ELSEVIER

Journal of Public Economics 87 (2003) 1873–1894

JOURNAL OF PUBLIC ECONOMICS

www.elsevier.com/locate/econbase

National Health Insurance and precautionary saving: evidence from Taiwan

Shin-Yi Chou[a], Jin-Tan Liu[b], James K. Hammitt[c,*]

[a]*Department of Humanities and Social Sciences, New Jersey Institute of Technology, Newark NJ and National Bureau of Economic Research, New York NY, USA*

[b]*Department of Economics, National Taiwan University, Taipei, Taiwan*

[c]*Department of Health Policy and Management and Center for Risk Analysis, Harvard School of Public Health, 718 Huntington Avenue, Boston, MA 02115-5924, USA*

Received 27 March 2001; received in revised form 27 November 2001; accepted 27 November 2001

Abstract

By reducing uncertainty about future medical expenses, comprehensive health insurance can reduce households' precautionary saving. We examine this effect using Taiwan micro-data spanning the 1995 introduction of National Health Insurance. The effects of National Health Insurance are identified using employment-based variation in prior insurance coverage. Replacement of the households' prior insurance coverage with National Health Insurance is exogenous to the household, so our estimates are not subject to selection bias. Compared with the preceding government insurance programs, National Health Insurance reduced saving by an average of 8.6–13.7% with the largest effects for households with the smallest saving.

Keywords: National Health Insurance; Precautionary saving; Prudence

JEL classification: D1; H4; I1

1. Introduction

The possibility of economic adversity leads households to save more and consume less than they would otherwise. Because health expenditures can be large

*Corresponding author. Tel.: +1-617-432-4030; fax: +1-617-432-0190.

E-mail address: jkh@hsph.harvard.edu (J.K. Hammitt).

0047-2727/02/$ – see front matter
doi:10.1016/S0047-2727(01)00205-5

relative to income, persistent and generally increase with age, they make a significant contribution to a households' uncertainty about its future economic circumstances.[1] The introduction of comprehensive health insurance, by reducing uncertainty about the magnitude of future out-of-pocket health expenditures, can substantially reduce the demand for precautionary saving and so increase current consumption. We investigate this effect by studying the 1995 introduction of National Health Insurance (NHI) in Taiwan.

Numerous theoretical studies have examined the precautionary-saving motive when future income or expenses are uncertain (see e.g. Leland, 1968; Sandmo, 1970; Drèze and Modigliani, 1972; Skinner, 1988; Zeldes, 1989a,b; Kimball, 1990; Caballero, 1990, 1991; Deaton, 1991). Most empirical studies have focused on uncertain future income and provide mixed evidence of precautionary saving. There have been few empirical studies testing the impact of social health insurance on saving behavior.

We use a natural experiment associated with the creation of NHI to examine the effect of reduction in uncertainty about future medical expenses on household saving and consumption behaviors. Before the implementation of NHI, health insurance in Taiwan had been provided through employment-based government programs.[2] A majority of the working population had almost complete coverage under Labor Insurance or Government Employees' Insurance. Two major differences between these government-sponsored policies enable us to exploit the variation with respect to uncertain health expenditures to identify the effect of NHI on saving. NHI covers workers after retirement and family members. Prior to NHI, only government employees received these benefits. As a result, the introduction of comprehensive coverage under NHI had a smaller effect on government-employed than on other households.

We estimate the effect of NHI on precautionary saving using a 'difference-in-differences' approach. We compare the change in saving for a treatment group with the change in saving for a control group. The change in saving for the control group accounts for any systematic structural change while the experimental group's change reflects both the systematic structural change and the impact of the policy intervention. Prior to NHI, a household could obtain health insurance for all household members if either the husband or wife worked in the government sector. Accordingly, we define treatment and control groups based on the husband's and wife's joint employment status.

[1] In the US, total health-care spending was equivalent to 16% of disposable personal income in 1997 (Bureau of Economic Analysis data). In Taiwan, medical care and health expenses were roughly 7.6% of household disposable income in 1998 (Survey of Family Income and Expenditure data). Feenberg and Skinner (1994) have shown that medical expenses are persistent, so that modest annual health costs can gradually deplete a family's resources.

[2] With the exception of supplementary coverage for selected conditions such as cancer or accidents, there is virtually no private health insurance in Taiwan. For detailed description of health insurance in Taiwan, see Peabody et al. (1995) and Chiang (1997).

Our data are from the Survey of Family Income and Expenditure, a nationally representative survey that collects detailed information on household income and consumption expenditures as well as demographic and employment status for each household member.[3] The characteristics of health-insurance programs in Taiwan and these data allow us to improve previous studies in three aspects. First, our estimates are not subject to selection bias, since National Health Insurance covers everyone and was inaugurated by the Taiwan government. Second, NHI is not an asset-based, means-tested program. Thus, the empirical analysis offers a direct test of the impact of NHI on precautionary saving, without an additional negative effect arising from means testing. Third, we are able to exploit variation across different insurance policies before the implementation of NHI to identify the effect of NHI on saving and consumption behaviors.

Our empirical results support the premise that the precautionary motive is an important determinant of household saving and consumption behaviors. We find that government provision of universal health insurance can cause a considerable reduction in private saving: Compared with the preceding Labor Insurance, implementation of National Health Insurance lowers average saving by 8.6–13.7% and raises average consumption expenditures by 2.9–3.6%. The effect on saving is strongest for households with the smallest saving, which is consistent with the hypothesis that prudence (the sensitivity of precautionary saving to risk) declines with wealth (Kimball, 1990).

The paper proceeds as follows. Section 2 provides some background on health insurance in Taiwan and a brief review of the related literature. Section 3 outlines a theoretical framework. Section 4 presents the data. Section 5 describes the empirical strategy and empirical specification. Section 6 reports the estimation results and Section 7 concludes.

2. Background

2.1. National Health Insurance in Taiwan

Taiwan inaugurated NHI in March 1995. Since implementation, NHI has increased the insured fraction of the population from 57% in 1994 to 97% in 1998. Prior to implementation, there were three major health-insurance programs—Labor Insurance, Government Employees' Insurance, and Farmers' Health Insurance. An individual could obtain health insurance only through one of these government-sponsored health plans, which were tied to his or her employment status.[4] Although most of the working population was covered by these three programs,

[3] For detailed description of the data, see Deaton and Paxson (1994a,b).

[4] After 1990, the government provided health insurance to low-income households, but this program covered less than 1% of the population.

almost half the total population was uninsured because only Government Employees' Insurance offered coverage to the worker's children, spouse and parents. In 1992, 37% of the population was covered under Labor Insurance, 8.2% under Government Employees' Insurance, and 8.2% under Farmers' Health Insurance (Peabody et al., 1995; Chiang, 1997). The 47% of the population who were not covered were mostly children, the elderly and housewives.

Labor Insurance was implemented in 1950 and initially designed to cover industrial workers employed in public or private factories. Under the 1970 Labor Insurance Statute, employers of journalistic, cultural, and non-profit organizations, and cooperative enterprises with five or more employees were required to insure all workers between the ages of 15 and 60 years. In 1988, Labor Insurance was extended to cover government employees who were not eligible for Government Employees' Insurance and to private-school teachers and employees. Members of an occupational union who had no regular employer or who were self-employed were also insured under the program. The premium for Labor Insurance was 6–8% of monthly-insured salary, 80% of which was paid by the employer and 20% by the worker. Labor Insurance did not provide coverage to workers' or employees' family members.

As implemented in 1958, Government Employees' Insurance provided mandatory coverage for government employees. The premium rate was 3–5% of the employee's salary, of which 35% was paid by the employee and 65% by the government. Eligibility for optional coverage was extended to retired government employees in 1965, and to spouses, parents and children of government employees in 1982, 1989 and 1992, respectively.

The Farmers' Health Insurance program, established in 1985, covered all farmers. In 1989, coverage was extended to almost all family members of agriculture households. We exclude agriculture households from our sample, since the major form of their savings is in non-liquid assets such as land. In order to eliminate potential impacts of Farmers' Health Insurance on female labor supply, we also limit our study period to years beginning with 1991.

In contrast to previous insurance programs, NHI covers all members of the population. 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. The maximum premium rate is 6%, which is shared by the employee, employer and government.[5]

Before implementation of NHI, all the social insurance programs provided similar benefits, including outpatient visits, inpatient care and prescription drugs. Approximately 85% of hospitals and 70% of clinics contracted with the social insurance programs in 1994. Two years later, after implementation of NHI, the proportion of contracting institutions increased to about 96.5% of hospitals and

[5]In 1996, the premium payable ranged from 2 to 5% of total household income.

89.5% of clinics. NHI 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. 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.

Table 1 summarizes the differences among Government Employees' Insurance, Labor Insurance and National Health Insurance. The diverse health-insurance programs provide an opportunity to study the effect of health insurance on precautionary saving against unexpected health expenditures. The implementation of National Health Insurance reduces the risk of catastrophic health expenditures and consequently weakens the precautionary-saving motive. We expect that NHI had a smaller impact on government-employed households' precautionary saving since their prior coverage was more generous than that of other households, and so NHI had less effect in reducing uncertainty about medical expenditures.

By exploiting the variation in uncertainty with respect to health expenditures before the implementation of NHI, we are able to identify the effect of national health insurance on households' precautionary-saving motives. Note that the variation is created by a series of laws implemented at the national level and does

Table 1
Comparison of health insurance programs in Taiwan

	Government Employees' Insurance	Labor Insurance	National Health Insurance
Year of implementation	1958	1950	1995
General provision	Maternity benefit Injury and sickness benefit Disability benefit Unemployment benefit Old-age benefit Death benefit	Maternity benefit Injury and sickness benefit Disability benefit Unemployment benefit Old-age benefit Death benefit	Maternity benefit Injury and sickness benefit
Insured persons	Government employees (civil servants)	Workers above 15 years and below 60 years of age	Six categories (see notes)
Dependents of the insured			
Spouse	1982	No	1995
Parents	1989	No	1995
Children	1992	No	1995
Retired employees	1985	No	–

Notes: The insured of NHI are classified into the following six categories: (1) Civil servants; employees of publicly or privately owned enterprises or institutions; employees employed by particular employers; employers or self-employed owners of business; independently practicing professionals and technicians. (2) Members of an occupational union; seamen serving on foreign vessels. (3) Members of the Farmers Association, the Irrigation Association and the Fishers Association. (4) Dependents of voluntary military officers, non-commissioned officers or servicemen. (5) Members of a household of low-income families. (6) Veterans. (National Health Insurance Act, Chapter II, Article 8).

not arise from differences in household behaviors. Moreover, the 1995 introduction of NHI created a sharp change in health-insurance conditions, and there were no other major changes in labor policies during the 1991–1998 period we analyze. This natural experiment allows us to study precautionary saving without selection bias, as discussed in the next section.

2.2. Related literature

The theoretical condition under which an increase in uninsurable risk leads to more precautionary saving was first derived by Leland (1968) and further analyzed by Sandmo (1970) and Drèze and Modigliani (1972). Kimball (1990) defined the concept of 'prudence' and showed that a prudent individual will engage in precautionary saving. The theory of precautionary saving was further sharpened by numerous recent studies (Skinner, 1988; Kotlikoff, 1989; Zeldes, 1989a,b; Caballero, 1990, 1991; Deaton, 1991; Hubbard et al., 1994a,b, 1995).[6]

Most empirical studies emphasize income uncertainty and provide mixed evidence of precautionary saving. Using subjective or objective risk measures, Skinner (1988), Guiso et al. (1992), and Dynan (1993) found no support for the precautionary motive, while other studies found more support for the precautionary view (Carroll and Samwick, 1998; Kazarosian, 1997). Zeldes (1989a) confirmed the importance of precautionary-saving motives using numerical simulation.

Several studies have considered the effects of health and other types of insurance on saving. Palumbo (1999) found that uncertain out-of-pocket medical expenses represent an important motive for precautionary saving among the elderly. Based on simulation results, Kotlikoff (1989) showed that saving for self-payment exceeds that under actuarially fair insurance, while saving is smallest for Medicaid (which is an asset-based, means-tested social insurance program). Recent theoretical work by Hubbard et al. (1995) suggested that means- and asset-tested social insurance programs create a significant disincentive for saving. Powers (1998) and Gruber and Yelowitz (1999) confirmed this prediction by showing a strong positive association between social insurance eligibility and consumption expenditures. Several studies also found a positive correlation between social health insurance (i.e. workers' compensation, unemployment insurance) and saving or wealth holdings (e.g. Kantor and Fishback, 1996; Engen and Gruber, 2001; Farley and Wilensky, 1985). Only Starr-McCluer (1996) found a positive effect of health-insurance coverage on wealth holdings, even after controlling for the potential selection effect.

The mixed empirical findings leave open the question of the effect of health insurance on saving behavior. Our study offers several advantages in examining

[6] See Deaton (1992) and Browning and Lusardi (1996) for reviews of this literature.

the impact of health insurance on precautionary saving. First, the National Health Insurance introduced in Taiwan in 1995 represents an exogenous factor; therefore, we do not confront the selection problems which are likely to cause estimation biases in most previous studies.[7] For example, Skinner (1988) used occupational dummies to classify households in different risk categories and did not find any significant correlation between earnings uncertainty and precautionary saving. These proxies for risk are almost inevitably correlated with observable or unobservable attributes which are correlated with saving behavior as well. A similar concern casts doubt on Starr-McCluer's (1996) finding that health insurance is positively associated with wealth holdings. Those individuals who are highly risk averse are more likely to both purchase private health insurance and accumulate wealth for self-insurance. As a result, it is difficult to distinguish the effect of health insurance per se.

Second, the NHI in Taiwan is not means-tested. Thus, our study offers a direct test of how saving is affected by the reduction of health expenditure uncertainty. As argued by Hubbard et al. (1995), asset-based, means-tested social insurance usually has two effects on saving. Insurance reduces the risk of unexpected medical expenditures and weakens the precautionary-saving motive. In addition, some households will spend-down their wealth in order to become eligible for means-tested social health insurance, such as Medicaid. Consequently, it is difficult to distinguish whether a low saving rate is attributable to the reduction of precautionary saving or the effect of the means test.

Third, as described in the previous section, we can exploit the variation with respect to prior health insurance to identify the pure effect of NHI on households' precautionary saving. It is usually difficult to obtain data sets that detail type of health-insurance coverage together with information about consumption and saving. We are able to identify the health-insurance policies through the household heads' and their spouses' employment status. Furthermore, there is usually little or no variation in the benefits households expect to receive, if the benefits of social insurance programs are set by the government. Various types of health-insurance programs provided by the government in Taiwan before NHI enable us to exploit the variation across employment status.

[7] There is a potential selection effect if, prior to NHI, workers' choices between government and private-sector jobs were significantly affected by differences in insurance coverage. This effect would bias downward our estimates of the effect of NHI on precautionary saving, if households that chose private sector jobs are less concerned about uncertain future health expenditures than are households that chose government jobs. In principle, one could account for the possible endogeneity of household head's employment status due to joint job and health insurance decisions by estimating employment status using instrumental variables. We do not pursue this because of a lack of suitable instruments in our cross-sectional data. In addition, because the survey does not provide information on job tenure, we do not know when the household makes its employment decision.

3. Conceptual framework

The implementation of NHI reduces a household's uncertainty about future health expenditures. If households are prudent, the reduction in risk will decrease saving and increase consumption (Kimball, 1990). There is, in addition, a potential income effect. Although NHI is offered at actuarially fair rates (i.e. the premium equals the expected medical expense), employees of government, publicly and privately owned enterprises or institutions, and of certain other employers bear only 30–40% of the premium. Unless there are compensating wage reductions, NHI increases expected income net of medical expenses for these households. This income effect will increase both consumption and saving. It can be distinguished from the risk effect which also increases consumption, but decreases saving. We expect the income effect to be trivial as the premium is only a few percent of household expenditures.

To understand how uncertain health expenditures can influence saving, we consider a stochastic life-cycle model, following Blanchard and Fischer (1989) and Deaton (1992). The household is assumed to be uncertain about future medical expenditures. In each period the household incurs out-of-pocket health expenditures M_t. In period t, after observing M_t, the household chooses consumption C_t and future consumption $\{C_{t+1}, \ldots, C_{T-1}\}$ to maximize the expected value of its additively time-separable Von Neumann–Morgenstern utility subject to the budget constraint.

Such dynamic decision problems under uncertainty yield no closed-form solution for optimal consumption except under specific utility functions. For simplicity, we assume that the utility function exhibits constant absolute risk aversion (and thus constant absolute prudence), following Kimball and Mankiw (1989), Caballero (1990) and Weil (1993). We further simplify by assuming the discount rate, ρ, and interest rate, r, are both equal to zero. Thus, at time zero, the household maximizes

$$E\left[\sum_{t=0}^{T-1}\left(-\frac{1}{\alpha}\right)\exp(-\alpha C_t)|I_0\right] \tag{1}$$

subject to

$$A_{t+1} = A_t + Y_t - M_t - C_t,$$

$$M_t, A_t \geq 0, \quad \forall t,$$

and

$$M_t = M_{t-1} + \varepsilon_t, \qquad \varepsilon_t \sim N(0, \sigma^2).$$

Health care expenditure is modeled as a random walk, with normally distributed error term. The degree of absolute risk aversion and the degree of absolute

prudence (Kimball, 1990) are both constant and equal to α. Finally, we assume households must have non-negative net worth A_t in all periods.

The optimal consumption levels as of time zero can be solved as

$$C_t = \frac{1}{T-t} A_t + (Y_t - M_t) - \frac{\alpha(T-t-1)\sigma^2}{4} \tag{2}$$

and optimal consumption satisfies

$$C_{t+1} = C_t + \frac{\alpha\sigma^2}{2} + \varepsilon_t. \tag{3}$$

Eq. (2) implies that increases in either uncertainty about future health care expenditures (σ^2) or the degree of absolute prudence (α) will yield smaller consumption and greater precautionary saving ($=Y_t - M_t - C_t$). Eq. (3) shows the effect of uncertain health expenditures on the slope of the consumption path. Higher risk of future health care expenditures (σ^2) or higher absolute prudence (α) lead the household to defer consumption and result in a steeper consumption path.

The implementation of NHI reduces the risk of unexpected medical expenditures, and thus discourages precautionary saving and flattens the consumption path. If the household's precautionary-saving motive is strong, the NHI will have a positive welfare effect in terms of consumption smoothing.[8]

In our empirical work, we test the assumption of constant absolute prudence imposed above. Kimball (1990) suggests that prudence, like risk aversion, is likely to decline with wealth. Decreasing absolute prudence implies that the precautionary-saving motive decreases with wealth. People who have amassed considerable assets will be less sensitive to risk.

The welfare implication of decreasing absolute prudence is important. It implies that lower-income people will be more sensitive to the risk reductions, that is, NHI will have a larger impact on their precautionary saving and consumption. In terms of consumption smoothing, the welfare gain from NHI is also larger for lower-income households.

[8]Another potential welfare gain is through the labor-market response. Unlike Government Employees' Insurance and Labor Insurance, the National Health Insurance program is not linked to employment status. As a result, workers may choose to work fewer hours or to change jobs. Increasing flexibility in job choice expands the opportunity set and improves welfare. Moreover, if NHI leads to an increase in maternity leave time, the long-run consequences on child development may be beneficial to society. The health and productivity of the workforce may also improve either through greater investment in health care or through a reduction in labor-force participation of marginal workers.

4. Data and sample

4.1. Data

The 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. The SFIE is a large, nationally representative household survey. We restrict our sample to the period 1991 through 1998 for two reasons. First, we want to exclude the impacts of other health-insurance policies prior to 1990. Second, we use more recent data to limit the impact of technology diffusion on growing medical-care expenditures.

The survey contains information on demographic characteristics, economic status, and industrial sector of employment for each member of the sampled households. It also includes information on household income and consumption. Household income includes employee compensation, 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. The 1991–1995 surveys include information on estimated value of the household's assets including residential property, other real estate, business equity, vehicles, machinery, and equipment. However, these questions were omitted from the 1996–1998 surveys. All samples are drawn each year, so we cannot track individual 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 1991 to 1998.

4.2. Sample

Our sample is restricted to households headed by a 20–65 year old married person who was employed in the public or private sectors or self-employed.[9] Agricultural families were excluded from the sample.[10] Also deleted were households whose data on net saving was missing or who had negative net saving. These restrictions result in a sample of 65,953 of which 58,445 household heads (88.6%) were non-government employees and 7508 (11.3%) were government employees. Among non-government employed households, 19,314 (33.0%) spouses did not work; and among government-employed households, 2074 (27.6%) spouses did not work.

[9]The public sector includes two types of employees: government and public enterprise. If employees of a public enterprise are not civil servants, their spouses, children and parents were not covered by government health insurance. We exclude this small proportion of employees.

[10]Agriculture accounts for a small share of the Taiwan economy. About 8% of households are agricultural and agriculture contributed 3.8% of GDP in 1991.

5. Empirical strategy

5.1. Difference-in-differences estimation

To estimate the effect of National Health Insurance on households' precautionary saving, our strategy is to compare the change in saving for non-government employed households before and after implementation of NHI with the corresponding change for government employed households (who received similar insurance packages before and after NHI). Prior to NHI, a household could obtain health insurance coverage for all family members if either the husband or wife worked in the government sector. Accordingly, we define three treatment groups and one control group based on the husband–wife joint employment status. The control group includes households where the head works in the public sector and the spouse (if any) either works in the public sector or is unemployed or out of the labor force ($N=4000$). Treatment group I includes households where the household head is a non-government employee and the spouse is either not in the labor force or unemployed ($N=19{,}314$). Treatment group II includes households where both the household head and spouse work in the private sector ($N=36{,}907$). Treatment group III includes households where the head and spouse work in different sectors, one in the private sector and one in the public sector ($N=5732$).

We anticipate that NHI affects saving by the first two treatment groups, but not by the third treatment group. Treatment group III is a 'null treatment group.' Because its members were able to obtain health insurance coverage for all household members through Government Employees' Insurance, their response to NHI should be similar to that of the control group. Treatment group III provides a test of the assumption that observed covariates are adequately controlled to estimate treatment effects (Meyer, 1995). We distinguish treatment group III from the control group because these households had access to both Government Employees' and Labor Insurance.

In contrast, treatment groups I and II are anticipated to change their saving and consumption behaviors because some household members were not able to obtain health insurance before the NHI reform. These groups differ with regard to whether only one or both spouses were employed. An advantage of using two treatment groups is that if we find similar results, we can be more confident that we are estimating an actual effect of NHI reform and not an effect of other contemporaneous changes. In the following text, 'government employed households' refers to the combination of control group and treatment group III (at least one household member works in the public sector), and 'non-government employed households' refer to the combination of treatment groups I and II (no household member works in the public sector).

The simple difference-in-differences estimator can be expressed as:

$$\Delta^{\mathrm{NHI}} = \left(Y^{\text{After NHI}}_{\text{treatment}} - Y^{\text{Before NHI}}_{\text{treatment}}\right) - \left(Y^{\text{After NHI}}_{\text{control}} - Y^{\text{Before NHI}}_{\text{control}}\right) \tag{4}$$

where Δ^{NHI} represents the effect of NHI, and Y denotes saving or consumption by the treatment and control group before and after NHI, as indicated by the sub- and superscripts, respectively.[11] As described in Section 2, the NHI is expected to have a larger impact on the saving and consumption behaviors of non-government employed households than on government employed households.

The difference-in-differences estimator can be expressed within a regression framework. We pool the 1991–1998 samples of control and treatment groups and estimate the following regression:

$$Y_{ht} = \alpha + \gamma_1 \mathrm{NHI}_{ht} + \gamma_2 \mathrm{Treat}_{ht} + \gamma_3 \mathrm{NHI}^{*}_{ht} \mathrm{Treat}_{ht} + \beta_1 X_{ht} + \beta_2 \delta_j + \beta_3 \tau_{kt} + \beta_4 \zeta_t + \varepsilon_{ht} \quad (5)$$

where h indexes households, j indexes region, k indexes city/county, and t indexes year. Y_h is the saving or consumption observed for household h, NHI is an indicator variable for the period after implementation of National Health Insurance, Treat is an indicator variable for the treatment group, X is a vector of observable household characteristics, δ_j is a fixed regional effect, τ_{kt} is the yearly city/county unemployment rate, ζ_t is a fixed year effect, and ε is a random error term. The coefficients of these control variables are assumed to be constant across years. The effect of NHI in Eq. (5) can be expressed as: $\Delta^{NHI} = [(\gamma_1 + \gamma_2 + \gamma_3) - \gamma_2] - [\gamma_1 - 0] = \gamma_3$. The coefficient γ_3 measures the difference-in-differences defined in Eq. (4).

5.2. Dependent and explanatory variables

We specify two dependent variables: (1) household consumption expenditures,[12] and (2) household saving, defined as the difference between total household disposable income and household consumption expenditures. The all-items Consumer Price Index (CPI) is used to convert all money figures to 1991 NT dollars.[13]

The mean and distribution of household saving by husband–wife joint employment status are presented in Table 2. For non-government employed households, average annual household saving is NT$254,039, which is the difference between average annual household income NT$919,703 and annual household consumption expenditures NT$665,664. The average saving, income, and consumption expenditures are higher for government-employed households. The distributions of saving

[11] Similar difference-in-differences estimators have been used widely, for example by Gruber (1994) and Hamermesh and Trejo (2000).

[12] Household consumption expenditures include food, beverage, tobacco, clothing, fuel, water, rent (paid or imputed), furniture and family facilities, medical care and sanitation, transport and communication, recreation, education, culture, and other miscellaneous expenditures.

[13] The average exchange rate was US$1 = 25.75 New Taiwan dollars (NT$) in 1991.

Table 2
Distribution of saving, income, and expenditures by husband–wife joint employment status

	Saving[a]		Total household income[b]		Total household expenditures[c]	
	Non-government employed household	Government employed household	Non-government employed household	Government employed household	Non-government employed household	Government employed household
Mean	254,039	396,005	919,703	1,209,561	665,664	813,556
Standard Deviation	294,403	377,714	512,903	573,337	335,647	359,142
10th percentile	34,458	74,539	465,871	640,153	344,233	439,386
25th percentile	84,398	163,925	599,027	837,484	442,953	566,974
50th percentile	179,152	317,160	800,896	1,118,273	589,711	753,274
75th percentile	331,263	528,264	1,098,400	1,469,689	800,752	985,160
90th percentile	542,404	775,852	1,501,513	1,838,172	1,069,818	1,244,854
Number of observations	56,221	9732	56,221	9732	56,221	9732

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

[a] Saving is defined as the difference between total household income and expenditures.

[b] Total household income includes employee compensation, entrepreneurial income, imputed rent income, current transfer receipts and other miscellaneous receipts.

[c] Total household expenditures include food, beverage, tobacco, rent (paid or imputed), fuel, household operations, furniture and family facilities, medical care and sanitation, transport and communication, recreation, education and culture, other miscellaneous expenditures.

and consumption are right-skewed for both groups of households. We use robust regression techniques to account for this feature.

X_{hjt} is a vector of demographic and economic characteristics of the household: the head's education (6 category dummies), age, age squared, gender, spousal education dummies, number of children under the age of 18 years, number of children over the age of 18 years, number of elderly parents or grandparents and the unemployment rate in the residential county. Table 3 presents summary statistics for the explanatory variables by husband–wife joint employment status. Compared with the treatment groups, household heads in the control group were older, better educated,[14] and had slightly fewer children under the age of 18 years and fewer elderly parents living in the household.

5.3. Marginal effect of dummy variable on logged dependent variable

We employ ordinary least square (OLS) to estimate the model and White's

[14] One reason that government employees are better educated is that Taiwan has a Civil Servant Certification Exam (much like the U.S. Foreign Service exam or the Postal Service Exam, but more comprehensive). The higher education of government employees' spouses may also reflect assortative mating.

Table 3
Sample statistics

Employment status	Control group		Treatment group I		Treatment group II		Treatment group III	
Household head	Work in the public sector.		Work in the private sector.		Work in the private sector.		Work in the private or public sector.	
Spouse	Work in the public sector or not in the labor force or unemployed		Not in the labor force or unemployed unemployed		Work in the private sector		Work in the public or private sector (i.e. work in different sectors)	
					Mean	Std. dev		
	Mean	Std. dev.	Mean	Std. dev.			Mean	Std. dev.
Dependent variables								
Saving	412,423	426,768	273,013	290,734	217,781	297,954	384,548	338,875
Consumption	763,281	343,691	565,316	273,157	718,177	352,907	848,640	365,496
Explanatory Variables								
Characteristics of houeshold head								
Junior high school	0.037	0.188	0.240	0.427	0.184	0.388	0.051	0.221
Senior high school	0.214	0.410	0.284	0.451	0.303	0.459	0.248	0.432
Community college	0.268	0.443	0.076	0.265	0.125	0.330	0.250	0.433
University	0.340	0.474	0.042	0.201	0.093	0.291	0.305	0.461
Graduate school	0.075	0.264	0.004	0.066	0.014	0.117	0.072	0.258
Male	0.932	0.251	0.940	0.237	0.949	0.220	0.921	0.270
Age	43.835	10.116	41.989	9.941	41.613	8.645	42.597	8.907
$Age^2(00)$	20.238	9.209	18.619	8.806	18.064	7.576	18.938	7.980
Characteristics of family members								
Spouse education dummies								
Junior high school	0.110	0.313	0.240	0.427	0.187	0.390	0.095	0.293
Senior high school	0.310	0.463	0.265	0.441	0.315	0.464	0.336	0.472
Community college	0.189	0.392	0.037	0.189	0.087	0.282	0.198	0.399
University	0.206	0.404	0.018	0.132	0.052	0.222	0.203	0.402
Graduate school	0.018	0.133	0.001	0.023	0.004	0.066	0.020	0.140
# of children under age 18	1.352	1.076	1.603	1.239	1.640	1.159	1.476	1.041
# of children over age 18	0.433	0.815	0.472	0.891	0.410	0.826	0.391	0.784
# of parents or grandparents	0.214	0.543	0.310	0.658	0.289	0.630	0.246	0.582
Other variables								
Unemployment rate by county	0.007	0.125	0.006	0.113	0.003	0.076	0.004	0.107
Regional dummies								
North	0.423	0.494	0.408	0.491	0.526	0.499	0.561	0.496
Middle	0.236	0.424	0.293	0.455	0.170	0.376	0.140	0.347
South	0.279	0.448	0.266	0.442	0.284	0.451	0.264	0.441
Sample size	4000		19,314		36,907		5732	

method to correct the estimate of the variance–covariance matrix for potential heteroscedasticity (White, 1980). As discussed by Manning (1998), if the residuals are non-normal or heteroscedastic, the marginal effect of the explanatory variables on the logged dependent variable is unbiased, but the marginal effect on the

untransformed dependent variable is biased. We follow Manning et al. (1987) and use the 'smearing' method to retransform the dependent variable to calculate the marginal effect of national health insurance on precautionary saving. Specifically, the marginal effect of NHI can be expressed as $E(Y|\text{NHI} = 1) - E(Y|\text{NHI} = 0)$. The general form of the retransformation for a loglinear model is given by $E(Y) = \phi \exp(X\beta)$, where the so-called smearing factor $\phi = E[\exp(\varepsilon)]$. The estimate of the smearing factor is the sample average of the exponentiated least-squares residuals. Finally, the standard errors of the marginal effects are obtained by bootstrapping.

5.4. Quantile regression

In addition to examining how average saving is affected by NHI, we investigate how the effect of NHI differs across households with different levels of saving. Precautionary saving depends on the risk of future medical expenses and the household's degree of absolute prudence (Eq. (2)). Kimball (1990) suggests that absolute prudence declines with wealth. Unless this decline is offset by a sufficiently large increase in risk of future medical expenses with wealth, households at the bottom of the saving distribution will be more sensitive to the introduction of NHI than will households at the top of the distribution. If so, this implies that the welfare gain, in terms of consumption smoothing, is larger for households in the bottom part of the saving distribution.

A natural and relatively simple way to explore differences across the distribution of household saving is through the use of quantile regressions (Buchinsky, 1994). Quantile regression can be used to estimate the marginal effect of an explanatory variable at a distinct point of the conditional distribution of the dependent variable.[15]

6. Empirical results

6.1. Difference-in-differences estimates

The first row (labeled baseline model) of Table 4 reports simple difference-in-differences estimates of the effect of National Health Insurance on households' saving and consumption expenditures that do not control for household characteristics, region and year effects. We calculate these estimates using the regression model (5) excluding the control variables. Because our dependent variables are measured in log terms, we retransform the estimated coefficients and present the estimated marginal effects in brackets. The simple difference-in-differences estimates imply that NHI significantly reduced saving in treatment groups I and II

[15]Estimates were calculated using the sqreg procedure of STATA Version 6.

Table 4
Estimates of national health insurance on saving and consumption

	Log (saving)						Log(consumption)					
	Treatment I		Treatment II		Treatment III		Treatment I		Treatment II		Treatment III	
	coeff.	std. err.	coeff.	std. err.	coeff.	std. err.	coeff.	std. err.	coeff.	std. err.	coeff.	std. err.
Baseline model												
NHI (post 1995)*Non-government	−0.182[a]	(0.038)	−0.098[a]	(0.035)	−0.076[c]	(0.042)	0.028[c]	(0.014)	0.062[a]	(0.014)	0.012	(0.017)
employment status	[−0.084][b]		[−0.063][c]		[−0.072][c]		[0.026][c]		[0.057][a]		[0.003]	
Full Specification												
NHI (post 1995)*Non-government	−0.209[a]	(0.034)	−0.122[a]	(0.032)	−0.083[b]	(0.038)	0.033[a]	(0.011)	0.039[a]	(0.011)	0.013	(0.013)
employment status	[−0.137][a]		[−0.086][a]		[−0.051]		[0.029][b]		[0.036][a]		[0.008]	
Non-government employment status	−0.315[a]	(0.027)	−0.124[a]	(0.023)	0.091[a]	(0.026)	−0.077[a]	(0.009)	0.089[a]	(0.008)	0.097[a]	(0.009)
NHI (post 1995)	0.250[a]		0.276[a]	(0.034)	0.164[a]	(0.042)	0.228[a]	(0.012)	0.244[a]	(0.012)	0.221[a]	(0.015)
Characteristics of houeshold head												
Junior high school	0.099[a]	(0.024)	0.021	(0.018)	0.092	(0.063)	0.079[a]	(0.007)	0.074[a]	(0.005)	0.079[a]	(0.019)
Senior high school	0.151[a]	(0.024)	0.105[a]	(0.018)	0.292[a]	(0.050)	0.169[a]	(0.007)	0.173[a]	(0.005)	0.178[a]	(0.015)
Community college	0.355[a]	(0.032)	0.250[a]	(0.023)	0.499[a]	(0.051)	0.260[a]	(0.010)	0.282[a]	(0.007)	0.258[a]	(0.016)
University	0.569[a]	(0.038)	0.408[a]	(0.026)	0.599[a]	(0.052)	0.360[a]	(0.012)	0.373[a]	(0.008)	0.321[a]	(0.016)
Graduate school	0.648[a]	(0.061)	0.493[a]	(0.043)	0.627[a]	(0.061)	0.474[a]	(0.021)	0.448[a]	(0.015)	0.417[a]	(0.020)
Male	0.258[a]	(0.034)	0.152[a]	(0.026)	0.141[a]	(0.041)	0.156[a]	(0.010)	0.071[a]	(0.009)	0.096[a]	(0.014)
Age	−0.038[a]	(0.007)	−0.026[a]	(0.006)	−0.007	(0.010)	0.025[a]	(0.002)	0.022[a]	(0.002)	0.028[a]	(0.003)
$Age^2(00)$	0.056[a]	(0.008)	0.036[a]	(0.006)	0.029[a]	(0.011)	−0.025[a]	(0.002)	−0.021[a]	(0.002)	−0.026[a]	(0.004)
Characteristics of family members												
Spouse education dummies												
Junior high school	0.028	(0.023)	0.017	(0.018)	−0.139[a]	(0.044)	0.057[a]	(0.007)	0.054[a]	(0.005)	0.069[a]	(0.014)
Senior high school	0.064[a]	(0.025)	0.074[a]	(0.018)	0.121[a]	(0.039)	0.107[a]	(0.007)	0.157[a]	(0.006)	0.177[a]	(0.012)
Community college	0.314[a]	(0.038)	0.281[a]	(0.025)	0.411[a]	(0.042)	0.243[a]	(0.012)	0.281[a]	(0.008)	0.332[a]	(0.014)
University	0.497 [a]	(0.043)	0.428[a]	(0.030)	0.573[a]	(0.045)	0.322[a]	(0.014)	0.351[a]	(0.010)	0.407[a]	(0.015)
Graduate school	0.667[a]	(0.117)	0.617[a]	(0.069)	0.783[a]	(0.073)	0.480[a]	(0.039)	0.461[a]	(0.026)	0.534[a]	(0.028)
# of children under age 18	−0.092[a]	(0.008)	−0.091[a]	(0.006)	−0.084[a]	(0.012)	0.074[a]	(0.002)	0.062[a]	(0.002)	0.056[a]	(0.004)
# of children over age 18	0.316[a]	(0.010)	0.193[a]	(0.008)	0.117[a]	(0.016)	0.231[a]	(0.003)	0.196[a]	(0.003)	0.177[a]	(0.005)
# of parents or grandparents	0.233[a]	(0.012)	0.177[a]	(0.009)	0.176[a]	(0.016)	0.106[a]	(0.004)	0.074[a]	(0.003)	0.061[a]	(0.006)
Unemployment rate	0.008	(0.059)	0.026	(0.064)	0.038	(0.086)	0.047[b]	(0.020)	0.011	(0.023)	0.021	(0.023)
Sample size	23314		40907		9732		23314		40907		9732	
F-statistics	227.56		189.06		70.10		619.91		1107.50		268.61	
Adjusted R^2	0.194		0.112		0.178		0.443		0.445		0.459	

Notes: Standard errors are in parentheses. Estimated marginal effects, incorporating the smearing factor, are in brackets. Control variables also include constant, 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.

by 8.4 and 6.3%, respectively. These estimates also suggest that NHI significantly increased households' consumption expenditures by 2.6 and 5.7%, for treatment groups I and II, respectively.[16]

Below the baseline model in Table 4, we report the difference-in-differences estimates including the other control variables identified in Eq. (5). The estimated effects are similar to those in the baseline model, which suggests that the difference-in-differences approach performs well in accounting for general economic shocks that are correlated with changes in the demographic, regional and time characteristics. The marginal effects on savings and consumption for treatment groups I and II are statistically significant at the 1 or 5% level. Results from the full specification imply that NHI significantly reduced household saving by 13.7 and 8.6% and increased consumption expenditures by 2.9 and 3.6% for treatment groups I and II, respectively.[17]

Results for treatment group III provide a test of the quality of our control group, since treatment group III is expected to have a similar response to the NHI reform as the control group. Although the simple difference-in-differences estimate suggests that NHI increased saving in the null treatment group III by 7.2% (significant at the 10% level), the estimated effects of NHI controlling for sample characteristics using the full specification are not significantly different from zero. This suggests we can identify the effect of NHI reform after controlling for other covariates. If we merge treatment group III with the control group, we obtain somewhat smaller estimates of the effect of NHI on saving and consumption, but the estimated effects are all significant at the 1% level.[18]

Taken together, these results are consistent with the theoretical prediction that

[16]Taiwan extended its Labor Standards Law to cover the banking, insurance, and service sectors in 1998, the end of our sample period. The law requires employers to provide retirement and severance benefits. Although this change would be anticipated to increase consumption and decrease saving by affected workers, Levenson (1996) showed that the 1985 adoption of the law, which initially covered manufacturing, construction, transportation, and other workers, had no significant affect on consumption by affected households. To test whether the 1998 reform affects our estimates of the effects of NHI, we deleted the affected workers (477 in treatment group I and 990 in treatment group II) and re-estimated the models in Table 4. The predicted marginal effects and significance levels are quite similar to those reported in Table 4, suggesting this change in labor law cannot account for our estimates of the effects of NHI. The alternative estimates (significance levels) are: for saving, −0.128 (1%) and −0.028 (1%) in treatment groups I and II; for consumption, 0.023 (10%) and 0.076 (5%) in treatment groups I and II, respectively.

[17]We estimate the same model on a sample of one-person households (government versus non-government households). The results (not reported) show that NHI decreased precautionary saving by 1.7% and decreased consumption by 0.14%. The effects are smaller than those for the full sample and are not statistically significant. They suggest that non-government employees place more weight on health insurance coverage for their family members than on the extension of coverage to their retirement.

[18]Using the pooled control group and treatment group III as a control group in the full specification, the estimated marginal effects on saving are −6.1 and −2.6% for treatment groups I and II, and the estimated marginal effects on consumption are 2.3 and 2.7% for treatment groups I and II, respectively.

NHI reduces households' precautionary saving and increases consumption expenditures. NHI has a smaller impact on the saving and consumption behaviors of the control group and the null treatment group III, which have comparable insurance coverage before NHI. In contrast, households in treatment groups I and II reduce their precautionary saving in response to improvements in health insurance benefits. By exploiting the variation in the uncertainty of health expenditures before the implementation of NHI, we are able to control for spurious economic shocks and identify the effect of NHI on precautionary saving.

The difference between the effects of NHI on saving and on consumption (a decrease in saving and increase in consumption) suggests that the effects are due to a reduction in risk, not an increase in expected income net of medical expenses that results from a subsidized insurance premium. The effect of an increase in current net income on saving may depend on expectations about future changes in net income, but seems unlikely to decrease current saving. NHI may also affect households' labor supply. For example, women may reduce their working hours or labor force participation, because NHI benefits are not linked to their employment status.[19]

6.2. Quantile regression results

To test the effect of NHI on saving across the household-saving distribution, we estimate quantile regressions on households' saving for treatment group I and II

Table 5
Quantile regression on saving

	Quantile				
	0.1	0.25	0.5	0.75	0.9
Treatment group I					
Log(saving)	−0.295[a]	−0.257[a]	−0.164[a]	−0.144[a]	−0.137[a]
	(0.087)	(0.056)	(0.034)	(0.027)	(0.028)
Treatment group II					
Log(saving)	−0.172[b]	−0.120[b]	−0.082[b]	−0.095[a]	−0.082[a]
	(0.085)	(0.054)	(0.036)	(0.023)	(0.024)

Notes: Bootstrapped standard errors for quantile regressions are given in parentheses.
[a] Statistically significant at the 1% level.
[b] Statistically significant at the 5% level.

[19] Chou and Staiger (2001) found that the availability of spousal health insurance in Taiwan decreased labor force participation by 4% among married women. Their results are based on the availability of National Health Insurance in 1995 and the expansion of Government Employees' Insurance to spouses in 1982. Other studies that provide empirical evidence on the effects of health insurance on labor supply are reviewed by Gruber (2000).

Table 6
Change in risk, change in saving, and absolute prudence by income quantile

Income quantile	(1) Risk of medical expenditures (00,000,000 NT$)	(2)	(3) Change in risk (NT$)	(4) Change in saving	(5) Absolute prudence
	Before NHI	After NHI	=(2)–(1)	(NT$)	=(4)/(3)
<=0.25	12.0201	12.01828	−182,283	−7797	0.043
>0.25 and <=0.5	12.17458	12.17008	−450,341	−10,047	0.022
>0.5 and <=0.9	16.57956	16.56621	−1,334,394	−16,560	0.012
>0.9	25.41353	25.35963	−5,389,936	−56,352	0.010

(Table 5). With the full specification, NHI has the largest negative impact (−0.295) on the first (lowest) decile for treatment group I. The effects decrease for higher quantiles, with the ninth decile having a point estimate of −0.137. In all cases the estimated coefficients are statistically significant at the 5% level. We observe the same pattern for treatment group II. These results suggest that NHI has the largest negative effect on saving at the bottom quantile, and the effects tend to become smaller the higher the quantile.

To investigate how the degree of prudence varies across income levels, we compare the absolute change in saving with the absolute change in risk of medical expenses by income quantile (Eq. (2)). First, we predict out-of-pocket medical expenses as a function of household characteristics and NHI. Second, we use the coefficients from the estimates in the first step to predict average medical expenses and the variance of residuals (σ^2 in Eq. (2)) before and after NHI. The results, shown in Table 6, indicate that uncertainty about medical expenditures was greater before NHI. Households in the top income quantile have the largest uncertainty with regard to out-of-pocket medical expenditures. The variances of the residuals drop drastically after implementation of NHI, indicating the NHI reduces uncertainty about out-of-pocket health expenditures. Risk of out-of-pocket expenditures, measured by the variance of the residuals, decreases the most for the top income quantile.

Third, we can estimate a number that is proportional to the degree of absolute prudence by dividing the change in saving (NT$) by the change in risk of medical expenses (NT$ squared). As shown in Table 6, the degree of absolute prudence declines with income.

7. Conclusion

The introduction of social health insurance can substantially reduce uncertainty about out-of-pocket health expenditures, and thus reduce households' pre-

cautionary-saving motive. Examination of the effect of National Health Insurance on Taiwanese households' saving and consumption behaviors suggests that households significantly reduced their saving and increased their consumption when the comprehensive health insurance became available. These results are robust to a variety of specifications.

Contrary to Starr-McCluer's (1996) finding that health insurance is positively related to wealth, our study offers a more direct test of the impact of health insurance on saving that is not subject to selection bias. By exploiting the fact that government and non-government employed households received different insurance packages before NHI, our approach controls for idiosyncratic shocks and identifies the effects of NHI on households' saving and consumption.

Our empirical results are consistent with recent studies that have found that coverage by other social programs, such as disability insurance (Kantor and Fishback, 1996), unemployment insurance (Engen and Gruber, 2001) and Medicaid (Gruber and Yelowitz, 1999), are negatively associated with saving. Unlike these studies, we examine health insurance, which is more likely to affect precautionary saving throughout the population.

We find that NHI has a larger impact on precautionary saving for households at the bottom of the saving distribution than for those at the top. This result supports the assumption of decreasing absolute prudence and is consistent with the theoretical argument of Kimball (1990) and the empirical result of Guiso et al. (1992). It further suggests that NHI yields a larger welfare improvement, through consumption smoothing, for households with smaller saving.

Our evidence supports the contention that precautionary motives are an important determinant of saving. This study provides some explanation for two consumption puzzles mentioned by Zeldes (1989b): the excess sensitivity of consumption to anticipated income fluctuations (people 'save too much') and the steep consumption path in the presence of a low or negative real interest rate (people 'consume too little'). Financial risk and the level of health expenditure affect saving and consumption decisions, as suggested by Kotlikoff (1989), Palumbo (1999) and Hubbard et al. (1995). Our findings suggest that the introduction and expansion of social health insurance will contribute significantly to the decline in private saving. Moreover, even if eligibility for the insurance policy is not means tested, it may still have a larger impact on households at the bottom than the top of the saving distribution.

Acknowledgements

We are grateful to an anonymous referee, the editor, and conference participants at the AEA-CEANA, Duke Health Economics Conference, and iHEA for helpful comments.

References

Blanchard, O.J., Fischer, S., 1989. Lectures on Macroeconomics. MIT Press, Cambridge, MA.

Browning, M., Lusardi, A., 1996. Household saving: micro theories and micro facts. Journal of Economic Literature 34 (4), 1797–1855.

Buchinsky, M., 1994. Changes in the U.S. wage structure 1963–1987: application of quantile regression. Econometrica 62 (2), 405–458.

Caballero, R.J., 1990. Consumption puzzles and precautionary savings. Journal of Monetary Economics 25 (1), 113–136.

Caballero, R.J., 1991. Earnings uncertainty and aggregate wealth accumulation. American Economic Review 81 (4), 859–871.

Carroll, C.D., Samwick, A.A., 1998. How important is precautionary saving? Review of Economics and Statistics 80 (3), 410–419.

Cheng, S.-H., Chiang, T.-L., 1997. The effect of universal health insurance on health care utilization in Taiwan: results from a natural experiment. Journal of American Medical Association 278 (2), 89–93.

Chiang, T.-L., 1997. Taiwan's 1995 health care reform. Health Policy 39, 225–239.

Chou, Y.-J., Staiger, D., 2001. Health insurance and female labor supply in Taiwan. Journal of Health Economics 20 (2), 187–211.

Deaton, A.S., 1991. Saving and liquidity constraints. Econometrica 59 (5), 1221–1248.

Deaton, A.S., 1992. Understanding Consumption. Oxford University Press, New York.

Deaton, A.S., Paxson, C.H., 1994a. Intertemporal choice and inequality. Journal of Political Economy 102 (3), 437–467.

Deaton, A.S., Paxson, C.H., 1994b. Saving, growth and aging in Taiwan. In: Wise, D.A. (Ed.), Studies in the Economics of Aging. University of Chicago Press, Chicago and London.

Drèze, J., Modigliani, F., 1972. Consumption decisions under uncertainty. Journal of Economic Theory 5 (3), 308–335.

Dynan, K.E., 1993. How prudent are consumers? Journal of Political Economy 101 (6), 1104–1113.

Engen, E.M., Gruber, J., 2001. Unemployment insurance and precautionary saving. Journal of Monetary Economics 47 (3), 545–579.

Farley, P.J., Wilensky, G.R., 1985. Wealth and health insurance as protection against medical risks. In: David, M., Smeeding, T. (Eds.), Horizontal Equity, Uncertainty, And Economic Well-being. University of Chicago Press, Chicago.

Feenberg, D., Skinner, J., 1994. The risk and duration of catastrophic health care expenditures. Review of Economic and Statistics 76 (4), 633–647.

Gruber, J., 1994. The incidence of mandated maternity benefits. American Economic Review 84 (3), 622–641.

Gruber, J., 2000. Health insurance and the labor market. In: Newhouse, J., Culyer, A. (Eds.), Handbook of Health Economics. Elsevier, Amsterdam.

Gruber, J., Yelowitz, A., 1999. Public health insurance and private savings. Journal of Political Economy 107 (6), 1249–1274.

Guiso, L., Jappelli, T., Terlizzese, D., 1992. Earnings uncertainty and precautionary saving. Journal of Monetary Economics 30 (2), 307–337.

Hamermesh, D.S., Trejo, S.J., 2000. The demand for hours of labor: direct evidence from California. Review of Economics and Statistics 82 (1), 38–47.

Hubbard, R.G., Skinner, J., Zeldes, S.P., 1994a. Expanding the life-cycle model: precautionary saving and public policy. American Economic Review Papers and Proceeding 84 (2), 174–179.

Hubbard, R.G., Skinner, J., Zeldes, S.P., 1994b. The importance of precautionary motives in explaining individual and aggregate saving. Carnegie–Rochester Conference Series on Public Policy 40, 59–125.

Hubbard, R.G., Skinner, J., Zeldes, S.P., 1995. Precautionary saving and social insurance. Journal of Political Economy 103 (2), 360–399.
Kantor, S.E., Fishback, P.V., 1996. Precautionary saving, insurance, and the origins of workers compensation. Journal of Political Economy 104 (2), 419–442.
Kazarosian, M., 1997. Precautionary savings: a panel study. Review of Economics and Statistics 79 (2), 241–247.
Kimball, M.S., 1990. Precautionary saving in the small and in the large. Econometrica 58 (1), 53–73.
Kimball, M.S., Mankiw, N.G., 1989. Precautionary saving and the timing of taxes. Journal of Political Economy 97 (4), 863–879.
Kotlikoff, L.J., 1989. Health expenditures and precautionary savings. In: Kotlikoff, L.J. (Ed.), What Determines Savings. MIT Press, Cambridge, MA.
Leland, H.E., 1968. Saving and uncertainty: the precautionary demand for saving. Quarterly Journal of Economics 82, 465–473.
Levenson, A.R., 1996. Do consumers respond to future income shocks? evidence from social security reform in Taiwan. Journal of Public Economics 62, 275–295.
Manning, W., 1998. The logged dependent variable, heteroscedasticity, and the retransformation problem. Journal of Health Economics 17 (3), 283–295.
Manning, W., Newhouse, J.P., Duan, N., Keeler, E.B., Leibowitz, A., Marguis, M.S., 1987. Health insurance and the demand for medical care: evidence from a randomized experiment. American Economic Review 77 (3), 251–277.
Meyer, B.D., 1995. Natural and quasi-experiments in economics. Journal of Business and Economic Statistics 13 (2), 151–161.
Palumbo, M.G., 1999. Uncertain medical expenses and precautionary saving: near the end of the life cycle. Review of Economic Studies 66 (2), 395–422.
Peabody, J.W., Yu, J.C.-I., Wang, Y.-R., Bickel, S.R., 1995. Health system reform in the Republic of China. Journal of American Medical Association 273 (10), 777–781.
Powers, E.T., 1998. Does means-testing welfare discourage saving? evidence from a change in AFDC policy in the United States. Journal of Public Economics 68 (1), 33–53.
Sandmo, A., 1970. The effect of uncertainty on saving decisions. Review of Economic Studies 37 (3), 353–360.
Skinner, J., 1988. Risky income, life cycle consumption, and precautionary savings. Journal of Monetary Economics 22 (2), 237–255.
Starr-McCluer, M., 1996. Health insurance and precautionary savings. American Economic Review 86 (1), 285–295.
Weil, P., 1993. Precautionary savings and the permanent income hypothesis. Review of Economic Studies 60 (2), 367–383.
White, H., 1980. A heteroscedasticity-consistent covariance matrix estimator and a direct test for heteroscedasticity. Econometrica 48, 817–838.
Zeldes, S.P., 1989a. Consumption and liquidity constraints: an empirical investigation. Journal of Political Economy 97 (2), 305–346.
Zeldes, S.P., 1989b. Optimal consumption with stochastic income: deviations from certainty equivalence. Quarterly Journal of Economics 104 (2), 275–298.