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HEALTH ECONOMICS IN TAIWAN

Households' precautionary behaviors—the effects of the introduction of National Health Insurance in Taiwan

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Abstract By reducing risk of large out-of-pocket medical expenses, comprehensive social health insurance may reduce households' motivation to engage in precautionary behaviors such as saving, procurement of private insurance, and spousal labor-force participation. We use the natural experiment provided by the 1995 introduction of National Health Insurance in Taiwan to examine these effects, using pre-existing differences in access to health insurance (tied to the household head's and spouse's joint employment status) to identify the effects of increasing insurance coverage. We find that comprehensive health insurance has a statistically significant and large effect on household savings, but no significant effects on purchase of private accident insurance and spousal employment.

Keywords Precautionary savings · Labor force participation · Insurance

JEL Classifications D1 · H4 · I1

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1 Introduction

Over the last century, both developed and developing countries have implemented a wide range of social insurance programs.[1] The introduction, expansion and reform of these programs raise important questions about the effects of the programs on the behavior of economic agents. One important question is the extent to which these programs crowd out private precautionary behaviors, such as saving, purchasing private insurance, or the entry of other household members into the labor force.

Understanding the motivations for household precautionary behaviors and the relationship with insurance has important policy implications. If precautionary motives are significant, economic models that ignore them, such as simple life-cycle models will tend to miscalculate the optimal size of government policy. Hubbard, Skinner, and Zeldes (1995) demonstrated the importance of accounting for precautionary savings to explain the effects of asset-based, means-tested social insurance on patterns in wealth accumulation. In the presence of precautionary motives, government policy may have unintended effects on individuals' welfare. For example, it may increase efficiency by pooling health risks through insurance rather than relying on individuals' precautionary saving, since those who reduce consumption today may not necessarily be ill in the future.[2]

While using theoretical models incorporating precautionary motives to explain economic behaviors when social insurance programs are introduced is appealing, the limited empirical work that is available provides mixed evidence about the strength of precautionary motives.[3] The difficulty that researchers typically face is that the variation in insurance programs owned by individuals is inevitably correlated with the individuals' unobserved preferences. For example, those who are highly risk-averse are more likely to have better health insurance and engage in various precautionary behaviors. Instrumental variables based on arbitrary exclusion restrictions (such as occupation or education) may provide no solution since these variables are likely to be correlated with personal preferences. This paper contributes to this emerging literature by providing empirical evidence on the impact of a significant change in social health insurance on households' precautionary behaviors in Taiwan. Specifically, we will examine the effects of health insurance on households' savings, purchase of accident insurance, and spousal labor supply.

[1] US examples include social security, unemployment insurance, Medicaid, and Medicare.

[2] For example, Gruber (1997) found strong evidence that unemployment insurance smooths individual consumption. Gertler and Gruber (2001) found that households in developing countries are not able to fully insure their consumption; their results suggest larger welfare gains in terms of consumption smoothing from public subsidies for medical care.

[3] For example, Guiso, Jappelli, and Terlizzese (1992) and Dynan (1993) found no support for the precautionary motive, while Skinner (1988), Carroll and Samwick (1998) and Kazarosian (1997) found more support for the precautionary view.

We exploit a unique natural experiment. In March 1995, the Taiwan government inaugurated National Health Insurance to cover health expenses for the entire population. Prior to implementation, there were three major health insurance programs—Government Employee's Insurance, Labor Insurance, and Farmer Health Insurance, which were tied to employment status. Only Government Employee's Insurance provided coverage to the insured's spouse, children and parents. The introduction of the comprehensive NHI coverage had a smaller impact on households in which at least one spouse worked in the government sector and could obtain insurance coverage for the entire household before NHI. By comparing changes in behavior between households with no government employees and households with at least one government employee, we are able to identify the impact of NHI. This is a difference-in-differences strategy.

Our difference-in-differences strategy is similar to Chou and Staiger (2001) and Chou, Liu, and Hammitt (2003). Chou and Staiger (2001) use the Survey of Family Income and Expenditure from 1992 to 1997 to analyze the impact of NHI on labor force participation among married women in Taiwan. They find that labor force participation of married women declines by about 4% point after the introduction of the NHI. Chou et al. (2003) estimate the impacts of NHI on saving behavior of households in Taiwan. Their results suggest that the precautionary motive is an important determinant of household saving and consumption behaviors, and that NHI reduces savings by an average of 8.6–13.7%.

Nevertheless, our study differs from Chou and Staiger (2001) and Chou et al. (2003) in three major ways. First and foremost, we employ a unique data set to exploit the underlying variation in medical benefits across households within treatment and control groups. Unlike the difference-in-differences method, this strategy allows us to take full advantage of the variation in insurance benefits within households at one point in time and to calculate the elasticity of response to the change in insurance benefits. Neither Chou and Staiger (2001) nor Chou et al. (2003) directly assessed the impact of insurance benefits on household behaviors.

Second, since insurance benefits could vary because of underlying tastes, the natural experiment described above allows us to use the husband–wife joint employment status as an instrument for insurance benefits and thus to identify the causal relationship between insurance and household's precautionary behaviors. In contrast to Chou and Staiger (2001) and Chou et al. (2003), we consider multiple treatment groups to reduce the importance of random variation in a single treatment group. Two factors suggest these instruments are likely to be valid. For one, the dramatic expansion of National Health Insurance significantly increased the insurance benefits for households with no government employees. Furthermore, the expansion of NHI is very likely uncorrelated with households' behaviors. As detailed below, although the development of NHI was predicated on concerns about rising health-care costs and access to care, the timing of implementation was determined by political factors unrelated to changes in health-care markets.

Finally, we use the data spanning from 1993 to 1999 which allows us to estimate a long-run labor force response to the NHI as opposed to the short-run response estimated by Chou and Staiger (2001).

Our analyses are based on the Survey of Family Income and Expenditure (SFIE) from 1993 to 1999. This survey contains individuals' labor market status together with detailed information on consumption and saving. The survey also contains information on insurance benefits received by each household.

Our results suggest that households have strong precautionary motives. Therefore, the introduction of comprehensive health insurance significantly reduces households' savings. However, private purchase of accident insurance and the entry of other family members in the labor force are not found to be related to the precautionary motives.

2 Background

2.1 Social insurance programs in Taiwan

National Health Insurance (NHI) was inaugurated in Taiwan in March 1995. NHI dramatically expanded the insured fraction of the population, from 57% in 1994 to 92% in 1995 and 96% in 2000. The timing of the reform was heavily influenced by political factors. In 1984, the Council for Economic Planning and Development recommended a national health insurance scheme to be phased-in by the year 2000. In 1986, the Premier declared the objective of ''health insurance for all by the year 2000'' in his statement to the Legislative Yuan (Congress). However, with the rapid growth of political participation and the growth of the opposing Democratic Progressive Party in the late 1980s, in February 1989 the Premier strategically announced the new target year for implementing a national health insurance scheme to be 1995. Foreseeing an election of Legislative Yuan representatives in December 1995 and the first Presidential election in March 1996, the ruling party (Kuomingtung) mobilized its legislators to pass the NHI Law in July 1994. NHI was fully implemented by March 1, 1995, so that the chaos resulting from implementation might vanish prior to the elections.[4] Thus, although the initiation of universal health insurance was motivated by concerns about health-care expenses, the timing of the policy was driven by politics. Therefore, the implementation of NHI was likely to be uncorrelated with households' economic behaviors.

Prior to implementation of NHI, health insurance was available through three government-sponsored programs—Labor Insurance (LI), Government Employees' Insurance (GEI), and Farmer Health Insurance (FHI). With the exception of GEI, these programs provided very little coverage for family

[4] Chiang (1997) provides a more detailed description of the reform process.

members of the employed individual. As a result, the majority of the uninsured were children under 14 years of age and adults over 65.[5]

The first social insurance program, Labor Insurance (LI), was promulgated in 1950 and initially provided only cash benefits, payable for maternity, injury or sickness, disability, old age, and death. Compensation for inpatient and outpatient medical expenses was added in 1956 and 1970, respectively.[6] LI was compulsory for five categories of workers between the ages of 15 and 60.[7] The premium was 6–8% of monthly salary, 80% of which was paid by the employer and 20% by the worker. Since 1995, medical care benefits for ordinary injury or sickness are covered by the National Health Insurance program, while medical costs from occupational injuries are still paid by the Labor Insurance program. Labor Insurance did not offer any benefits to the insured's spouse or other dependents. Self-employed workers (who account for a large share of the Taiwan labor force[8]) could obtain Labor Insurance only if they were members of an occupational union.

Government Employees' Insurance (GEI) was implemented in 1958 and provided benefits including maternity, injury or sickness, disability, old age and death as well as dependents' funeral allowance. Spouses, parents, and children of government employees gained coverage for injury and sickness under Health Insurance for Government Employees' Dependents Insurance in 1982, 1989 and 1992, respectively. Retired government employees and their dependents became eligible for injury and sickness benefits in 1985. The premium rate was 3–5% of the salary, of which 35% was paid by the employee and 65% by the government.

Farmers' Health Insurance (FHI) was established in 1985 and implemented in 1989. Under this program, mandatory coverage was provided to members of farmers' associations. Farmers who were above 15 year of age could participate in the program. Insurance benefits included maternity, injury or sickness, disability and death benefits and burial subsidy. Insured members paid 30% of the cost, while the government paid 70%. The labor insurance and farmer insurance participants received physicians' services through hospitals or clinics that contracted with the programs.

[5] Peabody, Yu, Wang, and Bickel (1995) and Cheng and Chiang (1997) provide detailed descriptions of the health insurance programs.

[6] Unemployment benefits were added in 1999.

[7] Those workers included (1) workers employed by mine, a company or firm, a journalistic, cultural, or non-profit cooperative enterprise with more than five employees; (2) employees of government offices or public or private schools who are not legally entitled to join civil servants' insurance or the insurance of teachers and employees of private schools; (3) workers employed in fishing production; (4) persons receiving vocational training in vocational training institutes registered with the government and (5) members of an occupational union and Fishermen who have no definite employer or who are self-employed.

[8] For example, in 1999, 16% of employed persons were self-employed.

Beginning in 1990, the government also provided health insurance, including maternity benefits and injury and sickness benefits, to low-income households.[9] Insurance premiums were paid by the government in full. In 1991, 50.3% of the population was covered by health insurance, of which 34.2% was covered under Labor Insurance, 5.3% under Government Employees' Insurance (with 0.6% under Retired Government Employees' Insurance), 7.9% under Farmer Health Insurance, and 0.5% under Low-Income Households' Health Insurance.[10]

Beginning March 1, 1995, all social insurance-contracted facilities were transferred automatically to hospitals and clinics contracted with the NHI program. By 1996, the Bureau of National Health Insurance contracted with 97% of the hospitals and 90% of the clinics. The NHI provides uniform comprehensive benefits, and is financed by payroll taxes and general revenues. By law, all citizens are required to participate in NHI. Insurance coverage is similar to the original social programs with some expansion for severe illnesses and home health care.

The principal source of finance is a payroll tax. The government share of the premium varies among the insured groups. For government employees and their dependents, the insurer and the government pay 40 and 60% of the premium, respectively. For private employees and their dependents, the insured and the employer pay 30 and 60% of the premium, and the government covers the remaining 10%. For the self-employed and their dependents, and for persons who do not fit into any working group, the insured pays 60% and the government pays 40%. For farmers and dependents, the insured pays 30% and the government 70%. For low-income families, the government pays the entire premium (Chiang, 1997).

Similar to the Medigap policies which are designed to fill some of the gaps left by the Medicare program in US, private (accident) insurance market emerged to fill some of the gaps left by the social insurance programs in Taiwan (Liu & Chen, 2002). There are two important roles of private insurance. First, private insurance prevents people from incurring huge financial losses due to catastrophic illness. Second, it assures people better quality of care by bypassing a waiting list when facing emergency care. Thus, the private health insurance is more likely to be a complement to any social insurance program in Taiwan.

[9] The government sets the "monthly minimum expenses" adjusted by the consumer price index and regional variation in income each fiscal year to determine eligibility for low-income households. For fiscal year 2001, for example, the monthly minimum expenses are US$337 in Taipei City, US$265 in Kaohsiung City, and US$220 in Taiwan Province. Families whose average monthly income is below this amount are classified as low-income. In 2000, only 0.6% of the population was considered members of low-income families (http://www.gio.gov.tw/taiwan-website/5-gp/yearbook).

[10] Military personnel (2.4% of the population in 1991) receive health coverage from National Defense hospitals.

2.2 Theoretical background and previous studies

Households can insure against or adapt to future economic downturns in a variety of ways, including precautionary saving, purchasing commercial life and accident insurance, entry of children or spouses into the labor force, or moving in with extended family when adversity occurs. With the availability of comprehensive health insurance to reduce unexpected medical expenditures, households may face less financial risk and may respond by reducing their precautionary behaviors.

Implementation of National Health Insurance might affect households' saving decisions through two pathways: a precautionary motive and an income (or redistribution) effect. By reducing uncertainty about the magnitude of future out-of-pocket health expenditures, comprehensive health insurance can substantially reduce the demand for precautionary savings. If it reduces a household's expected medical expenses (net of premiums and taxes to cover the program), NHI may also increase disposable income, and thus increase household savings.

Several studies provide evidence of a negative correlation between social health insurance and saving or wealth holdings. Using simulation, Kotlikoff (1989) showed that saving is smallest when public health insurance is available and largest when individuals have to self-insure against unexpected health expenditures. Kantor and Fishback (1996) found that the introduction of workers' compensation reduces private savings by approximately 25%. Engen and Gruber (2001) also showed that unemployment insurance leads to a significant reduction in asset accumulation. Only Starr-McCluer (1996) found a positive effect of health-insurance coverage on wealth holdings, even after controlling for the potential selection effect.

Intuitively, households without access to comprehensive health insurance have a stronger incentive to purchase other forms of insurance that will reduce their exposure to financial risk, such as accident insurance.[11] Thus, the implementation of NHI, by reducing the risk of future medical expenditures, may crowd out private purchase of accident insurance. In other contexts, Kantor and Fishback (1996) found that the presence of workers' compensation at least partially crowds out private accident insurance, and Cutler and Gruber (1996) suggested that the increase in Medicaid coverage was associated with a reduction in private insurance coverage. Alternatively, the introduction of NHI accompanied by the increase of private insurance providers may increase the private purchase of supplemental insurance by promoting

[11] The effects of the magnitude of one financial risk on an individual's willingness to incur other risks are complex, and have been investigated by Pratt and Zeckhauser (1987), Kimball (1993), and Gollier and Pratt (1964), among others.

health knowledge in the general public or by improving information flow in the market.[12,13]

Another potential response to the absence of health insurance is to increase labor supply by other family members.[14] As the labor supply of secondary earners is usually more elastic to household income, the introduction of NHI, by increasing the insurance benefits which are independent of employment status, may affect spousal labor supply. Chou and Staiger (2001) found that the availability of social health insurance reduced spousal labor force participation in Taiwan, and other studies have found that the availability of spousal health insurance leads married women to work fewer hours (Buchmueller & Valletta, 1999; Olson, 1998). Similarly, Cullen and Gruber (2000) found that unemployment insurance reduces spousal labor supply.

3 Identification strategy and data

3.1 Identification strategy

Our estimation strategy compares the changes in household precautionary behaviors associated with the introduction of NHI between two types of households: those covered by GEI, who experienced virtually no difference in insurance coverage before and after NHI, and those covered by other programs, who experienced an expansion of coverage for household members. Before NHI, if at least one spouse worked in the government sector, the other spouse, children, and parents could be covered under the extended insurance program. We use households with at least one government-employed spouse as our control group (Group G).

Based on the variations in insurance benefits available to households before NHI, we divide households with no government employees (''non-government employed households'') into five treatment groups according to their current employment status.[15] Households in the treatment groups received less generous benefits before NHI, and so the introduction of NHI should have had more significant impacts on these households' precautionary behaviors. Group PP consists of households where both household head and spouse work in the private sector. These households could obtain Labor Insurance for the head and spouse, but not for dependents, prior to the introduction of NHI. Group PN includes households where only the head works in the private sector and

[12] For example, Gertler, Strum, and Davidson (1994) found that information limitations reduce the demand for supplement Medical insurance.

[13] Six local and thirteen foreign companies entered the insurance market from 1987 to 1993. The total number of companies was 27. In 1997, the government further opened the life insurance market to all foreign companies. By 1998, there were 16 local and 17 foreign companies in life insurance market (Liu & Chen, 2002).

[14] Gruber and Madrian (2002) surveyed the literature and found that health insurance appears to be an important factor in the labor supply decision of married women.

[15] As described below, households are sampled independently each year and we are unable to track households over time.

the spouse is either not in the labor force or unemployed. Similar to Group PP, the household head was covered under Labor Insurance, but benefits were not extended to other family members. Group F is composed of agricultural households. These households were covered under Farmer's Health Insurance, which provides benefits only to household members who farm (e.g., children under age 14 were not covered). Group NN consists of non-employed households. This group is a mixture including retired, low-income households, and other non-employed households. Retired government employees could obtain health insurance for themselves and their spouse, but not for other dependents. Low-income households were also covered by insurance. Other non-employed households would not have access to health insurance, unless their children or parents had Government Employees' Insurance. Finally, Group PS includes households where both the head and spouse are self-employed, or one is self-employed and another does not work. Self-employed workers could obtain Labor Insurance only if they were members of an occupational union. Table 1 summarizes our control and treatment groups and their insurance coverage before NHI.

3.2 Data and sample

Our data are from the Survey of Family Income and Expenditure (SFIE), conducted each year since 1976 by the Directorate-General of Budget, Accounting and Statistics, Taiwan. These data have been used by other researchers (e.g. Chou & Staiger, 2001; Chou et al. 2003; Deaton & Paxson, 1994a, b). New samples are drawn each year, so we cannot track households longitudinally. About 13,000–16,000 households are surveyed and approximately 52,000–68,000 civilians aged 15 and above are interviewed each year from 1993 to 1999. The survey contains information on demographic characteristics, economic status, and industrial sector of employment of each member of the sampled households. It also includes information on household income and consumption. Household income includes salaries, entrepreneurial, property, and transfer income for all household members. Total consumption expenditures include both durable and non-durable goods. For the household head and spouse, the survey provides information on individual wage rates and incomes.

Our observation unit is the household, since the consumption expenditures and some income measures are collected only at the household level. Our sample is restricted to households headed by a 20 to 65-year old married person. The final sample consists of 64,967 households, of which 6,662 (10.3%) are in the control group (Group G), 11,819 (18.2%) are in Group PP, 24,193 (37.2%) are in Group PN, 7,068 (10.9%) are in Group F, 6,223 (9.6%) are in Group NN, and 9,002 (13.9%) are in Group PS.

When estimating spousal labor supply, we restrict attention to households where the head is employed. The analysis sample contains 50,423 households, of which 6,507 household heads work in the government sector and 43,916 household heads work in private sector.

Table 1 Insurance coverage for medical care in Taiwan[a]

	Description	Insurance programs before NHI		
		For self	For dependents	
			Spouse	Children
Control group				
G	At least one couple works in the government sector	Government Employees' Insurance	Health Insurance for Government Employees' Dependents	
Treatment groups				
PP	Both household head and spouse work in the private sector (employers or paid employees)	Labor Insurance	–	No
PN	Household head works in the private sector (employers or paid employees) and the spouse is either not in the labor force or unemployed	Labor Insurance	No	No
F	Agricultural household; either household head or spouse works in the agricultural sector	Farmer's Health Insurance	–	No
NN	Neither household head nor spouse works. Ex. Retired households, low-income households	Majority has no insurance. Have insurance only if government retired employees (Retired Government Employees' Insurance), or low-income households	No Spouse of government retired employees and low-income households has insurance	No
PS	Both household head and spouse are self-employed, or one is self-employed and another does not work	Majority has no insurance Labor Insurance if members of an occupational union	No No	No No

Notes:

[a] There were three major social insurance programs before the implementation of National Health Insurance (NHI) (March 1995)—Government Employee Insurance (GEI) (1958), Labor Insurance (LI) (1950) and Farmer's Health Insurance (FHI) (1985)

Descriptive statistics are presented in Table 2. The all-item Consumer Price Index (CPI) is used to convert all nominal figures to 1991 New Taiwan Dollars (NT$).[16] The control group (G) has the highest average household income (NT$1,023,000, or US$39,728), followed by groups PP, PN, PS, NN and F. Half of the NN households are headed by a female, while the proportion for the other groups is less than one quarter. Households in groups F and NN have older heads, fewer children younger than 18 years old, and more children older than 18. Reflecting the distribution of population and agriculture in Taiwan, 77% of group F resides in the middle or south of the island, while more than 45% of the other groups reside in the north. Education levels are significantly higher in the control group.

3.3 Insurance benefits for medical care

A key feature of the SFIE is the inclusion of insurance benefits under various social insurance programs. Insurance payments are available in the survey from 1993 to 1999. To distinguish the type of social insurance program available to the households, we rely on the household head's and spouse's employment status. As described in the previous section, after 1995, medical care benefits are offered by NHI but GEI, LI and FHI continue to provide other non-medical care benefits. The SFIE includes information on payments from all four insurance programs. Since our interest is the impact of medical care insurance on precautionary behaviors, only the medical-care insurance benefits are used in the analysis.

Each year, the survey imputes injury and sickness benefits for households based on the household's age composition and unreleased information on number of physician visits and number of hospitalizations.[17] Average health care insurance benefits covered under GEI, LI, and FHI were NT$19,870 and NT$24,039 in 1993 and 1994, respectively, and under NHI were NT$37,969, NT$39,495, NT$42,736, and NT$45,242 in 1996, 1997, 1998 and 1999, respectively.

Table 3 presents time trends and statistics of health insurance benefits across control and treatment groups. Agricultural families (Group F) (who are much older on average) received the highest health insurance benefits (NT$26,890) before NHI, followed by Groups G and PP. Self-employed households (Group PS) received the smallest benefits (NT$14,194) and Group NN received the second smallest (NT$19,745). Roughly 23% of households in Groups NN and PS received no benefits. After NHI, health insurance benefits increased for all households. The largest increases were to non-employed households (NN) (NT$25,091), followed by Group PS (NT$18,199) and

[16] The average exchange rate was US$1 = 25.75 NT$ in 1991.

[17] Medical care utilization information is available in the data only after NHI. The information on medical care insurance benefits for each respondent before NHI were obtained through personal communications with staff at the Directorate-General of Budget, Accounting and Statistics, Taiwan in November 2001.

Table 2 Sample statistics on selected explanatory variables

	Group											
	G		PP		PN		F		NN		PS	
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Household income (00,000)	10.230	5.101	9.106	4.880	7.492	4.476	5.881	3.721	6.542	4.240	6.784	3.335
Household head—male	0.774	0.418	0.830	0.375	0.743	0.437	0.892	0.310	0.494	0.500	0.820	0.384
Household head—age	43.888	9.295	41.773	8.430	43.906	9.594	52.156	9.502	51.380	11.423	44.625	9.161
# Of children under age 18	0.553	0.497	0.590	0.492	0.510	0.500	0.244	0.430	0.280	0.449	0.511	0.500
# Of children over age 18	0.276	0.447	0.280	0.449	0.340	0.474	0.496	0.500	0.460	0.498	0.349	0.477
# Of elderly parents	0.278	0.575	0.387	0.649	0.418	0.680	0.629	0.859	0.444	0.757	0.497	0.718
Region—north[a]	0.513	0.500	0.557	0.497	0.510	0.500	0.150	0.357	0.466	0.499	0.449	0.497
Region—middle[a]	0.171	0.376	0.159	0.366	0.183	0.387	0.355	0.478	0.191	0.393	0.219	0.413
Region—south[a]	0.262	0.440	0.264	0.441	0.281	0.449	0.411	0.492	0.296	0.456	0.299	0.458
Head education—junior high school[b]	0.057	0.232	0.160	0.367	0.184	0.388	0.134	0.341	0.153	0.360	0.231	0.421
Head education—senior high school[b]	0.246	0.431	0.291	0.454	0.288	0.453	0.095	0.294	0.204	0.403	0.266	0.442
Head education—community college[b]	0.228	0.420	0.143	0.350	0.100	0.300	0.018	0.134	0.051	0.220	0.057	0.232
Head education—university[b]	0.291	0.454	0.108	0.310	0.072	0.258	0.003	0.054	0.041	0.198	0.023	0.150
Head education—graduate school[b]	0.066	0.248	0.021	0.144	0.011	0.102	0.000	0.012	0.003	0.055	0.001	0.028
Spouse education—junior high school[b]	0.098	0.297	0.165	0.371	0.196	0.397	0.130	0.337	0.141	0.348	0.212	0.409
Spouse education—senior high school[b]	0.302	0.459	0.360	0.480	0.295	0.456	0.106	0.307	0.158	0.365	0.264	0.441
Spouse education—community college[b]	0.182	0.386	0.140	0.347	0.076	0.264	0.017	0.131	0.040	0.195	0.043	0.204
Spouse education—university[b]	0.200	0.400	0.083	0.276	0.048	0.215	0.005	0.071	0.040	0.196	0.020	0.140
Spouse education—graduate school[b]	0.031	0.174	0.012	0.107	0.004	0.066	0.000	0.000	0.002	0.049	0.001	0.032
Sample size	6,662		11,819		24,193		7,068		6,223		9,002	

Notes:

[a] The reference category is east

[b] The reference category is primary school

Table 3 Health insurance benefits (1993–1999)

	Group					
	G	PP	PN	F	NN	PS
Pre-NHI (1993–1994)	25,003	23,408	19,752	26,890	19,745	14,194
	(50,194)	(26,774)	(31,388)	(20,676)	(57,884)	(18,891)
	[2,774]	[4,569]	[9,262]	[3,383]	[2,233]	[3,430]
1993	24,451	22,680	17,783	24,973	18,391	12,418
1994	25,557	24,075	21,817	28,921	21,015	16,025
Post-NHI (1996–1999)	28,002	27,795	32,372	44,300	44,836	32,393
	(29,510)	(32,609)	(36,877)	(42,500)	(58,867)	(35,810)
	[3,888]	[7,250]	[14,931]	[3,685]	[3,990]	[5,572]
1996	24,492	25,094	29,225	49,148	37,656	32,824
1997	28,589	27,884	31,003	40,700	44,140	30,229
1998	28,727	29,577	34,199	42,896	46,832	32,273
1999	30,635	29,072	35,063	44,165	50,325	34,434
Difference (=post NHI—pre NHI)	2,999	4,386	12,620	17,409	25,091	18,199
	(981)	(576)	(461)	(806)	(1,546)	(662)
Whole sample (1993–1994, 1996–1999)						
Mean	26,753	26,099	27,541	35,967	35,833	25,459
	(39,487)	(30,559)	(35,412)	(34,955)	(59,737)	(31,745)
Number of observations	6,662	11,819	24,193	7,068	6,223	9,002

Notes: All values are in NT dollars. The 1991 exchange rate is US$1 = 25.75NT$

Standard deviations are in parentheses and sample sizes are in brackets

Group F (NT$17,409). Insurance benefits increased by only NT$2,999 for the control group G.

4 Empirical strategy

4.1 Difference-in-differences estimation

The 1995 introduction of NHI allows us to exploit the variation with respect to prior health insurance programs to identify the impact of NHI on households' precautionary behaviors. The most straightforward approach is to use the difference-in-differences (DD) framework. The behavior changes of the control group are assumed to capture any systematic factors, while the changes in the treatment groups reflect both the same systematic factors and the impact of the policy intervention. By comparing the changes of treatment and control groups, we seek to identify the effect of NHI. We omit the transition year 1995 and pool the control and treatment groups for 1993–1994 and 1996–1999 to estimate the probit equation:

$$P(Y_{ijt}) = \Phi\Bigg(\beta_0 + \beta_1 X_{ijt} + \sum_{k=1}^{5} \beta_{2k} T_{ijtk} + \beta_3 \mathrm{NHI}_{ijt} + \sum_{k=1}^{5} \beta_{4k} (T_{ijtk} \times \mathrm{NHI}_{ijt}) + \beta_5 \delta_j + \beta_6 \tau_t + \varepsilon_{ijt}\Bigg) \quad (1)$$

where i indexes household, j indexes geographic region and t indexes year. Y is the dependent variable, detailed below. X is a vector of observable characteristics, δ is a fixed regional effect and τ is a fixed year effect. NHI is an indicator for whether the year is after the policy change (1995), and T_k is a dummy indicating whether the household belongs to treatment group k. Each coefficient β_{4k} can be interpreted as an estimate of the impact of the program on a given treatment group.

We consider three binary dependent variables indicating whether the household (1) had positive savings, (2) purchased accident insurance, and (3) included an employed spouse. We also evaluate the effect of NHI on the magnitude of household savings, using an analogous OLS regression (including households with zero savings). Household savings is defined as the difference between total household disposable income and household consumption expenditures. As shown in Table 4, before NHI, 91.0% of the control group had positive savings, in contrast to only 78.5% of the NN group. After NHI, the fraction having positive savings remained almost the same in the control group, but decreased for all the treatment groups. The control group (G) and group PP increased saving after NHI, possibly due to economic growth during the period. In contrast, groups PN, F, NN and PS decreased their savings after the policy change. The simple DD indicates that the NHI reduced the savings by NT$64,605 for F group, NT$56,434 for PS group, NT$55,614 for NN group and NT$44,925 for PN group. The impact is the smallest for PP group, only by NT$20,304. Without controlling for other confounding factors, the reductions in savings are much higher than the increases of insurance benefits for all treatment groups reported in Table 4.

The survey asked households the amount paid for accident insurance premiums. We used this information to create a dummy variable with value one if the household purchased accident insurance and zero otherwise. However, this variable overstates the fraction of groups G and NN purchasing accident insurance before NHI. Because the amount paid for accident insurance premiums also includes the premiums paid for injury and sickness benefits for dependents of government employees and spouses of teaching and administrative staffs of private schools (36% of the Government Employees Insurance beneficiaries in 1991) and thus increases the fraction of group G having accident insurance. The fraction of NN having accident insurance is overstated because the amount paid for accident insurance premiums also includes the premiums paid for injury and sickness benefits for retired government employees, retired government employees' spouses, retired teaching and administrative staffs of private schools and their spouses (11% of the Government Employees Insurance beneficiaries in 1991). After NHI became effective, the administration of medical care benefits was transferred to the Bureau of National Health Insurance. Unfortunately, we are not able to distinguish those households from the households purchasing private accident insurance before NHI.

Table 4 Sample statistics on saving and accidental insurance before and after National Health Insurance

	Group					
	G	PP	PN	F	NN	PS
Fraction having positive savings (%)						
Pre-NHI (1993–1994)	0.910	0.918	0.850	0.859	0.785	0.858
	(0.286)	(0.275)	(0.357)	(0.348)	(0.411)	(0.349)
Post-NHI (1996–1999)	0.911	0.896	0.809	0.839	0.721	0.778
	(0.284)	(0.306)	(0.393)	(0.367)	(0.448)	(0.415)
Difference	0.001	–0.022	–0.040	–0.020	–0.064	–0.080
	(0.007)	(0.006)	(0.005)	(0.009)	(0.012)	(0.008)
Difference-in-difference		–0.023	–0.042	–0.021	–0.065	–0.081
		(0.009)	(0.010)	(0.011)	(0.013)	(0.012)
Savings (NT$)						
Pre-NHI (1993–1994)	337,406	279,018	195,644	204,371	151,444	166,054
	(370,435)	(288,363)	(343,252)	(295,399)	(308,492)	(247,730)
Post-NHI (1996–1999)	367,162	288,470	180,475	169,522	125,585	139,376
	(443,679)	(390,498)	(326,731)	(270,538)	(298,633)	(243,238)
Difference	29,756	9,452	–15,170	–34,849	–25,859	–26,678
	(10,308)	(6,697)	(4,406)	(6,732)	(7,987)	(5,316)
Difference-in-difference		–20,304	–44,925	–64,604	–55,614	–56,434
		(11,779)	(9,921)	(12,150)	(13,233)	(10,826)
Fraction having private accidental insurance (%)						
Pre-NHI (1993–1994)	0.860	0.766	0.736	0.497	0.609	0.749
	(0.347)	(0.423)	(0.441)	(0.500)	(0.488)	(0.434)
Post-NHI (1996–1999)	0.828	0.808	0.767	0.522	0.625	0.777
	(0.377)	(0.394)	(0.423)	(0.500)	(0.484)	(0.416)
Difference	–0.032	0.042	0.031	0.024	0.017	0.029
	(0.009)	(0.008)	(0.006)	(0.012)	(0.013)	(0.009)
Difference-in-difference		0.074	0.063	0.056	0.048	0.060
		(0.012)	(0.012)	(0.015)	(0.016)	(0.013)
Number of observations	6,662	11,819	24,193	7,068	6,223	9,002

Notes:
Savings are in NT dollars. The 1991 exchange rate is US$1 = 25.75NT$
Standard deviations are in parentheses

Table 5 Sample statistics on spousal labor supply before and after National Health Insurance

	Control group household head is in government sector	Treatment group household head is in private sector
Spousal labor force participation		
Pre-NHI	0.631	0.428
(1993–1994)	(0.483)	(0.495)
	[2,701]	[16,894]
Post-NHI	0.631	0.449
(1996–1999)	(0.482)	(0.497)
	[3,806]	[27,022]

Notes: Standard deviations are in parentheses and sample sizes are in brackets

In the control group, 86% purchased accident insurance before NHI, while the fraction of treatment group households purchasing accident insurance ranged between 49.7% (Group F) and 76.6% (Group PP) (see Table 4). After NHI, the percentage of households purchasing accident insurance increased for all groups except the control group (G). The ratio of purchasing accident insurance in control group is 82.8%. The ratios increase from 52.2% for Group F to 80.9% for Group PP. The simple DD estimate indicates that the NHI was accompanied by an increase in the private accidental insurance from 4.8% for Group NN to 7.4% for Group PP. However, we have to be cautious that the results represent upper bounds of the impact of NHI due to overstatement of the control group households purchasing accident insurance.

Spousal labor force participation is defined as a binary variable which is equal to one if the spouse works as an employer, employee or self-employed worker in the public or private sector.[18] As shown in Table 5, the spousal labor force participation rate of government households remained the same (63.1%) after the NHI reform, while the rate increased from 42.8 to 44.9% for the non-government households.

The variable X in Eq. 1 is a vector of demographic and economic characteristics of the household to control for any observable differences between households that might confound the analysis: household disposal income, household head's education, gender, age and age squared, spousal education, number of children under age 18, number of children over age 18, number of elderly parents or grandparents and yearly city/county unemployment rate. Education is measured by five dummy variables for completion of middle school (9 years of education), high school (12 years of education), community college (15 years of education), university (16 years of education), and graduate school (18 years of education).

Table 2 shows that our control and treatment groups are far from similar. The inclusion of the treatment dummies and observed covariates in our regression accounts at least in part for differences between the groups. However, it is possible that the effect of an observed covariate may differ

[18] We do not include non-paid household workers as labor force participants.

among groups. To account for this possibility, we also include interactions between household income and five treatment dummies.

The difference-in-differences approach requires several identifying assumptions. First, there should be no contemporaneous shocks (other than the NHI program) that might differentially affect precautionary behaviors of the treatment and control groups. Second, there should be no differences in the underlying trends in savings, private purchase of accident insurance, or spousal labor supply between the control and treatment groups. We discuss the extent to which violations of these assumptions may affect our results in more detail below.

One disadvantage of a difference-in-differences strategy is that it does not fully account for the variation in insurance benefits within the group. In the next subsection, we describe an improvement to the difference-in-differences approach that exploits the variations in insurance benefits. This approach is similar to the method used by Gruber (2000). Neither Chou and Staiger (2001) nor Chou et al. (2003) directly assessed the impact of insurance benefits on household behaviors.

4.2 Parameterized model and two-stage least squares estimation

Since the survey reports insurance benefits before and after NHI, we are able to estimate the following regression:

$$P(Y_{ijt}) = \Phi\left(\beta_0 + \beta_1 X_{ijt} + \sum_{k=1}^{5} \beta_{2k} T_{ijtk} + \beta_3 \mathrm{NHI}_{ijt} + \beta_4 B_{ijt} + \beta_5 \delta_j + \beta_6 \tau_t + \varepsilon_{ijt}\right) \tag{2}$$

where B represents insurance benefits for medical care and the other variables are as defined in Eq. 1. The coefficient β_4 estimates the impact of an additional dollar of insurance benefits on household precautionary behaviors. Although the amount of benefits are not known to the household ex ante, the amount of benefits may serve as an indicator of expected benefits, since households have much more information about their likely medical expenses than is available through the survey.

The estimated coefficient β_4 could be biased and inconsistent if there are omitted variables which are correlated with both insurance benefits and precautionary behaviors. For example, we do not have good measures for health. Households with poor health may receive higher insurance benefits because of more frequent or intensive treatment, and could also take more precautions to prevent future adverse events. In this case, we may underestimate the impact of insurance benefits. On the other hand, if households with poor health (who receive larger insurance benefits) are less able to self-insure against future economic downturns, then we may overestimate the impact of insurance benefits.

To resolve the problem of omitted variables, we estimate Eq. 2 using two-stage least squares. The natural experiment provides a source of instrumental variables. After controlling for fixed effects for the five treatment groups (T_k), policy change (NHI), region (δ) and time (τ), the model can be identified by the variations in insurance coverage changes after NHI in the treatment groups relative to the control group ($T_k \times$ NHI, k = 1,2,3,4,5).

The first stage results show that the NHI program significantly increased the insurance benefits received by households in the treatment groups. These results are of intrinsic interest because they suggest a redistributive effect of NHI toward lower income groups. Partial results of the first stage estimation are shown in Appendix Table 10. The increases in benefits were the largest for group NN (NT$23,069), followed by groups PS (NT$16,736), F (NT$15,282), PN (NT$11,206) and PP (NT$3,145). These coefficients are statistically significant at the 1% level. The F-test of joint significance of the five interaction terms is 83.44, which is significant at the 1% level. The partial R^2 of the excluded instruments from the first-stage regression is 0.058, which compares favorably with those reported by Bound, Jaeger, and Baker (1995). Weak instruments can cause an IV estimator to have a large asymptotic bias, but these results suggest that our instrumental variables have substantial explanatory power regarding insurance benefits.

5 Empirical results

5.1 Results on savings

The effects of NHI on the probability and magnitude of household savings are reported in Table 6. We find a negative and significant effect of NHI on both outcomes. The probit estimates imply that NHI reduced the odds of having positive savings by 7.5% for group PS, by 4.5% for group NN, and 3.2% for group PN, respectively. The coefficients for the three groups are statistically significant. The OLS estimates imply that NHI reduced average savings by roughly NT$17,500 for group F, and by NT$154,000, NT$12,700, NT$14,100, and NT$7,900 for groups PS, PN, NN and PP, respectively. These findings suggest that the NHI program has a sizable effect on savings behavior, which is consistent with a precautionary savings response to reductions in the risk of medical-care expenditures.

We also evaluate the marginal effect of the change in insurance benefits on household savings. As discussed above, insurance benefits could be endogenous due to omitted health variables. We report both probit/OLS and probit IV/2SLS results in Table 7. The results are similar to those of the difference-in-differences approach: household saving is significantly and negatively related to insurance benefits. The probit estimates suggest that the probability of positive savings falls by 7.4% for each NT$100,000 of insurance benefits. The OLS estimates suggest that savings fall by NT$0.41 for each NT$1 increase in insurance benefits. The estimated average elasticity is –0.055.

Table 6 Difference-in-differences estimates of the impact of National Health Insurance on saving

	Saving > 0			Saving (00,000)	
	Probit			OLS	
	Coeff.	SE	M.E.	Coeff.	SE
NHI (post 1995)*PP	–0.114[c]	(0.059)	–0.024	–0.079	(0.068)
NHI (post 1995)*PN	–0.156[a]	(0.052)	–0.032	–0.127[b]	(0.062)
NHI (post 1995)*F	–0.082	(0.061)	–0.017	–0.175[a]	(0.066)
NHI (post 1995)*NN	–0.209[a]	(0.062)	–0.045	–0.141[c]	(0.074)
NHI (post 1995)*PS	–0.327[a]	(0.059)	–0.075	–0.154[b]	(0.066)
PP	0.221[c]	(0.126)	0.040	0.671[a]	(0.238)
PN	–0.125	(0.093)	–0.025	0.550[b]	(0.218)
F	–0.529[a]	(0.127)	–0.130	0.433[b]	(0.191)
NN	–0.343[a]	(0.104)	–0.204	0.407[b]	(0.192)
PS	–0.760[a]	(0.104)	–0.077	0.781[a]	(0.184)
NHI (post 1995)	0.119[b]	(0.053)	0.024	0.027	(0.063)
Household income (00,000)	0.152[a]	(0.011)	0.030	0.722[a]	(0.018)
Household head—male	0.011	(0.016)	0.002	0.069[a]	(0.020)
Household head—age	–0.068[a]	(0.006)	–0.013	–0.159[a]	(0.008)
Household head—age^2 (00)	0.074[a]	(0.007)	0.015	0.170[a]	(0.008)
# Of children under age 18	–0.161[a]	(0.021)	–0.032	–0.539[a]	(0.025)
# Of children over age 18	–0.105[a]	(0.023)	–0.021	–0.528[a]	(0.035)
Sample size	64,967			64,967	
R^2	0.129			0.671	

Notes: Standard errors are in parentheses. Control variables also include constant, household head's five education dummies (junior, senior, community college, university, graduate school), spouse's five education dummies, unemployment rate, interactions between household income and five treatment dummies, region and year dummies which are not reported here

[a] Statistically significant at the 1% level

[b] Statistically significant at the 5% level

[c] Statistically significant at the 10% level

The two-stage least square estimates suggest stronger effects of insurance benefits. Using the probit IV estimates, we find that the probability of positive savings decreases by 17.7% for each NT$100,000 of insurance benefits, and that savings fall by NT$0.62 for each NT$1 increase in insurance benefits (an average elasticity of –0.083). Kantor and Fishback (1996) used a US household survey for 1917–1919 and found that the introduction of workers' compensation in the 1910s significantly reduced workers' saving. Each dollar increase in expected benefits was associated with a reduction in saving of $0.56–$2.24. Gruber and Yelowitz (1999) found that the Medicaid program lowered asset holdings by 38–43 cents for each dollar of Medicaid eligibility. Over the 1984–1993 period, the Medicaid expansion lowered wealth holding by an estimated 18%. Those findings demonstrate that the social insurance has a sizeable effect on savings behavior, which is consistent with a precautionary savings response to reduced risk of medical expenditure.

We test the validity of our exclusion restrictions using the test statistics NR^2 from regressing the IV regression residuals on the instruments (treatment group dummies and NHI dummy interactions) and exogenous variables,

Table 7 Estimates of medical care transfer payment on saving

	Saving > 0						Saving (00,000)					
	Probit			Probit IV			OLS			IV		
	Coeff.	SE	M.E.	Coeff.	SE	M.E.	Coeff.	SE	Elasticity	Coeff.	SE	Elasticity
Transfer payment (00,000)	–0.382[a]	(0.018)	–0.074	–0.916[a]	(0.208)	–0.177	–0.410[a]	(0.065)	–0.055	–0.620[b]	(0.246)	–0.084
Household income (00,000)	0.161[a]	(0.011)	0.031	0.172[a]	(0.009)	0.033	0.731[a]	(0.018)		0.736[a]	(0.019)	
Household head—male	0.020	(0.016)	0.004	0.029[c]	(0.017)	0.006	0.076[a]	(0.020)		0.079[a]	(0.021)	
Household head—age	–0.079[a]	(0.006)	–0.015	–0.093[a]	(0.008)	–0.018	–0.169[a]	(0.008)		–0.175[a]	(0.010)	
Household head—age^2 (00)	0.086[a]	(0.007)	0.017	0.101[a]	(0.009)	0.020	0.182[a]	(0.008)		0.188[a]	(0.011)	
# Of children under age 18	–0.151[a]	(0.021)	–0.029	–0.135[a]	(0.021)	–0.026	–0.527[a]	(0.026)		–0.520[a]	(0.026)	
# Of children over age 18	–0.101[a]	(0.023)	–0.020	–0.091[a]	(0.022)	–0.018	–0.520[a]	(0.035)		–0.516[a]	(0.035)	
Sample size	64,967			64,967			64,967			64,967		
R^2	0.137			0.129			0.674			0.673		

Notes: Standard errors are in parentheses. Control variables also include constant, household head's five education dummies (junior, senior, community college, university, graduate school), spouse's five education dummies, unemployment rate, interactions between household income and five treatment dummies, region and year dummies which are not reported here

[a] Statistically significant at the 1% level

[b] Statistically significant at the 5% level

[c] Statistically significant at the 10% level

where N is the sample size and R^2 is the goodness-of-fit statistic (Staiger & Stock, 1997). The test statistics ($\chi^2 = 2.74$) does not suggest violation of the overidentification restrictions. This test, together with the results from the first stage regression, suggests that our instruments are legitimate.

We can use OLS and 2SLS estimates to measure the net effect of the National Health Insurance program. The average increases in insurance benefits after NHI are reported in Table 3. Using the probit estimates, the estimated reductions in the odds of having positive savings are 1.9, 1.3, 1.3, 0.9 and 0.3% for groups NN, PS, F, PN, and PP, respectively. Results based on the IV probit estimates are larger, 4.4, 3.2, 3.0, 2.2 and 0.7% for groups NN, PS, F, PN, and PP, respectively. We also find that NHI reduces savings by between NT$1,798 (PP) and NT$10,287 (NN) based on the OLS estimates, and between NT$2,720 (PP) and NT$15,556 (NN) based on the 2SLS estimates. Different from the simple DD, controlling other covariates yields more reasonable results as the reductions in savings are smaller than the expected insurance benefits.

5.2 Results on private purchase of accident insurance

Table 8 reports the estimated effect of NHI on private purchase of accident insurance. The simple difference-in-differences estimates suggest that NHI

Table 8 Estimates of medical care transfer payment on private purchase of accidental insurance

	Probit (difference-in-differences)			Probit			Probit IV		
	Coeff.	SE	M.E.	Coeff.	SE	M.E.	Coeff.	SE	M.E.
Transfer payment (00,000)				–0.131[a]	(0.017)	–0.038	0.007	(0.188)	0.002
NHI (post 1995)*PP	0.403[a]	(0.052)	0.102						
NHI (post 1995)*PN	0.332[a]	(0.048)	0.089						
NHI (post 1995)*F	0.324[a]	(0.054)	0.083						
NHI (post 1995)*NN	0.166[a]	(0.058)	0.045						
NHI (post 1995)*PS	0.329[a]	(0.054)	0.085						
Household income (00,000)	0.021[a]	(0.005)	0.006	0.022[a]	(0.001)	0.006	0.019[a]	(0.005)	0.006
Household head—male	–0.203[a]	(0.016)	–0.056	–0.201[a]	(0.004)	–0.056	–0.203[a]	(0.016)	–0.057
Household head—age	0.331[a]	(0.005)	0.096	0.328[a]	(0.002)	0.095	0.331[a]	(0.005)	0.096
Household head—age^2 (00)	–0.358[a]	(0.006)	–0.104	–0.354[a]	(0.002)	–0.103	–0.358[a]	(0.006)	–0.104
# Of children under age 18	1.092[a]	(0.018)	0.306	1.095[a]	(0.005)	0.307	1.090[a]	(0.018)	0.306
# Of children over age 18	0.231[a]	(0.018)	0.065	0.234[a]	(0.005)	0.066	0.231[a]	(0.018)	0.065
Sample size	64,967			64,967			64,967		
Adjusted R^2	0.236			0.236			0.235		

Notes: Standard errors are in parentheses. Control variables also include constant, household head's five education dummies (junior, senior, community college, university, graduate school), spouse's five education dummies, unemployment rate, interactions between household income and five treatment dummies, region and year dummies which are not reported here

[a] Statistically significant at the 1% level

[b] Statistically significant at the 5% level

[c] Statistically significant at the 10% level

significantly increased the purchase of supplementary accident insurance. The marginal effects are 10.2, 8.9, 8.5, 8.3 and 4.5% for groups PP, PS, F, and NN, respectively. However, as discussed above, we have to be cautious about the interpretations of those results because the fraction of group G purchasing accident insurance is overestimated before NHI.

When considering insurance benefits directly, probit estimates suggest that the probability of purchasing private accident insurance decreases by 3.8% for each NT$100,000 increase in medical insurance benefits. The IV probit estimates suggest this effect is small and not significant.

5.3 Results on spousal labor supply

The introduction of NHI could also reduce spousal labor supply as one kind of self-insurance. Our simple Probit estimates show that the NHI has a negative impact on spousal labor force participation. However, our IV Probit reported in Table 9 does not suggest any significant effect. The estimate of IV Probit is not consistent with the study of Chou and Staiger (2001). One significant difference between the two studies is that we examine effects over a longer time period. The Chou and Staiger result may represent a short-run effect, while we estimate a longer run effect which is not statistically significant. Our results suggest that the precautionary motive for secondary earners' to work is very weak.[19] Gruber and Madrian (2002) concluded from a review of the literature that health insurance is important for the labor supply decisions of married women. However, all the studies they review assume that the husband's health insurance is exogenous to the wife's labor force participation, a debatable identification strategy.

5.4 Comparisons between estimates from DD, OLS and 2SLS

Compared with OLS, the two-stage least squares estimates suggest a larger effect of NHI on households' behaviors (see Table 7). One explanation is that our instrumental variables provide an estimate for specific groups (PP, PS, F and NN) affected by the policies. If these non-government-employed households have higher-than-average marginal responses to insurance benefits, then two-stage least squares estimates based on the husband–wife joint employment status might yield larger estimates of the response of increased insurance benefits than the corresponding OLS estimates.[20] The underlying heterogeneous responses to policy point to the weakness of difference-in-differences

[19] In our study we have men or women as principal earners who were previously covered by health insurance. Most of the US studies are about women as secondary earners. We also restrict our sample to male household heads and obtain similar results as reported in this paper.

[20] A similar argument has been made by Card (1999) to explain the large gap between 2SLS and OLS estimates on returns to education. The fact that the instrumental variables, and thus the 2SLS estimates, are affected by the underlying heterogeneity in response to the policy is discussed by Imbens and Angrist (1994) and emphasized by Angrist and Krueger (2001).

Table 9 Estimates of medical care transfer payment on spouse's labor supply

	Probit (difference-in-differences)			Probit			Probit IV		
	Coeff.	SE	M.E.	Coeff.	SE	M.E.	Coeff.	SE	M.E.
Transfer payment (00,000)				–0.103[a]	(0.025)	–0.035	0.394	(0.325)	0.132
NHI (post 1995)*Non-government employment status	0.051	(0.042)	0.017						
Non-government employment status	–0.757[a]	(0.053)	–0.279						
NHI (post 1995)	0.467[a]	(0.056)	0.151						
Household income (00,000)	0.097[a]	(0.004)	0.032	0.100[a]	(0.004)	0.033	0.089[a]	(0.008)	0.030
Spouse education—junior high school	0.294[a]	(0.026)	0.103	0.294[a]	(0.026)	0.103	0.295[a]	(0.026)	0.104
Spouse education—senior high school	0.539[a]	(0.024)	0.190	0.539[a]	(0.024)	0.190	0.545[a]	(0.024)	0.192
Spouse education—community college	0.993[a]	(0.034)	0.375	0.991[a]	(0.034)	0.374	1.006[a]	(0.036)	0.380
Spouse education—university	1.107[a]	(0.040)	0.418	1.102[a]	(0.040)	0.416	1.129[a]	(0.044)	0.426
Spouse education—graduate school	1.444[a]	(0.108)	0.526	1.436[a]	(0.108)	0.524	1.475[a]	(0.112)	0.535
# Of children under age 18	0.090[a]	(0.028)	0.030	0.094[a]	(0.028)	0.031	0.077[b]	(0.030)	0.026
# Of children over age 18	0.027	(0.030)	0.009	0.030	(0.030)	0.010	0.017	(0.031)	0.006
Sample size	39,857			39,857			39,857		
Adjusted R^2	0.455			0.455			0.455		

Notes: Standard errors are in parentheses. Control variables also include constant, household head's five education dummies (junior, senior, community college, university, graduate school), spouse's five education dummies, unemployment rate, interactions between household income and five treatment dummies, region and year dummies which are not reported here

[a] Statistically significant at the 1% level

[b] Statistically significant at the 5% level

[c] Statistically significant at the 10% level

and two-stage least squares estimates in that their results may not be generalized beyond the treatment groups in the study (Meyer, 1995).

5.5 Alternative explanations

The identification strategy used above requires several assumptions. In this subsection, we consider possible alternative explanations for our findings. If we fail to find strong evidence for the other possibilities, we will be more confident in our conclusion that NHI has a significant impact on households' precautionary behaviors.

If long-run trends in households' precautionary behaviors differ between control and treatment groups, then we may risk interpreting pre-existing trends as treatment effects. We test for this underlying trend by re-estimating the models on data from 1991 to 1994. We construct a new sample of households headed by a 20 to 65-year old married person with the data from 1991 and 1992 as the ''before'' period and 1993 and 1994 as the ''after.'' Most of the major reforms in government health insurance policies were implemented before 1990, and there were no major changes around 1993. We estimate the difference-in-differences model on those data. Negative and significant coefficient estimates imply that there was a pre-existing trend.

The estimated effects on savings (not reported in the table) of this new exercise are all positive except for group PP.[21] They are NT$–9,579 for group PP, and NT$8,758, NT$8,064, NT$23,228, and NT$11,342 for groups PS, PN, NN and F, respectively. None are statistically significant. These results suggest that there was no between-group difference in savings trends before the NHI reform; the differential between the control and treatment groups arises after the 1995 reform. Even if there is a significant pre-existing trend, our results suggest it goes in the opposite direction, against our findings.

Another alternative explanation for our findings is that some change in the economic environment other than NHI occurred and affected households in the control and treatment groups differently. One potential candidate is the business cycle. Between 1994 and 1996 the economic growth rate in Taiwan fell by 1%, from 7.1 to 6.1%. Since economic downturns will affect households' saving and labor supply decisions, our treatment effects may be contaminated by economic fluctuations.

To control for possible differential responses to the business cycle, we replace income and treatment dummies interactions with interactions between city/county unemployment rates and five treatment dummies in the models. Some of the coefficients on insurance benefits become slightly larger but are all still significant for saving. For example, simple Probit and IV Probit estimates imply that the probability of positive savings falls by 7 and 14.8% for each NT$100,000 increase in insurance benefits, respectively. The estimated effects from an OLS regression of savings are found to be larger than the estimates in Table 6. The estimates imply that the NHI reduced household annual savings by NT$55, 600 for the F group, NT$43,800 for the PS group,

NT$36,200 for the NN group, NT$32,500 for the PN group, and NT$26,800 for the PP group. All the coefficients are statistically significant. The impact of NHI on the accidental insurance and spousal labor force participation also follow the same patterns as shown in Tables 7, 8.

These results suggest that control and treatment groups did not respond differently to economic fluctuations and that our estimates of treatment effects may be attributed to the NHI reform.

6 Conclusion

Using the dramatic expansion of health insurance programs for various groups in Taiwan as instruments for changes in insurance benefits, we estimate the effect of social health insurance benefits on households' precautionary behaviors. Using coefficients from difference-in-differences, OLS and 2SLS model specifications, we estimate that the introduction of National Health Insurance decreased households' savings by 3–9% using difference-in-differences coefficients, 1–7% using OLS coefficients, and 1–10% using 2SLS coefficients. These results are consistent with recent studies that have found that coverage by other social programs, such as disability insurance (Kantor & Fishback, 1996), unemployment insurance (Engen & Gruber, 2001) and Medicaid (Gruber & Yelowitz, 1999), are negatively associated with savings. While there are a number of potential explanations for our results, we find the impact of the introduction of National Health Insurance to be the most compelling explanation.

We do not find significant impacts of NHI on households' purchase of private accident insurance based on 2SLS. Applying a similar empirical specification to spousal labor supply yields no evidence that the expansion of the NHI decreased labor force participation of secondary earners. These results suggest that precautionary motives are not among the most important reasons for purchasing private accident insurance and the decision of other household members to go to work in Taiwan.

Our study offers empirical support for the proposition that, by reducing uncertainty about future medical expenses, the introduction of large-scale social health insurance can substantially reduce households' precautionary behaviors. However, the welfare implication of the behavioral change is not clear. On the one hand, the reduction in household savings could improve welfare by increasing current consumption. If the household increases educational expenditures, for example, the long-run impact could be beneficial to society. However, high national saving is an important contributor to a nation's economic growth. How to balance these conflicting objectives and how social health insurance affects welfare over time remains unanswered. While this study provides useful data, more research is required to assess the welfare implications and to provide more accurate guidance for policy reform.

Appendix

Table 10 Partial first stage results

Dependent variable: transfer payment (00,000)	
NHI (post 1995)*F	0.153[a] (0.012)
NHI (post 1995)*PP	0.031[a] (0.011)
NHI (post 1995)*PN	0.112[a] (0.010)
NHI (post 1995)*NN	0.231[a] (0.013)
NHI (post 1995)*PS	0.167[a] (0.011)
Sample size	64,967
R^2	0.099

Notes: Standard errors are in parentheses. Control variables also include constant, five treatment dummies, NHI dummy, household income, household head's gender age, and age squared, household head's five education dummies (junior, senior, community college, university, graduate school), spouse's five education dummies, unemployment rate, interactions between household income and five treatment dummies, region and year dummies which are not reported here

[a] Statistically significant at the 1% level

[b] Statistically significant at the 5% level

[c] Statistically significant at the 10% level

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