Essays on Development Economics and Health Economics

by
Natt Hongdilokkul

M.A., Simon Fraser University, 2010
B.A. (First Class Hons.), Thammasat University, 2004

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Approval

Name: Natt Hongdilokkul

Degree: **Doctor of Philosophy (Economics)**

Title: Essays on Development Economics and Health Economics

Examining Committee: **Chair:** Chris Bidner
Assistant Professor, Department of Economics

Alexander Karaivanov
Senior Supervisor
Professor, Department of Economics

Brian Krauth
Supervisor
Associate Professor, Department of Economics

Hitoshi Shigeoka
Supervisor
Assistant Professor, Department of Economics

Fernando M. Aragon
Internal Examiner
Associate Professor, Department of Economics

Krislert Samphantharak
External Examiner
Associate Professor,
School of Global Policy and Strategy
University of California, San Diego

Date Defended/Approved: August 16, 2017

Abstract

In chapter 1, I estimate and decompose the welfare benefit of Thailand's universal health care policy, also known as the "30 Baht program". The total welfare impact of the 30 Baht program is defined as the amount of consumption that an enrollee would need to give up so as to leave her with the same expected utility as without the 30 Baht program. I find that the total welfare benefit is approximately 75 cents per dollar of government spending. The main source of the welfare effect can be attributed to improved consumption smoothing rather than increases in the consumption level. Using the difference in differences method, I find that the effect of the 30 Baht program on income is significantly positive, while the effect on consumption is slightly negative but not significant. This implies that the 30 Baht program has a positive impact on savings and future consumption, rather than current consumption.

In chapter 2, I investigate into the effect of the 30 Bath program on drinking and smoking behaviours. This effect is decomposed into the moral hazard component, the increased utilization component and the increased life expectancy component in the framework. Using Townsend Thai project monthly surveys, I estimate the average treatment effect of the program by difference in differences using households of government employees as the control group. I also use quantile regressions to study the treatment effect heterogeneity. Although the estimated average treatment effects of the 30 Baht program on smoking and drinking behaviours are not statistically significant, the quantile regression estimates suggest that (1) the effects of the program on smoking/drinking expenditure are negative at the 10^{th} percentile, and (2) the 30 Baht program negative affects smoking/drinking expenditure even though the moral hazard component and the increased utilization component are isolated.

In chapter 3, with Tenzin Yindok, we investigate into the effect of Thailand's 2003 black market lottery crackdown on households' gambling behaviours and consumption-saving behaviours. We estimate the average treatment effect by difference in differences technique using annual household spending on black market lottery as a continuous treatment variable. We find that the crackdown resulted in a statistically significant decrease in black market lottery activities, and an increase in participation and spending on government lotteries, although this increase is not commensurate with the reduction in black market gambling. Our main results on consumption and saving suggest that households responded to the policy by increasing their savings, without any statistically significant increase in non-gambling related consumption. We further find that the statistically significant and positive result on saving is driven by households in the poorest quintile and households in the richest quintile. The former effect is also the largest in terms of magnitude.

Keywords: Universal health care; Welfare; Consumption smoothing; Tobacco; Alcohol; Lottery

Dedication

For two great deceased persons: Dr. Sanguan Nitayarumphong, who was a very first campaigner of Thailand's universal health coverage, and my dad, who deserves the most credit for this milestone of my academic journey.

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1 Chapter One

Welfare Analysis of the Universal Health Care Program in Thailand

1.1 Introduction

The universal health care program in Thailand, also known as the 30 Baht program, was initiated in 2001. Gruber, Hendren and Townsend (2014) consider the 30 Baht program to be the biggest health reform ever in Thailand with two key features: replacing most of the pre-existing health care schemes with a fixed capitation[1] of 1,200 Baht (approximately USD 35[2]) and replacing out-of-pocket medical fees with a 30 Baht (approximately USD 0.85) flat rate co-payment. In 2002, the government of Thailand spent 4.7% of its total expenditure on the 30 Baht program.[3] Since universal health care takes a big part of government expenditure, it is crucial to evaluate how well the government's health care spending is translated into the welfare gain of its recipients.

The efficiency of the 30 Baht program depends not only on how much the total budget is, but also on how the government spends it on the program. Since the 30 Baht program may affect its enrollees' welfare through several channels, I also study the decomposition of welfare benefit in order to understand the mechanism of the welfare effect of the program. The 30 Baht program may improve welfare through an increase in consumption level because publicly-provided health care program may be interpreted as an in-kind transfer. It may improve welfare through improved consumption smoothing because the fixed and low flat rate co-payment alleviates the need for expensive medical payments. Since it increases health care utilization (Gruber, Hendren and Townsend (2014); Limwattananon et al (2015)), the 30 Baht program may also improve welfare through improved health. In this paper, I decompose the total welfare effect into the welfare effect through improved consumption and the welfare effect through improved health, which is measured by the number of days an individual stops working due to sickness. The welfare effect through consumption can be further decomposed into the transfer component, which is measured by an increase in consumption level, and the insurance component, which represents improved consumption smoothing.

My estimation suggests that the welfare benefit of the 30 Baht program is 831 Baht (approximately USD 24) per person per year. Most of the welfare effect is through consumption, and most of the welfare effect through consumption is from improved consumption smoothing, rather than an increase in consumption level. To evaluate the efficiency of the 30 Baht program, I calculate the ratio of the welfare benefit to the cost paid by government. My estimate of the 30 Baht program's welfare benefit to enrollees per dollar of government spending is 75 cents, implying that the welfare benefit to enrollees is below the cost of the program.

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[1] In the 30 Baht program, the capitation payment is the payment to a hospital, such that the amount paid is determined by the number of its enrollees in the 30 Baht program.

[2] One US dollar is approximately 35 Bahts

[3] In 2002, the total government expenditure was 1,023 billion Baht, and the expenditure on the 30 Baht program was 48.1 billions Bahts. Source: http://www.bb.go.th/budget/inbrveT/B45/1/1_doc.htm

Although the estimates suggest that the cost of the 30 Baht program exceeds its welfare benefit, my estimate of the total welfare effect of the 30 Baht program is larger than that of Medicaid, which is estimated to be 44 cents per dollar of government spending by Finkelstein, Hendren and Luttmer (2015) (FHL (2015) henceforth). While the sources of welfare benefit of Medicaid are from a balance of increased consumption level, improved consumption smoothing and improved health (FHL (2015)), my estimates suggest that improved consumption smoothing is the only non-trivial source of the welfare benefit of the 30 Baht program. In contrast, in another study on the welfare benefit from the 30 Baht program, Limwattananon et al (2015) estimate that the welfare benefit through improved consumption smoothing per dollar of government spending is only 15 cents, which is approximately two-fifths of that of my estimate. The differences in the estimation results might be driven by the different proxies we use for consumption and health. Due to the absence of directly observed consumption data, both FHL (2015) and Limwattananon et al (2015) use the difference between income and out-of-pocket medical spending as a proxy for consumption.

I argue that income is not a good proxy for consumption, especially in the context of developing countries. Health insurance may affect consumption and income differently because it also affects labour supply (Gruber and Madrian (2002)) and saving (Gruber and Yelowitz (1997); Starr-McCluer (1996); Chou, Liu and Hammitt (2003)). The discrepancy between consumption and income is even larger for households in rural Thailand. The majority of those households are self-employed, eg. farmers, and consume a significant amount of household production. Self employment also leads to potentially negative reported household income. This is another important issue, since many of the households that report negative income due to business or farming losses actually have a decent amount of consumption from household savings, often in a form of rice stocks, or borrowing from their kinship networks.

To accurately measure consumption, I use panel data from Townsend Thai Project Household monthly surveys. More than 600 of the sampled households are interviewed on a monthly basis. However, the survey team make the household visits on a weekly basis to collect consumption data. The surveys also provide extensive health data, including out-of-pocket medical spending, health care utilization and days of suffering from sickness. Following the theoretical framework of FHL (2015)[4], I define the welfare effect of the 30 Baht program as the amount of consumption that an individual would need to give up in the world with the 30 Baht program coverage in order to attain the same expected utility as in the world without the 30 Baht program. An estimation challenge is that the latter situation is a counterfactual. To address the challenge, I categorize households covered by the 30 Baht program and those that are not into different groups , exploiting the fact that the health coverage for government employees does not change after the 2001 health reform. I estimate counterfactual consumption of the households covered by the 30 Baht program based on the assumption that households with the same consumptions prior to the program would have had the same consumption growth rate in the absence of the 30 Baht program.

Are the estimates of welfare benefit underestimated or overestimated? To answer this question, I investigate the effects of the 30 Baht program on income, consumption and saving. From my difference-in-differences estimation, the 30 Baht program significantly increases household income, while current consumption slightly decreases, though insignificantly. These results are possibly

[4] Their main idea is that public-provided health care program is not traded in a free market therefore its welfare effect is measured by how an individual values it when its price is unobservable.

driven by increased life expectancy after the 30 Baht program. I define a household's saving as its income minus its consumption. Thus, I conclude that households covered by the 30 Baht program increase their savings and future consumptions. Since health insurance's welfare benefit through future consumption is not accounted for in the methodology used in all three studies, the estimates of the total welfare benefit are likely to be underestimated as a result.

The rest of the paper is organized as follows. In section 2, I provide a brief history of the health care schemes in Thailand before the 2001 health care reform, so that readers understand how I identify the control group and the treatment group of the 30 Baht program. I explain the welfare effect framework in section 3, in which I define the total welfare effect and its components. In section 4, I describe the dataset and how I apply the theoretical framework to its empirical counterpart. In particular, I explain how and why the effect of the 30 Baht program can be identified using occupations prior to the initiation of the 30 Baht program. Then, I state the empirical definitions of each variable in the theoretical framework. Since it is a crucial part of the estimation, this section also sheds light on how to estimate the counterfactual consumption in the absence of the 30 Baht program. The counterfactual estimation is based on the assumption I mentioned earlier. I also show that this assumption holds, at least prior to the reform, and describe the characteristics of the treatment group and the control group. Finally, I report the estimation results and discuss their discussion in section 5 and section 6, respectively.

1.2 The Background of the Universal Health Care Program in Thailand

In order to identify the beneficiaries from the 30 Baht program and to estimate the welfare effect on them, it is necessary to understand a brief history of health care schemes in Thailand around 2001, the year of the initiation of the 30 Baht program. Although the 30 Baht program is usually considered and mentioned as a universal health care, not all the Thai citizens are covered by the 30 Baht program. Before the health reform in 2001, there were many health care schemes in Thailand, for example, Medical Welfare Scheme (MWS), which provided free care for low income households. After 2001, all of these schemes were merged into the 30 Baht program, except the Social Security Scheme (SSS) and the Civil Servant Medical Beneficiary Scheme (CSMBS). Therefore, the 30 Baht program does not cover workers in the formal sector, in which employers are obliged to pay one-third of their employee's Social Security premium. Neither are the civil servants covered by the 30 Baht Program. While the SSS covers only the employees, the CSMBS provides free care to everyone in a civil servant's immediate family, including his or her spouse, children under the age of 18, and the civil servant's parents. Except those covered by these two schemes, all other of Thai citizens became covered by the 30 Baht program after 2001. Gruber, Hendren and Townsend (2014) summarize Thailand's health care scheme timeline and the distribution of population covered by different health care schemes in Table 1.

Table 1: Distribution of population covered by different health care schemes before and after 2001

<table>
<tr><th colspan="3">Health care Schemes</th></tr>
<tr><th>Before 2001</th><th>After 2001</th><th>Pop %</th></tr>
<tr><td>Uninsured[5] (self-employed, small business)</td><td rowspan="2">The 30 Baht Program</td><td>50%</td></tr>
<tr><td>MWS (the poor)</td><td>30%</td></tr>
<tr><td>SSS (formal sector)</td><td>SSS (formal sector)</td><td rowspan="2">20%</td></tr>
<tr><td>CSMBS (civil servants)</td><td>CSMBS (civil servants)</td></tr>
</table>

Source: Gruber, Hendren and Townsend (2014)

1.3 Frameworks for Welfare Analysis

The welfare analysis in this paper is done within the theoretical framework by FHL (2015). A representative agent's welfare is determined by the consumption of non-medical goods, c, and from health, $\mathbf{h}$, where $\mathbf{h}$ is a $k \times 1$ vector. Assume that the utility function has the following form:

$$u(c, h) = \frac{c^{1-\sigma}}{1-\sigma} + \tilde{\Phi}\mathbf{h}, \tag{1}$$

where σ denotes the constant coefficients of relative risk aversion and $\Phi = \frac{\tilde{\Phi}}{E[c^{-\sigma}]}$ is a $1 \times k$ vector of the marginal value of health in units of consumption. Assume that individual health is determined by medical spending, m, and the individual's health-related states of the world, θ , which includes all the factors affecting health and productivity of medical spending. The production function of health is described by $\mathbf{h} = f(m; \theta)$.[6] The representative agent receives the benefit of the 30 Baht program exogenously. It is important to note that the medical spending m includes not only the out-of-pocket spending, but also all other medical expenses paid by third parties, eg. the government. Let q denote the individual's 30 Baht program status: $q = 0$ if the individual is not covered by the program and $q = 1$ if the individual is covered by the program. Since consumption and health depend on two state variables, I can rewrite them as $c(q; \theta)$ and $\mathbf{h}(q; \theta)$, where $\mathbf{h}(q; \theta) \equiv f(m(q, \theta); \theta)$.

The welfare impact of the 30 Baht program is defined by γ, where

$$E\left[\frac{c(0;\theta)^{1-\sigma}}{1-\sigma} + \tilde{\Phi}\mathbf{h}(0;\theta)\right] = E\left[\frac{(c(1;\theta)-\gamma)^{1-\sigma}}{1-\sigma} + \tilde{\Phi}\mathbf{h}(1;\theta)\right] \tag{2}$$

The expected operator $E(\cdot)$ is with respect to θ. The term γ refers to the amount of consumption that the individual would need to give up in the world with the 30 Baht program coverage ($q = 1$) that would leave his or her with the same expected utility as in the world without the 30 Baht program ($q = 0$). Note that $c(0; \theta)$, which represents the amount that an insured person would have consumed if she were not covered by the 30 Baht program, is unobservable.

Since a health insurance scheme, which reduces out-of-pocket medical spending, may affect welfare through both an increase in consumption and better health, I decompose the welfare effect of health insurance into the consumption component and the health component, i.e. $\gamma = \gamma_C + \gamma_M$, where γ_C and γ_M denote the welfare components associated with the changes in consumption and

[6]This is implicitly assumed that all persons covered by the 30 Baht program faces the same distribution of θ.

health respectively. Therefore equation (2) can be rewritten as

$$E\left[\frac{c(0;\theta)^{1-\sigma}}{1-\sigma}+\tilde{\Phi}\mathbf{h}(0;\theta)\right]=E\left[\frac{(c(1;\theta)-\gamma_C-\gamma_M)^{1-\sigma}}{1-\sigma}+\tilde{\Phi}\mathbf{h}(1;\theta)\right] \tag{3}$$

The term γ_C is estimated from

$$E\left[\frac{c(0;\theta)^{1-\sigma}}{1-\sigma}\right]=E\left[\frac{(c(1;\theta)-\gamma_C)^{1-\sigma}}{1-\sigma}\right] \tag{4}$$

In other words, γ_C is the amount consumption that an insured agent is willing to give up when health outcomes are held constant. Note that the health term is not relevant in the estimation of γ_C because the $\frac{\partial^2 u}{\partial c \partial h}=0$, $\forall h \in \mathbf{h}$, according to additive separability of the utility function. By definition, the term γ_M is estimated from$\gamma_M \equiv \gamma - \gamma_C$.

Moreover, the term γ_C is also decomposed into a transfer component and a pure-insurance component. The transfer component in consumption, γ_{CT}, can be estimated by the mean increase in consumption , i.e.

$$\gamma_{CT}=E[c(1;\theta)-c(0;\theta)].$$

For example, if the mean consumption for those covered by the 30 Baht program is equal to the amount they would have expected to consume in the absence of the program, then the estimated γ_{CT} is zero. The pure-insurance component of consumption, γ_{CI}, is therefore estimated using $\gamma_{CI}=\gamma_C-\gamma_{CT}$.

To explain the concept of the welfare effect decomposition in an easy-to-understand manner, let us consider a special case in which the consumption across health-related states of the world is normally distributed. Given the utility function as in equation (1), the 30 Baht program may affect an agent's expected utility either through an increase in the mean of consumption or through a decrease in variance of consumption. In this case, γ_{CT} is the fixed amount of consumption that the agent is willing to give up regarding to the increased expected utility from an increase in the mean of consumption, while γ_{CI} is its counterpart associated with a decrease in the variance of consumption.

1.4 Data and Identification strategies

There are two points I have to clarify when I move from the theoretical model to its statistical counterpart used for estimating the welfare effect. Firstly, in the theoretical model, the 30 Baht program status, which is called the treatment status from now on, takes the value $q=1$ if an individual is covered by the 30 Baht program and takes the value $q=0$ for the counterfactual case in which the same individual were not covered by the program. Empirically, I can only observe the outcomes with the treatment status $q=1$ from the households covered by the 30 Baht program after the 30 Baht program was implemented, but I cannot directly observe the outcomes with the treatment status $q=0$ unless I make some assumptions that will be explained later. Secondly, all the expectation terms in the theoretical framework in the previous section are taken with respect to the possible health-related states of the world, θ. Empirically, for each treatment status q, I use an average value over households in the data as its empirical counterpart.

I use data from several sources for the estimation. The main source of data is the individual and household level panel data from Townsend Thai project household monthly surveys. Approximately 600 households were randomly selected from the rural areas of four provinces: two provinces, Chachoengsao and Lopburi, in the central region, and two provinces, Buriram and Srisaket, in the Northeastern region of Thailand. A province consists of several districts. Each of the districts is a collection of villages with at least one urbanized area at its centre. These four provinces are different in term of economic conditions and activities, but villages within the same district are similar. The sampled households were interviewed on a monthly basis, with the questions regarding household consumption being asked on a weekly basis. The survey was initiated in September 1998. Since the data regarding household consumption, income, assets, liabilities and wealth need to be calculated carefully, instead of using my own calculation, I use the Monthly Survey Household Financial Accounting, which is publicly provided by the Research Institute for Policy Evaluation and Design (RIPED) at the University of the Thai Chamber of Commerce. This dataset is also based on Townsend Thai project household monthly surveys.

The advantage of Townsend Thai project household monthly surveys is that they provide credible reported consumption. Most of national household surveys provide only reported household income. For the estimate of the welfare benefit from the 30 Baht program, income is not a good proxy for consumption. First, the 30 Baht program may affect consumption and income differently. Second, many households in the dataset report negative income. Since many of them are self-employed, households in developing countries do not separate their own income from their business, farming or livestock income. In many cases these incomes are negative, since it takes time until self-employed households receive returns from their spending on business or farming investment. Samphantharak and Townsend (2010) refer to this arrangement as "household as corporate firms". In the dataset I use for the estimation, in each year approximate 20% of households report negative or zero income. As FHL (2015) mention that "welfare estimates are sensitive to consumption at the low values", it is necessary to drop observations with very low values of consumption, and the estimation is probed to be biased if I drop a significant number of observations.

The estimation requires data from both the pre-30 Baht period and the post-30 Baht period. Henceforth, the post-30 Baht period refers to the period from June 2002 to May 2004, and the pre-30 Baht period refers to the period from June 1999 to May 2001. Please note that transition period of the 30 Baht program took about a year. Among the four provinces in the surveys, all hospitals in the province of Srisaket began the 30 Baht program on June 1st, 2001, while hospitals in the other 3 provinces launched the program at unknown dates between October 1st, 2001 and April 1st 2002.

Treatment group vs. Treatment status (q)

It is crucial to distinguish the empirical definition of treatment group from that of treatment status. Let me begin by clarifying the definitions of the treatment group and the control group, since the empirical definition of treatment status is based on them. I categorize households in the surveys into 3 groups: the control group, the treatment group, and the group that is excluded from this study. The control group consists of the households with **at least one** member working for the government prior to June 2001. Any household whose **at least one** of its member reported to have received a free health care paid by the Social Security Scheme prior to June 2001 will be excluded from the

Table 2: Treatment group vs Control group

Group	Criteria	% of total households in the survey
Control	At least one member is a government worker (No member is covered by the program)	19.4%
Excluded	Some members are covered by the Social Security (Some members are covered by the program)	4.2%
Treatment	The rest (All members are covered by the program)	76.4%

study. The treatment group consists of the other households in the survey. The definitions of these groups are summarized in Table 2.

Since I cannot observe health insurance status, the definitions of the treatment group and the control group are based on household members' occupations prior to the health care reform, exploiting the fact that the health coverage of government workers, who are covered by the Civil Servant Medical Beneficiary Scheme (CSMBS), and workers in the formal sector, in which they are obliged to enroll in the Social Security Scheme (SSS), was not affected by the 30 Baht program. Because the CSMBS extends its health coverage to the whole family of each enrollee, no household member in the control group is covered by the 30 Baht program. On the other hand, I exclude the households in which some of its members are enrolled in the Social Security Scheme since not all of its members are covered by the 30 Baht program. This paper is not the first to use occupations to define the treatment group. Chou, Liu and Hammitt (2003) used variation in occupations to identify the treatment effect of the national health care in Taiwan, and Limwattananon et al (2015) applied a similar strategy to identify the effect of the 30 Baht program in Thailand.

The identification of the treatment group is based on the assumptions that the 30 Baht program did not create either spillover or crowding out effects for the households in the control group. Limwattananon et al (2015) argue that the case in which the 30 Baht program crowded out care at public facilities for those covered by the CSMBS was not likely. The per capita expenditure on the CSMBS was "2.5 times greater" than that on the 30 Baht program when the latter was introduced. Also, the CSMBS "pays fee-for-service with no cap on expenditures". Combining these two facts, health care providers have no incentives to prioritize 30 Baht program insurees over government workers.

The treatment status is assigned according to household member's occupations in the pre-30 Baht period rather than those in the post-30 Baht period. Since it gives self-employed persons better health coverage than what they received before the health care reform, the 30 Baht program may incentivize to employed persons to switch to be self-employed after the reform. This implies that an occupation choice observed in the post-30 Baht program period does not well identify the treatment effect of the 30 Baht program due to selection bias. One might still be concerned that if household members did change their occupational choice after the program, the treatment group, which is defined by occupations before the program, may fail to map to the actual treatment group after the program. I argue that this is not an important issue, according to Limwattananon et al (2015). Similar to my definition, they define the treatment group as the group consisting of "households in which there are no public sector employees and not every member is a private sector salaried employee" using the survey in 2000 (pre-30 Baht period). They checked the validity of this approximation using household member's insurance status in the survey in 2004 (post-30 Baht period), and found that "over four-fifths of individuals in households assigned to the treatment group" were indeed covered by the 30 Baht program.

Based on the definition of the treatment group, I can now define the treatment status. I define the treatment status as "being covered by the 30 Baht program", indicated by $q = 1$, to actual outcomes of the households in the treatment group, as defined in Table 2, in the post-30 Baht period, and define the treatment status as "not being covered by the 30 Baht program", indicated by $q = 0$, to the counterfactual outcomes of the households in the treatment group in the post-30 Baht period in the absence of the 30 Baht program. The counterfactual outcomes will be estimated using the outcomes of the control group.

Consumption (c)

Household consumption $c(q;\theta)$ is calculated from an average annual household per-capita consumption on non-medical goods and services over 24 months. The household consumption consists of consumption expenditure and the consumption of household production. The unit of consumption is Baht per person per year. Let $c^T_{i,t}(q)$ denote the treatment group's consumption in year t of a household i with a treatment status q, and $c^C_{i,t}(q)$ are that of the control group. Without loss of generality, I assume that $t \in \{0, 1\}$. We can interpret $t = 0$ as a pre-30 Baht program period, and Let $t = 1$ as a post-30 Baht program period.

The empirical counterparts of $c(0;\theta)$ and $c(1;\theta)$ are $c^T_{i,1}(0)$ and $c^T_{i,1}(1)$ respectively. The term $c^T_{i,1}(0)$ is not directly observable, but it can be estimated under an assumption. I assume that in the absence of the 30 Baht program, households with the same consumption level prior to the program would have had the same consumption growth rate. Please note that I need to make the assumption stronger than the standard parallel trend assumption, that is generally made for a difference in differences estimation, because the welfare estimation results depend not only on the average consumption, but also on its distribution. In practice, I categorize households in the control group and the treatment group into 5 groups based on their consumption brackets in the pre-30 Baht period. I summarize the consumption brackets and the distributions of the household in the control group and the treatment group over these brackets in the pre-30 Baht period in Table 3. Under this assumption, the counterfactual consumption of household i in the bracket k is estimated from

$$c^T_{i,k,1}(0) = (1 + g_k)c^T_{i,k,0}(0)\,, \; \forall i \, \forall k, \tag{5}$$

where $g_k = \frac{\bar{c}^C_{k,1}(0) - \bar{c}^C_{k,0}(0)}{\bar{c}^C_{k,0}(0)}$ is percentage change of the control group's average consumption in the bracket k between pre- and post-30 Baht program periods.

One may be concerned that the assumption I make for the counterfactual estimation may not be

Table 3: Distribution of households and consumption growth over consumption brackets in the pre-30 Baht period

Consumption (C) Brackets	Control Group		Treatment Group		Consumption growth
(unit: Baht/person/year)	no. of household	%	no. of household	%	of the control group
$C < 8{,}000$	26	18.6%	166	31.3%	35.6%
$8{,}000 \leq C < 13{,}000$	32	22.9%	183	34.5%	15.7%
$13{,}000 \leq C < 18{,}000$	32	22.9%	83	15.7%	13.6%
$18{,}000 \leq C < 25{,}000$	25	17.9%	50	9.4%	35.1%
$C > 25{,}000$	25	17.9%	48	9.1%	-6.2%
total	140	100%	530	100%	-

Table 4: Average annual consumption growth in the pre-30 Baht period

Consumption (C) Brackets	Consumption growth (percent)		Differences
(unit: Baht/person/year)	Control Group	Treatment Group	
$C < 8{,}000$	22.32	27.4	-5.081
	(58.73)	(96.59)	(14.07)
$8{,}000 \leq C < 13{,}000$	26.7	14.9	11.79
	(145.2)	(69.81)	(10.95)
$13{,}000 \leq C < 18{,}000$	15.51	5.299	10.21
	(65.04)	(62.76)	(9.572)
$18{,}000 \leq C < 25{,}000$	-5.041	-3.615	-1.426
	(30.85)	(32.42)	(6.29)
$C \geq 25{,}000$	-7.509	-1.637	-5.872
	(38.23)	(76.93)	(12.02)

Standard errors in parentheses * $p<0.05$, ** $p<0.01$, *** $p<0.001$

realistic. I argue that the consumption growth rate of the control group and the treatment group in each bracket are similar in the pre-30 Baht period. I group the pre-30 Baht period into 3 periods: period 1 (between September 1998 and August 1999), period 2 (between September 1999 and August 2000) and period 3 (between September 2000 and August 2001). Using the same brackets as those in Table 3, I categorize households in the treatment group and the control group into 5 groups based on their consumption brackets in period 1. For each household, I calculate the annual household consumption growth from period 1 to period 2 and the growth from period 2 to period 3, and show the average year-on-year growth rate by consumption brackets in Table 4. According to Table 4, in every consumption brackets, the average year-on-year growth rates between the control group and the treatment group are not significantly different. Moreover, to my knowledge, there was no policy that would have affected consumption of households in the control group differently from those in the treatment group in the post-30 Baht period.

According the welfare estimation framework, the welfare gain γ would be meaningless if it exceeds the consumption level. Therefore, I drop any observations with the annual consumption lower than 1,000 Baht/year/person.

Health (h)

Let the empirical counterpart of $\mathbf{h}(0;\theta)$ and $\mathbf{h}(1;\theta)$ be denoted by $h^T_{i,1}(0)$ and $h^T_{i,1}(1)$, where $h^T_{i,t}(j)$ is an average number of non-working days from sickness per year per one member of household i that belongs to the treatment group over a period t. I assume that the average number of non-working days would not have changed in the absence of the 30 Baht program. Therefore the counterfactual $h^T_{i,1}(0)$ is simply calculated from $h^T_{i,0}(0)$ in the pre-30 Baht program period.

Parameters (σ and Φ)

Following FHL (2015), I assume that the coefficient of relative risk aversion $\sigma = 3$. Since the health outcome is proxied by the number of days suffering from sickness, the marginal (dis)values of sickness in term of unit of consumption, Φ , are negative numbers of willingness of pay (WTP) for treatment. To my knowledge, Thavorncharoensap et al. (2013) are the only authors who have studied the WTP for treatment in Thailand. They found that the average WTP for treatment in 6 types of sickness that lasts 5 years are as follows: 99,600 Baht for unilateral blindness, 154,000 Baht for bilateral blindness, 117,900 Baht for paraplegia, 165,600 Baht for quadriplegia, 31,000 Baht for mild allergy and 39,000 Baht for moderate allergy. I assume that the discount rate is zero, and therefore the WTP for one-day-long sickness treatment is the WTP for 5-year-long sickness treatment divided by 1825. As a result, the (dis)value of sickness is ranged from a minimum of -19.18 Baht per day per person to a maximum of -73.56 Baht per day per person. I use the midpoint of this range to represent the (dis)value of sickness. That is, $\Phi = -46.7$ Baht per day per person.

Summary Statistics

Table 5 shows the summary statistics of the control group and the treatment group in both the pre-30 Baht period and the post 30-Baht period. In the pre-30 Baht period, although the numbers of household members and the income sources of the control group and the treatment group are not very different, the control group has much higher wealth, incomes and expenditures than those of the treatment group. Note that household wealth is defined as the difference between household assets and household liabilities, and household savings is defined as the difference between household income and household consumption.

The first row of Table 5 shows that the control group and the treatment group are not very different in term of numbers of household members. Occupations and sources of household incomes are represented from the second row to the sixth row of Table 5. The control group and the treatment group are not very different in term of income sources. These rows also imply that multiple occupations are common among the sampled households. One might be surprised by the multiple occupations of the control group, which is the group of government workers. There are at least two reasons for this fact. First, it is common that spouses of government workers run businesses that are related to the government workers. For example, a janitor's wife usually sells food at the canteen of her husband government office building. Second, the definition of government workers in this paper includes those who do not actually receive salary from the government but are covered by the Civil Servant Medical Beneficiary Scheme (CSMBS), for example, heads of villages. It is not rare that these people are local wealthy and powerful businesspersons or farmers. The number of household members and income sources of the control group and those of the treatment group are similar in both the pre-30 Baht period and the post-30 Baht period, although it seems like the trends in business ownership between the control group and the treatment group are opposite.

The other rows of Table 5 show that, in the pre-30 Baht period, the control group has much higher wealth, incomes, savings and expenditures than those of the treatment group. In spite of a slight difference in average consumption, the average income and saving of the control group is more than 50% higher than that of the treatment group. The control group has approximately twice the assets and wealth of the treatment group. Surprisingly, the control group spend on medical services more than two times of those of the treatment group, although they receive the best health care coverage. This might be explained by the fact that the control group is wealthier, and that the Civil Servant Medical Beneficiary Scheme (CSMBS) does not cover luxurious medical services provided by private hospitals. After the 30 Baht program was introduced, the trends of these variables are diverse. The consumption growth rates of the control group and the treatment group are almost the same, although the growth rate of medical spending of the control group is higher. While the average income and saving of the treatment group grows faster after the 30 Baht program, the control group beats the treatment group in term of asset and wealth growth.

The bottom line is that, although the control group has much higher average income and average wealth, the difference in average consumption between two groups is not very high. Moreover, in order to estimate the counterfactual consumption of the treatment group in the post-30 Baht period, I map the growth rate of the control group to the treatment group within the same consumption bracket. Therefore, difference in average consumption is not an issue to my estimation of the welfare effect.

It is surprising that the out-of-pocket medical spending of the treatment group is actually higher after the 30 Baht program. These households might have spent on some medications or medical services that are not covered by the 30 Baht program, for example, Thai traditional treatment. Although the average out-of-pocket medical spending of the treatment group increases after the 30 Baht program, the spending of the households in the high percentiles of medical spending actually decreases. Table 6 and Table 7 show that the out-of-pocket medical spending per one visit of outpatient care and those of inpatient care decrease by 11% and 40% respectively. I may conclude that, although the 30 Baht program does not decrease out-of-pocket medical spending on average, it does decrease the spending at the high percentiles.

1.5 Results

The Effect of the 30 Baht Program on Consumption, Income and Saving

Before showing the welfare estimation results, it is crucial to examine how the 30 Baht program affects consumption, income and saving in order to understand and evaluate the validity of the welfare estimation. While available literature uses income as a proxy for consumption, eg. FHL(2015) and

Table 5: Summary Statistics

Variables	Control Group		Treatment Group	
	pre-30 Baht	Post- 30 Baht	pre-30 Baht	Post- 30 Baht
Average number of household members	4.5	4.3	4.0	3.9
Having non-zero farming income	77.1%	69.3%	75.9%	70.2%
Having non-zero livestock income	60.7%	58.6%	74.8%	72.8%
Having non-zero fish or shrimp farming income	52.1%	34.3%	43.7%	31.2%
Having non-zero business income	41.4%	38.6%	31.4%	32.3%
Having non-zero labour income	96.4%	90.0%	81.8%	77.9%
average annual consumption unit: Baht/year/person	17,425 (191.1)	19,294 (235.6)	13,022 (111.1)	14,367 (101.4)
average annual income unit: Baht/year/person	26,789 (738.7)	28,872 (756.6)	17,392 (769.4)	19,954 (486.6)
average annual saving unit: Baht/year/person	8,474 (726.7)	8,405 (727.3)	3,996 (769.4)	5,142 (466.6)
average assets unit: Baht/person	8,830,995 (497,981)	9,982,706 (532,379)	4,330,819 (92,166)	4,584,564 (757,74)
average liabilities unit: Baht/person	498,786 (21,365)	606,186 (22,157)	212,433 (4,867)	298,698 (7,127)
average wealth unit: Baht/person	8,332,210 (498,275)	9,376,520 (532,279)	4,118,385 (90,235)	4,285,866 (73,083)
out-of-pocket medical spending per a visit as an outpatient unit: Baht/year/person/visit	278 (15.2)	325 (31.1)	124 (2.5)	177 (2.9)
out-of-pocket medical spending per a visit as an inpatient unit: Baht/year/person/visit	360 (15.2)	398 (39.1)	130 (6.2)	137 (13.6)
total out-of-pocket medical spending unit: Baht/year/person	890 (27.5)	1,172 (114.9)	375 (9.0)	444 (15.9)

Standard errors in parentheses.

Table 6: Distribution of out-of-pocket medical spending on outpatient care of the treatment group (unit:Baht/year/person/visit)

percentiles of medical spending	10%	25%	50%	75%	90%	max
pre-30 Baht program	4.75	19.4	55.8	181.5	455.5	2662.3
post-30 Baht program	10	25.9	67.2	204.2	405	3831.9
% change	+105%	+34%	+20%	+13%	-11%	-

Table 7: Distribution of out-of-pocket medical spending on inpatient care of the treatment group (unit:Baht/year/person/visit)

percentiles of medical spending	10%	25%	50%	75%	90%	max
pre-30 Baht program	5	12.5	33.3	203.3	1,466.7	9,553
post-30 Baht program	4.3	12.5	31.4	186.7	940	33,140
% change	-14%	+0%	-6%	-8%	-40%	-

Limwattananon (2015), this paper directly uses consumption to estimate the welfare gain from the health insurance. Since saving is equal to the difference between income and consumption by definition, it may explain the discrepancy in welfare estimation between this paper and other papers.

I use difference in differences to estimate the treatment effect of the 30 Baht program on outcomes, and the regression model is

$$y_{im} = \alpha_i + \beta_1 Treat_m + \beta_2 Post_t + \beta_3 Treat_i \times Post_m + \epsilon_{im},$$

where y_{im} is an outcome of household i in month m. α_i is the household fixed effect. $Treat_i$ is an indicator, which equals 0 if the household is belonged to the control, and $Treat_i = 1$ if the household is belonged to the treatment group. $Post_m$ is an indicator, where $Post_m = 0$ if month m is in the pre-30 Baht period and $Post_m = 1$ if month m is in the post-30 Baht period. $Treat_i \times Post_m$ is an interaction term between $Treat_i$ and $Post_m$, and its coefficient, β_3 , is the coefficient of interest because it represents the treatment effect of the 30 Baht program.

The regression is based on the assumption that the outcomes of the treatment group and the control group would have followed the same trend in the absence of the 30 Baht program. All the outcomes are in the form of logarithm. Therefore, the assumption implies that, in the absence of the 30 Baht program, the outcomes of control group and the treatment would have had the same percentage growth rate, rather than the same change in level. One issue is that many observations of the outcomes, especially income and saving, are negative. These observations would be dropped by the log transformation, and the estimation results would be different. To solve this issue, instead of the log transformation, I use the inverse hyperbolic sine transformation. The inverse hyperbolic sine transformation of an observation y_{im} is $\ln\left(y_{im} + \sqrt{y_{im}^2 + 1}\right)$. With the inverse hyperbolic transformation, the observations with zero or negative values are not dropped. Moreover, the hyperbolic sine transformation dependent variables can be interpreted in approximately the same way as logarithmic ones.

The estimation results are shown in Table 6. The treatment effect of the 30 Baht program on consumption is estimated to be negative, but small and not statistically significant. The treatment effects on income and saving are positive, but it is statistically significant only for the effect on income. The coefficient of the interaction term in the regression in which its dependent variable is household income is 0.5941. This can be interpreted that the 30 Baht program raises per capita household income of the treatment group by 61.49% on average.[7] I conclude that, in spite of the

[7] If a household switches from the control group to the treatment group , the percentage impact of the 30 Baht on

Table 8: Difference in differences estimation results

dependent variables	Consumption	Income	Saving
$Treat \times Post$	-.0375	0.5941*	0.3386
	(.0303)	(.3270)	(0.4108)
N	30,339	30,339	30,339
No. of HH	679	679	679

Robust standard errors are reported in parentheses. All regressions include household fixed effects. * 10% significant level, ** 5% significant level, *** 1% significant level

increase in income, the effect of the 30 Baht program on consumption is small and negative, because households are more likely to increase their savings.

The Welfare Effect Estimation Results

Table 9 summarizes the estimation of welfare effect from the 30 Baht program. The estimated total welfare effect (γ) is 831 Baht per year per person. I decompose the welfare effect into the consumption component (γ_C) and the health component (γ_M). The consumption component of the welfare effect is estimated by holding the health outcome constant. The estimated consumption component of the welfare effect is 830 Baht per year per person. By definition, the health component is only 1 Baht per year per person. This is because the average non-working days from sickness, which is a proxy of the health outcome, changes very little. The average non-working days from sickness is 2.40 days per year per person in the pre-30 Baht period, and it is 2.33 days per year per person in the post-30 Baht period.

The consumption component (γ_C) is also decomposed into the transfer component and the pure-insurance component. The transfer component is define the the change in the average of counterfactual consumption $c_{i,1}^T(0)$ and the average of actual consumption $c_{i,1}^T(1)$. The average actual consumption of the treatment group in the post-30 Baht period is 15,533 Baht per year per person and the average of its counterfactual counterpart is 15,544 Baht per year per person. Thus, $\gamma_{CT} = -11$ Baht per year per person because the average consumption decreases by 11 Baht per year person after the initiation of the 30 Baht program. By definition, γ_{CI} is equal to $\gamma_C - \gamma_{CT}$. Therefore γ_{CI} is equal to 841 Baht per year per person.

To evaluate efficiency of the 30 Baht program, I compare the welfare benefit with the increase in government spending on health coverage. According to Table 1, 37.5% population in the treatment group were covered by the Medical Welfare Scheme (MWS), while the others in the treatment group were uninsured before 2001. Gruber, Hendren and Townsend (2014) documented that, under the MWS, the government gave "reimbursements to public hospitals of roughly 250 Baht per enrollee per year." Therefore, the average government health care funding to the treatment group in the pre-30 Baht program period was 93.75 Baht per year per person. At the beginning of the 30 Baht program, the government increased funding to these hospitals to 1,200 Baht per year per person. Therefore, the increase in capitation payment is approximately 1,106.25 Baht per year per person.

per capita household income is $100[\exp(\beta_3) - 1]$.

Table 9: Welfare Effect Estimates (unit: Baht/year/person)

	gain	% of an increase in capitation payment
Total Welfare effect (γ)	831	75.1%
Decomposition of Welfare Effect		
Consumption (γ_C)	830	75.0%
—Transfer Component (γ_{CT})	-11	-1.0%
—Pure-Insurance Component (γ_{CI})	841	76.0%
Health (γ_M)	1	0.1%

Note: 1 USD is approximately 35 Baht.

Table 10: Estimates of the pure-insurance component using different values of σ

	Welfare gain (unit: Baht/year/person)			% of an increase in capitation payment		
Values of CRRA	$\sigma = 2$	$\sigma = 3$	$\sigma = 4$	$\sigma = 2$	$\sigma = 3$	$\sigma = 4$
Estimatedγ_{CI}	191	841	1,076	17.3%	76.0%	97.3%

Note: The benchmark estimates are those using $\sigma = 3$.

Compared with the increase in capitation payment, the welfare effect is approximate three fourths of the additional government spending. In other words, an enrollee in the 30 Baht program receives approximately 75 cents per dollar of government spending. According to Table 9, all the welfare effect comes from the pure-insurance component, while the sizes of other components are negligibly small. I therefore conclude that the only main source of the welfare effect is the decrease in consumption volatility due to the 30 Baht program.

Robustness Checks

The pure-insurance component estimate should be taken cautiously. I also investigate the sensitivity of the insurance component estimate with respect to variation in the coefficient of relative risk aversion, σ. Table 10 reports that, instead of 841 Baht/year/person as that in the benchmark case, the estimated welfare gain can be as low as 191 Baht/year/person when using $\sigma = 2$, or it can be as high as 1,076 Baht/year/person when using $\sigma = 4$.

One might also question the validity of the pure-insurance estimates, since the pure-insurance component is defined as a residual of the consumption component (γ_C) after the transfer component (γ_{CT})is isolated. To measure if the treatment group has better consumption smoothing in the post-30 Baht period, I estimate a simplified version of the main reduced-form equation of Townsend(1994), which investigates into the relationship between household consumption and risk. The regression equation includes both sub-district ("Tambon"[8] in Thai) aggregate risk and idiosyncratic risk as its explanatory variables. Using households panel data, the regression equation is

$$c_{im} = \alpha_i + \beta\bar{c}_m + \xi X_{im} + \epsilon_{im},$$

, where $\bar{c}_m = \frac{1}{n}\sum_{i=1}^{n} c_{im}$ is Tambon average per capita consumption. c_{im} is per capita consumption of household i in month m. α_i is a household fixed effect. X_i is a matrix of covariates representing idiosyncratic risk, including household income from crop production, income from livestock, income from fish and shrimp farming, income from working outside the household, household business profit, total income, days sickness and days not working from sickness. If full insurance is satisfied, ξ is a vector of zero, which is the null hypothesis of the above regression. To test this hypothesis, I choose households in the treatment group from four different Tambon. All Tambon are from different provinces, but households in the same Tambon have similar characteristics. For each Tambon, I separate the observations into those in the pre-30 Baht period and those in the post-30 Baht period.

Table 11 supports that the treatment group has better consumption smoothing after the initiation of the 30 Baht program. Table 11 shows that, in Tambon II and Tambon III regressions, the coefficients of the crop income variable are positive and statistically significant in the pre-30 Baht period, but they turn to be not statistically significant in the post-30 Baht period. The coefficients of the household business profit variable and the labour income variable go in the similar direction. It is surprising that the coefficients of the total income variable in some Tambon are significantly negative in the pre-30 Baht period. This is possible that, after controlling for all types of earned income, the total income variable represents external transfers (eg. remittance and government transfer), which may negatively correlate with household consumption. For example, young members working in Bangkok may give more to their families when they are in time of need.

To take treatment effect heterogeneity into account, I also estimate the welfare effect and its components using sub-samples by wealth levels. As the 30 Baht program is funded by taxation, households with high wealth, who pay higher taxes, may bear more financial burdens of the program. Table 12 suggests that households in the low wealth group's total welfare gain is approximately 10 times more than that of the high wealth group. This is attributed to the negative estimated transfer component of the high wealth group. The pure-insurance component estimates, on the other hand, suggest that both groups enjoy benefit from consumption smoothing in similar magnitude.

1.6 Discussion

The decrease in consumption volatility, which is the main source of the welfare effect of the 30 Baht program, can be explained by the fact that the 30 Baht program reduced out-of-pocket medical spending at the high percentiles, as shown in Table 6 and Table 7.

Although this study has no evidence for significant welfare gain from the health improvement from sampled population in this survey, Gruber, Hendren and Townsend (2014) found that the 30 Baht program reduced the infant mortality rate by 13% - 30%. Limitation of health related data

[8] Tambon is a cluster of villages. Villages in the same Tambon are similar in term of occupations, income and wealth.

Table 11: Consumption smoothing regression on the treatment group in the pre- and post- 30 Baht program periods

Dependent Variable: Household consumption								
Tambon	I		II		III		IV	
Period	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Tumbon's average consumption	1.220	1.140*	0.387	1.138	0.547***	1.239**	1.874*	0.516
	(1.108)	(0.550)	(0.230)	(0.624)	(0.123)	(0.411)	(0.811)	(0.284)
Total income	-0.007	-0.017	-0.213**	-0.019	-0.0160*	-0.008	-0.067	-0.010
	(0.012)	(0.038)	(0.066)	(0.029)	(0.006)	(0.008)	(0.041)	(0.011)
Crop income	0.013	0.021	0.197**	-0.008	0.0278**	0.015	0.064	0.007
	(0.016)	(0.038)	(0.063)	(0.028)	(0.008)	(0.009)	(0.046)	(0.018)
Livestock income	0.016	0.138	0.061	0.330	0.006	0.015	-0.771	-0.218
	(0.010)	(0.123)	(0.508)	(0.254)	(0.033)	(0.054)	(0.584)	(0.156)
Fish and shrimp farming income	0.008	0.024	0.020	0.032	0.017	0.000	0.233	0.387
	(0.012)	(0.041)	(0.689)	(0.201)	(0.019)	(.)	(1.193)	(0.509)
Household business profit	0.191	-0.265	0.230**	0.152	0.0595***	-0.110	-0.039	0.119
	(0.179)	(0.370)	(0.075)	(0.156)	(0.012)	(0.112)	(0.108)	(0.222)
Labour income	0.299***	0.022	0.223**	0.015	0.037	-0.030	0.104	0.039
	(0.077)	(0.040)	(0.067)	(0.030)	(0.020)	(0.021)	(0.059)	(0.027)
Days sickness	42.4	0.8	25.15**	10.6	18.1	5.0	-8.2	29.6
	(21.4)	(8.2)	(9.4)	(10.5)	(17.1)	(63.3)	(21.1)	(21.9)
Days not working from sickness	-23.4	-255.0*	142.1	54.1	-57.8	147.5	57.1	-32.7
	(20.3)	(121.3)	(118.1)	(47.5)	(43.5)	(188.1)	(74.3)	(31.8)
N	835	665	1043	1285	1444	1395	900	1022
No. of HH	90	88	140	136	150	144	122	108

Robust standard errors are reported in parentheses. All regressions include household fixed effects. * 5% significant level, ** 1% significant level, *** 0.1% significant level. Units of measurement of total income, crop income, livestock income, fish and shrimp farming income, household business profit and labour income are Baht/month/person. Units of measurement of days sickness and days not working from sickness are day/month/person.

Table 12: Welfare effect estimates

	Welfare gain (unit: Baht/year/person)		% of an increase in capitation payment	
Wealth Group	Low	High	Low	High
Total Welfare effect (γ)	954	94	86.2%	8.5%
Decomposition of Welfare Effect				
Consumption (γ_C)	956	78	86.4%	7.1%
—Transfer Component (γ_{CT})	332	-656	30.0%	-59.3%
—Pure-Insurance Component (γ_{CI})	624	734	56.4%	66.4%
Health (γ_M)	-2	16	-0.2%	1.4%

Note: The low wealth group and the high wealth group are separated by the median household wealth prior to the initiation of the 30 Baht program.

Table 13: Welfare effect comparison with other studies

	Welfare effect per dollar of government spending		
	This study	FHL (2015)[9]	Limwattananon et al (2015)
Total Welfare effect (γ)	0.75	0.44	n/a
Decomposition of Welfare Effect			
Consumption (γ_C)	0.75	0.31	n/a
—Transfer Component (γ_{CT})	-0.01	0.14	n/a
—Pure-Insurance Component (γ_{CI})	0.76	0.17	0.15
Health (γ_M)	0.00	0.13	n/a

in the surveys could be one reason to explain why the estimate of the health component of the welfare effect is close to zero. The other reason is that the 30 Baht program may improve the health outcomes of marginalized groups, eg. infants in a poor province, but not those of the average population.

Table 13 compares the estimation of the welfare effect from health insurance in this study with the other two studies. FHL (2015) studies the welfare effect of Medicaid, but use the same framework as the one in this study. On the other hand, Limwattananon et al (2015) study the welfare effect of the 30 Baht program, but they use different framework to estimate the welfare effect. Note that all three papers use the same CRRA utility function and the same constant coefficients of relative risk aversion ($\sigma = 3$).

According to Table 13, the total welfare effect of the 30 Baht program in this study is 75 cents per dollar of government spending, while FHL(2015) estimate that the welfare effect of Medicaid is only 44 cents per dollar of government spending. Since Limwattananon et al (2015) use different estimation framework, the total welfare effect is not available. In term of its composition, FHL (2015) estimate that about three fourths of the total welfare effect is contributed from the consumption component, and the other one fourth is from the health component. The consumption is approximately halved into the transfer component and the pure-insurance component. In contrast, in this study all the total welfare effect is contributed by the consumption pure-insurance component.

Limwattananon et al (2015) define the welfare gain from the 30 Baht program by the change in risk premium between the pre-30 Baht and the post-30 Baht period.[10] By definition, this is equivalent to the pure-insurance component in my study. They find that the average welfare gain from the 30 Baht program is equal to 13.69 Baht per person per month, or 164.28 Baht per person per year, which can be translated into 15 cents per dollar of government spending. It is interesting that this number is very close to the one estimated by FHL(2015), although these two estimates are from two studies of health insurance schemes in different countries.

While different contexts and different estimation frameworks may explain the discrepancy, I argue that the main reason why my estimation is different from the others is measurement. The framework used by FHL(2015) and Limwattananon et al (2015) require consumption data, and both of them state that they proxy consumption by subtracting income by out-of-pocket medical spending. I have shown that the 30 Baht program affects consumption and income differently. While the treatment group's average income significantly increases after the 30 Baht program, its average consumption actually slightly decreases due to increased saving. Note that the positive effect of the 30 Baht program on income is similar to FHL(2015)'s estimation, in which the consumption transfer component, which is define the change in the difference between average income and out-of-pocket medical spending, is positive.

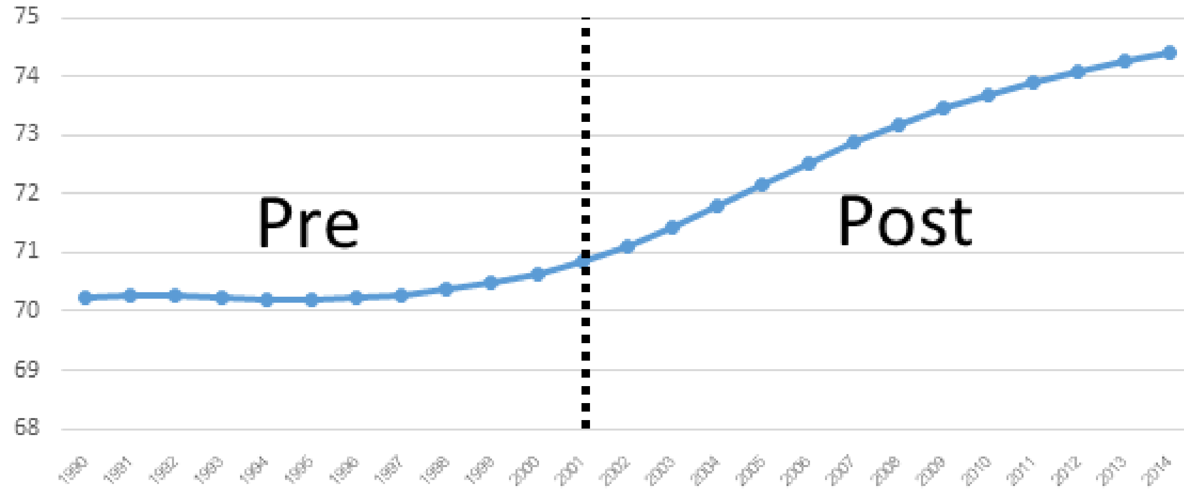
On the other hand, the positive effect of the 30 Baht program on saving is opposite to the study of Chou, Liu and Hammitt (2003). They find that the National Health Insurance in Taiwan reduced saving of the treatment group. They explain that health insurance decreases the variance of future medical spending, therefore households decide to reduce precautionary saving.

One possible reason why the sampled households in this survey increase saving is possibly because of increased life expectancy. Given a fixed amount of income and strictly concave utility function, an unexpected additional period of life causes a decrease in current consumption and an increase saving, which increases future consumption. Figure 1 shows that life expectancy in Thailand had changed less than 1 year during the decade of 1990's. After 2001, when the 30 Baht program is initiated, life expectancy increased more than 3 years within 13 years.

I do not have any strong evidence to explain why consumption decreases and saving increases after the 30 Baht program. Whatever the cause may be, however, the bottom line is that it is necessary to take intertemporal consumption into account, in order to estimate more accurate welfare effect. Additional saving turns into consumption in the future periods, and the welfare effect from this source is excluded in the static framework of welfare effect estimation.

[10] Although their framework is different from mine, both of our frameworks use CRRA utility function with the same constant coefficients of relative risk aversion.

Figure 1: Thailand's Life Expectancy before and after the reform



Source: The World Bank

2 Chapter Two

The Effect of Thailand's Universal Health Care Program on Risk-Prone Health Behaviours

2.1 Introduction

A causal relationship between health insurance and risk-prone health behaviours can be ambiguous because of the entanglement of multiple pairs of causal relationship. This paper aims to estimate and decompose the effect of Thailand's universal health care program, which is called "the 30 Baht program", on drinking and smoking behaviours. The 30 Baht program, which is Thailand's biggest ever implemented health reform initiated in 2001, can be considered a natural experiment for identifying such a causal relationship because it provides health coverage to all the Thai citizens who have never been covered by any other public health insurance programs. Similarly to other cases of natural experiment, the 30 Baht program divides individuals into the control group - the group which is covered by publicly provided health insurance plan prior to the health reform, including government employees and their families - and the treatment group, which is the rest of the population.

According to the literature, health insurance may affect risk-prone health behaviours through two channels: moral hazard and increased health care utilization. While moral hazard leads to an increase in risk-prone health behaviours (Dave and Kaestner 2009; Kelly and Markowitz 2009; Bhattacharya et al 2011), health insurance, on the other hand, may reduce unhealthy behaviours through a better access to health knowledge and awareness that come after increased contacts with health care providers (Courbage and Coulon 2004; Brunsberg Rosser and Smolenski 2012). In this paper, I propose that health insurance may affect risk-prone health behaviours through another channel: increased individual life expectancy. Theoretically, when an individual expects to live longer, it is more costly to spend for an instant gratification (drinking and smoking, for example) that put a burden on herself in the future. Following this idea, if health insurance improves the quality of health care and thus increases life expectancy, it may help discourage drinking and smoking. Empirically, after the 30 Baht program was initiated, life expectancy in Thailand has increased rapidly, as shown in Figure 1. The increase in life expectancy may come from the significant decrease in child mortality after the program. Gruber, Hendren and Townsend (2014) suggested that the 30 Baht program might lead to "a large aggregate reduction in infant mortality of 13–30 percent." Similarly, Sen (2015) also mention the impact of the 30 Baht program on Thailand's life expectancy as follows:

> The result of universal health coverage in Thailand has been a significant fall in mortality (particularly infant and child mortality, with infant mortality as low as 11 per 1,000) and a remarkable rise in life expectancy, which is now more than 74 years at birth – major achievements for a poor country. There has also been an astonishing removal of historic disparities in infant mortality between the poorer and richer regions of Thailand;

so much so that Thailand's low infant mortality rate is now shared by the poorer and richer parts of the country.

Besides estimating the total effect of the 30 Baht program on drinking/smoking behaviours, one of the main challenges is to distinguish this effect through increased life expectancy, which is not identified from the available data, from the other components. To deal with the challenge, I formulate a framework to understand the total effect of the 30 Baht program on drinking and smoking behaviours and decompose the total effect into 3 components: moral hazard, increased health care utilization and increased life expectancy. Based on the structural model, I formulate a reduced form estimation model and, firstly, estimate the total effect using a baseline difference-in-differences regression equation. Two observable components of the total effect - moral hazard and increased life expectancy - are then isolated from the total effect. The remaining effect after the isolation is the increased life expectancy component under the assumption that there is no omitted relevant explanatory variable.

Beside the decomposition of the effect of health insurance on risk-prone health behaviours, I also focus on heterogeneity of the effect, which is neglected by all studies in the literature. It is natural to believe that the effect of health insurance on a health behaviour is heterogeneous across its distribution. For example, a light smoker might respond to the 30 Baht program differently from a chain smoker after being covered by the program. By this reason, in addition to the treatment effect, this paper will also study the effect of the 30 Baht program across the distribution of outcomes using quantile regressions.

2.2 Universal Health Care in Thailand

Universal healthcare in Thailand was implemented in 2001 after a relatively left-wing political party came to power. As they promised during the campaign, the government launched the universal health coverage scheme, also known as the 30 Baht program, aiming to extend health coverage to all citizens in Thailand. Beside a more-than-double increase in capitation paid to hospitals, the 30 Baht program replaced out-of-pocket medical fees with a 30 Baht (approximately $1) flat rate co-payment per one visit.

Although the 30 Baht program is generally mentioned as a universal health care program, it does not cover all the Thai citizens. It covers all the citizens who had never been covered under any medical insurance scheme and those who had been covered under several medical care schemes prior to 2001, including the Medical Welfare Scheme (MWS), which provided provided free care for low income households and the voluntary health care scheme, also known as 500 Baht program. However, the 30 Baht program doesn't cover those who are covered under the Social Security Scheme (SSS) and the Civil Servant Medical Beneficiary Scheme (CSMBS). According to Thailand's labour protection law, any organization with more than 10 employees must register their employees in the Social Security Scheme (SSS), which provides free care for workers. The Civil Servant Medical Beneficiary Scheme (CSMBS) is considered the most superior health care scheme in Thailand since the government provides free care to each civil servant and his or her immediate family, including a spouse, 18-year-old-or-younger children, and parents. Unlike private health insurance plans, this exogeneity nature of the 30 Baht program rules out self-selection by the pool of insurees is dominated by risky typed individuals. Gruber, Hendren and Townsend (2014) summarize the distribution of

Table 14: Distribution of population covered by different health care schemes before and after 2001

Health care Schemes

Before 2001	After 2001	Pop %
Uninsured[11] (self-employed, small business)	The 30 Baht Program	50%
MWS (the poor)		30%
SSS (formal sector)	SSS (formal sector)	20%
CSMBS (civil servants)	CSMBS (civil servants)	

Source: Gruber, Hendren and Townsend (2014)

population covered by different health care schemes in Table 14.

2.3 Framework

Let a representative individual be endowed with the wealth of w dollars and the health insurance coverage status $q \in [0, 1]$, where $q = 0$ if the individual is not covered by the 30 Bath program at all and $q = 1$ if she is fully covered. The individual may trade some of her endowment for units of an instant gratification good (IG good, henceforth) with a price equal to 1. Consuming the IG good gives the individual instant gratification, but shorten her life expectancy. After making the choice, the individual has to draw a lottery, which may result in three possible outcomes: "being healthy", "being sick" and "dying young" If the individual is healthy, then she enjoys the rest of the endowment. If the individual is sick, then she must pay out-of-pocket medical treatment fee $r(q)$, which depends whether she is covered by the 30 Baht program, and receives the rest of the endowment. If the individual dies young, then she loses the rest of the endowment. The probability of being healthy is $\pi_1 = \Pi_1(k, m, q)$, the probability of being sick is $\pi_2 = \Pi_2(k, m, q)$ and the probability of dying young is $1 - \pi_1 - \pi_2$, where q is the insurance status, $k = K(q)$ denotes the units of IG good she consume and $m = M(q)$ denotes a measure of preventive health care utilization. Assume that both π_1 and π_2 are additively separable in their arguments, so they can be simplified as $\pi_i(k, m, q) = \pi_{ik}k + \pi_{im}m + \frac{d\pi_i}{dq}q$, $\forall i \in \{1, 2\}$. I assume that the probability of being healthy is decreasing in IG consumption and is increasing in preventive health care utilization, but their effects on the probability of being sick is opposite, i.e. $\pi_{1k} < 0$, $\pi_{1m} > 0$, $\pi_{2k} > 0$ and $\pi_{2m} < 0$. I also assume that $\pi_{1k} + \pi_{2k} < 0$, $\pi_{1m} + \pi_{2m} > 0$, implying that the probability of dying young is increasing in IG good consumption but is decreasing in preventive health care utilization. Note that the term $\frac{d\pi_i}{dq}$ incorporates in the probability functions the marginal effect which is not through a change in IG good consumption or preventive health care utilization. For example, the 30 Baht program might help improve medical services through an increase in funding to public hospitals. The better services might help save patients' lives although their health-related behaviours do not change. Assume an individual's utility function is quasilinear.[12] The expected utility of this individual can be written as follow:

$$E[U] = \pi_1(w - k) + \pi_2(w - k - r(q)) + U(k),$$

[12] This implies that the individual's demand for the IG good does not depend on her wealth.

where $U(\cdot)$ is strictly increasing and strictly concave. For simplicity I also assume that $U^{'''}(\cdot) = 0$. In other words, $U^{''}(\cdot) \in \mathbb{R}_{<0}$. Given the above expected utility, the policy function $\mathbf{k}(q) : [0,1] \rightarrow \mathbb{R}^{+}$ is characterized by the following first order condition:

$$U^{'}(\mathbf{k}(q)) = \pi - (\pi_{1k} + \pi_{2k})(w - \mathbf{k}(q)) + \pi_{2k} r(q), \tag{6}$$

where $\pi \equiv \pi_1 + \pi_2$ is the probability of not dying young. The above equation shows that the marginal benefit and the expected marginal cost of the IG good consumption are equal at the optimal choice $\mathbf{k}(q)$. On the LHS of the equation, the marginal benefit is equal to the marginal utility with respect to the IG good at the optimal level $\mathbf{k}(q)$. The RHS shows that the expected marginal cost is decomposed into three components. The term π represents the monetary marginal cost. If the individual does not die young (with probability π), an additional unit of IG good consumption means one dollar less in the remaining wealth, since the price of the IG good is one dollar. Equation (6) also take into account the implicit marginal cost of IG good consumption. The second term on the RHS implies that an additional unit of IG good consumption decreases the likelihood of the case in which the individual does not die young and enjoys the remaining wealth of $w - \mathbf{k}(q)$ with probability $\pi_{1k} + \pi_{2k}$. Moreover, the third term on the RHS implies that an additional unit of IG good consumption increases the likelihood of the case in which the individual is sick and loses $r(q)$ dollars with probability π_{2k}.

For the uniqueness of the optimal choice, I assume that the second-order condition $\frac{\partial^2 E[U]}{\partial k^2} = SOC = -2(\pi_{1k} + \pi_{2k}) + U^{''}(\mathbf{k}(q)) < 0$. Following this assumption, $U^{''}(\mathbf{k}(q)) < 2(\pi_{1k} + \pi_{2k})$, implying that, to guarantee the uniqueness of the optimal $\mathbf{k}(q)$ at every q, the marginal utility with respect to k must decrease fast enough. Taking the total differentiation on the first-order condition with respect to q, the marginal effect of the 30 Bath program on IG good consumption is

$$\frac{d\mathbf{k}(q)}{dq} = \underbrace{\frac{\pi_{2k}}{SOC}\frac{dr}{dq}}_{\text{Moral Hazard (+)}} + \underbrace{\frac{(\pi_{1m} + \pi_{2m})}{SOC}\frac{dm}{dq}}_{\text{Increased Utilization (-)}} + \underbrace{\frac{1}{SOC}\frac{d\pi}{dq}}_{\text{Increased life expectancy (-)}} \tag{7}$$

According equation (7), although the sign of the marginal effect of the 30 Baht program on IG good consumption is ambiguous, the sign of each of its components can be determined by supporting evidence from related literature. The sign of the first component, moral hazard, depends on the term $\frac{dr}{dq}$, which reflects how the 30 Baht program affects out-of-pocket medical spending. Since the 30 Bath program replaces out-of-pocket medical fee with a fixed co-payment of 30 Bahts (USD 0.9), I assume that $\frac{dr}{dq} < 0$. Since the cost of treatment in the case where an insured person gets sick is transferred to the government through the 30 Bath program, the marginal cost of IG good consumption decreases. This gives an incentive to the insured person to consume more IG good, i.e. the first term is positive. The second term and the third term show that the moral hazard effect can be offset by both the increased utilization $\left(\frac{dm}{dq} > 0\right)$ and the increased life expectancy $\left(\frac{d\pi}{dq} > 0\right)$, which work through an increase in probability of not dying young (π). Since the individual enjoys her remaining wealth $w - \mathbf{k}(r)$ only if she does not die young, an increase in the likelihood of this case makes IG good consumption more costly. Gruber, Hendren and Townsend (2014) suggest that the 30 Baht program leads to a decrease in child mortality by approximately 13% - 30%, implying positive causal relationship of the 30 Baht program to life expectancy. This effect might come from both the positive impact of the 30 Bath program on health care utilization, i.e. $\frac{dm}{dq} > 0$, as documented in Gruber, Hendren and Townsend (2014) and Limwattananon et al (2015), and the quality improvement on the supply side of the health care service, i.e. $\frac{d\pi}{dq} > 0$, through approximately the fourfold increase in funding to public hospitals after the 30 Baht program was initiated.

From the marginal effect, the total effect of the 30 Bath program on IG good consumption can be derive by integrating with respect to q. According to equation (7),

$$\int_0^1 \frac{d\mathbf{k}(q)}{dq}dq = \frac{\pi_{2k}}{SOC}\int_0^1 \frac{dr}{dq}dq + \frac{(\pi_{1m}+\pi_{2m})}{SOC}\int_0^1 \frac{dm}{dq}dq + \frac{1}{SOC}\int_0^1 \frac{d\pi}{dq}dq$$

Let $\triangle y \equiv \int_0^1 \frac{dy}{dq}dq, \forall y \in \{k, r, m, \pi\}$. The total effect of the 30 Baht program on IG consumption in a reduced form is

$$\triangle k = \underbrace{\alpha_r \triangle r}_{\text{Moral Hazard (+)}} + \underbrace{\alpha_m \triangle m}_{I\text{ncreased Utilization (-)}} + \underbrace{\alpha_\pi \triangle \pi}_{I\text{ncreased life expectancy (-)}}, \tag{8}$$

where $\alpha_i \in \mathbb{R}_{<0}, \forall i \in \{r, m, \pi\}$. Similar to the marginal effect, equation (8) shows that the total effect of the 30 Baht program on IG good consumption can be decomposed into three components: moral Hazard, increased utilization and increased life expectancy. Lastly, the coefficients α_i are constant because I assume that U'' is a constant negative number. If I allow a non-zero third derivative of the utility function, the second-order condition SOC will depend on the level of $\mathbf{k}(q)$. Consequently, the coefficients α_i may no longer be a constant, but rather depends on $\mathbf{k}(q)$. Therefore, a more general version of equation (8) is

$$\triangle k = \underbrace{\alpha_r(\mathbf{k}(q)) \triangle r}_{\text{Moral Hazard (+)}} + \underbrace{\alpha_m(\mathbf{k}(q)) \triangle m}_{\text{Increased Utilization (-)}} + \underbrace{\alpha_\pi(\mathbf{k}(q)) \triangle \pi}_{\text{Increased life expectancy (-)}}, \tag{9}$$

in which its coefficient estimation requires a non-parametric or a semi-parametric estimation, for example, a quantile regression.

2.4 Data and Identification Strategies

This section focuses on the estimation of the effect of the 30 Baht program on risk-prone health behaviours based on the framework described in the previous section using difference in differences (DD). Intuitively, according to DD, the total effect of the 30 Baht program on an outcome is estimated from the difference between the average change in the outcome of the treatment group, which receives benefit from the 30 Baht program, and that of the control group, which is not affected by the program. To calculate the total effect, let $z^C_{is}(q)$ denote the outcome z in period s of household i which is a member of the control group and receives the health insurance status q, and let $z^T_{is}(q)$ denote the outcome in case household i is a member of the treatment group. Let $z \in \{k, r, m, \pi\}$ $q \in \{0, 1\}$ and $s \in \{0, 1\}$. We can interpret $s = 0$ as the pre-30 Baht program period, and Let $s = 1$ as the post-30 Baht program period. The total effect of the 30 Baht program on outcome z ($\triangle z$ as stated in equation (8) and equation (9)) is defined as

$$\triangle z = \bar{z}^T_1(1) - \bar{z}^T_1(0),$$

where $\bar{z}_s^T(q)$ denotes the average outcome z of the treatment group receiving the status q in period s. Since the treatment group is covered by the 30 Baht program in the post-30 Baht program period, the term $\bar{z}_1^T(0)$ is counterfactual. Although this term is not directly observable, the total effect $\triangle z$ can still be estimated under a parallel trend assumption, which states that in the absence of the 30 Baht program the trends in the outcome variable would have been the same. Mathematically, I assume that $\bar{z}_1^T(0) - \bar{z}_0^T(0) = \bar{z}_1^C(0) - \bar{z}_0^C(0)$. Substituting this expression in the above equation, the total effect of the 30 Baht program on the outcome z can be calculated as

$$\triangle z = \left(\bar{z}_1^T(1) - \bar{z}_0^T(0)\right) - \left(\bar{z}_1^C(1) - \bar{z}_0^C(0)\right) \tag{10}$$

On the right hand side of the above equation, the first term represents a change in the treatment group's average outcome and the second term represents that of the control group.

For the estimation, I use panel data in individual and household level from Townsend Thai Project Household monthly surveys. More than 600 households were randomly selected from the rural areas of two provinces in the central region and two provinces in the Northeastern region of Thailand. These four provinces are different in term of economic conditions and activities, but villages within the same district are similar. The survey was initiated in September 1998. The sampling household were interviewed on a monthly basis, expect the questions regarding household expenditures, which were asked on a weekly basis.

The most crucial part of the DD is to identify the treatment group and the control group of the 30 Bath program. The treatment of the 30 Baht program is identified using household members' occupations prior to the 2001 health policy reform. While majority of Thai citizens receive benefit from the 30 Baht program, those who were insured by two employment-based health care schemes, namely the Social Security Scheme (SSS) and the Civil Servant Medical Beneficiary Scheme (CSMBS), did not. The CSMBS scheme and the SSS scheme are also different in term of coverage. While the CSMBS scheme provides health insurance coverage for the entire family, including the one's spouse, parents and children, of every government worker, the SSS scheme provides the coverage only for employees in the formal sector, but not their families. Therefore, I defines the control group as the group of households in which at least one of its members was a government worker prior to the health reform in 2001. I drop all the households in which at least one of its member ever received a free medical treatment reimbursed by the SSS prior to the health reform, since they received only partial treatment of the 30 Baht program. Finally, the treatment group consists of the rest of the households in the survey. This identification strategy is very similar to the one used by Chou, Liu and Hammitt (2003), which studied the effect of Taiwan's national health insurance program on consumptions and savings. To rule out self-selection, I assume that the 30 Baht program did not create spillover effect or crowding out effect to the control group, which includes those who were not insured by the program.

After the treatment of the 30 Baht program is identified, the next step is to state the DD regression equation. Following the idea from equation (10), the total effect of the 30 Baht program on risk-prone health behaviours, $\triangle k$, can be estimated using the baseline DD regression model as follows.

$$y_{it} = \alpha_i + \beta_1 Treat_i + \beta_2 Post_t + \beta_3 Treat_i x Post_t + \epsilon_{it} \tag{11}$$

y_{it} is measures of risk-prone health behaviours of household i in month t. These measures capture household alcohol and tobacco consumptions, including an indicator of being a smoker/a drinker, and per-capita spending on tobacco/alcohol. α_i is a household fixed effect. $Treat_i$ is an indicator which takes values $Treat_i = 0$ if **at least one** of the household members was a government worker prior to June 2001, and $Treat_i = 1$ otherwise. $Post_t$ is a dummy variable, where $Post_t = 0$ for any observations collected between June 2000 and May 2001 and $Post_t = 1$ for any observations collected between June 2002 and May 2003. ϵ_{it} is an error term, and $E(\epsilon_{it}) = 0$.

The reason why I drop observations from June 2001 to May 2002 is that they were collected during the transition period of the 30 Baht program. The program was not implemented in provincial hospitals at the same time. Among the provinces in the surveys, all hospitals in the provinces of Srisaket began the 30 Baht program on June 1st, 2001, while hospitals in the other 3 provinces launched the program at unknown dates between October 1st, 2001 and April 1st 2002. I choose 12 months of observations for both pre- and post-program, because household annual alcohol consumptions follow a cycle, in which households tend to drink more during big festivals.

The coefficient β_3 is the coefficient of interest because it represents the treatment effect of the 30 Baht program on risk-prone health behaviours. The value of $\hat{\beta}_3$ is equal to the difference between the treatment group's change in the outcome and the control group's change in the outcome. Mathematically, under the parallel trend assumption, $\hat{\beta}_3 = \left(\bar{y}_1^1 - \bar{y}_0^1\right) - \left(\bar{y}_1^0 - \bar{y}_0^0\right)$, where $\bar{y}_p^g$ is the average outcome over the observations where $Treat_i = g$ and $Post_t = p$.

To estimate the decomposition of the effect of the 30 Baht program on risk-prone health behaviour as characterized in equation (8) and equation (9) in the previous section, I estimate another difference-in-differences regression model,

$$y_{it} = \alpha_i + \gamma_1 Treat_i + \gamma_2 Post_t + \gamma_3 Treat_i x Post_t + \gamma_4 r_{it} + \gamma_5 m_{it} + \epsilon_{it}, \tag{12}$$

where r_{it} and m_{it} is out-of-pocket medical spending and health practitioner visits of household i in month t. The interpretation of the term γ_3 in equation (12) is slightly different from that of the term β_3 in equation (11). While the term β_3 represents the total effect of the 30 Baht program on risk-prone health behaviours, the term γ_3 represents the effect of the 30 Baht which is **not** through increased utilization or moral hazard. Assuming the exogeneity of the variables m_{it} and r_{it}, i.e. $E(\epsilon_{it}|m_{it}, r_{it}, \forall t) = 0$, on top of the parallel trend assumption, I can estimate that

$$\hat{\gamma}_3 = \left(\bar{y}_1^1 - \bar{y}_0^1\right) - \left(\bar{y}_1^0 - \bar{y}_0^0\right) - \hat{\gamma}_4\left(\left(\bar{r}_1^1 - \bar{r}_0^1\right) - \left(\bar{r}_1^0 - \bar{r}_0^0\right)\right) - \hat{\gamma}_5\left(\left(\bar{m}_1^1 - \bar{m}_0^1\right) - \left(\bar{m}_1^0 - \bar{m}_0^0\right)\right)$$

, and the structural counterpart of the above equation is

$$\hat{\gamma}_3 = \triangle k - \hat{\gamma}_4 \triangle r - \hat{\gamma}_5 \triangle m \tag{13}$$

Comparing equation (13) with equation (8), **under the assumption that there are no other relevant determinants of y_{it},** I can conclude that the term $\hat{\gamma}_3$ is an estimate of the term $\alpha_\pi \triangle \pi$, which is the increased life expectancy component of Δk, the total effect of the 30 Baht program on drinking/smoking.

Table 15: Summary Statistics

Variables	Control Group		Treatment Group	
	Pre	Post	Pre	Post
Health Care Utilization (unit: times per month)	0.47 (1.10)	0.35 (0.75)	0.28 (0.62)	0.31 (0.65)
Medical Spending (Out-patients) (unit: Baht/person/month)	577.35 (1552.03)	658.93 (1456.16)	273.34 (674.64)	255.40 (659.30)
Medical Spending (In-patients) (unit: Baht/person/month)	4,025.56 (11,046.39)	6,620.27 (20,928.88)	3,048.00 (10,218.97)	3,357.507 (10,940.57)
Spending on Alcohol (unit: Baht/person/month)	193.80 (1384.80)	152.43 (405.65)	126.13 (476.30)	153.80 (666.70)
Spending on Tobacco (unit: Baht/person/month)	72.92 (159.48)	84.85 (162.42)	58.58 (139.53)	61.80 (130.63)

Standard deviation in parentheses

2.5 Summary Statistics and Regression Results

The summary statistics of key variables in this paper are presented in Table 15, which shows the average of the variables of the control group and the treatment group by period "Pre" (from June 2000 and May 2001) and "Post" (from June 2002 to May 2003). Utilization is the number of times a member in a household visits health practitioners. Medical expenditures (unit: Thai Baht), either for in-patients or out-patients, include the transportation cost, the additional medicine cost and the treatment cost when a member of a household visits health care practitioners. Alcohol and tobacco spending are monthly household expenditures (unit:Thai Baht) on alcoholic beverages and tobacco respectively.

According to Table 15, the treatment Group visited health care practitioner more frequently after the reform, while it was the other way around for the control group. The 30 Baht program also reduced both the average and the standard deviation of out-of-pocket medical payment. Compared to the control group, the treatment group's means and standard deviations of medical expenditures decreased for both out-patients' cost and in-patients' cost. Alcohol consumption decreased for the control group, but increased for the treatment group, while the trends of tobacco expenditures are similar for both groups.

The rest of this section will focus on the estimation of two main regression equations in this paper: equation (11) and equation (12). The 30 Baht program may affect smoking and drinking behaviours on both an extensive margin, where there is a switch from being a smoker/a drink to being a non-smoker/non-drinker or vice versa, and an intensive margin, which is a change in drinking/smoking intensity of a drinker/a smoker. To estimate the effect on the extensive margin, I choose an indicator of being a drinker/ smoker as a dependent variable in the regression equations. The intensive marginal is represented by non-zero per-capita spending on alcohol and tobacco. The effect of the 30 Baht program on smoking and drinking behaviours on the extensive margin is presented in Table 16, in which the dependent variable Drinker and Smoker are indicators which take the value of 1

Table 16: The effect of the 30 Baht program on being a drinker/a smoker

Dependent variable	(1) Drinker	(2) Drinker	(3) Smoker	(4) Smoker
$Treat_i \times Post_t$	-0.00486	0.00858	0.0143	0.0365
	(0.212)	(0.205)	(0.300)	(0.310)
Utilization		-0.406**		-0.573**
		(0.152)		(0.196)
Out-of-pocket		-0.0000280		0.0000989
medical spending		(0.0000409)		(0.000125)
N	12,250	12,202	8,498	8,439

All regressions are estimated using a logit model and include household fixed effects. Robust standard errors are reported in parentheses. * 5% significant level, ** 1% significant level, *** 0.1% significant level.

if the household spending on alcohol/tobacco is positive, and take the value of 0 otherwise. Table 16 shows that in all columns the estimated coefficients of the term $Treat_i \times Post_t$ are small and not statistically significant. However, the estimated coefficients of health care utilization, $\hat{\gamma}_5$, are negative in both column 2 and column 4. This imply that the 30 Baht program coverage correlates with the increased likelihood of stopping drinking/smoking through increased frequency of health practitioner meeting. It is important to note that this is a causal relationship only if there is no omitted variables that are correlated with health care utilization, i.e. $E(\epsilon_{it}|m_{it}, \forall t) = 0$. However, with the household fixed effects, the negative coefficient of health care utilization cannot be attributed to differences in time-invariant variables (risk attitudes, for example) between drinkers/smokers and non-drinkers/non-smokers.

The effect of the 30 Baht program on smoking and drinking behaviours on the intensive margin is presented in Table 17.1, which shows the treatment effect, and Table 17.2, which shows the effects across the distribution of drinking/smoking expenditures. Although Table 17.1 suggests that the 30 Baht program has no effect on non-zero alcohol and tobacco expenditures, this is explained by Table 17.2, which suggests heterogeneity in responses to the program. Column 1 and column 2 in Table 17.2 show that the coefficients of the term $Treat_i \times Post_t$ are negative and statistically significant only for the 10th and the 30th percentiles, implying that the 30 Baht program leads to less spending on alcohol only for the light drinkers. The coefficients of the term $Treat_i \times Post_t$ at the 10th and the 30th percentiles in column 1 imply that their decreases in annual spending on alcohol are -31.43 Baht/person and 70.00 Baht/person respectively.[13] These numbers can be translated into approximate decreases in 0.5 and 1.2 litre of Thai rice whisk ("Lao Khao" in Thai) at the 10th percentile and the 30th percentile respectively. The decomposition of the total effect of the 30 Baht program on alcohol expenditure is presented by the estimated coefficients in column 2, in which the moral hazard component and the increased health care utilization component are isolated. After controlling for health care utilization and out-of-pocket medical spending, the coefficients of the term

[13] The two figures are calculated by multiplying the corresponding coefficients by 12 months.

$Treat_i \times Post_t$ in column 2 are still negative and statistically significant at the 10th percentile and the 30th percentile. Under the assumption that there is no omitted relevant explanatory variable, the increased life expectancy component plays a major role among these percentiles.

As for the effect of the 30 Baht program on tobacco expenditure, column 3 suggests that the 30 Baht program leads to a decrease in tobacco expenditure only at the 10th percentile, where the coefficient of the term $Treat_i \times Post_t$ is negative and statistically significant. However, after isolating the moral hazard component and the increased health care utilization component, column 4 shows that the remaining effect of the 30 Baht program on tobacco expenditure is negative and significant at the 50th percentile and the 70th percentile. Again, since these estimations in column 4 are negative and statistically significant, under the assumption that there is no omitted relevant explanatory variable, the increased life expectancy component affects the smokers at the 50th percentile and the 70th percentile.

2.6 Conclusion and Discussion

This chapter investigates the effect of the 30 Baht program on smoking and drinking behaviours. In the framework, the treatment effect of the program is decomposed into three components: the moral hazard component, the increased utilization component, and the increased life expectancy component. Although there is no evidence supporting that the program affects smoking and drinking behaviours on average, using quantile difference in differences, I find that the 30 Baht program leads to a statistically significant decrease in alcohol spending at the 10th percentile and the 30th percentile, and a statistically significant decrease in tobacco spending at the 10th percentile. After the moral hazard component and the increased utilization component are isolated, the 30 Baht program still negatively affects alcohol spending at the 10th percentile and the 30th percentile, while it negatively affects tobacco spending at the 50th percentile and the 70th percentile. This substantiates existence of the increased life expectancy component if the assumption that there is no other relevant determinant of spending on alcohol and tobacco is satisfied.

Since the above assumption is strong, we need to be cautious to conclude that the quantile regression estimates imply existence of the increased life expectancy component. Although increased life expectancy is one of the candidates, there could be alternative complementary mechanisms that may aso lead to the decrease in spending on alcohol and tobacco. For example, the 30 Baht program may lead to an occupational switch from farmers to wage workers, and the switch may negatively correlates with spending on drinking/smoking.

In the future work, the theoretical framework needs to address several issues. First, the framework needs to reconcile the increased life expectancy in the theoretical framework, in which an individual expects her very own self to live longer, with the actual increased life expectancy which appears to be primarily driven by reduced infant and child mortality (Gruber, Hendren and Townsend ;2014). To address this issue, I may formulate another framework with overlapping generation and altruism. This framework may predict that decreased infant and child mortality leads to more future-oriented behaviours aiming to increase resources to the offspring generation. The other downside of the current framework is that the health care utilization is assumed to be exogenous. If utilization is actually endogenous, the estimates of the utilization variable do not imply causal relationship to

Table 17: The effect of the 30 Baht program on non-zero alcohol and tobacco expenditures (unit: Baht per person per month)

Table 17.1 Treatment effect

	(1)	(2)	(3)	(4)
Dependent variable	Alcohol	Alcohol	Tobacco	Tobacco
$Treat_i \times Post_t$	18.95	19.12	-4.520	-4.423
	(21.70)	(21.77)	(3.873)	(3.893)
Utilization		-15.58		-2.085
		(20.66)		(2.438)
Out-of-pocket medical spending		0.00601		-0.000338
		(0.00491)		(0.00160)
N	5966	5966	9208	9208

All regressions include household fixed effects. Robust standard errors are reported in parentheses. * 5% significant level, ** 1% significant level, *** 0.1% significant level.

Table 17.2 Quantile Regression

		(1)	(2)	(3)	(4)
Percentiles	Dependent variable	Alcohol	Alcohol	Tobacco	Tobacco
10th	$Treat_i \times Post_t$	-2.619*	-2.857*	-0.917***	-0.695
		(1.173)	(1.333)	(0.271)	(0.466)
	Utilization		2.482		0.674
			(2.315)		(0.534)
	Out-of-pocket medical spending		0.00184		-0.000125
			(0.00171)		(0.000180)
30th	$Treat_i \times Post_t$	-5.833*	-7.013*	-0.357	-0.585
		(2.898)	(3.386)	(0.496)	(0.596)
	Utilization		15.03***		3.143*
			(3.989)		(1.274)
	Out-of-pocket medical spending		0.00399		0.00110
			(0.00263)		(0.000937)
50th	$Treat_i \times Post_t$	-4.000	-6.659	-2.643	-3.308**
		(5.994)	(4.711)	(1.689)	(1.217)
	Utilization		26.34***		7.597***
			(7.885)		(1.778)
	Out-of-pocket medical spending		0.00287		0.00202
			(0.0115)		(0.00106)
70th	$Treat_i \times Post_t$	14.17	3.890	-7.500	-9.435***
		(9.245)	(5.923)	(4.291)	(2.620)
	Utilization		21.23*		7.998***
			(9.411)		(2.166)
	Out-of-pocket medical spending		0.0182		0.00430
			(0.0210)		(0.00388)
90th	$Treat_i \times Post_t$	5.000	5.000	-1.917	2.000
		(25.75)	(28.29)	(6.552)	(8.438)
	Utilization		-4.029		13.76
			(24.44)		(14.43)
	Out-of-pocket medical spending		0.0183		0.0124
			(0.0365)		(0.00726)
	N	5966	5966	9208	9208

The estimation performs 20 bootstrap replications. Bootstrap standard errors are reported in parentheses. * 5% significant level, ** 1% significant level, *** 0.1% significant level.

spending on drinking/smoking. This can be improved by endogenizing utilization in order to get a reduced form regression without omission of relevant variables.

3 Chapter Three

The Effect of Thailand's 2003 Black Market Lottery Crackdown on Household Consumption and Saving

With Tenzin Yindok

3.1 Introduction

Data on rural households in Thailand suggest that a majority of households buy lotteries. Standard economic theory, with the assumption of diminishing marginal utility in consumption, is unable to explain simultaneous expenditure on insurance and lottery. On a related note, the spending patterns of poor households have in general been "puzzling" for economists at first glance, as pointed out in Banerjee and Duflo (2006), especially in terms of non-trivial spending on alcohol, tobacco, festivals and various forms of entertainment. In this paper, we analyze the impact of a 2003 government crackdown on black market gambling in Thailand on household behaviour. In doing so, we shed light on the motivations behind relatively poor households' consumption of lotteries.

In particular, we investigate the effect of the policy on household saving and consumption, assuming that the policy differentially affected households with different pre-policy spending on black market lotteries. That is, we estimate the treatment effect as a difference in differences using annual household spending on black market lottery as a continuous treatment variable. The identifying assumption is that in the absence of the ban on black market gambling, the gap in outcome between households with different levels of pre-policy spending would have remained the same, after controlling for household fixed effects and month fixed effects.

We find that the crackdown resulted in a statistically significant decrease in black market lottery activities, and an increase in participation and spending on government lotteries. The increase is however not commensurate with the decrease in black market gambling. Our main results on consumption and saving suggest that households responded to the policy by increasing their savings, without any statistically significant increase in non-gambling related consumption. We further find that the statistically significant and positive result on saving is driven by households in the poorest quintile and households in the richest quintile. The former effect is also the largest in terms of magnitude.

The seminal paper on the simultaneous consumption of insurance and lotteries is by Friedman and Savage (1948), which show that such behaviour can be explained by a concave-convex-concave utility function. A low-income consumer, presumably in the initial concave part of the utility would be willing to insure against incurring a loss. The same consumer could also buy a gamble that offers a large chance of losing a small amount but a small chance of winning a relatively large sum (such as a lotto) that crosses over to the convex part of the utility function. Friedman and Savage argue that the two concave parts of the utility function could correspond to different "socioeconomic levels" (p298), while the convex part could be interpreted as corresponding to the transition between the two levels. Formalizing this basic idea, Robson (1992) shows that a model where a consumer cares about the level of wealth *and* her relative standing in the wealth distribution could produce the Friedman-Savage utility function. That is, although the utility function is concave in wealth itself, accounting for the indirect effect on status can produce a convex utility in wealth over some intermediate range.[14,15]

The previous papers analyze gambling as a means of increasing one's wealth. The alternative view is that certain gambles offer direct consumption value. Even if the expected monetary outcome of a gamble is negative, the fun of gambling could include associated non-monetary activities such as attending a race or watching a lotto ball drop where one has a stake in the outcome. In such cases, the financial motive is secondary to motives such as "recreation, socialization, exercise of intellectual prowess, or escapism" (Eadington, 1987, p 269). Conlisk (1993) and Johnson et al. (1999) include a direct utility of gambling to reflect the anticipation and excitement involved in the gamble in addition to the ordinary expected utility term. The former shows that this inclusion is sufficient to explain risk-averse agents accepting a wide range of small gambles with unfair odds (such as lotto's where the loss is small enough and the gain large enough). Kallick et al. (1979) present evidence from the Survey of American Gambling Attitudes and Behavior (1975), concluding that the primary motive for most forms of gambling among survey respondents in Nevada is the activity itself rather than its implications for wealth. Johnson et al. (1999) uses the consumption motive to explain other puzzling behaviour among those who participate in the horse-racing betting market in the UK.

We tentatively interpret our main empirical results as providing support for the wealth motive behind gambling. While it is possible that some individuals engage in black market gambling for its consumption value, we do not find any evidence of households that were previously engaged in black market lotteries switching into alternative entertainment activities (such as other forms of gambling, alcohol and tobacco) after the crackdown. In Section 2, we review the specifics of black market lotteries in Thailand, outlining the fact that black market lotteries not only provide better odds than government lotteries, the social network created among lottery players also seems to function as a form of insurance.

A paper that is closely related is Miller and Paulson (2007), which finds that the likelihood and the amount of gambling in Thailand (buying government or black market lottery tickets) increase with the quality of informal insurance provided by remittances. The paper interprets this response as households who are more insured shifting their portfolios toward "riskier" investments, implying that the wealth motive drives gambling behaviour. Our findings are somewhat in contrast to Kearney (2005), which finds that the introduction of a state lottery in U.S. states is associated with a decline of \$137 per quarter in households expenditures on non-gambling items (or \$24 per-adult), so that spending on lottery is financed completely by a reduction in non-gambling expenditures in the US. It also finds that households in the lowest income third have the most pronounced response to the introduction of a state lottery in terms of reducing spending on food eaten in the home, home mortgage, rent, and other bills.

[14] Ray (1998) alludes to this kind of aspirational motive among individuals and households who are neither too poor nor too rich in developing countries, albeit in reference to a possible concave-convex-concave savings function with respect to wealth.

[15] A host of papers have further justified the convex part of utility over wealth using various market failures. For example, Appelbaum and Katz (1981) and Kim (1965) use capital market imperfections and Ng. (1965) uses education.

3.2 Background

What is black market lottery in Thailand?

Black market lottery or underground lottery, called "Hauy Tai Din" in Thai, is the most popular form of gambling in Thailand. Wannathepsakun (2011) documents that about 40% of Thai population engages in activities regarding black market lottery. Based on the 1988 and 1990 Thai Socioeconomic Survey (SES), Miller and Paulson (2007) report that every weeks in Thailand, approximately 27 million government lottery tickets are sold, yielding gross annual revenues of $648 million to the government of approximately . Gambling accounts for approximately 4% of total monthly expenditures among households with positive gambling expenditures.

The black market lottery, in contrast to the government lottery, give relatively generous prizes, give higher chances to win, and allow divisible wagers. Although black market lotteries rely on the government lottery's winning numbers, black market lotteries give more generous prizes. For example, the black market lottery prize for matching the last three numbers exactly is higher than the government one. Also, it is relatively easy to win a black market lottery prize, since black market lotteries' rules are less strict. For example, black market lotteries give prizes for matching the last three numbers of the government lottery's first prize numbers or for matching the last three numbers in any order. Lastly, gamblers must pay a fixed amount of wager on government lottery tickets, but they can pay a wager in any amount they are willing to pay for the black market lotteries.

According to the cite regarding black market lottery in Thailand, we can explain why Thai people play black market lottery by at least two factors: 1) "hope" or "dream" to move up their economic and social status, and 2) social networking and peer effect.

Black market lotteries are perceived as a "hope" or a "dream" for their players to climb up economic and social and status. Despite negative expected returns, black market players consider their bets negligible compared to the prizes they "hope" to win. Samosorn and Bunprakarn (2014) interviewed black market lottery players in the southern area of Thailand. This quotation is a piece of the interviews.

> "We all hope to win. If we buy 10 baht, we will gain 6,000 baht. So it's worth the investment. If I lose, it is not a lot of money. If I win once, I will be inspired to buy again next time. I am happy when winning it." (Manod Saengtham (assumed name) interviewed on October 4, 2010)

Social networking also plays a crucial role in the black market lotteries in Thailand. They are operated through extensive networks rather than a market mechanism. Black market lottery players interact with local croupiers, who establish trust and social bonds with the players in villages. Wannathepsakun (2011) documented that the local croupiers build trust and social bonds with players through patron-client relationships. They often own big houses, luxurious cars, or anything else to show their high economic and social status. They also make a lot of donations and help the players in their circles in time of need. Wannathepsakun (2011) suggested that showing off high status may be the croupiers' strategy to make the players perceive that the black market lottery may help them fulfill their "hope" or "dream". The patron-client relationship between the local croupiers and their players may also imply that the black market lottery networks may serve their members as informal insurance. The local croupiers also act as a bridge that links between the players and the "big" croupiers and other middlemen, who are generally well-to-do capitalists. The local croupiers also generally have relationship with local politicians and policemen. This may explain why black market lotteries are prevalent before the 2003 crackdown even though they are illegal.

The 2003 black market lottery crackdown

The black market lottery has been illegal but tolerated until the 2003 crackdown. The 2003 crackdown was a part of the government policy "war on mafia" at the time, since all the black market croupiers are considered "mafias" by the government. After the 2003 crackdown, the government nationalized the black market lottery business. Starting from August 1st, 2003, the government lottery office (GLO) launched the "last-three-numbers-last-two-number" lottery, which has exactly the same rules and prizes as previously illegal black market lotteries, along with the standard government lottery. The profit earned from running the new government lottery was spent on the government's One District One Scholarship (ODOS) program. The nationalized and legalized government lottery ended in 2006, when the military government seized the power.

3.3 Data

The data for this paper comes from the Townsend Thai project household monthly surveys, a panel dataset at the household level. Approximately 600 households were randomly selected from the rural areas of two provinces, Chachoengsao and Lopburi in the central region, and two additional provinces of Buriram and Srisaket in the Northeastern region of Thailand. A province consists of several districts. Each of the sub-districts is a collection of villages with at least one urbanized area at its centre. These four provinces are different in terms of economic conditions, but villages within the same sub-district are similar. The sampled households were interviewed on a monthly basis, with the questions regarding household expenditure, including expenditure on gambling activities, being asked on a weekly basis. The survey was initiated in September 1998. Data regarding household consumption, income, assets, liabilities and wealth are from the Monthly Survey of Household Financial Accounting, based on the Townsend Thai Project Household Monthly Surveys and is publicly provided by the Research Institute for Policy Evaluation and Design (RIPED) at the University of the Thai Chamber of Commerce.

One might be concerned that expenditure on the black market lottery might be under-reported after the 2003 crackdown. I argue that this is not a likely issue. Since the crackdown was a part of the war on mafias, the government focused on enforcing the laws by targeting black market lottery dealers rather than buyers. In addition, since the Townsend Thai project survey team visits the sampled households on a weekly basis, they build relationship and trust so the households are ensured that the interview answers are kept privately.

Before April 2003, a majority of households in the dataset participated in the buying of black market lotteries. Table 18 shows that 73 percent of households in the sample bought a ticket at least once in the 12 months preceding the ban.[16] About 20% of households participated in government lottery, a small percentage (4 percent) participated in other forms of gambling. Table 19 shows that conditional on non-zero spending, households spent an average of 700 baht per year per person on

[16] Miller and Paulson (2007) report that 40% of households surveyed in the 1988 and 1990 Thai Socioeconomic Survey (SES) report some gambling in the month before the survey.

Table 18: Percentage of households engaging in gambling activities at least one time in 12 months

	Pre	Post
Black Market Lottery	73.40%	26.47%
Government Lottery	19.91%	35.29%
Other Gambling	3.63%	6.62%

Table 19: Household expenditure on gambling (unit: Baht/year/person)

	Mean		Median		90th pc	
	Pre	Post	Pre	Post	Pre	Post
Black Market Lottery	703.18	368.94	216.58	70.13	1485	669.46
Government Lottery	191.12	236.05	79.64	74.17	413.95	577.25
Other Gambling	484.38	572.39	250	100	1361	1450
All Gambling	756.27	489.54	235.33	115	1550	1036.34

Note: These calculations use only non-zero spending on gambling.

black market lotteries before the ban, taking up 3.8% of annual household consumption per capita as shown in Table 20. Spending on black market lotteries dominates household spending on lotteries as the average spending on all gambling conditional on non-zero spending is about 750 baht per person per year. The median spending on black market lotteries is approximately 200 baht per person per year, and the 90th percentile spent 1485 baht per person per year.

We find that the 2003 crackdown reduced both the propensity and the spending in black market lotteries. The black market lottery crackdown in April 2003 was effective in the sense that there was a large drop in households engaging in the black market, from 73 percent to 26 percent. There is also some evidence that households substitute black market lottery with government lottery, but not perfectly; the percentage of households engaging in government lottery increased from 20 percent to 35 percent. The proportion engaging in other forms of gambling also increased from approximately 4 to 7 percent. Spending on black market lotteries decreased from an average of 700 baht to 370 baht per person per year. Since the average household spending on government lottery increased to a smaller extent than that of the decrease in black market lotteries, the average spending on all gambling decreased. This pattern of decrease is seen when we look at the median as well as the 90th percentile.

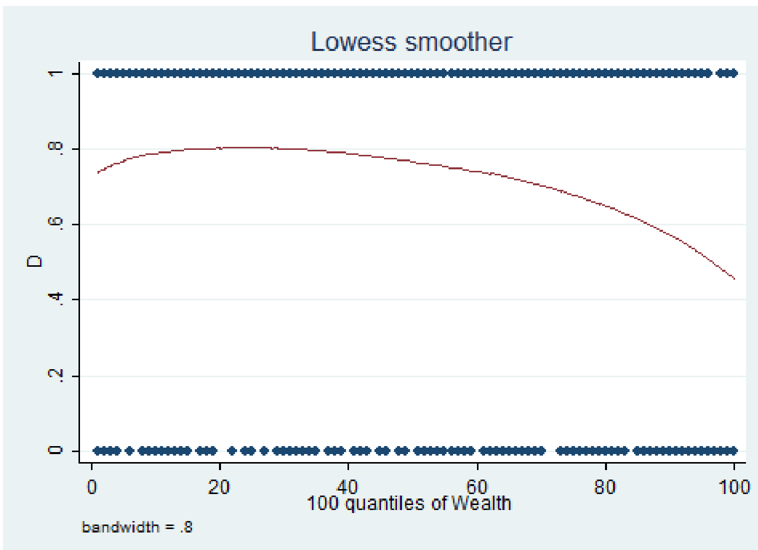
Figure 2 shows that relationship between gambling in the black-market and wealth is hump-shaped before the ban on such lotteries. The probability of buying a black market lottery at least once in the year preceding the ban is higher in the poorest deciles than in the richest deciles, and peaks around the third decile of wealth. Table 21 shows that median annual spending on black market lotteries is also higher among the lower quintiles of wealth, with the median share in total consumption strictly decreasing in wealth quintile. The average spending and consumption share (and the standard deviations) of the fifth quintile is relatively high, but this is driven by a few

Table 20: Share in total household consumption (annual, per person)

	Mean		Median		90th pc	
	Pre	Post	Pre	Post	Pre	Post
Black Market Lottery	3.83%	1.51%	1.95%	0.40%	9.73%	3.16%
Government Lottery	0.85%	1.02%	0.39%	0.40%	2.16%	2.73%
Other Gambling	3.14%	2.91%	1.70%	0.86%	9.67%	7.38%
All Gambling	4.10%	2.13%	1.99%	0.75%	10.18%	5.32%

Note: These calculations use only non-zero spending on gambling.

Figure 2: Participation in black market lotto by quantiles of wealth



The figure plots a locally weighted regression of a dummy variable D that equals 1 if the household bought black market lottery at least once in the year prior to the ban, on quantiles of wealth (annual average prior the the ban).

outliers. It is possible that some households in the wealthiest group are the local croupiers we described in Section 2.

3.4 Empirical Estimation

To examine the effect of the black market lotto ban on consumption and saving, we estimate an equation of the following form:

$$y_{it} = \alpha_i + \lambda_t + \delta(BL_i \times Post_t) + \epsilon_{it} \tag{14}$$

where y_{it} is the outcome variable of interest for household i in month t, α_i is a household fixed effect, λ_t is a month fixed effect, BL_i is the average monthly expenditure on black market lotto from May

Table 21: Household annual spending on black market lottery and its share in annual total consumption before the ban by wealth quintiles

Wealth quintile	Wealth (quintile's mean) (unit: Baht/person)	Annual spending (unit: Baht/person/year) mean	median	Share in total consumption (unit: percent) mean	median
1st	28,302	309.95 (499.77)	118.50	2.85 (3.63)	1.40
2nd	89,484.10	322.64 (512.70)	136.03	2.84 (4.02)	1.32
3rd	172,680.23	437.11 (1,104.05)	101.50	2.95 (6.38)	1.03
4th	338,460.38	367.82 (680.79)	81.96	2.19 (4.08)	0.69
5th	1,860,000.00	1,142.04 (4,543.98)	43.75	3.24 (8.19)	0.28

Note: Standard deviation in parenthesis

2002 to April 2003, $Post_t$ is an indicator variable for month after April 2003, and ϵ_{it} is the error term. We consider three dependent variables: per capita consumption of household i in month t, per capita consumption net of spending on gambling of household i in month t (other consumption), and per capita saving of household i in month t. We take the inverse hyperbolic sine transform of the dependent variables.[17]

The variable of interest is the interaction term $BL_i \times Post_t$, where the average monthly expenditure on black market lotto prior to the ban captures the extent to which a household is "treated" by the policy. That is, we assume that the effect of the ban would differ by the intensity of spending on the lottery prior to the ban on the lottery. The identifying assumption in equation (14) is that in the absence of the ban, the gap in outcome y_{it} between households with different levels of BL_i would have remained the same, after controlling for α_i and λ_t. The coefficient on the interaction term (δ) estimates whether households with higher black-market lottery spending saw a greater or smaller change in the outcome variable y between the pre- and post-period. Specifically, it measures the percentage change in the outcome variable between the pre- and post- period if a household spent an additional baht per month on black market lottery before the ban.

Results

Table 22 reports the treatment effect respectively on household saving per capita, household consumption per capita and household consumption net of spending on gambling (other consumption). The estimate of coefficient δ on the interaction term $BL_i \times Post_t$ for saving indicates that an additional average monthly spending of 10 baht per household on black market lottery prior to the ban is associated with approximately 1.6 percent higher monthly saving (per person at the household level) after the ban, and approximately 0.24 percent lower consumption (per person at the household level). We argue that the positive impact on saving is not driven by increased income since the

[17] Inverse hyperbolic sine transform of a variable y is defined as $\ln(y + \sqrt{y^2+1})$. Except for very small values of y, this transform is approximately equal to $\ln(2y_i)$, and is therefore a suitable alternative to log transformation when dealing with many zeros and negative values.

Table 22: Treatment effect on consumption and saving

Dependent variable	Saving	Income	Monthly consumption (including gambling)	Other consumption (excluding gambling)
$BL \times Post$	0.0158***	0.00043	-0.0024*	-0.0002
	(0.00398)	(0.00081)	(0.00097)	(0.00042)
N	16,047	16,047	16,047	15,983
No. of HH	688	688	688	688

Dependent variables (measured in baht/person/month at household level) are inverse hyperbolic sine transformed. Coefficient estimates and standard errors are multiplied by 10. Robust standard errors are reported in parentheses. All regressions include household fixed effects and month fixed effects. * 5% significant level, ** 1% significant level, *** 0.1% significant level

estimate of coefficient δ on the interaction term $BL_i \times Post_t$ for income is not significantly, although it is positive.

As for consumption, there is no statistically significant effect on other consumption net of gambling expenditures. We also check the effect of the crackdown on household expenditures on alcohol, tobacco, durable goods and Rosca. None of these estimates are statistically significant.

Table 23 reports the treatment effect on saving by different wealth groups (on the basis of average annual wealth before the ban). Among the richest 20 percent of households, an additional average monthly spending of 10 baht per household on black market lottery before the ban is associated with approximately 1.8 percent higher monthly household saving per person after the ban. When the low-wealth group is defined as the poorest 30 percent, the effect is not statistically significant. However, among the poorest 20 percent of households, an additional average monthly spending of 10 baht per household on black market lottery before the ban increases saving after the ban by about 17.6%. The ban has no effect on monthly saving of households in the middle quantiles of wealth (20th to 80th percentile).

Table 23 also indicates that the ban on black market lottery had no impact on household consumption net of spending on gambling, even if we stratify the data by different wealth groups. We also confirm statistically insignificant results for income when the data is stratified by wealth groups.

3.5 Robustness Checks

Table 24 shows that the results are robust to aggregating data on saving, consumption and income from monthly to quarterly-year. An additional average monthly spending of 10 baht per household on black market lottery prior to the ban is associated with approximately 2.8 percent higher quarterly-yearsaving per person at the household level after the ban, and approximately 0.3 percent lower consumption. The effect on quarterly-yearincome is statistically insignificant.

The bottom panel in Table 24 shows that among the poorest 20 percent of households, an additional average monthly spending of 10 baht per household on black market lottery prior to the ban is associated with 25.5% higher quarterly-yearsaving per person, and 14.8% additional quarterly-

Table 23: Treatment effect on saving and consumption by wealth groups

	Wealth Percentiles		
	Low (0-20 pct)	Middle (20-70 pct)	High (70-100 pct)
Saving			
$BL \times Post$	0.176**	-0.0119	0.0178***
	(0.0654)	(0.0174)	(0.0035)
N	3,171	8,050	4,826
No. of HH	138	344	206
Other consumption			
$BL \times Post$	-0.00085	-0.00166	-0.00012
	(0.00358)	(0.00279)	(0.00039)
N	3,159	8,013	4,811
No. of HH	138	344	206
Income			
$BL \times Post$	0.0307	-0.0267	0.0060
	(0.0479)	(0.0233)	(0.0077)
N	3171	8050	4826
No. of HH	138	344	206

Dependent variables (measured in baht/person/month at household level) are inverse hyperbolic sine transformed. Coefficient estimates and standard errors are multiplied by 10. Robust standard errors are reported in parentheses. All regressions include household fixed effects and month fixed effects. * 5% significant level, ** 1% significant level, *** 0.1% significant level. The wealth groups are made by combining deciles; Low = 1st - 2nd deciles and Middle = 3rd - 7th deciles.

Table 24: Robustness: quarterly-yearRegressions

Treatment effect on quarterly-yearsaving, income and consumption

	Saving	Income	Consumption incld. gambling	Other consumption excld. gambling
$BL \times Post$	0.028***	0.019	-0.003*	-0.0004
	(0.006)	(0.016)	(0.001)	(0.0005)

Treatment effect on quarterly-yearsaving and consumption by wealth groups

	Wealth Percentiles		
	Low	Middle	High
Saving			
$BL \times Post$	0.255**	-0.009	0.0311***
	(0.090)	(0.025)	(0.006)
Other consumption			
$BL \times Post$	0.013	-0.005	0.0001
	(0.013)	(0.005)	(0.0004)
Income			
$BL \times Post$	0.148*	-0.0576	0.0245
	(0.072)	(0.039)	(0.016)

Dependent variables (measured in baht/person/quarterly-yearat household level) are inverse hyperbolic sine transformed. Coefficient estimates and standard errors are multiplied by 10. Robust standard errors are reported in parentheses. All regressions include household fixed effects and quarterly-yearfixed effects. * 5% significant level, ** 1% significant level, *** 0.1% significant level. The wealth groups are made by combining deciles; Low = 1st - 2nd deciles, Middle = 3rd - 7th deciles and High = 8th decile and above.

yearincome per person. Therefore, while there is a weakly significantly positive effect on income when we aggregate income to quarterly-yearfrequency, the effect on saving is of higher magnitude.

Estimates from using saving, income and consumption in Thai baht (instead of using the IHS transforms) are reported in Table 25, excluding the bottom and the top one percentile of saving, income or consumption. Overall, there is no statistically significant effect on saving or income. That is, there is no evidence that households with higher average monthly spending on black market lottery prior to the ban saved more in absolute terms post-ban, or that their incomes increased by more in absolute terms post-ban. However, when data is stratified by wealth, we see that an additional average monthly spending of 10 baht per household on black market lottery prior to the ban is associated with about 46 baht additional saving and 40 baht additional income post-ban among the poorest 20 percent of households.

The reasons behind the positive differential impact on quarterly-yearincome and the level of income (in absolute terms) for the poorest 20 percent of households require further inquiry. However, the effects on saving are of greater magnitude, which supports the baseline finding that the ban on

Table 25: Robustness: Regressions in Levels of Baht (excluding the bottom and top one percentile of the dependent variable)

Treatment effect on monthly saving, income and consumption in Thai baht

Dependent variable	Saving	Income	Consumption (incld. gambling)	Other consumption (excld. gambling)
$BL \times Post$	0.526	-2.84	-4.50*	1.36
	(2.19)	(2.46)	(1.88)	(2.42)

Treatment effect in Thai baht by wealth groups

	Wealth Percentiles		
	Low	Middle	High
Saving			
$BL \times Post$	46.23**	-7.78	2.48
	(16.52)	(6.71)	(2.35)
Net consumption			
$BL \times Post$	1.56	0.21	1.13
	(5.48)	(1.92)	(1.60)
Income			
$BL \times Post$	40.30*	-15.56**	-1.20
	(17.92)	(5.84)	(2.24)

Dependent variables are measured in baht/person/month at the household level. Coefficient estimates and standard errors are multiplied by 10. Robust standard errors are reported in parentheses. All regressions include household fixed effects and month fixed effects. * 5% significant level, ** 1% significant level, *** 0.1% significant level. The wealth groups are made by combining deciles; Low = 1st - 2nd deciles, Middle = 3rd - 7th deciles and High = 8th decile and above.

black market lottery increased household saving.

3.6 Conclusion

This chapter analyzes the effect of Thailand's 2003 black market lottery crackdown on household consumption and savings. Overall, we estimate a positive and statistically significant impact on household saving and no effect on non-gambling consumption. More precisely, we find that an additional 10 baht of average monthly spending on black market lottery before the ban is associated with 1.6 percent higher saving post-ban, with the effect strongest (at 17.6 percent) among the poorest 20 percent, statistically insignificant for households in the middle deciles of wealth and statistically significant but smaller (at 1.8 percent) for the richest 20 percent.

These findings provide new empirical evidence on how gambling is associated with other financial decisions that households make, potentially shedding light on the motives behind such risk-taking behavior. We tentatively interpret our results as supporting the view that in playing the lottery, the wealth motive is stronger than the consumption motive, since households choose to save more instead of consuming close substitutes. Further research is required to tie the empirical findings of this paper more directly to the economic theories on gambling.

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