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THE EFFECTS OF TAIWAN'S NATIONAL HEALTH INSURANCE ON ACCESS AND HEALTH STATUS OF THE ELDERLY

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SUMMARY

The primary objective of this paper is to evaluate the impact of Taiwan's National Health Insurance program (NHI), established in 1995, on improving elderly access to care and health status. Further, we estimate the extent to which NHI reduces gaps in access and health across income groups. Using data from a longitudinal survey, we adopt a difference-in-difference methodology to estimate the *causal* effect of Taiwan's NHI. Our results show that Taiwan's NHI has significantly increased utilization of both outpatient and inpatient care among the elderly, and such effects were more salient for people in the low- or middle-income groups. Our findings also reveal that although Taiwan's NHI greatly increased the utilization of both outpatient and inpatient services, this increased utilization of health services did not reduce mortality or lead to better self-perceived general health status for Taiwanese elderly. Measures more sensitive than mortality and self-perceived general health may be necessary for discerning the health effects of NHI. Alternatively, the lack of NHI effects on health may reflect other quality and efficiency problems inherent in the system not yet addressed by NHI. Copyright © 2006 John Wiley & Sons, Ltd.

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INTRODUCTION

Almost all advanced economies have established universal health insurance coverage to provide equal access to care and to improve the health of their populations. Taiwan followed suit in 1995 when it established the National Health Insurance (NHI) program. Ten years after its inception, there is little or no systematic empirical assessment of the extent to which Taiwan's NHI has improved equal access to care or the health of the population. This paper aims to fill this gap. In particular, this paper focuses on the elderly population, who constituted the largest proportion of the uninsured, next to children, before the establishment of NHI.

Before 1995, about 57% of the population was insured through three separate programs. Launched in 1950, the Labor Insurance program covered workers of government-run enterprises, private company employees, blue-collar employees, and members of professional unions between the ages of 15 and 60.

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Established in 1958, the Government Employee Insurance program covered officers and full-time employees of government agencies, teaching and administrative staff of government-owned schools and private schools, and retirees. In 1988, the Farmers' Insurance program extended coverage to members of farmers' associations and individual farmers over 15 years old.

The three programs had similar benefits packages, covering outpatient visits, hospitalizations, diagnostic tests, and prescription drugs. Dependents, in general, were not covered, except under the Government Employee Insurance program. Cost-sharing for the three programs was modest; beneficiaries were only required to pay a fixed registration fee for outpatient visits. Those without any insurance coverage were responsible for the full cost of health care utilization. Among the uninsured, the majority were the children, followed by the elderly (Cheng and Chiang, 1998).

In 1995, Taiwan introduced the NHI program and extended insurance coverage to all its citizens with an equal and comprehensive benefits package. By the end of 1995, 97% of the population had enrolled in the NHI, and the coverage rate has reached almost 99% in 1997 and has remained at that level ever since. The NHI essentially adopted the benefits package from existing public insurance programs, and also extended coverage to traditional Chinese medicine, certain preventive services, limited dental care, home nurse visits, and day care for the mentally ill. Patients enjoy free choice of providers and have direct access to specialist care without going through a gatekeeper or referral system. There is also no limit to the number of visits a patients can have. The NHI thus reduced the financial barriers to access to care for all citizens, irrespective of socioeconomic background and/or residential location.

Using data from the series of Surveys of Health and Living Status of The Elderly in Taiwan, a longitudinal governmental study which began in 1989, we adopt a difference-in-difference methodology to estimate the *causal* effect of NHI on elderly access to care and health. Further, we estimate the extent to which NHI reduces gaps in access and health across income groups.

Our paper makes a number of contributions. First, since most of the world's national and/or social health insurance systems were established decades ago, there exists little empirical evidence on their impacts on various aspects of a health system's performance since there is exists little or no data for the period before their national/social insurance systems were implemented. As the latest industrialized state to establish national health insurance, Taiwan's experience provides a unique opportunity to address this gap. Our findings are expected to provide valuable insights, especially for countries considering establishing a national health insurance system. Second, unlike many existing studies that examine the effect of insurance on access and health, we employ a study design and methodology that allows us to isolate the *causal* effect of NHI. We compared *changes* in access and health for elderly who became insured as a result of NHI to *changes* for those who were already insured before NHI.

The paper is organized as follows. In the next section, we provide a brief review of the literature on the effect of health insurance on access and health outcome, with an emphasis on prior studies on Taiwan. We then discuss the conceptual framework underlying our hypothesis testing. Next, we discuss our empirical strategy and data. The penultimate section gives the results of our analysis. We conclude the paper with a discussion of the implications of our results, limitations of our study, and suggested areas for future research.

LITERATURE REVIEW

The insurance effect on access and health

The literature focusing specifically on the influence of national health insurance systems on access and health is limited. Much of the existing literature examines the effect of voluntary health insurance. However, due to sample selection problems associated with endogeneity in health status, propensity to

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use health care, and selecting health insurance programs, studies that use cross-section data can only observe associative relationships (Franks *et al*., 1993; Short and Lair, 1994; Roetzheim *et al*., 2000; Winter *et al*., 1993; Hsia *et al*., 2000; Merrill, 2001; Wu *et al*., 2001; Walters, 1999; Franks *et al*., 1993; McWilliams *et al*., 2004). Although advances have been made in estimation methods in an attempt to reduce biases inherent in observational and cross-sectional data, many studies, as pointed out by Levy and Meltzer (2004), failed to provide solid evidence on the causal effects of health insurance on access to health care and health status.

To identify the causal effects of health insurance on access to health care and health, randomized controlled experiments or natural experiments (sometimes called quasi-experiments) hold the greatest promise. Due to the high costs required to conduct a randomized controlled experiment of health insurance, the RAND Health Insurance Experiment remains the only one in the literature to date. The focus of the RAND experiment was, however, not on the expansion of social health insurance, but rather on the effects of cost-sharing on utilization and health outcome (Newhouse *et al*., 1993).

In recent years, taking advantage of policy interventions and health system reforms, a number of studies that adopt a natural-experimental design have emerged. The populations studied vary from infants and children (Currie and Gruber, 1996a,b, 1997; Haas *et al*., 1993a,b; Hanratty, 1996), working adults (Perry and Rosen, 2001), elderly persons (Card *et al*., 2004; Decker and Remler, 2004), veterans (Fihn and Wicher, 1988), medically indigent (Lurie *et al*., 1986), to HIV patients (Goldman *et al*., 2001). Many of these studies investigated the effects of expansion of social health insurance on a number of outcomes. Among them, two in particular focused on investigating the causal effects of expanding social health insurance on health status and access to health care for the elderly. Both studies utilized entrance into the Medicare program in the US to construct a natural-experimental research design. Card *et al*. (2004) exploited differences in health insurance coverage by race and education before age 65 to create their control and treatment groups. They found that race and education groups receiving the largest gains in insurance coverage due to Medicare experienced larger reductions in the probability of delaying or not receiving medical care, and larger increases in the probability of having an annual doctor visit at age 65. They also found a statistically significant effect of health insurance coverage on improving self-reported health. However, they did not find evidence on the effect of health insurance on mortality.

Decker and Remler (2004) used Canadians, who have insurance coverage under Canada's National Health Insurance program for all ages, as the control group and Americans who only received insurance coverage through Medicare as they turned 65 as the treatment group to identify the effect of social insurance expansion on self-reported health and having a regular source of care. They found that the differences in socioeconomic gradients in health and regular source of care between the Canadians and Americans declined significantly after age 65, thus providing evidence for the positive effect of universal health insurance on health and health care utilization.

The effect of Taiwan's NHI on health

A few previous studies have investigated the effect of Taiwan's NHI on health outcomes. For instance, Dow *et al*. [Dow WH, Stewart SR, Li YC. Did Taiwanese national health insurance increase longevity? *Applied Population and Policy*, in press] compared changes in mortality rates across regions and demographic groups before and after the implementation of NHI in 1995, using rural male working-aged adults as the comparison group since many persons in this group were already insured through the Farmers' Insurance Program before the introduction of NHI. They did not find evidence of the effect of NHI on mortality reduction. However, since their study could not identify individuals' prior insurance status directly, their results could not be taken as conclusive.

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Another study, by Zimmer *et al.* (2002), used data from the same series of surveys used in our study. They reported an increasing prevalence of functional limitations among Taiwanese elderly between 1993 and 1999, and suggested that this increase may be related to the effect of Taiwan's NHI on increasing the survival chance of very ill elderly persons. To investigate this question further, Zimmer *et al.* (2005) used the same data to analyze one-year age-adjusted probabilities of dying for elderly persons with different functional statuses. They found that the group with the most severe functional limitations was the only group with a substantially declining trend in mortality after the introduction of NHI. Both studies, however, basically conducted a pre–post comparison analysis, and therefore could not identify the true NHI effect as their results were confounded by other trend effects that took place at the same time as the NHI.

CONCEPTUAL FRAMEWORK

To examine the effect of NHI on health and on access to health care, we use a conceptual framework based on the human capital model to form our hypotheses. In this model, an individual's stock of health capital at a given time is a function of commodity and time inputs that contribute to production of health during the current time period, the stock of health capital left from the previous time period, and the individual's characteristics and environment (Grossman, 2000). Individuals choose optimal amounts of commodity and time inputs for producing health, subject to time and money constraints. Any previous choices and shocks related to health also influence current health through the stock of health capital left from the previous period. Within such a framework, the conditional reduced form of health capital at a given time is expected to be a function of the prices of commodities related to health production and other commodities competing for expenditures, the lifetime income level, the stock of health capital from the previous period, and other relevant factors.

Within this framework, a reduction in the price of health inputs, such as medical care utilization, is predicted to increase demand for health care, which in turn leads to increased health status. As NHI reduces prices of health care for households/individuals, we hypothesize that the NHI has a positive effect on health care utilization and the health status of individuals. If health care is a normal good, as has been shown in the literature (Gertler *et al.*, 1987), and exhibits diminishing marginal returns (Folland *et al.*, 2001), lower-income households would react more strongly to the price reduction than wealthier households. Thus, we hypothesize that the NHI has a stronger effect on lower-income households than higher-income households.

METHODOLOGY

Study design

We adopt a natural experimental design, complemented by longitudinal data to identify the *causal* effect of the NHI. Since the NHI is mandatory, and since most persons with health insurance before the implementation of NHI were covered by specific public programs through their employment and/or occupation, the expansion of health insurance to those not previously covered is exogenous. Therefore, Taiwan's setting provides the opportunity to observe national health insurance as a natural experiment. Had people received pre-NHI insurance from programs of their own choosing, their insured status may have been correlated with unobserved characteristics such as underlying health status and/or propensity to use services.

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Empirical estimation

Our analysis uses a difference-in-difference (DD) methodology, or a pre–post design with control group (Yip and Eggleston, 2001, 2004). This method represents an improvement over pre–post comparison without a control group. A problem with a pre–post comparison without a control group is that if other factors in the environment are changing at the same time as the NHI was being established yet cannot be controlled for statistically, then the analysis incorrectly attributes their effect to the NHI. One solution is to find a control group that experiences similar changes in the environment but does not experience the NHI reform change. For our study, those individuals who were already covered by one of the three pre-existing health insurance programs provide a natural control group.

To analyze the impact of the NHI on access to care and health status, we use a difference-in-difference approach. This methodology is based on intuitive comparisons – before and after the policy change, for the treatment and control groups – controlling for other relevant factors. We operationalize this method with the following empirical specification:

$$Y_i = \beta_0 + \beta_1 \text{No\_Pre\_NHI\_Ins}_i + \beta_2 Y1996_i + \beta_3 Y1999_i + \beta_4 \text{No\_Pre\_NHI\_Ins}_i * Y1996_i + \beta_5 \text{No\_Pre\_NHI\_Ins}_i * Y1999_i + \beta_6 X_i + \varepsilon \quad (1)$$

Y_i indicates *access to care* or *health*. We measure access to care as the probability of having an outpatient visit in the last month or having any hospitalization (inpatient care) in the year preceding the survey. We did not examine the number of visits or admissions conditional on positive use because of limited variations in these variables. For outpatient care, since the data are based on respondents' recalls in the month prior to the interview, 85% of the users had only one visit. For inpatient care, since hospitalization is a rare event, more than 90% of the cases with positive admission only had one admission in the previous year. We also did not examine the conditional length of stay since this variable can reflect other efficiency issues in addition to access to care. As for health, we use two measures of health, mortality within one year and self-perceived health. While the former is objective and the latter more subjective, studies have consistently shown that self-perceived health is highly predictive of future mortality in population studies (Idler and Kasl, 1995; Rogers, 1995; Yu *et al*., 1998).

No_Pre_NHI_Ins_i is a dummy variable equal to 1 if elderly i became insured as a result of NHI. β_1 thus captures time-independent differences in *treatment* versus *control* individuals. The sample who were not insured before NHI were more likely to suffer from the lack of access, and thus poorer health status; therefore, we expect that $\beta_1 < 0$ when the dependent variable measures access to health care and $\beta_1 > 0$ when the dependent variable measures poor health.

$Y1996_i$ and $Y1999_i$ are two dummy variables indicating observations in 1996 and 1999, respectively. These two years were the years when Taiwan's Department of Health conducted the first two waves of post-NHI surveys in the series of Surveys of Health and Living Status of The Elderly in Taiwan. Because the patterns of the NHI effects might differ in 1996 and 1999, we adopt this empirical specification in order to distinguish differences in the patterns of 1996 and 1999. β_2 captures the difference in the pre-NHI period and year 1996, reflecting changes in access and health that are due to factors that occur concurrently with the NHI. Similarly, β_3 captures the difference in the pre-NHI period and year 1999. Given general trends of increase in health care utilization and improvement in health, we expect that the two coefficients to be positive when the dependent variable measures access to health care and negative when the dependent variable measures poor health.

The difference-in-difference estimates of the impacts of NHI are captured by the coefficients on the two interaction terms, $\text{No\_Pre\_NHI\_Ins}_i * Y1996_i$ and $\text{No\_Pre\_NHI\_Ins}_i * Y1999_i$. Since supply-side factors are similar for all individuals and trends (β_2 and β_3) are differenced out, this methodology allows isolation of the demand-side effects of NHI (β_4 and β_5).

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The following table illustrates the difference-in-difference methodology and how it corresponds to the estimated equation.

	The difference-in-difference methodology	
	No Pre-NHI insurance ('Treatment Group')	Has Pre-NHI insurance ('Control Group')
Before (1989, 1993)	$\beta_0 + \beta_1$	β_0
1996	$\beta_0 + \beta_1 + \beta_2 + \beta_4$	$\beta_0 + \beta_2$
1999	$\beta_0 + \beta_1 + \beta_3 + \beta_5$	$\beta_0 + \beta_3$
Difference (1) (1996 – Before)	$\beta_2 + \beta_4$	β_2
Difference (2) (1999 – Before)	$\beta_3 + \beta_5$	β_3
Difference-in-difference (1) ($\text{Diff}_{\text{treatment,1996}}$-$\text{Diff}_{\text{control,1996}}$)	β_4	
Difference-in-difference (2) ($\text{Diff}_{\text{treatment,1999}}$-$\text{Diff}_{\text{control,1999}}$)	β_5	

In addition to the five major explanatory variables in our analysis, we also control for a set of variables reflecting individual demographic and economic characteristics and health problems. Demographic characteristics included in the model are age, gender, ethnicity, living arrangements, the urbanization level of residence, and residential area. Socioeconomic characteristics included in the model are education and income level as of 1989; these variables are regarded as reflections of lifetime education and income levels, since the sample includes only elderly persons having been or about to be retired. Chronic health problems considered in the model include heart disease, hypertension, stroke, diabetes, kidney disease, bronchitis, pneumonia, other respiratory ailments, and liver or gall bladder disease, all of which are common diseases or conditions in Taiwan. In models for health care utilization and mortality, we also control for self-reported poor health.

We used the probit model for exploring factors associated with the probability of use, the probability of dying in the next year, and the probability of reporting poor health status. Since data for this study are from a longitudinal survey, we used the random-effects probit model in our analysis except that for the probability of dying in the next year. We applied the random-effects model instead of the fixed effect model because our key variable of interest is exogenous and using the fixed effect model would have been less efficient. For analysis for one-year mortality, we used the pooled estimator rather than the panel estimator, as our corresponding specification test indicates the two estimators are not statistically different and the random-effects model thus has no additional contribution.

In order to ascertain whether NHI has had any distribution effect, that is, whether it has reduced gaps in access and health status between different income groups, we also estimated the above models separately for low-, middle-, and high-income individuals. If we detect greater effects of NHI for the low-income group than for the high-income group, we will have evidence of NHI's distribution effect.

Data and sample characteristics

Sources of data. This study utilizes data from four waves of the 'Survey of Health and Living Status of The Elderly in Taiwan' (Table I), a longitudinal survey conducted by the Department of Health (DOH) of Taiwan which collected data from Taiwanese elderly people. In 1989, the first survey was

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Table I. Background information on the original sample for Surveys of Health and Living Status of the Elderly in Taiwan

Wave of survey	Survey period	Number of cases interviewed	Response rate (%)	Accumulated number of cases deceased
I	April to June, 1989	4049	91.8	—
II	April to June, 1993	3155	91.0	582
III	April to June, 1996	2669	88.9	1047
IV	April to August, 1999	2310	90.1	1486

Source: http://www.bhp.doh.gov.tw/BHP/do/www/themeParkDocRead?themeParkDocumentId = 48088&type = document&themeParkId = 638 (a website of Department of Health, Taiwan; date of access: 3 August 2004).

successfully administered to 4049 Taiwanese aged 60 or older. Since then, the same individuals have been re-surveyed in 1993, 1996, 1999, and 2001. The sample is representative of the Taiwanese elderly population born before 1929 and the response rate was over 90% (see Table I). The survey added a younger cohort into the sample in 1996, but we did not include the added sample because our empirical strategy is to follow the 1989 cohort through 1999.

In addition to detailed demographic and socioeconomic information, the survey included information on health and living conditions, health insurance status in the pre-NHI period, and health care utilization. Taiwan's DOH has made efforts to fill in missing information for previous waves in the survey by later follow-up data collection; consequently, the database has very few information gaps.

For this study, we were able to obtain data from the first four waves of surveys, along with corresponding data from death certificates issued up to late November 2000. Selected basic information on the original sample is shown in Table I. Because the period covered by the four waves of interviews spanned the late 1980s to the late 1990s, these longitudinal data provide a good opportunity to investigate the effects of the NHI, which began in 1995.

Information on health insurance status in the pre-NHI period is essential for investigating the effect of NHI. Although the 1989 survey did not contain such information, the 1993 survey allows us to identify an individual's health insurance status in one of the pre-NHI public insurance programs: the Government Employees' Insurance Program, the Labor Insurance Program, and the Farmers' Insurance Program. Because elderly persons with public health insurance usually received such benefits through employment, which tended to start at an earlier time in life, we assumed that their 1989 insurance status was identical to their 1993 insurance status. Because the 1993 survey only successfully interviewed 3155 persons, while the sample for the 1989 survey had 4049 persons, we assigned insurance status for those without 1993 information based on whether he or she was a governmental employee, soldier, or farmer in 1989. This resulted in 150 persons for whom we had no information on pre-NHI status. Thus, our final analytical sample consists of 3899 elderly persons.

Sample characteristics. Table II shows basic demographic and socioeconomic characteristics in 1989 for all 3899 elderly persons in our final analytical sample, and separately by their pre-NHI insurance status. About 60% of the respondents were males and more than 40% were illiterate. The high proportions of males among the elderly are consistent with the large number of male immigrants from Mainland China after the Second World War. Around 29% of the elderly earned less than NT$5000 per month (or around US$155), which included all income sources for the individual and the spouse, but excluded income for any other household member. We assigned the approximately 4% of respondents who failed to report their income levels in 1989 to the lowest income group because their demographic and social characteristics are most similar to the subsample reporting the lowest income.

Prior to the establishment of NHI the Farmers' Insurance Program covered about 41% of the elderly, while the Government Employee Insurance Programs covered another 29%. The percentage of elderly

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Table II. Basic sample characteristics – as of 1989

	Total ($n = 3899$) (%)	With pre-NHI insurance ($n = 2990$) (%)	Without pre-NHI insurance ($n = 909$) (%)
Gender			
Male	59.04	61.77	50.06
Female	40.96	38.23	49.94
Ethnicity			
Fu-Chien	60.12	55.48	75.36
Hakka	14.88	16.66	9.02
Mainlander	22.75	25.22	14.63
Other	1.72	2.11	0.44
Missing	0.54	0.54	0.55
Educational level			
Illiterate	40.19	38.49	45.76
Literate but with no formal education	8.80	8.93	8.36
Elementary school	31.29	30.81	32.89
Junior high school	8.34	9.06	5.94
Senior high school	5.92	6.65	3.52
College	5.10	5.72	3.08
Graduate school	0.13	0.10	0.22
Missing	0.23	0.23	0.22
Monthly income			
< 3000	17.75	16.99	20.24
3000–4999	11.41	10.90	13.09
5000–9999	21.44	22.17	19.03
10 000–14 999	17.18	17.22	17.05
15 000–19 999	10.82	11.14	9.79
20 000–49 999	15.03	16.09	11.55
> 50 000	2.64	2.51	3.08
Missing	3.72	2.98	6.16
Insurance status in the pre-NHI period			
Government Employees' insurance	29.44	38.39	0.00
Labor insurance	4.18	5.45	0.00
Farmers' insurance	41.34	53.91	0.00
Other insurance	1.72	2.24	0.00
No insurance	23.31	0.00	100.00
Age			
60–64	37.32	39.16	31.24
65–69	28.90	28.46	30.36
70–74	17.62	17.36	18.48
75–79	10.44	9.53	13.42
80 +	5.72	5.48	6.49
Household member living together			
A spouse	63.07	66.12	53.03
At least a child	71.38	69.80	76.57
At least one other member	54.68	52.94	60.40
Urbanization level of residential location			
City	47.01	40.00	70.08
Town	18.06	19.80	12.32
Rural area	34.93	40.20	17.60
Residential area			
North	32.11	27.86	46.10
Central	32.11	34.48	24.31
South	30.57	31.71	26.84
East	5.21	5.95	2.75

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Table II. (*continued*)

	Total ($n = 3899$) (%)	With pre-NHI insurance ($n = 2990$) (%)	Without pre-NHI insurance ($n = 909$) (%)
Chronic disease			
Hypertension	26.26	26.09	26.84
Heart disease	21.39	20.70	23.65
Diabetes	8.03	7.56	9.57
Kidney	6.18	5.85	7.26
Stroke	4.33	3.95	5.61
Respiratory system disease	18.24	18.36	17.82
Liver or gall bladder problems	5.87	6.05	5.28

persons without any insurance in the pre-NHI period was around 23%. Those in the sample with pre-NHI insurance were more likely to be male, younger, originally from the Mainland, more educated, and to report higher income than those with no pre-NHI insurance. It is not surprising that men, younger people, and those with higher socioeconomic conditions were more likely to have health insurance before the launch of NHI, since pre-NHI public insurance programs were mainly designed for persons with jobs. Those originally from the Mainland were more likely to have health insurance before the launch of NHI because people of this group were more likely to have jobs than people originally from Taiwan. More of the insured persons lived in rural areas, primarily because of the Farmers Insurance Program. Both the insured and uninsured have similar distribution of chronic diseases.

We also examined sample characteristics over time (not reported here). As the data were from a cohort in a longitudinal survey, the sample became older and smaller over time as subjects died. However, the changes are similar for the samples with and without pre-NHI insurance, and therefore do not bias our difference-in-difference estimates.

RESULTS

Table III presents descriptive results comparing differences in health care utilization and health status before the implementation of the NHI, in 1996, and in 1999, for the previously insured and uninsured samples. Table IV presents the difference-in-difference estimates in the probability of having outpatient health care utilization in the month preceding the survey. Tables V–VII present the difference-in-difference estimates for the probability of having inpatient utilization during the year before, the probability of dying in the following year, and the probability of reporting poor health, respectively.

NHI effects on access

The first two rows of Table III show that one year after the establishment of NHI, the proportion of previously uninsured elderly people receiving outpatient care increased by 27.97% – from 33.61 to 61.58%. Meanwhile, the proportion of previously insured sample receiving outpatient care increased by only13.34% – from 48.57 to 61.91%, leading to a difference-in-difference (DD) of 14.63%, which reflects the NHI effect. Three years after the introduction of NHI, the difference-in-difference remained a considerable 10.74%.

Similar patterns were observed for utilization of inpatient services. Before the establishment of NHI, the previously uninsured were significantly less likely to have hospital use than the insured. After the NHI was introduced, the previously insured and uninsured samples achieved almost identical rates of utilization, resulting in a difference-in-difference of 10.81% for 1996 and 9.42% for 1999. These descriptive results are supported by the regression analysis results in Tables IV and V. As hypothesized,

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Table III. Comparison of outpatient care utilization, inpatient care utilization, mortality and general health between the 'no pre-NHI insurance' group and the 'pre-NHI insurance group'

	'No pre-NHI insurance' group					'Pre-NHI insurance' group						
	Before NHI	1996	1999	Diff(1)	Diff(2)	Before NHI	1996	1999	Diff(1)	Diff(2)	DD(1)	DD(2)
Persons using outpatient care in the past month (%)	33.61 (598)	61.58 (518)	65.21 (457)	27.97 [9.74]	31.60 [10.48]	48.57 (2557)	61.91 (2132)	69.43 (1835)	13.34 [10.28]	20.86 [15.09]	14.63 [4.73]	10.74 [3.16]
Persons using inpatient care in the past year (%)	9.70 (598)	22.20 (518)	22.98 (457)	12.50 [5.79]	13.28 [5.95]	19.79 (2557)	21.48 (2132)	23.65 (1835)	1.69 [1.64]	3.86 [3.66]	10.81 [4.83]	9.42 [4.24]
Persons failing to surviving 1 year (%)	4.97 (1490)	4.85 (515)	3.08 (455)	−0.12 [−0.10]	−1.89 [−1.72]	3.34 (5509)	4.38 (2125)	1.87 (1823)	1.04 [2.15]	−1.47 [−3.25]	−1.16 [−1.10]	−0.42 [0.19]
Persons reporting poor general health (%)	4.31 (1507)	5.21 (518)	12.47 (457)	0.90 [1.11]	8.16 [6.00]	3.73 (5547)	4.78 (2132)	8.87 (1826)	1.05 [2.87]	5.14 [9.26]	−0.15 [−0.25]	3.02 [1.11]

Notes:

1. The 'before NHI' period included 1989 and 1993. Diff(1) is '1996' minus 'before NHI', and Diff(2) is '1999' minus 'before NHI'. DD(1) is Diff(1) for the 'no pre-NHI insurance' group minus Diff(1) for the 'pre-NHI insurance' group. DD(2) is Diff(2) for 'no pre-NHI insurance' the group minus Diff(2) for the 'pre-NHI insurance' group.
2. The numbers of observations are in parentheses.
3. Only the 1993, 1996 and 1999 surveys offered information on outpatient and in inpatient care utilization, while all the four waves of surveys provided information on mortality and self-reported general health.
4. Asymptotic z-scores or z-scores for corresponding tests are in brackets.

the difference-in-difference parameters, the coefficients of the interaction terms (1996* no pre-NHI insurance and 1999* no pre-NHI insurance) are statistically significant and positive.

The last three columns in Tables IV and V show the difference-in-difference estimates by different income groups. Again, as hypothesized, the NHI effect is strongest among the lowest income sample (defined for the study as 1989 monthly income $<$ NT$5000). These results suggest that not only did NHI improve access, but also reduced gaps in access to care among the low- and high-income ($\geq$ NT$15 000) elderly. In addition, the results showed that the NHI effects were smaller in 1999 than in 1996.

NHI effects on health

In contrast to the results on access to care, we did not find evidence of an NHI impact on health status of the elderly, whether measured as one-year mortality rate or self-perceived health status. The percentage dying in one year dropped from 4.97% in the pre-NHI period to 4.85% in 1996 among those who were not insured prior to NHI (Table III); the difference, −0.12%, was not statistically significant. In 1999 the difference was −1.89%, which was greater than that for 1996 but still not statistically significant. The mortality rate of the group that was previously insured increased from 3.34% in the pre-NHI period to 4.38% in 1996, and then dropped to 1.87% in 1999; the differences corresponding to 1996 and 1999 for the previously insured group were statistically significant. Nevertheless, both the estimates for the difference of the differences were statistically insignificant. Further, regression analysis results shown in Table VI indicate that the NHI did not reduce the one-year mortality rate overall, or for any of the three income groups.

The proportion of people reporting poor general health increased for both the previously uninsured and the previously insured groups. Before the NHI was launched, 4.31% of those without insurance reported poor health; this increased to 5.21% in 1996, and further to 12.47% in 1999. Of those who had insurance, 3.73% reported poor health in the pre-NHI period, and the proportion increased to 4.78% in 1996, and further to 8.87% in 1999. While most of the differences were statistically significant, both the

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Table IV. The effects of national health insurance on the level of and income inequality in use of outpatient care – random-effects probit model results

	Insurance effect		Association of income effect with insurance status					
			1989 income level (NT$)					
			< 5000		5000–14 999		≥ 15 000	
	Coef.	Robust Std.Err.	Coef.	Robust Std.Err.	Coef.	Robust Std.Err.	Coef.	Robust Std.Err.
Pre-NHI insurance status (*reference group*: *with pre-NHI insurance*)								
No pre-NHI insurance	−0.47**	0.07	−0.50**	0.11	−0.56**	0.12	−0.36*	0.15
Time period (*reference group*: *the 'before NHI' period*)								
1996	0.41**	0.04	0.37**	0.08	0.39**	0.07	0.50**	0.08
1999	0.63**	0.05	0.42**	0.09	0.64**	0.08	0.84**	0.10
Interaction terms								
1996*no pre-NHI insurance	0.42**	0.10	0.46**	0.16	0.51**	0.16	0.28	0.19
1999*no pre-NHI insurance	0.25*	0.10	0.46**	0.17	0.29	0.17	0.01	0.19
Gender (*reference group*: *male*)								
Female	0.07	0.04	0.10	0.08	0.18*	0.07	−0.09	0.09
Ethnicity (*reference group*: *Fu-Chien*)								
Hakka	0.01	0.05	−0.07	0.10	0.08	0.08	−0.02	0.11
Mainlander	0.02	0.05	0.05	0.15	0.08	0.09	−0.01	0.08
Other	0.04	0.17	−0.02	0.22	0.07	0.28	−0.02	0.60
Age as of interview (*reference group*: *60–64*)								
65–69	0.01	0.11	−0.16	0.28	0.10	0.18	−0.04	0.17
70–74	0.07	0.11	−0.02	0.28	0.20	0.18	−0.07	0.18
75–79	0.10	0.12	0.04	0.28	0.21	0.19	−0.12	0.19
80+	0.01	0.12	−0.21	0.28	0.27	0.20	−0.04	0.21
Living arrangement (*reference group*: *living alone*)								
With spouse	0.09*	0.04	0.04	0.07	0.13*	0.06	0.09	0.08
With at least one child	0.00	0.05	−0.02	0.09	0.03	0.07	−0.03	0.08
With relative or others	−0.02	0.04	−0.05	0.09	−0.02	0.07	−0.01	0.07
Educational level (*reference group*: ≥ *high school*)								
With no formal education	−0.03	0.07	0.11	0.27	0.08	0.14	−0.03	0.10
Elementary or junior high school	−0.02	0.07	0.20	0.27	0.08	0.14	−0.06	0.09
1989 income level (*reference group*: *monthly income NT$5000–14 999*)								
< NT$5000	0.5	0.05	–	–	–	–	–	–
≥ NT$15 000	−0.07	0.05	–	–	–	–	–	–
Urbanization level of residential location (*reference group*: *city*)								
Town	0.03	0.06	0.10	0.11	−0.04	0.10	0.10	0.12
Rural area	0.10*	0.05	0.19*	0.09	0.06	0.08	0.07	0.09
Residential area (*reference group*: *north of Taiwan*)								
Central	−0.04	0.05	−0.27**	0.10	0.07	0.09	0.07	0.09
South	−0.10	0.05	−0.18	0.10	0.02	0.08	−0.17*	0.09
East	−0.18	0.10	−0.21	0.17	−0.23	0.15	−0.08	0.22
Chronic disease (*reference group*: *without such chronic disease*)								
Hypertension	0.59**	0.04	0.51**	0.07	0.63**	0.06	0.62**	0.07
Heart disease	0.54**	0.05	0.45**	0.08	0.50**	0.07	0.69**	0.09
Diabetes	0.48**	0.06	0.42**	0.11	0.52**	0.10	0.49**	0.10
Kidney	0.20**	0.07	0.07	0.12	0.38**	0.12	0.12	0.13
Stroke	−0.12	0.07	−0.25*	0.11	0.05	0.12	−0.12	0.14
Respiratory system disease	0.33**	0.05	0.31**	0.09	0.30**	0.08	0.41**	0.10
Liver or gall bladder problems	0.38**	0.08	0.40*	0.16	0.37**	0.13	0.39*	0.15
Self-reported general health (*reference group*: *good/fair*)								
Poor	0.45**	0.08	0.48**	0.13	0.44**	0.13	0.50**	0.19
Number of individuals	3317		1009		1313		995	
Number of observations	8097		2366		3247		2484	
Log likelihood ratio:	$\chi^2(33) = 956.34$**		$\chi^2(31) = 250.92$**		$\chi^2(31) = 408.43$**		$\chi^2(31) = 328.28$**	

**$p < 0.01$; *$p < 0.05$.

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Table V. The effects of national health insurance on the level of and income inequality in use of inpatient care – random-effects probit model results

	Insurance effect		Association of income effect with insurance status					
			1989 income level (NT$)					
			< 5000		5000–14 999		≥ 15 000	
	Coef.	Robust Std.Err.	Coef.	Robust Std.Err.	Coef.	Robust Std.Err.	Coef.	Robust Std.Err.
Pre-NHI insurance status (*reference group*: *with pre-NHI insurance*)								
No pre-NHI insurance	−0.49**	0.09	−0.81**	0.16	−0.34**	0.13	−0.35*	0.17
Time period (*reference group*: *the 'before NHI' period*)								
1996	0.05	0.05	0.06	0.09	0.01	0.07	0.06	0.08
1999	0.04	0.05	0.12	0.10	−0.02	0.08	0.07	0.10
Interaction terms								
1996*no pre-NHI insurance	0.49**	0.11	0.77**	0.20	0.39*	0.17	0.30	0.22
1999*no pre-NHI insurance	0.44**	0.11	0.64**	0.21	0.26	0.18	0.38	0.22
Gender (*reference group*: *male*)								
Female	−0.25**	0.04	−0.16	0.09	−0.19**	0.06	−0.44**	0.08
Ethnicity (*reference group*: *Fu-Chien*)								
Hakka	−0.01	0.05	−0.16	0.11	−0.02	0.08	0.14	0.09
Mainlander	−0.05	0.05	0.32*	0.16	−0.10	0.08	−0.01	0.08
Other	−0.17	0.17	−0.74**	0.28	0.22	0.25	0.15	0.54
Age as of interview (*reference group*: *60–64*)								
65–69	−0.01	0.13	0.19	0.37	0.13	0.20	−0.12	0.17
70–74	0.10	0.13	0.38	0.37	0.31	0.20	−0.17	0.18
75–79	0.15	0.13	0.40	0.38	0.30	0.21	−0.05	0.19
80+	0.25	0.13	0.47	0.38	0.39	0.21	0.25	0.20
Living arrangement (*reference group*: *living alone*)								
With spouse	−0.02	0.04	0.07	0.08	−0.01	0.06	−0.13	0.08
With at least one child	−0.04	0.05	0.01	0.10	−0.09	0.07	0.00	0.07
With relative or others	0.05	0.04	−0.05	0.10	0.13	0.07	0.01	0.07
Educational level (*reference group*: ≥ *high school*)								
With no formal education	0.09	0.07	0.61	0.33	0.01	0.13	0.18*	0.09
Elementary or junior high school	0.04	0.07	0.64*	0.33	−0.02	0.13	0.05	0.08
1989 income level (*reference group*: *monthly income NT$5000–14 999*)								
<NT$5000	−0.07	0.05	–	–	–	–	–	–
≥ NT$15 000	−0.09	0.05	–	–	–	–	–	–
Urbanization level of residential location (*reference group*: *city*)								
Town	−0.10	0.06	−0.03	0.12	−0.04	0.09	−0.22	0.11
Rural area	−0.07	0.05	−0.13	0.10	0.01	0.07	−0.15	0.08
Residential area (*reference group*: *north of Taiwan*)								
Central	−0.03	0.05	−0.15	0.11	−0.05	0.08	0.08	0.08
South	0.16**	0.05	0.25*	0.11	0.10	0.08	0.16*	0.08
East	0.15	0.10	0.24	0.18	−0.01	0.14	0.25	0.18
Chronic disease (*reference group*: *without such chronic disease*)								
Hypertension	0.05	0.04	0.11	0.08	0.12**	0.06	−0.12	0.07
Heart disease	0.26**	0.04	0.17	0.09	0.22**	0.06	0.41**	0.08
Diabetes	0.28**	0.05	0.42**	0.11	0.18*	0.08	0.26**	0.09
Kidney	0.28**	0.07	0.20	0.13	0.30**	0.10	0.30**	0.11
Stroke	0.54**	0.06	0.38**	0.12	0.63**	0.10	0.63**	0.12
Respiratory system disease	0.29**	0.05	0.39**	0.09	0.23**	0.07	0.32**	0.09
Liver or gall bladder problems	0.40**	0.08	0.70**	0.16	0.19	0.11	0.49	0.13
Self-reported general health (*reference group*: *good/fair*)								
Poor	0.61**	0.07	0.71**	0.12	0.55**	0.10	0.61**	0.15
Number of individuals	3317		1009		1313		995	
Number of observations	8097		2366		3247		2484[a]	
Log likelihood ratio:	$\chi^2(33) = 524.50$**		$\chi^2(31) = 180.90$**		$\chi^2(31) = 209.96$**		$\chi^2(31) = 216.99$**	

**$p < 0.01$; *$p < 0.05$.

[a] Probit model results (the corresponding specification test suggests the pooled estimator).

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Table VI. The effects of national health insurance on the level of and income inequality in one-year mortality – probit model results

	Insurance effect		Association of income effect with insurance status					
			1989 income level (NT$)					
			< 5000		5000–14 999		≥ 15 000	
	Coef.	Robust Std.Err.	Coef.	Robust Std.Err.	Coef.	Robust Std.Err.	Coef.	Robust Std.Err.
Pre-NHI insurance status (*reference group*: *with pre-NHI insurance*)								
No pre-NHI insurance	0.20**	0.07	0.18	0.11	0.22	0.12	0.22	0.19
Time period (*reference group*: *the 'before NHI' period*)								
1996	0.02	0.07	0.02	0.10	−0.01	0.11	0.07	0.14
1999	−0.53****	0.09	−0.80**	0.16	−0.33**	0.14	−0.67**	0.19
Interaction terms								
1996*no pre-NHI insurance	−0.20	0.13	−0.13	0.20	−0.13	0.21	−0.45	0.34
1999*no pre-NHI insurance	−0.01	0.16	0.29	0.26	−0.22	0.25	−0.12	0.40
Gender (*reference group*: *male*)								
Female	−0.41**	0.06	−0.60**	0.09	−0.34**	0.09	−0.24	0.13
Ethnicity (*reference group*: *Fu-Chien*)								
Hakka	0.17**	0.07	0.17	0.10	−0.04	0.11	0.49**	0.14
Mainlander	−0.12	0.07	−0.21	0.18	−0.19	0.11	0.12	0.14
Other	0.29	0.21	0.38	0.24	0.17	0.45	–	–
Age as of interview (*reference group*: *60–64*)								
65–69	0.10	0.09	0.11	0.18	−0.03	0.14	0.32	0.20
70–74	0.23*	0.10	0.27	0.17	0.05	0.14	0.48*	0.21
75–79	0.54**	0.10	0.50**	0.17	0.43**	0.15	0.94**	0.22
80+	0.79**	0.10	0.82**	0.17	0.54**	0.16	1.26**	0.23
Living arrangement (*reference group*: *living alone*)								
With spouse	−0.13*	0.05	−0.19*	0.08	−0.15	0.08	−0.05	0.13
With at least one child	0.12	0.06	0.18	0.11	0.10	0.10	0.12	0.13
With relative or others	−0.09	0.06	−0.19	0.09	−0.11	0.09	0.04	0.12
Educational level (*reference group*: ≥ *high school*)								
With no formal education	0.24*	0.10	0.13	0.30	0.57*	0.24	0.01	0.15
Elementary or junior high school	0.06	0.10	−0.06	0.30	0.35	0.25	−0.01	0.14
1989 income level (*reference group*: *monthly income NT$5000–14 999*)								
< NT$5000	0.14*	0.06	–	–	–	–	–	–
≥ NT$15 000	−0.05	0.07	–	–	–	–	–	–
Urbanization level of residential location (*reference group*: *city*)								
Town	0.04	0.08	−0.01	0.12	0.01	0.13	0.20	0.19
Rural area	0.05	0.06	0.01	0.10	0.08	0.09	0.10	0.13
Residential area (*reference group*: *north of Taiwan*)								
Central	−0.08	0.07	−0.06	0.10	−0.10	0.11	−0.08	0.15
South	0.09	0.06	0.06	0.11	−0.03	0.10	0.33*	0.13
East	−0.30*	0.14	−0.21	0.20	−0.51*	0.24	−0.15	0.34
Chronic disease (*reference group*: *without such chronic disease*)								
Hypertension	−0.05	0.05	−0.03	0.08	−0.02	0.09	−0.12	0.13
Heart disease	0.16**	0.06	0.10	0.09	0.17	0.09	0.31*	0.12
Diabetes	0.35**	0.07	0.57**	0.10	0.20	0.12	0.21	0.14
Kidney	0.17*	0.08	0.15	0.14	0.20	0.14	0.15	0.18
Stroke	0.47**	0.08	0.52**	0.11	0.31*	0.14	0.59**	0.17
Respiratory system disease	0.23**	0.06	0.16	0.09	0.16	0.09	0.54**	0.13
Liver or gall bladder problems	0.04	0.10	0.18	0.16	−0.05	0.18	−0.06	0.25
Self-reported general health (*reference group*: *good/fair*)								
Poor	0.52**	0.08	0.40**	0.12	0.60**	0.13	0.79**	0.21
Number of observations	11 917		3636		4709		3572	
Log likelihood ratio:	$\chi^2(33) = 462.29$**		$\chi^2(31) = 230.00$**		$\chi^2(31) = 124.27$**		$\chi^2(30) = 209.86$**	

**$p < 0.01$; *$p < 0.05$.

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Table VII. The effects of national health insurance on the level of and income inequality in self-reported poor general health – random-effects probit model results

	Insurance effect		Association of income effect with insurance status					
			1989 income level (NT$)					
			< 5000		5000–14 999		≥ 15 000	
	Coef.	Robust Std.Err.	Coef.	Robust Std.Err.	Coef.	Robust Std.Err.	Coef.	Robust Std.Err.
Pre-NHI insurance status (*reference group*: *with pre-NHI insurance*)								
No pre-NHI insurance	0.09	0.09	0.13	0.13	0.00	0.15	0.14	0.24
Time period (*reference group*: *the 'before NHI' period*)								
1996	0.16*	0.07	0.03	0.13	0.25*	0.11	0.17	0.19
1999	0.56**	0.08	0.66**	0.12	0.52**	0.12	0.58*	0.21
Interaction terms								
1996*no pre-NHI insurance	−0.10	0.15	−0.17	0.24	−0.05	0.24	0.05	0.37
1999*no pre-NHI insurance	0.15	0.13	0.01	0.21	0.22	0.22	0.26	0.32
Gender (*reference group*: *male*)								
Female	0.05	0.06	0.00	0.11	0.13	0.09	0.08	0.17
Ethnicity (*reference group*: *Fu-Chien*)								
Hakka	−0.04	0.08	−0.08	0.13	−0.15	0.12	0.19	0.19
Mainlander	−0.02	0.08	0.10	0.20	−0.05	0.12	−0.08	0.17
Other	0.15	0.20	0.08	0.29	0.29	0.30	–	–
Age as of interview (*reference group*: *60–64*)								
65–69	0.00	0.10	−0.16	0.18	0.10	0.14	−0.02	0.20
70–74	0.00	0.10	−0.07	0.17	0.09	0.15	−0.17	0.23
75–79	0.17	0.11	0.09	0.18	0.15	0.17	0.32	0.26
80+	0.03	0.12	−0.02	0.19	0.09	0.19	−0.21	0.35
Living arrangement (*reference group*: *living alone*)								
With spouse	−0.01	0.06	−0.06	0.10	−0.06	0.08	0.32	0.18
With at least one child	−0.16*	0.07	−0.17	0.12	−0.20*	0.10	−0.03	0.16
With relative or others	0.01	0.06	−0.04	0.11	0.00	0.10	0.13	0.15
Educational level (*reference group*: ≥ *high school*)								
With no formal education	0.34**	0.12	−0.31	0.31	0.56*	0.24	0.49*	0.22
Elementary or junior high school	0.17	0.12	−0.51	0.31	0.46	0.24	0.16	0.20
1989 income level (*reference group*: *monthly income NT$5000–14 999*)								
< NT$5000	0.14*	0.07	–	–	–	–	–	–
≥ NT$15 000	−0.14	0.08	–	–	–	–	–	–
Urbanization level of residential location (*reference group*: *city*)								
Town	0.08	0.09	0.15	0.14	0.07	0.13	−0.13	0.26
Rural area	0.12	0.07	0.10	0.12	0.13	0.10	0.20	0.17
Residential area (*reference group*: *north of Taiwan*)								
Central	0.07	0.08	0.15	0.14	0.12	0.12	−0.18	0.19
South	0.02	0.08	0.07	0.14	0.06	0.12	−0.17	0.18
East	0.49**	0.12	0.59**	0.21	0.46*	0.18	0.44	0.33
Chronic disease (*reference group*: *without such chronic disease*)								
Hypertension	0.01	0.06	−0.02	0.09	0.06	0.08	−0.06	0.14
Heart disease	0.43**	0.06	0.45**	0.09	0.46**	0.08	0.40**	0.15
Diabetes	0.35**	0.07	0.23	0.13	0.33**	0.11	0.55**	0.17
Kidney	0.45**	0.08	0.50**	0.13	0.37**	0.12	0.67**	0.19
Stroke	0.92**	0.08	0.79**	0.13	0.94**	0.12	1.20**	0.21
Respiratory system disease	0.37**	0.06	0.29**	0.10	0.37**	0.09	0.63**	0.16
Liver or gall bladder problems	0.16	0.10	0.14	0.17	0.08	0.15	0.35	0.23
Number of individuals	3899		1282		1506		1111	
Number of observations	11 987		3646		4748		3593	
Log likelihood ratio:	$\chi^2(32) = 439.79$**		$\chi^2(30) = 150.41$**		$\chi^2(31) = 198.91$**		$\chi^2(29) = 76.44$**	

**$p < 0.01$; *$p < 0.0$.

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estimates reflecting the difference of the differences were statistically insignificant. Moreover, regression analysis results did not reveal any insurance effects.

Effects of control variables

For access to health care, the most predictive variables were the presence of any chronic disease and self-rated health status. As expected, presence of chronic conditions and poorer health status are associated with higher probability of health care utilization. There are also indications that those living in the south and those living in the rural areas are more likely to have a hospitalization and outpatient visit, respectively. In general, most of the demographic and socioeconomic variables have limited explanatory power on access to health care.

As expected, mortality rates were higher among older people and those with poorer health status, including presence of chronic conditions. Females and those living with spouses have lower mortality rates than their counterparts. Hakka people exhibited higher mortality as did those with lower education and income. Similar results are found for self-rated health. Interestingly, elderly people living in the east of Taiwan were more likely to report poor general health although they had lower mortality rates than their counterparts living in other regions of Taiwan. Also, while one might expect those living with children more likely to report poor health, we found the opposite.

DISCUSSION AND CONCLUSIONS

In summary, we found that the NHI improved the elderly's access to health care and reduced inequalities between the high- and low-income elderly in the distribution of access. In contrast, we did not find any evidence of an NHI effect on health status. Since we imputed data for individuals with no pre-NHI insurance status information in 1993 and for those with no income information in 1989, we conducted two sets of sensitivity analyses. In the first one, we excluded the sample who did not have pre-NHI insurance status in 1993. In the second one, we excluded the sample that did not have income data in 1989. The results from both sets of analyses show that our results presented in Tables IV–VII are robust (results available upon request).

Based on the regression estimates, we predicted the probabilities of health care use, mortality within one year, and reporting poor general health for the previously insured and uninsured samples, in the pre-NHI period and in 1996 and 1999, holding sample characteristics constant at the baseline level. The introduction of the NHI caused a 14.18% increase and an 8.52% increase in use of outpatient services in 1996 and 1999, respectively (see Table VIII). The increases in use of inpatient services due to the NHI were 9.05 and 7.88% for 1996 and 1999, respectively. Thus, by 2000 Taiwan's NHI had significantly reduced disparities in utilization of both outpatient and inpatient care between people with and without pre-NHI insurance.

We further predicted a NHI effect for utilization of outpatient and inpatient services, separately for the low- and high-income individuals. As Table IX shows, after the introduction of NHI, the rate of outpatient care utilization increased among the high-income group by 8.87% in 1996 and only 0.44% in 1999, but the increases for the low-income group were much higher, at 16.28% in 1996 and 16.40% in 1999. For inpatient care use, the NHI increased use by 6.05% in 1996 and 8.07% in 1999 for the high-income group, and 10.69% in 1996 and 7.80% in 1999 for the low-income group. These results are encouraging from a policy perspective, particularly for outpatient health care. Inequality in access has been widely documented (Adamson *et al.*, 2003; Andersen *et al.*, 2002; Auchincloss *et al.*, 2001; Goddard and Smith, 2001; Keskimaki, 2003; Niefeld and Kasper, 2005; Pannarunothai and Mills, 1997; Rusinova and Brown, 2003; Schoen and Doty, 2004) and providing equal access to health care is often a policy priority. Our results provide strong evidence that a national health insurance system with comprehensive coverage is an effective way to reduce access disparities.

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Table VIII. Simulation results regarding the levels of outpatient care utilization, inpatient care utilization, mortality and general health

	'No pre-NHI insurance' group					'Pre-NHI insurance' group						
	Before NHI	1996	1999	Diff(1)	Diff(2)	Before NHI	1996	1999	Diff(1)	Diff(2)	DD(1)	DD(2)
Persons using outpatient care in the past month (%)	30.94	59.83	61.53	28.89	30.59	46.88	61.59	68.95	14.71	22.07	14.18	8.52
Persons using inpatient care in the past year (%)	8.14	18.28	17.09	10.14	8.95	17.23	18.32	18.30	1.09	1.07	9.05	7.88
Persons failing to surviving 1 year (%)	4.47	3.20	1.45	−1.27	−3.02	3.06	3.21	0.96	0.15	−2.10	−1.42	−0.92
Persons reporting poor general health (%)	2.31	2.63	8.28	0.32	5.97	1.93	2.67	5.60	0.74	3.67	−0.42	2.30

Notes:

1. Diff(1) is '1996' minus 'before NHI'. Diff(2) is '1999' minus 'before NHI'. DD(1) is Diff(1) for the 'no pre-NHI insurance' group minus Diff(1) for the 'pre-NHI insurance' group. DD(2) is Diff(2) for the 'no pre-NHI insurance' group minus Diff(2) for the 'pre-NHI insurance' group.
2. These simulation results are based on the characteristics of the 1989 sample (a national representative sample of 4049 persons aged 60 or older).

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Table IX. Simulation results regarding the levels of outpatient care utilization and inpatient care utilization – for low- and high-income groups

	'No pre-NHI insurance' group					'Pre-NHI insurance' group						
	Before NHI	1996	1999	Diff(1)	Diff(2)	Before NHI	1996	1999	Diff(1)	Diff(2)	DD(1)	DD(2)
Low-income group												
Persons using outpatient care in the past month (%)	34.62	63.94	65.94	29.32	31.32	52.41	65.45	67.33	13.04	14.92	16.28	16.40
Persons using inpatient care in the past year (%)	4.52	16.57	14.97	12.05	10.45	15.90	17.26	18.55	1.36	2.65	10.69	7.80
High-income group												
Persons using outpatient care in the past month (%)	31.54	57.72	60.31	26.18	28.77	43.17	60.48	71.50	17.31	28.33	8.87	0.44
Persons using inpatient care in the past year (%)	11.79	19.43	21.71	7.64	9.92	19.20	20.79	21.05	1.59	1.85	6.05	8.07

Notes:

1. Diff(1) is '1996' minus 'before NHI'. Diff(2) is '1999' minus 'before NHI'. DD(1) is Diff(1) for the 'no pre-NHI insurance' group minus Diff(1) for the 'pre-NHI insurance' group. DD(2) is Diff(2) for the 'no pre-NHI insurance' group minus Diff(2) for the 'pre-NHI insurance' group.
2. These simulation results are based on the characteristics of low-income and high-income groups in the 1989 sample (1362 low-income persons and 1142 high-income persons).
3. High income refers to monthly income $\geq$ NT\$15 000, and low income is $<$NT\$5000.

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By comparison, the NHI effect on health is much smaller. Table VIII shows that the one-year mortality rate fell after the introduction of NHI, and the reduction was faster for the previously uninsured sample than the insured sample. However, the difference-in-difference estimate is not statistically significant. In other words, while there is a general trend in the reduction of one-year mortality, the results from our analysis do not allow us to attribute the reduction to the effect of NHI.

Both the previously insured and uninsured groups showed increased probability of reporting poor health. This may reflect actual deterioration in health status, but may also reflect rising expectations over time. Again, the difference between the two groups is negligible.

To examine whether there are differential NHI effects on the health outcome of individuals with different health conditions, we re-estimated the health equations separately for those above and below 70 years of age and for those with and without reports of chronic conditions. We did not find any significant differential effects. To further explore the effect of improved access on health outcomes, we re-estimated the health equations, including health care utilizations and their interactions with the NHI as independent variables. Although higher utilization rates are associated with better health outcomes, we did not find a direct link between improved utilization and health outcome attributable to the implementation of NHI.

Why did major improvement in access not produce health improvements for the population studied? There are several plausible explanations. First, one-year mortality rate may not be a sufficiently sensitive measure of health outcome for the short time period that our study covers. Mortality is determined by lifetime investment in health, from childhood through adulthood to current period (Hertzman, 1999; Singer and Ryff, 1999). Since our data only cover the four years after the NHI was implemented, it may be difficult to detect any effect on mortality. As Levy and Meltzer (2004) pointed out, mortality rates are not good measures for health in examination of the effect of health insurance on health, and more sensitive measures reflecting health-related quality of life are better candidates.

Second, the literature on the determinants of health has found that use of health care services is not the major determinant of health. Other factors such as the environment, lifestyle, and health behavior play significant roles in improving a population's health (Marmot and Wilkinson, 1999; Cockerham, 1997; Denton *et al.*, 2004; Gepkens and Gunning-Shepers, 1996; Woo *et al.*, 2002). Since these factors are not affected by the NHI, it is not too surprising that we observe only limited change in health status.

Third, the lack of NHI effect on health may reflect quality and efficiency problems inherent in the system. Taiwan's health care providers have traditionally emphasized treatment of diseases rather than prevention. Furthermore, the health care delivery system is segmented rather than integrated, thus seriously threatening continuity of care. In addition, there has been little policy attention to quality of care issues until recently. So, even though the quantity of health care has increased, the lack of improvement in quality of health care may have limited the improvement in health status.

Finally, the increases in health care utilization may reflect an increase in moral hazard for services with little marginal health benefits rather than a correction of under-use of effective health services. Verification of this hypothesis will require data on effective and/or appropriate health care use, which our data do not include. This is a question worthy of future research. Nonetheless, the findings that the lowest income groups experienced the greatest improvements in access to care suggest that some of the increase in utilization resulted in correction of under-use that existed before NHI.

Future research is highly recommended to uncover the mechanisms underlying the relationship between the NHI and its effect on health outcome so that appropriate policies can be developed. Additional studies using other types of health measures and focusing on specific disease conditions are also necessary before we can draw conclusions regarding the NHI's effect on health status.

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