9	51	47.1	43.1	9.8	0
59	70	20.0	50.0	22.9	7.1	45	60.0	28.9	8.9	2.2
60	66	18.1	48.5	25.8	7.6	40	52.5	40.0	5.0	2.5
61	67	16.4	56.6	22.5	4.5	54	33.3	53.7	11.1	1.9
62	61	11.4	67.2	14.8	6.6	43	41.9	46.5	9.3	2.3
63	60	23.3	53.3	16.7	6.7	42	47.6	45.2	2.4	4.8
64	61	16.4	42.6	32.8	8.2	39	48.7	43.6	7.7	0
65	72	13.9	54.1	20.8	11.2	40	52.5	35.0	12.5	0
66	63	20.6	33.3	39.6	6.5	24	54.2	29.2	4.2	12.4
67	26	11.5	42.3	34.6	11.5	7	42.9	57.1	0	0
68	2	0	50.0	50.0	0	1	0	0	100	0
69	1	0	100	0	0	0	0	0	0	0
70	2	0	0	100	0	0	0	0	0	0

Note:

1. According to the 1996 SHLS data, the effective sample has 2052 observations, including 1228 men and 824 women.

2. A represents an informal education and 0 schooling year, B is primary school and 1-6 schooling years, C is high school and 7-12 schooling years, D is college and university and 13 -17 schooling years.

2.4.2.3 Race

Shih (1999) focused on race and occupation factors to examine the impact of pensions on the retirement decisions of older men in Taiwan. The male immigrant population, Mainlander, has occupations concentrated in military and clerical duties mainly in the government sector and to some extent in the tertiary industries[9]. In contrast, the native-born men, collectively known as Taiwanese, are more likely to be farmers, self-employed, or employed by their families, or work in primary industries. Shih found that within the self-employed Taiwanese, most have no pension coverage and have the lowest retirement probability at all ages. The rate of retirement for pensioners before age 60 is generally lower than for non-pensioners, but becomes substantially greater between ages 60 and 65.

The ethnic groups are collected from the SHLS data and some preliminary characteristics are analysed in Table 2.8. The Fujianese group made up 72.5% of the sample[10], but only 23.5% of them have been educated for 7 or more years and 21.4% have eligibility for a pension. Further, Fujianese health is poorer than Mainlander and Hakka. Next, the Hakka group made up 17.2% of the sample and 26.2% of them have been educated for 7 or more years and 25.6% are eligible for a pension. They are the second largest social group in Taiwan after Mainlanders. Furthermore, the Mainlander group made up 8.7% of the sample, 60.7% of Mainlanders have been educated for 7 or more years, 74.7% of the group are eligible for a pension, and Mainlander health is better than Fujianese and Aboriginal. Finally, the Aboriginal group made up 1.6% of the sample, and only 6.1% have been educated for 7 or more years and 9.1% are

[9] Primary industries include agriculture, mining, and fishing. Secondary industries include manufacturing and construction. Tertiary industries include electricity, gas, and water; commerce; transportation, storage, and communication; finance, insurance, and real estate; business services; social, personal, and related community services; and public administration.

[10] See Table 2.8 note.

eligible for a pension. Aboriginal health and economic situations are the poorest in Taiwanese society.

These observations are consistent with the previous discussions, where we noted that Mainlanders had better educational attainments and enjoyed many benefits and pensions from the government sector. The other ethnic groups, including Fujianese, Hakka and Aboriginal, had lower educational attainments and worked in the private sector or were self-employed. They received few benefits or pensions from the government sector until the 1990s. These special situations undoubtedly influence their retirement behaviour.

Table 2.8 Main Characteristics of Race by Different Groups

Unit: %

Race	Fujianese	Hakka	Mainlander	Aboriginal
Age Groups				
Age1 (50-54)	33.1	26.7	11.8	18.2
Age2 (55-59)	33.9	34.1	13.4	57.5
Age3 (60-64)	25.1	29.5	28.1	15.2
Age4 (65-70)	7.9	9.7	46.6	9.1
Gender				
Female	41.8	44.0	15.7	57.6
Male	58.2	56.0	84.3	42.4
Education				
Informal	28.7	18.5	14.6	30.3
1-6 years	47.8	54.3	24.7	63.6
7-12 years	17.9	20.0	40.4	6.1
13-17 years	5.6	6.2	20.3	0
Marital Status				
Married	84.5	86.1	71.9	63.7
Single	1.8	2.0	12.4	3.0
Divorced	1.8	1.1	8.4	12.1
Separated	0.9	0.6	0.6	0
Widowed	11.0	10.2	6.7	21.2
Health Status				
Excellent	17.2	31.0	24.3	23.3
Good	22.8	25.5	26.0	3.3
Average	35.0	24.9	29.0	30.0
Not so good	21.9	17.4	16.6	30.0
Poor	3.1	1.2	4.1	13.4
Pension	21.4	25.6	74.7	9.1
NHI	89.1	92.9	83.7	81.8
Residence Status				
Urban	40.5	24.2	60.3	12.1
Town	23.3	26.2	22.7	21.2
Rural	36.2	49.6	17.0	66.7
Sample	1488	352	178	34

2.4.2.4 Marital Status

It is important to understand the relationship between marital status and retirement behaviour of the elderly. For example, Blau (1998) considered the impact of marital status on retirement and analysed the dynamics of joint labour force behaviour of older couples in the United States. He suggested any policy that increased the incentive for one member of a married couple to retire would have an additional effect on retirement of the other spouse. An et al. (1999) used the Cox proportional hazard model to analyse the retirement behaviour of married couples in the US and confirmed the asymmetric effects between a husband's and a wife's income on their retirement hazards. In Taiwan, most people are more likely to be married, and dual-career couples are becoming increasingly predominant in the cohorts approaching retirement and are likely to coordinate their retirement. Therefore, this study will examine the effect of marital status on retirement behaviour.

The SHLS records some relationships between employment and marital status, including whether respondents are married, single, divorced, separated or widowed. First, for participation in work, Table 2.3 shows that 88.2% of full-time workers married are higher than 81.7% of part-time workers married. This implies that people with full-time job may have a higher proportion of married than with part-time work. Second, for those who stopped work and retirees, Table 2.4 presents that 77.7% of those who stopped work married are similar with 76.8% of retirees married. Third, for labour force transitions, Table 2.5 illustrates that 86.8% of those who were continuing work married, 85% moving from work to retirement married, and 78.8% who moved from work to unemployment married as well. This suggests that people continuing working may have a higher proportion of married than otherwise.

2.4.2.5 Health Status

In many empirical studies, health has been found to be an important factor in the decision to retire. Poor health is associated with a higher probability of retirement. For example, Quinn (1977) analysed a sample of 4354 white married men aged 58 to 63, using data from the US Longitudinal Health and Retirement Survey (LRHS). His major findings were that health and current eligibility for social security and other pensions are the most important determinants of labour force participation and both have negative effects on work. Diamond and Hausman (1984) found that bad health had the largest positive effect on retirement probability of the demographic variables, and both pension and social security had the expected positive effects on the probability of retirement. Dwyer and Mitchell (1998) found that health problems influence retirement plans more strongly than do economic variables. Specifically, men in poor overall health were expected to retire one to two years earlier, an effect that persisted after allowing for potential endogeneity of self-rated health problems.

Some preliminary characteristics between employment and health status are presented below. For participation in work, Table 2.3 shows that only 14.7% of the full-time workers with poor health (including not so good and poor) are lower than 18.8% of part-time workers with poor health. This suggests that people working full-time job may have a lower proportion of poor health than working part-time. However, for those who stopped work and retirees, Table 2.4 presents that 36.2% of those who stopped work with poor health are lower than 41.0% of retirees with poor health. This implies that people with poor health may be forced to retire, that is a mandatory retirement. In contrast, people stopped work might consider other factors, not only for poor health. Therefore, those who stopped work may have a lower proportion of poor health than retirees'. Finally, for labour force transitions, Table 2.5

illustrates that 15.0% of those who were continuing work in 1996, 14.1% of those who were continuing work in 1999, and 21.8% who moved from work to retirement had poor health. In particular, the Taiwanese government operated the programmes of National Health Insurance (NHI) for improving people's health from 1995. Hence, people continuing work in 1999 may have a lower proportion of poor health than in 1996. Therefore, health status is an important determinant of labour force participation and retirement behaviour.

2.4.2.6 Pension

A number of studies have examined the effect of pension provision on retirement. For example, Lazear (1986) found that those with pension entitlements are more likely to retire than those without. Hurd (1990) summarised that private pension coverage grew rapidly and influenced retirement decisions, including defined benefit pensions and defined contribution pensions. The former plan is defined by the retirement benefits that the workers will have. Typically benefits are a function of years of service at a particular firm, age at retirement, and earnings with the firm. The latter plan is defined by the contributions the workers and the firm make to the plan. Typically the plan will specify that the firm will contribute some fraction of the workers' earnings to purchase financial assets.

Table 2.8 shows that in Taiwan 74.7% of the Mainlander group is eligible for a pension, but only 21.4% of the Fujianese group, 25.6% of the Hakka group and 9.1% of the Aboriginal group are eligible for pensions. This unique situation heavily influences the retirement choices of various ethnic groups. This study examines workers with eligibility for pensions and the impact of pensions on the expected years of work in old age. Government employees, including civilians and soldiers, are

eligible for a pension. When they retire and receive their pension, they can deposit part of this amount with financial institutions which are required to pay 18% per annum interest.[11] This acts as a great inducement to elderly workers with a pension to retire early.

2.4.2.7 Social Security System

Previous studies that examined the effects of social security benefits on retirement behaviour have found them to be similar to those of people eligible for a pension. Lazear (1986) showed that eligibility for social security benefits is associated with earlier retirement. Hurd (1990) stated that social security benefits would be one of three sources of retirement income, the others being private pensions and savings. However, Burtless (1999) noted that the effect of social security on retirement depends on the social security tax and the benefit formula linking monthly pension to a worker's past covered earnings. If early contributors to the pay-as-you-go retirement system make much smaller contributions to the scheme than will be needed when the system is fully mature, future generations will not receive such a good deal under social security. Young workers today may actually receive lower benefits under the system than their contributions would have earned if they had been invested in safe assets, such as government bonds.

However, the availability of the social security benefits and taxes system is quite limited in Taiwan. As mentioned in Chapter 1, most elderly people still depend on their personal savings and family support. Only a relatively small proportion of people working in the government sector or large companies have occupational pensions. As shown in Tables 2.3 and 2.4, about 90% of current workers and retirees

[11] This regulation is contained in the Civil Servant Retirement Regulations in Taiwan.

joined in the National Health Insurance system in 1996. The Taiwanese government had been planning to provide a simple national pension programme for older people beginning in the year 2000. However, there was a big earthquake in 1999, as a result of which the Taiwanese government delayed implementing this system because funds were not available for it.

2.4.2.8 Economic Status

Hurd (1990) recorded his research on the elderly, including economic status, retirement, and consumption and saving. As he found these measures of economic well-being to be better than simple income statistics, he used these measures to determine if the economic status of the elderly has improved faster than the economic status of the non-elderly, and if it is higher than the economic status of the non-elderly. Furthermore, Hermalin et al. (1999) attempted to provide a multi-dimensional concept to examine the economic status of the elderly in Taiwan. The data used was from the first panel of 1989 and 1996 SHLS and it was found that there were three major sources of income for the elderly – earnings (20%), pension and retirement funds (29%), and children (36%) – with other sources, like savings and investments and family businesses, cited by the remaining respondents as their major source.

Table 2.9 presents the major sources of income for respondents and their spouses in the 1996 SHLS, which include income from earnings, pension, savings, family businesses, farming, children or other relatives, and others. For over 50% of respondents their most important source of income is from earnings and the earnings of their spouses; for 10.4% it is from pensions; for 4.1% it is from rented property, savings, and stock; for less than 10% it is from self employment i.e. family businesses or farming, timber, fishing, animal husbandry; and for 20.2% of those individuals it is

from children or other relatives. In general, those who relied on children as their major income source reported lower incomes than those who reported other major sources, as one might expect.

Table 2.9 Major Sources of Respondent and their Spouse's Income

Major Sources of Income	Each Term Percentage (%)	Cumulated Percentage (%)
Respondent's Earnings from Work	41.9	41.9
Spouse's Earnings from Work	12.7	54.6
Pension, Retirement Fund, Insurance	10.4	65.0
Rental Property, Savings, Stock etc.	4.1	69.1
Family Businesses	3.7	72.8
Farming, Timber, Fishing, Animal Husbandry	5.9	78.7
Children or Other Relatives	20.2	98.9
Other	1.1	100.0

Note:
According to the 1996 SHLS data, the effective sample has 2052 observations, including 2019 observations answering as the above results and 33 observations answering "no income" or "do not know".

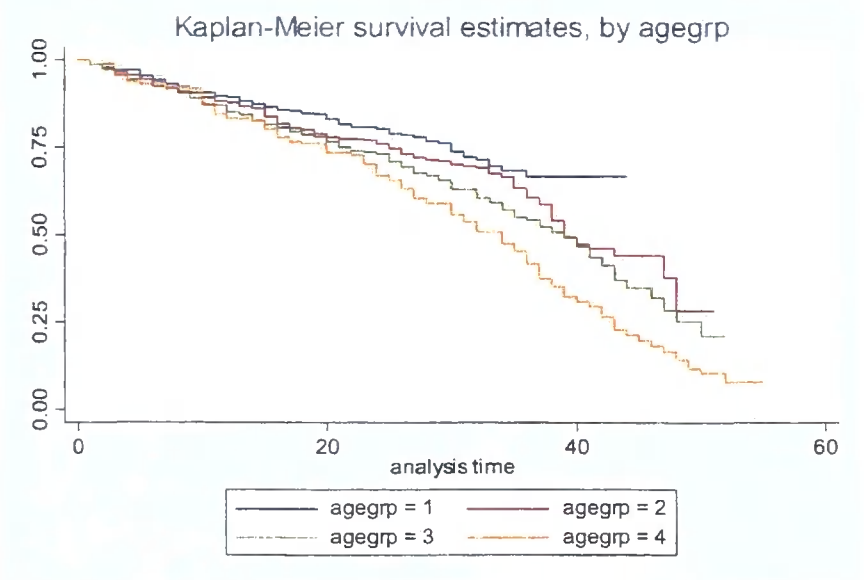
2.5 Preliminary Results of Study of Retirement Behaviour in Taiwan

This section uses a nonparametric approach[12] - Kaplan-Meier (KM) estimates to conduct a preliminary analysis of decisions to retire made by Taiwanese people. First, Table 2.10 lists the number of respondents, the estimated median time of employment duration, the number of retirees, and rates of retirement for each group. Second, Table 2.11 shows test statistics and p-values for examining the null hypothesis of employment survival function in the SHLS Study. Third, preliminary result of the factors influencing retirement hazard, including the variables of age, gender, race, educational attainment, marital status, health, pension benefits, social security system, and economic status are discussed. In particular, the log-rank test is a large-sample chi-square test that uses as its test criterion a statistic that provides an overall comparison of the KM curves being compared. For two groups, the null hypothesis (H_0) being tested is that there is no overall difference between the two employment survival curves. Under this null hypothesis, the log-rank statistic is approximately chi-square with one degree of freedom. Thus, a P-value for the log-rank test is determined from tables of the chi-square distribution. The log-rank test can also be used to compare three or more survival curves. The null hypothesis for this more general situation is that all survival curves are the same (see, Kleinbaum and Klein, 2005).

First, age is explored. The effect of ageing alone is important in explaining why people retire. According to the Labour Standards Law (Chapter 6 Retirement, Article 53 and 54) in Taiwan, workers can choose their retirement ages at 50, 55, 60 or 65. Therefore, the age is a continuous variable, but it can be divided into four groups:

[12] This approach can be a discrete time model, and the time of duration in employment t is an integer ranging from 0 to n in steps of 1 year. See, 2.7 Appendixes (A).

Age1 (aged 50 to 54), Age2 (aged 55 to 59), Age3 (aged 60 to 64), and Age4 (aged 65 to 70) for considering the above four possible retirement ages. The estimated median time of employment duration is 43 years for the oldest group in Table 2.10, which is considerably longer than the estimated median in each of the other groups. This implies that the oldest subjects may have longer employment duration than younger subjects. Thus, the oldest workers have a higher proportion rate of retirement. In addition, Table 2.11 shows that the log-rank statistic of Age groups is 31.40, the generalised Wilcoxon test is 16.18, and the corresponding P-value is zero to three decimal places. This P-value presents that null hypothesis should be rejected. Therefore, the Age groups have significantly different KM employment survival curves. In the meanwhile, the graphs of Kaplan-Meier estimates of the employment survival function for the four age groups are also shown in Figure 2.6. Note that the employment survival curve for Age1 group lies above those of the other three groups. Therefore, the relatively older groups have a lower employment survival rate and are more likely to retire.



Note: Agegrp = 1 is workers aged 50 to 54, Agegrp = 2 is workers aged 55 to 59, Agegrp = 3 is workers aged 60 to 64, and Agegrp = 4 is workers aged 65 to 70.

Figure 2.6 Kaplan-Meier Survival Estimates by Age

Table 2.10 Number of Respondents, Estimated Median Employment Duration, Retirees, and Rate of Retirement in the SHLS Study

Variables	Number of Respondents (Persons)	Estimated Median Employment Duration (95% CIE) (Years)	Number of Retirees (Persons)	Rate of Retirement (%)
Age				
Age1 (50-54)	540	34 (30, 38)	96	17.8
Age2 (55-59)	553	36 (32, 40)	166	30.0
Age3 (60-64)	442	39 (35, 41)	213	48.2
Age4 (65-70)	197	43 (39, 46)	135	68.5
Gender				
Male	1059	43 (42, 46)	271	25.6
Female	673	29 (26, 32)	339	50.4
Race				
Fujianese	1254	39 (38, 40)	436	34.8
Hakka	302	46 (42, 49)	91	30.1
Mainlander	148	30 (25, 32)	72	48.6
Aboriginal	28	41 (27, 46)	11	39.3
Education				
Informal	432	35 (32, 37)	204	47.2
1-6 years	819	40 (38, 43)	288	35.2
7-12 years	362	40 (37, 43)	94	26.0
13-17 years	119	42 (40, 44)	24	20.2
Health Status				
Excellent	342	47 (42, 49)	66	19.3
Good	379	44 (42, 48)	85	22.4
Average	542	38 (36, 41)	190	35.1
Not so good	348	34 (28, 36)	195	55.0
Poor	52	30 (21, 34)	42	80.8
Marital Status				
Married	1457	40 (39, 42)	469	32.2
Single	47	32 (26, 39)	23	48.9
Divorced	40	28 (16, 43)	18	45.0
Separated	12	- (10, -)	2	16.7
Widowed	176	30 (26, 36)	98	55.7

Pension				
Eligible	463	37 (35, 40)	147	31.7
Otherwise	1269	39 (38, 41)	463	36.5
NHI				
Eligible	1548	39 (38, 41)	549	35.5
Otherwise	184	38 (35, 42)	61	33.2
Residence				
Urban	658	37 (35, 39)	235	35.7
Town	411	36 (34, 39)	155	37.7
Rural	663	43 (40, 47)	220	33.2

Note:

1. According to the 1996 SHLS data, the sample of duration model that has 1732 observations, including 610 retirees and 1122 current workers. However, there are 69 observations missing for no answer the questions about health status.
2. The rate of retirement means that the number of retirees is divided by the number of respondents, and the benchmark retirement rate is 35.2% (610/1732).

Table 2.11 Listing of the Test Statistics and *p*-Values for the Different Employment Survival Curves in the SHLS Study

Variables	Log-rank Test		Generalised Wilcoxon Test	
	Value	*p*-Value	Value	*p*-Value
Age Groups	31.40	0.000	16.18	0.000
Gender	195.74	0.000	204.78	0.000
Race Groups	44.73	0.000	16.32	0.001
Education Groups	26.06	0.000	24.53	0.000
Health Statuses	99.45	0.000	70.64	0.000
Marital Status	35.36	0.000	30.62	0.000
Pension	101.51	0.000	32.55	0.000
NHI	1.56	0.211	0.97	0.324
Residence Groups	37.18	0.000	27.73	0.000

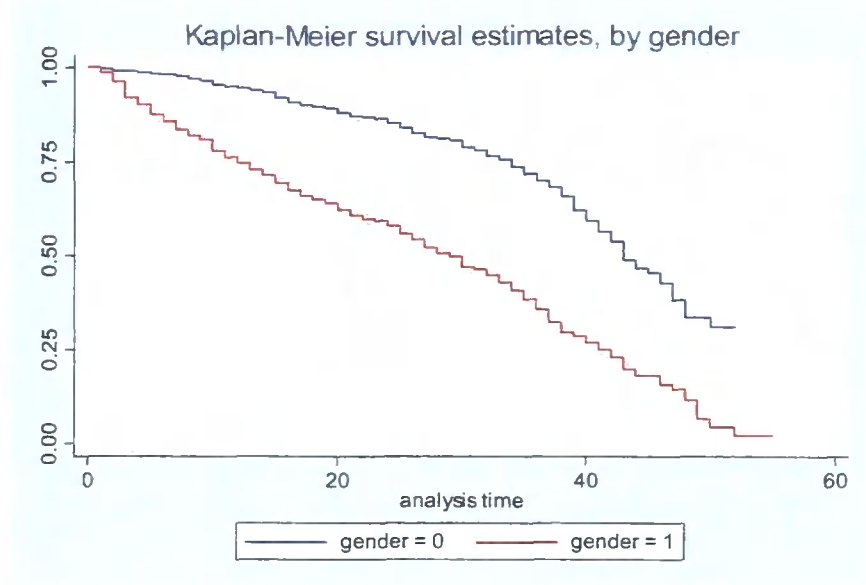
Note: See Table 2.10.

For the Gender variable, Table 2.10 indicates that the estimated median time of employment duration is 43 years for male workers, which is considerably longer than female workers. This suggests that men may have a longer employment survival experience than women. In particular, the traditional social values of Taiwanese society mean that women tend to carry out domestic work and often abstain from working outside the home. Thus, female workers have a higher proportion rate of retirement than males. In addition, Table 2.11 shows that the log-rank statistic of Gender is 195.74, the generalised Wilcoxon test is 204.78, and the corresponding P-value is zero to three decimal places. This P-value indicates that null hypothesis should be rejected. We can therefore conclude that male and female groups have significantly different KM employment survival curves. Moreover, Figure 2.7 shows the graph of the Kaplan-Meier estimates of the survival functions for gender groups. Basically, female workers survival estimates tend to be below those of male workers. This implies that females have a lower survival rate of employment duration and are more likely to retire.

Regarding the Race variables, due to the differences in cultural attitudes to work or differences in family support arrangements, the estimated median time of employment duration is 46 years for Hakka workers, 41 years for Aboriginals, 39 years for Fujianese, and 30 years for Mainlanders as shown in Table 2.10. This suggests that these Hakka workers may have a more favourable employment survival experience than the other three groups. Thus, Hakka workers have the lowest rate of retirement. In addition, Table 2.11 shows that the log-rank statistic of Race is 44.73, the generalised Wilcoxon test is 16.32, and the corresponding P-value is zero to three decimal places. This P-value indicates that null hypothesis should be rejected. Therefore, we can find that Race1 (Fujianese), Race2 (Hakka), Race3 (Mainlander)

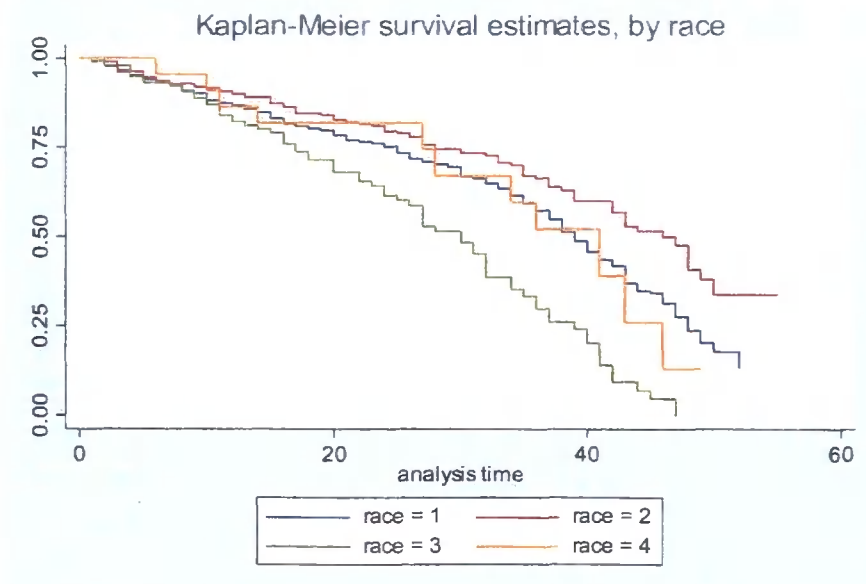
and Race4 (Aboriginal) groups have significantly different KM employment survival curves. In the meantime, the Kaplan-Meier estimates of the survival functions for the four race groups are shown in Figure 2.8. Note that the survival curve for the Race2 (Hakka) group lies above those of the other three groups, next is Race4 (Aboriginal), then Race1 (Fujianese) and Race3 (Mainlander).

For the Education variable, workers with better educational attainment attract more (as well as more desirable) job opportunities and they would be expected to have longer employment duration. For instance, Table 2.10 shows that the estimated median time of employment duration is statistically significant at 42 years for Edu4 (university), 40 years for Edu3 (high school), 40 years for Edu2 (primary school), and 35 years for Edu1 (informal education). In addition, Table 2.11 shows that the log-rank statistic of Education Groups is 26.06 and the generalised Wilcoxon test is 24.53. This P-value indicates that null hypothesis should be rejected. Therefore, the groups of Edu1 (informal education), Edu2 (primary school), Edu3 (high school) and Edu4 (university) have significantly different KM employment survival curves. In the meanwhile, the graph of the Kaplan-Meier estimates of the employment survival function for education levels is shown in Figure 2.9. Interestingly, the employment survival curve for Edu4 level lies above those of the other three levels before 42 years in the duration of employment, next is Edu3, then Edu2, and Edu1. The basic interpretation is that the better the education levels, the higher the survival rate, particularly that people with better educational attainments have significantly longer employment duration.



Note: Gender = 1 is female workers, and Gender = 0 is male workers.

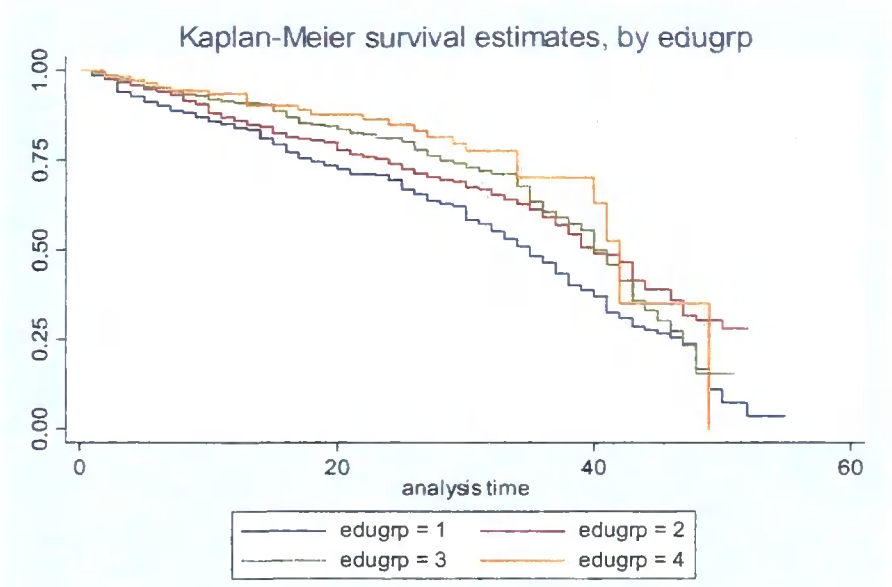
Figure 2.7 Kaplan-Meier Survival Estimates by Gender



Note: Race = 1 is Fujianese, Race = 2 is Hakka, Race = 3 is Mainlander, and Race = 4 is Aboriginal.

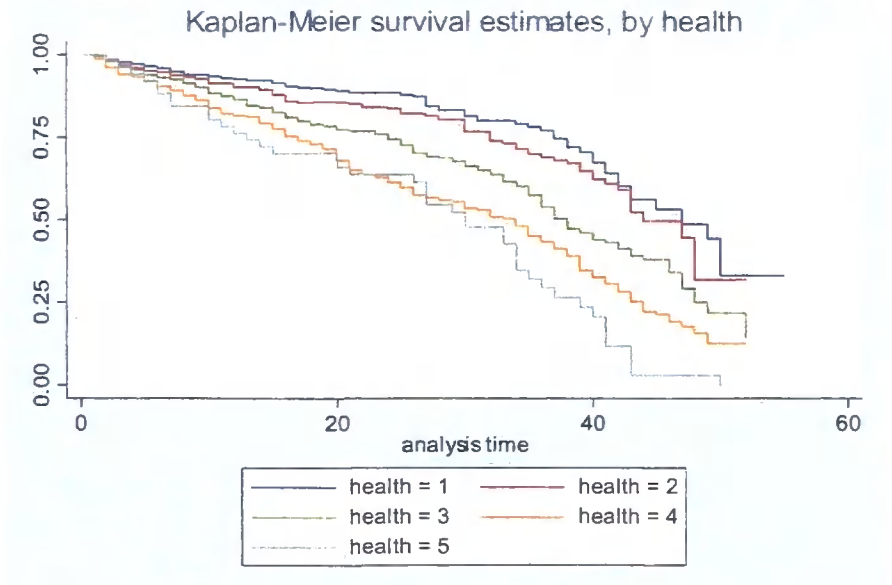
Figure 2.8 Kaplan-Meier Survival Estimates by Race

Next, the effects of Health on labour force participation are in most cases statistically significant and negative. Hence, the estimated median time of employment duration is 47 years for workers with excellent health, 44 years for good health, 38 years for average, 34 years for not so good, and 30 years for poor health as shown in Table 2.10. This suggests that workers with poor health may have a less favourable employment survival experience than others. That is, workers with poor health have a higher proportion rate of retirement. In addition, Table 2.11 shows that the log-rank statistic of Health Statuses is 99.45 and the generalised Wilcoxon test is 70.64. This P-value indicates that null hypothesis should be rejected. Therefore, the statuses of Health1 (excellent), Health2 (good), Health3 (average), Health4 (not so good), and Health5 (poor) have significantly different KM employment survival curves. In the meanwhile, the Kaplan-Meier estimates of the employment survival functions for the five health groups are shown in Figure 2.10. Note that the survival curve for workers with excellent health group lies above those of the other four groups.



Note: Edugrp = 1 is people with informal education; Edugrp = 2 is with 1-6 years of schooling; Edugrp = 3 is with 7-12 years of schooling; and Edugrp = 4 is with 13-17 years of schooling.

Figure 2.9 Kaplan-Meier Survival Estimates by Education



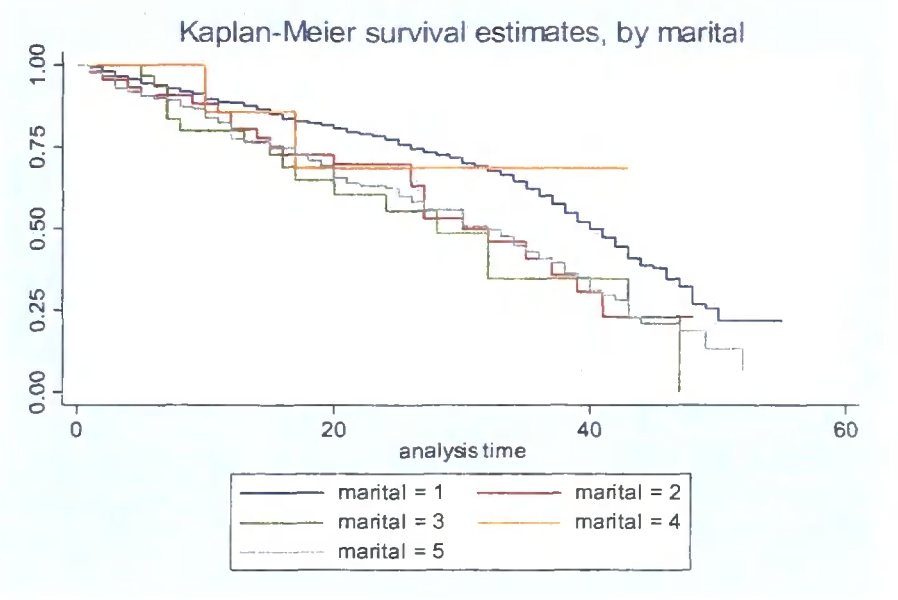
Note: Health = 1 is workers with excellent health, Health = 2 is workers with good health, Health = 3 is workers with average health, Health = 4 is workers with not so good health, and Health = 5 is workers with poor health in the 1996 SHLS survey.

Figure 2.10 Kaplan-Meier Survival Estimates by Health Status

According to the SHLS survey, the Marital status variable can be broken into five groups: Married, Single, Separated, Divorced, and Widowed. The estimated median time of employment duration is 40 years for the Married group as shown in Table 2.10, which is considerably larger than the estimated median for each of the other groups. This suggests that these married subjects may have a more favourable survival experience than unmarried subjects. Thus, married workers relatively have a lower proportion rate of retirement, except for the separated group. In addition, Table 2.11 shows that the log-rank statistic of Marital Statuses is 35.36 and the generalised Wilcoxon test is 30.62. This P-value indicates that null hypothesis should be rejected. Therefore, the statuses of Marital1 (Married), Marital2 (Single), Marital3 (Separated), Marital4 (Divorced), and Marital5 (Widowed) have significantly different KM employment survival curves. In the meanwhile, the Kaplan-Meier estimates of the survival functions for the five marital status groups are shown in Figure 2.11. Note that the survival curve for the Married group lies above those of the other groups, except for the Separated group.

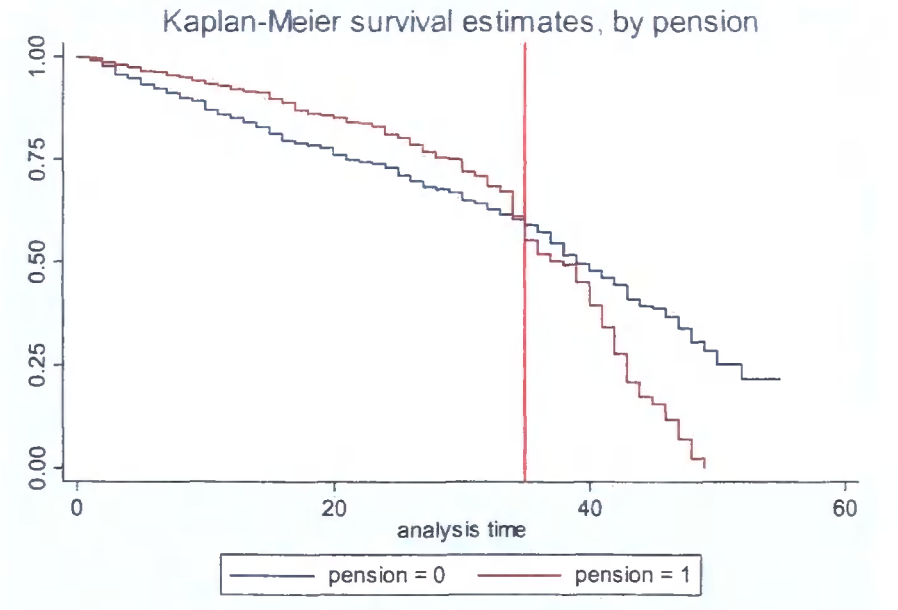
Regarding the Pension variable, the estimated median time of employment duration is 37 years for workers eligible for a pension as shown in Table 2.10, which is considerably lower than for workers ineligible for a pension. This suggests that workers eligible for a pension may have a less favourable employment survival experience than workers ineligible for a pension. In the meanwhile, Table 2.11 shows that the log-rank statistic of Pension is 101.51 and the generalised Wilcoxon test is 32.55, and the corresponding P-value is zero to three decimal places. This P-value indicates that null hypothesis should be rejected. We can therefore conclude that workers eligible and ineligible for a pension have significantly different KM employment survival curves. In addition, Figure 2.12.1 presents a curious observation

from the graph of the Kaplan-Meier estimates of the employment survival function for workers eligible for a pension. For workers with less than 35 years employment duration, the survival curve for workers eligible for a pension lies above that of workers ineligible for a pension. The intuition behind this fact is that eligibility for a pension provides a higher incentive for continued labour force participation, in order to continue building up the size of pension entitlement. But after working 35 years people eligible for a pension have a lower survival rate than those ineligible for a pension. This suggests that after 35 years of employment duration, those workers with pensions have a lower utility in working than retiring with a pension. Perhaps workers place greater emphasis on leisure than continuing participation in the labour force. However, there are some different situations for men and women. For instance, men eligible for a pension have a lower survival rate of employment duration after working 17 years, and women eligible for a pension have a higher survival rate of employment duration before working 47 years and a lower survival rate of employment duration after working 47 years as shown in Figures 2.12.2 and 2.12.3.



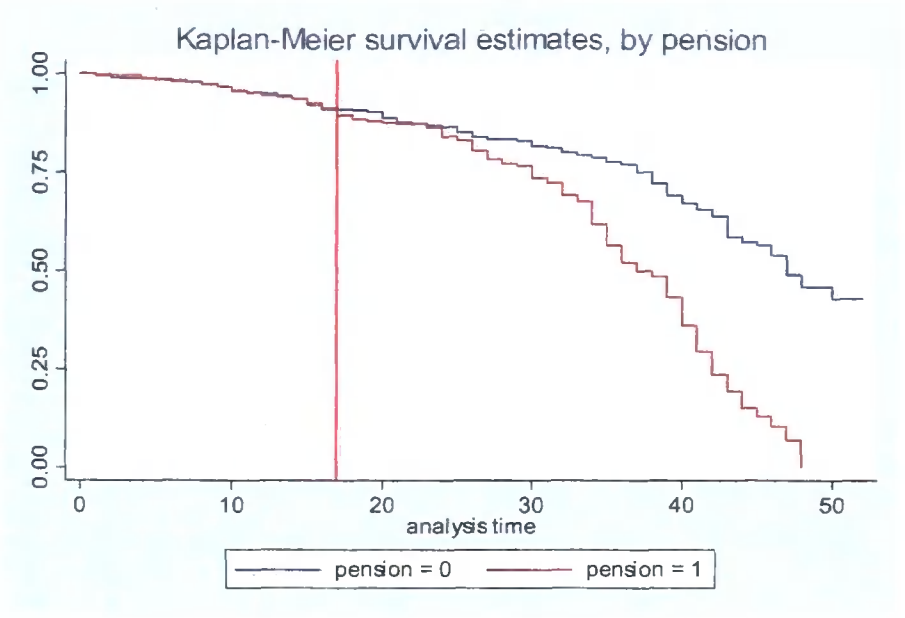
Note: Marital status if Marital = 1 is married, Marital = 2 single, Marital = 3 separated, Marital = 4 divorced, and Marital = 5 deceased in the 1996 SHLS survey.

Figure 2.11 Kaplan-Meier Survival Estimates by Marital Status



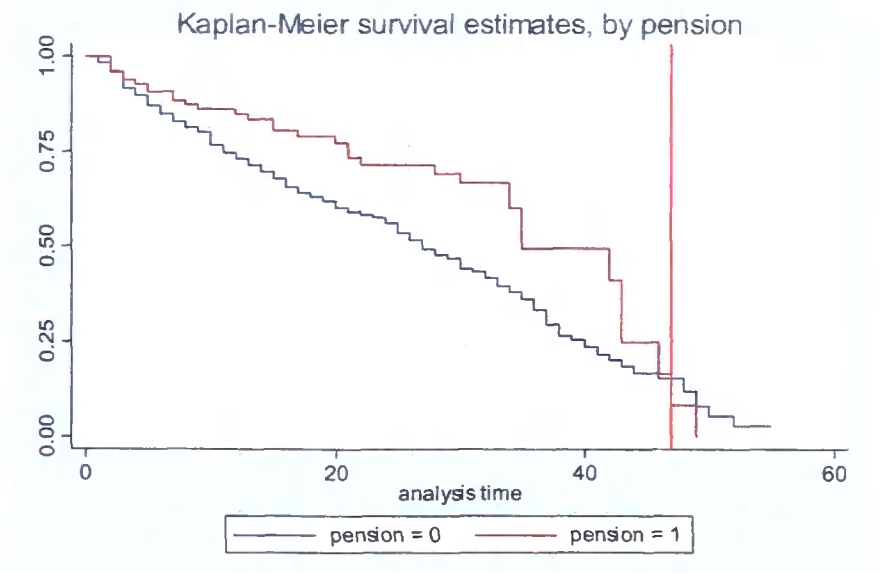
Note: Pension = 1 is workers eligible for a pension, and Pension = 0 is workers not eligible for a pension. The vertical red line represents 35 years of employment duration.

Figure 2.12.1 Kaplan-Meier Survival Estimates by Pension



Note: Pension = 1 is workers eligible for a pension, and Pension = 0 is workers not eligible for a pension. The vertical red line represents 17 years of employment duration by men.

Figure 2.12.2 Kaplan-Meier Survival Estimates by Pension and Men



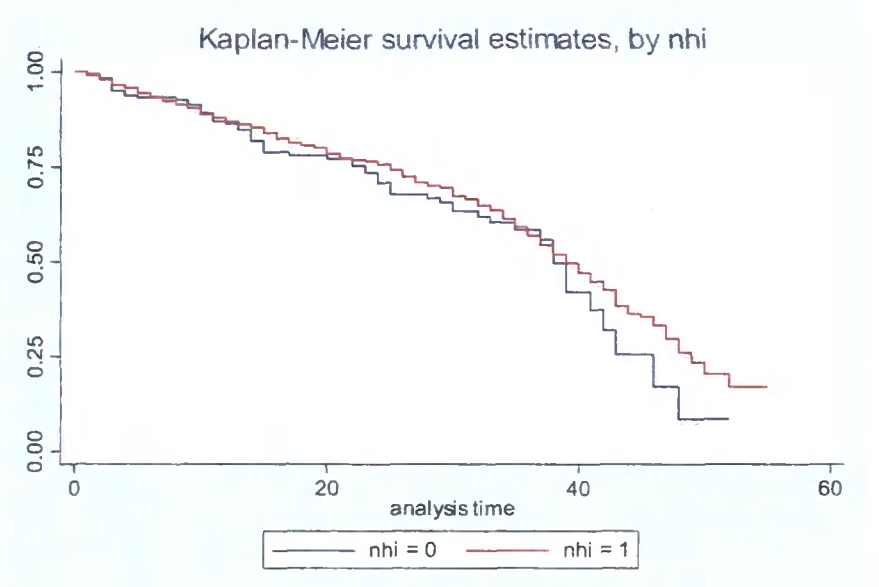
Note: Pension = 1 is workers eligible for a pension, and Pension = 0 is workers not eligible for a pension. The vertical red line represents 47 years of employment duration by women.

Figure 2.12.3 Kaplan-Meier Survival Estimates by Pension and Women

For the National Health Insurance (NHI) variable, Table 2.10 indicates that the estimated median time of employment duration is 39 years for workers with NHI, which is considerably larger than workers without NHI. This suggests that these workers with NHI may have a more favourable survival experience than workers without NHI, but workers with NHI still have a higher proportion rate of retirement. Furthermore, Table 2.11 shows that the log-rank statistic of NHI variable is 1.56 and the generalised Wilcoxon test is 0.97. The corresponding P-value is 0.211 and 0.324 respectively. This P-value indicates that null hypothesis should be not rejected. Therefore, workers with and without NHI have insignificantly different KM employment survival curves. It might need more time and more data to examine the influence of this factor on retirement behaviour in Taiwan. In the meanwhile, the Kaplan-Meier estimates of the survival functions for workers with NHI groups are shown in Figure 2.13. Note that the survival curve for workers with NHI group lies above those of the workers without NHI.

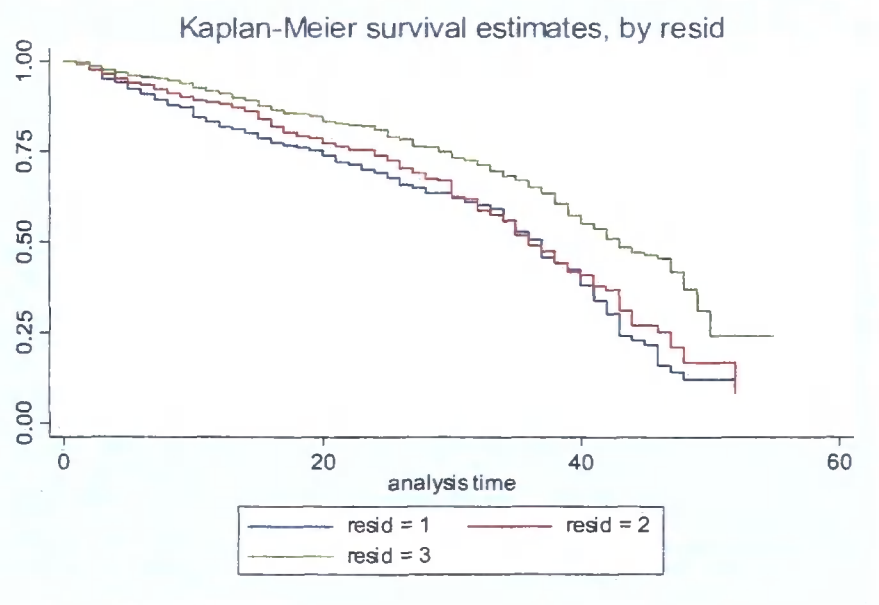
Lastly, regarding the Residence Status variable, due to the differences in job opportunities, the estimated median time of employment duration is 37 years for workers living in urban areas, 36 years in town, 43 years in rural areas as shown in Table 2.10. This suggests that rural workers may have a more favourable survival experience than those living in the other areas. Thus, rural workers have the lowest rate of retirement. In the meantime, Table 2.11 shows that the log-rank statistic of Residence variable is 37.18 and the generalised Wilcoxon test is 27.73, and the corresponding P-value is zero to three decimal places. This P-value indicates that null hypothesis should be rejected. Therefore, workers living in Resid1 (urban), Resid2 (town), and Resid3 (rural) have significantly different KM employment survival curves. In addition, the Kaplan-Meier estimates of the survival functions for the three

residence statuses are shown in Figure 2.14. Note that the survival curve for Resid3 (Rural) group lies above those of the other two groups. This implies that rural workers perhaps have more opportunities for lower skilled jobs or self-employment.



Note: NHI = 1 is workers with National Health Insurance, and NHI = 0 is workers without National Health Insurance.

Figure 2.13 Kaplan-Meier Survival Estimates by NHI



Note: Resid = 1 is workers living in urban areas, Resid = 2 is town areas, Resid = 3 is rural areas.

Figure 2.14 the Kaplan-Meier Survival Estimates by Residence Status

2.6 Conclusions

This Chapter has provided a detailed analysis of the SHLS data and discussed the measures of labour force participation, retirement, and labour force transition. First, a more suitable version of the definition of retirement for the Taiwanese situation is adapted from Diamond and Hausman (1984), Lazear (1986), and Shih (1999). Furthermore, the dependent variable is defined by the specific concept of employment duration, and explanatory variables include relative influencing factors on retirement decisions from the SHLS data. Lastly, non-parametric approaches are used to examine the influencing factors of retirement behaviour in Taiwan.

The preliminary results of this chapter are summarised as follows: (1) the expected retirement ages are at 55, 60 and 65. (2) Female workers have a higher hazard rate of retirement than males. This is due to the traditional domestic role women play in households. (3) Most Mainlanders working in the government sector or in the army have a better social position and benefits. Hence, they have a higher hazard rate of retirement than other ethnic groups. (4) Workers with better educational attainment have a lower hazard rate of retirement and they are more likely to continue working. (5) Married workers usually have greater economic needs and they are less likely to retire earlier. (6) Workers eligible for a pension tend to have a higher incentive for employment than workers not eligible for a pension before 34 years worked; and, in contrast, after this duration of employment, workers eligible for a pension have a higher hazard of retirement than workers not eligible for a pension. Lastly, (7) workers with poor health have a higher hazard rate of retirement.[13] For the rest of this thesis, a variety of statistical models are employed, such as the binary response model and duration model, to examine the issues in greater depth.

[13] Findings (2) – (5) are at a given age, as is finding (7).

2.7 Appendix (A):

Duration analysis or survival analysis includes nonparametric, parametric, and semi-parametric approaches. In particular, the nonparametric approach makes no assumption about the functional form of the hazard and survival functions. One main analysis is the Kaplan-Meier (product-limit) estimates as follows:

Let $t_1 < t_2 < t_j < t_k < \infty$ represent the observed retirement time at which the duration of employment is completed spell ends. Further let:

d_j : represent persons observed to retire at t_j.

m_j : represent persons whose observed duration of employment is censored in the interval $\left[t_j, t_{j+1}\right)$ that is still in state at t but not in state by $t+1$.

n_j : represent persons whose duration of employment is at risk ending just immediately prior to t_j that is

$$\begin{aligned} n_j &= (m_j + d_j) + (m_{j+1} + d_{j+1}) + \cdots + (m_k + d_k) \\ &= \sum_{i \geq j}^{k} (m_i + d_i). \end{aligned} \tag{1}$$

Let $\hat{S}(t_1)$ be the proportion of those entering an employment state that survives to the first observed survival time t_1, defined as one minus the proportion who made a transition out of employment state by that time. The latter can be estimated by the number of exits from the labour market divided by the number who were at risk of employment transition: $d_1/(d_1 + m_1) = d_1/n_1$. Further let $\hat{S}(t_2)$ be the proportion surviving to the second observed survival time t_2, defined by one minus the

proportion who made a transition out of the employment state between t_1 and t_2. More generally, at survival time t_j,

$$\hat{S}(t_j) = \prod_{j|t_j<t} (1 - \frac{d_j}{n_j}). \tag{2}$$

The empirical survival function is therefore given by the product of one minus the number of exits from the labour market divided by the number of persons at risk of exit from the labour market. Furthermore, the failure function $\hat{F}(t_j) = 1 - \hat{S}(t_j)$ and integrated hazard function $\hat{H}(t_j)$ can be derived as follows:

Since $\hat{S}(t) = \exp\left[- \hat{H}(t) \right]$, then

$$\hat{H}(t_j) = -\log \hat{S}(t_j). \tag{3}$$

The integrated hazard function can also be used to derive an estimate of the empirical hazard function $h(t_j)$.

2.7 Appendix (B):

The STATA commands for analysing the SHLS data are given below:

```
Use "C:\Documents and Settings\User\My Documents\Revised 2007
Summer\SHLS Data 2007\(A) 1996 Data Set 11062007.dta"

Table 2.3
sum age1- age4 gender race1- race4 edu1- edu4 marit1- marit5 heal1- heal5
pension1 nhi resid1- resid3 if labour==2
Sum age1- age4 gender race1- race4 edu1- edu4 marit1- marit5 heal1- heal5
pension1 nhi resid1- resid3 if labour==1

Table 2.4
sum age1- age4 gender race1- race4 edu1- edu4 marit1- marit5 heal1- heal5
pension3 nhi resid1- resid3 if history==1
sum age1- age4 gender race1- race4 edu1- edu4 marit1- marit5 heal1- heal5
pension3 nhi resid1- resid3 if censor==1

Table 2.5
use "C:\Documents and Settings\User\My Documents\Wen-Shai 2008\Revised
2007 Summer\SHLS Data 2007\Chapter 4 Data Set 082007.dta",
sum age1-age4 gender race1-race4 edu1-edu4 marit1-marit5 heal1-heal5
pension nhi resid1-resid3 if duration~=. & resid~=. & race~=. & eyhat~=.
& censor==0
Use "C:\Documents and Settings\User\My Documents\Wen-Shai 2008\Revised
2007 Summer\SHLS Data 2007\1999 (3) Data Set 082007.dta",
sum age91- age94 gender race1-race4 edu1-edu4  heal91-heal95  marit91-
marit95 pen9 nhi9 resid91-resid93 if dur~=. & resid~=. & cen==0
sum age91- age94 gender race1-race4 edu1-edu4  heal91-heal95  marit91-
marit95 pen9 nhi9 resid91-resid93 if dur~=. & resid~=. & cen==1
sum age91- age94 gender race1-race4 edu1-edu4  heal91-heal95  marit91-
marit95 pen9 nhi9 resid91-resid93 if e1_2==4

Table 2.6
Use "C:\Documents and Settings\User\My Documents\Revised 2007
Summer\SHLS Data 2007\(A) 1996 Data Set 11062007.dta"
stset duration, failure (censor)
sts list
```

```
Table 2.7
tab edugrp if age96==50 & gender==1 & history~=0
tab edugrp if age96==51 & gender==1 & history~=0
.....
tab edugrp if age96==69 & gender==1 & history~=0
tab edugrp if age96==70 & gender==1 & history~=0

tab edugrp if age96==50 & gender==0 & history~=0
tab edugrp if age96==51 & gender==0 & history~=0
.....
tab edugrp if age96==69 & gender==0 & history~=0
tab edugrp if age96==70 & gender==0 & history~=0

Table 2.8
sum age1-age4 gender edu1-edu4 marit1-marit5 heal1-heal5 pension nhi
resid1-resid3 if history~=0 & race==1
sum age1-age4 gender edu1-edu4 marit1-marit5 heal1-heal5 pension nhi
resid1-resid3 if history~=0 & race==2
sum age1-age4 gender edu1-edu4 marit1-marit5 heal1-heal5 pension nhi
resid1-resid3 if history~=0 & race==3
sum age1-age4 gender edu1-edu4 marit1-marit5 heal1-heal5 pension nhi
resid1-resid3 if history~=0 & race==4

Table 2.9
tab f17g3c1
gen mainincome = f17g3c1
replace mainincome=. if mainincome==0| mainincome==9
tab mainincome if history~=0

Table 2.10
stset duration, failure(censor)
stci, by(agegrp)
stci, by(gender)
stci, by(race)
stci, by(edugrp)
stci, by(marital)
stci, by(health)
```

```
stci, by(pension)
stci, by(nhi)
stci, by(resid)

Table 2.11
sts test agegrp, logrank
sts test agegrp, w
sts test gender, logrank
sts test gender, w
sts test race, logrank
sts test race, w
sts test edugrp, logrank
sts test edugrp, w
sts test marital, logrank
sts test marital, w
sts test health, logrank
sts test health, w
sts test pension, logrank
sts test pension, w
sts test nhi, logrank
sts test nhi, w
sts test resid, logrank
sts test resid, w

Figure 2.6
sts graph, by(agegrp)

Figure 2.7
sts graph, by(gender)

Figure 2.8
sts graph, by(race)

Figure 2.9
sts graph, by(edugrp)

Figure 2.10
sts graph, by(health)
```

Figure 2.11

```
sts graph, by(marital)
```

Figure 2.12

```
sts graph, by(pension) xline(35)
```

Figure 2.13

```
sts graph, by(nhi)
```

Figure 2.14

```
sts graph, by(resid)
```

Chapter 3

Labour Force Participation

3.1 Introduction

The purpose of this chapter is to analyse the determinants of labour force participation of the middle-aged and elderly in Taiwan. This is an important topic for understanding their participation in employment, and also acts as a stepping stone to further our knowledge about retirement issues. As mentioned earlier, in Chapter 1, the proportion of the Taiwanese elderly population aged 65 and older rose from 2.5% in 1958 to 8.6% in 2000. This implies that Taiwan has become to an ageing society. Moreover, according to the Yearbook of Manpower Survey Statistics (YMSS, 2002), the labour force participation rates of the middle aged and elderly gradually declined between 1978 and 2000. In particular, the participation rate of male workers aged 50 to 54 decreased from 90.5% in 1978 to 85.5% in 2000. During the same period and for the same age group, the participation rate of females increased from 28.8% to 42.1%. These trends suggest that male workers have a higher participation rate in employment, but their participation rates have gradually declined. Female workers have a relatively lower participation rate in employment, and their participation rates have gradually increased. This raises interesting questions about the relationship between the labour force behaviour of male and female workers amongst the middle-aged and elderly. Which factors are the determinants of labour force participation behaviour? Are the effects of economic variables symmetric, or do the characteristics of individuals affect their decisions?

These and related questions are of inherent scientific interest, and are important for public policy. Recent reforms and proposed changes in National Health Insurance and portable pension plans in Taiwan will alter the incentives and opportunities for the middle-aged and elderly to coordinate their labour force behaviour.

Numerous theoretical studies have examined the determinants of labour force participation (hereafter, LFP), often modelling it as a trade-off between consumption and leisure utility (Killingsworth and Heckman, 1986). Most empirical studies have focused on uncertain future income and provided mixed evidence on the determinants of LFP (see, e.g. Gunderson, 1977; Hurd, 1990; Blau, 1998). Only a few empirical studies test the impact of relevant variables on LFP by using the ordered probit model. Of the empirical studies in Taiwan, Chang (1980) and Chang (1999) focused on living arrangements issues; San (1988) looked at labour law; Schoenbaum (1995), Chou and Staiger (2001), and Mete and Schultz (2002) all focused on health status; Ross and Wu (1995) and Kuo (1997) focused on female workers' labour supply; Zimmer and Liu (1999) examined the impact of education on LFP; and Shih (1999) researched the influence of pensions on individual retirement behaviour.

From these studies, the determinants of LFP are found to originate from a number of factors. The first, naturally, is age, and the second is work experience, as older workers tend to have more work experience and better social positions, and the last factor is education. Since the Survey of Health and Living Status of the Middle-Aged and Elderly in Taiwan (SHLS) is a large, longitudinal survey that follows a cohort and their spouses aged 50 to 70 in 1996, it is specially designed to track the labour market behaviour of older Taiwanese, and their health status. In general, the workers in this sample data were born between 1926 and 1946, a period

that included the Second World War. Consequently the education levels of this group were much lower than those of the current younger workers in Taiwan (YMSS, 2002).

This chapter uses discrete choice models including probit, ordered probit and multinomial logit models to investigate labour force participation determinants. Factors such as personal characteristics, family factors, economic status, and employment opportunity have all been found to influence the LFP rate of the middle-aged and elderly.[1] In general, a probit model can simply examine the choice to work or not work. If there are more than two choices of LFP, a polychotomous model might be used to also analyse the question of whether to work full-time or part-time. However, Duncan (2000) and Mete and Schultz (2002) considered that these choices had a natural (ordinal) ranking and used ordered probit models to analyse the determinants of LFP. By contrast, Boskin (1974) and Schmidt and Strauss (1975) thought that the occupational choices were unordered and used the multinomial logit model to examine the determinants of occupational choices. Thus, this chapter uses the ordered probit and multinomial logit models to examine the choices of whether to work full-time or part-time, and compares the empirical results for these two models. In particular, employers may be much less reluctant to hire and retain older employees if they have the flexibility to hire older workers on a part-time basis, to vary responsibilities as the capabilities of older workers change, and to pay a wage commensurate with productivity rather than one based on seniority.

Furthermore, the factors affecting LFP decisions of the middle-aged and elderly in Taiwan are found to vary by gender. This is because the Taiwanese labour market still has gender segregation. In fact, Taiwan exhibits the so-called core-periphery

[1] See, Raymo and Comman (1999), and Hung (2003a).

phenomenon, a society where males make up the core and females make up the periphery (Goodman and Peng, 1996). Traditionally, men are the income-earners while women stay at home. But the proportion of females in employment has increased from 28.4% in 1951 to 46.61% in 2002 (MUS, 2002). In particular, Kuo noted (1997, p.102) that *"the emphasis on female education has already contributed to upgrading the social status of women, as can be seen in the increasing female participation in labour force rate, female employment, and female earnings"*. To reflect this effect, the estimates of men and women (i.e., gender effects) are separated to analyse the effect on the LFP rate.

The structure of this chapter is as follows. First, the LFP variables among the middle-aged and elderly are described and used in discussion of the current LFP trend in Taiwan, taking into account the rapidly changing social context. Second, the major hypotheses proposed in the literature are tested with discrete choice models. Specifically, the intention is to examine the choice to work or not work by using the probit model, and further to examine the choice to work full-time or part-time using the ordered probit and multinomial logit models. Third, we consider the effects of gender and other factors on LFP decisions using probit, ordered probit and multinomial logit models. The testing of effects is undertaken at the end.

3.2 Basic Facts about Labour Force Participation in Taiwan

This section summarises some basic facts about labour force participation amongst the middle aged and elderly in Taiwan. For the historical trends of labour force participation rates from 1978 to 2006, Table 3.1 shows that there was a slight fall in the labour force participation rates of workers aged 50 to 54 from 65.4% in 1978 to 64.8% in 2006.[2] For men aged 50 to 54, the LFP rate declined 7.1 percentage points between 1978 and 2006. In contrast, the LFP rate of women increased from 28.8% to 46.4% over the same period. However, the decline was steep for men aged 60 to 64, from 67.2% in 1978 to 46.8% in 2006, as more men chose to retire earlier. Moreover, this trend continued for other age groups as well, although at a slower rate. Regarding demographic structure, Table 3.1 can be compared with the sample of SHLS data those who aged 50 to 70 in 1996. The labour force participation rates declined from 65.3% by aged 50 to 54 groups to 8.9% by aged 65 and over groups. The LFP rates of men declined from 88.6% to 13.0% and for women also declined from 41.7% to 3.9% over the same age groups.

There has been a marital status difference in the labour force participation rate as shown in Table 3.2. For single status, there was a fall in the labour force participation rates of men aged 50 to 54 from 67.6% in 1993 to 59.9% in 2005, and for women from 61.9% to 57.1% over the same period. However, the other three age groups showed different trends. The decline was steep for men aged 55 to 59, from 63.3% in 1993 to 46.2% in 2005, but for women there was an increase from 33.3% to 49.5%. This implies that older single women are more determined to manage their later lives than single men, so they have an increasing trend of participation rate. For married

[2] In general, the labour force participation rate is defined as the number of persons in the labour force, (including employed and unemployed) as a percentage of the working age population.

status, Table 3.2 also shows that married male workers have a higher participation rate than single males. In contrast, married female workers have a lower participation rate than single females. This indicates that male Taiwanese workers support their family economically after marriage, whilst some female workers may depend on their partner for economic support and stay at home. But these trends of labour force participation rates for married and single people all declined with age. For widowed, divorced or separated status, Table 3.2 shows that these unmarried workers for most aged groups have a participation rate between married and single workers. This implies that if people cease to be married they have a lower labour force participation rate; however, they have a greater responsibility for their family. So they have a greater incentive to participate in work and have a higher participation rate than those of single status.

The trends in the labour force participation rates by educational attainment are shown as in Table 3.3. Men not only have greater participation rates than women, but are also more likely to be employed if they have better education, particularly for the younger sample. In 1996, for workers aged 50 to 54, 93.3 percent of male college graduates and 68.3 percent of female college graduates were in the labour force, as compared to only 88 and 38 percent of male and female junior high school dropouts, respectively. However, after 1999, most participation rates of labour force gradually declined with age.

The data presented in this section provide the basic stylised facts that have motivated much of the work on the decisions of labour force participation. As we will see, the evidence suggests that personal characteristics, family factors, economic status, and employment opportunity have all been found to influence the LFP rate of the middle-aged and elderly in Taiwan.

Table 3.1 Labour Force Participation Rates for the Middle Aged and Elderly in Taiwan, 1978-2006

Unit: %

Age	50-54			55-59			60-64			65+		
Year	Both	M	F	Both	M	F	Both	M	F	Both	M	F
1978	65.4	90.5	28.8	56.8	82.0	21.5	43.5	67.2	12.9	9.4	16.8	2.4
1979	66.0	91.1	29.7	57.4	82.0	22.8	42.5	64.9	13.1	9.2	16.7	2.0
1980	66.0	90.8	30.7	56.3	79.7	22.8	40.8	62.3	12.4	8.4	15.2	1.7
1981	65.7	90.9	31.0	56.4	80.0	22.7	40.7	62.2	12.1	8.5	15.2	1.8
1982	65.2	90.5	31.7	56.9	79.8	23.7	40.3	60.7	12.8	8.4	14.8	2.0
1983	65.7	89.8	35.0	58.3	79.8	26.8	41.2	60.1	15.6	9.1	15.3	2.7
1984	66.3	90.3	37.3	58.8	79.8	28.2	41.3	59.5	16.4	9.0	15.0	2.8
1985	65.9	90.1	38.4	58.0	79.0	28.0	41.0	58.3	17.0	9.7	15.7	3.3
1986	65.9	90.1	39.6	57.9	78.1	30.0	40.1	56.1	17.5	10.5	16.6	3.8
1987	66.1	90.4	40.5	58.5	79.1	30.9	41.2	57.6	19.3	10.5	16.7	3.8
1988	65.6	91.0	39.4	58.4	80.1	30.9	41.6	57.5	19.0	9.6	15.2	3.4
1989	65.5	91.7	39.0	58.0	80.6	30.7	41.9	58.1	18.9	10.3	16.0	3.9
1990	65.0	90.8	39.1	56.4	79.7	29.9	40.9	56.3	19.0	9.7	14.8	4.0
1991	65.6	91.2	39.9	56.2	80.9	29.9	41.8	57.8	20.0	9.9	14.9	4.1
1992	65.9	91.6	40.1	56.7	81.7	30.9	41.9	58.5	20.3	9.6	14.4	4.0
1993	65.8	91.0	40.4	56.0	81.1	30.8	41.6	58.2	20.8	9.8	14.7	4.0
1994	66.1	90.6	41.4	55.5	80.7	30.4	40.6	58.0	20.1	9.6	14.3	4.0
1995	65.7	90.1	41.3	55.7	80.8	31.1	41.0	59.1	21.0	9.7	14.3	4.2
1996	65.3	88.6	41.7	55.1	80.0	30.8	39.7	57.8	21.0	8.9	13.0	3.9
1997	65.0	88.5	41.4	54.7	79.2	30.8	40.1	59.3	20.9	8.7	12.8	3.8
1998	65.4	89.0	41.7	53.5	77.9	29.7	38.2	57.8	19.2	8.5	12.4	3.8
1999	64.2	86.8	41.6	52.3	74.9	30.1	37.2	56.2	19.0	7.9	11.4	3.8
2000	63.9	85.5	42.1	50.5	72.5	28.8	35.6	53.9	18.4	7.7	11.2	3.7
2001	62.3	83.3	41.1	49.2	71.1	27.7	34.1	52.0	17.3	7.4	10.9	3.5
2002	62.8	82.8	42.6	49.1	70.8	27.8	33.9	51.6	17.2	7.8	11.5	3.7
2003	63.5	83.0	44.1	48.5	68.8	28.6	34.0	50.2	18.7	7.7	11.3	4.0
2004	64.3	83.6	45.0	48.6	68.5	29.1	33.5	49.9	17.9	7.4	10.8	3.9
2005	64.5	83.7	45.4	48.7	68.7	29.1	32.5	48.0	17.7	7.3	10.7	3.8
2006	64.8	83.4	46.4	48.1	68.0	28.7	31.6	46.8	17.1	7.6	11.1	4.0

Note: M is males, and F is females.

Source: Author calculating these data from Table 7 at the website of Directorate General of Budget, Accounting and Statistics, Executive Yuan, ROC, Taiwan (in Chinese): http://www.stat.gov.tw/ct.asp?xItem=17286&ctNode=517.

Table 3.2 Labour Force Participation Rates for the Middle Aged and Elderly by Marital Status in Taiwan, 1993-2005

Unit: %

Single												
Age	50-54			55-59			60-64			65+		
Year	Both	M	F	Both	M	F	Both	M	F	Both	M	F
1993	65.8	67.6	61.9	56.9	63.3	33.3	31.1	31.7	23.6	8.6	8.5	10.8
1994	67.7	72.6	53.6	64.4	65.6	56.3	33.6	34.4	26.5	8.8	8.8	7.7
1995	67.2	71.0	57.5	55.4	56.3	52.9	33.5	33.8	31.4	7.0	7.0	7.0
1996	61.7	62.0	61.2	55.2	58.1	46.9	36.6	39.0	26.4	6.3	6.0	12.1
1997	62.6	65.5	57.4	58.5	62.4	47.0	39.6	41.8	31.3	6.1	6.0	6.9
1998	62.0	64.4	57.6	52.4	54.9	44.3	35.9	36.7	31.0	4.7	4.4	9.8
1999	60.0	59.8	60.3	54.4	54.2	54.8	38.5	40.3	32.0	5.4	5.1	9.1
2000	59.0	59.7	58.0	53.6	51.1	61.0	28.0	29.6	22.4	3.5	3.2	6.8
2001	54.5	51.3	59.8	46.7	46.9	46.3	39.7	37.4	48.5	2.9	2.5	8.0
2002	58.2	55.6	61.8	43.2	41.0	46.5	36.2	32.5	44.3	5.0	4.8	7.0
2003	59.1	55.8	63.4	45.5	48.6	41.9	35.2	36.7	32.1	4.6	4.3	6.9
2004	61.1	60.2	62.2	46.6	47.1	45.9	35.5	36.4	32.5	5.3	4.3	13.2
2005	58.7	59.9	57.1	47.8	46.2	49.5	30.8	31.0	30.3	5.4	4.1	13.6
Married												
1993	66.5	91.9	39.4	57.6	82.1	30.8	44.5	60.9	21.6	13.1	17.4	5.3
1994	66.9	91.5	40.7	56.9	81.6	30.1	43.1	60.0	25.0	12.8	16.7	5.5
1995	66.7	91.1	40.7	57.4	82.0	30.5	43.8	61.1	21.9	12.9	16.7	5.9
1996	66.2	89.6	40.9	56.9	81.1	30.6	42.0	59.0	21.6	11.8	15.1	5.7
1997	66.0	89.8	40.5	56.4	80.3	30.5	42.3	60.5	21.3	11.6	15.0	5.4
1998	66.4	90.2	40.8	55.2	79.2	29.3	40.9	59.3	19.8	11.4	14.7	5.4
1999	65.4	88.3	40.6	54.0	76.1	29.9	39.4	57.0	19.5	10.3	13.3	5.3
2000	64.9	86.9	41.1	51.9	73.7	28.1	37.9	55.5	18.6	9.9	12.8	5.0
2001	63.6	85.4	40.1	50.8	72.3	27.4	36.2	53.3	17.5	9.6	12.5	4.8
2002	63.8	84.6	41.4	50.7	72.2	27.3	36.0	52.9	17.1	10.2	13.1	5.4
2003	64.6	85.1	42.5	50.0	69.9	28.3	35.8	51.1	18.7	10.4	13.0	5.4
2004	65.3	85.3	43.8	50.1	69.7	28.5	35.2	51.0	17.7	9.5	12.2	5.3
2005	65.6	85.7	44.1	50.9	69.9	28.0	34.2	48.9	17.7	9.3	12.1	5.1

Table 3.2 (Continued)

Widowed, Divorced, or Separated												
Age	50-54			55-59			60-64			65+		
Year	Both	M	F	Both	M	F	Both	M	F	Both	M	F
1993	58.1	86.1	45.6	43.8	75.3	30.4	29.4	50.7	18.6	4.4	8.2	2.7
1994	57.5	84.4	45.4	43.5	74.9	31.1	28.7	49.9	18.7	4.3	8.2	2.6
1995	55.6	82.8	43.6	43.3	72.2	33.0	27.9	49.7	17.9	4.6	8.9	2.6
1996	56.5	84.7	45.2	42.0	72.4	31.2	28.3	51.4	18.6	4.0	8.0	2.2
1997	56.7	80.1	45.6	41.9	69.5	31.8	28.0	51.3	19.6	3.7	6.9	2.3
1998	57.2	83.2	45.5	40.6	68.1	30.6	25.1	49.0	17.0	3.6	6.4	2.4
1999	54.5	77.8	44.8	39.1	65.2	29.8	25.7	52.2	16.8	3.4	6.3	2.2
2000	55.5	78.3	45.8	40.1	65.0	30.5	24.3	43.4	17.3	3.7	7.0	2.3
2001	52.9	71.7	44.2	37.9	63.0	27.9	22.6	42.0	15.8	3.3	6.0	2.1
2002	54.8	74.5	45.6	38.5	62.4	28.8	22.4	42.1	16.1	3.1	6.0	1.9
2003	56.5	72.8	48.6	37.9	61.5	28.2	24.3	42.9	18.1	3.4	5.9	2.4
2004	57.3	75.7	48.0	38.5	61.0	29.7	24.2	41.1	18.4	3.3	5.9	2.2
2005	58.0	74.5	49.7	40.0	61.9	31.3	24.0	42.6	17.3	3.2	5.7	2.3

Note: M is males, and F is females.

Source: Author calculating these data from Table 40 at the website of Directorate General of Budget, Accounting and Statistics, Executive Yuan, ROC, Taiwan (in Chinese): http://www.stat.gov.tw/ct.asp?xItem=17286&ctNode=517.

Table 3.3 Labour Force Participation Rates for the Middle Aged and Elderly by Educational Attainment in Taiwan, 1996 and 2005

Unit: %

Year	1996											
Age	50-54			55-59			60-64			65+		
Sample	Both	M	F	Both	M	F	Both	M	F	Both	M	F
Informal Education	44.9	74.7	39.9	41.9	76.9	31.2	31.2	57.2	22.3	5.5	9.7	3.6
Primary School	63.1	88.0	39.3	56.0	79.1	29.8	42.0	59.5	20.4	12.0	15.5	4.9
Junior High School	67.6	88.0	38.0	56.7	80.7	24.6	36.1	50.8	14.0	11.1	13.4	3.5
Senior High School	75.8	90.0	48.8	68.4	81.8	35.5	47.9	54.5	22.5	9.9	11.3	4.3
University	86.5	93.5	68.3	79.2	86.1	53.8	55.2	59.0	33.8	10.8	11.8	3.0
Year	1999											
Informal Education	40.1	66.7	34.5	37.4	66.0	30.1	30.3	54.4	20.3	4.9	8.5	3.1
Primary School	59.2	85.9	38.7	51.2	74.9	28.6	39.2	59.1	18.5	11.0	14.9	5.2
Junior High School	64.2	86.0	37.8	53.2	74.5	26.1	32.0	48.5	11.5	8.2	10.4	3.0
Senior High School	72.9	88.2	48.5	62.7	75.5	34.7	43.2	52.2	20.6	7.1	8.4	3.3
University	82.3	90.1	64.2	71.2	79.2	48.9	49.0	55.9	26.6	8.3	9.1	3.1
Year	2003											
Informal Education	41.4	57.1	37.9	31.8	54.3	27.1	26.5	45.8	20.6	5.6	9.3	4.0
Primary School	57.9	81.5	40.2	46.4	70.1	27.9	36.1	54.3	18.8	10.5	15.1	4.8
Junior High School	66.3	84.5	43.5	50.0	69.1	25.4	32.1	46.6	13.7	7.3	9.9	2.6
Senior High School	68.1	85.4	48.2	55.1	70.5	32.2	36.6	45.7	19.5	5.3	7.0	1.4
University	74.4	83.8	56.4	55.4	65.6	33.4	35.9	44.6	14.2	6.3	7.2	1.9
Year	2005											
Informal Education	38.8	55.0	35.6	29.1	51.2	25.9	22.4	46.1	17.4	5.1	8.8	3.7
Primary School	58.1	82.6	41.1	45.3	69.0	27.9	34.2	52.1	19.5	9.6	13.7	4.6
Junior High School	66.6	84.7	43.1	51.3	71.1	27.9	30.5	44.9	12.4	6.0	8.2	2.5
Senior High School	68.5	85.3	50.1	54.6	70.2	33.9	31.6	44.1	12.6	6.5	8.4	2.4
University	73.1	83.3	55.6	53.9	65.8	31.4	34.0	41.1	17.0	6.1	7.0	2.3

Note: M is males, and F is females.

Source: Author calculating these data from Table 41 at the website of Directorate General of Budget, Accounting and Statistics, Executive Yuan, ROC, Taiwan (in Chinese): http://www.stat.gov.tw/ct.asp?xItem=17286&ctNode=517.

3.3 Theoretical Framework of Labour Force Participation

This section presents a simple model of LFP in Taiwan. According to labour supply theory, the demand by individuals for leisure and consumer goods depends on wages offered in the labour force and other exogenous factors (See, for example, Killingsworth and Heckman, 1986). This simple labour supply framework leads directly to a model of labour force participation (L) as a function of a number of variables. This chapter extends the analysis to Taiwan and takes into account the local economic and social structure. We first state the relevant factors and then provide individual explanations for the choice of selected factors.

The specific factors used in the estimation include: Age (A_i), Gender (G_i), Race (R_i), Education (E_i), Health status (H_i), Marital status (M_i), Pension (P_i), Residence (U_i), and other variables (α_i). In notation form:

$$L = L(A_i, G_i, R_i, E_i, H_i, M_i, P_i, U_i, \alpha_i) \qquad i = 1,2,...,n.. \tag{3.1}$$

where n is the total number of observations. Before actually estimating the model it will be useful to discuss the signs of the estimated coefficients that one might expect. The details are as follows.

Age: For obvious reasons, old age implies workers' productivity gradually declines and fewer job opportunities are available to them. More importantly perhaps, the marginal utility of leisure time may be an increasing function of age, so that, even if productivity and wage rates do not decline with age, individuals may be more likely to retire as they become older. For instance, Hurd (1990) noted that the fall in employment is greatest at the most advanced ages in the US. The LFP rates of men fell from 79.7% for those aged 55 to 59 to 54.9% for those aged 60 to 64 and 25.8% for those aged 65 to 69 in 1987. Furthermore, Table 3.1 also shows that the LFP rates

fell from 65.3% of those aged 50 to 54 to 39.8% of those aged 60 to 64, and 8.9% of those aged 65 to 69 in 1996.

Gender: In a gender-biased society like Taiwan, older females simply do not have the same chances to work as males. Kuo (1997), for example, noted that women have fewer opportunities to participate in society and in economic activity than men. Some of this is due to women's traditional culture and disadvantages in education or training. Hence, most female workers have a relatively lower probability of participation.

Race: As described in Chapter 2, race groups in Taiwan include Fujianese, Hakka, Mainlander, and Aboriginal. In general, most of the Fujianese and Hakka workers have their own land and are self-employed. They are expected to have a higher probability of working in agriculture and family businesses in the labour force. In contrast, Mainlanders moved from China in 1949 and belong to the immigrant population. Most of them worked in army or government sectors. In particular, the Kuomintang (KMT) party government always taught them that they could go back to China and reconstruct their government. The government provided a temporary house and other benefits for their family. They were supposed to stay in Taiwan only for a short period. Hence, they are expected to have a lower probability of participation in work. Finally, most of the Aboriginal people live in the mountain areas and have lower educational attainments and poor living standards. But they are also expected to have a higher probability of entering the labour force and keeping their basic living style.

Education: Better education makes more (as well as more desirable) job

opportunities available to people. For example, an empirical study by Chang (1999) indicated that the educational status of the elderly is an important factor in determining their economic independence and health status, which implies that better-educated elderly people are more likely to work and to be healthy enough to do so. Furthermore, Ross and Wu (1995) stated that education inequalities tend to produce differences in work and economic conditions, such as income, work fulfilment, and physical fitness. Hence, people with better education can increase labour force productivity, which leads to higher earnings and therefore better health care. To show this, Zimmer and Liu (1999) conducted a comparative analysis of the association between socio-economic status, education and health, among three samples of randomly selected older adults aged 60 and over from Taiwan, Thailand and the Philippines. They suggested that educational development can improve people's health for labour force participation. Therefore, workers with better educational attainments have better health and a higher probability of participation.

Health: We would expect a negative sign for this because, when workers' health becomes poor, they are less likely to enter the labour force. For instance, Schoenbaum (1995) tested the effect of health on LFP among elderly Taiwanese and found that health is a major determinant of LFP. Individuals in poor health are significantly less likely to work. Mete and Schultz (2002) examined the consequences of health on LFP of elderly men and women in Taiwan from 1989 to 1996, and found that estimates of health's effect on LFP are in most cases statistically significant and negative. Hence, workers with poor health have a lower probability of participation.

Marital Status: Marital status and family circumstances also affect LFP behaviour. If a man is married, he tends to have more opportunities to work, and

perhaps an increased desire or need to work as he is likely to be the main earner for his family. In contrast, a married woman might do more housework and have a lower desire to work. For example, Vere and Wong (2002) examined the effects of changes in occupation and changes in the overall female labour force. They used data from the Taiwanese Panel Study of Family Dynamics (TPSFD) in 1999 and 2000, which selected samples of people aged 36-45 and 46-65, respectively. They found a higher probability of joining the labour market for the younger female workers after they married. The relationship between family circumstances and LFP decision is attracting growing attention in the field of LFP studies.

Pension: This is a measure of benefit offerings to workers and can be expected to show a positive effect for the pre-condition for being eligible for an occupational pension on the probability of LFP. In particular, nearly 95% of all businesses in Taiwan are small and medium sized enterprises without occupational pensions. People need to join the big private companies or government sectors to have eligibility for a pension. Hence, pension eligibility can provide a strong incentive for people to participate in work. Furthermore, after their working life, which may be 35 years, workers eligible for pensions might have a higher hazard rate of retirement than those who are ineligible for a pension. Especially, pension eligibility can also provide workers with a better benefit for their later lives and allow them to retire earlier.

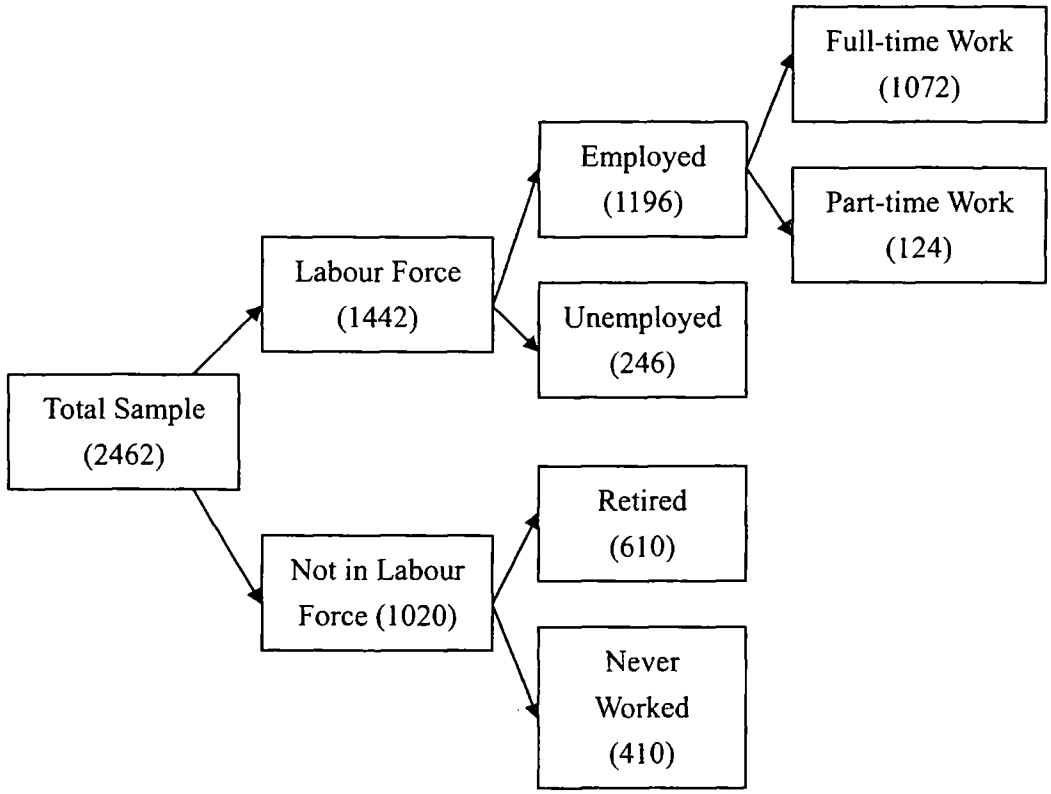
Residence: In urban areas employment opportunities are more diverse than in rural areas, particularly for service and white-collar occupations. One might therefore expect that states having a larger fraction of the population living in urban areas will have a higher participation rate. On the other hand, rural workers tend to help out by feeding livestock and poultry and doing other farm chores. Thus, they will already be

part of the labour force. This means that if a state has more rural areas, then LFP may be higher, resulting in a positive sign. The net effect can be determined only empirically. For example, Gunderson (1977) assumed that urban residence reflected the larger array of employment opportunities in the service and white-collar occupations – notably in cleaning, childcare, cooking, and the entertainment industry. He found that the higher LFP rate of married women in urban rather than rural non-farm households reflected their greater employment opportunities, and the availability of substitutes for household production, as well as a growing social acceptance of working outside of the household. However, Gunderson's paper only focused on younger and middle-aged married women in Canada. Here we consider the LFP of the middle-aged and elderly in Taiwan, which is quite different from Gunderson (1977). The underlying hypothesis here is that workers living in town and rural areas have more opportunities to work in the agricultural sector or become self-employed and fewer opportunities to enter skilled jobs. Hence, workers in rural areas may have a higher probability of participation.

3.4 Data Description

3.4.1 Data Source

Data for this study come from the second panel of interviews of the Survey of Health and Living Status of the Middle-Aged and Elderly in Taiwan (SHLS) in 1996, a joint survey conducted by the Taiwan Provincial Institute of Family Planning and the Population Studies Centre, University of Michigan. The SHLS covers a representative national sample of people born between 1926 and 1946 (inclusive), so that respondents in the sample frame were aged 50 to 70 at the time of the first wave. The SHLS survey contains eight distinct, fairly comprehensive sections, and thus allows for a detailed discussion on LFP of the middle-aged and elderly in Taiwan. The total sample has 2462 observations, including the sub-samples 1442 observations in the labour force and 1020 not in the labour force. The former includes 1196 observations employed (1072 persons working full-time and 124 persons working part-time) and 246 unemployed. The latter includes 610 workers retired and 410 people who have never worked, as shown in Figure 3.1.



Note:

The reasons for those who have stopped doing their job include: (1) reaching retirement age, (2) health problems, (3) work didn't suit, (4) company lay-offs, (5) business failure, (6) unhappy with wages, and (7) family factors in the SHLS survey. For empirical analysis, terms (3) to (6) can be classed as unemployment, so only terms (1), (2), and (7) are used to define retirement behaviour.

Figure 3.1 Labour Force Status of the 1996 SHLS Survey

3.4.2 Variables Specifications

3.4.2.1 Dependent Variables

3.4.2.1.1 Probit Model and Ordered Probit Model

Probit analysis considers the labour force participation status of individuals: whether they are working or not working. Hence the dependent variable is simply specified as $y = 1$ if an individual chooses to work and zero otherwise. However, it becomes more complex if there are more than two choices of LFP, such as work full-time, part-time and not work. How to specify the dependent variable? For instance, Duncan (2000) and Mete and Schultz (2002) considered that these choices had a natural (ordinal) ranking and one should use the ordered probit model to analyse the determinants of LFP.

3.4.2.1.2 Multinomial Logit Model

The implied outcomes can be divided into two binary choices: firstly, a choice is made to work or not. Next, conditional on working, a second choice is made to work full-time or part-time. The second stage dependent variable is specified as $y = 1$ if an individual chooses to work part-time, and $y = 2$ if an individual chooses to work full-time. By contrast, Boskin (1974) and Schmidt and Strauss (1975) thought that the occupational choices were unordered and used the multinomial logit model to examine the determinants of occupational choices. Even though the outcomes are coded 1, 2, and 3, the numerical values are arbitrary in the sense that 1<2<3 does not imply that outcome 1 (choose to not work) is less than outcome 2 (choose to work part-time) is less than outcome 3 (choose to work full-time).[3] Thus, this chapter will use the above two models to examine the choices of whether to work full-time or part-time, and comparing the differences in estimation results.

[3] For an introduction to multinomial logit models, see, for instance, Greene (2000, Chapter 19), Hosmer and Lemeshow (2000, 260-287), Long (1997, chapter 6).

3.4.2.2 Explanatory Variables

Explanatory variables include personal characteristics, family factors, employment opportunities, and economic factors, as described in Section 3.3. Here we categorise them into a more detailed format suitable for the probit estimation. First, for individual characteristics, from the 1996 SHLS data, age can be separated into four groups: Age1 (aged 50 to 54), Age2 (aged 55 to 59), Age3 (aged 60 to 64), and Age4 (aged 65 to 70). This corresponds to the normal retirement ages in Taiwan of 50, 55, 60, and 65. The Gender variable is coded 1 for female and 0 for male. Regarding the Race or Ethnicity groups, the codification in the SHLS survey has four groups, namely Race1 (Fujianese), Race2 (Hakka), Race3 (Mainlander), and Race4 (Aboriginal). The Education variable is coded into four levels according to the number of years of schooling, namely Edu1 (informal schooling, including illiterate and can read), Edu2 (primary level: 1 to 6 years), Edu3 (medium level: 7 to 12 years) and Edu4 (high level: 13 to 17 years). The self-assessment of health has five levels: excellent, good, average, not so good, and poor.[4] Therefore, the Health variable is coded 1 for poor health, including "not so good" and "poor" health, and 0 for otherwise.

Regarding the Marital Status factor, this includes married, single, divorced, separated, and widowed. For simplicity, the married variable is coded 1 for married and 0 otherwise. For employment opportunities, the areas of Residence include workers living in urban, town and rural areas. For the economic factors, the dummy variable is 1 if the respondent has eligibility for a pension, which includes the retirees who have received pension benefits and workers who expect to receive pension

[4] The questionnaires of the 1996 SHLS survey asked, "C1: Regarding your state of health, do you feel it's: excellent, good, average, not so good, or poor?"

benefits, and 0 otherwise. According to the SHLS data, 68.2% of retirees have already received the entire amount of retirement payments or pension benefits, and 31.8% of retirees continue to receive them. A full definition of the variables and summary statistics of the sample are given in Table 3.4.

Table 3.4 Descriptive Statistics of Variables

Variables	Description	Mean	Standard Error
WORK	1 = Work,	.583	(.493)
	0 = Not work		
JOB	2 = Full-time work,	1.103	(.965)
	1 = Part-time work,		
	0 = Not work		
AGE1	1 = Aged from 50 to 54,	.299	(.458)
	0 = Otherwise		
AGE2	1 = Aged from 55 to 59,	.325	(.469)
	0 = Otherwise		
AGE3	1 = Aged from 60 to 64,	.260	(.438)
	0 = Otherwise		
AGE4	1 = Aged from 65 to 70,	.116	(.320)
	0 = Otherwise		
GENDER	1 = Female,	.402	(.490)
	0 = Male		
RACE1	1 = Fujianese,	.725	(.446)
	0 = Otherwise		
RACE2	1 = Hakka,	.172	(.377)
	0 = Otherwise		
RACE3	1 = Mainlander,	.087	(.281)
	0 = Otherwise		
RACE4	1 = Aboriginal,	.016	(.125)
	0 = Otherwise		
EDU1	1 = Informal schooling,	.257	(.437)
	0 = Otherwise		
EDU2	1 = 1-6 years of schooling,	.472	(.499)
	0 = Otherwise		
EDU3	1 = 7-12 years of schooling,	.202	(.401)
	0 = Otherwise		
EDU4	1 = 13-17 years of schooling,	.069	(.253)
	0 = Otherwise		
MARRIED	1 = Married,	.835	(.372)
	0 = Otherwise		

Table 3.3 (Continued)

HEALTH	1 = Poor health, 0 = Otherwise	.228	(.419)
PENSION	1 = Eligible for a pension, 0 = Otherwise	.265	(.441)
URBAN	1 = Live in urban areas, 0 = Otherwise	.389	(.487)
TOWN	1 = Live in town areas, 0 = Otherwise	.237	(.425)
RURAL	1 = Live in rural areas, 0 = Otherwise	.374	(.483)

Note:

According to the 1996 SHLS survey, the total sample has 2462 observations, but 410 persons never worked. Therefore, the effective sample has 2052 observations, including 1072 people working full-time, 124 working part-time, 246 unemployed and 610 retired.

3.5 Empirical Specifications

This section seeks appropriate ways to measure the effects of the determinants of labour force participation (LFP) in Taiwan. LFP research has commonly used global questions such as, "Are you presently working?" or "Is your current job full or part time?" Therefore, the first model follows Jenkins (1992) and uses a probit model to estimate the probability of working or not working. The second model follows Mete and Schultz (2002)[5] and uses an ordered probit model for analysing the choice to work full-time or part-time. In the meantime, the second model also considers Schmidt and Strauss (1975)[6] and uses a multinomial logit model to estimate the choice between working full-time or part-time. The impact of gender on LFP decisions is also considered.

3.5.1 Probit Model

Let y represent the labour force participation choice ($y=1$ if working, 0 otherwise) and let the two outcomes, working and not working, be described by the state-specific utilities U_y^*:

$$U_{y=1}^* = x'\beta_1 + u_1 \tag{3.2A}$$

$$U_{y=0}^* = x'\beta_0 + u_0 \tag{3.2B}$$

where x' represents a common set of control variables, β_0 and β_1 are vectors of unknown parameters, u_0 and u_1 represent unobservable (state-specific) taste components. Under this characterisation, an individual will choose to participate if the utility to be enjoyed when working (denoted $U_{y=1}^*$) exceeds the utility to be gained

[5] See, for example, Mete and Schultz (2002) who used an ordered probit model to analyse the determinants of health and labour force participation of the elderly in Taiwan.
[6] See, for example, Schmidt and Strauss (1975) who used multiple logit models to predict the occupational choices in the US.

when not working (denoted $U^{*}_{y=0}$). A potential labour force participant will decide to work if $U^{*}_{y=1} > U^{*}_{y=0}$, and therefore the decision to work $y = 1\ (U^{*}_{y=1} - U^{*}_{y=0} > 0)$.

Consequently the observation rule (3.2A) and (3.2B) can be rewritten as:

$$\begin{aligned} y &= 1\,(U^{*}_{y=1} > U^{*}_{y=0}) \\ &= 1\,(x'\beta_1 + u_1 > x'\beta_0 + u_0) \\ &= 1\left[(u_1 - u_0) > -x'(\beta_1 - \beta_0)\right] \end{aligned} \tag{3.3}$$

Clearly, both sets of parameters β_0 and β_1 cannot be identified. However, the difference $\beta_1 - \beta_0$ can be identified, and implicitly parameterise the choice model as:

$$y = 1\,(y^{*} > 0)$$

where $y^{*} = x'(\beta_1 - \beta_0) + (u_1 - u_0) = x'\beta + u$. Maximum likelihood estimation (hereafter, MLE) considers the probability of observing a sample of behavioural outcomes and characteristics. Consider a sample of n observations $\{y_i, x_i\}$ drawn at random from a population, where y_i is binary. Assuming the observability criterion $y_i = 1\,(y_i^{*} > 0)$ for a latent variable equation of the form $y_i^{*} = x_i'\beta + u_i$, and, assuming that the distribution of u_i is standard normal and independent across observations, MLE solves for the parameter vector β which is most likely to have generated the data $\{y_i, x_i\}$. For any vector β, the probability of observing the outcomes y_i conditional on the data x_i is

$$L(\beta \mid x_i) = \prod_{i=1}^{n} \Pr(y_i = 0 \mid x_i; \beta)^{1-y_i} \cdot \Pr(y_i = 1 \mid x_i; \beta)^{y_i} \tag{3.4}$$

Taking a natural log to obtain:

$$\ln L(\beta \mid x_i) = \sum_{i=1}^{n} \left[(1 - y_i) \cdot \ln \Pr(y_i = 0 \mid x_i; \beta) + y_i \cdot \Pr(y_i = 1 \mid x_i; \beta)\right] \tag{3.5}$$

For the probit model, the following conditions for probability have:

$$\Pr(y_i = 1 \mid x_i; \beta) = \Phi(x_i'\beta) \tag{3.6}$$

$$\Pr(y_i = 0 \mid x_i; \beta) = 1 - \Phi(x_i'\beta) \tag{3.7}$$

where $\Phi(x)$ is the standard normal cumulative distribution function. Substituting the above into (3.5) gives a conditional likelihood function of the form:

$$\ln L(\beta \mid x_i) = \sum_{i=1}^{n} \{(1 - y_i) \cdot \ln[1 - \Phi(x_i'\beta)] + y_i \cdot \ln \Phi(x_i'\beta)\}. \tag{3.8}$$

The first-order condition requires that:

$$\frac{\partial \ln L(\beta \mid x_i)}{\partial \beta} = \sum_{i=1}^{n} \frac{[y_i - \Phi(x_i'\beta)]}{\Phi(x_i'\beta) \cdot [1 - \Phi(x_i'\beta)]} \cdot \phi(x_i'\beta) \cdot x_i = 0. \tag{3.9}$$

yielding the ML estimate $\tilde{\beta}$.

3.5.2 Ordered Probit Model

Ordered probit analysis supposes that three possible labour force states are observed: full-time, part-time, and non-participation. The ordered probit model, first considered by Aitchison and Silvey (1957), is derived from modelling the probit of the cumulative probabilities as a linear function of the covariates:

$$y_i^* = x_i'\beta + u_i, \quad \text{for} \quad i = 1, \ldots, n. \tag{3.10}$$

where y_i^* is unobserved and thus can be thought of as the underlying tendency of an observed phenomenon. Further, u_i is normally distributed with a zero mean error term, β is a vector of unknown parameters, x_i' is a vector of respondent's

characteristics. Supposing this is an ordering of non-participation, part-time and full-time to observe three possible labour force states: $y_i = 0$, non-participation; $y_i = 1$, part-time work; and $y_i = 2$, full-time work. That is

$$\begin{aligned} y_i &= 0, \textit{if } y_i^* \le \mu_0 \ (=0), \textit{ that is, non participation,} \\ &= 1, \textit{if } \mu_0 \le y_i^* \le A_i, \textit{ that is, part time work,} \\ &= 2, \textit{if } y_i^* \ge A_i, \textit{ that is, full time work.} \end{aligned} \tag{3.11}$$

where A_i represents the working hours condition.[7] The following three probabilities are:

$$\begin{aligned} \Pr(y_i = 0) &= \Pr(y_i^* \le 0) \\ &= \Pr(x'_i \beta + u_i \le 0) \\ &= \Pr(u_i \le -x'_i \beta) \\ &= \Phi(-x'_i \beta) \end{aligned} \tag{3.12}$$

$$\begin{aligned} \Pr(y_i = 2) &= \Pr(y_i^* \ge A_i) \\ &= \Pr(x'_i \beta + u_i \ge A_i) \\ &= \Pr(u_i \le A_i - x'_i \beta) \\ &= 1 - \Phi(A_i - x'_i \beta) \end{aligned} \tag{3.13}$$

$$\begin{aligned} \Pr(y_i = 1) &= 1 - \Pr(y_i = 0) - \Pr(y_i = 2) \\ &= 1 - \Phi(-x'_i \beta) - \left[1 - \Phi\left(A_i - x'_i \beta\right)\right] \\ &= \Phi\left(A_i - x'_i \beta\right) - \Phi\left(-x'_i \beta\right) \end{aligned} \tag{3.14}$$

where $\Phi(x)$ is the standard normal cumulative distribution density function. The marginal effect is the slope of the curve relating x_i to $\Pr(y_i = m), m = 0, 1, or\ 2$, holding all other variables constant. Hence, the marginal effects of changes in the regressors can be calculated and defined to be:

$$\frac{\partial \Pr(y_i = 0)}{\partial x_i} = -\phi(x'_i \beta)\beta, \tag{3.15}$$

$$\frac{\partial \Pr(y_i = 1)}{\partial x_i} = \left[\phi(-x'_i \beta) - \phi\left(A_i - x'_i \beta\right)\right]\beta, \tag{3.16}$$

[7] A worker is considered full-time if he/she works for more than 40 hours per week in Taiwan, but it might not be consistent with the definition of full-time work in some advanced countries. See YMSS (2002), pp. 233-236.

$$\frac{\partial \Pr(y_i = 2)}{\partial x_i} = \phi(A_i - x'_i \beta)\beta \tag{3.17}$$

respectively. Since the marginal effect depends on the levels of all variables, more commonly, it is computed at the mean values of all variables. In general, the marginal effect does not indicate the change in the probability that would be observed for a unit change in x_i. However, if an independent variable varies over a region of the probability curve that is nearly linear, the marginal effect can be used to summarise the effect of a unit change in the variable on the probability of an outcome.

To derive the likelihood function for the ordered probit model, define the possible labour force states for y_i. Then, the likelihood function becomes:

$$L = \prod_{y_i=0} \Pr(y_i = 0) \cdot \prod_{y_i=1} \Pr(y_i = 1) \cdot \prod_{y_i=2} \Pr(y_i = 2). \tag{3.18}$$

Finally, taking logarithms yields the log-likelihood function and maximising it gives ML estimates.

3.5.3 Multinomial Logit Model

The multinomial logit model also supposes that three possible labour force states are observed: full-time, part-time, and non-participation in work. To develop this model, assume $y_i = 0$ as the baseline outcome for non-participation in work, and to form logits comparing $y_i = 1$ (choose to work part-time) and $y_i = 2$ (choose to work full-time) to it. Then, the conditional probabilities of each outcome category given the covariate vector are

$$\Pr(y_i = 0 \mid x_i; \beta) = \frac{1}{1 + e^{x_i \beta_1} + e^{x_i \beta_2}}, \tag{3.19}$$

$$\Pr(y_i = 1 \mid x_i; \beta) = \frac{e^{x_i \beta_1}}{1 + e^{x_i \beta_1} + e^{x_i \beta_2}}, \tag{3.20}$$

and

$$\Pr(y_i = 2 \mid x_i;\beta) = \frac{e^{x_i'\beta_2}}{1 + e^{x_i'\beta_1} + e^{x_i'\beta_2}}. \tag{3.21}$$

A general expression for the conditional probability in the multinomial logit model is

$$\Pr(y_i = j \mid x_i;\beta) = \frac{e^{x_i'\beta_j}}{\sum_{k=0}^{2} e^{x_i'\beta_k}}, \quad j = 0, 1, 2. \tag{3.22}$$

Where j denotes the $j+1$ possible unordered choices, y_i is the indicator variable of choices, x_i denotes the vector of the independent variables, β_j is the corresponding coefficient vector, and the β_0 vector is normalised to zero.

Then the likelihood function for the multinomial logit model can be written as

$$L(\beta \mid x_i) = \prod_{i=1}^{n}\left[\Pr(y_i = 0 \mid x_i;\beta)^{y_{0i}} \cdot \Pr(y_i = 1 \mid x_i;\beta)^{y_{1i}} \cdot \Pr(y_i = 2 \mid x_i;\beta)^{y_{2i}}\right] \tag{3.23}$$

Taking the log and using the fact that $\sum_{j=0}^{2} y_{ji} = 1$ for each i, the log function is

$$\begin{aligned} \ln L(\beta \mid x_i) &= \sum_{j=0}^{2}\sum_{i=1}^{n} y_{ji} \cdot \log \Pr(y_i = j \mid x_i;\beta) \\ &= \sum_{i=1}^{n} y_{1i} \cdot (x_i'\beta_1) + y_{2i} \cdot (x_i'\beta_2) - \ln\left[1 + e^{x_i'\beta_1} + e^{x_i'\beta_2}\right] \end{aligned} \tag{3.24}$$

The likelihood equations are found by taking the first partial derivatives of $\ln L(\beta \mid x_i)$ with respect to each of the unknown parameters. The general form of these equations is

$$\frac{\partial \ln L(\beta \mid x_i)}{\partial \beta_{jk}} = \sum_{i=1}^{n} x_{ki}\left[y_{ji} - \Pr(y_i = j \mid x_i;\beta)\right] \tag{3.25}$$

for $j = 0, 1, 2$ and $k = 0, 1, 2, \ldots, p$ with $x_{0i} = 1$ for each subject. The maximum likelihood estimator, $\hat{\beta}$, is obtained by setting these equations equal to zero and solving for β. The solution requires the same type of iterative computation that is used to obtain the estimate in the probit model.

3.6 Empirical Results

The first subsection presents the empirical results from the probit model on work or not work, followed by the ordered probit and multinomial logit models for examining working full-time or part-time in the second and third subsections. The impact of gender on the labour force participation decision is also considered. For ease of interpretation, this section also reports the marginal effects based on marginal distributions.[8]

3.6.1 Probit Model

Table 3.5 shows the coefficients estimates of labour force participation for the probit model. From the results based on these estimates, the probability of LFP can be calculated for the benchmark individual and for other individuals with different demographic circumstances.

First, for the benchmark individual in the overall sample, all explanatory variables take a value of zero. The benchmark individual in all cases is an unmarried Fujianese man aged 50 to 54, who is in good health, has no pre-condition of being eligible for a pension, lives in an urban area, and has informal education. This benchmark value is reflected in the constant variable in Table 3.5, where the probability is

$$\Pr(y_i = 1 \mid x_i; \beta) = \Phi(0.821) = 0.794.$$

The effects on the probability of LFP can also be worked out for different demographic circumstances (Duncan, 2000). Holding other factors equal, how does the LFP probability change for workers who have poor health and different residence

[8] The marginal effects are calculated for each observation, and then averaged to obtain the mean marginal effects over the sample. The standard errors of the mean marginal effects are calculated using the Delta method (Greene, 2000).

status? This situation models changes in the probability of LFP for workers who have poor health:

$$\Pr(y_i = 1 \mid x_i; \beta) = \Phi(0.821 - 0.600) = 0.587.$$

That is, workers with poor health will decrease the probability of LFP from 0.794 to 0.587. Furthermore, the second situation presents the probability of LFP change for workers living in rural areas, keeping other variables constant:

$$\Pr(y_i = 1 \mid x_i; \beta) = \Phi(0.821 + 0.251) = 0.858,$$

That is, workers living in rural areas will increase their probability of working from 0.794 to 0.858, holding other variables equal. Therefore, if the estimated coefficients are positive, the probabilities of working increase. If the estimated coefficients are negative, then the probabilities of working decrease.

In general, the results shown in Table 3.5 confirm the theoretical expectations in Section 3.3, with most regressors showing statistically significant negative effects on LFP, particularly for Age, Gender, and Health variables. The probit coefficients for the Age variables indicate that the LFP rates of the middle-aged and elderly decline with age in Table 3.5. Translating the probit coefficient of Age2 (-0.416) to the probability of 0.657; workers aged 55 to 59 have a probability of participation that is 13.7 percentage points lower than the omitted category (Age1: aged 50 to 54), holding other variables equal. The probit coefficient of Age3 (-.833) is evaluated with a probability of 0.495; workers aged 60 to 64 have a probability of participation that is 29.9 percentage points lower than the omitted category (Age1), holding other variables equal. The probit coefficient of Age4 (-1.329) is evaluated with a probability of 0.306; workers aged 65 to 70 have a probability of participation that is 48.8 percentage points lower than the omitted category (Age1), other things being equal. On the other hand, Table 3.6 shows that marginal effect estimates of LFP have similar

probabilities with the coefficient estimates. For instance, holding other variables equal, a person in Age2 has a probability of participation that is 16.1 percentage points lower than a person with Age1, and those in Age3 have 32.2 percentage points lower, while Age4 have 51.4 percentage points lower, respectively. This is consistent with the results reported in Mete and Schultz (2002). For example, Mete and Schultz (2002) noted that the LFP of men and women all declined with age. They also based their finding on a sample aged 50 and above.

The Gender variable has a negative effect on LFP, which implies that female workers have a lower participation rate as shown in Table 3.5. For instance, translating the probit coefficient of lower case (-0.643) to the probability of 0.571, females have a probability of participation that is 22.3 percentage points lower than males. Furthermore, Table 3.6 indicates marginal effect estimates that female workers have a probability of participation which is 24.9 percentage points lower than males. According to traditional social values, females tend to carry out domestic work and often abstain from working outside the home.

For the Race variables, Hakka (Race2) variable has a significantly positive effect on LFP, which implies that Hakka workers have a higher participation rate than Fujianese workers (Race1) as shown in Table 3.5. Furthermore, Table 3.6 also shows marginal effect estimates that, holding other variables equal, Race2 have a probability of participation that is 7.9 percentage points higher than Race1. This is consistent with the results reported in Hermalin et al. (1999). However, the coefficients and marginal effects of Mainlander (Race3) and Aboriginal (Race4) are insignificant.

For the Education variables, Table 3.5 shows that Edu2, Edu3, and Edu4

variables have a positive effect on LFP, but this is statistically significant only for the male sample. This implies that male workers with better education have a higher participation rate. Moreover, Table 3.6 indicates marginal effect estimates that, holding other variables equal, male workers with Edu2 (primary education) have a probability of participation that is 7.7 percentage point higher than male workers with Edu1 (informal education), and Edu3 (high school levels) have a probability 12.7 percentage points higher and Edu4 (college levels) have 12.9 percentage points higher, respectively. However, the coefficients and marginal effects are insignificant for females in Tables 3.5 and 3.6.

The Married variable has a positive effect on LFP as shown in Table 3.5, which implies that married workers have a higher probability of participation than unmarried, but the coefficient is insignificant for the female sample. In particular, the marginal effect estimates indicate that, holding other variables equal, married male workers have a probability of participation that is about 13.5 percentage points higher than unmarried male workers as shown in Table 3.6.

Health is also important in explaining labour force participation. Table 3.5 shows the variable Health has a negative effect on LFP, which implies that workers with poor health have a lower probability of participation. Translating the probit coefficient of health variable minus 0.600 into a probability gives 0.587 and it shows that workers with poor health are 20.7 percentage points less likely to participate in work than otherwise. On the other hand, the marginal effect estimates indicate that, holding other variables equal, workers with poor health have a probability of participation that is 23.2 percentage points lower than workers with good health. This finding justifies the view that health is an important determinant of the LFP behaviour, and it is

consistent with the results reported in Mete and Schultz (2002). However, Mete and Schultz (2002) also further noted that the change in National Health Insurance (NHI) financing did not appear to have contributed to a reduction in elderly participation rates in 1996.

The Pension variable has a positive effect on LFP as shown in Table 3.5, which implies that workers eligible for a pension have a higher probability of participation, but the coefficient is only significant for female workers. In particular, the marginal effect estimates indicate that, holding other variables equal, female workers eligible for a pension have a probability of participation that is about 13.3 percentage points higher than female workers ineligible for a pension as shown in Table 3.6.

Finally, the variable Rural has a positive significant effect on LFP, which implies that rural workers have a higher probability of participation and also reflects the larger array of employment opportunities in agriculture and blue-collar occupations, especially for female workers. The marginal effect estimates indicate that, holding other variables equal, rural workers have a probability of participation that is 9.7 percentage points higher than urban workers.

3.6.1.1 Gender Effects

The effects of gender on labour force participation are estimated in Tables 3.5 and 3.6. For instance, some estimated effects of male and female LFP decisions are similar, such as Age groups and Health variables. The Age group variables are strongly significant with a negative sign, implying that when comparing men and women all have a lower probability of participation in work than the omitted category. In particular, the marginal effect estimates all decline with age and the trends of

decline for females are larger than males. An explanation for this result may be that there are fewer employment opportunities for older women than men. Further, the Health variable also has a significant negative effect on LFP for men and women. Men with poor health have a probability of participation that is about 23.6 percentage points lower than men with good health, and women with poor health have a probability of participation that is about 19.4 percentage points lower than women with good health. Hence, as regards making labour force participation decisions, men consider their health more than women.

By contrast, some estimated effects of male and female LFP decisions are different. For example, the Race2, Education groups', and Married variables are only significant for men, and the Pension and Rural variables are only significant for women. Due to the differences in cultural attitudes to work or differences in family support arrangements, the estimated results suggest that male Hakka, male workers with better education, and married male workers have a higher probability of participation than the omitted category. However, the above coefficients are insignificant for females. In particular, the jobs available to elderly female workers are predominantly low skilled jobs, which are capable of being filled both by highly educated and less educated females. Then educational attainment would have a negligible effect on the expected earnings of females in employment and hence might be expected to have little impact on the participation decision. Furthermore, women eligible for a pension or living in rural areas have a higher probability of LFP. Eligibility for a pension can indicate that people have a better job and a higher social position. Hence, they are more likely to participate in the labour market, especially females. Table 3.6 also shows that the marginal effect estimates, holding other variables constant, suggest that rural female workers significantly have a probability

of participation that is 15.9 percentage points higher than females in urban areas, but this is insignificant for males.

Table 3.5 Probit Coefficient Estimates of LFP

Sample	Overall		Male		Female	
Variables	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Age2	-.416***	(.080)	-.380***	(.113)	-.508***	(.117)
Age3	-.833***	(.083)	-.844***	(.116)	-.836***	(.124)
Age4	-1.329***	(.115)	-1.381***	(.148)	-1.276***	(.200)
Gender	-.643***	(.067)	-		-	
Race2	.204**	(.083)	.324***	(.121)	.093	(.119)
Race3	-.185	(.122)	-.058	(.147)	-.008	(.263)
Race4	.118	(.247)	.408	(.402)	-.029	(.322)
Edu2	.026	(.077)	.225*	(.121)	-.058	(.105)
Edu3	.154	(.102)	.369***	(.141)	-.073	(.169)
Edu4	.213	(.151)	.374**	(.189)	.026	(.293)
Married	.135*	(.081)	.392***	(.123)	-.080	(.111)
Health	-.600***	(.072)	-.682***	(.099)	-.494***	(.108)
Pension	.121	(.080)	-.001	(.102)	.338**	(.135)
Town	.021	(.080)	-.093	(.105)	.171	(.126)
Rural	.251***	(.074)	.132	(.101)	.404***	(.113)
Constant	.821***	(.135)	.521***	(.192)	.308*	(.158)
N	2033		1214		819	
Log likelihood	-1152.401		-635.163		-503.391	
LR chi2 (15)	458.74***		258.45***		117.55***	

Notes:

1. The sample has 2052 observations, but 19 observations are missing for residence areas variables. Thus, the effective sample only has 2033 observations, including 1214 males and 819 females.
2. The omitted (reference) categories: Age1 for age groups dummy variable; male for gender; Race1 for race groups; Edu1 for educational groups; and Urban for residence areas.
3. * Effect is significant at $p \leq .10$; ** $p \leq .05$; *** $p \leq .01$.
4. Goodness of fit: the result of Log-likelihood ratio test can reject the hypothesis that all coefficients except the intercept are 0 at the 0.01 level. Considering the Gender variable, the LR chi2 of male and female sample is LR chi2 (14), respectively.

Table 3.6 Probit Marginal Effect Estimates of LFP

Sample	Overall		Male		Female	
Variables	dy/dx	Std. Err.	dy/dx	Std. Err.	dy/dx	Std. Err.
Age2	-.161***	(.031)	-.131***	(.038)	-.200***	(.046)
Age3	-.322***	(.032)	-.292***	(.039)	-.329***	(.049)
Age4	-.514***	(.044)	-.478***	(.051)	-.502***	(.078)
Gender	-.249***	(.026)				
Race2	.079**	(.032)	.112***	(.041)	.036	(.047)
Race3	-.072	(.047)	-.020	(.051)	-.003	(.103)
Race4	.046	(.095)	.141	(.139)	-.011	(.126)
Edu2	.010	(.030)	.077*	(.041)	-.023	(.041)
Edu3	.059	(.039)	.127***	(.048)	-.028	(.066)
Edu4	.082	(.058)	.129**	(.065)	.010	(.115)
Married	.052*	(.031)	.135***	(.042)	-.031	(.043)
Health	-.232***	(.028)	-.236***	(.034)	-.194***	(.042)
Pension	.046	(.031)	-.001	(.035)	.133**	(.053)
Town	.008	(.031)	-.032	(.036)	.067	(.049)
Rural	.097***	(.029)	.046	(.035)	.159***	(.044)
Predicted Probability	0.596		0.703		0.434	
Observations	2033		1214		819	

Notes:

1. The dy/dx is for discrete change of dummy from 0 to 1.
2. The omitted (reference) categories: Age1 for age groups dummy variable; male for gender; Race1 for race groups; Edu1 for educational groups; and Urban for residence areas.
3. * Effect is significant at $p \leq .10$; ** $p \leq .05$; *** $p \leq .01$.

3.6.2 Ordered Probit Model

The ordered probit model is estimated where the dependent variable is an ordered categorical variable which distinguishes between full-time and part-time workers and those not working in the labour market. The determinants of the labour force categories are estimated by ML by fitting an ordered probit model (Maddala, 1983). The estimated coefficients β_i reflect the effects on the probability of labour force participation (LFP). If $\beta_i > 0$, the probability of LFP will increase. If $\beta_i < 0$, then the probability of LFP will decrease. If $\beta_i = 0$, there is no effect on the probability of LFP.

Choice one: working or not working. Most estimated effects of LFP decision are similar and consistent with the probit model. In general, the results of Table 3.7 confirm the theoretical expectations set out in Section 3.3, with most regressors being statistically significant, including Age2 (aged 55 to 59), Age3 (aged 60 to 64), Age4 (aged 65 to 70), Gender, Race2, Edu3 (7-12 years of schooling), Edu4 (13-17 years of schooling), Married, Health, Pension, and Rural variables. The ordered probit coefficients for the Age variable indicate that the LFP of the middle-aged and elderly declines at different ages while all other effects are kept constant. This is consistent with the results reported in Gunderson (1977) and Mete and Schultz (2002). However, Gunderson (1977) estimated the LFP of individuals aged 15 to 64, and Mete and Schultz (2002) examined those aged 50 and over.

In addition, the results from ordered probit regression analysis on the effects of Gender and Health variables have a significantly negative value on LFP decision, thus implying that female workers have a lower probability of participation, holding other variables constant. This is consistent with the results reported in Vere and Wong

(2002). In particular, Vere and Wong (2002) suggested that Taiwanese women over 50 might have left the labour force due to retirement or old age. Workers with poor health have a lower probability of participation than workers with good health. This finding can be confirmed by the results reported in Shih (1999) and Mete and Schultz (2002).

In contrast, the estimated results from ordered probit regression analysis of Race2 (Hakka), Edu3 (7-12 years of schooling), Edu4 (13-17 years of schooling), Married, Pension, and Rural variables have a significant and positive effect on LFP. That means Hakka workers have a higher probability of participation than Fujianese. This is similar to the results reported in Hermalin et al. (1999), particularly for those not having an income sufficient for their retirement. Further, workers with better educational attainment, married workers, workers eligible for a pension, and rural workers have a higher probability of participation. These results are somewhat different from the results reported in Gunderson (1977). For instance, Gunderson focused on relatively younger married women and assumed that urban areas could provide more employment opportunities; hence urban workers in Canada had a higher probability of participation.

Choice two: working full-time or part-time. Table 3.8.1 shows the marginal effects after ordered probit, the predicted probability of participation is 0.523 for full-time work, 0.069 for part-time work, and 0.408 for not work. For participation in full-time work, the marginal effect estimates indicate that, holding other variables constant, a worker with Age2 (aged 55 to 59) has a probability of participation that is about 15.7 percentage points lower than a person with Age1 (aged 50 to 54), and Age3 (aged 60 to 64) have 30.5 percentage points lower, Age4 (aged 65 to 70) have

43.7 percentage points lower, respectively. This finding confirms that older workers have a lower probability of participation in full-time work. Next, female workers have a probability of participation that is 23.1 percentage points lower than males. Workers with poor health have a probability of participation in full-time work that is 22.1 percentage points lower than workers with good health. Hakka workers have a probability of participation that is 9.2 percentage points higher than Fujianese. Workers with Edu3 have a probability of participation in full-time work that is 8.8 percentage points and Edu4 12 percentage points higher than workers with Edu1. Married workers have a probability of participation in full-time work that is about 6 percentage points higher than unmarried workers. Eligibility for a pension also gives a probability of participation in full-time work that is 8 percentage points higher than otherwise. Rural workers have a probability of participation in full-time work that is 10.3 percentage points higher than urban workers.

For participation in part-time work, the marginal effect estimates, holding other variables constant, suggest that a worker with Age2 has a probability of participation that is 0.2 percentage points higher than a person with Age1, but Age3 have 0.2 percentage points lower, Age4 have 2.4 percentage points lower, respectively. This means that older workers relatively have a lower probability of participation in part-time work. Further, female workers have a probability of participation in part-time work that is 0.3 percentage points higher than males. Workers with poor health have a probability of participation that is 0.1 percentage points lower than workers with good health.

3.6.2.1 Gender Effects

Most estimated effects of male and female labour force participation (LFP)

decisions are similar to the probit model. For instance, the estimated coefficients of Age2, Age3, and Age4 variables have a significantly negative effect on full-time work as shown in Tables 3.8.2 and 3.8.3, which implies that older workers have a lower probability of participation. In particular, the marginal effect estimates, holding other variables constant, for male workers with Age2 show a probability of participation in full-time work that is about 14.1 percentage points lower than the omitted category (Age1), while Age3 have 30.3 percentage points lower and Age4 have 48.3 percentage points lower, respectively. Further, female workers with Age2 have a probability of participation in full-time work that is about 16.9 percentage points lower than Age1, while Age3 have 27.7 percentage points lower and Age4 have 33.5 percentage points lower, respectively. However, Tables 3.8.2 and 3.8.3 also show that older male workers have a higher probability of participation in part-time work and older female workers have a lower probability, respectively. An explanation for this result may be that there are more employment opportunities for older men than women.

For the Race variables, only male Hakka workers (Race2) have a significantly different probability of participation in full-time work at about 12.6 percentage points higher, and in part-time about 1.2 percentage points lower than male Fujianese (Race1), other things being equal. The other estimated results of Race are insignificant.

For the Education variable, results in Table 3.7 show that the educational attainments for men have positive effects on LFP. In particular, Table 3.8.2 shows marginal effect estimates that, holding other variables constant, male workers with Edu2 (primary levels) show a probability of participation in full-time work that is 9.4

percentage points higher than workers with Edu1 (informal education), while Edu3 (high school levels) has 15.5 percentage points higher and Edu4 (college levels) has 16.1 percentage points higher, respectively. In contrast, Table 3.8.3 shows that females with Edu2 (primary levels) show a probability of participation in full-time work that is 0.6 percentage points lower than workers with Edu1 (informal education), while Edu3 (high school levels) has 0.2 percentage points lower and Edu4 (college levels) has 4.8 percentage points higher, respectively.

For the Marital Status variable, the sign of the married variable is as expected: it has a positive effect on participation for men and a negative effect on participation for women, but the coefficient is only significant for men, as shown in Table 3.7. In Taiwan, male workers always have a higher responsibility for their family's economic support than do females. Table 3.8.2 shows that male married workers have a higher probability of participation. From the marginal effect estimates, holding other things constant, male married workers have a probability of participation in full-time work that is about 14.3 percentage points higher than male unmarried workers, but for part-time work about 0.8 percentage points lower.

Further, Table 3.7 shows that the Health variable has a significant negative effect on participation. In particular, from the marginal effect estimates, holding other variables constant, male workers with poor health have a probability of participation in full-time work that is about 25.2 percentage points lower; but in part-time work that is about 1 percentage point higher than male workers with good health in Table 3.8.2; female workers with poor health have a probability of participation in full-time work that is about 16.4 percentage points lower, and in part-time work that is about 0.9 percentage points lower than female workers with good health as shown in Table 3.8.3.

These findings are consistent with the results reported in Mete and Schultz (2002).

For the Pension variable, Table 3.7 shows that workers' eligibility for a pension has a positive effect on participation in work, but the coefficient is only significant for females. From the marginal effect estimates, holding other variables constant, female workers eligible for a pension have a probability of participation in full-time work that is about 15.2 percentage points higher, and in part-time work about 0.3 percentage points higher than females not eligible for a pension as shown in Table 3.8.3. This suggests that a pre-condition for being eligible for a pension provides a strong incentive for females to participate in work.

Finally, for the Residence Status variables, Table 3.7 shows that the variable Rural has a significant and positive effect on participation. This implies that workers living in rural areas have a higher probability of participation. From the marginal effect estimates, holding other variables constant, male workers living in rural areas have a probability of participation in full-time work that is about 5.9 percentage points higher, and in part-time work that is about 0.5 percentage points lower than males living in urban areas, but the latter effect is statistically insignificant as shown in Table 3.8.2. Female workers living in rural areas have a probability of participation in full-time work that is about 15.4 percentage points higher, and in part-time work that is about 0.5 percentage points higher than females living in urban areas as shown in Table 3.8.3.

Table 3.7 Ordered Probit Coefficient Estimates of LFP

Sample	Overall		Male		Female	
Variables	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Age2	-.395***	(.075)	-.368***	(.103)	-.462***	(.113)
Age3	-.793***	(.079)	-.785***	(.108)	-.810***	(.121)
Age4	-1.267***	(.112)	-1.310***	(.142)	-1.203***	(.196)
Gender	-.586***	(.065)	-		-	
Race2	.234***	(.080)	.349***	(.112)	.113	(.116)
Race3	-.191	(.119)	-.092	(.143)	-.008	(.257)
Race4	.186	(.238)	.574	(.394)	-.043	(.313)
Edu2	.061	(.074)	.249**	(.114)	-.017	(.102)
Edu3	.223**	(.098)	.430***	(.133)	-.004	(.164)
Edu4	.308**	(.145)	.465***	(.180)	.125	(.289)
Married	.151*	(.079)	.367***	(.119)	-.035	(.108)
Health	-.564***	(.071)	-.647***	(.096)	-.455***	(.106)
Pension	.203***	(.077)	.105	(.097)	.389***	(.133)
Town	.039	(.076)	-.043	(.099)	.158	(.123)
Rural	.260***	(.072)	.156*	(.095)	.403***	(.110)
z_1 (part-time)	-.672	(.122)	-.399	(.183)	-.194	(.153)
z_2 (full-time)	-.496	(.124)	-.206	(.183)	-.036	(.153)
N	2033		1214		819	
Log likelihood	-1532.465		-880.707		-638.811	
LR chi2 (15)	468.21***		263.82***		117.78***	

Notes:

1. The sample has 2052 observations, but 19 observations are missing for residence areas variables. Thus, the effective sample only has 2033 observations, 1214 males and 819 females.
2. The omitted (reference) categories: Age1 for age groups dummy variable; male for gender; Race1 for race groups; Edu1 for educational groups; and Urban for residence areas.
3. * Effect is significant at $p \leq .10$; ** $p \leq .05$; *** $p \leq .01$.
4. Goodness of fit: the result of Log-likelihood ratio test can reject the hypothesis that all coefficients except the intercept are 0 at the 0.01 level. Considering the Gender variable, the LR chi2 of male and female samples is LR chi2 (14), respectively.

Table 3.8.1 Ordered Probit Marginal Effect Estimates of LFP: Overall

With	Full-time Work		Part-time Work		Not Work	
Respect to	dy/dx	Std. Err.	dy/dx	Std. Err.	dy/dx	Std. Err.
Age2	-.157***	(.029)	.002***	(.001)	.154***	(.029)
Age3	-.305***	(.028)	-.002***	(.001)	.308***	(.030)
Age4	-.437***	(.028)	-.024*	(.009)	.460***	(.032)
Gender	-.231***	(.025)	.003**	(.001)	.227***	(.025)
Race2	.092***	(.031)	-.004	(.002)	-.089***	(.030)
Race3	-.076	(.047)	.001	(.001)	.075	(.047)
Race4	.073	(.092)	-.003	(.002)	-.070	(.087)
Edu2	.024	(.030)	-.001	(.001)	-.024	(.029)
Edu3	.088**	(.038)	-.003	(.001)	-.085**	(.036)
Edu4	.120**	(.055)	-.006	(.003)	-.114**	(.051)
Married	.060*	(.032)	-.001	(.001)	-.059*	(.031)
Health	-.221***	(.026)	-.001***	(.001)	.221***	(.027)
Pension	.080***	(.030)	-.003	(.002)	-.078***	(.029)
Town	.016	(.031)	-.001	(.001)	-.015	(.030)
Rural	.103***	(.028)	-.003	(.002)	-.100***	(.027)
Predicted Probability	0.523		0.069		0.408	

Notes:

1. The sample has 2052 observations, but 19 observations are missing for residence areas variables. Thus, the effective sample only has 2033 observations, 1214 males and 819 females.
2. The dy/dx is for discrete change of dummy from 0 to 1.
3. The omitted (reference) categories: Age1 for age groups dummy variable; male for gender; Race1 for race groups; Edu1 for educational groups; and Urban for residence areas.
4. * Effect is significant at $p \leq .10$; ** $p \leq .05$; *** $p \leq .01$.

Table 3.8.2 Ordered Probit Marginal Effect Estimates of LFP: Males

With	Full-time Work		Part-time Work		Not Work	
Respect to	dy/dx	Std. Err.	dy/dx	Std. Err.	dy/dx	Std. Err.
Age2	-.141***	(.039)	.009***	(.002)	.132***	(.038)
Age3	-.303***	(.041)	.013***	(.002)	.290***	(.040)
Age4	-.483***	(.042)	-.004	(.005)	.487***	(.047)
Race2	.126***	(.038)	-.012***	(.005)	-.113***	(.034)
Race3	-.035	(.055)	.003	(.004)	.033	(.052)
Race4	.189*	(.106)	-.023	(.019)	-.165*	(.088)
Edu2	.094**	(.043)	-.007**	(.003)	-.087**	(.040)
Edu3	.155***	(.045)	-.015***	(.008)	-.141***	(.040)
Edu4	. 161***	(.056)	-.018**	(.018)	-. 144***	(.048)
Married	.143***	(.047)	-.008***	(.002)	-.136***	(.046)
Health	-.252***	(.037)	.010***	(.002)	.241***	(.037)
Pension	.039	(.036)	-.003	(.003)	-.036	(.033)
Town	-.016	(.038)	.001	(.003)	.015	(.035)
Rural	.059*	(.035)	-.005	(.003)	-.054*	(.032)
Predicted Probability	0.628		0.070		0.302	

Notes:

1. The male sample has 1228 observations, but 14 observations are missing for residence areas variables. Thus, the effective male sample only has 1214 observations.
2. The dy/dx is for discrete change of dummy from 0 to 1.
3. The omitted (reference) categories: Age1 for age groups dummy variable; male for gender; Race1 for race groups; Edu1 for educational groups; and Urban for residence areas.
4. * Effect is significant at $p \leq .10$; ** $p \leq .05$; *** $p \leq .01$.

Table 3.8.3 Ordered Probit Marginal Effect Estimates of LFP: Females

With	Full-time Work		Part-time Work		Not Work	
Respect to	dy/dx	Std. Err.	dy/dx	Std. Err.	dy/dx	Std. Err.
Age2	-.169***	(.032)	-.009***	(.003)	.177***	(.042)
Age3	-.277***	(.034)	-.019***	(.005)	.296***	(.040)
Age4	-.335***	(.037)	-.037***	(.009)	.372***	(.040)
Race2	.043	(.032)	.001	(.001)	-.045	(.046)
Race3	-.003	(.074)	-.001	(.004)	.003	(.101)
Race4	-.016	(.091)	-.001	(.005)	.017	(.122)
Edu2	-.006	(.029)	-.001	(.001)	.007	(.040)
Edu3	-.002	(.048)	-.001	(.002)	.002	(.065)
Edu4	.048	(.083)	.001	(.002)	-.049	(.115)
Married	-.013	(.031)	-.001	(.001)	.014	(.043)
Health	-.164***	(.031)	-.009***	(.003)	.174***	(.039)
Pension	.152***	(.035)	.003**	(.001)	-.154***	(.052)
Town	.061	(.034)	.002	(.001)	-.063	(.049)
Rural	.154***	(.031)	.005***	(.002)	-.158***	(.043)
Predicted Probability	0.371		0.061		0.568	

Notes:

1. The female sample has 824 observations, but 5 observations are missing for residence areas variables. Thus, the effective female sample only has 819 observations.
2. The dy/dx is for discrete change of dummy from 0 to 1.
3. The omitted (reference) categories: Age1 for age groups dummy variable; male for gender; Race1 for race groups; Edu1 for educational groups; and Urban for residence areas.
4. * Effect is significant at $p \leq .10$; ** $p \leq .05$; *** $p \leq .01$.

3.6.3 Multinomial Logit Model

The multinomial logit model is estimated where the dependent variable is an unordered categorical variable which distinguishes between full-time and part-time workers and those not working in the labour market. The determinants of the labour force categories are estimated by ML by fitting the multinomial logit model (Maddala, 1983). The estimated coefficients β_i can reflect the effects on the probability of full-time work compared with not work (F/N), or part-time work compared with not work (P/N). If $\beta_i > 0$, the probability of F/N, or P/N will increase. If $\beta_i < 0$, then the probability of F/N, or P/N will decrease. If $\beta_i = 0$, there is no effect on the probability of F/N, or P/N.

First, for full-time work compared with omitted category by not work (F/N), most estimated effects of LFP decisions are similar and consistent with the ordered probit model. For example, Table 3.9 shows that the Age2 (aged 55 to 59), Age3 (aged 60 to 64), Age4 (aged 65 to 70), Gender, and Health variables have a statistically significant negative effect on F/N. The Age variables indicate that the F/N of the middle-aged and elderly declines at different ages while all other effects are kept fixed. In addition, the Gender and Health variables have a significantly negative value on F/N, thus implying that female workers have a lower probability of participation, holding other variables constant.

In contrast, the estimated results from multinomial logit regression analysis of Race2 (Hakka), Edu3 (7-12 years of schooling), Edu4 (13-17 years of schooling), Married, Pension, and Rural variables have a significant and positive effect on F/N. That means Hakka workers have a higher probability of participation in F/N than Fujianese. Further, workers with better educational attainment, married workers,

workers eligible for a pension, and rural workers have a higher probability of participation in F/N.

Second, for part-time work compared with omitted category by not work (P/N), Table 3.9 shows that some estimates have a statistically significant effects on P/N decision which are similar to the F/N, including Age2, Age3, Age4, Gender, and Health variables. This implies that older people, female workers, and workers with poor health are less likely to work part-time and this likelihood declines at different ages while all other effects are kept fixed. However, the Pension variable has a significant and negative effect on part-time work; this is quite different from full-time work. It suggests that if workers are eligible for a pension they are more likely to participate in full-time work, and less likely to work in part-time jobs. Furthermore, workers with better education have a higher probability of participation in full-time work, and are less likely to participate in part-time work, but the latter coefficients are insignificant.

In order to properly determine the direct effect of an independent variable on the probability of choosing an alternative method of LFP, we can compute the partial derivative of the probability of choosing an alternative with respect to the explanatory variable of interest, evaluated at the means of those independent variables (Greene, 2000). Table 3.10 lists the marginal effect estimates of each independent variable on all three categories of job choices. These estimates can be interpreted in a similar way to those of standard regression coefficients; they represent the change in the choice probability of each alternative with respect to a change in the independent variables. By way of construction, they necessarily sum to zero across all the alternative job choices.

For instance, for participation in full-time work, marginal effect estimates indicate that, holding other variables constant, a worker with Age2 (aged 55 to 59) has a probability of participation in full-time work that is about 16.1 percentage points lower than a person with Age1 (aged 50 to 54), and Age3 (aged 60 to 64) have 32.1 percentage points lower, Age4 (aged 65 to 70) have 43.9 percentage points lower, respectively. This finding confirms that older workers have a lower probability of participation in full-time work. Next, female workers have a probability of participation that is about 23.2 percentage points lower than males. Workers with poor health have a probability of participation in full-time work that is about 22.4 percentage points lower than workers with good health. Hakka workers have a probability of participation that is about 9.3 percentage points higher than Fujianese. Workers with Edu3 (7-12 years of schooling) have a probability of participation in full-time work that is about 10.4 percentage points, and Edu4 (13-17 years of schooling) about 14.1 percentage points higher than workers with Edu1 (informal education). Married workers have a probability of participation in full-time work that is about 7.4 percentage points higher than unmarried workers. Eligibility for a pension also gives a probability of participation in full-time work that is about 9.7 percentage points higher than otherwise. Rural workers have a probability of participation in full-time work that is about 11.7 percentage points higher than urban workers.

For participation in part-time work, the marginal effect estimates, holding other variables constant, suggest that a worker with Age4 (aged 65 to 70) significantly has a probability of participation in part-time work that is about 4 percentage points lower than a person with Age1 (aged 50 to 54). This means that older workers have a relatively lower probability of participation in part-time work. Further, female

workers have a probability of participation in part-time work that is 2.1 percentage points lower than males. Workers with better education have a lower probability of participation in part-time work. They might choose working full time or not working in preference to working part time. Workers with poor health also have a probability of participation in part-time work that is about 1.7 percentage points lower than workers with good health. Eligibility for a pension also gives a probability of participation in part-time work that is about 4.1 percentage points lower than otherwise.

Finally, an easier way to understand the effect of individuals' characteristics on their choices of jobs is to ask how likely it is that a certain type of individual would make a particular decision. Table 3.11 shows the predicted probabilities of job choices by individuals with certain demographic and occupational characteristics. For instance, the younger people (Age1) have a higher predicted probability of participation in full-time work, and these predicted probabilities decline with increasing age. Women have a lower predicted probability of participation in full-time work. Hakka workers have a higher predicted probability of participation in full-time work than otherwise. Workers with better education also have a higher predicted probability of participation in full-time work. These are consistent with the results reported by the ordered probit model in Table 3.8.1 and the multinomial logit model in Table 3.10.

Table 3.9 Multinomial Logit Coefficient Estimates of LFP

Variables	Full-time Work		Part-time Work	
	Coef.	Std. Err.	Coef.	Std. Err.
Age2	-.711***	(.138)	-.561**	(.257)
Age3	-1.432***	(.146)	-.959***	(.273)
Age4	-2.222***	(.203)	-2.073***	(.479)
Gender	-1.058***	(.117)	-1.019***	(.226)
Race2	.388***	(.145)	.061	(.293)
Race3	-.301	(.207)	.057	(.488)
Race4	.304	(.414)	-.668	(1.061)
Edu2	.118	(.134)	-.223	(.242)
Edu3	.368**	(.174)	-.581	(.362)
Edu4	.474*	(.258)	-1.952	(1.057)
Married	.285**	(.142)	-.118	(.262)
Health	-.996***	(.126)	-.885***	(.253)
Pension	.318**	(.136)	-.801**	(.346)
Town	.067	(.137)	-.025	(.265)
Rural	.488***	(.129)	.081	(.244)
Constant	1.049***	(.236)	-.129	(.425)
N	2033		2033	
Log likelihood	-1513.076		-1513.076	
LR chi2 (30)	506.99***		506.99***	

Notes:

1. The sample has 2052 observations, but 19 observations are missing for residence areas variables. Thus, the effective sample only has 2033 observations.

2. The omitted (reference) category is "not-work" for methods; Age1 for age groups dummy variable; male for gender; Race1 for race groups; Edu1 for educational groups; and Urban for residence areas.

3. * Effect is significant at $p \leq .10$; ** $p \leq .05$; *** $p \leq .01$.

4. Goodness of fit: the result of Log-likelihood ratio test can reject the hypothesis that all coefficients except the intercept are 0 at the 0.01 level.

Table 3.10 Multinomial Logit Marginal Effect Estimates of LFP

With	Full-time Work		Part-time Work		Not-work	
Respect to	dy/dx	Std. Err.	dy/dx	Std. Err.	dy/dx	Std. Err.
Age2	-.161***	(.031)	-.008	(.011)	.170***	(.032)
Age3	-.321***	(.030)	-.012	(.011)	.333***	(.031)
Age4	-.439***	(.029)	-.040***	(.010)	.480***	(.029)
Gender	-.232***	(.026)	-.021**	(.009)	.254***	(.026)
Race2	.093***	(.033)	-.008	(.012)	-.085***	(.032)
Race3	-.076	(.050)	.012	(.028)	.064	(.050)
Race4	.088	(.095)	-.029	(.024)	-.058	(.093)
Edu2	.035	(.032)	-.014	(.011)	-.021	(.031)
Edu3	.104***	(.040)	-.033***	(.011)	-.071*	(.039)
Edu4	.141**	(.057)	-.054***	(.009)	-.087	(.057)
Married	.074**	(.034)	-.015	(.015)	-.059*	(.033)
Health	-.224***	(.028)	-.017*	(.010)	.241***	(.029)
Pension	.097***	(.032)	-.041***	(.011)	-.056*	(.031)
Town	.017	(.033)	-.003	(.012)	-.014	(.032)
Rural	.117***	(.030)	-.009	(.011)	-.108***	(.029)

Notes:

1. The sample has 2052 observations, but 19 observations are missing for residence areas variables. Thus, the effective sample only has 2033 observations.

2. The dy/dx is for discrete change of dummy from 0 to 1.

3. The omitted (reference) categories: Age1 for age groups dummy variable; male for gender; Race1 for race groups; Edu1 for educational groups; and Urban for residence areas.

4. * Effect is significant at $p \leq .10$; ** $p \leq .05$; *** $p \leq .01$.

Table 3.11 Predicted Probabilities of LFP by Type of Individuals

With	Sample	Full-time Work		Part-time Work		Not-work	
Respect to	(Observations)	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.
Age1	609	.697	(.151)	.062	(.032)	.239	(.139)
Age2	660	.551	(.180)	.063	(.033)	.384	(.177)
Age3	528	.397	(.176)	.061	(.032)	.542	(.180)
Age4	236	.263	(.132)	.025	(.015)	.712	(.135)
Male	1214	.613	(.193)	.060	(.036)	.326	(.193)
Female	819	.385	(.186)	.054	(.026)	.559	(.193)
Race1	1473	.516	(.218)	.064	(.033)	.420	(.222)
Race2	351	.601	(.217)	.048	(.025)	.351	(.217)
Race3	176	.415	(.187)	.034	(.033)	.551	(.189)
Race4	33	.515	(.238)	.030	(.015)	.455	(.246)
Edu1	526	.384	(.180)	.074	(.033)	.542	(.200)
Edu2	956	.524	(.205)	.066	(.028)	.410	(.217)
Edu3	412	.631	(.202)	.036	(.018)	.333	(.206)
Edu4	139	.705	(.197)	.007	(.004)	.288	(.197)
Married	1698	.552	(.213)	.057	(.031)	.391	(.217)
Health	464	.321	(.178)	.047	(.025)	.631	(.188)
Pension	538	.606	(.224)	.022	(.013)	.372	(.223)
Urban	791	.508	(.227)	.054	(.036)	.437	(.229)
Town	482	.502	(.218)	.060	(.033)	.438	(.222)
Rural	760	.549	(.213)	.061	(.029)	.390	(.218)
Total	2033	.522	(.221)	.058	(.033)	.420	(.224)

Notes:

The sample has 2052 observations, but 19 observations are missing for residence areas variables. Thus, the effective sample only has 2033 observations.

3.7 Discussions

First, the main results by probit model can confirm that variables associated with increasing age are associated with lower labour force participation rates (Tables 3.5 and 3.6). In particular, workers' productivity and job opportunities gradually decline with ages. This is consistent with the result noted by Hurd (1990), where the fall in employment is greatest at the most advanced ages in the US.

Tables 3.5 and 3.6 also present the results by gender for labour force participation. The labour supply for males is more detailed, since the remaining variables do not have significant effects on females' supply. In particular, male Hakka workers, male workers with better education, and married male workers are associated with higher labour force participation rates. These results confirm that some special cultural and social valuation may affect labour force participation behaviour in Taiwan. Furthermore, as expected, health limitations are of major importance for both males and females to make their labour force participation decisions. Holding other variables constant, the marginal effect estimates find that males with poor health significantly have a probability of participation that is about 23.6 percentage points lower than males with good health, and females with poor health have a probability of participation that is about 19.4 percentage points lower than females with good health. This is consistent with the result reported by Hanoch and Honig (1983). Among the additional variables in the model for women is pension eligibility that is associated with significantly higher labour force participation rates and probably represents the overall advantageous status of the few women in pensionable, established salaried positions in the government sector or big companies.

Second, comparing the results from Tables 3.8.1 and 3.10 by the ordered probit

model and multinomial logit model, most marginal effect estimates of LFP are similar and consistent. This similarity suggests that the ordered probit and multinomial logit models fit the data about equally. For instance, holding other variables equal, a person with Age2 will have a probability of participation that is 15.7 percentage points lower than a person with Age1 by the ordered probit model, and 16.1 percentage points by the multinomial logit model. In general, holding other variables equal, for a person with Age3, Age4, Gender, Race2, Edu3, Edu4, Married, health, Pension, and Rural variables, the absolute marginal effects estimates on full-time work by the multinomial logit model are a little larger than by the ordered probit model. Furthermore, for part time work, there are some differences between the two models. For instance, holding other variables equal, females have a probability of participation in part time work that is 0.3 percentage points higher than males by the ordered probit model, but 2.1 percentage points lower than males by the multinomial logit model. Better education has a significant negative effect on participation in part time work by the multinomial logit model, but it is insignificant by the ordered probit model. An explanation for this result may be that there are fewer observations for part time cases. Finally, for not working, the two models have similar empirical results as shown in Tables 3.8.1 and 3.10. This suggests that if the models only have two or three outcomes, it might not be necessary to consider whether the outcomes are ordered or unordered. The main empirical results would be similar.

3.8 Conclusions

This chapter aims at contributing to understanding the determinants of labour force participation by using three different models, including a probit model to investigate the influence on working or not working, and the ordered probit and multinomial logit models for examining working full-time or part-time. The impact of gender is also considered on the decision of LFP. The results confirm that personal and family, economic, and employment opportunity factors are all important determinants of labour force participation for the middle aged and elderly in Taiwan.

For the personal and family factors, older workers are less likely to remain employed and more likely to exit the labour force. More importantly, by comparing the participation rate of male and female workers, we find that female workers have a lower probability of participation than males, other things being equal. The possible reasons include the restrictions of cultural attitudes to work or differences in family support arrangements, for example, there has been sex-discrimination against females in access to work during and since the Second World War in Taiwan. Hence, sex-discrimination in the labour market means that for the jobs available to female workers wage rates tend to be relatively low and this discourages labour force participation. Furthermore, for the race factor, Hakka workers are more likely to remain employed and less likely to exit the labour force, but Mainlander and Aboriginal workers are more likely to exit and less likely to enter the labour force. For the marital status factor, most married male workers have a greater financial responsibility for their family and have a higher probability of participation. Health has a significant effect on labour force participation. For instance, this study highlights the finding that people with poor health have an overall probability of participation in full-time work about 22.4 percentage points lower, and part-time work

about 1.7 percentage points lower, than people with good health, using the multinomial logit model. From a policy point of view, knowing the magnitude of health effects on participation is important, because it can be used to estimate the indirect costs of health problems arising through a reduction in labour force participation. Therefore, the larger indirect costs of health problems estimated from a more efficient model can lend support to investment in policies aimed at improving health, especially older workers' health.

For the economic factors, with a few exceptions the effect of pension is in the expected direction: a pre-condition of being eligible for a pension provides a strong incentive for people to participate in work. In particular, there is a significant effect for female workers, those eligible for a pension have a probability of participation in full time work about 15.2 percentage points higher than females ineligible for a pension in the ordered probit model. It was not easy to have an occupational pension before 1993, because Taiwan's pension system was a defined benefit system, except for government employees or those working in big private companies. Therefore, a pre-condition for being eligible for a pension can provide a strong incentive for people to participate in work. It will be interesting to continue examining the pension variable using a duration model and this is pursued in the next chapter.

For the employment opportunity factors, residence status also has a significant effect on labour force participation. This chapter highlights the finding that rural workers have an overall probability of participation in full-time work about 10.3 percentage points higher than urban workers. In particular, female rural workers have a probability of participation in full-time work about 15.4 percentage points higher than female urban workers. Most firms in Taiwan are small and medium sized

enterprises located in rural areas. The rural areas may provide more opportunities for low skilled jobs amongst the middle-aged and elderly female workers.

These results also have a number of policy implications. For instance, attempts to foster employment may be unsuccessful unless male workers can have better education and family support from their marital situations. The findings suggest that education and marital status are very important determinants of labour force participation for older men. Further, the findings also suggest that workers with poor health have a lower probability of participation in employment, including full-time and part-time work. However, the above findings all belong to a cross-section analysis; they are not enough to describe the dynamic behaviour of labour force participation. For example, respondents whose health declines are less likely to remain employed and more likely to exit the labour force. To remedy this weakness, Chapter 5 will combine the different waves of the SHLS data and consider the time-varying covariates in a further dynamic analysis of labour force transition.

3.9 Appendix

The STATA commands for analysing the labour force participation by the probit, ordered probit, and multinomial logit models are given below:

use "C:\Documents and Settings\happy\My Documents\New results 240106\Dataset\ch3.250106.dta"

Table 3.4

sum work labour age1-age4 gender race1-race4 edu1-edu4 married poorh pension resid1-resid3 if history~=0

Table 3.5

probit work age2-age4 gender race2-race4 edu2-edu4 married poorh pension resid2 resid3 if history~=0

probit work age2-age4 race2-race4 edu2-edu4 married poorh pension resid2 resid3 if history~=0 & gender==0

probit work age2-age4 race2-race4 edu2-edu4 married poorh pension resid2 resid3 if history~=0 & gender==1

Table 3.6

probit work age2-age4 gender race2-race4 edu2-edu4 married poorh pension resid2 resid3 if history~=0

mfx compute, nodiscrete

probit work age2-age4 race2-race4 edu2-edu4 married poorh pension resid2 resid3 if history~=0 & gender==0

mfx compute, nodiscrete

probit work age2-age4 race2-race4 edu2-edu4 married poorh pension resid2 resid3 if history~=0 & gender==1

mfx compute, nodiscrete

Table 3.7

oprobit labour age2-age4 gender race2-race4 edu2-edu4 married poorh pension resid2 resid3 if history~=0

oprobit labour age2-age4 gender race2-race4 edu2-edu4 married poorh pension resid2 resid3 if history~=0 & gender==0

oprobit labour age2-age4 gender race2-race4 edu2-edu4 married poorh pension resid2 resid3 if history~=0 & gender==1

Table 3.8.1

```
oprobit labour age2-age4 gender race2-race4 edu2-edu4 married poorh pension resid2
resid3 if history~=0
mfx compute, predict(outcome(0))
mfx compute, predict(outcome(1))
mfx compute, predict(outcome(2))
```

Table 3.8.2

```
oprobit labour age2-age4 gender race2-race4 edu2-edu4 married poorh pension resid2
resid3 if history~=0 & gender==0
mfx compute, predict(outcome(0))
mfx compute, predict(outcome(1))
mfx compute, predict(outcome(2))
```

Table 3.8.3

```
oprobit labour age2-age4 gender race2-race4 edu2-edu4 married poorh pension resid2
resid3 if history~=0 & gender==1
mfx compute, predict(outcome(0))
mfx compute, predict(outcome(1))
mfx compute, predict(outcome(2))
```

Table 3.9

```
mlogit labour age2-age4 gender race2-race4 edu2-edu4 married poorh pension resid2
resid3 if history~=0 , base(0)
```

Table 3.10

```
mfx compute, predict(outcome(0))
mfx compute, predict(outcome(1))
mfx compute, predict(outcome(2))
```

Table 3.11

```
predict idage12 if age1==1& history~=0, outcome(2) p
sum idage12
predict idage11 if age1==1& history~=0, outcome(1) p
sum idage11
predict idage10 if age1==1& history~=0, outcome(0) p
sum idage10
```

```
predict idage22 if age2==1& history~=0, outcome(2) p
sum idage22
predict idage21 if age2==1& history~=0, outcome(1) p
sum idage21
predict idage20 if age2==1& history~=0, outcome(0) p
sum idage20

predict idage32 if age3==1& history~=0, outcome(2) p
sum idage32
predict idage31 if age3==1& history~=0, outcome(1) p
sum idage31
predict idage30 if age3==1& history~=0, outcome(0) p
sum idage30

predict idage42 if age4==1& history~=0, outcome(2) p
sum idage42
predict idage41 if age4==1& history~=0, outcome(1) p
sum idage41
predict idage40 if age4==1& history~=0, outcome(0) p
sum idage40

predict idgender12 if gender==1& history~=0, outcome(2) p
sum idgender12
predict idgender11 if gender==1& history~=0, outcome(1) p
sum idgender11
predict idgender10 if gender==1& history~=0, outcome(0) p
sum idgender10

predict idgender02 if gender==0 & history~=0, outcome(2) p
sum idgender02
predict idgender01 if gender==0 & history~=0, outcome(1) p
sum idgender01
predict idgender00 if gender==0 & history~=0, outcome(0) p
sum idgender00

predict idrace12 if race1==1& history~=0, outcome(2) p
sum idrace12
predict idrace11 if race1==1& history~=0, outcome(1) p
```

```
sum idrace11
predict idrace10 if race1==1& history~=0, outcome(0) p
sum idrace10

predict idrace22 if race2==1& history~=0, outcome(2) p
sum idrace22
predict idrace21 if race2==1& history~=0, outcome(1) p
sum idrace21
predict idrace20 if race2==1& history~=0, outcome(0) p
sum idrace20

predict idrace32 if race3==1& history~=0, outcome(2) p
sum idrace32
predict idrace31 if race3==1& history~=0, outcome(1) p
sum idrace31
predict idrace30 if race3==1& history~=0, outcome(0) p
sum idrace30

predict idrace42 if race4==1& history~=0, outcome(2) p
sum idrace42
predict idrace41 if race4==1& history~=0, outcome(1) p
sum idrace41
predict idrace40 if race4==1& history~=0, outcome(0) p
sum idrace40

predict idedu12 if edu1==1& history~=0, outcome(2) p
sum idedu12
predict idedu11 if edu1==1& history~=0, outcome(1) p
sum idedu11
predict idedu10 if edu1==1& history~=0, outcome(0) p
sum idedu10

predict idedu22 if edu2==1& history~=0, outcome(2) p
sum idedu22
predict idedu21 if edu2==1& history~=0, outcome(1) p
sum idedu21
predict idedu20 if edu2==1& history~=0, outcome(0) p
sum idedu20
```

```
predict idedu32 if edu3==1& history~=0, outcome(2) p
sum idedu32
predict idedu31 if edu3==1& history~=0, outcome(1) p
sum idedu31
predict idedu30 if edu3==1& history~=0, outcome(0) p
sum idedu30

predict idedu42 if edu4==1& history~=0, outcome(2) p
sum idedu42
predict idedu41 if edu4==1& history~=0, outcome(1) p
sum idedu41
predict idedu40 if edu4==1& history~=0, outcome(0) p
sum idedu40

predict idmarried02 if married==0 & history~=0, outcome(2) p
sum idmarried02
predict idmarried01 if married==0 & history~=0, outcome(1) p
sum idmarried01
predict idmarried00 if married==0 & history~=0, outcome(0) p
sum idmarried00

predict idmarried2 if married==1& history~=0, outcome(2) p
sum idmarried2
predict idmarried1 if married==1& history~=0, outcome(1) p
sum idmarried1
predict idmarried0 if married==1& history~=0, outcome(0) p
sum idmarried0

predict idresid12 if resid1==1& history~=0, outcome(2) p
sum idresid12
predict idresid11 if resid1==1& history~=0, outcome(1) p
sum idresid11
predict idresid10 if resid1==1& history~=0, outcome(0) p
sum idresid10

predict idresid22 if resid2==1& history~=0, outcome(2) p
sum idresid22
```

```
predict idresid21 if resid2==1& history~=0, outcome(1) p
sum idresid21
predict idresid20 if resid2==1& history~=0, outcome(0) p
sum idresid20

predict idresid32 if resid3==1& history~=0, outcome(2) p
sum idresid32
predict idresid31 if resid3==1& history~=0, outcome(1) p
sum idresid31
predict idresid30 if resid3==1& history~=0, outcome(0) p
sum idresid30

predict p2 if e( id) & history~=0, outcome(2)
sum p2
predict p1 if e( id) & history~=0, outcome(1)
sum p1
predict p0 if e( id) & history~=0, outcome(0)
sum p0
```