HEALTH CARE UTILIZATION AND IMPACTS OF ACUTE ILLNESS ON WEALTH OF AGEING POPULATION IN THAILAND

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ABSTRACT

Title of Dissertation Health care Utilization and Impacts of Acute Illness on Wealth of Ageing Population in Thailand

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The proportion of older citizens is increasing in the population of most countries. Keeping the well-being of this cohort usually demands more attention and resources. The elderly as a group are generally in poorer health than the rest of the population. They are more likely to suffer from disability and visit the doctor more often. Those with chronic ailments particularly need continuing treatment, some require long-term care in a nursing facility. For this more intensified health care, a larger portion of their income goes to health care. To meet the higher and more frequent medical expenditure, individual or family savings are usually tapped. In developing countries, many elderly do not normally have enough earnings to cover recurring and higher health care expenditures. Fortunately, the traditional value of intergeneration caring remains in many societies, as in Thailand. The younger, productive generation takes care of the welfare of their parents and, in many cases, grandparents. Nevertheless, public health care and welfare spending, such as in public insurance, will likely increase. The higher spending will be driven by the more frequent demand for health care from the growing number of elderly, chronically ill patients, and higher cost of medical care. On top of this, governments are investing on improvements in health care systems and medical technology.

This research proposes an advanced analysis of the utilization of health care in Thailand focusing on the demand for health care services by the elderly. The study takes a micro-analytic approach. An econometric model was developed to analyze a bivariate effect. This enabled an inference of the incidences of chronic diseases and

acute illness, health status of the population and health-related behavior e.g., exercise. The effect of chronic ill patient to wealth of family is analyzed. Moreover, under insurance scheme, health care access of that population group is analyzed. And finally, health care utilization is measured in the case of people who have particular chronic diseases such as hypertension, diabetes, heart problems, and cancer. The analysis is disaggregated into different groups by occupation, age-cohort, economic status, and other attributes. The analysis also describes possible scenarios based on the projections on demographic change, urbanization, and other changes in society. The results would inform a forecast of the magnitude of national financial requirements for health care. The research results aid in the formulation of policy by providing the probability and magnitude of the elderly facing acute and chronic diseases.

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CHAPTER 1

INTRODUCTION TO THE STUDY

1.1 Introduction

1.1.1 Rationale

The demographic transition to an ageing society is now a cause of wide concern among many countries. Research on the well-being of an ageing population needs to be focused. The public and private sectors should be made more aware of the issues related to an ageing society. An ageing society is faced by many consequences including the possible disruption in the food consumption of an actively employed person when she retires, high proportion of the acutely and chronically ill patients among the elderly, disproportionately higher out-of-pocket health expenses compared to family income, high demand for health care utilization, rising cost of public pensions, and other effects of an ageing population. All these issues would adversely affect the well-being of every member of the society so that health care utilization and access to health care service should be made more readily available and efficient.

In Thailand, the Institute for Population and Social Research, Mahidol University (2006), Thailand states that 10.3% of the population in Thailand in 2005 are the elderly aged 60 years and over. The proportion of the elderly will increase to 11.8%, 14%, 16.8%, and 19.8% in every five years from 2010, 2015, 2020, and 2025 respectively. This rapid increase in the proportion of the Thai elderly is a warning to the government to be well prepared for public health service found that 10.3% of the population in Thailand in 2005 is the elderly, aged 60 years and over. It has projected that the proportion of the elderly will increase to 11.8%, 14%, 16.8%, and 19.8% every five years from 2010 to 2025. This rapid increase in the proportion of the elderly is an urgent signal to the government to improve the effectiveness of public health service.

The public health service in Thailand has undergone a major reform since 2001 when the government launched the universal health coverage (UC) program that covered millions of people who had no health insurance. The UC program has proved to be beneficial to Thai people; to a certain extent it has lessened financial burden for millions of poor people (Viroj NaRanong and Anchana NaRanong, 2006: 3-10). Nevertheless, inequity in health care persists, showing up in many forms such as high morbidity and short life-expectancy among the poor. As the Thai society is ageing, the financial burden of health care is likely to increase rapidly, not only from an increase in demand for health care from the elderly and from chronically ill patients, but also from the high cost of health care and the development or acquisition of advanced health technology. For these reasons, it is timely to investigate and envision alternative approaches to health financing, health care access and health care utilization.

1.1.2 Research Questions

The study attempt to answer these questions;

1) How is health status affected by chronic disease and acute illness?
2) How do chronic disease and acute illness affect household wealth?
3) Under the health insurance scheme, how do people access a health care service?
4) How do people utilize health care services when health problems such as chronic disease or acute illness occur?

1.1.3 Objectives

In line with its rationale, this study proposes an advanced analysis of the utilization of health care, taking into consideration the burden from acute illness and chronic disease on the elderly in Thailand. The first objective is related to the differences in health status and inequity in health care and their correlation with economic status. The probability of the effect on health status when acute illness and chronic disease occur in bivariate effect will be analyzed. The second objective is to identify and describe how acute illness and chronic diseases affect household wealth. The third objective is to analyze health care access by using health insurance scheme, and the fourth is to measure health care utilization by people who have chronic diseases such as hypertension, diabetes, heart conditions, and cancer.

1.1.4 Scope

The study will take a micro-analytic empirical approach to investigate the issues of health care utilization related to an ageing society and the differences in the health status among social classes in Thailand. Econometric models will be applied to infer the incidences of chronic disease, acute illness, health care utilization, health status and health-related behavior such as exercise. The econometric techniques are applied for hypothetical testing. For instance, bivariate probit regression estimation technique is applied to analyze the evidence of chronic and acute illness occuring in different conditions. This technique is also applied to explain health status and the relevant factors. Multinomial logit regression technique is applied to analyze the alternative choices of health care access which is defined by health insurance scheme of an individual. Poisson regression technique is applied for investigating health care utilization, which is defined by in-patient day. Instrument variable estimation technique is applied to explain the depletion of household wealth when a member has a health problem. Finally, policy implication will be simulated. The analysis is disaggregated into different groups by occupation, age, economic status, and socioeconomic characteristics.

The research is based on two large datasets. The Socio-Economic Survey (SES) and the Health and Welfare Survey (HWS) conducted by the National Statistical Office (NSO) in the 2007 are used in this study. These provide rich sources of information related to the economic and social status of household and household members. The datasets include information on health status and welfare of respondents.

1.1.5 Contribution of the Study

The study will contribute to the literature on health status inequity and health care utilization in Thailand with new empirical evidences highlighted from datasets resulting from recent surveys. It will also contribute to policy by suggesting new ways of looking at and addressing policy issues.

1.1.6 Limitation of the Study

The limitations of the study include the following: some important variables are not consistent with other variables, such as occupation and access to insurance. A worker in government or a state enterprise should automatically have a Civil Servant Medical Benefit insurance scheme. However, from the datasets, it has been noted that civil servants also have other insurance schemes such as social security or universal health care coverage scheme. Moreover, the wealth variable, which is calculated from value of property and financial asset, may have been underestimated.

1.1.7 Organization of the study

This manuscript is organized as follows: Chapter 1 is the Introduction; Chapter 2 reviews literature concerning an ageing society and particularly papers that are most relevant to this study; Chapter 3 assesses the current situation of the ageing society and health insurance scheme in Thailand; Chapter 4 describes the methodologies that are applied in the study as well as the sources of data and the nature of datasets; Chapter 5 explains the empirical results and the results of the analyses; Chapter 6 contains the conclusion and policy implications.; and the last section lists the references and provides the appendices.

CHAPTER 2

LITERATURE REVIEW

One of the most important phenomena in this 21st century has been the changing demographic structure of many countries caused by an ageing population. The United Nations has projected that the Asia-Pacific region will have more than one billion people aged 60 and older by 2025. This shall be 14.4 percent of the region's total population (United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), 1999). In 2050, there will be nearly two billion people aged 60 and above (Chan, 2005: 269). Considering the countries in the region that have been experiencing a demographic transition, i.e. Japan, Singapore and Republic of Korea, and now Thailand, the issues of ageing has become a wide concern that needs in-depth research and closer policy attention. Advanced health care technology has lengthened the life expectancy of people in developed countries, raising the proportion of the elderly in the population. For instance, life expectancy for Singaporeans was 78.1 year in 2000 but, in less than a decade it has increased to 80 years in 2008 and 80.5 years in 2009. In the Republic of Korea life expectancy has increased from 75.5 years in 2000 to 79 years in 2008 and 79.5 years in 2009 (see Table 2.1). This has been happening in Thailand as well: the life expectancy of Thais has increased from 69.3 years in 2000 to 73.5 years in 2008 (Chan, 2005: 271; UNESCAP, 2008, 2009). A long term perspective of this phenomenon is provided by Japan. The life expectancy of Japanese was 59.6 years for men and 63.9 years for women in the 1950s, 77 years for men and 83.6 years for women by 1996 (Chan, 2005: 270-271), and 79 and 86 years, respectively, in 2008 (UNESCAP, 2008). This rapid ageing of Japan's population has also caused household savings to decline.

Horioka, Suzuki, and Hatta (2007) studied the impact of ageing on Japan's household savings rate and on its public pension system, as well as the impact of the public pension system on Japan's household saving rate. Their simulation analysis showed that Japan's high household saving rate occurred over temporary periods, especially during the 1960s and 1970s. The rate dropped in 1995. Japan's pay-as-you-go pension system increased the savings rate of the cohort born in 1960, slowing the decline in Japan's household saving rate as the proportion of this cohort increased. The study indicated that the reform in the public pension in 2004 alleviated the intergenerational inequities of Japan's public pension system but would in the long run exacerbate the downward trend household savings rate (Horioka, Suzuki and Hatta, 2007: 1-27).

Table 2.1 Population Ageing in Some Asian Countries, 2008

Country or Area	Mid-2008 Population ('000)	Life Expectancy at Birth (years)		Percentage of Population Aged		Ageing Index
		Males	Females	0-14	60+	
China	1,336,311	71	75	20	12	58
Japan	128,026	79	86	14	29	212
Republic of Korea	48,607	76	82	17	15	89
Hong Kong	6,977	79	85	13	17	125
Cambodia	14,656	58	62	35	5	16
Indonesia	234,342	69	73	27	9	32
Lao PDR	5,963	63	66	37	5	14
Malaysia	27,663	72	77	30	7	25
Myanmar	49,221	59	65	26	8	32
Philippines	90,457	70	74	35	6	18
Singapore	4,490	78	82	17	15	85
Thailand	63,121	70	77	22	11	52
Vietnam	86,373	70	73	29	9	30

Source: UNESCAP, 2008: 11-14.

Retirees including those who have had high income need wealth to maintain their consumption levels after retirement. There are a number of arguments regarding the issue on saving for retirement. One point of view is that large numbers of household have very slim opportunity to accumulate an adequate retirement savings because of unexpected out-of-pocket health expenses. Contingencies such as unexpected loss earning near retirement time, unexpected out-of-pocket health expenditure, and lower rate of returns on investment are some of the possible causes of inadequate household savings. An American report has shown that there is a risk of substantial decline in retirement income of households in the U.S. On the other hand, some economists, think that many households do not need to save because of the reduced expenses, i.e., the parents no longer have to financially support the children who now may start to leave the home, or they can apply for state insurance (Skinner, 2007: 1-22).

When workers retire, they lose their wage and other benefits they receive while employed. A study on Medicare, retirement costs and labor supply at older age (Johnson, 2002: 1-22) shows that Medicare eligibility may lead many workers to delay retirement because Medicare eligibility reduces the cost of retiring for workers who receive health benefits from their employers, especially when the benefits do not continue after retirement. The study further shows how a potential increase in the age of Medicare eligibility affects retirement behavior by relating the health insurance costs of retirement to labor supply decisions. He measured the effect of insurance costs on labor force withdrawals by including the net present value of premium costs in a multivariate model of retirement. He then simulates the impact of changes in the Medicare eligibility age by re-computing premium costs under the assumption that individuals could not receive Medicare coverage until they reach age 67. He found that health insurance costs significantly discourage retirement, and that an increase in the age of Medicare eligibility would reduce retirement rates.

Johnson, Penner and Toohey (2008: 1-33) studied out-of-pocket health care cost and found that those who receive health benefits from their employers tend to delay their retirement to reduce the risk of high out-of-pocket health care costs. They also examined the impact of expected future out-of-pocket medical spending on retirement decisions. They considered two types of out-of-pocket health care costs, namely, the real health insurance premium costs associated with retirement before age 65 and the expected future real health care costs from age 65 until death. The results show that the premium costs associated with retirement before age 65 and expected out-of-pocket health care costs after 65 substantially delay retirement.

Attanasio and Rohwedder (2003) studied the relationship between pension savings and discretionary private savings using three major UK pension reforms. They modeled the responses of each individual household based on data from the Family Expenditure Survey (FES). The analysis indicated that the earning-related tier of the pension scheme has a negative impact on private savings with substitution elasticities approaching -1.0. They cite Feldstein (1974) as having been among the first to empirically study the relationship between public pension and private savings. His study was based on time series behavior of aggregate saving rates. Pension wealth indicates a large negative effect of pension wealth on saving rates. Attanasio and Rohwedder (2003) use the life-cycle framework to model the behavioral response of household. Pension wealth is defined as the sum of future benefits. They computed the expected present value of net pension wealth minus future taxes, assuming continued participation until retirement and used this measure as an estimate of subjective wealth expectations. The pension wealth profiles show substantial differences across and within cohorts and occupational groups. Their results confirm Felstern’s (1974) findings, which are the negative elasticity of substitution for financial wealth, thus confirming the basic prediction of life-cycle model (Attanasio and Rohwedder, 2003: 1499-1521).

Another important issue related to ageing is the well-being of the elderly. Income and wealth clearly determine the well-being of a person in terms of health. Good health is positively associated with savings, labor force participation and earning. It is negatively related to old age, social security, and benefits replacement rate (Michauda and Soest, 2008: 1312-1315); older people usually have worse health (Banerjee, Deaton and Duflo, 2004: 327). Health can affect wages, productivity and labor supply as well as the retirement decisions and capability to accumulate savings for retirement. Using six biennial waves of couples aged 51-61 in 1992 from the US Health and Retirement Study, Michauda and Soest (2008) studied the relation of health and wealth by using the dynamic panel data models to test for the causal effects of health on socioeconomic status and vice versa, among elderly couples in the US. Their result shows the evidence of causal effect from health to wealth, and that there is no evidence that specify the effect from wealth to either husband's or wife's health.

The relation between health and wealth is widely studied. Deaton, Banergee, and Duflo (2004) collected data in Udaipur district, Rajasthan, India to study the relation between health, wealth and health services. They used household total per capita expenditure (PCE) as a measurement of economic status, level of hemoglobin and body mass index (BMI) as the measurements of health, as well as self-reported health status. The results confirm the worldwide phenomenon that the health status of the older people is worse than the younger. Women were found to have worse health than men at all ages. Moreover, individuals in the lower third of the per capita income distribution have a lower level of self-reported health, lower BMI, and lower lung capacity on average, and they are more likely to have a low hemoglobin count (i.e. below 12) than those in the upper third. An observation that goes back many years in India and other developing countries is that the better-off people report more sickness, the probable reason being that they are more aware of their health status (Murrey and Chen, 1992; Sen,2002 quoted in Banjaree, Deaton and Duflo, 2004: 328). A comparison of the bottom three deciles and the top three deciles revealed that self-reported health status was higher in the higher deciles. The household in the top three deciles spent 11 percent of the household budget on health care.

Health care access and health utilization are important in developing countries as direct indicators of welfare. The complex relationship among health utility, health inequality, income, and wealth inequality has shown that the inequalities in income distribution are reflected in the access and utilization of health services as well as in the actual health conditions of individuals across income groups. Health improves when wealth increases. The higher income group usually has health plan and the coverage from health insurance coverage increases greatly with income (Giuffrida, Savedoff and Iunes, 2005: 1-14). Health status is also correlated with income. The nonlinear relationship between health and income at the individual level generates a relationship that health is negatively correlated with the degree of inequality. Deaton (1999) has shown that income differences are associated with an expanding univariate distribution of health. He also found a link between education and health; if people have more schooling, the inequality gets wider. The differences in the level of income and education lead to the differences in the opportunity to benefit from new technology or new preventive methods. The poor, for instance, do not have access to the new medical protocol for reducing heart-disease which is expensive, while the people with higher income and/or higher education can have easier access to the treatment (Deaton, 1999: 1-30). Deaton pointed out that the richer and the better educated people get to live longer than the poorer and less educated ones. The educated people know how to use health information and are in a better position to access a good health care system and superior health services. Economists attribute the increase in the productivity of workers to better health and a higher level of education.

A lower education attainment is also correlated to higher mortality and morbidity. Chronic diseases such as diabetes, hypertension, cancer, and heart conditions, which cause mortality and morbidity, are particularly associated with low education level. The incidence of cognitive impairment, disability, and loss of functions is also higher in people with a lower level of socioeconomic status. The researchers use demographic approaches to health differentials focusing on socioeconomic and race differences. They show that the health differentials are high before old age. During old age, the differences in the disability and the loss of functions are higher than the difference in cognitive impairment (Crimmins and Seeman, 2004: 91-92).

The hourly wage of workers is related to health status. Studies on the issue of potential endogeneity of health status found causal relationships between health and labor productivity in poor countries. Economic studies have shown the link between health and productivity. Thomas and Strauss (1995) investigated the impact on wages of urban workers of four indicators of health, namely, height, body mass index (BMI), per capita calories in take, and per capita protein intake. They found that all four measures of health significantly affect wages even after accounting for endogeneity and concluded that health yields substantial return at least in the market wage sector. Better health may result in a worker being more productive, and the higher income is spent on improving one's health. In addition, unobserved factors related to human capital or tastes may affect both current health and productivity (Thomas and Strauss, 1995: 159-183). The researchers also found a negative correlation between socioeconomic status and some risk behavior such as smoking, drinking, eating behavior, and exercises. These factors may directly affect health (Deaton, 2003). Deaton and Paxon (1998) found a negative correlation between self-reported health status and income and this correlation varies at different ages. The dispersion of health is increasing with age and is different by race. Their research shows that the distribution among blacks worsens even at early age (Crimmins and Seeman, 2004: 91;Deaton and Paxson, 1998: 431-456).

The above studies indicate that the current status of the elderly in developing countries is very much related to the economic assets which they may have accumulated over their productive life time, since few alternative forms of support are available in later life. According to the survey of older persons in Thailand in 2007, the sources of their assets mostly come from their family (Table 2.2). For over 80% of the elderly their assets are from their children, and this is true in rural and urban areas. Less than 40 % of their assets come from their own work. Among older old persons (aged 70 years and over), the source of income from their work was only 20% and from elderly allowance 34%. These figures reflect the decline in work force participation of the elderly; these also imply the need for more support from the government (Knodel and Chayovan, 2008: 1-12).

Table 2.2 Source of Income of the Elderly, Thailand 2007

Income Sources (percentage)	Total	Age		Gender		Type of Area	
		60–69	70+	Men	Women	Urban	Rural
Work	37.8	50.2	20.1	51	27.2	28.7	41.4
Pension(a)	5.4	6.2	4.2	8.5	2.9	12.2	2.6
Elderly allowance	24.4	17.7	34	23.1	25.5	14.1	28.6
Interest/savings/rent	31.7	33.7	29	33.8	30.1	36.8	29.7
Spouse	23.3	30	13.7	24.8	22.1	20.3	24.5
Children	82.7	79	87.9	79.5	85.3	77.6	84.8
Relatives	11	9.7	12.9	9.5	12.3	11	11.1
Other	1.5	1.2	2	1.3	1.7	1.7	1.5
Percent distribution by main income sources							
Work	28.9	39.6	13.6	41.4	18.8	23.3	31.1
Pension(a)	4.4	4.8	3.7	6.6	2.5	10.1	2.1
Elderly Allowance	2.8	1.2	5	2.5	3	1.4	3.3
Interest/savings/rent	2.9	2.6	3.2	3	2.7	5.1	2
Spouse	6.1	7.9	3.6	3.8	7.9	6.7	5.9
Children	52.3	41.8	67.3	40.8	61.5	49.9	53.2
Relatives	2.3	1.8	3	1.4	2.9	2.9	2
Other	0.5	0.3	0.8	0.4	0.6	0.6	0.5
Total	100	100	100	100	100	100	100

Source: Knodel and Chayoyan, 2008: 10.

Since the elderly are more prone to chronic illness and their health care expenditure becomes a burden to their family, health insurance is one option to alleviate the burden. In Thailand, according to the Health and Welfare survey in 2007, about 96.3 % of the population has a health insurance. There were four major health insurance schemes in the country: universal health care coverage scheme (UCS) which is the main insurance cover for 76.6 percent of the population, civil servant medical benefit scheme (CSMBS) for civil servants and state enterprise employees which covers 9.5 percent, social security scheme (SSS) 12.7 percent, and private health insurance cover 2.3 percent of the population.

Table 2.3 Percentage of Population with Health Insurance Scheme 2003-2007

Type of Health Insurance	Year				
	2003	2004	2005	2006	2007
Universal Health Coverage	80.4	78.8	76.4	77.8	77.6
Social Security and Compensation Fund	9.7	11.2	11.9	12.2	12.7
Civil Servant Medical Benefit	9.4	10	10.6	9.5	9.5
Private Health Insurance	2	4.4	2.8	2.3	2.3
Welfare from Employer	0.4	0.5	0.5	0.4	0.4
Population with health security	94.9	93.4	95.1	96	96.3

Source: National Statistical Office (NSO), 2008: 5.

Even though most people in the country have health security, there may be disparities in medical care access and utilization among different health insurance schemes. Furthermore, moral hazard in the use of some health insurance scheme may increase the health expenditure for the government. When a person enrolls in an insurance plan, the price of medical care services decreases in accordance with the law of supply and demand (Feldstein, 1988 quoted in Cheng and Chiang, 1998: 613). However, the use of health care, physician visits, and hospital admissions were found to increase when people have health insurance (Cheng and Chiang, 1998: 613). The analysis of Cheng and Chiang (1998) also shows that a person with different insurance plans tends to see a doctor more often than one who is uninsured.

CHAPTER 3

AGEING AND HEALTH INSURANCE SCHEME IN THAILAND

3.1 Ageing Population Structure

3.1.1 Ageing Situation in Thailand

According to the international standard, a country that has more than 10% of population aged 60 years and older and/or has a population with the median age of more than 30 years shall be deemed an "ageing society" (Shryock, 2004 quoted in the Foundation of the Thai Gerontology Research and Development Institute, 2007: 2). By this standard, Thailand is facing an ageing society. In 2006, more than 11% of the population was aged 60 years and over and the median age of population was approximately 33 years. The proportion of the elderly in the population increased from 5.0% in 1950 to 10.1% in 2000, which took 50 years. It has been projected to increase to 15.6% in 2015, to 21.5% in 2025, and to 25% in 2033 (Foundation of Thai Gerontology Research and Development Institute (TGRI), 2007: 3). This rapidly increasing rate makes Thailand a country in ageing transition. The oldest-old population (80 years and older) group has a high dependency. The size of this group will increase from 1% in 2000 to 2% in 2015. It will then increase to 3% in 2027 and 4% in 2035. This is further evidence of the rapid increase in the proportion of older people in Thai society.

As of December 31, 2006, the Thai population was 61.4 million, consisting of 21% youth population (aged less than 15 years), 68% working age population (15-59 years), and 10.6% older age population or approximately 6.5 million people. The older age population consists of three groups: 5.9% are in the early ageing group or young-old group (aged 60-69); 3.5% are in the middle ageing group or the old-old group (70-79); and 1.3% in the late ageing group or the oldest-old group (80 and older). Comparing these three older age groups between the years 2002 and 2006, the proportion of the young old age group has decreased from 62.7% in 2002 to 53.6% in

2006 whereas the proportion of the middle old age group has increased from 28.3% to 34.2% (Table 3.4). As to gender, in 2006 there were more women than men whose average age was older. In addition, the older people live with other family members. However, the proportion of older persons who live alone has increased from 6.3% in 2002 to 7.9% in 2006.

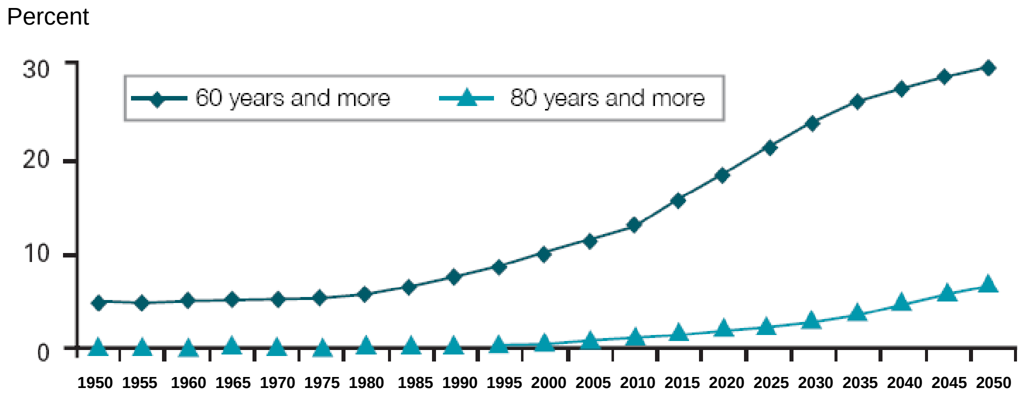

Figure 3.1 Percentage of Population Aged 60 Years and Over and Population Aged 80 Years and Over

Source: The Foundation of Thai Gerontology Research and Development Institute (TGRI), 2007: 4**.**

Table 3.1 Total Population , Number and Percentages of Persons Aged 60 Years or More, Number and Percentages of Persons Aged 80 Years or More, and the Median Age for the Period 1950-2050

Years	Total Population ('1000)	The Population Aged 60 years and more		The Population Aged 80 years and more		Median Age
		Number ('1000)	Percent	Number ('1000)	Percent	
1950	20,607	1,041	5.1	85	0.4	18.6
1955	23,757	1,179	5.0	90	0.4	18.7
1960	27,652	1,411	5.1	95	0.3	18.4
1965	32,293	1,684	5.2	117	0.4	17.8
1970	37,247	2,002	5.4	138	0.4	17.8
1975	42,180	2,339	5.5	166	0.4	18.5
1980	46,809	2,697	5.8	215	0.5	19.9
1985	50,820	3,364	6.6	272	0.5	22.7
1990	54,291	4,225	7.8	343	0.6	25.1
1995	57,523	5,116	8.9	428	0.7	27.4
2000	60,666	6,130	10.1	602	1.0	30.1
2005	63,003	7,122	11.3	820	1.3	32.6
2010	65,125	8,463	13.0	1073	1.6	34.7
2015	66,763	10,396	15.6	1,329	2.0	36.5
2020	67,990	12,611	18.5	1,603	2.4	38.2
2025	68,803	14,782	21.5	1,836	2.7	39.8
2030	69,218	16,596	24.0	2,259	3.3	41.2
2035	69,260	18,069	26.1	2,936	4.2	42.3
2040	68,940	19,059	27.6	3,669	5.3	43.1
2045	68,286	19,675	28.8	4,298	6.3	43.7
2050	67,376	20,071	29.8	4,732	7.0	44.3

Source : The Foundation of Thai Gerontology Research and Development Institute (TGRI), 2007: 3.

Remark: The median age of 35 years means 50% of the population aged less than 35 years and the other 50% is more than 35 years.

Additionally, the life expectancy of Thai people has increased, 70 years in 2005 and 71 in 2007. Women have a longer life expectancy than men. Between 2005 and 2007, the life expectancy at birth for women was 74 years, for men it was 66 years in 2005; in 2006 women was 75 years, men 68.2 years; and in 2007 women was 75.2 years, men 68.4 years (Foundation of Thai Gerontology Research and Development Institute (TGRI), 2007: 5).

Such change in the population structure has revealed a new phenomenon, the decline in the youth population, a result of the decline in fertility rate. The total fertility rate has decreased from 2% in 1995 to 1.5% in 2005 even as the death rate has decreased slightly. In 2006, the Ageing Index was 50, increasing gradually thereafter. This means that the number of older population has increased to about half the youth population in 2006. Subsequently, in less than 15 years from 2006, the number of the older population will exceed the youth population. At this point the Thai society shall have become fully an ageing society (National Statistical Office (NSO), 2008a: 15).

Table 3.2 The Thai Population Classified by Age 2006-2007

Age (Year)	**2006**		**2007**	
	Number	**%**	**Number**	**%**
0-14	13,088,148	21.3	12,849,360	20.09
15-59	41,756,928	68	41,910,182	68.2
60-69	3,687,117	5.9	3,681,920	6.0
70-79	2,133,569	3.5	2,205,603	3.6
80 +	729,734	1.3	817,538	1.3
Total	61,395,496	100	61,464,603	100

Source : Foundation of Thai Gerontology Research and Development Institute (TGRI), 2007: 10; 2009: 10.

Table 3.3 Aspects of the Older Population in 2002 and 2006

Population Aspects	Percentage 2002	Percentage 2006
Sex	100	100
Male	45.7	43.5
Female	54.3	56.5
Age		
Young-old (60-69)	62.7 (male: 46.7, female: 53.3)	53.6 (male: 45.7, female: 54.3)
Old-old (70-79)	28.3 (male: 45.7, female: 54.3)	34.2 (male: 42.1, female: 57.9)
Oldest-old (80+)	9.1 (male: 38.6, female: 61.4)	9.1 (male: 37.3, female: 62.7)
Living Arrangement		
Alone	6.3	7.9
With Others	93.7	92.1

Source : Foundation of Thai Gerontology Research and Development Institute (TGRI), 2007: 14.

3.1.2 Ageing Dependency Ratio

There are three types of ageing dependency ratio, namely, dependency, old-age and youth. Dependency ratio is the ratio of the youth and the older populations to the working age population. The youth population is the population that is aged less than 15 years; the older population is aged 60 years or more; and the working population refers to those whose age is between 15 to 59 years. Old-age dependency ratio means the number of the older population for every 100 persons of working age population. Finally, youth dependency ratio means the number of youth population for every 100 persons of working age population. A high value of dependency ratio means there is a large number of dependents relative to the number of the working age population.

The data from the United Nations and from the Office of the National Economic and Social Development Board show that old-age dependency ratio has almost doubled from 10% in 1962 to 19.6% in 2010 and will nearly triple to 29.6% in 2025. The data also indicate that in 2020 the youth dependency ratio will equal the old-age dependency ratio, which would be about 30%. Thereafter, the old-age dependency ratio is expected to exceed the youth dependency ratio (Table 3.4). When this occurs, Thailand will completely become an ageing society

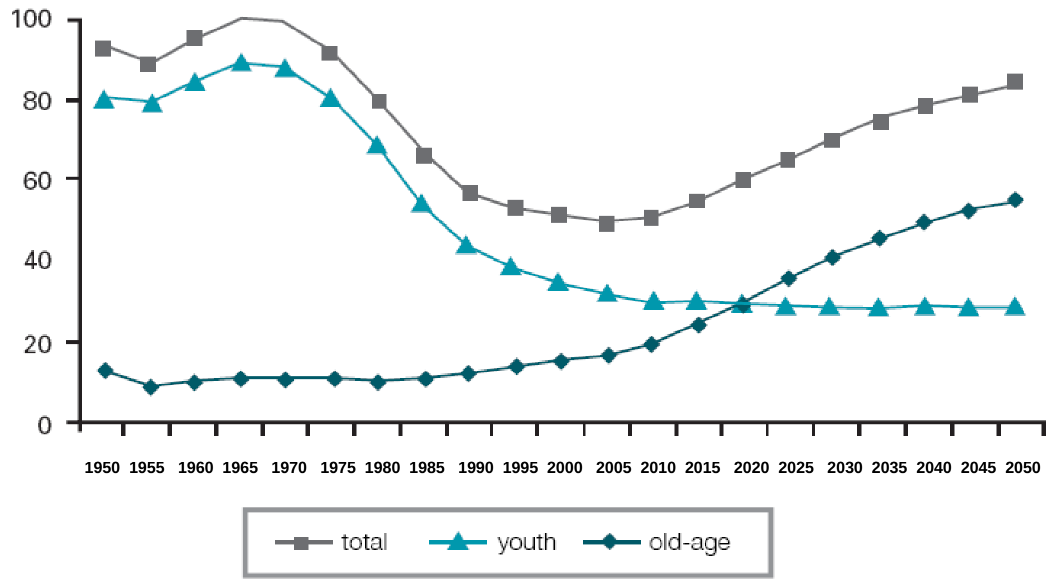

Figure 3.2 Total Dependency Ratio, Youth Dependency Ratio and Old-age Dependency Ratio

Source: Foundation of Thai Gerontology Research and Development Institute (TGRI), 2007: 7.

3.2 Health Problems in Thai Elderly

3.2.1 Chronic Disease

The Health and Welfare Survey in 2006 by the National Statistical Office (NSO) reports that there was a high number of chronically ill in the old age group. Older women are found to be more ill with chronic disease than older men in each of their ageing period. Comparing the years 2003 and 2006, chronic disease in both older men and women apparently declined. In 2003, 45.4% of the older men and 54.8% of the older women were found to have chronic disease, while in the year 2006, the percent of older men and women with chronic disease declined to 41.1% and 53.3%, respectively. In 2004-2006, the top 5 chronic diseases among Thai elderly were (1) cardiovascular diseases (2) endocrinism (3) muscular, tendon and bone diseases (4) gastronomic diseases and (5) respiratory diseases. However, in 2007, the Survey of the Older Person in Thailand by NSO found that the top 3 chronic diseases among older people have changed; they are (1) hypertension, (2) diabetes, and (3) cardiovascular disease. More people in the age group 70-79 years have chronic diseases than those in the age group 60-69 years and age group 80 years or older (Foundation of Thai Gerontology Research and Development Institute (TGRI), 2009: 24).

Table 3.4 Percentage of the Old Age Group with Chronic Disease in 2006

Age	Chronic Disease in		
	Male	Female	Total
60-64 years	31.6	51.3	42.0
65-69 years	40.6	53.4	47.5
70-74 years	49.7	57.2	53.9
75 years and more	51.2	52.8	52.1

Source: The National Statistical Office, 2006.

Table 3.5 Percentage of the Population that Had One of the Top 5 Chronic Diseases in 2004-2006

Chronic Disease	**2004**	**2005**	**2006**
Cardiovascular diseases	26.2	28.0	31.1
Endocrinism	16.7	18.9	19.7
Muscular, tendon and bone diseases	15.7	15.7	13.0
Gastronomic disease	11.9	11.1	11.6
Respiratory disease	11.6	11.2	10.0

Source: The National Statistical Office, 2004, 2005, 2006.

3.2.2 Other Health Problems in Thai Elderly

The other illness of the elderly that has a direct impact on their caregivers and families is dementia or Alzheimer's disease. Dementia is likely to increase in ageing people. HIV/AIDS is another problem found in the elderly in Thailand. Fortunately, the number of elderly who have AIDS has decreased. Among these people, more of the older men are found to be ill with AIDS than the older women. Other new illnesses often found in the elderly are sight problems, and injuries from falling accidents. Moreover, some of the habits of the elderly, including smoking and alcohol drinking, may harm their health. (Foundation of Thai Gerontology Research and Development Institute (TGRI), 2007: 7). Suffering from illnesses can have severe physical and mental impacts as well as financial burden.

3.3 Current Health Insurance Scheme

3.3.1 Public Health Care

3.3.1.1 Universal Health Care Coverage Scheme

The government has prepared for the demographic transition to an ageing society. In 1999, the government established the National Commission on the Elderly which is related to the second National Plan for Older Persons (2002-2021). This plan concerns the well-being of older persons, social security for older persons, and the preparation for quality ageing (United Nations Population Fund (UNFPA), 2006).

In 2001, the 30 Baht Universal Health Care Coverage Scheme was initiated. Under this scheme, people were required to pay 30 Baht (less than 1 US Dollar) for a treatment in a state-run health station or hospital. This scheme was reformed in 2006 and the government stopped collecting the 30 Baht fee. This scheme covered more than 90% of the Thai elderly (Jiraporn Kespichayawattana and Sutthichai Jitapunkul, 2009: 40) and 76.7% of the total population in 2007 (National Statistical Office (NSO), 2008b: 7).

3.3.1.2 The Civil Servant and State Enterprise Medical Benefit Scheme

The government and state enterprises had have a medical service welfare system for civil servants and state enterprise employees as well as their spouses, children and parents since 1978. This scheme is fully paid by the government and the state enterprises. The eligible person in civil servants and his/her spouse can have a treatment at any public hospital. In case of emergency, they can have a treatment at private hospital. However, the treatment at private hospital of the civil servants has a limitation on reimbursement. The state enterprises employees can choose any hospital for treatment (Suwit Wibulpolprasert, 2008: 397). The state enterprises are responsible for the health expenditure of their employees and the Ministry of Finance is responsible for civil benefits. This scheme covered 9.5% of the population in 2007. (Jiraporn Kespichayawattana and Sutthichai Jitapunkul, 2009: 40;National Statistical Office (NSO), 2008b: 7).

3.3.1.3 Social Security Scheme

The Social Security Fund provides social security scheme for private sector employees. It was established to insure people for a contingent situation in health care. The medical care expense of the member under this fund is jointly paid in an equal proportion by the government, employers, and employees. The Fund is under the management of the Social Security Office of the Ministry of Labour through the Social Security Commission. It provides six types of benefits: (1) sickness or injury, (2) maternity, (3) child allowance, (4) death, (5) invalidity, and (6) old-age pension benefits (Jiraporn Kespichayawattana and Sutthichai Jitapunkul, 2009: 40). This scheme covered the employees in the private sector, which was 12.7% of the population in 2007 (National Statistical Office (NSO), 2008b: 7).

3.3.2 The Other Health Insurance

3.3.2.1 Private Health Insurance

The private health insurance plan in Thailand is usually a part of life or accident group insurance. Its purpose is to alleviate unexpected medical expenses. The role of private health insurance is limited to the segment of the population that has a good economic status and can afford the premium. The premium usually depends on the risk level of the insured. The benefits of private health insurance mostly cover the medical expenses of both inpatient and outpatient, depending on the conditions agreed with the provider (Suwit Wibulpolprasert, 2008: 399). In 2007, some 2.3% of the Thai population was reported to have private health insurance (National Statistical Office (NSO), 2008b: 7).

CHAPTER 4

METHODOLOGY

4.1 RESEARCH METHODS

4.1.1 Conceptual Framework

In health economics, measurement of the outcomes is often based on dependent or qualitative variables. These variables are integer counts, e.g., the number of inpatient days or the number of doctor visits; binary responses variable, e.g., whether or not the individual has chronic diseases or whether or not the individual has taken the medicines; and multinomial responses variable, e.g., the choices of health insurance scheme or the choices of health provider. In this study, nonlinear models are chosen as most appropriate for the analysis (Jones, 2007: 2-3). Moreover, the linear regression estimation such as Instrumental Variable (IV) regression is applied to analyze the continuous outcome variable such as health care expenditure or wealth.

4.1.2 Research Models

4.1.2.1 Bivariate Probit Model

The bivariate probit model is applied when there are two separate binary outcome variables. Technically, two independent binary probit models are used and the results are estimated together. The relationship of the two outcomes are explained with some conditions on the explanatory variables, **x**. The relatedness occurs via the correlation of the errors between the binary outcome models. Generally, the two outcomes are determined by two latent variables, y_1^*, y_2^*, that are assumed to be linear functions of a set of explanatory variables, **x**.

$$y_1^* = \mathbf{x}_1'\beta_1 + \varepsilon_1,$$

$$y_2^* = \mathbf{x}_2'\beta_2 + \varepsilon_2,$$

and the errors terms, ε_1 and ε_2, are jointly normally distributed with mean of 0, the variances of 1 and the correlations of ρ (Cameron and Trivedi, 2009: 515; Greene, 2003: 710-712).

$$y_1 = \begin{cases} 1 \text{ if } y_2^* > 0 \\ 0 \text{ if } y_2^* > 0 \end{cases} \quad \text{and} \quad y_2 = \begin{cases} 1 \text{ if } y_2^* > 0 \\ 0 \text{ if } y_2^* > 0 \end{cases}$$ ((National Statistical Office (NSO), 2008a)4.1)

$$E[\varepsilon_1 \mid \mathbf{x}_1, \mathbf{x}_2] = E[\varepsilon_2 \mid \mathbf{x}_1, \mathbf{x}_2] = 0,$$

$$\text{Var}[\varepsilon_1 \mid \mathbf{x}_1, \mathbf{x}_2] = \text{Var}[\varepsilon_2 \mid \mathbf{x}_1, \mathbf{x}_2] = 1,$$

$$\text{Cov}[\varepsilon_1, \varepsilon_2 \mid \mathbf{x}_1, \mathbf{x}_2] = \rho.$$

If ρ =0, the model would collapse into two separated probit models for y_1 and y_2. Essentially, if the two variables (or errors) are correlated, cov(ε_1, ε_2) $\neq 0$ then, for each individual ith, there are

$$\varepsilon_{1i} = \eta_i + u_{1i}$$

$$\varepsilon_{2i} = \eta_i + u_{2i.}$$

if it is assumed that all three types of errors are normally distributed, then the ε_{si} will also be normal. However, each ε_{si} depends on the value of η_i and they are related to one another. To find the joint probabilities between y_1 and y_2 from the standard model, there are

$$Pr(y_{1i} = 1) = Pr(\varepsilon_{1i} > -x_{1i}\beta_i)$$

$$= Pr(\varepsilon_{1i} + \eta_i > -x_{1i}\beta_i)$$

and

$$Pr(y_{2i} = 1) = Pr(\varepsilon_{2i} > -x_{2i}\beta_i)$$

$$= Pr(\varepsilon_{2i} + \eta_i > -x_{2i}\beta_i).$$

If y_1 and y_2 are independent,

$$Pr(y_1=1,y_2=1) = F(y_1) \text{ x } F(y_2)$$

$$Pr(y_0=1,y_2=1) = [1-F(y_1)] \text{ x } F(y_2)$$

$$Pr(y_0=1,y_2=0) = [1-F(y_1)] \text{ x } [1-F(y_2)].$$

The log-likelihood function is derived from these probabilities and the parameters are estimated by Maximum Likelihood estimation. Since they both depend on the value of η_i, the bivariate joint distribution will be considered for the joint probabilities of nonindependent event (Davis, 2006: 1-14).

For two standard-normally distributed ε_is, the joint density will be:

$$\phi(\varepsilon_1,\varepsilon_2) = \frac{1}{2\pi\sigma_{\varepsilon 1}\sigma_{\varepsilon 2}\sqrt{1-\sigma^2}} \exp\left[-\frac{1}{2}\left(\frac{\varepsilon_1^2 + \varepsilon_2^2 - 2\rho\varepsilon_1\varepsilon_2}{1-\rho^2}\right)\right] \quad (4.2)$$

where ρ is a correlation parameter.

4.1.2.2 Instrumental Variable Estimation and Two-Stage Least Squares

Instrumental variable estimation (IV) is also called Two-Stage Least Squares (2SLS) which developed by Bollen (1996) (Oczkowski, 2003: 2). It is the statistical technique that is used in the analysis of structural equations, which extended from the Ordinary Least Square (OLS) method; it does not require any distributional assumptions for independent variables, which can be binary, non-normal or something else. Consider the simple model:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_K x_K + ... + u \quad (4.3)$$

$$E(u) = 0, \text{Cov}(x_j, u) = 0, j=1,2,\ldots,K\text{-}1 \quad (4.4)$$

where y is dependent variable, and independent variables, $x_1, x_2, \ldots, x_{K-1}$ are exogenous, but x_K is potentially endogenous. β_0, $\beta_1, \ldots, \beta_K$ are estimation parameters and u is an error term. If x and u are correlated, ordinary least squares (OLS) regression would not be appropriated because it violates the assumption of the regression framework. The result would not be consistent. Then, one way to solve this problem to apply 2SLS procedure (Oczkowski, 2003: 1-2). In 2SLS regression analysis, the problematic causal variable is the dependent or endogenous variable whose error term is correlated with the other dependent variable error term. This problematic causal variable should be replaced with substitute variables, which are called instrument variables in the first Stage of 2SLS (David, 2009: 1). The instruments are exogenous variables and must be assumed to be correlated to the problematic predictor but not the error term. Additionally, the regression model should be correctly specified with homoscedastic relationship, in other words the error variance of all response variables are the same and the error terms must be normally distributed. Furthermore, the observations should be independent from each other and there are no outliers in the dataset.

To use IV approach when x_K is endogenous variable, let z_1 is observe variable that is uncorrelated with u, $\text{Cov}(z_1, u) = 0$, but it must be correlated with x_K, $\text{Cov}(z_1, x_K) \neq 0$. In other words, x_K is a linear function of all exogenous variables:

$$x_K = \delta_0 + \delta_1 x_1 + \delta_2 x_2 + \ldots + \delta_{K-1} x_{K-1} + \theta_1 z_1 + r_K \quad (4.5)$$

and r_K is uncorrelated with $x_1, x_2, \ldots, x_{K-1}$, and z_1, $E(r_K) = 0$, and $\theta_1 \neq 0$. Then z_1 is an instrument variable (IV) for x_K. The instrument variables used in the model can be more than one variable, z_1, z_2,…,z_M. Practically, one or both of x_K and z_1 can be continuous or discrete variables.

The linear function in equation 4.5 is called a reduced form equation for the endogenous variable x_K. the we obtain y:

$$y = \alpha_0 + \alpha_1 x_1 + \ldots + \alpha_{K-1} x_{K-1} + \lambda_1 z_1 + v \qquad (4.6)$$

where the reduced form of error is $v = u + \beta_K r_K$, $\alpha_j = \beta_j + \beta_K \delta_j$, and $\lambda_1 = \beta_K \theta_1$.

In terms of population moments in observable variable,

$$\boldsymbol{\beta} = [\mathrm{E}(\mathbf{z}'\mathbf{x})]^{-1}\mathrm{E}(\mathbf{z}'y). \qquad (4.7)$$

By using a random sample on ($\mathbf{x}$,y,z_1), the expectations $\mathrm{E}(\mathbf{z}'\mathbf{x})$ and $\mathrm{E}(\mathbf{z}'y)$ can be consistently estimated.

The instrument variables estimator of $\boldsymbol{\beta}$ is

$$\begin{aligned}\hat{\boldsymbol{\beta}} &= (N^{-1}\textstyle\sum_{i=1}^{N} z_i' x_i)^{-1}(N^{-1}\sum_{i=1}^{N} z_i' y_i)\\ &= (\mathbf{Z}'\mathbf{X})^{-1}\mathbf{Z}'\mathbf{Y}\end{aligned}$$

where **Z** and **X** are the matrics N x K and **Y** is the vector N x 1 on the y_i, given a random sample$\{(\mathbf{x}_i, y_i, \mathbf{z}_{i1}): i = 1,2,\ldots,N\}$.

4.1.2.3 Multinomial Logit Model

The multinomial logit model applies to discrete dependent variables or categorical choices, assuming that they do not imply any natural ordering of the outcomes (Jones, 2007: 26). It can be thought as simultaneously estimating binary logits for all possible comparisons among the outcome categories (Long, 1997: 149). Schmidt and Strauss (1975) are among the first to use this method for the prediction of individual occupation based on personal characteristics, e.g., race, sex, educational attainment and labor force experience, as exogenous variables. The categories of occupation are professional, white collar, craft, blue collar, and menial. Race and sex are zero-one dummy variables, each taking the value one for whites and males respectively. Educational attainment is measured by the school years and labor force experiences are calculated from age minus years of schooling minus five (Schmidt and Strauss, 1975: 471-486).

In health economics, multinomial logit models are applied in choosing categorized choices, i.e., the choice of health care provider or of health insurance plan. In addition, the models are used to model a choice of treatment regimen for patient

(Jones, 2007: 26). The models can be also applied to describe the hospital utilization for health planners that emphasize on population-based utilization. Lee and Cohen (1985: 159) have used the multinomial logit model to explain and predict hospital market share in a service area by variety of patient, hospital provider and structure attributes in the state of Rhode Island. The model is also applied in the study of demand for health care in different subpopulations.

In this study, the multinomial logit model is applied to identify the preference for a universal health care scheme by each individual. Accordingly, choice-base conjoint (CBS) data is collected from Mae Rim district in the northern part of Thailand and analyzed by the multinomial logit model. The choice is the utility level measure of relative desirability or worth. The higher the utility, the more desirable the attribute level (Thitiwan Sricharoen, Buchebrieder and Dufhues, 2008: 65-92).

The model for categorical choices can be explained by the random utility model which is based on the principle that an individual chooses the outcome that maximizes the utility gained from that choice. If there is J choices for ith consumer and suppose that the utility of choice j is

$$U_{ij} = \mathbf{z}'_{ij}\boldsymbol{\beta} + \varepsilon_{ij}.$$

Assuming that U_{ij} is the maximum among the j utilities if the consumer ith chooses choice j. So the probability model of choosing choice j is

$$\Pr(U_{ij} > U_{ik}) \text{ for all other } k \neq j.$$

Let y_i be a random variable indicating the choice made by consumer ith, there is the set of probabilities for the J+1 choices with some explained variables x_i, the multinomial logit model:

$$\Pr(y_i = j) = \frac{e^{\beta'_j \mathbf{x}_i}}{\sum_{k=0}^{J} e^{\beta'_k \mathbf{x}_i}} \quad , j = 0, 1, \ldots, J. \qquad (4.8)$$

Therefore, if $\beta = 0$, since $e^{\beta'_1 \mathbf{x}_i} = \exp(\mathbf{x},0) = 1$, probabilities are

$$\Pr(y_i = 1|\mathbf{x}_i) = \frac{1}{1 + \sum_{k=2}^{J} e^{\beta'_k \mathbf{x}_i}}$$

$$\Pr(y_i = j \mid \mathbf{x}_i) = \frac{e^{\beta'_j \mathbf{x}_i}}{1 + \sum_{k=1}^{J} e^{\beta'_k \mathbf{x}_i}} \quad , j = 0, 2, \ldots, J, \boldsymbol{\beta}_0 = \mathbf{0}. \qquad (4.9)$$

The multinomial logit model can be expressed in terms of the odds ratios. The odds of outcome j versus outcome k given $\mathbf{x}$ is

$$\frac{\Pr(yi = j|\mathbf{x}i)}{\Pr(yi = k|\mathbf{x}i)} = \frac{\frac{e^{\beta_j' \mathbf{x}_i}}{\sum_{k=1}^{J} e^{\beta_j' \mathbf{x}_i}}}{\frac{e^{\beta_k' \mathbf{x}_i}}{\sum_{k=1}^{J} e^{\beta_j' \mathbf{x}_i}}} = \frac{e^{\beta_j' \mathbf{x}_i}}{e^{\beta_k' \mathbf{x}_i}} = \exp(\mathbf{x}_i'[\boldsymbol{\beta}_j - \boldsymbol{\beta}_k])$$

or simply

$$\frac{P_{ij}}{P_{ik}} = \exp(\mathbf{x}_i'[\boldsymbol{\beta}_j - \boldsymbol{\beta}_k]) \tag{4.10}$$

Taking logs equation (4.10) to show linearity in the logit, obtains log odds -ratio

$$\ln\left[\frac{P_{ij}}{P_{ik}}\right] = \mathbf{x}_i'(\boldsymbol{\beta}_j - \boldsymbol{\beta}_k) = \mathbf{x}_i'\boldsymbol{\beta}_j \text{ if } k = 0. \tag{4.11}$$

The difference $(\boldsymbol{\beta}_j - \boldsymbol{\beta}_k)$ is the effect of **x** on the logit of outcome j versus outcome k which is called contrast (Long, 1997: 154).

For each individual, if alternative *j* is chosen by individual *i*, and 0 otherwise for the *J*-1 outcomes, the log-likelihood can be derived as

$$\ln L = \sum_{i=1}^{n} \sum_{j=0}^{J} \ln \text{Prob}(y_i = j).$$

The marginal effects of the choice characteristics on the probabilities are obtained by differentiating equation (4.8):

$$\delta_j = \frac{\partial P_j}{\partial \mathbf{x}_i} = P_j\left[\beta_j - \sum_{k=0}^{J} P_k \beta_k\right] = P_j[\beta_j - \bar{\beta}] \tag{4.12}$$

(Greene, 2003: 719-722).

For the *J*-1 outcomes, the log-likelihood can be derived, for each individual, by defining $d_{ij} = 1$ if alternative *j* is chosen by individual *i*, and 0 otherwise.

$$\text{Ln } L = \sum_{i=1}^{n} \sum_{j=0}^{J} d_{ij} \ln \text{Prob}(Y_i = j)$$

Then the derivatives are

$$\frac{\partial \ln L}{\partial \beta_j} = \sum_i (d_{ij} - P_{ij})\mathrm{x}_i \text{ for j} = 1, \ldots, J$$

and second derivatives are

$$\frac{\partial^2 \ln L}{\partial \beta_j \partial \beta_l'} = - \sum_{i=1}^{n} P_{ij} [\mathbf{1}(j = l) - P_{il}]\mathrm{x}_i\mathrm{x}_i',$$

where **1** equals 1 if *j* equals *l* and 0 otherwise (Greene, 2003: 719-722).

4.1.2.4 Poisson Regression Model

Count data are not well estimated by using OLS regression because they seem to be non-normal (University of California at Los Angeles. UCLA Academic Technology Services. Statistical Consulting Group, 2006b). If the response variable is a count variable, the Poisson regression has been used widely to analyze this kind of data. Hence, y_i is a responsible variable to the equation with parameter λ_i related to the regressors x_i. The equation of the model is that

$$\text{Prob}(Y_i = y_i \mid x_i) = \frac{e^{-\lambda_i}\lambda_i^{y_i}}{y_i!}, \; y_i = 0, 1, 2, \ldots.$$

And the parameter λ_i is the loglinear model, $\ln\lambda_i = \mathbf{x}_i'\beta$ which can be shown as

$$E\,[y_i \mid \mathbf{x}_i] = \text{Var}[y_i \mid \mathbf{x}_i] = \lambda_i = e^{x_i'\beta}, \qquad (4.13)$$

then marginal effect is:

$$\frac{\partial E\,[y_i \mid x_i]}{\partial x_i} = \lambda_i\,\beta. \qquad (4.14)$$

The log-likelihood function is

$$\ln L = \sum_{i=1}^{n}[-\lambda_i + \; y_i x_i'\beta - \ln y_i!]$$

which is maximized by the maximum likelihood estimator (MLE).

The Poisson MLE solves the associated first order condition, the likelihood equations are

$$\frac{\partial \ln L}{\partial \beta} = \sum_{i=1}^{n}(y_i - \; \lambda_i)\mathbf{x}_i = \mathbf{0}.$$

The estimates are given so the prediction for observation i is $\widehat{\lambda_i} = \exp(x'\hat{\beta})$ (Greene, 2003: 740-741).

4.2 Definitions

Acute illness is a disease with a rapid onset and usually a short duration which could be severe and impair normal ability of functioning (Mosby's Medical Dictionary, 2009). Chronic disease, as defined by the U.S. National Center for Health Statistics, is a disease that lasts for long time, at least three months or more (Medicinenet, 2009) or a disease that the patient cannot completely recover from, or for which a patient has to receive consecutive treatments to control and prevent it from worsening (Foundation of Thai Gerontology Research and Development Institute (TGRI), 2007: 24). The World Health Organization (WHO) defines chronic diseases as those that last for a long duration and generally of slow progression. Chronic diseases tend to become more common with age. According to the WHO, half of the 35 million people who died from chronic diseases were under 70 years old, half of which were women. The major chronic diseases in developing countries are cardiovascular disease i.e. stroke and heart attack, cancer i.e. breast and colon cancer, diabetes, obesity, epilepsy and seizures, and oral health problem (WHO, 2010).

The proxy of wealth is household asset. It is the combination of household real asset which consists of the value of the house, land and building, value of vehicles owned by household, and value of financial assets.

Old age people are people 60 years old or older. They comprise three sub groups, namely, the young old group (aged 60-69 years), the old-old group (70-79 years), and the oldest old group (80 years or older).

4.3 Datasets and Data Sources

The datasets used in this research are those from the Health and Welfare Survey (HWS) and Socio-Economic Survey (SES) conducted in 2007 by the National Statistical Office (NSO) of Thailand. Both datasets were collected from January to December 2007. These two datasets were merged by using a personal identification number with 69,679 individual observations from 21,539 households. This is in accordance with the number of HWS observations. According to the general purpose of this research is to analyze the impacts of health on the ageing population, so the dataset are narrowed down to the respondents aged 45 years and older. The head of household are used to be a representative in this research which is 24,725 observations.

SES and HWS were designed as cross-section surveys and represent random samples of the population. In principle, each individual should have an equal probability of being selected in the survey and each observation is dependent. The whole numbers of household could be obtained directly from these national representative samples and can be used to extrapolate the results to the entire population.

CHAPTER 5

EMPIRICAL STUDY

5.1 RESEACRH DESIGN

This research employs economic regression models to answer the hypothetical questions. The study investigates health care utilization and identifies the burden from chronic diseases and acute illness in a situation of a rapidly increasing cohort of ageing population. Health status of individual will be identified by the probabilities of having chronic diseases and acute illness; the bivariate effects will be applied. The probabilities of becoming ill will be predicted in some conditions. Furthermore, the impact of chronic diseases and acute illness of a household member on household wealth will be clarified. (On this point, the question, “How is wealth impacted if a household member is having a chronic disease?” will not be asked in such an obvious way. Access to health care services by Thais will be indicated by the health insurance scheme that each individual holds. Finally, health care utilization will be measured by using the number of days stay in a hospital as inpatient; this is the outcome variable. In this part of the analysis, being ill and having some chronic diseases such as hypertension, diabetes, heart conditions, and cancer will be used as explanatory variables to the response variable. Moreover, the exercise variable will be introduced to the model to examine its impact on the utilization of health care.

5.2 VARIABLES

The datasets used in this research have been collected by the National Statistical Office (NSO) of Thailand. The datasets provide the necessary variables for the research and represent a random sample of the population. Information on the head of household are used to represent each household, e.g., household's wealth, health expenditure, and other including socio-economic information. The age of the household head is classified into four categories; 45- 59 years old, which represents the nonretirement group, 60-69 years, 70-79 years, and 80 years and older. There are 10,975 men and 10,750 women in the sample (see Table 5.1).

The first part of the empirical study is the analysis of health care status of the people. This part uses the bivariate probit regression technique to explain the probabilities of being ill and having chronic disease and predict the probabilities of being ill in some conditions. In this part, the necessary variables used to explain health status were a person's medical history in the past 12 months before interview, e.g., being ill, having chronic diseases and socio-economic characteristic, e.g., asset group, and work status, gender, age group, region, living area, i.e. urban or rural. The measurement of the chronic variable is derived from (i) the report in which the respondent answered the question on whether they have diabetes and hypertension from the Health and Welfare survey, and (ii) from their answers to the question as to whether they have heart problem and cancer from the Socio Economic survey. "Not sure" answers are included in the non-chronic part (which equals zero in dummy). This may underestimate the number of chronically ill patients in the country. Illness variable is measured from the answer to the question as to whether the respondent has had some illness in the past 12 months before the interview. Asset group has five categories, namely, asset worth less than 250,000 baht, 250,001-500,000 baht, 500,001- 1,000,000 baht, 10,000,001-45,000,000 baht, and higher than 45,000,000 baht (US$ 1 was approximately Baht 34 at the time of the study). "Region" refers to the four regions of Thailand and Bangkok, and work status is in six categories (see Table 5.2).

The details of each variable are as follows: *ill1* is a dummy variable of being ill; *ill1* equals 1 if ill and 0 if not ill, *chronic1* is a dummy variable of whether a person has a chronic disease or not; *chronic1* equals 1, which means that the person has a chronic disease, and 0 means he/she does not have any chronic; *female* equals 1 and male equals 0; *rural* equals 1 if people live in non-municipal area and 0 if they live in a municipal area; *assetgr* is a dummy for asset group classification; *reg* stands for regions in Thailand, *reg_1* for Bangkok Metropolis, *reg_2* for Central Thailand except Bangkok, *reg_3* for North, *reg_4* for Northeast, and *reg_5* for South. The last variable is *workstat* for work status, which is divided into 6 categories. *workstat_1* means unemployed group, *workstat_2* means employer, *workstat_3* means own account worker, *workstat_4* means government and state enterprise employee, *workstat_5* means private company employee, and *wkstatus_6* means housewife.

Table 5.1 Age – Sex Cohort

Age*	Male	Female	Total
45 - 59	6,645	7,984	14,629
60 - 69	2,511	3,027	5,538
70- 79	1,387	1,957	3,344
80 - 99	432	782	1,214
Total	**10,975**	**13,750**	**24,725**

*At time of sampling

The second part of the analysis is the study of how a chronic disease and/or acute illness affect household wealth. Instrumental variable regression is applied. The dependent variable is lnasset and the hinc which stands for household income is instrumented; the others are instrument variables. The additional variable from the first part is education, which has six categories, namely, *edu* for education of individual; *edu_1* for primary education, *edu_2* for lower secondary/vocational education, *edu_3* for upper education/vocational education, *edu_4* for high vocational, *edu_5* for a bachelor degree, and *edu_6* for a master degree and higher. The other variables are the same as in the first part.

The third part is the analysis of health care access, which is defined by the insurance scheme held by the individual. The technique used in this part is multinomial logit. The dependent variable is the insurance scheme. The explained variables are living area, gender, age group, asset group classification and occupation. Insurance scheme is categorized into No health insurance, Universal health care Coverage scheme (UCS), Social Security scheme (SSS), Civil Servant Medical Benefit scheme (CSMBS), and Private insurance. The occupation variable, *occ*, has 9 categories. *occ_1* for legislator, senior official, and general manager; *occ_2* for professional, technician and associate professional; *occ_3* for office clerk and secretary, *occ_4* for service worker, shop and market sales worker, *occ_5* for skilled agricultural and fishery worker, *occ_6* for crafts and related workers, *occ*_7 for plant and machine operator and assembler, *occ_8* for elementary occupation and *occ_9* for the economically inactive.

Table 5.2 Insurance Scheme

Insurance Scheme	**Frequency**	**Percent**	**Cumulative**
No health insurance	535	2.16	2.16
Universal Health Care Coverage	17,281	69.89	72.06
Social Security Scheme	972	3.93	75.99
The Civil Servant and State Enterprise Medical Benefit Scheme	5,711	23.1	99.09
Private insurance	226	0.91	100
Total	24,725	100	

The last part of the empirical analysis is the study of health care utilization when a person has a chronic disease, specifically, diabetes, hypertension, heart problem, and cancer. According to the characteristics of the dependent variable, which is the admission days in the hospital as inpatient, the poisson regression is applied. The exercise variable is introduced into the model to find its indirect effect on health. The definitions of the other variables are summarized in Table 5.3.

Table 5.3 Meaning of Variables in the Models

Variable	Meaning	Obs.	Mean	Std. Dev.
ill1	Illness=1, no illness=0	24,725	0.274459	0.446250
chronic	chronic=1, no chronic=0	24725	0.187138	0.390031
female	female=1, male=0	24725	0.556117	0.496851
rural	rural=1, urban=0	24725	0.400525	0.490014
assetgr_1	have asset between 0-250,000 Baht*	14,601	0.590535	0.491744
assetgr_2	have asset between 250,001-500,000 Baht*	2,486	0.100546	0.300733
assetgr_3	have asset between 500,001-1,000,000 Baht*	3,079	0.124529	0.330192
assetgr_4	have asset between 1,000,00-10,000,000 Baht*	4,368	0.176663	0.381391
assetgr_5	have asset > 10,000,000 Baht*	191	0.007725	.0875535
agegr_59	age between 45-59 years old	14,629	0.130412	0.336759
agegr_69	age between 60-69 years old	5,538	0.223983	0.416919
agegr_79	age between 70-79 years old	3,344	0.135247	0.341994
agegr_99	age > 80 years old	1,214	0.049100	0.216081
workstat_1	Unemployed	5,794	0.234337	0.423592
workstat_2	Employer	1,060	0.042871	0.202571
workstat_3	Own account worker	10,515	0.425278	0.494395
workstat_4	Government and state enterprise employee	2,277	0.092093	0.289163

Table 5.3 (Continued)

Variable	Meaning	Obs.	Mean	Std. Dev.
wkstatus_5	Private company employee	2,692	0.108877	0.311491
wkstatus_6	Housewife	2,387	0.096542	0.295339
insscheme_1	No health insurance	535	0.021638	0.145501
insscheme_2	Universal card (UCS)	17,281	0.698928	0.458733
insscheme_3	Social security scheme (SSS)	972	0.039312	0.194341
insscheme_4	Civil servant medical benefit scheme (CSMBS)	5,711	0.230980	0.421468
insscheme_5	Private insurance	226	0.009140	0.095170
reg_1	Bangkok Metropolis	1,211	0.048978	0.215828
reg_2	Central	6,826	0.276076	0.276076
reg_3	North	6,709	0.271344	0.444662
reg_4	Northeast	6,840	0.276643	0.447347
reg_5	South	3,139	0.126956	0.332931
occ_1	Legislators, senior officials	2,297	0.092901	0.290300
occ_2	Professionals, technicians and associate professionals	1,457	0.058928	0.235495
occ_3	Clerks and secretaries worker	272	0.011001	0.104309
occ_4	Service workers/shop and market	2,793	0.112962	0.316553
occ_5	Skilled agricultural and fishery workers	5,755	0.232760	0.422599
occ_6	Crafts and related workers	1,341	0.054236	0.226488
occ_7	Plant and machine operators and assemblers	699	0.028271	0.165749
occ_8	Elementary occupation	1,934	0.078220	0.268523
occ_9	Economically inactive occupation	8,177	0.330717	0.470481

Note: * 1 USD ≈ 34 Thai Baht

5.3 EMPIRICAL RESULTS

5.3.1 Estimation of Probability of Having Illness and Chronic Diseases

The bivariate probit model considers two binary outcomes and the relatedness between outcomes in the form of the correlation of the error terms of the binary outcomes model (Cameron and Trivedi, 2009: 515; Greene, 2003: 710-712). As such, the two outcomes are determined by two unobserved latent variables,

$$y_1^* = \boldsymbol{x}_1^{'}\beta_1 + \varepsilon_1$$
$$y_2^* = \boldsymbol{x}_2^{'}\beta_2 + \varepsilon_2$$

where the error terms ε_1 and ε_2 are jointly normally distributed with means 0, variances 1, and correlation ρ. The observed binary outcomes are

$$y_1 = \begin{cases} 1 & \text{if } y_2^* > 0 \\ 0 & \text{if } y_2^* > 0 \end{cases} \quad \text{and} \quad y_2 = \begin{cases} 1 & \text{if } y_2^* > 0 \\ 0 & \text{if } y_2^* > 0 \end{cases} \quad .$$

Specifically, this technique is used to estimate the probability of someone who is reported as being “ill” together with the probability of being a “chronic” patient, with explanatory variables of his/her socioeconomic characteristics e.g. gender, age and social status such as occupation, work status, living area and social class which is defined by the asset group.

In bivariate probit model, the random error terms between two regression equations are assumed to be correlated. In this case, it is assumed that there are some correlations between chronic disease and illness. Hence, the correlation between two dependent variables is tested under the hypothesis H_0: $\rho = 0$.

According to the research model in 4.1.2.1 (in Chapter 4), the two dependent variables used to analyze the binary outcomes are *ill1* and *chronic1* representing those people who have had illness and chronic diseases, respectively, in the 12 months before the interview. In this research model, dummy variable *ill1*equals 1 if someone reports having illness and 0 otherwise, and *chronic1* equals 1 if someone reports having a chronic disease and 0 otherwise. The explanatory variables are *assetgr* representing asset group, and *agegr* for age group. Additionally, female equals 1 and male equals 0; *rural* for someone living in non-municipal area, while others live in municipal area; *occ* for occupations; *reg* for regions, and *workstat* for work status.

From the result in Table 5.4, females have a significantly higher probability of having both illness and chronic diseases than males. Those who live in a rural area are found to have less chronic diseases than those who live in an urban area. It may be because people living in urban areas have more opportunity to have a health checkup than people living in rural areas. Age shows a significant impact on having both illness and chronic diseases, especially in people aged 70-79 years old compared to people aged less than 60 years old. People have a higher propensity to ill health as they get older. The probability of the old age group of having illness is higher than the youngest group by 0.17, 0.27, and 0.18 times in the young-old, the old-old, and the oldest-old group, respectively. The result in chronic diseases is almost the same; the probability to have chronic disease is 0.30, 0.37 in the young-old and the old-old group, respectively. For the oldest-old group, the result is insignificant.

The asset variable also shows some important effects correlations with illness. As it is categorized to five categories, the first category, _Iassetgr_250000, is omitted as a reference group. The result shows that a person who has more assets has lower probability of having illness. Therefore, it could be said that in general the wealthier a person is, the healthier he or she will be. However, asset does not have the same impact on chronic diseases as it does on illness. It cannot be concluded that one who has more asset will have a lower probability of having chronic diseases. The reason could be that some chronic diseases such as diabetes, cancer, obesity, cardiovascular diseases are associated with such risk factors as dietary habits, physical activity, and personal behaviors (Puska, Waxman and Porter, 2010: 1-2). The result shows that the higher asset a person has the higher is his/her probability of having chronic diseases. Furthermore, people who live in the northern and the central regions of Thailand have a significantly higher probability of having both illness and chronic diseases than those who live in the metropolitan area.

From the hypothesis testing of bivariate probit, the result is significantly different from zero of rho, in which rho equals 0.425. This means that there is some covariance of error terms between the probability of having illness and having chronic diseases. This also indicates the interdependence of the two adoption decisions, which is an important information for policy makers in developing a public health care policy. Moreover, conditional probability analysis after probit regression shows that the probability of having illness and a chronic disease (p11) is 9.8%; the probability of being ill with no chronic disease (p10) is 17.67%; the probability of having chronic diseases but not being ill (p01) is 8.93%; and the probability of having good health or no illness nor chronic diseases (p00) is 63.64%. These imply that 36.36% of Thais have some health problems (see Table 5.5).

Table 5.4 Bivariate Probit Regression Result

Bivariate probit regression				Number of obs	=	24725
				Wald chi2(36)	=	1639.17
Log likelihood = -24808.837				Prob > chi2	=	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
ill1						
female	0.283892	0.0196094	14.48	0.00	0.245459	0.322326
rural	0.026579	0.0181431	1.46	0.14	-0.008981	0.062139
_Iagegr_69	0.170706	0.0229809	7.43	0.00	0.125664	0.215748
_Iagegr_79	0.276062	0.0304011	9.08	0.00	0.216477	0.335647
_Iagegr_99	0.183516	0.0453577	4.05	0.00	0.094616	0.272415
_Iass~500000	0.167129	0.0298064	5.61	0.00	0.108709	0.225548
_Ias~1000000	0.099556	0.0279008	3.57	0.00	0.044871	0.154240
_Ia~10000000	0.033543	0.0257327	1.30	0.19	-0.016893	0.083978
_Ia~45000000	-0.068323	0.1049133	-0.65	0.52	-0.273949	0.137303
_Ireg_2	0.098585	0.0445934	2.21	0.03	0.011183	0.185986
_Ireg_3	0.224408	0.0446189	5.03	0.00	0.136956	0.311859
_Ireg_4	0.032380	0.044953	0.72	0.47	-0.055727	0.120486
_Ireg_5	0.022537	0.048367	0.47	0.64	-0.072261	0.117335
_Iworkstat_1	-0.067379	0.0491473	-1.37	0.17	-0.163706	0.028948
_Iworkstat_2	-0.120458	0.027127	-4.44	0.00	-0.173626	-0.067290
_Iworkstat_3	-0.191981	0.0408883	-4.70	0.00	-0.272120	-0.111841
_Iworkstat_4	-0.209821	0.0374533	-5.60	0.00	-0.283228	-0.136414

Table 5.4 (Continued)

	Coef.	Std. Err.	Z	P>|z|	[95% Conf. Interval]	
_Iworkstat_5	-0.165517	0.0363812	-4.55	0.00	-0.236823	-0.094212
_cons	-0.892441	0.0502439	-17.76	0.00	-0.990917	-0.793964
chronic1						
female	0.368440	0.0218481	16.86	0.00	0.325618	0.411261
rural	-0.091168	0.0200626	-4.54	0.00	-0.130490	-0.051846
_Iagegr_69	0.297108	0.0248344	11.96	0.00	0.248433	0.345782
_Iagegr_79	0.369581	0.0322264	11.47	0.00	0.306419	0.432744
_Iagegr_99	0.035758	0.0494452	0.72	0.47	-0.061153	0.132669
_Iass~500000	0.158263	0.0332769	4.76	0.00	0.093041	0.223485
_Ias~1000000	0.174535	0.0306984	5.69	0.00	0.114367	0.234703
_Ia~10000000	0.237456	0.0276662	8.58	0.00	0.183232	0.291681
_Ia~45000000	0.309917	0.1043936	2.97	0.00	0.105309	0.514525
_Ireg_2	0.155870	0.0475443	3.28	0.00	0.062685	0.249055
_Ireg_3	0.111958	0.0478449	2.34	0.02	0.018183	0.205732
_Ireg_4	-0.057285	0.0482971	-1.19	0.24	-0.151945	0.037376
_Ireg_5	-0.034390	0.0522832	-0.66	0.51	-0.136863	0.068084
_Iworkstat_1	-0.276120	0.0545945	-5.06	0.00	-0.383123	-0.169117
_Iworkstat_2	-0.226458	0.0286924	-7.89	0.00	-0.282694	-0.170222
_Iworkstat_3	-0.333385	0.0452739	-7.36	0.00	-0.422120	-0.244650
_Iworkstat_4	-0.422692	0.0423048	-9.99	0.00	-0.505608	-0.339776
_Iworkstat_5	-0.046137	0.0375491	-1.23	0.22	-0.119732	0.027458
_cons	-1.170503	0.0539855	-21.68	0.00	-1.276313	-1.064694
/athrho	0.453830	0.012997	34.92	0	0.428356	0.479304
rho	0.425042	0.010649			0.403947	0.445686
Likelihood-ratio test of rho=0:	chi2(1) =	1315.6	Prob > chi2 = 0.0000			

Table 5.5 Outcome Variables and Predicted Probabilities from Bivariate Probit Regression

Variable	Mean	Std. Dev.	Min	Max
ill1	0.274459	0.446250	0	1
chronic1	0.187139	0.390031	0	1
biprob1	0.274258	0.076093	0.120883	0.534119
biprob2	0.187012	0.089539	0.040785	0.513284
biprob11(p11)	0.097664	0.054836	0.018061	0.296638
biprob10(p10)	0.176594	0.032745	0.083228	0.300590
biprob01(p01)	0.089349	0.037721	0.022724	0.274921
biprob00(p00)	0.636394	0.105046	0.337544	0.831196

5.3.2 Wealth and the Impact of Chronic Diseases and Acute Illness

Chronic diseases and acute illness are a financial burden not only to an individual but also to the government. This part of the analysis studies the impact on household asset of chronic disease, which is defined as an illnesses that requires a long time treatment and is gradually developed (WHO, 2010) such as hypertension, cardiovascular disease, cancer, diabetes, etc., and the illness that the respondents have had in the 12 months before they were interviewed. The variable asset is calculated from household financial and nonfinancial assets, e.g., the value of the dwelling, land, business building, and vehicle. The instrumental variable regression technique is used to prevent the violation of the assumption of OLS framework. The results from instrumental variable regression method are shown in Table 5.6. The model is as follows and the number in the blankets is z score.

$$\ln(\text{asset}) = 10.822650 + 0.000046\textit{hinc}^{*} + 0.042708\textit{age}^{*} - 0.000289\textit{agesq}^{*}$$
$$(23.67) \quad (31.03) \quad (2.84) \quad (-2.39)$$
$$- 0.134799\textit{female}^{*} - 0.296841\textit{chronic1}^{*} - 0.053999\textit{ill1}^{**}$$
$$(-4.36) \quad (-4.60) \quad (-1.72)$$
$$+ 0.041123\textit{workstat\_1} + 0.030253\textit{workstat\_2} - 0.277757\textit{workstat\_3}^{*}$$
$$(0.58) \quad (0.70) \quad (4.24)$$
$$- 0.826293\textit{workstat\_4}^{*} - 0.034221\textit{workstat\_5}$$
$$(-14.52) \quad (-0.47)$$

* 95 % significant, ** 90% significant

With household income, *hinc*, being instrumented, the result shows that household wealth*, lnasset* which is a proxy for household wealth, will be depleted if a member in such household has some chronic diseases or illness, with a 95% level of significance. The wealth of a household that has a member with a chronic disease is 34.56% less than the wealth of a household that has no chronically ill member. Additionally, if there is a member that has an illness, the wealth of that household is 5.55% less than the household with no ill member. The result is based on the assumptions that other variables are held constant.

The age variables show a quadratic relation of age in wealth. The asset will increase in the working period and diminish in old age according to the life cycle model. In this case, the results show no R^2 because the sum of squares of the model and R^2 are negative and R^2 has no statistical meaning in the context of two-stage least square or instrumental variable regression (Sribney, Wiggins and Drukker, 2005: 1).

Table 5.6 Instrumental Variables Estimation Results

Instrumental variables (2SLS) regression					Number of obs = 12694	
					Wald chi2(12) = 2269.54	
					Prob > chi2 = 0.0000	
					R-squared = .	
					Root MSE = 1.5293	

lnasset	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
hinc	0.000046	0.000001	31.03	0.00	0.000044	0.000049
age	0.042708	0.015012	2.84	0.00	0.013284	0.072131
agesq	-0.000289	0.000121	-2.39	0.02	-0.000527	-0.000052
female	-0.134799	0.030914	-4.36	0.00	-0.195389	-0.074210
rural	0.237757	0.031083	7.65	0.00	0.176835	0.298679
chronic1	-0.296841	0.064534	-4.60	0.00	-0.423325	-0.170357
ill1	-0.053999	0.031338	-1.72	0.09	-0.115421	0.007422
_Iworkstat_1	0.041123	0.070728	0.58	0.56	-0.097502	0.179748
_Iworkstat_2	0.030253	0.043360	0.70	0.49	-0.054732	0.115238
_Iworkstat_3	-0.277757	0.065468	-4.24	0.00	-0.406071	-0.149442
_Iworkstat_4	-0.826293	0.056924	-14.52	0.00	-0.937862	-0.714724
_Iworkstat_5	-0.034221	0.072878	-0.47	0.64	-0.177059	0.108617
_cons	10.822650	0.457162	23.67	0.00	9.926626	11.718670

Instrumented: hinc

5.3.3 Health care Access

In health economics, multinomial logit is used to analyze the factors that have an impact on the choices of insurance scheme of each individual(Jones, 2007: 26). It specifies that

$$P_{ij} = \frac{e^{\beta'_j \mathrm{x}_i}}{\sum_{k=0}^{J} e^{\beta'_k \mathrm{x}_i}} \; , j = 0, 1, \ldots, J$$

where $\mathbf{x}_i$ are specific explanatory variables of receiving choice *j* relative to choice *k* of individual *i* (see equation 4.8 in chapter 4, (Cameron and Trivedi, 2009: 484)). Furthermore, the coefficient of this method can be explained in terms of odds ratios or relative- risk ratios which is the ratio of the probability of choosing one outcome category over the probability of choosing the reference category (University of California at Los Angeles. UCLA Academic Technology Services. Statistical Consulting Group, 2006: 2). The odds ratio or relative-risk ratios of receiving choice *j* rather than choice 1 is given by

$$\frac{\Pr(yi=j)}{\Pr(yi=1)} = \exp\,(\boldsymbol{x}'_i \beta_j)$$

in which e^{β_j} gives the proportionate change in the relative risk of receiving choice *j* rather than choice 1 when $\boldsymbol{x}_i$ changes by 1 unit (Cameron and Trivedi, 2009: 486).

In this study, the analysis of access to health care service by an individual is applied by using multinomial logit method to analyze the health insurance that each individual receives for health care. Access to the health care service is defined by an individual having a health care insurance under any of these schemes: universal health-care coverage scheme (UCS), government and state enterprises welfare or civil servant medical benefit welfare scheme (CSMBS), social security scheme (SSS), private insurance and other health care program, all of which are applied to insurance scheme. The outcome variable, i.e. the insurance scheme, is treated as categorical variable which assumes that the levels of insurance schemes have no natural ordering. The relationship between the outcome variable which is insurance scheme (*insscheme*) and explanatory variables *female*, *rural*, occupation (*occ*), asset group (*assetgr*) and age group (agegr) is assumed to be linear. Work status is not used in this part because of collinearity.

Table 5.7 Health Insurance Scheme and Gender

Health Insurance Scheme	Gender		Total
	Males %	Females %	%
No health insurance	229	306	535
	2.09	2.23	3.29
Universal Health-Care	7,471	9,810	17,281
Coverage (UCS)	68.07	71.35	69.89
Social Security Scheme (SSS)	564	408	972
	10.33	9.11	9.69
Civil Servant Medical Benefit	4,770	5,582	10,352
Scheme (CSMBS)	5.14	2.97	3.93
Private insurance	100	126	226
	0.91	0.92	0.91
Total	10,975	13,750	24,725
%	100.00	100.00	100.00

From the regression result in Table 5.8, Universal health care coverage scheme (UCS) is the reference base outcome. Since the parameter estimates are relative to the referent group, the first model is therefore an estimated model for people having no health insurance relative to UCS. The multinomial logit for a person who lives in a non- municipal area (rural) relative to one who lives in a municipal area (urban) is 0.500 units less than that of a person who receives no insurance to receiving UCS. This means that a person who lives in a municipal area tends to have a UCS, rather than not being insured, as compared to one who lives in a non-municipal area, assuming the other variables in the model are constant. Also, the multinomial logit for females relative to males is 0.267 units lower for having no insurance than receiving UCS. In other words, males rather have UCS than not have insurance compared to females. For asset class analysis, it seems that persons who are in the lowest income group have UCS rather than have no insurance. However, those in the higher income class seem to have no insurance rather than have UCS. It is possible that those in the high income group have another health insurance policy such as CSMBS or SSS or private insurance. The other variables in this model are insignificant.

The second model is an estimated model for people having social security insurance scheme (SSS) relative to UCS. The multinomial logit for a person who lives in a non-municipal area relative to one who lives in a municipal area is 0.447 units less than that of a person who receives SSS to receive UCS. In other words, people who live in non-municipal rather have UCS than SSS for 0.447 units. For females relative to males, the multinomial logit is 0.278 units higher than that of a person who receives SSS to those who receive UCS. In occupational analysis, the legislator, senior officer and manger group is a base referent, the multinomial logit comparing the professional group and the legislators and senior officer group is 2.605 units higher for having SSS relative to having UCS. In age group analysis, the group of age less than 60 years old is the base referent, the multinomial logit comparing the working age group (45-59 years old) to the young old group (aged 60-69 years old), the old-old group, and the oldest old group for SSS relative to UCS is lower for having SSS relative to having UCS. This means that the persons in the working age group relative to those in the older age group have SSS rather than UCS. In other words, the old age group relative to the young group tends to have a UCS rather than an SSS.

It could be easier to interpret the result in relative risk ratios (rrr) forms. The results can be obtained by exponentiating the multinomial logit coefficients, e^{coef}. Table 5.9 shows the relative risk ratios results. For instance, in the third model, relative risk ratio comparing females to males for having CSMBS relative to UCS is shown with the other variables in the model held constant. For people who live in rural area relative to those who live urban area, the ratio of relative risk of having CSMBS over UCS is exp(-0.824584) or 0.438417. A comparison of the three old age groups to the youngest group shows that the relative risk ratio of having CSMBS relative to the UCS is positive in every group. This means that those in the old age groups have CSMBS rather than UCS compared to the youngest group. The same result is observed in the asset class analysis: the richer classes have CSMBS rather than UCS compared to the lowest class.

The fourth model compares between having private insurance and UCS. Comparing the richest group and the poorest class, the relative risk ratio for those having private insurance relative to UCS is 0.434 in asset group between 250,000 - 500,000 and the relative risk ratio is higher in the higher asset group than in the lowest asset class. This means that those in the high income class have private insurance rather than UCS. The same result is seen by age group: the older age group tends to have private insurance rather than UCS compared to the youngest age group.

The results are according to the hypothesis testing that could not be rejected for the relative risk ratios of the particular health insurance scheme which have been found to be statistically different from zero associated alpha level of 0.05.

Table 5.8 Multinomial Logistic Regression in Terms of Coefficients

Multinomial logistic regression					Number of obs	= 24725
					LR chi2(68)	= 7727.83
					Prob > chi2	= 0.0000
Log likelihood = -16952.778					Pseudo R2	= 0.1856
Insurance Scheme	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
No health insurance						
rural	-0.500629	0.100601	-4.98	0.00	-0.697804	-0.303454
female	-0.266707	0.098779	-2.70	0.01	-0.460310	-0.073105
_Iagegr_69	-0.048715	0.115771	-0.42	0.67	-0.275621	0.178192
_Iagegr_79	-0.149910	0.150636	-1.00	0.32	-0.445152	0.145331
_Iagegr_99	-0.117538	0.217326	-0.54	0.59	-0.543489	0.308413
_Iass~500000	-1.218542	0.227956	-5.35	0.00	-1.665326	-0.771757
_Ias~1000000	-0.922476	0.189231	-4.87	0.00	-1.293363	-0.551590
_Ia~10000000	-0.142487	0.137257	-1.04	0.30	-0.411507	0.126532
_Ia~45000000	1.067395	0.370488	2.88	0.00	0.341253	1.793538
_Iocc_2	1.058906	0.335555	3.16	0.00	0.401230	1.716582
_Iocc_3	1.376644	0.555985	2.48	0.01	0.286934	2.466354
_Iocc_4	0.314506	0.175788	1.79	0.07	-0.030033	0.659044
_Iocc_5	-1.345880	0.214680	-6.27	0.00	-1.766644	-0.925115
_Iocc_6	0.123269	0.210953	0.58	0.56	-0.290191	0.536729
_Iocc_7	-0.339079	0.338598	-1.00	0.32	-1.002719	0.324562
_Iocc_8	0.172201	0.194892	0.88	0.38	-0.209780	0.554182
_Iocc_9	0.055221	0.170565	0.32	0.75	-0.279080	0.389523
_cons	-2.798726	0.162501	-17.22	0.00	-3.117223	-2.480230

Table 5.8 (Continued)

Insurance Scheme	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Social Security Scheme (SSS)						
rural	-0.447101	0.080025	-5.59	0.00	-0.603947	-0.290254
female	-0.277817	0.080899	-3.43	0.00	-0.436377	-0.119257
_Iagegr_69	-1.118836	0.132679	-8.43	0.00	-1.378882	-0.858790
_Iagegr_79	-3.053030	0.506771	-6.02	0.00	-4.046282	-2.059778
_Iagegr_99	-3.152105	1.008306	-3.13	0.00	-5.128348	-1.175862
_Iass~500000	-0.631012	0.143795	-4.39	0.00	-0.912845	-0.349178
_Ias~1000000	-0.166884	0.115727	-1.44	0.15	-0.393705	0.059937
_Ia~10000000	0.258311	0.102284	2.53	0.01	0.057838	0.458783
_Ia~45000000	1.925594	0.287319	6.70	0.00	1.362459	2.488730
_Iocc_2	2.604963	0.171135	15.22	0.00	2.269545	2.940381
_Iocc_3	3.679770	0.250971	14.66	0.00	3.187876	4.171665
_Iocc_4	-0.303792	0.153188	-1.98	0.05	-0.604035	-0.003549
_Iocc_5	-2.184504	0.218552	-10.00	0.00	-2.612858	-1.756150
_Iocc_6	0.540831	0.147967	3.66	0.00	0.250822	0.830840
_Iocc_7	1.783062	0.142097	12.55	0.00	1.504556	2.061568
_Iocc_8	0.981036	0.131753	7.45	0.00	0.722806	1.239267
_Iocc_9	-1.027709	0.178294	-5.76	0.00	-1.377160	-0.678259
_cons	-2.293826	0.124757	-18.39	0.00	-2.538345	-2.049307
Civil Servant Medical Benefit Scheme (CSMBS)						
rural	-0.824584	0.039902	-20.67	0.00	-0.902790	-0.746378
female	-0.048482	0.039501	-1.23	0.22	-0.125902	0.028939
_Iagegr_69	0.156893	0.045784	3.43	0.00	0.067159	0.246627
_Iagegr_79	0.311630	0.054332	5.74	0.00	0.205142	0.418119
_Iagegr_99	0.252327	0.077636	3.25	0.00	0.100163	0.404491
_Iass~500000	-0.286429	0.069515	-4.12	0.00	-0.422675	-0.150183
_Ias~1000000	0.262875	0.055688	4.72	0.00	0.153729	0.372021
_Ia~10000000	0.984728	0.047063	20.92	0.00	0.892486	1.076971

Table 5.8 (Continued)

Insurance Scheme	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
_Ia~45000000	1.332137	0.179536	7.42	0.00	0.980253	1.684020
_Iocc_2	3.694697	0.116708	31.66	0.00	3.465954	3.923439
_Iocc_3	3.116644	0.220736	14.12	0.00	2.684010	3.549278
_Iocc_4	0.066329	0.073968	0.90	0.37	-0.078645	0.211303
_Iocc_5	-0.651460	0.072103	-9.04	0.00	-0.792778	-0.510141
_Iocc_6	-0.807732	0.117155	-6.89	0.00	-1.037351	-0.578114
_Iocc_7	0.071296	0.123225	0.58	0.56	-0.170222	0.312813
_Iocc_8	-0.425255	0.095064	-4.47	0.00	-0.611577	-0.238933
_Iocc_9	0.439943	0.065374	6.73	0.00	0.311813	0.568074
_cons	-1.393678	0.065169	-21.39	0.00	-1.521406	-1.265950
Private Insurance Scheme						
rural	-0.613703	0.162922	-3.77	0.00	-0.933025	-0.294381
female	0.039332	0.156268	0.25	0.80	-0.266948	0.345612
_Iagegr_69	-0.854817	0.211346	-4.04	0.00	-1.269048	-0.440585
_Iagegr_79	-0.827009	0.276774	-2.99	0.00	-1.369476	-0.284542
_Iagegr_99	-1.310287	0.525124	-2.50	0.01	-2.339511	-0.281063
_Iass~500000	-0.834691	0.350707	-2.38	0.02	-1.522063	-0.147318
_Ias~1000000	-0.288731	0.255683	-1.13	0.26	-0.789860	0.212398
_Ia~10000000	0.558958	0.183496	3.05	0.00	0.199313	0.918604
_Ia~45000000	2.435113	0.345808	7.04	0.00	1.757343	3.112884
_Iocc_2	1.327087	0.312883	4.24	0.00	0.713848	1.940326
_Iocc_3	1.492695	0.558474	2.67	0.01	0.398106	2.587284
_Iocc_4	-0.302146	0.220167	-1.37	0.17	-0.733665	0.129374
_Iocc_5	-1.515831	0.260564	-5.82	0.00	-2.026527	-1.005135
_Iocc_6	-1.222032	0.388927	-3.14	0.00	-1.984316	-0.459749
_Iocc_7	-1.331161	0.601445	-2.21	0.03	-2.509972	-0.152351
_Iocc_8	-0.964306	0.313845	-3.07	0.00	-1.579431	-0.349180

Table 5.8 (Continued)

Insurance Scheme	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
_Iocc_9	-0.602615	0.222060	-2.71	0.01	-1.037844	-0.167386
_cons	-3.272816	0.205268	-15.94	0.00	-3.675135	-2.870498

(insurance scheme==Universal card is the base outcome)

Table 5.9 Multinomial Logit Regression in Terms of Relative-Risk Ratios

Multinomial logistic regression					Number of obs	= 24725
					LR chi2(68)	= 7727.83
					Prob > chi2	= 0.0000
Log likelihood = -16952.778					Pseudo R2	= 0.1856
insscheme	RRR	Std. Err.	z	P>|z|	[95% Conf.	Interval]
No health insurance						
rural	0.606149	0.060979	-4.98	0.00	0.497677	0.738264
female	0.765897	0.075654	-2.70	0.01	0.631088	0.929504
_Iagegr_69	0.952453	0.110266	-0.42	0.67	0.759100	1.195055
_Iagegr_79	0.860785	0.129665	-1.00	0.32	0.640727	1.156423
_Iagegr_99	0.889107	0.193226	-0.54	0.59	0.580719	1.361263
_Iass~500000	0.295661	0.067398	-5.35	0.00	0.189129	0.462200
_Ias~1000000	0.397533	0.075226	-4.87	0.00	0.274347	0.576033
_Ia~10000000	0.867199	0.119029	-1.04	0.30	0.662651	1.134886
_Ia~45000000	2.907796	1.077303	2.88	0.00	1.406709	6.010680
_Iocc_2	2.883215	0.967478	3.16	0.00	1.493661	5.565475
_Iocc_3	3.961583	2.202579	2.48	0.01	1.332336	11.779420
_Iocc_4	1.369582	0.240756	1.79	0.07	0.970414	1.932943
_Iocc_5	0.260311	0.055883	-6.27	0.00	0.170906	0.396486
_Iocc_6	1.131189	0.238627	0.58	0.56	0.748121	1.710403
_Iocc_7	0.712426	0.241226	-1.00	0.32	0.366880	1.383425
_Iocc_8	1.187917	0.231515	0.88	0.38	0.810763	1.740517
_Iocc_9	1.056774	0.180249	0.32	0.75	0.756479	1.476276

Table 5.9 (Continued)

insscheme	RRR	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Social Security Scheme (SSS)						
rural	0.639480	0.051175	-5.59	0.00	0.546650	0.748074
female	0.757436	0.061276	-3.43	0.00	0.646374	0.887580
_Iagegr_69	0.326660	0.043341	-8.43	0.00	0.251860	0.423674
_Iagegr_79	0.047216	0.023928	-6.02	0.00	0.017487	0.127482
_Iagegr_99	0.042762	0.043117	-3.13	0.00	0.005926	0.308553
_Iass~500000	0.532053	0.076507	-4.39	0.00	0.401381	0.705267
_Ias~1000000	0.846298	0.097940	-1.44	0.15	0.674553	1.061770
_Ia~10000000	1.294741	0.132431	2.53	0.01	1.059544	1.582148
_Ia~45000000	6.859224	1.970788	6.70	0.00	3.905784	12.045970
_Iocc_2	13.530720	2.315579	15.22	0.00	9.674995	18.923060
_Iocc_3	39.637290	9.947819	14.66	0.00	24.236880	64.823280
_Iocc_4	0.738014	0.113055	-1.98	0.05	0.546601	0.996457
_Iocc_5	0.112534	0.024594	-10.00	0.00	0.073325	0.172709
_Iocc_6	1.717434	0.254123	3.66	0.00	1.285082	2.295247
_Iocc_7	5.948041	0.845201	12.55	0.00	4.502155	7.858279
_Iocc_8	2.667219	0.351413	7.45	0.00	2.060206	3.453081
_Iocc_9	0.357826	0.063798	-5.76	0.00	0.252294	0.507500
Civil Servant Medical Benefit Scheme (CSMBS)						
rural	0.438417	0.017494	-20.67	0.00	0.405437	0.474081
female	0.952675	0.037632	-1.23	0.22	0.881701	1.029361
_Iagegr_69	1.169870	0.053561	3.43	0.00	1.069465	1.279702
_Iagegr_79	1.365650	0.074198	5.74	0.00	1.227700	1.519101
_Iagegr_99	1.287017	0.099919	3.25	0.00	1.105351	1.498539
_Iass~500000	0.750940	0.052201	-4.12	0.00	0.655291	0.860550
_Ias~1000000	1.300664	0.072431	4.72	0.00	1.166174	1.450664
_Ia~10000000	2.677085	0.125992	20.92	0.00	2.441192	2.935772
_Ia~45000000	3.789131	0.680284	7.42	0.00	2.665131	5.387169

Table 5.9 (Continues)

insscheme	RRR	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_Iocc_2	40.233370	4.695539	31.66	0.00	32.006980	50.574090
_Iocc_3	22.570500	4.982113	14.12	0.00	14.643700	34.788180
_Iocc_4	1.068578	0.079040	0.90	0.37	0.924368	1.235287
_Iocc_5	0.521284	0.037586	-9.04	0.00	0.452586	0.600411
_Iocc_6	0.445868	0.052235	-6.89	0.00	0.354392	0.560956
_Iocc_7	1.073899	0.132332	0.58	0.56	0.843478	1.367266
_Iocc_8	0.653603	0.062134	-4.47	0.00	0.542495	0.787468
_Iocc_9	1.552619	0.101501	6.73	0.00	1.365899	1.764865
Private Insurance Scheme						
rural	0.541343	0.088197	-3.77	0.00	0.393362	0.744993
female	1.040116	0.162537	0.25	0.80	0.765713	1.412854
_Iagegr_69	0.425361	0.089899	-4.04	0.00	0.281099	0.643660
_Iagegr_79	0.437355	0.121049	-2.99	0.00	0.254240	0.752359
_Iagegr_99	0.269743	0.141648	-2.50	0.01	0.096375	0.754981
_Iass~500000	0.434009	0.152210	-2.38	0.02	0.218261	0.863019
_Ias~1000000	0.749214	0.191561	-1.13	0.26	0.453909	1.236639
_Ia~10000000	1.748850	0.320907	3.05	0.00	1.220564	2.505789
_Ia~45000000	11.417110	3.948127	7.04	0.00	5.797012	22.485810
_Iocc_2	3.770044	1.179582	4.24	0.00	2.041833	6.961017
_Iocc_3	4.449068	2.484689	2.67	0.01	1.489001	13.293610
_Iocc_4	0.739231	0.162754	-1.37	0.17	0.480146	1.138116
_Iocc_5	0.219626	0.057227	-5.82	0.00	0.131793	0.365995
_Iocc_6	0.294631	0.114590	-3.14	0.00	0.137475	0.631442
_Iocc_7	0.264170	0.158884	-2.21	0.03	0.081271	0.858687
_Iocc_8	0.381248	0.119653	-3.07	0.00	0.206092	0.705266
_Iocc_9	0.547378	0.121551	-2.71	0.01	0.354218	0.845873

(insscheme==Universal card is the base outcome)

5.3.4 Health care Utilization

The utilization of health care service can be measured in many ways, such as by the number of times an individual visits the doctor during a given period, the number of prescriptions dispensed to a patient, or the number of days admitted to the hospital as an inpatient (Jones, 2007: 49). The technique applied in the analysis is poisson regression. The objective of this analysis is to analyze how acute a particular chronic disease such as diabetes, heart problem diseases, cancer, or hypertension is, which is implied as the burden to the individual and to the public health service. To study how people utilize health care services if they have a health problem, the number of days admitted as inpatient is used as a proxy of health care service utilization. Additionally, if those who have a health problem perform exercises, with the assumption that exercise affects the length of admission, the exercise variable is introduced to the model. In this model, the response variable is the number of days that the respondent is admitted to the hospital as an inpatient in the 12 months before being interviewed (*ipday*)[1]. The predictor variables that would affect inpatient days are gender (*female*), living area (*rural*), exercise (*exercise*), age cohort (*agegr*), income class (*assetgr*), health insurance scheme (*insscheme*), and some diseases such as diabetes cancer, heart problem, and hypertension.

In accordance with 4.1.2.4 in Chapter 4, hence y_i is the response variable in the equation with parameter λ_i related to the regressors x_i, the model is

$$\text{Prob}(Y_i = y_i \mid \mathbf{x}_i) = \frac{e^{-\lambda_i}\lambda_i^{y_i}}{y_i!},\ y_i = 0, 1, 2, \ldots$$

and the parameter λ_i is the loglinear model, $\ln\lambda_i = x_i'\beta$ which can be shown as $\lambda_i = e^{x_i'\beta}$. The exponential function is used to ensure that the intensity of the process is always positive given x_i (Jones, 2007: 49) so the prediction for observation *i* is $\hat{\lambda}_i = \exp(x'\hat{\beta})$(Greene, 2003: 710-714).

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1 The variable names are in the parenthesis

Specifically, poisson regression coefficient is a difference between the logs of expected counts to incidence rate ratio. The poisson regression results in Table 5.10 show the poisson regression coefficient comparing a person who has the particular characteristic predictor variables with one who does not have those characteristics, with the other variables held constant in the model. The difference in the logs of expected inpatient days is expected to be 0.150 units higher for a person who has diabetes compared to one who does not have it, while holding the other variables constant. A person who has cancer has logs of expected inpatients days 0.648 units higher than one who has none. In the same way, a person who has heart condition such as cardiovascular disease or heart failure has logs of expected inpatients days 0.208 units higher than one without heart condition. However, a person who has hypertension has logs of expected inpatients day 0.078 units lower than one who does not have it. This means that the person with hypertension has a lower probability of admission in a hospital than the one who does not have hypertension. This result is not surprising because hypertension is not a severe chronic ailment. The one who does not have hypertension may have other more severe disease such as diabetes or heart attack. From the analysis, 43.31% of the samples have hypertension and heart problems and 48.57% have both hypertension and diabetes.

As to gender, the difference in the logs of expected inpatient days is expected to be less for females than males by 0.158 units. And a person who lives in a rural area has expected logs of expected inpatients days 0.126 shorter than one who lives in an urban area. In terms of age group, the oldest old has logs of expected inpatients days 0.389 units higher than the youngest group, which age is less than 60 years old. The old-old group and the young old group also have higher logs of expected inpatient days than the youngest group.

The results can be interpreted from another perspective. Poisson regression coefficients can be interpreted in term of incidence rate ratio (irr). The term of incidence rate ratios (irr) or the log of the ratio of expected count could be used to explain each event. For instance, a person who has diabetes compared to one without it is expected to have a rate 1.162 times longer for inpatient days, while holding the other variables constant. Additionally, a person who has cancer or a heart problem compared to one who does not have any disease is expected to have a rate 1.911 and

1.231 times longer for inpatient days, respectively. But, a person who has hypertension is expected to have a rate 0.925 times shorter than one who has none. When the exercise variable is introduced to the model to find its impact on the length of admission of a person as inpatients, it was shown that a person who does some exercise is expected to have a rate 0.818 times shorter than one who does not.

The impact on the inpatient days of an aging population is also examined, considering only the personal characteristics of the respondent, such as age, gender, and health problems such as diabetes, cancer, heart problems, and hypertension, with other variables held constant. The results are shown in Table 5.12 and the IRR results are shown in Table 5.13.

The results indicate that a person who has health problems is expected to have more inpatient days than one who is healthier, at 99 percent significance level. In age group analysis, the young old, the old-old, and the oldest old, compared to the youngest group (age less than 60 years old), are expected to have a rate 1.093, 1.067, and 1.536 times more inpatient days, respectively.

Table 5.10 Poisson Regression Result for Days of Inpatient

Poisson regression				Number of obs	=	2031
				LR chi2(18)	=	894.39
				Prob > chi2	=	0.0000
Log likelihood = -10410.985				Pseudo R2	=	0.0412

ipday	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
diabetes	0.150243	0.027345	5.49	0.00	0.096647	0.203838
cancer	0.647708	0.032463	19.95	0.00	0.584081	0.711335
heartpb	0.208142	0.023315	8.93	0.00	0.162445	0.253838
hyperts	-0.078015	0.023553	-3.31	0.00	-0.124179	-0.031852
female	-0.158011	0.019152	-8.25	0.00	-0.195548	-0.120473
rural	-0.125514	0.018805	-6.67	0.00	-0.162370	-0.088658
exercise	-0.200703	0.020763	-9.67	0.00	-0.241397	-0.160009
_Iagegr_69	0.088304	0.023165	3.81	0.00	0.042903	0.133706
_Iagegr_79	0.051473	0.024130	2.13	0.03	0.004179	0.098768
_Iagegr_99	0.389356	0.029008	13.42	0.00	0.332500	0.446211
_Iass~500000	-0.026912	0.029573	-0.91	0.36	-0.084875	0.031050
_Ias~1000000	-0.075822	0.029290	-2.59	0.01	-0.133229	-0.018416
_Ia~10000000	0.018614	0.025721	0.72	0.47	-0.031798	0.069026
_Ia~45000000	-0.375587	0.099144	-3.79	0.00	-0.569906	-0.181268
_Iinsschem~1	0.030167	0.082354	0.37	0.71	-0.131245	0.191578
_Iinsschem~2	-0.060847	0.097291	-0.63	0.53	-0.251534	0.129839
_Iinsschem~3	0.138283	0.083335	1.66	0.10	-0.025050	0.301617
_Iinsschem~4	0.379884	0.118336	3.21	0.00	0.147951	0.611818
_cons	1.833153	0.083936	21.84	0.00	1.668642	1.997665

Table 5.11 Poisson Regression for Days of Inpatient with IRR

Poisson regression					Number of obs	= 2031
					LR chi2(18)	= 894.39
					Prob > chi2	= 0.0000
Log likelihood = -10410.985					Pseudo R2	= 0.0412

ipday	IRR	Std. Err.	z	P>|z|	[95% Conf. Interval]	
diabetes	1.162116	0.031778	5.49	0.00	1.101472	1.226100
cancer	1.911155	0.062043	19.95	0.00	1.793342	2.036708
heartpb	1.231387	0.028710	8.93	0.00	1.176383	1.288963
hyperts	0.924950	0.021786	-3.31	0.00	0.883222	0.968650
female	0.853841	0.016353	-8.25	0.00	0.822384	0.886501
rural	0.882043	0.016587	-6.67	0.00	0.850126	0.915159
exercise	0.818155	0.016987	-9.67	0.00	0.785529	0.852136
_Iagegr_69	1.092320	0.025303	3.81	0.00	1.043836	1.143056
_Iagegr_79	1.052821	0.025405	2.13	0.03	1.004188	1.103810
_Iagegr_99	1.476029	0.042817	13.42	0.00	1.394450	1.562381
_Iass~500000	0.973447	0.028788	-0.91	0.36	0.918627	1.031537
_Ias~1000000	0.926981	0.027151	-2.59	0.01	0.875265	0.981753
_Ia~10000000	1.018789	0.026204	0.72	0.47	0.968703	1.071464
_Ia~45000000	0.686886	0.068101	-3.79	0.00	0.565579	0.834212
_Iinsschem~1	1.030626	0.084877	0.37	0.71	0.877003	1.211160
_Iinsschem~2	0.940967	0.091548	-0.63	0.53	0.777607	1.138645
_Iinsschem~3	1.148301	0.095694	1.66	0.10	0.975261	1.352043
_Iinsschem~4	1.462115	0.173020	3.21	0.00	1.159456	1.843779

Table 5.12 Estimation for Inpatient Day Responding from Personal Characteristics and Health Problems

Poisson regression					Number of obs	= 2031
					LR chi2(8)	= 682.28
					Prob > chi2	= 0.0000
Log likelihood = -10517.04					Pseudo R2	= 0.0314

ipday	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
diabetes	0.126144	0.027059	4.66	0.00	0.073110	0.179178
cancer	0.663116	0.032235	20.57	0.00	0.599936	0.726297
heartpb	0.209381	0.023257	9.00	0.00	0.163798	0.254964
hyperts	-0.093712	0.023268	-4.03	0.00	-0.139316	-0.048107
female	-0.138948	0.017999	-7.72	0.00	-0.174225	-0.103671
_Iagegr_69	0.089218	0.022835	3.91	0.00	0.044463	0.133974
_Iagegr_79	0.064698	0.023661	2.73	0.01	0.018323	0.111072
_Iagegr_99	0.429772	0.028354	15.16	0.00	0.374199	0.485345
_cons	1.757522	0.018106	97.07	0.00	1.722035	1.793000

Table 5.13 Estimation for Inpatient Day Responding from Personal Characteristics and Health Problem in RRR Terms

Poisson regression				Number of obs	=	2031
				LR chi2(8)	=	682.28
				Prob > chi2	=	0.0000
Log likelihood = -10517.04				Pseudo R2	=	0.0314

ipday	IRR	Std. Err.	z	P>|z|	[95% Conf.	Interval]
diabetes	1.134445	0.030697	4.66	0.00	1.075849	1.196233
cancer	1.940831	0.062564	20.57	0.00	1.822002	2.067410
heartpb	1.232914	0.028674	9.00	0.00	1.177976	1.290415
hyperts	0.910545	0.021187	-4.03	0.00	0.869953	0.953032
female	0.870273	0.015664	-7.72	0.00	0.840108	0.901522
_Iagegr_69	1.093319	0.024966	3.91	0.00	1.045466	1.143363
_Iagegr_79	1.066836	0.025242	2.73	0.01	1.018492	1.117476
_Iagegr_99	1.536907	0.043578	15.16	0.00	1.453826	1.624735

CHAPTER 6

CONCLUSION AND POLICY IMPLICATION

6.1 CONCLUSION

The health status of individual is clarified by the bivariate effect of having chronic and acute illness. Since economic status has an influence on an individual's health status. The probability of having illness is less in a person with high income. This suggests that, in general, the wealthier the person is, the healthier he or she will be. However, the same cannot be said with chronic disease because some chronic diseases and disorders such as diabetes, cancer, obesity, cardiovascular diseases are associated with such risk factors as dietary habit, physical activity, and personal behavior. Besides, age group has a significant impact on the probability of a person having illness and chronic diseases: the older a person is, the higher the probability he or she will contract an illness and chronic disease. Since there is some covariance of error terms between the probabilities of having illness and having chronic diseases, this indicates the interdependence of the two adoption decisions in developing a policy on public health care. The probability of being ill among the Thai population is a high, 18%. However, an 8.93% probability of having chronic disease should not be ignored either.

Chronic disease and acute illness have been shown to affect household wealth under certain circumstances. If a household member has a chronic disease or comes down with an acute illness, the wealth of the household definitely depletes. Health care is expensive and getting more so due to the advancements in medical treatment and technology. Yet, too many people cannot afford the medication they need, with some prescription medicines accounting for a large share of out-of-pocket medical expense. Households with a high dependency ratio, such as having a number of youthful and/or elderly members, should be well prepared for medical contingencies particularly unexpected medical expenses. Equity in health care access should be also considered. The universal health care coverage scheme has enabled a majority of the Thai people to have easier and more frequent access to health care services. The working age population employed in the formal sector have social security insurance scheme and the old age group relative to the young group seems to have UCS rather than SSS. A large portion of the old age population is in the informal sector so that the UCS helps to alleviate the impacts of a serious health problem. Economic status certainly affects the ability to access health care; the richest group has CSMBS rather than UCS. They also prefer having private insurance to UCS. The probability of having UCS by age group is higher in the older group. The findings show clearly that the most vulnerable, the ones with less assets and the elderly, have the least access to a comprehensive health care service and to well-equipped health care facilities. This strongly the need for a policy that assures a good quality of public health care for the poor and the elderly.

The utilization of health care by people who have chronic and acute illness is also a matter of important concern. The empirical study shows that a person who has some chronic disease, i.e., diabetes, heart problem, and cancer, is expected to have a more frequent admission rate in a hospital as inpatient than one who has not reported having chronic disease or acute illness. In addition, a male and one who live in a municipal area is expected to stay longer in the hospital. And the oldest old group is expected to stay 1.48 times longer in a hospital than the youngest group. These findings indicate that the different segments of the population require different types of care and health service, with the more vulnerable old age group requiring special attention.

One other finding of the study is noteworthy: That a person who does some exercise is expected to stay in a hospital as inpatient 0.818 times shorter than one who does not. This is not a surprise but it does suggest an option for a public education campaign.

6.2 POLICY IMPLICATION

The financial burden of a household due to health problem should be alleviated for low income class who work in the informal sector. The ageing population who have worked in the informal sector and thus lack social security should have equal access to health care. The Universal health care scheme covers almost 95% of the Thai population and benefits those who are eligible to this scheme. The ones who are not covered need more attention from the government. To alleviate the burden of a household due to a member's chronic or acute ailment, health promotion can be used as a tool to improve the health of the population. The higher incidence of chronic disease and acute illness in the elderly increases the burden of household. While prescription medicine can save lives and cure illness or prevent illness and disease from worsening, the cost of drugs and medical treatment can be a heavy burden for low income family. The government could either subsidize the cost of medicines for the poorer families or work out a pricing and procurement scheme with the drug companies to lower the price of drugs, or both

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APPENDICES

APPENDIX A

Regression Results

Bivariate Probit Regression Result

```
. xi:biprobit ill1 chronic1 female rural i.agegr3 i.assetgr i.reg i.workstat
i.agegr3          _Iagegr3_59-99      (naturally coded; _Iagegr3_59 omitted)
i.assetgr         _Iassetgr_250000-45000000(naturally coded; _Iassetgr_250000 omitted)
i.reg             _Ireg_1-5           (naturally coded; _Ireg_1 omitted)
i.workstat        _Iworkstat_0-5      (naturally coded; _Iworkstat_0 omitted)

Fitting comparison equation 1:

Iteration 0:   log likelihood = -14529.489
Iteration 1:   log likelihood = -14182.596
Iteration 2:   log likelihood = -14182.049
Iteration 3:   log likelihood = -14182.049

Fitting comparison equation 2:

Iteration 0:   log likelihood = -11918.614
Iteration 1:   log likelihood = -11320.658
Iteration 2:   log likelihood = -11316.024
Iteration 3:   log likelihood = -11316.023

Comparison:    log likelihood = -25498.072

Fitting full model:

Iteration 0:   log likelihood = -25498.072
Iteration 1:   log likelihood = -24845.412
Iteration 2:   log likelihood = -24838.983
Iteration 3:   log likelihood =  -24838.98

Bivariate probit regression                       Number of obs   =      24725
                                                  Wald chi2(32)   =    1579.29
Log likelihood =  -24838.98                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
ill1         |
      female |    .284834   .0195977    14.53   0.000     .2464233    .3232447
       rural |   .0278387   .0181313     1.54   0.125    -.0076979    .0633753
 _Iagegr3_99 |   .1978446   .0213415     9.27   0.000     .1560161    .2396731
_Iass~500000 |   .1684295   .0297812     5.66   0.000     .1100594    .2267996
_Ias~1000000 |    .100923   .0278885     3.62   0.000     .0462625    .1555835
_Ia~10000000 |   .0331052   .0257198     1.29   0.198    -.0173047     .083515
_Ia~45000000 |  -.0707092   .1048815    -0.67   0.500    -.2762732    .1348549
     _Ireg_2 |   .0999032   .0445689     2.24   0.025     .0125498    .1872566
     _Ireg_3 |   .2256701   .0445953     5.06   0.000      .138265    .3130752
     _Ireg_4 |   .0324796   .0449353     0.72   0.470    -.0555921    .1205513
     _Ireg_5 |   .0234169   .0483385     0.48   0.628    -.0713248    .1181586
_Iworkstat_1 |  -.0887763   .0481219    -1.84   0.065    -.1830934    .0055409
_Iworkstat_2 |  -.1416448   .0250821    -5.65   0.000    -.1908049   -.0924847
_Iworkstat_3 |  -.2123035   .0397094    -5.35   0.000    -.2901325   -.1344744
_Iworkstat_4 |  -.2309121   .0359931    -6.42   0.000    -.3014572    -.160367
_Iworkstat_5 |  -.1868195   .0347617    -5.37   0.000    -.2549512   -.1186879
       _cons |  -.8744125   .0494654   -17.68   0.000    -.9713629   -.7774622
-------------+----------------------------------------------------------------
chronic1     |
      female |   .3656707   .0218139    16.76   0.000     .3229162    .4084252
       rural |  -.0923277   .0200317    -4.61   0.000     -.131589   -.0530664
 _Iagegr3_99 |   .3041246   .0231866    13.12   0.000     .2586797    .3495694
_Iass~500000 |    .165353   .0332219     4.98   0.000     .1002393    .2304667
_Ias~1000000 |   .1782235   .0306686     5.81   0.000     .1181141     .238333
_Ia~10000000 |   .2408937   .0276285     8.72   0.000     .1867428    .2950445
_Ia~45000000 |   .3137496   .1044182     3.00   0.003     .1090936    .5184056
     _Ireg_2 |   .1520458   .0474955     3.20   0.001     .0589563    .2451352
     _Ireg_3 |   .1081775   .0477977     2.26   0.024     .0144957    .2018594
     _Ireg_4 |  -.0602163    .048251    -1.25   0.212    -.1547866    .0343539
     _Ireg_5 |  -.0401383   .0522282    -0.77   0.442    -.1425038    .0622271
_Iworkstat_1 |  -.2539362   .0536867    -4.73   0.000    -.3591601   -.1487122
_Iworkstat_2 |  -.2002714   .0267202    -7.50   0.000    -.2526419   -.1479008
_Iworkstat_3 |   -.310218   .0442298    -7.01   0.000    -.3969068   -.2235293
_Iworkstat_4 |  -.3960915   .0409824    -9.66   0.000    -.4764156   -.3157674
_Iworkstat_5 |  -.0171059   .0358992    -0.48   0.634    -.0874669    .0532552
       _cons |  -1.191111   .0532907   -22.35   0.000    -1.295559   -1.086663
-------------+----------------------------------------------------------------
     /athrho |   .4537695    .012982    34.95   0.000     .4283252    .4792139
-------------+----------------------------------------------------------------
         rho |   .4249926   .0106372                      .4039207    .4456138
------------------------------------------------------------------------------
Likelihood-ratio test of rho=0:     chi2(1) =  1318.18    Prob > chi2 = 0.0000
```

Instrumental Variable Regression Result

```
. xi: ivregress 2sls lnasset age agesq female rural chronic_old ill1 i.workstat (hinc = age agesq female rural i.edu)
i.workstat        _Iworkstat_0-5      (naturally coded; _Iworkstat_0 omitted)
i.edu             _Iedu_1-6           (naturally coded; _Iedu_1 omitted)

Instrumental variables (2SLS) regression              Number of obs =   12694
                                                      Wald chi2(12) = 2269.54
                                                      Prob > chi2   =  0.0000
                                                      R-squared     =       .
                                                      Root MSE      =  1.5293
```

lnasset	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
hinc	.0000464	1.49e-06	31.03	0.000	.0000435	.0000493
age	.0427076	.0150121	2.84	0.004	.0132844	.0721309
agesq	-.0002894	.000121	-2.39	0.017	-.0005267	-.0000522
female	-.1347993	.0309135	-4.36	0.000	-.1953887	-.0742099
rural	.2377573	.0310833	7.65	0.000	.1768352	.2986794
chronic_old	-.2968407	.0645338	-4.60	0.000	-.4233247	-.1703566
ill1	-.0539994	.0313381	-1.72	0.085	-.115421	.0074221
_Iworkstat_1	.0411232	.0707284	0.58	0.561	-.0975019	.1797483
_Iworkstat_2	.0302528	.0433604	0.70	0.485	-.0547321	.1152376
_Iworkstat_3	-.2777566	.0654679	-4.24	0.000	-.4060713	-.1494419
_Iworkstat_4	-.8262928	.0569241	-14.52	0.000	-.9378619	-.7147236
_Iworkstat_5	-.034221	.0728776	-0.47	0.639	-.1770585	.1086165
_cons	10.82265	.4571621	23.67	0.000	9.926626	11.71867

```
Instrumented:  hinc
Instruments:   age agesq female rural chronic_old ill1 _Iworkstat_1
               _Iworkstat_2 _Iworkstat_3 _Iworkstat_4 _Iworkstat_5 _Iedu_2
               _Iedu_3 _Iedu_4 _Iedu_5 _Iedu_6
```

Marginal Effect of Instrumental Variable Regression

```
Marginal effects after ivregress
      y  = Fitted values (predict)
         =   13.20033
```

variable	dy/dx	Std. Err.	z	P>|z|	[95%	C.I.]	X
hinc	.0000464	.00000	31.03	0.000	.000043	.000049	21517.9
age	.0427076	.01501	2.84	0.004	.013284	.072131	58.6183
agesq	-.0002894	.00012	-2.39	0.017	-.000527	-.000052	3539.87
female*	-.1347993	.03091	-4.36	0.000	-.195389	-.07421	.334252
rural*	.2377573	.03108	7.65	0.000	.176835	.298679	.389869
chroni~d*	-.2968407	.06453	-4.60	0.000	-.423325	-.170357	.048369
ill1*	-.0539994	.03134	-1.72	0.085	-.115421	.007422	.279896
_Iwork~1*	.0411232	.07073	0.58	0.561	-.097502	.179748	.065149
_Iwork~2*	.0302528	.04336	0.70	0.485	-.054732	.115238	.423586
_Iwork~3*	-.2777566	.06547	-4.24	0.000	-.406071	-.149442	.121002
_Iwork~4*	-.8262928	.05692	-14.52	0.000	-.937862	-.714724	.118166
_Iwork~5*	-.034221	.07288	-0.47	0.639	-.177058	.108616	.049315

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Multinomial Logit Regression Result

```
. xi: mlogit insscheme rural female i.agegr i.assetgr i.occ
i.agegr           _Iagegr_59-99       (naturally coded; _Iagegr_59 omitted)
i.assetgr         _Iassetgr_250000-45000000(naturally coded; _Iassetgr_250000 omitted)
i.occ             _Iocc_1-9           (naturally coded; _Iocc_1 omitted)

Iteration 0:   log likelihood = -20816.693
Iteration 1:   log likelihood =  -18784.68
Iteration 2:   log likelihood = -17303.342
Iteration 3:   log likelihood = -17189.645
Iteration 4:   log likelihood =   -17175.4
Iteration 5:   log likelihood = -16965.179
Iteration 6:   log likelihood = -16955.574
Iteration 7:   log likelihood =  -16953.02
Iteration 8:   log likelihood = -16952.783
Iteration 9:   log likelihood = -16952.778
Iteration 10:  log likelihood = -16952.778

Multinomial logistic regression                   Number of obs   =      24725
                                                  LR chi2(68)     =    7727.83
                                                  Prob > chi2     =     0.0000
Log likelihood = -16952.778                       Pseudo R2       =     0.1856

------------------------------------------------------------------------------
   insscheme |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
No health ~e |
       rural |  -.5006293   .1006013    -4.98   0.000    -.6978042   -.3034543
      female |  -.2667072   .0987787    -2.70   0.007    -.4603098   -.0731046
  _Iagegr_69 |  -.0487147   .1157709    -0.42   0.674    -.2756214    .1781921
  _Iagegr_79 |    -.14991   .1506362    -1.00   0.320    -.4451515    .1453314
  _Iagegr_99 |  -.1175381   .2173259    -0.54   0.589     -.543489    .3084127
_Iass~500000 |  -1.218542   .2279556    -5.35   0.000    -1.665326   -.7717569
_Ias~1000000 |  -.9224762   .1892312    -4.87   0.000    -1.293363   -.5515899
_Ia~10000000 |  -.1424872   .1372574    -1.04   0.299    -.4115067    .1265322
_Ia~45000000 |   1.067395   .3704876     2.88   0.004      .341253    1.793538
    _Iocc_2 |   1.058906   .3355553     3.16   0.002     .4012299    1.716582
    _Iocc_3 |   1.376644   .5559847     2.48   0.013     .2869335    2.466354
    _Iocc_4 |   .3145057    .175788     1.79   0.074    -.0300325    .6590439
    _Iocc_5 |   -1.34588   .2146798    -6.27   0.000    -1.766644   -.9251148
    _Iocc_6 |   .1232693   .2109528     0.58   0.559    -.2901906    .5367291
    _Iocc_7 |  -.3390787   .3385984    -1.00   0.317    -1.002719     .324562
    _Iocc_8 |   .1722014   .1948918     0.88   0.377    -.2097796    .5541824
    _Iocc_9 |   .0552212   .1705651     0.32   0.746    -.2790803    .3895227
       _cons |  -2.798726   .1625012   -17.22   0.000    -3.117223    -2.48023
-------------+----------------------------------------------------------------
Social sec~y |
       rural |  -.4471005   .0800252    -5.59   0.000     -.603947   -.2902539
      female |  -.2778168   .0808994    -3.43   0.001    -.4363768   -.1192569
  _Iagegr_69 |  -1.118836     .132679    -8.43   0.000    -1.378882   -.8587901
  _Iagegr_79 |   -3.05303   .5067706    -6.02   0.000    -4.046282   -2.059778
  _Iagegr_99 |  -3.152105   1.008306    -3.13   0.002    -5.128348   -1.175862
_Iass~500000 |  -.6310118   .1437953    -4.39   0.000    -.9128453   -.3491783
_Ias~1000000 |  -.1668837   .1157272    -1.44   0.149    -.3937048    .0599374
_Ia~10000000 |   .2583108   .1022837     2.53   0.012     .0578383    .4587832
_Ia~45000000 |   1.925594   .2873194     6.70   0.000     1.362459     2.48873
    _Iocc_2 |   2.604963   .1711349    15.22   0.000     2.269545    2.940381
    _Iocc_3 |    3.67977   .2509712    14.66   0.000     3.187876    4.171665
    _Iocc_4 |  -.3037923     .153188    -1.98   0.047    -.6040354   -.0035493
    _Iocc_5 |  -2.184504     .218552   -10.00   0.000    -2.612858    -1.75615
    _Iocc_6 |   .5408313   .1479665     3.66   0.000     .2508223    .8308403
    _Iocc_7 |   1.783062   .1420974    12.55   0.000     1.504556    2.061568
    _Iocc_8 |   .9810363   .1317526     7.45   0.000     .7228059    1.239267
    _Iocc_9 |  -1.027709   .1782943    -5.76   0.000     -1.37716   -.6782586
       _cons |  -2.293826   .1247569   -18.39   0.000    -2.538345   -2.049307
-------------+----------------------------------------------------------------
Government~f |
       rural |   -.824584   .0399018   -20.67   0.000    -.9027902   -.7463779
      female |  -.0484816   .0395009    -1.23   0.220    -.1259018    .0289387
  _Iagegr_69 |    .156893   .0457835     3.43   0.001      .067159     .246627
  _Iagegr_79 |   .3116304   .0543318     5.74   0.000     .2051422    .4181187
  _Iagegr_99 |    .252327   .0776361     3.25   0.001     .1001632    .4044909
_Iass~500000 |  -.2864292   .0695146    -4.12   0.000    -.4226753   -.1501831
_Ias~1000000 |   .2628749   .0556879     4.72   0.000     .1537285    .3720212
_Ia~10000000 |   .9847284   .0470632    20.92   0.000     .8924862    1.076971
_Ia~45000000 |   1.332137   .1795357     7.42   0.000     .9802532     1.68402
    _Iocc_2 |   3.694697   .1167076    31.66   0.000     3.465954    3.923439
    _Iocc_3 |   3.116644   .2207356    14.12   0.000      2.68401    3.549278
    _Iocc_4 |    .066329   .0739677     0.90   0.370     -.078645     .211303
    _Iocc_5 |  -.6514596   .0721027    -9.04   0.000    -.7927782   -.5101409
    _Iocc_6 |  -.8077322   .1171545    -6.89   0.000    -1.037351   -.5781137
    _Iocc_7 |   .0712956   .1232253     0.58   0.563    -.1702216    .3128128
    _Iocc_8 |  -.4252548   .0950641    -4.47   0.000     -.611577   -.2389327
    _Iocc_9 |   .4399434   .0653741     6.73   0.000     .3118125    .5680742
       _cons |  -1.393678   .0651686   -21.39   0.000    -1.521406    -1.26595
-------------+----------------------------------------------------------------
private in~e |
       rural |   -.613703   .1629223    -3.77   0.000    -.9330248   -.2943812
      female |   .0393319   .1562682     0.25   0.801    -.2669482    .3456119
  _Iagegr_69 |  -.8548167   .2113463    -4.04   0.000    -1.269048   -.4405854
  _Iagegr_79 |  -.8270092    .276774    -2.99   0.003    -1.369476   -.2845421
  _Iagegr_99 |  -1.310287   .5251239    -2.50   0.013    -2.339511   -.2810628
_Iass~500000 |  -.8346906   .3507066    -2.38   0.017    -1.522063   -.1473183
_Ias~1000000 |   -.288731   .2556826    -1.13   0.259    -.7898596    .2123976
_Ia~10000000 |   .5589584   .1834959     3.05   0.002     .1993129    .9186038
_Ia~45000000 |   2.435113   .3458078     7.04   0.000     1.757343    3.112884
    _Iocc_2 |   1.327087   .3128828     4.24   0.000     .7138478    1.940326
    _Iocc_3 |   1.492695   .5584741     2.67   0.008     .3981055    2.587284
    _Iocc_4 |  -.3021455   .2201672    -1.37   0.170    -.7336653    .1293742
    _Iocc_5 |  -1.515831     .260564    -5.82   0.000    -2.026527   -1.005135
    _Iocc_6 |  -1.222032   .3889273    -3.14   0.002    -1.984316   -.4597488
    _Iocc_7 |  -1.331161   .6014452    -2.21   0.027    -2.509972   -.1523505
    _Iocc_8 |  -.9643058   .3138453    -3.07   0.002    -1.579431   -.3491804
    _Iocc_9 |   -.602615   .2220596    -2.71   0.007    -1.037844   -.1673861
       _cons |  -3.272816   .2052684   -15.94   0.000    -3.675135   -2.870498
------------------------------------------------------------------------------
(insscheme==Universal card is the base outcome)
```

Multinomial Logit Regression in Term of IRR

```
. xi: mlogit insscheme rural female i.agegr i.assetgr i.occ, rrr
i.agegr           _Iagegr_59-99       (naturally coded; _Iagegr_59 omitted)
i.assetgr         _Iassetgr_250000-45000000(naturally coded; _Iassetgr_250000 omitted)
i.occ             _Iocc_1-9           (naturally coded; _Iocc_1 omitted)

Iteration 0:   log likelihood = -20816.693
Iteration 1:   log likelihood =  -18784.68
Iteration 2:   log likelihood = -17303.342
Iteration 3:   log likelihood = -17189.645
Iteration 4:   log likelihood =   -17175.4
Iteration 5:   log likelihood = -16965.179
Iteration 6:   log likelihood = -16955.574
Iteration 7:   log likelihood =  -16953.02
Iteration 8:   log likelihood = -16952.783
Iteration 9:   log likelihood = -16952.778
Iteration 10:  log likelihood = -16952.778

Multinomial logistic regression                   Number of obs   =      24725
                                                  LR chi2(68)     =    7727.83
                                                  Prob > chi2     =     0.0000
Log likelihood = -16952.778                       Pseudo R2       =     0.1856
```

insscheme	RRR	Std. Err.	z	P>|z|	[95% Conf.	Interval]
No health ~e						
rural	.6061491	.0609794	-4.98	0.000	.4976769	.7382636
female	.7658973	.0756543	-2.70	0.007	.6310881	.9295036
_Iagegr_69	.9524529	.1102663	-0.42	0.674	.7591002	1.195055
_Iagegr_79	.8607854	.1296654	-1.00	0.320	.6407272	1.156423
_Iagegr_99	.8891066	.1932259	-0.54	0.589	.5807186	1.361263
_Iass~500000	.295661	.0673976	-5.35	0.000	.1891289	.4622003
_Ias~1000000	.3975334	.0752257	-4.87	0.000	.2743467	.5760332
_Ia~10000000	.8671986	.1190294	-1.04	0.299	.6626511	1.134886
_Ia~45000000	2.907796	1.077303	2.88	0.004	1.406709	6.01068
_Iocc_2	2.883215	.9674781	3.16	0.002	1.493661	5.565475
_Iocc_3	3.961583	2.202579	2.48	0.013	1.332336	11.77942
_Iocc_4	1.369582	.2407561	1.79	0.074	.970414	1.932943
_Iocc_5	.2603107	.0558834	-6.27	0.000	.1709055	.3964859
_Iocc_6	1.131189	.2386274	0.58	0.559	.748121	1.710403
_Iocc_7	.7124264	.2412264	-1.00	0.317	.3668804	1.383425
_Iocc_8	1.187917	.2315153	0.88	0.377	.8107629	1.740517
_Iocc_9	1.056774	.1802488	0.32	0.746	.7564792	1.476276
Social sec~y						
rural	.6394797	.0511745	-5.59	0.000	.5466497	.7480736
female	.7574356	.0612761	-3.43	0.001	.6463741	.8875798
_Iagegr_69	.3266598	.0433409	-8.43	0.000	.25186	.4236744
_Iagegr_79	.0472156	.0239275	-6.02	0.000	.0174873	.1274823
_Iagegr_99	.042762	.0431172	-3.13	0.002	.0059263	.308553
_Iass~500000	.5320532	.0765067	-4.39	0.000	.4013805	.7052674
_Ias~1000000	.846298	.0979397	-1.44	0.149	.6745531	1.06177
_Ia~10000000	1.294741	.132431	2.53	0.012	1.059544	1.582148
_Ia~45000000	6.859224	1.970788	6.70	0.000	3.905784	12.04597
_Iocc_2	13.53072	2.315579	15.22	0.000	9.674995	18.92306
_Iocc_3	39.63729	9.947819	14.66	0.000	24.23688	64.82328
_Iocc_4	.7380141	.1130549	-1.98	0.047	.5466014	.996457
_Iocc_5	.1125335	.0245944	-10.00	0.000	.0733247	.1727085
_Iocc_6	1.717434	.2541227	3.66	0.000	1.285082	2.295247
_Iocc_7	5.948041	.8452009	12.55	0.000	4.502155	7.858279
_Iocc_8	2.667219	.3514131	7.45	0.000	2.060206	3.453081
_Iocc_9	.3578258	.0637983	-5.76	0.000	.2522942	.5075
Government~f						
rural	.4384173	.0174937	-20.67	0.000	.4054368	.4740806
female	.9526749	.0376315	-1.23	0.220	.8817014	1.029361
_Iagegr_69	1.16987	.0535608	3.43	0.001	1.069465	1.279702
_Iagegr_79	1.36565	.0741982	5.74	0.000	1.2277	1.519101
_Iagegr_99	1.287017	.0999189	3.25	0.001	1.105351	1.498539
_Iass~500000	.7509402	.0522013	-4.12	0.000	.6552913	.8605504
_Ias~1000000	1.300664	.0724313	4.72	0.000	1.166174	1.450664
_Ia~10000000	2.677085	.1259921	20.92	0.000	2.441192	2.935772
_Ia~45000000	3.789131	.6802841	7.42	0.000	2.665131	5.387169
_Iocc_2	40.23337	4.695539	31.66	0.000	32.00698	50.57409
_Iocc_3	22.5705	4.982113	14.12	0.000	14.6437	34.78818
_Iocc_4	1.068578	.0790403	0.90	0.370	.924368	1.235287
_Iocc_5	.5212844	.037586	-9.04	0.000	.4525857	.6004109
_Iocc_6	.4458681	.0522354	-6.89	0.000	.3543923	.5609555
_Iocc_7	1.073899	.1323315	0.58	0.563	.8434779	1.367266
_Iocc_8	.6536032	.0621342	-4.47	0.000	.5424947	.7874679
_Iocc_9	1.552619	.1015011	6.73	0.000	1.365899	1.764865
private in~e						
rural	.5413426	.0881968	-3.77	0.000	.3933621	.7449925
female	1.040116	.162537	0.25	0.801	.7657128	1.412854
_Iagegr_69	.4253612	.0898985	-4.04	0.000	.2810991	.6436595
_Iagegr_79	.4373554	.1210486	-2.99	0.003	.2542401	.7523587
_Iagegr_99	.2697427	.1416483	-2.50	0.013	.0963748	.7549809
_Iass~500000	.4340087	.1522097	-2.38	0.017	.2182612	.8630192
_Ias~1000000	.7492137	.1915609	-1.13	0.259	.4539085	1.236639
_Ia~10000000	1.74885	.3209069	3.05	0.002	1.220564	2.505789
_Ia~45000000	11.41711	3.948127	7.04	0.000	5.797012	22.48581
_Iocc_2	3.770044	1.179582	4.24	0.000	2.041833	6.961017
_Iocc_3	4.449068	2.484689	2.67	0.008	1.489001	13.29361
_Iocc_4	.7392305	.1627543	-1.37	0.170	.4801459	1.138116
_Iocc_5	.2196257	.0572265	-5.82	0.000	.1317925	.3659954
_Iocc_6	.2946308	.11459	-3.14	0.002	.1374747	.6314422
_Iocc_7	.2641703	.1588839	-2.21	0.027	.0812705	.8586873
_Iocc_8	.3812478	.1196528	-3.07	0.002	.2060923	.7052659
_Iocc_9	.5473784	.1215506	-2.71	0.007	.3542176	.845873

(insscheme==Universal card is the base outcome)

Poisson Regression Result

```
. xi: poisson ipday diabetes cancer heartpb hyperts female rural exercise i.agegr i.assetgr  i.insscheme
i.agegr           _Iagegr_59-99       (naturally coded; _Iagegr_59 omitted)
i.assetgr         _Iassetgr_250000-45000000(naturally coded; _Iassetgr_250000 omitted)
i.insscheme       _Iinsscheme_0-4     (naturally coded; _Iinsscheme_0 omitted)

Iteration 0:   log likelihood = -10411.059
Iteration 1:   log likelihood = -10410.985
Iteration 2:   log likelihood = -10410.985

Poisson regression                                Number of obs   =       2031
                                                  LR chi2(18)     =     894.39
                                                  Prob > chi2     =     0.0000
Log likelihood = -10410.985                       Pseudo R2       =     0.0412
```

ipday	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
diabetes	.1502426	.0273452	5.49	0.000	.096647	.2038381
cancer	.6477078	.0324634	19.95	0.000	.5840807	.7113348
heartpb	.2081415	.0233151	8.93	0.000	.1624448	.2538382
hyperts	-.0780153	.0235532	-3.31	0.001	-.1241788	-.0318519
female	-.1580108	.0191522	-8.25	0.000	-.1955484	-.1204732
rural	-.1255141	.0188046	-6.67	0.000	-.1623704	-.0886577
exercise	-.2007032	.0207627	-9.67	0.000	-.2413974	-.160009
_Iagegr_69	.0883041	.0231645	3.81	0.000	.0429025	.1337058
_Iagegr_79	.0514734	.0241302	2.13	0.033	.004179	.0987677
_Iagegr_99	.3893555	.0290082	13.42	0.000	.3325004	.4462106
_Iass~500000	-.0269124	.0295733	-0.91	0.363	-.084875	.0310502
_Ias~1000000	-.0758223	.0292897	-2.59	0.010	-.133229	-.0184156
_Ia~10000000	.0186143	.0257209	0.72	0.469	-.0317978	.0690263
_Ia~45000000	-.3755871	.0991441	-3.79	0.000	-.569906	-.1812682
_Iinsschem~1	.0301667	.0823544	0.37	0.714	-.1312449	.1915783
_Iinsschem~2	-.0608473	.0972908	-0.63	0.532	-.2515339	.1298392
_Iinsschem~3	.1382832	.083335	1.66	0.097	-.0250503	.3016167
_Iinsschem~4	.379884	.1183356	3.21	0.001	.1479506	.6118175
_cons	1.833153	.0839358	21.84	0.000	1.668642	1.997665

Poisson Regression in Term of IRR

```
. xi: poisson ipday diabetes cancer heartpb hyperts female rural exercise i.agegr i.assetgr  i.insscheme, irr
i.agegr           _Iagegr_59-99       (naturally coded; _Iagegr_59 omitted)
i.assetgr         _Iassetgr_250000-45000000(naturally coded; _Iassetgr_250000 omitted)
i.insscheme       _Iinsscheme_0-4     (naturally coded; _Iinsscheme_0 omitted)

Iteration 0:   log likelihood = -10411.059
Iteration 1:   log likelihood = -10410.985
Iteration 2:   log likelihood = -10410.985

Poisson regression                                Number of obs   =       2031
                                                  LR chi2(18)     =     894.39
                                                  Prob > chi2     =     0.0000
Log likelihood = -10410.985                       Pseudo R2       =     0.0412
```

ipday	IRR	Std. Err.	z	P>|z|	[95% Conf.	Interval]
diabetes	1.162116	.0317783	5.49	0.000	1.101472	1.2261
cancer	1.911155	.0620425	19.95	0.000	1.793342	2.036708
heartpb	1.231387	.0287099	8.93	0.000	1.176383	1.288963
hyperts	.9249502	.0217855	-3.31	0.001	.8832219	.96865
female	.8538405	.0163529	-8.25	0.000	.8223835	.8865008
rural	.8820434	.0165865	-6.67	0.000	.8501263	.9151587
exercise	.8181552	.0169871	-9.67	0.000	.7855294	.8521361
_Iagegr_69	1.09232	.0253031	3.81	0.000	1.043836	1.143056
_Iagegr_79	1.052821	.0254048	2.13	0.033	1.004188	1.10381
_Iagegr_99	1.476029	.042817	13.42	0.000	1.39445	1.562381
_Iass~500000	.9734465	.028788	-0.91	0.363	.9186271	1.031537
_Ias~1000000	.9269809	.027151	-2.59	0.010	.8752646	.981753
_Ia~10000000	1.018789	.0262042	0.72	0.469	.9687025	1.071464
_Ia~45000000	.6868859	.0681007	-3.79	0.000	.5655786	.8342116
_Iinsschem~1	1.030626	.0848766	0.37	0.714	.877003	1.21116
_Iinsschem~2	.9409669	.0915475	-0.63	0.532	.7776071	1.138645
_Iinsschem~3	1.148301	.0956936	1.66	0.097	.9752608	1.352043
_Iinsschem~4	1.462115	.1730202	3.21	0.001	1.159456	1.843779

APPENDIX B

Nominal Unit Cost of Some Chronic Disease in 2007 (Baht)

Age Group (Year)	cancer	diabetes	cardiovascular	hypertension	vascular disease
0-4	26,452.26	5,000.49	23,392.41	2,003.96	19,420.74
5-9	24,194.84	5,499.68	17,710.18	5,417.12	14,965.10
10-14	33,679.50	8,471.94	24,459.41	5,355.83	27,060.63
15-19	41,788.30	8,453.79	27,573.82	6,436.78	22,120.27
20-24	42,616.85	9,998.35	26,719.57	5,551.79	18,732.23
25-29	40,927.40	10,901.10	29,895.65	6,752.56	19,958.99
30-34	31,305.58	11,445.35	28,754.73	5,702.72	20,812.52
35-39	27,725.08	10,186.21	27,670.91	5,488.86	22,948.29
40-44	27,622.28	10,874.30	27,516.92	3,930.79	26,265.39
45-49	27,517.11	9,853.98	29,152.05	4,123.29	26,850.97
50-54	27,419.71	9,665.58	28,783.88	4,791.74	26,819.47
55-59	27,628.81	9,352.60	28,904.89	4,376.27	27,867.35
60-64	27,617.06	8,393.54	28,118.37	4,266.40	26,961.81
65-69	32,500.08	10,603.10	33,418.45	4,943.70	33,494.87
>70	25,891.84	8,681.51	21,823.37	4,313.02	27,982.72

Note: 1 USD ≈ 34 Thai Baht

Source: Health Insurance System Research Office (HISR), 2009

APPENDIX C

Thailand Population Structure 2003-2007

Indicator	Year				
	2003	**2004**	**2005**	**2006**	**2007**
Population registration					
(1,000 person)	63,079.80	61,973.6	62,418.00	62,828.70	63,038.20
Population density	122.4	120.8	121.6	122.4	123
Sex ratio	98.2	97.6	97.5	97.5	97.4
- Urbanization (%)	28.6	28.9	29.1	29.3	30
- Growth rate (%)	0.44	*	0.72	0.66	0.33
- Dependency ratio (%)	47.6	47.7	47.3	47	46.8
- Life expectancy at Birth (year)					
- Male	67.9	67.9	67.9	68.2	68.4
- Female	75	75	75	75.1	75.2
- Life expectancy at Sixty (year)					
- Male	19.6	19.6	19.6	19.1	19.1
- Female	21.9	21.9	22	21.5	21.5
- Percentage of the Elder	9.7	9.9	10.4	10.5	10.7
- Crude Birth Rate (per 1,000					
population)	14.5	14	13	12.9	12.7
- Crude Death Rate (per 1,000					
population)	6.8	6.8	6.8	7.9	8
- Total Fertirity Rate	1.7	1.7	1.7	1.6	1.6

Source: The National Statistical Office, 2008.

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