Do Adult Children Matter? – The Effects of National Health Insurance on Retirement Behavior: Evidence from Taiwan

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Abstract

Using a unique survival-time data set from "the Survey of Health and Living Status of the Elderly in Taiwan", we investigate the impact of National Health Insurance (NHI) on elderly employee's retirement behavior. A proportional hazard model is constructed to test how prospective retirees with different numbers of adult children responded to this social experiment. We find that the retirement hazards of male private employees in non-agricultural sectors increased after the implementation of NHI. Particularly, elderly males who had a stronger "safety net" in the form of adult children were less sensitive to NHI.

JEL Classification: I10, I18, J14, J26.

Keywords: Retirement, Adult Children, National Health Insurance, Taiwan.

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1 Introduction

The U.S. literature suggests that the availability of post-retirement health insurance or pensions makes retirement more attractive. However, there has been little investigation of this issue in developing countries. In Taiwan, post-retirement health insurance was limited to government employees before the introduction of National Health Insurance (NHI) on March 1, 1995. National Health Insurance provides universal health insurance coverage for all citizens in Taiwan. This interesting social experiment makes it possible for economists to examine people's sensitivity to post-retirement health insurance when they consider their labor force participation decisions.

In this paper, we assess the effect of NHI on the retirement behavior of elderly workers in Taiwan using longitudinal data from "the Survey of Health and Living Status of the Elderly in Taiwan". Specifically, we ask whether NHI had a bigger effect on people with fewer adult children. Health insurance could have different effects on retirement in a country like Taiwan than it has in the U.S. because the elderly depend on their children to a greater extent in Taiwan. In fact, despite an increasing tendency to live independently, most elderly still live with their children in Taiwan. Moreover, most adult children (no matter whether they live with their parents or not) offer substantial

financial support to their parents. These facts are in line with Kotlikoff and Spivak (1981)'s argument that families can self-insure against uncertainties. Therefore, the elderly who have a "safety net" in the form of supportive children could be less sensitive to public programs. One interesting social norm in Taiwan is that adult sons take more responsibility for taking care of parents than adult daughters do. Consequently, we also try to examine whether there exists gender bias when prospective retirees consider the role of their adult children.

Drawing on estimates from a proportional hazard model, we find that male employees who worked in non-agricultural private sector jobs had higher retirement hazards after NHI. Particularly, male employees who had more adult children responded less to NHI than those with fewer adult children. We also find that elderly men with more adult sons had a significantly higher retirement hazard than men with fewer adult sons, and elderly women with more adult daughters had a significantly higher retirement hazard than women with fewer adult daughters. So there exist gender differences which are particularly striking for women given social norms that dictate that it is sons who have primary responsibility for elderly parents. As Taiwan is planning to introduce a nation-wide old age pension system soon, we also

hope our study can help policy makers to understand the extent to which these types of programs affect labor markets.

The paper proceeds as follows. Section 2 presents some background on labor force participation among the elderly, living patterns among the elderly, the economic resources of the elderly and background about health insurance in Taiwan. After describing the data in section 3, we set up the model and present the empirical findings in Section 4. Section 5 concludes and offers directions for future research.

2 Background

2.1 Trends in Labor Force Participation among the Elderly

The labor force participation rate (LFPR) for elderly workers fell after the implementation of NHI in 1995. As shown on Table 1, LFPR for 65+ workers was 9.79% in 1995, but fell to 7.39% in 2001. Similar trends can be observed for other age groups. For example, LFPR for those 55-59 years old was 55.75% in 1995, but reduced to 49.22% in 2001. The cause of elderly workers' decreasing LFPR is early retirement (DGBAS, 2001a, 2001b). If NHI has

significant effects on elderly workers' labor force participation and retirement behavior, policy makers may want to monitor related policy effects in the future.

2.2 Dependence on Children among the Elderly

Families with members above age 65 have grown rapidly in Taiwan. In the year 1990, these families were only 20.6% of total families. In the year 2000, they constituted almost 30% (29.3%) of total families (DGBAS, 2001d).

The elderly in Taiwan depend on their children in many dimensions. First of all, most elderly live with their children. Figure 1 shows that, although more and more senior citizens chose to live independently during the period 1976-1996, the fraction of the elderly who live with children is still above 60%. This fraction is as high as 75.6% for elderly woman in 2000 (The Ministry of the Interior, Taiwan, 2000).

Secondly, many adult children, no matter whether they live with their parents or not, offer financial support to their parents. Among the elderly above 65 years old, 47.13%'s major financial support comes from children, 15.39%'s major financial support comes from pensions, and 13.72%'s major financial support comes from labor income. Among the elderly women above

65 years old, 63% of them said that their major financial support comes from children, 6.2% said their major financial support comes from a pension, and only 9.8% said their major financial support comes from labor income (The Ministry of the Interior, Taiwan, 2000).

Thirdly, children play an important role on caring for the elderly when they are hospitalized. Among elderly males above 50 years old, 37.48% stated that their wife took care of them when they were hospitalized and 29.01% said that their children took care of them when they were hospitalized. Among elderly females above 50 years old, 16.02% stated that their husband took care of them when they were hospitalized and 40.45% said that their children took care of them (The Ministry of the Interior, Taiwan, 2000).

Finally, many children pay medical expenses for their parents.[1] Among the 3,511 individuals who answered the question: "Who paid most of your medical fees during last year?" in the 1989 interview of "the Survey of Health and Living Status of the Elderly in Taiwan", 39.82% of respondents chose "myself", 27.11% said "insurance" and 26.63% answered "children or

[1]In 1989, on average, health care and medical expenditures are only 4.9% of family's total consumption. In 1999, this ratio has increased to 11%. In addition, the ratio for low income families (7.6% in 1989 and 16.9% in 1999) is much higher than that for high income families (4.0% in 1989 and 8.7% in 1999). (DGBAS, 2001c) In the year 2001, health care and medical expenditure are 21.29% of total consumption among families whose head is 65 or above, which is much higher than that of all families (11.5%). That means medical outlays are relatively important for senior citizens.

children-in-law". If we restrict the sample to respondents with children, we find that 39.87% of them chose "myself", 26.19% said "insurance" and 28.05 % answered "children or children-in-law".

To sum up, we expect that a social insurance program like NHI will lessen the elderly's dependence on their children and thus affect their retirement decisions. In addition, because adult children act as a "safety net" for the elderly, we expect NHI to be more important for senior citizens with fewer adult children.

2.3 Health Insurance in Taiwan

National Health Insurance is aimed at promoting health and providing health services to all citizens in Taiwan. The first official committee responsible for scheduling NHI was established in November, 1987. After eight years of preparation, NHI was formally implemented in March, 1995. Unlike many public health insurance programs in western countries, NHI is not means-tested, so every citizen is eligible for it.

Before the implementation of NHI, an individual could obtain health insurance through one of three programs–Labor Insurance (LI), Farmer's Insurance (FI) and Government Employee's Insurance (GEI). These insurance

programs are government-sponsored and tied to an individual's employment status. GEI covers government employees, LI covers private employees and a few blue collar workers in the public sector, and FI covers farmers. There were only very few private health insurance programs in Taiwan.

In 1994, 2.95% of the population was covered under GEI, 8.23% under FI, and 40.22% under LI. The 48% of the population who were not covered by GEI, FI or LI were mostly children, housewives and senior citizens.

In contrast with the above public insurance programs, NHI covers all citizens. "The premium payable by the insured and his or her dependents depends on the insured payroll-related amount and the premium rate of the insured.[2] The maximum premium rate is 6%[3], which is shared by the employee, employer, and government....Approximately 85% of hospitals and 70% of clinics contracted with the social insurance programs in 1994. Two years later, after the implementation of NHI, the proportion of contracted institutions increased to about 96.5% of hospitals and 89.5% of clinics.[4] NHI

[2]Only dependents (the spouse and family members of direct family relationships) who are not working are covered. Total premium of the insured = unit premium of the insured * (1 + number of non-working dependents). If the insured has more than five dependents, he/she only needs to pay premiums for five dependents. This limit has decreased to three dependents since July 17, 1999. Also, the government pays all the premiums for low-income families.

[3]The premium rate was 4.25% between March 1, 1995 and September 1, 2002. It has been increased to 4.55% since September 1, 2002.

[4]Before NHI, a patient could only go to some specific institutions contracted with

coverage also extends to severe illnesses and home health care (Cheng and Chiang, 1997). For outpatient visits, the out-of-pocket expenditure ranges from NT$80 to NT$150.[5] For hospitalization, the co-payment ranges from 5% to 30% for both acute and chronic care, depending on the hospital length of stay. In the case of major illness and injury, no co-payment is required." (see Chou, Liu and Hammitt (2001), pp. 4-5)

Table 2 summarizes the generosity of four social insurance plans. Essentially, the maternity, injury and sickness benefits of GEI, LI and FI are all replaced by NHI. We find two important features from Table 2. First, post-retirement health insurance was *only* available in the GEI plan before the introduction of NHI. So we expect the previously LI-insured and FI-insured to find early retirement more attractive after 1995 than before. Secondly, unlike GEI and FI, LI does not provide coverage for dependents. Hence the generosity of NHI may provide the previous LI-insured additional incentive to retire earlier in that their dependents are now all covered by NHI.

Finally, we present the percentage of people insured in each social insurance program from 1966 to 1999 in Table 3. Because GEI, LI and FI have

his/her insurance plan. After NHI, most clinics and hospitals contract with NHI, so a patient has more choices than before.

[5]The exchange rate US$1 was around 32-33 New Taiwanese dollars (NT$) in 2000.

some benefits that NHI does not offer, some people still keep their old plans and therefore are covered by more than one plan after 1995.

2.4 Previous Research

The more recent literature about health insurance/pensions/Medicare and retirement is summarized in Appendix 1.

Madrian (1994), Gruber and Madrian (1995) and Rogowski and Karoly (2000) use U.S. data and find that post-retirement health insurance makes early retirement more attractive. Hausman and Wise (1985) show that the increase in social security benefits between 1969 and 1975 accounts for a 3%-5% increase in the probability of retirement for men 62-66. In Costa (1995), the elasticity of nonparticipation with respect to Union Army pensions is 0.73. Another branch of research investigates the effect of Medicare on retirement, and includes Rust and Phelan (1997) and Madrian and Beaulieu (1998). Rust and Phelan (1997) find that elderly men whose only "pension" is social security, whose only "retiree health insurance" is Medicare, and whose income is in the low to middle brackets, tend to remain employed until they are eligible for Medicare at 65. Madrian and Beaulieu (1998) conclude that an elderly man with a Medicare-eligible wife has a higher retirement hazard

than otherwise. In general, access to post-retirement health insurance or pensions makes early retirement more attractive in the U.S. Medicare also plays an important role when workers consider the timing of retirement. Finally, the literature which includes health measures as predictors finds that poor health is associated with early retirement (Currie and Madrian (1999)).

It is interesting that none of the above studies include "number of adult children" as a predictor. There are two possible explanations. First, the U.S. has a well-established social insurance system, so senior citizens do not need to depend on their children after retirement. Second, the elderly in the U.S. are more independent than the elderly in East Asian countries. McGarry (1998) investigates the role of adult children in caring for the elderly in the U.S. She finds that the strongest predictor of receiving care is need. Children, including non-coresident children, provide assistance with housekeeping tasks, while coresident individuals (including spouses, children, and others) help with personal care needs. However, "...Only 10 percent of children provide time to help their parents (8.5 percent of non-coresident children). For children who do not live near a parent or whose hours are taken up with work and other responsibilities, the provision of cash assistance would be a logical substitute. However, fewer than 2 percent of children are reported to

have made cash transfers to their impaired parents. Even more surprising, cash transfers are positively correlated with the provision of time assistance. Thus it is not the case that children who are unable to spend time helping a parent compensate with financial assistance." (McGarry (1998, p. 162)) Although McGarry (1998)'s finding is based on primary caregivers and thus needs to be interpreted with a degree of caution, it reflects (to some extent) the relationship between parents and adult children in the U.S.

In their important study, Mete and Schultz (2002) conduct the first investigation of the effect of National Health Insurance on the labor force participation of the elderly in Taiwan. Using 1989, 1993 and 1996 data from the "Survey of Health and Living Status of the Elderly in Taiwan" (SHLSET), they use public workers as a control group and find that NHI did not contribute to a reduction in elderly labor force participation rates in 1996. However, a pension reform inaugurated in the public sector on July 1, 1995 compounds the difficulty of identification and makes their control group (government employees) suspect. They do not account for this pension reform in their estimation. Moreover, government employees are a very small and select group of workers in Taiwan.[6] They constitute only 6.3% - 6.9% of

[6]Passing an entrance exam is required for working in public sectors in Taiwan.

total employment in Taiwan over the period 1974 - 1998. (The Ministry of Civil Service, Taiwan, 2001). Their average education level is much higher than that of private workers. For example, in 1978, workers with "college and above" degrees accounted for 4.3% of total employment in Taiwan, but 23.48% of government employment. In 1998, this ratio was 10.8% of total employment, but 45.41% of government employment (The Ministry of Civil Service, Taiwan, 2001). Therefore, government employees may be an invalid control group, even in the absence of pension reform in the government sector.

Some research regarding the effect of NHI on other outcomes, such as female labor supply, precautionary savings or health care utilization has been done. These studies may furnish insights relevant to our topic. Therefore, we also summarize them in Appendix 2. Chou and Staiger (2001) show that NHI was associated with a decline of 4.6 percentage points in the labor force participation of women aged 20-65 whose husband's were paid employees. The effect is larger (6.7 percentage point) among wives of less educated men. Chou, Liu and Hammit (2001) document that NHI lowered average savings by 6.9% and raised average consumption by 2.4%. The effect on savings is especially strong for the households with the smallest savings.

However, the results in Chou and Staiger (2001) and Chou, Liu and Hammit (2001) need to be interpreted with a degree of caution, because like Mete and Schultz (2002), they use government employees as the control group in their studies.

3 The Data

In this paper, we use a longitudinal data set from the "Survey of Health and Living Status of the Elderly in Taiwan (SHLSET)". It was collected in Taiwan by the Taiwan Provincial Institute of Family Planning (TPIFP) (which has been renamed the Bureau of Health Promotion, Department of Health, Taiwan, since 2001) and the Population Studies Center in the University of Michigan, Ann Arbor (PSC, UM). The survey was initiated in 1989 with 4,049 respondents aged 60 and above. Of these, 3,155 individuals were reinterviewed in the 1993 follow-up and 2,669 individuals were interviewed again in the 1996 follow-up.

TPIFP extended the survey by launching a second panel of individuals aged 50-66 in 1996. The completed second sample contains 2,462 individuals. Because NHI started in 1995, we use the 1989, 1993 and 1996 surveys (of

both old panel and young panel) for our analysis. The 1999 survey has been completed, but has not yet been released. For convenience, we will label the original panel the "old panel" and the new panel the "young panel" in the following text.

The SHLSET provides rich information about an individual's background characteristics, family structure, marital history, health status, residence history and work history (the starting time, the ending time, the occupation and the employment status of *each job* after 50 years old). It allows us to construct a unique panel data set characterizing a worker's job history from 50 years old onward.[7] The oldest worker in our sample was 103 years old in 1996. That means his job history started as early as 1943 (=1996-(103-50)). The younger cohort's job history began in later years. Hence, we end up with a panel data set for the period 1943-1996, whereas Mete and Schultz (2002) only utilize data in two years before NHI (1989 and 1993) and one year after NHI (1996). The structure of our data set will enable us to investigate a senior citizen's retirement behavior in a dynamic framework.

Despite its nice panel data structure, the SHLSET provides relatively little information about an individual's income, wealth and consumption. A

[7]It is usually called "multiple-record single-failure survival-time data " in survival analysis.

respondent was asked about his/her income from his/her jobs in 1989, 1993 and 1996 only. The response rate for questions regarding income was also very low. For people who refused to report their exact income, interviewers asked about the "range" of income instead. But still, the response rate was low. Therefore, we do not use this information.

3.1 Definition of Retirement in the Estimation

Different definitions of retirement have been used in the empirical literature on retirement, including "(1) a "permanent" departure from the labor force; (2) a substantial reduction in the usual number of hours worked;[8] (3) self-reported retirement; and (4) receipt of pension or social security benefits." (Madrian(1994), p. 204).

The 1989 survey of the old panel contains self-reported retirement status and age at retirement. These data come from the following questions: "Have you ever retired from work? If you have, how long ago?". In addition, there is also a second question: "When did you stop doing your last job?". The 1993 and 1996 surveys, however, only include the second question. This question is

[8]Although definition (2) is one of the ways researchers define retirement, we will not treat part-time workers as retirees. We think it is hard to find a reasonable threshold to define a "substantial" reduction in hours worked.

more ambiguous than the self-reported one. In order to identify "retirement" more precisely, we use the 1989 retirement status as a starting point for the old panel. We trace a respondent's subsequent labor force attachment in 1993 and 1996 follow-ups and update his/her retirement status accordingly except for those who left the survey due to data attrition. If an individual self-reported himself/herself retired in 1989 and did not resume working between 1989 and 1996, then he/she is considered to be permanently out of the labor force and thus compliant with definition (1) above. If an individual self-reported himself/herself retired in 1989, but resumed working afterwards, he/she will not be categorized as "retired" unless he/she stops working again later on.

Unfortunately, we can not trace the young panel, since its first follow-up (the 1999 survey) has not been released yet. If we can obtain the 1999 data in the future, we can take advantage of the longitudinal structure further and obtain more precise measurement of "retirement", as well as additional post-NHI years of data.

Mete and Schultz (2002) use a different model from the proportional hazard model that we use. The key dependent variable in their ordered probit model is an ordered categorical variable which distinguishes between

full-time workers, part-time workers and those who are not in the labor force in 1989, 1993 and 1996 respectively. Their dependent variable is not related to a worker's work history. Although they do not discuss their definition of "full-time workers", "part-time workers" and "not working", they are likely to have come from the following questions in the survey: "Are you presently working? If yes, is your current job full-time or part-time?" Like us, Mete and Schultz(2002) do not treat part-time workers as retirees.

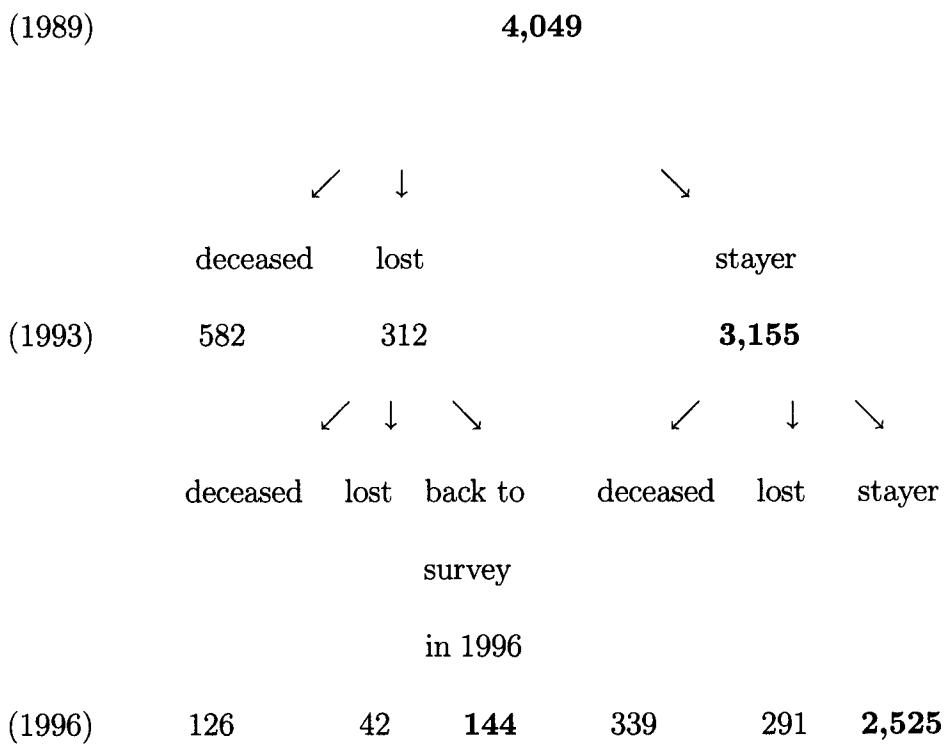
3.2 Data Attrition and Data Structure

It is helpful to understand the extent of data attrition for the old panel before we build our data set. Therefore, we use Diagram 1 to visualize it. To prevent the loss of information from deceased and lost subjects in the follow-ups, we use an unbalanced panel. A mover (a deceased or lost individual) who had already retired when he/she left the survey is included in the sample. A mover who was still working when he/she left the survey is treated as general right-hand censoring—his/her survival time goes from his/her entrance to the last contact (please see Appendix 3).

In essence, we follow each individual until he/she retired or became censored. We will list the number of retirees and censored individuals in each

regression of our empirical analysis.

[Diagram 1] Data Attrition



3.3 Identification and Selection Rules for the Sample

As stated above, using government employees as the control group may fail to approximate a randomized experiment. In 1995, the government in Taiwan brought a pension reform to the public sector, which changed the original

unfunded system[9] into a fully funded system. This new policy might have affected labor force participation in the government sector. In other words, it compounds the difficulty of identification when we study the effect of NHI on retirement.

Even in the absence of the 1995 pension reform, however, government employees can not serve as a valid control because they are select. In order to investigate the extent of selection of government employees in the SHLSET, we summarize certain demographic characteristics of employees in the government sectors and private sectors in Table 4. Considering the structure of the data set and job changes over the life-cycle, an observation-level comparison (using all records of each individual in the data set) is more informative than an individual-level comparison. As stated in section 1, the yearly proportion of government employees in total employment is around 6.3% - 6.9% in Taiwan over the period 1974 - 1998. A similar measure - the proportion of observations in the government sector - is 15.25% in Table 4 where we conduct the observation-level comparison. Because of compulsory retirement in the public sector, observations in the public sector are on average younger than those in the private sector. Government employees have

[9]The old system is in a similar spirit to a pay-as-you-go system. It is like a pure transfer scheme, whereas the amount of pension received by each retiree depends on his/her tenure.

the highest proportion of observations with spouses. They also have fewer adult children and have a 2 - 8-percentage-point higher fraction of people reporting chronic illnesses.[10] We also see that government workers are more likely to be males and more likely to be Mainlanders. Because Taiwanese, Haka people and Mainlanders share very similar cultural backgrounds, there might not be much heterogeneity among them. So differences in race across groups might not be relevant here. However, the huge gap in education across different groups disqualifies government workers as a valid control group. It is very obvious that workers in the government sector are much more educated (26.4% of them have more than 13 years of schooling) than other groups. In essence, observations in the government sector and those in the non-government sector are very different.

It is hard to implement the regular difference-in-difference approach to test whether NHI increased the overall retirement when a valid control group is not available.[11] In the following discussion, we will focus solely on private employees and test another interesting hypothesis which is that the effect of

[10]Some people may argue that because government employees have GEI, they visit hospitals more freqently and thus have more chances to detect chronic illnesses and report them than people otherwise (e.g. the self-employed).

[11]Matching method could be a good way to solve the selection problem, if there was no 1995 pension reform.

NHI is greater for people who lack a child safety net.

Several observations are excluded from our sample, including individuals who have never worked, individuals whose retirement ages are under 50 years old, observations over 80 years old, and individuals who "retired" due to layoff, shut-down or business failure. We exclude individuals who retired before 50 and observations over 80 so that we can avoid the impact of outliers. Excluding workers who "retired" due to layoff, shut-down or business failure is aimed at focusing on voluntary retirement. However, it is possible that people reported layoff/shut-down/business failure as the reason ex post when it wasn't. Also, employers might be more likely to lay off workers when workers are eligible for NHI. Thus we also try including workers who claimed that the reason for retirement was layoff/shut-down/business failure in the second sample. As it is difficult to define retirement for farmers and the self-employed, they are also excluded from our sample.[12] In short, we will focus on private employees in non-agricultural sectors.

For this group, Table 5 lays out the differences in observable characteristics across groups with various numbers of adult children. For men, these differences are not large. Some of the observations without adult children

[12]Mete and Schultz (2002) do not describe their detailed selection rules. Consequently, we do not know whether they include farmers and the self-employed or not.

belong to single individuals, so it is reasonable that the proportion of with-spouse observations in the no-adult-children-group is lower than in other groups. Observations with 5+ adult children are older, since the number of adult children is increasing in people's age. Observations with 5+ adult children also have a 3 - 4-percentage-point higher probability of chronic illness than those with fewer adult children. The groups are not strikingly different in terms of education, although observations with 5+ adult children are on average less educated than other groups. There exist some differences in race across groups, although as stated above, these differences may not be relevant. For females, the differences across groups are quite big. This perhaps reveals the fact that our female sample is smaller than the male sample. The bigger differences for women also imply that the results for women may not be as compelling as those for men.

3.4 Descriptive Statistics

The unconditional survival estimates in Figure 2 show that private employees working in non-agricultural sectors have lower survival rates after NHI (NEWNHI=1) than before NHI (NEWNHI=0). The survival rate drops universally for every age group. (age=analysis time +50) The male sample in

Figure 3 behaves similarly to all samples in Figure 2. But the decrease in the survival rate is less obvious for females in Figure 4.

Do people with different "safety nets" behave differently? Comparing Figure 5 and 6, we see that the decrease in the survival rate after NHI for employees with **no adult children** is indeed more significant than that for employees with **three adult children or more** when the age goes beyond 60. In other words, the elderly with weaker "safety net" seem to be more sensitive to NHI.

To further investigate retirees' dependence upon children before and after NHI, we also use the old panel to calculate ratios of retirees living with adult children, married children or working children in 1989, 1993 and 1996. As is clear from Table 6, these ratios decrease for both balanced and unbalanced panels as time goes by, but the fraction of people living with adult children is still above 64% in 1996. Hence intergenerational support is still important after NHI.

4 A Sequential Decision Model

Van der Klaauw and Wolpin (2002) worked out an explicit sequential decision model of savings and the labor supply of elderly individuals to investigate the importance of pensions, social security benefits and employer provided health insurance coverage. Although the variables required to estimate this kind of dynamic model – such as age-varying wages, assets, wealth, and consumption – are not available in our data set, formulating a similar model before empirical estimation can still shed some light on our research questions. Therefore, we borrow their model and modify it in this section.[13] Our major modifications will be the inclusion of premiums and the assumption of one-sided altruism – that adult children are willing to take care of their elderly parents when parents are ill and that no bequests exist.

Lee, Parish and Willis (1994) use the 1989 Taiwan Family and Women Survey and probit analysis to study intergenerational support in Taiwan. They try to test three interesting hypotheses suggested by the bargaining model, the mutual aid model and the altruism model respectively. The bargaining model suggests that "parents with more resources (high income and undistributed property) relative to children will elicit more money and service

[13] We will follow the notations in their model.

contributions from children." (Lee, Parish and Willis (1994, p.1017)) The short-term quid pro quo mutual aid model suggests that children's continuing support results from their prospect of parental assistance, such as daily chores and child care. Thus, "parents providing help with chores and child care will receive more resources." (Lee, Parish and Willis (1994, p.1018)) On the other hand, the altruism model suggests that "children who received more investment from parents (education, property) will provide more," and "parents with more need (fewer resources, poor health) will receive more." (Lee, Parish and Willis (1994, p.1018)) Their evidence shows that the bargaining model hypothesis is the least supported. The short-term mutual aid model can explain only a portion of intergenerational transactions. In contrast, the loan hypothesis and insurance hypothesis implied by the altruism model are very consistent with their data. They find that repayment of parent's investment in children's human capital is an important part of adult children's financial support. These findings can explain the source of altruism in the following modified model.

4.1 The Choice Set, State Space and Preferences

The targets of our study are private employees over 50 in non-agricultural sectors. These employees are either uninsured or covered by Labor Insurance (LI) before NHI.[14]

At any age a, an individual of gender j ($j = m(male),\ f(female)$) chooses consumption C_a^j[15] and hours of work in the labor market h_a^j. Hours worked are allowed to take on three values: retirement ($h_a^j = 0$), part-time hours ($h_a^j = 1$) and full-time hours ($h_a^j = 2$). We define $D_a^j \equiv \{C_a^j, h_a^j\}$ as the choice set, and d_a^j as a specific choice within D_a^j. A vector of covariates z_1^j denotes age-invariant personal characteristics and z_{2a}^j represents age-varying personal characteristics. The number of adult children N_a^j at each age a is exogenous to the decision maker and part of z_{2a}^j.[16] Furthermore, let H_a^j be an indicator of health status at age a ($H_a^j = 1$ if healthy; and 0 otherwise), W_a^j represents net assets at age a, the $\epsilon's$ are age-varying shocks to the marginal utility of consumption and hours worked, μ^{uj} is a time-invariant unobserved individual specific heterogeneity component, δ is the discount factor, and π_a^{sj}

[14]Labor Insurance is compulsory for employees aged 15-60 and worked in firms with 5+ workers. Other private employess can join Labor Insurance voluntarily.

[15]$C_a^j \geq \underline{C}$, where $\underline{C}$ is the minimum consumption for an individual.

[16]Modeling number of children is beyond the scope of this paper. That is, we model decisions of consumption and hours worked conditional on the number of children at each age.

denotes the survival rate from a to $a+1$. The health insurance indicator HI_a^j equals to 1 if the respondent is covered by LI or NHI at age a, and 0 otherwise. Then the state space can be described as follows:

$$\Omega_a^j \equiv \{a, j, z_1^j, z_{2a}^j, H_a^j, HI_a^j, W_a^j\}, \tag{1}$$

and a well-defined preference over own consumption and employment status can be characterized as

$$U_a^j = U^j(C_a^j, h_a^j;\ j, z_1^j, z_{2a}^j, H_a^j, \epsilon_a^{cj}, \epsilon_a^{hj}, \mu^{uj}). \tag{2}$$

So we can write the Bellman equation as:

$$V_a^j(\Omega_a^j) = \max_{D_a^j}[U_a^j(\Omega_a^j) + \delta\pi_a^{sj} E\{V_{a+1}^j(\Omega_{a+1}^j)|\ \Omega_a^j, d_a^j(\Omega_a^j)\}\ ], \tag{3}$$

4.2 Transition Functions

Following Van der Klaauw and Wolpin (2002), the survival hazard (the probability that an employee survives to age $a+1$ given his/her survival to age a) is $\pi_a^{sj} \equiv \pi^s(a,\ j, H_a^j, \mu^{sj})$, in which μ^{sj} is a heterogeneity component. Moreover, the probability of being in good health at $a+1$ is assumed to be

$\pi^{Hj}_{a+1} \equiv \pi^H(a+1,\ j, H^j_a, HI^j_a, \mu^{Hj})$, where μ^{Hj} is a heterogeneity component.

4.3 Budget Constraint

We assume that a senior citizen in poor health but covered by health insurance (no matter LI or NHI) at age a has no out-of-pocket expenses as does a person in good health.

4.3.1 Without NHI

Before the introduction of NHI, the budget constraint of an employee covered by Labor Insurance is

$$\text{s.t. } C^j_a + W^j_{a+1} = W^j_a + (1-\tau)[(1-t_{LI})\omega^j_a h^j_a + rW^j_a] - \sum_{i=1}^{d^j_a} q_H(1-H^{ji}_a), \quad (4)$$

and the budget constraint if he/she retired was

$$\text{s.t. } C^j_a + W^j_{a+1} = W^j_a + (1-\tau)[rW^j_a] - q_H(1-H^j_a) * (\frac{1}{\lambda})^{N^j_a}, \quad (5)$$

where τ is the proportional income tax rate, t_{LI} is the premium rate of LI, ω^j_a is the hourly wage rate, and r represents the fixed (borrowing and lending) rate of interest. Because LI does not cover dependents, a LI-insured needs to

pay health care expenses for his/her dependents. q_H is the constant cost of health care, d_a^j represents the number of dependents, and H_a^{ji} indicates the ith dependent's health status when the respondent is at age a ($H_a^{ji} = 1$ if the ith dependent is healthy; and 0 otherwise). The shocks H_a^{ji} are uncorrelated, i.i.d. processes. We assume that a retiree does not need to bear any medical expenditures for dependents. In equation (5), N_a^j represents the number of adult children at age a, and $\lambda > 1$ measures the magnitude of the adult children's filial piety (altruism towards parents). Because Labor Insurance does not offer post-retirement health insurance, retirees from LI-insured jobs must count on themselves or their children when they need to buy health care. We presume that adult children in Taiwan all have a certain extent of filial piety which is reflected by the parameter λ. The greater λ is, the less a parent needs to pay by himself/herself and the more filial his/her adult children are. For simplicity, siblings in the same family are assumed to be homogeneous and share the same λ. Furthermore, other things being equal, the more adult children (N_a^j) a senior citizen has, the less medical expenditures he/she needs to bear on his/her own. In summary, a retired senior citizen in poor health needs to pay $q_H * (\frac{1}{\lambda})^{N_a^j}$ on his/her own.

As for an uninsured employee, his/her budget constraint is

$$\begin{aligned} \text{s.t. } C_a^j + W_{a+1}^j &= W_a^j + (1-\tau)[\omega_a^j h_a^j + rW_a^j] - q_H(1-H_a^j) * (\frac{1}{\lambda})^{N_a^j} \\ &\quad - \sum_{i=1}^{d_a^j} q_H(1-H_a^{ji}), \end{aligned} \tag{6}$$

and the budget constraint if he/she retired was the same as equation (5):

$$\text{s.t. } C_a^j + W_{a+1}^j = W_a^j + (1-\tau)[rW_a^j] - q_H(1-H_a^j) * (\frac{1}{\lambda})^{N_a^j},$$

4.3.2 With NHI

After the introduction of NHI, the budget constraint of an LI-insured employee is

$$\text{s.t. } C_a^j + W_{a+1}^j = W_a^j + (1-\tau)[(1-t_{LI}-t_{NHI}(1+d_a^j))\omega_a^j h_a^j + rW_a^j], \tag{7}$$

where t_{NHI} is the premium rate of NHI. As indicated in section 2.3, many people still keep their LI plans to enjoy LI's unemployment benefit, old-age benefit and death benefit that NHI does not offer. So they still pay the LI premium after 1995. Also, because NHI provides coverage for dependents,

the employee pays total premium $t_{NHI}(1+d_a^j))\omega_a^j$,[17] instead of total medical expenses $\sum_{i=1}^{d_a^j} q_H(1-H_a^{ji})$. Likewise, the budget constraint of an previous uninsured employee is

$$\text{s.t. } C_a^j + W_{a+1}^j = W_a^j + (1-\tau)[(1-t_{NHI}(1+d_a^j))\omega_a^j h_a^j + rW_a^j], \quad (8)$$

He/She pays total premium $t_{NHI}(1+d_a^j))\omega_a^j$, instead of total medical expenses $q_H(1-H_a^j) * (\frac{1}{\lambda})^{N_a^j} + \sum_{i=1}^{d_a^j} q_H(1-H_a^{ji})$.

As for a retiree, he/she would face one of the budget constraints in the following. First, if he/she was entitled to be the dependent of one of his/her direct family members (mostly an adult child or the spouse), this family member would pay the premium for him/her. So his/her budget constraint was

$$\text{s.t. } C_a^j + W_{a+1}^j = W_a^j + (1-\tau)[rW_a^j]. \quad (9)$$

Second, if a retiree had no family member to depend upon but was eligible for subsidy[18], the government would pay the NHI premium for him/her. So his/her budget constraint was the same as equation (9). Thirdly, if a retiree

[17] Please refer to footnote 2.

[18] For example, low-income families, native Taiwanese over 55, citizens of Taipei over 65 (The city government of Taipei implemented this policy on July, 1996), and citizens of Kaoshiung over 65 are eligible for the subsidy.

had no family member to depend upon and was not eligible for subsidy, he/she would need to pay a lump-sum premium s on his/her own[19] and his/her budget constraint would be:

$$\text{s.t. } C_a^j + W_{a+1}^j = W_a^j + (1-\tau)[rW_a^j] - s. \tag{10}$$

So NHI substitutes for the "family health insurance" provided by adult children and bears the burden that a senior citizen needed to bear on his/her own before NHI.

4.4 Income Effects and Substitution Effects

Comparing (4) and (7), we can see that, for the LI-insured, NHI decreases the net wage rate by $t_{NHI}(1+d_a^j)$ because he/she and his/her dependents are covered by NHI. How individuals respond to this change depends on the magnitude of income and substitution effects. To simplify the exposition, we denote income effects and substitution effects due to decreased net wage rates as "income effect 1" and "substitution effect 1". In addition, an employee

[19]This monthly lump-sum premium is NT$ 555 from March 1995 to June 1996, NT$ 546 from July 1996 to June 1997, NT$ 576 from July 1997 to June 1998, and NT$ 604 from July 1998 onward. The exchange rate of US$1 was around NT$ 33 in 1998.

saves $\sum_{i=1}^{d_a^j} q_H(1 - H_a^{ji})$ after NHI, which could generate a pure income effect and induce an employee to work less. We denote this income effect as "income effect 2".

Comparing (5) and (9), we also see that, NHI provides a positive post-retirement income transfer ($= q_H(1 - H_a^j) * (\frac{1}{\lambda})^{N_a^j}$) for the previously LI-insured when he/she needs health care after retirement. We denote the resulting effect as "income effect 3". This expected income transfer induces the elderly employees to save less, consume more leisure, and retire earlier. Most important of all, this transfer is greater for the elderly with fewer adult children.[20] So we expect parents with fewer adult children to be more sensitive to NHI than parents with more adult children. Even though a single or childless individual would need to pay a lump-sum premium s on his/her own and face budget constraint (10), he/she could still retire earlier as long as the expected net income transfer ($=q_H(1 - H_a^j) * (\frac{1}{\lambda})^{N_a^j}$ - s) is positive.

As for the previously uninsured, NHI also induces similar substitution and income effects.

In summary, the net effect of NHI depends on the magnitude of "substitution effect 1" and three income effects. If "income effect 1" dominates, an

[20] We assume adult children's generosity is fixed and not affected by this income transfer.

individual will increase labor supply. In contrast, if "substitution effect 1", "income effect 2" or "income effect 3" dominates, an individual will decrease labor supply. This economic model also conveys an important message via "income effect 3": when the government implements a universal policy like NHI, people may respond very differently because of their adult children's altruism. This results from the peculiar role of adult children in Taiwan. Consequently, we expect parents with fewer adult children to be more sensitive to NHI than those with more adult children.

5 Estimation Method and Empirical Results

Direct estimation of the previous sequential decision model would be a good way to investigate the effect of NHI. However, the SHLSET does not contain information about age-varying wages, assets, wealth, and consumption which is crucial to the estimation. Therefore, we need to take another econometric approach which can take account of the inherently dynamic characteristics of the retirement decision. A hazard model, as a reduced-form approach to a dynamic model, is a good choice.

5.1 The Proportional Hazard Model

As Hausman and Wise (1985) have suggested, retirement behavior can be naturally modeled in the following hazard framework.

Think of the age of retirement of any particular person as a continuous random variable, A, and consider a as a realization of A. Furthermore, consider a large population of people who entered the state of "being at risk of retiring" at 50 years old.[21] Then the probability that a person *has* retired by age a is given by the distribution function:

$$F(a) = 1 - \frac{1}{\exp[\int_{50}^{a} h(u)du]} \tag{11}$$

where $h(.) > 0$. This specification has the intuitive interpretation that the probability of retirement goes to 1 as an individual gets older (a gets large).

The Cox proportional hazard model with age-varying covariates can be specified by the hazard relationship as follows:

$$h(a; Z(a)) = \lim_{da \longrightarrow 0} \frac{P(a \leq A < a + da | \ A \geq a, Z(a))}{da} = h_0(a)e^{Z(a)\beta} \tag{12}$$

[21] We can also change the threshold into any other age.

where $h_0(a)$ is an arbitrary and unspecified base-line hazard function; $Z(a) = (z_1, z_2(a))$ consists of age-invariant covariates z_1 and age-varying covariates $z_2(a)$; β is a column vector of regression parameters. Given this hazard function, we can calculate the survival function as

$$S(a; Z(a)) = \frac{1}{\exp[\int_{50}^{a} h(u; Z(u))du]} \tag{13}$$

and rewrite the distribution function in equation (11) as

$$F(a; Z(a)) = 1 - \frac{1}{\exp[\int_{50}^{a} h(u; Z(u))du]} \tag{14}$$

Given $h(a; Z(a))$ and $S(a; Z(a))$, the calculation of the density function $f(a; Z(a))$ is straightforward:

$$f(a; Z(a)) = h(a; Z(a)) * S(a; Z(a)) \tag{15}$$

The proportional hazard model is nonparametric in that it involves an unspecified base-line hazard function.[22] In consequence, this model is more

[22]Lancaster (1990, p250) call the inferences based on partial likelihood *semi-parametric*: "...This is why partial likelihood is a *limited information* likelihood; it does not require the investigator to provide the information that would be contained in a parametric form of θ_0 (the base-line hazard function in his notation). It is also why inferences based

flexible than others. For example, the Exponential regression model and the Weibull model are two special cases of the proportional hazards family.[23] Estimating a flexible model like this can prevent us from deriving conclusions driven by a specific parametric assumption. That is, our conclusion will be robust and independent of the choice of functional form of the base-line hazard function.

Recent related literature using the proportional hazard model includes Bowlus (1995), Hausman and Wise (1985), as well as Gruber and Madrian (1995). Bowlus (1995) uses the proportional hazard model to study the effect of the business cycle on job matching and job tenure. Hausman and Wise (1985) use this model to investigate the effects of social security payments and social security wealth on retirement. Gruber and Madrian (1995) also use this model when analyzing the effect of continuation coverage of employer-provided health insurance on retirement.

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on partial likelihoods are sometimes called *semi-parametric*; only μ (some person-specific term, which is equal to $\exp\{x'\beta\}$ in his notation) needs to be specified parametrically and no parametric specification of θ_0 is required..."

[23] Think of the simpler case in which all the covariates are time-invariant ($Z(a) = Z, \forall a$). If $h_0(a) = \lambda$, a constant, equation (12) reduces to the Exponential regression model $h(a) = \lambda e^{Z\beta}$. If $h_0(a) = \alpha \exp\{\beta_0\} a^{\alpha-1}$, equation (12) reduces to the Weibull regression model $h(a) = \alpha \exp\{\beta_0\} a^{\alpha-1} e^{Z\beta} = \alpha a^{\alpha-1} \exp\{\beta_0 + Z\beta\}$.

5.2 Estimation Method[24]

Cox (1975) suggests using the partial likelihood to estimate β in the proportional hazard model. The most important feature of this partial likelihood method is the way the base-line hazard $h_0(.)$ is treated. It is irrelevant how $h_0(.)$ is parameterized because $h_0(.)$ always cancels out from each ratio inside the product in partial likelihood function. We present the details of this partial likelihood method in Appendix 4. It has been shown by Cox that the method used to construct this likelihood offers maximum "partial" likelihood estimates that are consistent and asymptotically normally distributed (Kalbfleisch and Prentice (1980), p. 77).

5.3 Covariates

The covariates in our model ($Z(a)$) consist of age-invariant covariates z_1 and age-varying covariates $z_2(a)$.

z_1 contains a set of demographic characteristics, including:

- *male* : an indicator for males.
- $s2$, $s3$ and $s4$: education categories for 1-6 years, 7-12 years and 13+

[24]**Two good references are Lancastor (1990) and Kalbfleisch and Prentice (1980).**

years of schooling respectively. The reference group is the illiterate.

- $r2$, $r3$ and $r4$: ethnic dummies. They refer to Haka people,[25] people whose ancestors came from Mainland China (Mainlanders), and others respectively. The reference group is Taiwanese.

$z_2(a)$ contains :

- $spouse_a$: an indicator equal to one if the respondent has a spouse at age a.

- NHI_a : an indicator equal to one if the corresponding year is 1995[26] or 1996 at age a;

- $chronic_a$: an indicator for people who have chronic illnesses (high blood pressure, diabetes, heart disease, stroke, cancer, bronchitis, pneumonia or other respiratory illnesses, arthritis or rheumatism, gastric ulcer or stomach illnesses, liver or gall bladder disease) at age a. We generate this variable according to "the duration of each chronic disease" that a respondent reported in the survey.

[25] A specific group of people whose ancestors came from certain south-eastern areas of Mainland China.

[26] It is possible that 1995 is not the exact time that the natural experiment began, since the first official committee responsible for scheduling NHI was established in 1987. In that case, we could move the 1995 threshold to an earlier year.

We expect people with chronic illnesses to respond to NHI differently from healthy people. Hence, an interaction of NHI_a and $chronic_a$ is also included in the regression.

- $chronic_a * NHI_a$: an interaction term.

In order to identify the elderly's dependence on adult children and get at the effect of NHI, we add the following variables in $z_2(a)$. These will be the key predictors to test our hypothesis.

- ac_a : the number of adult children (children older than or equal to 25[27]) at age a;

- $ac_a * NHI_a$: an interaction term.

The policy indicator NHI_a, the age-varying covariate ac_a and their interaction term will work together to test whether individuals with different numbers of adult children behaved differently or not before and after the policy.

Moreover, to investigate the effect of dependents and dependent-coverage provided by NHI, we proxy the number of dependents with the number of

[27]The normal age of graduating from a college is 23. Moreover, males in Taiwan need to spend two years for compulsory military service after he reaches 18. So we assume that a child can work and support his/her family approximately from 25 onward.

children under 25 and add an interaction term between this variable and the NHI indicator.

- dep_a : the number of young children (children younger than 25) at age a;
- $dep_a * NHI_a$: an interaction term.

Although age-varying income and wealth are not available in our data set, we proxy them with occupation dummy variables so that the impact of omitted variables bias can be reduced. We use seven dummies to indicate professionals, managers, clerks, salesmen, craftsmen, operators and workers in the service industry. The reference group is the laborer.

5.4 Empirical Results

The main spirit of equation (12) is allowing all the workers(survivors) to compete to retire at a given age. So age is a fixed constant for each competition. Estimates of equation (12) are presented in Table 7 where workers who stopped working due to layoff/shutdown/business failure are excluded. Instead of reporting coefficient estimates, we present the more intuitive exponential coefficients which are exactly relative hazard ratios.

For example, we can rewrite equation (12) as

$$h(a; Z(a)) = h_0(a) \exp[\alpha * male + \widetilde{Z}(a)\gamma] \tag{16}$$

where the $\widetilde{Z}(a)$ matrix contains all predictors except *male*. α and γ are coefficients for *male* and $\widetilde{Z}(a)$ respectively. Hence,

$$h(a|male; \widetilde{Z}(a)) = h_0(a) \exp[\alpha + \widetilde{Z}(a)\gamma] \tag{17}$$

$$h(a|female; \widetilde{Z}(a)) = h_0(a) \exp[\widetilde{Z}(a)\gamma] \tag{18}$$

Dividing (17) by (18), we have

$$e^{\alpha} = \frac{h(t|male; \widetilde{Z}(a))}{h(t|female; \widetilde{Z}(a))} \tag{19}$$

Table 7 shows that this relative hazard ratio is approximately 0.69 and statistically significant.[28] In other words, the retirement hazard of males is 31% less than that of females. This is consistent with the stylized fact that

[28] We conduct a one-tailed test with the alternative hypothesis that H_A: $e^{\alpha} > 1$, i.e., H_A: $\alpha > 0$. All the following tests are one-tailed too.

men tend to stay in the labor market longer than women do.[29]

A male employee with a wife has a significantly lower retirement hazard than a single man. The spouse effect for female workers is not significant.

Individuals with chronic diseases have significantly higher retirement hazard rate than people otherwise.[30] This indicates that healthier workers stay in the labor market longer.

We also expect people with chronic illnesses to change their retirement hazards after NHI. Again, we can rewrite equation (12) as

$$h(a; Z(a)) = h_0(a) \exp[\beta_1 * NHI_a + \beta_2 * chronic_a + \beta_3 * chronic_a * NHI_a + \underline{Z}(a)\theta], \tag{20}$$

where the $\underline{Z}(a)$ matrix includes all predictors except NHI_a, $chronic_a$ and $chronic_a * NHI_a$. Parameters β_1, β_2, β_3 and θ are coefficients for NHI_a, $chronic_a$, $chronic_a * NHI_a$ and $\underline{Z}(a)$ respectively. For individuals who have chronic illnesses at age a ($chronic_a = 1$), the relative hazard ratio

$$e^{\beta_1+\beta_3} = \frac{h(a|After\ NHI; \underline{Z}(a))}{h(a|Before\ NHI; \underline{Z}(a))} \tag{21}$$

[29] It is possible that elderly females retire earlier to take care of their grandchildren.

[30] We obtain the main effect of chronic illnesses in a specification without the interaction term $chronic_a * NHI_a$.

measures their average response to the policy. Using the full sample, we obtained an insignificant ratio equal to 1.422 (z=1.627). However, chronically ill males indeed responded to NHI by increasing their retirement hazards significantly ($e^{\beta_1+\beta_5} = 1.776$ (z=2.443)). The relative hazard ratio for females was less than one (0.731 (z=-0.753), which may indicate that women with chronic illnesses got better health care and therefore became more productive after NHI, leading to deferred retirement. Other things being equal, the average influence of NHI on observations without chronic disease is reflected by e^{β_1}, which is 1.830 (z=2.15) for the full sample, 2.153(z=2.28) for the male sample and 1.009(z=0.02) for females. This coefficient showed that observations without chronic disease also increase their average retirement hazard after NHI. The magnitude of increase for chronically ill observations was smaller than that for observations otherwise. It is possible that the average productivity of chronically ill observations went up more significantly after NHI than that of observations without chronic disease. Therefore, the average post-NHI retirement hazard for the chronically ill observations was not as high as expected.

The estimates of the number of young children dep_a and the interaction term $dep_a * NHI_a$ are not significant. Hence the effect associated with

dependent-coverage provided by NHI could be insignificant.

Our key estimates are hazard ratios for the number of adult children ac_a, the policy indicator NHI_a and the interaction effect spotlighted by $ac_a * NHI_a$. As expected, employees who have more adult children have a significantly higher retirement hazard than otherwise.[31] This main effect of adult children is stronger for females than for males. It is consistent with our discussion in section 2.2 that elderly women have a strong dependence upon their adult children.

Again, we can rewrite equation (12) as

$$h(a; Z(a)) = h_0(a) \exp[\beta_1 * NHI_a + \beta_4 * ac_a + \beta_5 * ac_a * NHI_a + \overline{Z}(a)\delta] \quad (22)$$

where the $\overline{Z}(a)$ matrix includes all predictors except NHI_a, ac_a and $ac_a * NHI_a$. The parameters β_1, β_4, β_5 and δ are coefficients for NHI_a, ac_a, $ac_a * NHI_a$ and $\overline{Z}(a)$ respectively. For an individual who has adult children at age a,

$$h(a|After\ NHI; \overline{Z}(a)) = h_0(a) \exp[\beta_1 + \beta_4 * ac_a + \beta_5 * ac_a + \overline{Z}(a)\delta] \quad (23)$$

[31] We obtain the main effect of adult children in a specification without the interaction term $ac_a * NHI_a$.

$$h(a|Before\ NHI; \overline{Z}(a)) = h_0(a) \exp[\beta_4 * ac_a + \overline{Z}(a)\delta] \tag{24}$$

So the ratio

$$e^{\beta_1+\beta_5*ac_a} = \frac{h(a|After\ NHI; \overline{Z}(a))}{h(a|Before\ NHI; \overline{Z}(a))} \tag{25}$$

gives the relative risk of the exposure to NHI for elderly people. Other things being equal, e^{β_1} measures the average response of observations without adult children. It is significantly greater than one for the full sample (1.830) and for men (2.153). Conditional on all private employees working in non-agricultural sectors and having *one* adult child, the ratio ($e^{\beta_1+\beta_5*1}$) is equal to 1.676 and significant at the 2.5% level in the one-tailed test (z=2.059). It is 1.845 (z=1.998) for the male sample and 1.068 (z=0.161) for the female sample. The significant hazard ratios of males and the full sample manifest the phenomenon that people who have a weak familial safety net (only one adult child) increase their retirement hazards after NHI. Likewise, conditional on private employees working in non-agricultural sectors and having *two* adult children, the ratio in equation (25) becomes 1.535 (z=1.883). These ratios are 1.581 (z=1.607) and 1.129 (z=0.333) for males and females respectively. If we focus on employees with *three* adult children, the relative hazards for the

full sample and males become less significant (the ratios are 1.406 (z=1.591), 1.355 (z=1.106) and 1.195 (z=0.520) for the full sample, males and females respectively). We expect relative retirement hazards to become much less significant for individuals with four or more children. Comparing male employees with different numbers of adult children, we see that the more adult children an individual has, the smaller and less significant his relative hazard ratio is. In short, male employees with more adult children responded to NHI less than those with fewer adult children.

When employees who retired due to layoff, shutdown or business failure are included, our sample contains 44 more male individuals and 25 additional female employees. The results are similar to those in Table 7. For example, conditional on all private employees working in non-agricultural sectors and having *one* adult child, the relative hazard ratio is equal to 1.752 and significant at the 1% significance level (z=2.389). Males have a ratio equal to 1.942 (z=2.341), while females have a smaller and less significant ratio (1.161 (z=0.387)) than their counterpart. Likewise, conditional on having *two* adult children, the relative hazard becomes 1.610 and significant at the 2.5% significance level (z=2.247). These ratios are 1.701 (z=2.032) and 1.175 (z=0.465) for males and females accordingly. Comparing these results with

the estimates without layoff sample, we find that the effect of NHI is a little bit more significant when these additional individuals are included.

Table 8, Figure 7-1 and Figure 7-2 summarize all the preceding policy effects.

Notice that elderly women seem to be insensitive to NHI. As indicated in section 3.3, this might due to the fact that the female sample is relatively small and very different across groups with different numbers of adult children in many dimensions.

It is plausible that the effect of adult children is not linear. That is, the marginal effect between no-adult-children group and one-adult-child group could be larger than that between one-adult-child group and two-adult-children group, and the marginal effect between one-adult-child group and two-adult-children group could be larger than that between two-adult-children group and three-adult-children group,..., etc. Therefore, we also try using child dummy variables to categorize this effect. To simplify exposition, we denote the response to NHI of each group (parallel to equation (25)) as R(number of adult children). For the male sample, we find that $\frac{R(0)}{R(1)} = 1.374 * \frac{R(1)}{R(2)}$, $\frac{R(1)}{R(2)} = 1.178 * \frac{R(2)}{R(3)}$, and $\frac{R(2)}{R(3)} = 0.401 * \frac{R(3)}{R(4+)}$.[32] However,

[32]Details are available from the author.

none of these effects is significant. In consequence, drastic nonlinearity may be absent in our sample.

Because adult sons have more responsibility to take care of parents in Taiwan, we also try to test whether there exists gender bias when prospective retirees take into account support from their adult children. We replace the predictor ac_a with "number of adult sons" and "number of adult daughters" to probe gender difference. It is interesting that elderly men with more adult sons had a significantly higher retirement hazard than men with fewer adult sons, and elderly women with more adult daughters had a significantly higher retirement hazard than women with fewer adult daughters. We conduct a test of the difference between the coefficient on "number of adult sons" and that of "number of adult daughters". Our evidence shows that male workers are indeed more dependent on sons, while female workers are more dependent on daughters– although this gender difference for females is not significant.[33] The gender of adult children does not matter in terms of the response to NHI,[34] however.

[33]We test major gender bias based on a specification without $son_a * NHI_a$ and $daughter_a * NHI_a$. That is, $h(a; Z(a)) = h_0(a) \exp[\beta_1 * NHI_a + \gamma_1 * son_a + \gamma_2 * daughter_a + \check{Z}(a)\phi]$. $H_0 : \gamma_1 - \gamma_2 = 0$, $H_1 : \gamma_1 - \gamma_2 > 0$. We find that $e^{\gamma_1}/e^{\gamma_2} = 1.125$ ($z = 1.944$) for males, and $e^{\gamma_1}/e^{\gamma_2} = 0.907$ ($z = 1.498$) for females.

[34]To test whether gender of children matter in terms of policy response, we use a specification with interaction terms $son_a * NHI_a$ and $daughter_a * NHI_a$. That is,

In summary, NHI is less important for individuals with more adult children. For male private employees in the non-agricultural sectors, NHI increases their hazard of retirement, while the interaction term $ac_a * NHI_a$ decreases their hazard of retirement. So the "insurance" provided by adult children "mitigates" part of NHI's effect on the retirement hazard.

Comparing our estimated effects with the evidence from Medicare in the U.S., we conjecture that Medicare might have smaller effects on retirement if there were similar familial safety nets in the U.S. For example, people with employer-provided health insurance but without employer-provided retiree health insurance might be more willing to leave the labor force before age 65 if they had additional financial support from children. Madrian and Beaulieu (1998) documented that the lack of Medicare dependent coverage creates an incentive for men who are covered by employer-provided health insurance and are themselves Medicare eligible to continue working until their wives are Medicare eligible as well. This effect might be less obvious if adult children

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$h(a;Z(a)) = h_0(a)\exp[\beta_1 * NHI_a + \gamma_1 * son_a + \gamma_2 * daughter_a + \gamma_3 * son_a * NHI_a + \gamma_4 * daughter_a * NHI_a + \check{Z}(a)\phi]$. The response to NHI for individuals with adult sons is $e^{\beta_1+\gamma_3*son_a} = \frac{h(a|After\ NHI;\check{Z}(a))}{h(a|Before\ NHI;\check{Z}(a))}$. The response to NHI for individuals with adult daughters is $e^{\beta_1+\gamma_4*daughter_a} = \frac{h(a|After\ NHI;\check{Z}(a))}{h(a|Before\ NHI;\check{Z}(a))}$. So our hull hypothesis and alternative hypothesis are $H_0 : \gamma_3 - \gamma_4 = 0, H_1 : \gamma_3 - \gamma_4 > 0$. For example, comparing the response of an individual having one adult son with that of an individual having on adult daughter, the estimate of $(\gamma_3 - \gamma_4)$ is 1.052 (z=0.292) for the male sample and 0.915 (z=0.486) for the female sample.

provided more help for their parents.

6 Conclusions

In an East Asian country like Taiwan, where social security and health insurance systems are not well-established, the elderly often depend on their adult children. Adult children not only offer their parents emotional support but also substantial financial support. This "family insurance" is an important factor when the elderly consider their retirement decisions.

In this paper, we investigate the impact of National Health Insurance on retirement behavior and ask how prospective retirees with different numbers of adult children responded to this social experiment. Taking advantage of the longitudinal structure of "the Survey of Health and Living Status of the Elderly in Taiwan", we build a unique panel data set to test our hypothesis. The evidence suggests that the retirement hazard of males increased after the implementation of NHI. The altruism of adult children induced parents to behave differently when NHI was implemented. Particularly, elderly males who had a stronger "safety net" in the form of adult children were less sensitive to NHI. This could be a phenomenon unique to Eastern Asian countries

like Taiwan. Our evidence also shows gender differences. We find that, consistent with social norms in Taiwan, male employees with more adult sons had a significantly higher retirement hazard than men with fewer adult sons. However, elderly women with more adult daughters had a significantly higher retirement hazard than women with fewer adult daughters. Concerning the response to NHI, the gender of adult children does not make a big difference.

Are these findings short-run effects? Should we consider the joint-decision of the couple? To what extent can similar public programs or the coming National Old Age Pension System substitute for child-provided "family insurance" in the future? Should we take into account elderly parents' willingness to leave bequests to their children? To answer these questions will require more data. We will leave them for future work.

[Appendix 1] : Evidence of Health Insurance/Pensions/Social Security on Retirement

Authors D: Dataset S: Sample	Re: Retirement HI: Health Insurance Pen: Pensions HM: Health Measure	Estimation Techniques	Results
Hausman and Wise (1985) D: RHS (1969,71,73,75, 77,79) S: Non-self-employed males	Re: Self-reported retirement status Social Security HM: Work Limitation (an indicator equal to 1 if bad health limited the kind and amount of work)	1. Proportional Hazards Model 2. A continuous time model based on a Brownian motion process.	Increase in social security benefits accounts for a 3%-5% increase in the probability of retirement for men 62-66. Bad health raises retirement hazard.
Madrian (1994) D: NMES (1987) SIPP-EWH (1984) SIPP-CJR (1984-86) S: men 55-84	Re: NMES: having ever retired and not currently working SIPP-EWH: not working and NILF SIPP-CJR: receipt of pension income and not working HI: RHI HM: none	1. OLS & truncated regression for age at retirement 2. Probit for retirement before age 65 (sample restricted to ages 70-84)	Effect of RHI on age at retirement: 5-16 mths earlier; Effect of RHI on prob. of <65 retirement: 7-15 pp greater.
Gruber and Madrian(1995) D: CPS March 1980-90 S: Men 55-64 D: SIPP 1984-87 panels S: Men 55-64	Re:CPS: self-reported retirement SIPP: departure from labor force HI: availability and mths of continuation coverage Health: none	CPS: Probit for self-reported retirement SIPP: Proportional Hazard Model for labor force departure	1 year of continuation coverage raises the probability of retiring by 2.2 pp 1 year of continuation coverage raises the retirement hazard by 30%
Costa (1995) D: Union Army (UA) Veteran Data S: Men 50-81	Re: If the census enumerator specifically stated that he was "retired", or had "no occupation", or if he left the occupational field empty Pen: Pensions covering UA HM: SRHS	Probit, two-stage conditional MLE and logit for probability of retirement	The elasticity of nonparticipation wrt UA pensions was 0.73

1. Reference: Currie and Madrian (1999), pp. 3378-3384.
2. NILF: Not In Labor Force
3. RHI: Employer-provided Retiree Health Insurance
4. SRHS: Self-Reported Health Status

[Appendix 1 (continued)] : Evidence of Health Insurance/Pensions/Social Security on Retirement

Authors D: Dataset S: Sample	Re: Retirement HI: Health Insurance Pen: Pensions HM: Health Measure	Estimation Techniques	Results
Rust and Phelan (1997) D: RHS (1969-79) S: Men 58-63 in 1969 whose only pension is social security	Re: Discretize annual hours of working into full-time, part-time and NILF HI: EPHI, GPHI, Medicaid, Medicare and NI HM: SRHS	Structural dynamic programming model of labor supply	People who have no RHI other than Medicare tend to remain employed until they are eligible for Medicare at 65
Madrian and Beaulieu(1998) D: 1980 and 1990 US Census S: Married men 55-69 who worked at least 1 week in the previous 16 mths	Re: NILF HI: Wife is age eligible for Medicare HM: SRHS	OLS linear probability model for being NILF	55-69 men w/ Medicare-eligible wifes have a higher hazard than men without Medicare-eligible wifes
Rogowski and Karoly(2000) D: HRS (1992, 1996) S: age-eligible men working full-time in 1992 & not lost due to attrition or death in 1996	Re: Transition from full-time work in 1992 to being NILF in 1996 HI: RHI HM: SRHS and Body Mass Index	Probit for probability of retirement b/w 1992 & 1996	Male workers w/ RHI are 68% more likely to retire than their counterparts

5. EPHI: Employer-Provided Health Insurance.
6. GPHI: General Private Health Insurance (e.g. Blue Cross/ Blue Shield).
7. NI: No Medicaid and private health insurance.

[Appendix 2] : Evidence of National Health Insurance on Other Outcomes in Taiwan

Authors D: Dataset S: Sample	Outcome: the outcome of interest HI: Health Insurance HM: Health Measure	Estimation Techniques	Results
Cheng and Chiang (1997) D: Taiwan Health Interviews Survey 1994-1995 S: 1021 randomly selected Taiwanese adults	Outcome: Health care utilization HI: NHI HM: physician visits, hospital admissions and emergency department visits	Descriptive statistics	The newly insured after NHI consumed more than twice the amount of outpatient physician visits than before NHI
Chou and Staiger (2001) D: (1)SFIE (1979-81, 1983-85) (2)SFIE (1992-94,1996-97) S: Married women 20-65 whose husbands are paid employees in public or private sectors	Outcome: Female Labor Supply HI: (1) GEI (2)* NHI HM: none	Probit for LFP	The availability of HI for non-workers was associated with a 4 pp. decline in LFP among married women, esp. for low income households
Chou, Liu and Hammit (2001) D: SFIE (1991-98) S: Households headed by a 20-65 married person employed by public or private sector, or self-employed	Outcome: Precautionary savings HI: NHI HM: none	Difference-in-Difference estimates for the effect of NHI on savings & consumptions; Quantile regression on savings.	NHI lowers average savings by 6.9% and raises average consumption by 2.4%, esp. for households at the bottom of the savings distribution.

1. SFIE: the Survey of Family Income and Expenditures, collected annually in Taiwan from 1969 onward.
2. GEI: Government Employee's Insurance
3. *: Analysis (2) using NHI is a "reverse test" of analysis (1).

[Appendix 3] A Bird's-eye View of the Data

ID	AGE	Year	Occupation	Indicator of Failure (retirement)	
1	50	1966	5	0	
1	51	1967	5	0	
1	52	1968	5	0	
1	53	1969	5	0	
1	54	1970	5	0	
1	55	1971	4	0	
1	56	1972	4	0	
1	57	1973	4	0	
1	58	1974	4	0	
1	59	1975	4	0	
1	60	1976	4	0	
1	61	1977	4	0	
1	62	1978	4	0	
1	63	1979	4	0	
1	64	1980	4	0	
1	65	1981	4	0	
1	66	1982	4	0	
1	67	1983	4	0	
1	68	1984	4	0	
1	69	1985	4	0	
1	70	1986	4	0	
1	71	1987	4	0	
1	72	1988	4	0	
1	73	1989	4	0	
1	74	1990	4	0	
1	75	1991	4	0	
1	76	1992	4	0	
1	77	1993	4	1	**uncensored**
95	50	1979	7	0	
95	51	1980	7	0	
95	52	1981	7	0	
95	53	1982	7	0	
95	54	1983	7	0	
95	55	1984	7	0	
95	56	1985	7	0	
95	57	1986	7	0	
95	58	1987	7	0	
95	59	1988	7	0	
95	60	1989	7	0	
95	61	1990	7	0	
95	62	1991	7	0	
95	63	1992	7	0	
95	64	1993	7	0	
95	65	1994	7	0	
95	66	1995	7	0	
95	67	1996	7	0	**censored**

[Appendix 4]. Cox Partial Likelihood

Cox (1975) suggests using the partial likelihood to estimate β in the proportional hazard model.

Suppose that with independent right censoring in the data, we have M uncensored t (=age a in our case) and $N - M$ censored t in the list of times. Let us denote a few convenient notations as follows:

Definition 1 *$t_{(1)}, t_{(2)}, ..., t_{(M)}$ are the ordered observed exit times.*

Definition 2 *y_j is the set of individuals observed retiring at $t_{(j)}$, $j = 1, 2, ..., M$.*

Definition 3 *R_j is the set of all people who have not exited (retired) the instant before $t_{(j)}$, $j = 1, 2, ..., M$. Because R_j represents the set of people at risk of exiting (retiring) at $t_{(j)}$, it is called the **risk set** at $t_{(j)}$.*

Definition 4 *$R_j(y_j)$ is the set of all subsets of y_j items chosen from the risk set R_j without replacement, $j = 1, 2, ..., M$.*

Definition 5 *$Z(t_{(j)})$ is the time-varying covariate at $t_{(j)}$, $j = 1, 2, ..., M$.*

Definition 6 *$s_j(t_{(j)})$ is the sum of time-varying covariates of individuals observed to retire at $t_{(j)}$. $s_j(t_{(j)}) = \sum_{k=1}^{d_j} Z_{jk}(t_{(j)})$, $j = 1, 2, ..., M$.*

Then, the estimates of β can be obtained by maximizing the following partial likelihood:

$$\mathcal{L}_p = \prod_{j=1}^{M} \frac{\exp\{s_j(t_{(j)})\beta\}}{(\sum_{l \in R_j(y_j)} \exp\{s_l(t_{(j)})\beta\})}$$

This partial likelihood is very difficult computationally. However, it can be well approximated by the following expression (Kalbfleisch and Prentice (1980), p133, equation (5.22)):

$$\mathcal{L}_p^* = \prod_{j=1}^{M} \frac{\exp\{s_j(t_{(j)})\beta\}}{[\sum_{l \in R_j} \exp\{Z_l(t_{(j)})\beta\}]^{y_j}}$$

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Figure 1: Living Arrangements of the Elderly Aged 65 and above in Taiwan (unit: percent). Source: Kan, Park and Chang (2001)

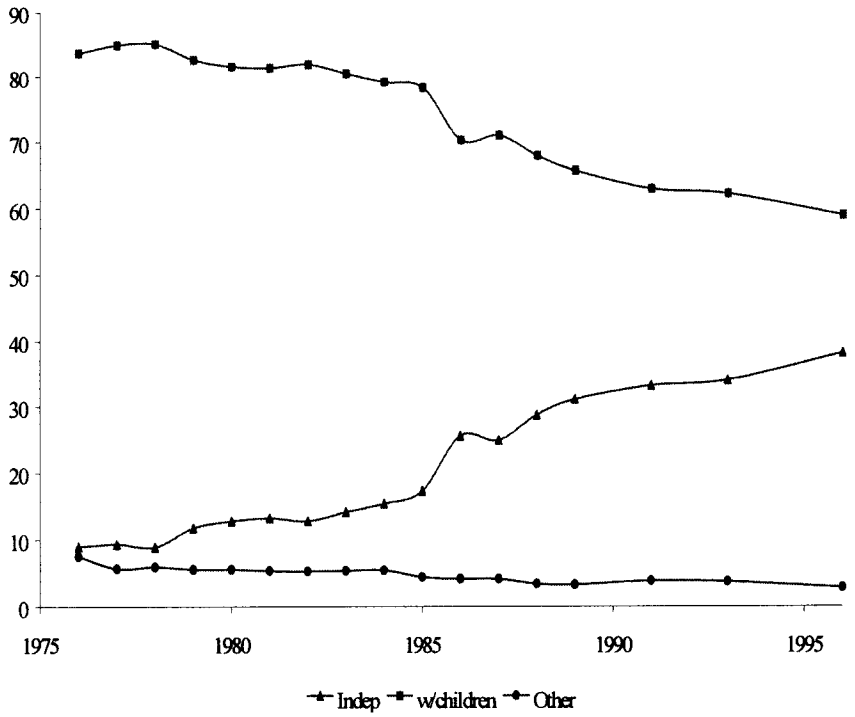
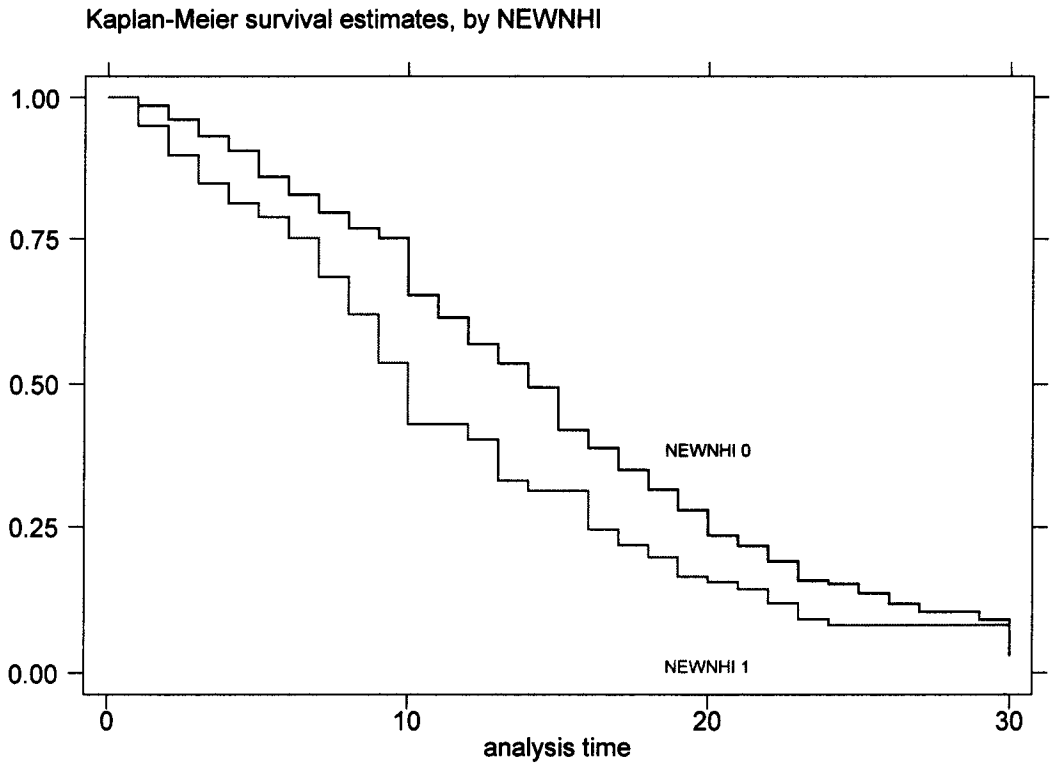


Figure 2. Survival functions of All private employees in non-agricultural sectors



* Age = analysis time + 50

Figure 3. : Survival functions of Male private employees in non-agricultural sectors

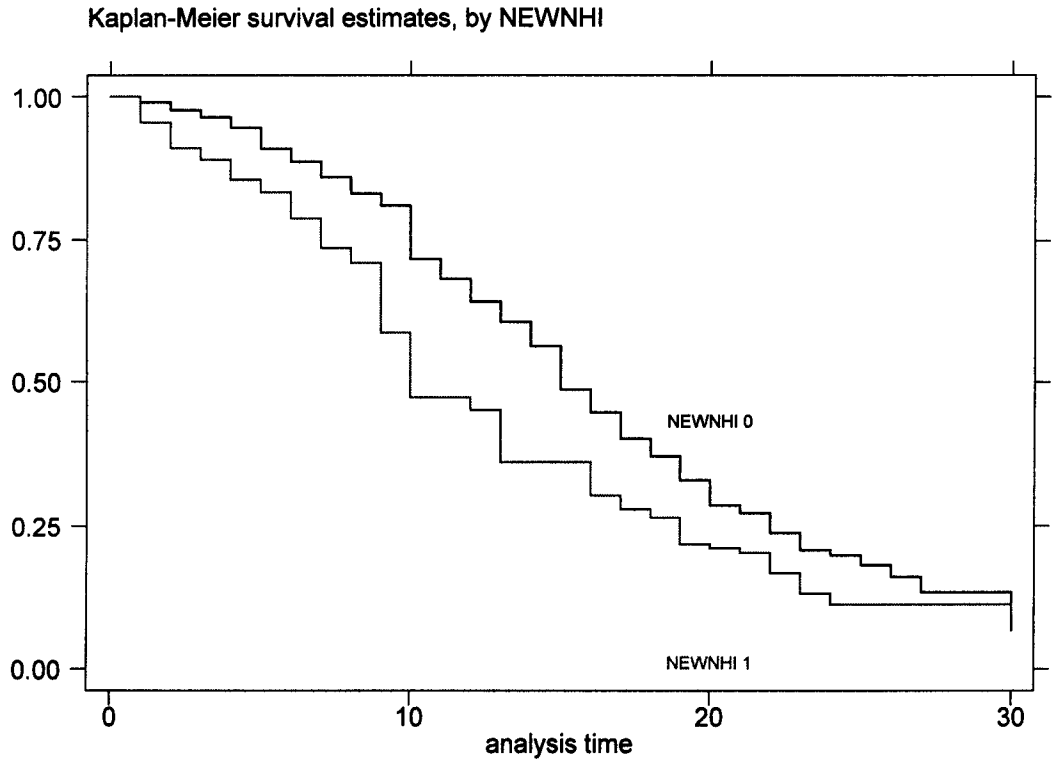


Figure 4. : Survival functions of Female private employees in non-agricultural sectors

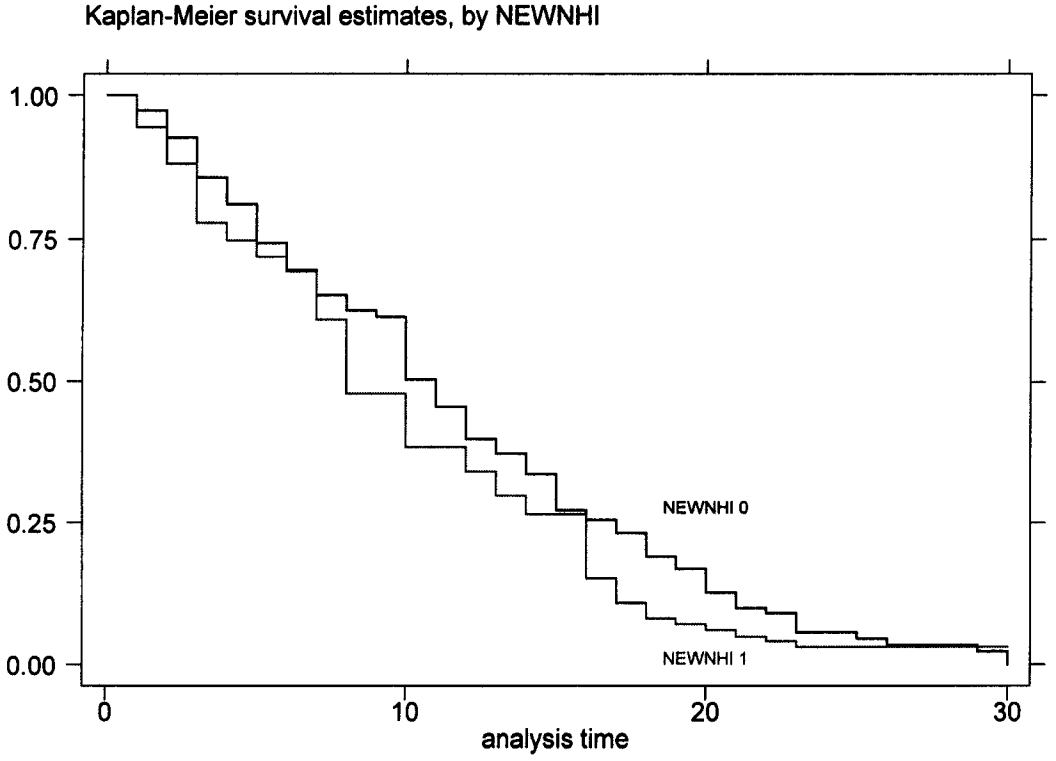


Figure 5. Survival functions of observations (private employees in non-agricultural sectors) with No adult children

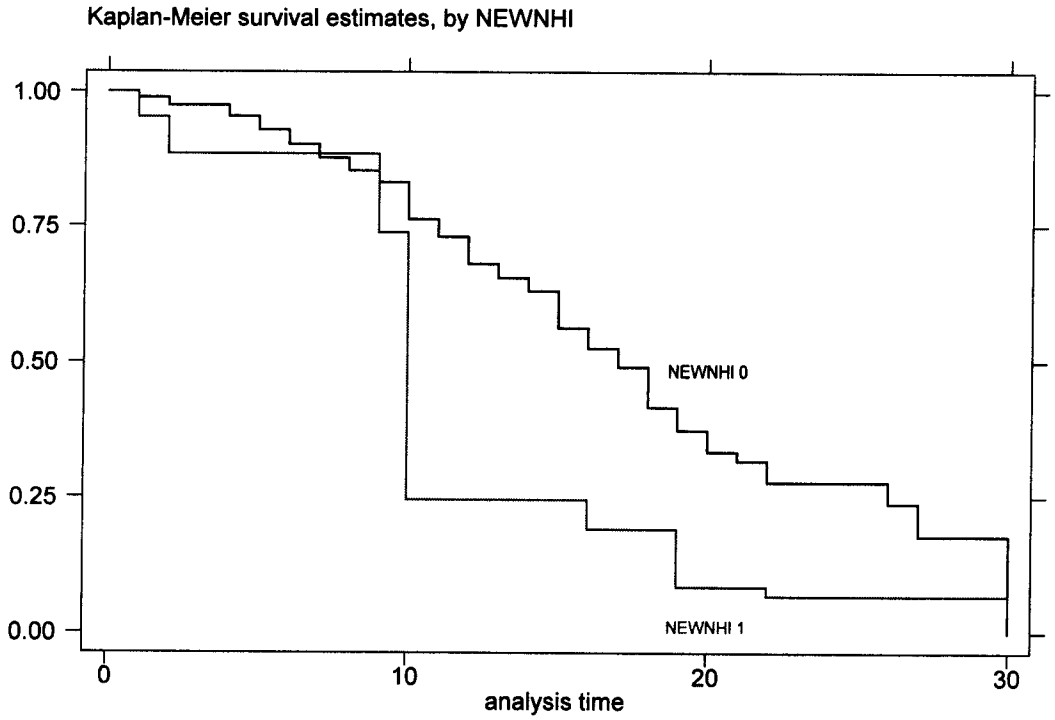


Figure 6. Survival functions of observations (private employees in non-agricultural sectors) with 3+ adult children

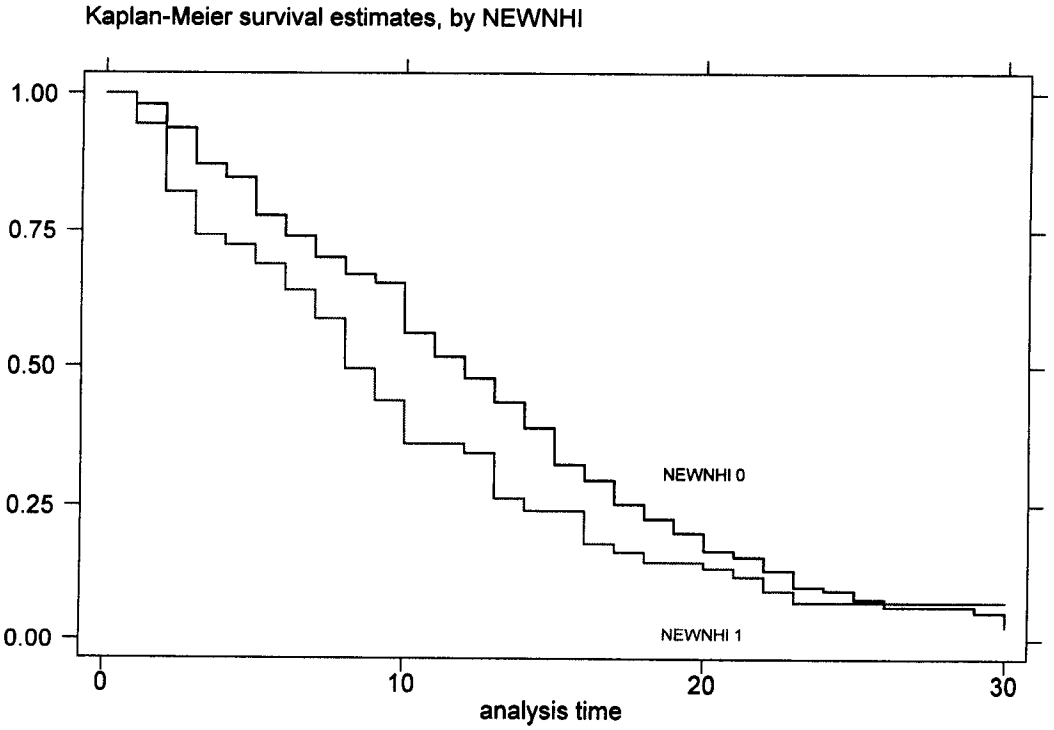


Figure 7-1. Retirement Hazard after NHI / Retirement Hazard before NHI (Without Layoff Sample)

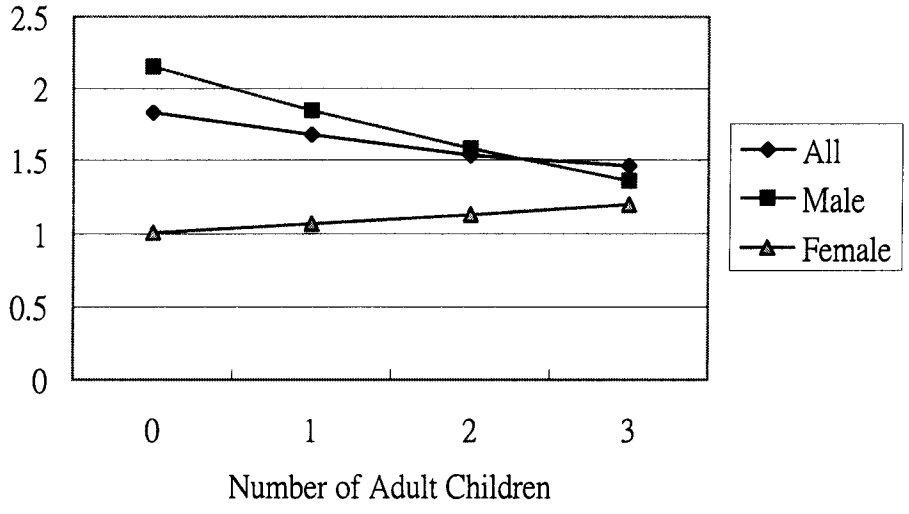


Figure 7-2. Retirement Hazard after NHI / Retirement Hazard before NHI (With Layoff Sample)

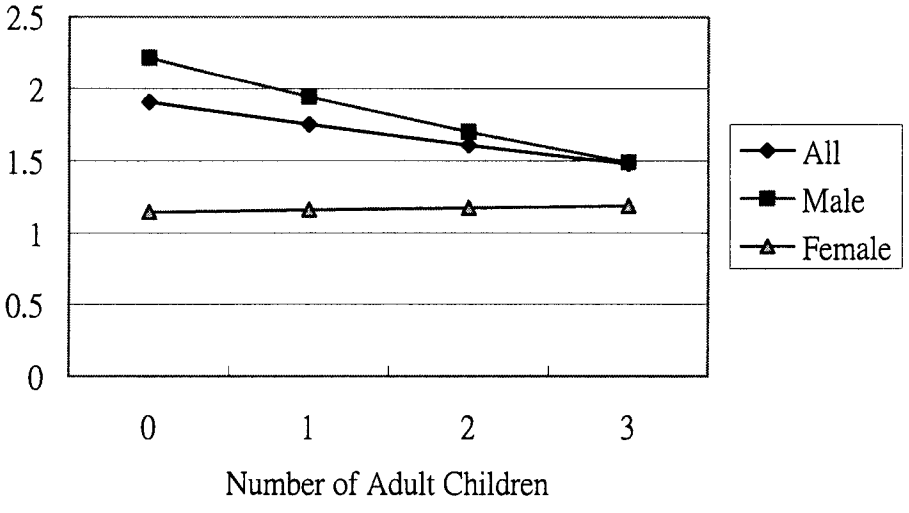


Table 1: Labor Force Participation Rate by Age

Year	Total	15-24	25-44	45-64				65+
				subtotal	45-49	50-54	55-59	60-64	
1979	58.73	53.11	69.69	61.24	69.66	66.01	57.46	42.51	9.26
1984	59.72	50.25	73.66	60.98	70.94	66.32	58.82	41.33	9.07
1989	60.12	46.29	76.51	60.64	72.73	65.54	58.07	41.98	10.34
1994	58.96	39.78	78.15	60.24	73.48	66.11	55.52	40.61	9.68
1995	**58.71**	**38.46**	**78.21**	**60.83**	**73.98**	**65.79**	**55.75**	**41.06**	**9.79**
1996	58.44	37.40	78.60	60.87	74.20	65.30	55.18	39.79	8.95
1997	58.33	36.88	78.80	61.20	74.07	65.09	54.75	40.10	8.76
1998	58.04	35.96	79.17	60.81	73.61	65.49	53.52	38.25	8.51
1999	57.93	36.56	79.36	60.35	73.64	64.25	52.31	37.24	7.92
2000	57.68	36.28	79.60	59.80	73.43	63.91	50.54	35.68	7.71
2001	57.23	35.47	79.71	59.13	73.43	62.33	49.22	34.15	7.39

1.Data source: DGBAS.

Table 2: Generosity of Major Insurance Plans

	Gov't Employees' Insurance (1958-)	Labor Insurance (1950-)	Farmer's Insurance (1985-)	National Health Insurance (1995-)
maternity benefit	✓*[2]	✓*	✓*	✓
injury and sickness benefits	✓*	✓*	✓*	✓
disability benefit	✓	✓	✓	
unemployment benefit		✓		
old-age benefit	✓	✓		
death benefit	✓	✓	✓	
dependents' funeral allowance	✓			
Insured Persons	government employees	workers aged 15-60[3]	farmers aged 15+	All population
Dependants of the Insured				
Spouses	Yes (1982-)	No	Yes (1989-)	Yes (1995-)
Parents	Yes (1989-)	No	Yes[4] (1989-)	Yes (1995-)
Children	Yes (1992-)	No	Yes[4] (1989-)	Yes (1995-)
Post-retirement Insurance[5]	Yes (1965-)	No	No	Yes (1995-)

1.Data Source: The main context of this table comes from Chou, Liu and Hammit (2001) and The Council for Economic Planning and Development, Executive Yuan, Taiwan

2. *: Replaced by NHI from March, 01, 1995 onward

3. People can be insured under LI after 60 years old if they continue to work after 60 years old.

4. Parents who work in the same farm. Children who are over 15 years old and work in the same farm.

5. The post-retirement insurance entitled under GEI is a voluntary insurance.

Table 3: Percentage of People Insured in Government-Sponsored Insurance Programs

year	Gov't Employees' Insurance* (1958-)	Retired Gov't Employees' Insurance** (1965-)	Farmer's Insurance (1985-)	Labor Insurance (1950-)	National Health Insurance (1995-)	Total Population
1966	1.96	0.02	-	5.02	-	100
1971	2.05	0.04	-	6.67	-	100
1976	2.24	0.05	-	10.34	-	100
1981	2.50	0.05	-	15.34	-	100
1982	2.53	0.05	-	15.98	-	100
1983	2.55	0.05	-	17.74	-	100
1984	2.60	0.05	-	19.43	-	100
1985	2.61	0.38	0.52	21.03	-	100
1986	2.63	0.45	0.58	24.22	-	100
1987	2.63	0.60	1.11	27.05	-	100
1988	2.63	0.66	3.40	30.04	-	100
1989	2.70	0.56	6.69	32.57	-	100
1990	2.79	0.57	7.72	33.67	-	100
1991	2.83	0.59	8.04	35.42	-	100
1992	2.87	0.60	8.17	37.15	-	100
1993	2.92	0.63	8.16	38.89	-	100
1994	2.95	0.67	8.23	40.22	-	100
1995	2.97	0.66	8.45	35.84	89.76	100
1996	3.00	-	8.44	34.62	93.34	100
1997	2.99	-	8.36	34.59	94.51	100
1998	2.86	-	8.26	34.74	94.91	100
1999	3.05	-	8.15	35.03	95.46	100

1.Source: DGBAS. 2.*: includes "Insurance for Teaching and Administrative Staffs of Private Schools" since 1981. 3.**: includes "Health Insurance for Retired Government Employees", "Health Insurance for Spouses of Retired Government Employees", "Heath Insurance for Retired Teaching and Administrative Staffs of Private Schools", "Heath Insurance for Spouses of Retired Teaching and Administrative Staffs of Private Schools" and "Heath Insurance for Retired Employees and their Dependents in Government Organizations and Private Schools".

Table 4. Are observations in the government sector and observations in non-government sectors very different?

	All		Government Employees		Private Employees		The Self-employed	
Dimensions	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.
male	0.716	0.002	0.911	0.003	0.698	0.004	0.672	0.003
with spouse	0.789	0.002	0.843	0.004	0.691	0.004	0.828	0.002
age	58.568	0.026	57.16	0.055	58.31	0.047	59.105	0.038
# of adult children	2.759	0.009	1.895	0.022	2.223	0.016	3.299	0.012
have chronic illnesses	0.277	0.002	0.325	0.005	0.303	0.004	0.249	0.003
s2 (1-6 yrs. of edu.)	0.436	0.002	0.273	0.005	0.427	0.004	0.487	0.003
s3 (7-12 yrs. of edu.)	0.161	0.002	0.404	0.006	0.149	0.003	0.099	0.002
s4 (13+ yrs. of edu.)	0.067	0.001	0.264	0.005	0.055	0.002	0.019	0.001
r2 (Haka people)	0.173	0.002	0.123	0.004	0.116	0.003	0.22	0.002
r3 (Mainlanders)	0.214	0.002	0.506	0.006	0.32	0.004	0.074	0.002
r4 (others)	0.019	0.001	0.003	0.001	0.007	0.001	0.03	0.001
observations	51,525		7,858		15,615		28,052	

1. This is an observation-level comparison. We use all observations(records) of each individual in the survival-time data.
2. The classification here refers to each observation's corresponding employment status.
3. The reference group for education dummies is the illiterate.
4. The reference group for racial dummies is Taiwanese.
5. Data source: author's calculations from the SHLSET.

Table 5. Descriptive Statistics by "Number of Adult Children" (ac): Are observations with different # of adult children similar?
Definition: ac= number of adult children (25+)
Definition: c= number of children

Male Private Employees in Non-agricultural Sectors

	All		ac=0						ac=1 or 2		ac=3 or 4		ac>=5	
			Total		*ac=0 & c=0*		*ac=0 & c>0*							
Dimensions	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.
with spouse	0.7	0.005	0.532	0.008	0.093	0.008	0.791	0.008	0.796	0.008	0.855	0.008	0.827	0.013
age	58.367	0.061	57.463	0.09	59.032	0.166	56.536	0.099	57.569	0.114	59.057	0.123	63.269	0.18
chronic illnesses *	0.302	0.005	0.291	0.007	0.285	0.012	0.294	0.009	0.297	0.009	0.314	0.011	0.342	0.016
s2 (1-6 yrs. Of edu.)	0.516	0.005	0.532	0.008	0.607	0.013	0.488	0.01	0.534	0.01	0.518	0.011	0.38	0.017
s3 (7-12 yrs. Of edu.)	0.234	0.004	0.23	0.007	0.178	0.01	0.26	0.009	0.212	0.008	0.265	0.01	0.242	0.015
s4 (13+ yrs. Of edu.)	0.088	0.003	0.081	0.004	0.063	0.006	0.092	0.006	0.106	0.006	0.067	0.006	0.111	0.011
r2 (Haka people) *	0.089	0.003	0.059	0.004	0.041	0.005	0.07	0.005	0.116	0.006	0.085	0.006	0.147	0.012
r3 (Mainlanders) *	0.501	0.005	0.785	0.007	0.855	0.009	0.743	0.009	0.394	0.01	0.233	0.01	0.143	0.012
r4 (Others)	0.004	0.001	0.004	0.001	0.008	0.002	0.002	0.001	0.003	0.001	0.007	0.002	0.004	0.002
observations	9,073		3,819		1,419		2,400		2,504		1,906		844	

Female Private Employees in Non-agricultural Sectors

	All		ac=0						ac=1 or 2		ac=3 or 4		ac>=5	
			Total		*ac=0 & c=0*		*ac=0 & c>0*							
Dimensions	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.
with spouse	0.622	0.009	0.511	0.031	0.293	0.048	0.625	0.037	0.557	0.015	0.659	0.013	0.707	0.02
age	57.624	0.099	55.388	0.259	57.576	0.506	54.244	0.253	56.441	0.178	57.451	0.136	61.57	0.243
chronic illnesses *	0.385	0.009	0.317	0.028	0.522	0.052	0.21	0.031	0.389	0.015	0.36	0.013	0.477	0.022
s2 (1-6 yrs. Of edu.) *	0.298	0.008	0.403	0.03	0.304	0.048	0.455	0.038	0.265	0.014	0.295	0.012	0.319	0.02
s3 (7-12 yrs. Of edu.) *	0.051	0.004	0.086	0.017	0	0	0.131	0.025	0.057	0.007	0.056	0.006	0.008	0.004
s4 (13+ yrs. Of edu.) *	0.017	0.002	0.049	0.013	0	0	0.074	0.02	0.028	0.005	0.009	0.003	0	0
r2 (Haka people) *	0.145	0.006	0.119	0.02	0.174	0.04	0.091	0.022	0.123	0.01	0.134	0.009	0.234	0.018
r3 (Mainlanders) *	0.094	0.005	0.272	0.027	0.293	0.048	0.261	0.033	0.111	0.01	0.064	0.007	0.049	0.009
r4 (Others) *	0.01	0.002	0	0	0	0	0	0	0.004	0.002	0.019	0.004	0.004	0.003
observations	3,253		268		92		176		1,041		1,418		526	

1. This is an observation-level comparison. We use all observations(records) of each individual in the survival-time data.
2. The reference group for education dummies is the illiterate.
3. The reference group for racial dummies is Taiwanese.
4. Data source: author's calculations from the SHLSET.

Table 6. Ratios of the retired elderly who live with their children

	Unbalanced Panel		Balanced Panel	
1989	%	#	%	#
w/ children	71.52	1,730	73.46	1,038
w/ adult children	66.18	1,601	67.66	956
w/ married children	51.8	1,253	52.44	741
w/ children who are working	63.04	1,525	65.11	920
Total retirees		2,419		1,413
1993	%	#	%	#
w/ children	67.37	1,441	68.59	1,140
w/ adult children	64.38	1,377	65.58	1,090
w/ married children	49.28	1,054	50.18	834
w/ children who are working	58.16	1,244	59.87	995
Total retirees		2,139		1,662
1996	%	#	%	#
w/ children	66.82	1,271	67.42	1,227
w/ adult children	64.35	1,224	64.84	1,180
w/ married children	48.53	923	49.01	892
w/ children who are working	57.57	1,095	58.02	1,056
Total retirees		1,902		1,820

Note: Author's calculation from the Old panel only.

Table 7. Key Empirical Findings using Proportional Hazard Model
Private Employees in Non-agricultural Sectors

	ALL		MALE		FEMALE	
covariates	hazard ratio	z value	hazard ratio	z value	hazard ratio	z value
Male	0.691***	-3.79				
spouse	0.888	-1.46	0.799**	-2.12	0.983	-0.14
NHI	1.830**	2.15	2.153**	2.28	1.009	0.02
chronic	1.487***	4.82	1.546***	4.17	1.423***	2.64
chronic*NHI	0.777	-1.09	0.825	-0.64	0.724	-0.86
# of young children	1.026	0.88	1.037	0.97	1.009	0.19
# of young children*NHI	0.967	-0.29	0.898	-0.74	1.101	0.48
# of adult children	1.069***	2.97	1.060**	2.01	1.083**	2.29
# of adult children*NHI	0.916*	-1.73	0.857***	-2.64	1.058	0.66
No. of individuals	1,393		939		454	
No. of failures (retirement)	697		437		260	
No. of censored individuals	696		502		194	
No. of observations	12,326		9,073		3,253	
Wald chi2(d.f.)	130.93(22)		79.04(21)		28.65(21)	

1. Coefficients for educational dummies, racial dummies and occupational dummies are not reported.
2. *: statistically significant at 5% level in a one-tailed test. Alternative Hypothesis: hazard ratio>1.
   **: statistically significant at 2.5% level in a one-tailed test. Alternative Hypothesis: hazard ratio>1.
   ***: statistically significant at 1% level in a one-tailed test. Alternative Hypothesis: hazard ratio>1.
3. Wald chi2(d.f.) is the chi-square statistic for the global test.(a likelihood-ratio test for all coefficients equal to zero.) d.f. :degree of freedom. Pr(chi2(21)>32.6705)=0.05, Pr(chi2(22)>33.9244)=0.05 .

Table 8: Summary of Policy Effects for the Elderly with Adult Children

The relative hazard in eq. (25): $\exp(\beta_1 + \beta_5 * ac_a)$ and its z statistic				
	Without layoff/shutdown sample		**With layoff/shutdown sample**	
$ac_a = 0$	$\exp(\beta_1)$	z value	$\exp(\beta_1)$	z value
All	1.830**	2.146	1.906***	2.441
Male	2.153**	2.278	2.217***	2.532
Female	1.009	0.019	1.147	0.314
$ac_a = 1$	$\exp(\beta_1 + \beta_5)$	z value	$\exp(\beta_1 + \beta_5)$	z value
All	1.676**	2.059	1.752***	2.389
Male	1.845**	1.998	1.942***	2.341
Female	1.068	0.161	1.161	0.387
$ac_a = 2$	$\exp(\beta_1 + \beta_5 * 2)$	z value	$\exp(\beta_1 + \beta_5 * 2)$	z value
All	1.535*	1.883	1.610**	2.247
Male	1.581	1.607	1.701**	2.032
Female	1.129	0.333	1.175	0.465
$ac_a = 3$	$\exp(\beta_1 + \beta_5 * 3)$	z value	$\exp(\beta_1 + \beta_5 * 3)$	z value
All	1.406	1.591	1.479**	1.974
Male	1.355	1.106	1.490	1.593
Female	1.195	0.520	1.189	0.534

1. ac_a : The number of adult children at age a.
2. $*$: statistically significant at 5% level in a one-tailed test: H_A: hazard ratio>1.
   $**$: statistically significant at 2.5% level in a one-tailed test: H_A: hazard ratio>1.
   $***$: statistically significant at 1% level in a one-tailed test: H_A: hazard ratio>1.