The impact of subsidies on deductible choice in health insurance*

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Abstract

This paper analyzes how subsidies affect health insurance deductible choices among low-income adults in Switzerland. I start by using the kinked relationship between prior earnings and subsidy levels to identify the effect of the subsidies using a regression-kink discontinuity design. Empirically, I document that subsidies increase the demand for low-deductible insurance contracts. I find that 40 percent of subsidy recipients select the lowest deductible plan, compared to 30 percent in the non-subsidy high-income group. In addition, low-income individuals respond to subsidies that constitute a combination of income effect and subsidy effect. This paper disentangles the two effects by exploring two variations. First, subsidies are dependent on the income generated two years previous. I explore the lag of premium aid and present evidence that, in the absence of a subsidy, when high-income adults face subtle income decreases, they exhibit strong risk-averse behavior and select high coverage plans. I also examine individuals who receive subsidies but have increased income in the current year to explore the subsidy effect on deductible choice. Second, subsidy levels are fixed coupon conditional on the lowest deductible plan(most generous plan). Individuals face zero out-of-pocket premiums for higher deductible plans as subsidy levels increase. I explore discontinuities in the availability of zero-premium plans to examine the pricing effect(substitution effect) of subsidies on deductible choices.

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1 Introduction

Low-income households, which are not adequately covered by insurance, are financially vulnerable to expenditure shocks from health issues. In fact, in the US, many low-income individuals are completely uninsured. Even in countries with mandatory health insurance coverage, such as Switzerland, low-income households are still exposed to shocks because of deductibles and co-payments. Even though low-income individuals need high insurance coverage for high-risk protection, health insurance premiums have increased dramatically in the last 10 years and have become unaffordable for many individuals, thus impeding the take-up of high coverage plans. To address this equity issue, governments provide substantial financial aid, which is a policy applied globally. The Swiss government, for instance, spent 5.5 billion Swiss francs (5.5 billion US dollars) in 2020 to support low-income individuals. Despite this scale of spending, the economic literature provides few guidelines on how to evaluate these expenditures. To evaluate the efficiency of government spending, it is thus important to understand how low-income individuals are trading off premium and deductible shocks separately under subsidy schemes. Yet, this issue remains underexplored.

The goal of this paper is to estimate the effect of subsidies on deductible choices in health insurance. To do so, I explore three sources of variation in the mandatory Swiss health insurance market. I start by identifying the effects of subsidies using a regression kink discontinuity (RKD) design, thereby exploiting the kink relationship between subsidy level and prior income in the schedules of the subsidy schemes. In addition, low-income individuals respond to subsidies consisting of a combination of income effect and subsidy effect. I disentangle these two effects using a structural model and provide empirical evidence of two different sources of variations. First, **subsidies are calculated based on a person's income earned two years previous.** In other words, individuals who experience income drops receive subsidies two years later. In the absence of subsidies, individuals who experience income drops make deductible choices under the income effect. Individuals who receive subsidies with increased income levels make deductible choices under the impact of the subsidy effect. Second, the subsidy amount is fixed conditional on the lowest deductible plan (highest coverage plan), regardless of the plan being selected. When individuals receive subsidies above specific thresholds of higher deductible plan premiums, the premium out-of-pocket amount varies with the different deductible plans of subsidy recipients. I explore the kinked relationship within different plans to examine the pricing effect of subsidies on deductible levels.

Using kinks in the schedule of subsidies, I identify the effect of subsidies in the regression kink discontinuity (RKD) design. To obtain the preliminary result[1], I find that 40 percent of the subsidy recipients select the lowest deductible plan, compared to 30 percent in the high-income group. The RK design involves checking whether the propensity for choosing the high coverage plan changes among subsidy recipients and high-income non-recipients close to the eligible kink point. I provide graphical representation of the significant responses of deductible choices with regard to subsidy eligibility. Additionally, I conduct various tests of the robustness of the RK design and assess its validity to overcome the issue of endogeneity in eligibility variation. The result is prevailing and consistent.

Exploring the lag of the subsidy distribution, I find that, in the absence of subsidy, individuals who experience a subtle income drop increase their opting into the highest coverage plan by six percentage points compared to the high-income non-subsidy group. In addition, individuals who receive subsidies but have a high-income level in the current year have an average share of selecting the highest coverage plan of 29 percent compared to 31 percent in the subsidy recipients group. The trend in these decisions continues when individuals no longer receive the subsidy.

The Swiss health insurance market offers six plans differentiated into deductible levels. **The subsidies are fixed coupon conditional on the most generous plan.** As the subsidy level increases above a specific threshold, the premium out-of-pocket levels for high deductible plans become cheaper and decrease to zero for individuals. Therefore, as susbidies increase to a certain threshold, individuals face different premiums for the same deductible plans because of the subsidy amount. I explore the kinked price for consumers to estimate the effect of subsidy effect on subsidy.

This paper contributes to several related studies. Most narrowly, it studies the impact of subsidies on intensive margin decisions (which to buy) in insurance. Limited studies have examined how subsidies affect the extensive margin (whether to buy) in the US market. The main reason for this lack is that low-income individuals are either uninsured when offered opt-out options or mandatorily (automatically) insured in some nations, such as Germany (UK), leaving them with little or no choice. This circumstance reduces researchers' ability to study these beneficiaries' willingness to pay, as it is difficult to analyze a market that does not exist. Before the Affordable Care Act (ACA) was legislated in the US, low-income

[1]This paper relies on two datasets. The first is the individual admin data that covers individuals in Switzerland, including information on individual socio-demographic data, residence region, deductible choice,subsidies, predicted health cost, and claims. The second is the admin data linked to household survey data for a representative sample, which covers rich information on socio-demographic data, deductible choice, and household financial information. At the current stage, I implement the analysis using the Swiss longitudinal household panel data from 2017 to 2019.

uninsured faced prices that were difficult to observe. The ACA market policy change enacted in 2010 inspired studies such as Frean, Gruber, and Sommers (2017), which assessed how low-income insurance demand responded to subsidies across different public insurance programs and found that moderate subsidies improved insurance coverage (Tebaldi (2017)). Since the mandate penalty setting was introduced in Massachusetts with sharp discontinuities in subsidies, more effort has been made to empirically examine the impact of premium subsidies on consumer decisions. Among the limited extant literature, the most influential work is Finkelstein, Hendren, and Shepard (2019), who studied the discontinuity subsidy design in the Massachusetts market and found that, given the generous subsidies, low-income adults had a modest willingness to pay for health insurance compared to their costs. No prior work has investigated the influence of subsidies on intensive margin decisions (which coverage to buy). This paper will contribute to closing this research gap. It differs from the prior notable work of Finkelstein, Hendren, and Shepard (2019) in several key aspects: (i) while their work focuses on the impact of subsidies on extensive margin decision (whether to buy insurance), this study contributes by analyzing the influence of subsidies in a mandatory market setting and, more specifically, on intensive insurance demand; that is, which insurance coverage to buy. (ii) Second, this work investigates the income-linear subsidy compared to the step-wise subsidies in the previous work. (iii) Lastly, a mandatory setting without an opt-out option has been a widely touted solution for the problem of uninsured citizens in other markets outside the US. This study works as a front runner and examines the efficiency of government spending as financial aid.

Additionally, this paper contributes to a small but growing body of literature studies the economic incentive and trade-offs involved in subsidy policies. That is, the health insurance decision depends on the two key factors underlying the decision-making process of subsidy recipients, which are income effect and the subsidy effect (substitution effect). A collection of literature illustrates the effect of financial constraints on insurance demand. For instance, Casaburi and Willis (2018) show that, when a premium creates large liquidity shocks, the demand for insurance decreases. Ericson and Sydnor (2018) also conclude that the liquidity constraining low-income adults were sensitive to deductibles as health expenditure shocks. Given the subsidies, Gross et al. (2022) provide evidence that liquidity-sensitive consumers delay the drug consumption until the subsidy receipt. In terms of subsidy effect, Drake et al. (2021) find that zero-premium health insurance plans increase the duration of insurance coverage, but not the take-up rate, primarily because of transaction cost. More researchers intend to explore the role of liquidity constraints or financial constraints on insurance decisions theoretically. This paper will help illuminate the underlying trade-offs by providing the first empirical evidence on this topic. This work will empirically document the insurance choice of low-income individuals with and without subsidy.

More broadly, this work also contributes to the stream of literature concerning subsidy schemes. Kaufmann, Schmid, and Boes (2017) study the different subsidy schemes—in-kind versus cash transfers—and their impact on insurance choice, finding that in-kind transfer is more likely to specifically aid health insurance. Finkelstein, Hendren, and Shepard (2019) examine the impact of premium subsidies on the uptake rate in the Massachusetts market, in which the premium scheme gives a certain amount of subsidy to households with a given income level. In this paper, I intend to focus on the other subsidy scheme, namely the income linear subsidy.

The remainder of this paper is organized as follows. Section 2 provides the institutional background and the incentives incorporated in the subsidy scheme. Section 3 describes the data sources and the empirical identification strategy. Section 4 presents the empirical analysis. Finally, Section 5 concludes the paper.

2 Institutional background

This paper examines the Swiss health insurance system, in which health insurance is mandatory without an opt-out option, meaning that every citizen residing in Switzerland must be insured under the compulsory basic health insurance. All contracts offer standardized services and cover an identical scope of benefits as well as ensure the equal treatment of all insured persons. The insured are offered six vertically differentiated insurance options. These options differ only in terms of the insurance provider and the deductible level. The six deductible levels begin at the default of CHF 300 and increase to CHF 500, CHF 1000, CHF 1,500, CHF 2,000, and finally CHF 2,500. A coinsurance rate of 10 percent applies to all costs exceeding the respective deductible, while the out-of-pocket co-insurance amount is capped at CHF 700. The difference in premiums between the default insurance product (CHF 300 deductible plan) and the contract with the extra deductible is fixed at 69 percent. Insurance companies bid competitively for the premiums of the default CHF 300 deductible plan, and all premiums for the other plans are fixed according to the premium difference regulated by the government. The selection of health-care plans by consumers takes place yearly within a set period before the end of November. Insurance is financed through per capita premiums and each member of the family is individually insured. Table 1 illustrates all attributes of these plans.

Health premiums are community-rated for the same age groups within each canton. There are three main age groups: children under 18[2], young adults between ages 18 and 26, and

[2]The premium levels vary in accordance with different age groups within cantons. For children 18 and

adults aged 26 and older. For the main interest group, the uniform premium pricing system is highly regulated, implying the availability of a full sample of men and women, young and old, sick and healthy, rich and poor, all of whom are offered the same menu of insurance options within one canton.

Table 1: The distribution of deductible choices (CHF)

Deductible	Co-insurance	Cap- oop	Premium
CHF 300	10 %	CHF 700	$4,960$
CHF 500	10 %	CHF 700	$4,960-(500-300)\times 69\%=4,822$
CHF 1,000	10 %	CHF 700	$4,960-(1,000-300)\times 69\%=4,477$
CHF 1,500	10 %	CHF 700	$4,960-(1,500-300)\times 69\%=4,132$
CHF 2,000	10 %	CHF 700	$4,960-(2,000-300)\times 69\%=3,787$
CHF 2,500	10 %	CHF 700	$4,960-(2,500-300)\times 69\%=3,442$

Price variation across markets Switzerland has 26 regional states, or cantons (Kantons in German). A universally mandated health insurance package with a list of distinct options is offered across each canton. Each canton has the decisive power to regulate the indicative premiums on the default contract (CHF 300 deductible level) based on the supply side of the health cost, the administrative cost, the cost of living, wages, and other factors, such as physician density. The costs vary among cantons but are not significantly different. Appendix A plots the population structure for all cantons and show that the cost distribution as well as population structure does not differ across cantons. When breaking down the cost of healthcare, as in Appendix A, the cost of the general provision of medical services, hospitalization fees, and doctor treatment fees does not differ across most of the cantons, as the GDP level captures all living cost differences, wages, and other economic factors. Figure 1 presents the GDP per capita along with vastly different indicative premiums across cantons in 2017. The average monthly premium for the base deductible contract varies from canton to canton, from CHF 347 (approximately 376 US dollars) to CHF 498 (approximately 539 US dollars). Notably, there is positive but weak correlation between health care premiums and the level of GDP per capita in the canton.

Health insurance premium subsidies To ensure low-income individuals' access to health insurance, the federal and cantonal government provide financial aid for health insurance to the insured with modest economic conditions.

under, the options structure is different in that it is divided into seven deductible levels: CHF 0, CHF 100, CHF 200, CHF 300, CHF 400. CHF 500 and CHF 600.

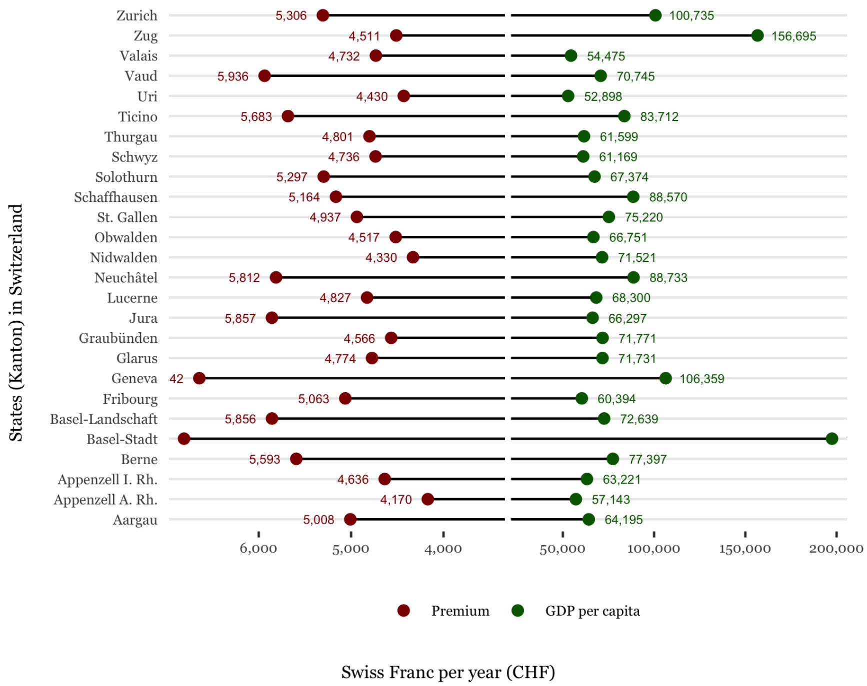

Figure 1: Premium and GDP per capita across markets, 2017

Cantons have the decisive power to regulate subsidy design for their insured population. Main subsidy schemes are implemented across the 26 cantons, either in an income-linear subsidy or a stepwise decreasing fashion with reference to income. In the current Swiss health system, eight cantons apply the step-wise method (similar to the ACA in the US market), while the remaining 18 cantons[3] implement an income-linear subsidy.

The step-wise decreasing function form for subsidies is similar to the subsidy rules applied in the US Affordable Care Act (ACA) market (see Finkelstein, Hendren, and Shepard (2019) for more details). Subsidy amount is dependent on income level and the different groups to which the insured are assigned according to their household type. The main rationale for implementing a proportional subsidy is to ensure that health insurance is affordable to low-income individuals, while the step-wise subsidy scheme saves on administrative costs when distributing subsidies. A figure mapping the relationship for the step-wise subsidy is described in Appendix B.

The linear subsidy form indicates that the subsidy amount is a proportion of the prior

[3]The following cantons specify their subsidy model as a mixed of step-wise subsidy and the income-linear subsidy. These cantons are: Canton of Lucerne, Obwalden, Glarus, Fribourg, Solothurn, Appenzell I.Rh, St Gallen, Graubuenden, Ticino, and Vaud. At its essence, they regulates the premium load according to different level of the household income. Therefore, in this paper, I include these cantons in the income-linear subsidy.

household income. The cantons define a certain proportion of premium load for households and pay the subsidy to make up the difference between the indicative premium and the premium load of the household income. For instance, Figure 2 depicts a one-person family residing in the canton of Nidwalden (NW), where the cantonal government stipulates that the premium amount should not exceed 10 percent of household income as premium load and will pay the difference between the indicative premium and this 10 percent level. For example, if one 30-year-old single male has a taxable income of CHF 40,0000 in 2017, while the indicative premium equals CHF 4,500 in the same year, he is entitled to a subsidy of CHF $4500 - 40,000 \times 10\% = 500$. The premium of his own share should be $40000 \times 10\% = 400$.

Two factors determine the subsidy amount entitled. First, cantons regulate the indicative premium for the default CHF300 contract for different age groups[4]. This indicative premium is set for implementing the subsidy eligibility and the risk compensation scheme as well as guiding the insurance company pricing on the default contract. Second, the canton sets the upper-bound income level (in a step-wise subsidy) or the maximum of premium burden (in income-linear subsidy) account for prior income for subsidy eligibility. For administrative reasons, the household taxable income for determining eligibility is given by the taxable income declared in the tax declaration 2 years previous. For instance, the subsidy calculation for year 2019 is based on the taxable income at year 2017. In addition, household taxable income is determined by the type of household, including information about marital status and how many children are in the household.

The subsidy distribution mechanism differs vastly across cantons. All cantons implementing a step-wise subsidy scheme automatically transfer the subsidy. For the other cantons implementing the income-linear subsidy, eligible citizens receive notification via mail in June, and they then must file the application for the subsidy themselves in the regulated time. The effective time for filing the application varies across cantons from one month to twelve months. For instance, the canton of St. Gallen has a three-month application period, and the canton of Basel-Landeschaft offers 12 months to respond to the letter. The final subsidy amount would be noticed before the annual health insurance decision is made each year in November.[5]

[4]There are three dividing age groups in the Swiss health insurance system: children aged 18 and under, young adults under 26, and adults aged 26 and above. For children aged 18 and under, the following seven deductible levels are established: CHF 0, CHF 100, CHF 200, CHF 300, CHF 400, CHF 500, and CHF 600. For the other groups, the law defines six deductible levels from CHF 300 to CHF 2,500. Young adults are offered a discount for each deductible level.

[5]For the eighteen cantons implementing the 'income-linear' subsidy, eligible citizens residing in the canton of Basel (BS) are reliable to check the subsidy regulation and file applications for the subsidy themselves. For the rest cantons, eligible adults receive a notification letter, and they have limited time to apply for the subsidies.

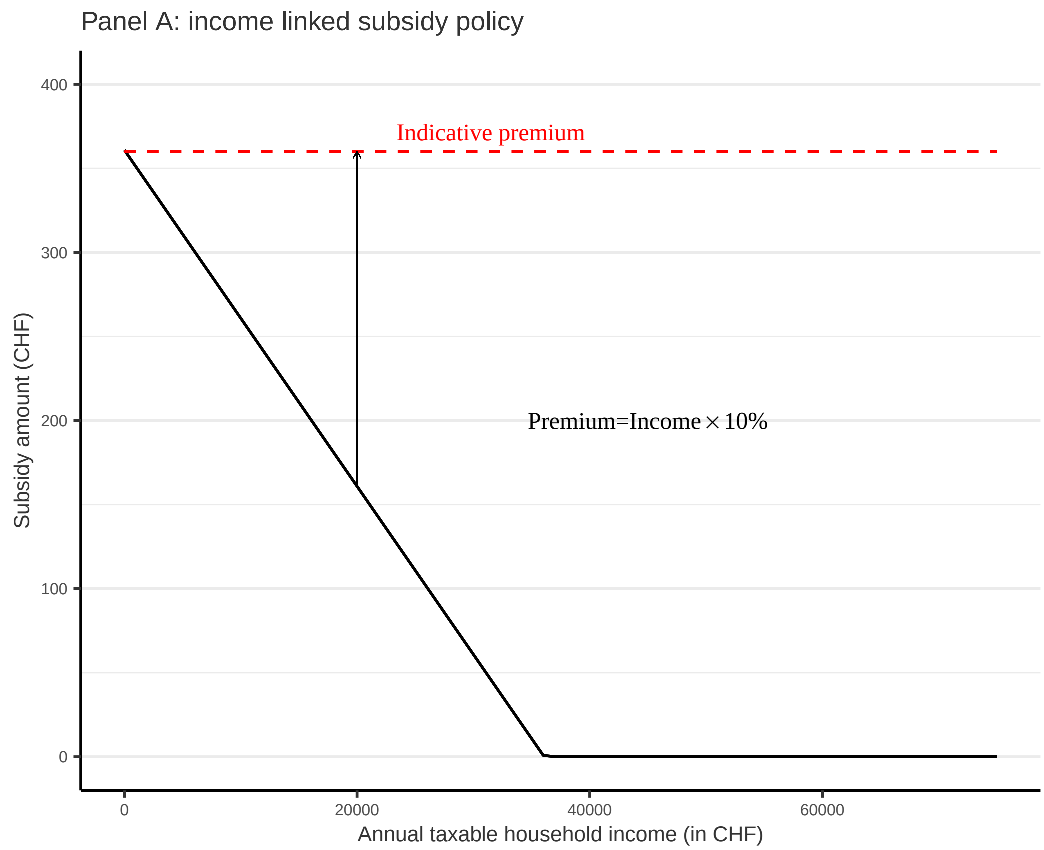

Figure 2: Subsidy structure

Note: The figures show how subsidy amount vary across taxable household inccome for a single 30-year-old man. Panel A plots the subsidy structure for canton Zurich, which implements certain amount subsidy policy conditional on the household income. Panel B maps the relationship in the canton of Nidwalden, which implements income linear subsidy.

Premium subsidiesare fixed coupons Across all cantons except Neuchatel, the subsidy amount is calculated based on the indicative premium of the most generous plan (default CHF 300 deductible plan); therefore, it is a fixed coupon regardless of the plan being selected by the subsidy recipients. The canton of Neuchatel, however, regulates the subsidy received, which varies with the choice of deductible.

Table 2 shows the relationship between the subsidy and the premium out-of-pocket rates. It also lists the premium amount for three hypothetical figures, Lina, Medline, and Hana. According to her prior income, Lina receives the lowest subsidy amount of CHF 3,500, which equates to a premium level for the CHF 2,500 deductible plan. Lina has to pay zero for the CHF 2,500 deductible plan and CHF 350 if she selects the CHF 2,000 deductible plan. As the subsidy increases to CHF 3,500, Hana must pay zero for the CHF 2,500 plan and CHF 50 if she selects the CHF 2,000 deductible plan.

Table 2:

		Person Lina		Person medline		Person Hana	
Deductible	Premium	Subsidy	Premium oop	Subsidy	Premium oop	Subsidy	Premium oop
CHF 2,000	3,750	3,400	350	3,500	250	3,700	50
CHF 2,500	3,400	3,400	0	3,500	0	3,700	0

Note:
This table shows how the premium out-of-pocket varies as the subsidy levels vary.

Table 2 illustrates that, as the subsidy levels increase, the highest deductible plan becomes zero premium, and lower deductible plans are available at a low but slightly positive level for an individual. As this trend continues, I can identify five kink zero-premium deductible plans as the subsidy levels increases.

Premium subsidies generosity In principle, the Federal Government stipulates that the health insurance premiums liable for subsidy recipients should be capped at 10 percent of disposable income. The cantonal government has decisive power when determining how generous these subsidies will be. Among the cantons implementing an income-linear subsidy scheme, the government decides the specific percentage of their household income as out-of-pocket premium borne by the insured, which is referred to as the premium load. The premium load varies across cantons from the lower value of 8 percent (in the canton of Zug) to the highest value of 18 percent (in the canton of Aargau). Within one canton, the cantonal governments adjust the premium load each year. For instance, while the canton of Schwyz kept the premium load at 12 percent over the years, the canton of Vaud increased the premium load to 12 percent in 2018 from 10 percent in 2017 and decreased again to 10 percent in 2019.

Furthermore, since 2014, all 26 cantons have been required by federal law to apply an in-kind transfer, which requires that subsidies from the cantonal government be given to the insurer to remove consumers' incentives to exhaust financial aid. Subsidies are generally paid out on a monthly basis. The Swiss residence is insured individually in each household; however, the subsidy is calculated by family unit and distributed evenly to all adult household members.

3 Data and methodology

3.1 Data sources and description of variables

This project relies on two datasets. The first is the individual admin data that covers individuals in Switzerland, including information on individual socio-demographic data, residence region, deductible choice, predicted health cost, claims, premiums, and subsidies. The second is the admin data linked to household survey data for a representative sample, which covers rich information on self-report health status, registered individual financial situation, household type information, and household financial information. For the preliminary result, I am conducting research based on the Swiss Household Panel (SHP) data from 2016 to 2019. The new data is expected to be delivered in mid-August 2022. I restrict my attention herein to all individuals aged 26 years and up. The remaining sample consists of 7,729 adults.

Health insurance subsidy Subsidy eligibility criteria are based primarily on premium and household financial status. The subsidy calculation differs across cantons in terms of household types, income ceilings, premium load, and indicative premium levels. I manually collected information from most cantonal government offices to determine their calculation base and methodology. I developed a subsidy calculation model based on cantonal regulations and apply it to the households in the SHP data. I derived the household premium with reference to the number of adults and number of children in the household. The taxable income I use for calibration takes account of all relevant deductions such as for childcare, education, church taxes and other old age provisions. For the linear subsidy income, I allocate the premium load regulated by the canton, then calculate the subsidy, which equates to the difference between household premium and the load of the household taxable income. With the new admin data, the subsidy amount is available at individual level.

Based on the eligible information, I trim the sample into two groups T_e and T_{ne}, as shown in Table 3. The interested group T_e represents the group in which individuals are entitled to a premium reduction. In contrast, the comparable group, T_{ne} are individuals who earn higher incomes, therefore, not eligible for subsidy. In this sample, 36 percent of the population are eligible for the subsidy, which is consistent with the statistic revealed by BAG that individuals whose income are below 40th percentile of the income distribution are eligible for government subsidy, as well as the work of Kaufmann, Schmid, and Boes (2017), where they estimates 35 percent of their sample are entitled for subsidy in Switzerland using survey data from year of 2012.

Table 3: Groups

Groups	Format
T_e	eligibility for subsidy
T_{ne}	not eligibility for subsidy

Health care expenditures I derive the ex ante health cost according to the risk adjustment scheme implemented in the Swiss market. As Swiss health insurance is a highly regulated and managed market without price competition, insurance companies are not permitted to select consumers, and their prices for default premiums are highly regulated with only slight changes between them. Some insurance companies would incur high risks if they were to attract more high-risk consumers. To balance a possible bunching of high-risk individuals in certain firms, as well as to avoid incentives to attract low-risk individuals, the Swiss Financial Market Supervisory Authority (FINMA) introduced a risk compensation scheme among health insurers. This scheme allocates individuals to different risk groups according to four factors: age groups, gender, chronic diseases released by the Federal office, and overnight hospital stays. The FINMA then publishes the health costs according to different risk groups in different cantons. To generate the health risk index, I apply the risk compensation scheme's approach to aggregate the rich demographic data into a predicted expected health cost. The average cost varies widely across groups. For instance, the average health cost for a 60- to 65-year-old man is around 4.31 times that of a 25- to 30-year-old man (CHF 5,323 versus CHF 1,235). It is however worth noting that, although I expect the ex ante health costs, for this specific feature in Switzerland, the health costs used are the health costs borne by the insured, which are equivalent to the ex post health costs. With the newly added administrative data, I will present the health care expenditure in later analysis.

Health insurance deductible Each individual is free to select from one of the following deductible levels: CHF 300, CHF 500, CHF 1,000, CHF 1,500, CHF 2,000 and CHF 2,500. By opting for a higher deductible, the consumer pays a lower premium. Table 4 describes the choice patterns of the groups. Around 36 percent of the population in group T_{ne} selects the CHF 300 deductible, while 42 percent in T_e select the insurance contracts that provide the highest insurance coverage. While trifling sums spread across the intermediate plans, and as 30 percent of the population in T_{ne} select the CHF 2,500 deductible option, which decreases to around 20 percent of the low-income population opting for the CHF 2,500 deductible. In this paper, I focus on the selection of the highest coverage contract, the CHF 300 deductible contract, or deductible less than CHF 500 contract, and aggregate other contracts as low-coverage plans. This strategy has several important advantages. First, the Swiss system does not have an opt-out option; therefore, the demand for lowest insurance coverage might be biased because of the legal mandate. Second, as the previous literature suggests, intermediate plans in a vertical structure system are rarely rationalizable. Therefore, focusing on the demand for the CHF 300 deductible allows me to focus on insurance coverage demand.

Table 4 presents the descriptive statistics of the sample, and is structured in five parts, namely the dependent variables, the determinants of subsidy eligibility, additional socio-economic background, the respondent's health status, and the health-related risk factors. The main dependent variable is an indicator for the low deductible levels, one for merely the lowest deductible level CHF 300, and the other is the two lowest deductible levels (CHF 300 and CHF 500). From the statistics, low deductibles are more commonly selected by the subsidy recipients than the other groups. And low-income individuals in group T_e compare to the individuals with average income in group T_{ne} are on average approximately 10 percent point more likely to choose a low deductible plan. The group T_e has average taxable income of CHF 80,717 compare to average household income of 129,757 CHF in group T_{ne}. The results are not surprising given that these variables determine the eligibility status.

Regarding the health status, I include self-report health status, binary indicator for chronic illness based on the drug consumption, binary indicator for overnight hospital stays, nights spend at hospitals, a binary indicator for whether report illness and accident last year,days affected by the health issues, and the ex ante expected cost after the risk compensation among insurance companies. Although it is expected ex ante health cost, it is the real health cost liable for health insurance company. Table 4 indicates that subsidy recipients have the similar health condition as the high income group, however, reports poorer health condition.

3.2 Identification strategy

To identify the effect of subsidy on deductible choice, I use the kinks in the subsidy schedule following a sharp RK design. The empirical challenge in identification lies in two assumptions. First, the direct marginal effect of the assignment variable-income- on the outcome should be smooth. Second, the density of the unobserved heterogeneity should evolve smoothly with the assignment variable at the kink.

The local smooth homogeneous assignment condition seems credible in my context. More specifically, the subsidy is calculated based on two main factors: (1) taxable income two years ago and (2) the indicative premium published by the cantonal government each year, which cannot be predicted by people. To be able to perfectly manipulate ex ante one's position in the schedule of subsidy benefit, it is necessary to know the precise indicative premium published by the government, which is not possible for people to predict. In the next section, I provide further empirical evidence in support of the RKD assumptions.

Following Card et al. (2015), the denominator is deterministic, so the RKD estimation only relies on the estimation of the numerator, which is the change in the slope of the conditional

Table 4: Descriptive statistics

	Linear	
	T_e	T_{ne}
Low deductibles: =1 for deductible equals CHF 300	*0.409*	*0.308*
Low deductibles: =1 for deductible less or equal CHF 500	0.636	0.467
Doctor visit: = 1 if visit to doctor within last year	0.792	0.775
Number of doctor visits last year	6.1	5.1
Eligibility determinants		
Married	*0.851*	*0.841*
Number of kids in households	0.564	0.441
Number of adult kid (17-25) in households	0.290	0.186
Household Income	80,717	129,757
Health status		
Self-report health status		
good: = 1 if self-reported health is well	0.794	0.872
fair: = 1 if self-reported health is average	0.178	0.112
poor: = 1 if self-reported health is poor	0.028	0.016
Objective health status		
Chronic illness	*0.398*	*0.374*
Overnight hosptial stay: = 1 if stays overnight at hospital	0.169	0.152
Nights spend at hospitals:	1.698	1.057
Illness: = 1 if illness	0.218	0.184
Days affected by health problem:	16	12
Expected health cost: after risk adjustment	1,262	1,125
Social-economic background		
Female	*0.588*	*0.514*
Age 45 - 64	0.353	0.460
Age 65 +	0.355	0.260
University: = 1 if respondent completed unviersity	0.178	0.343
Risk factors		
Smoker: =1 if respondent is currently smoking	0.175	0.157
Physical activity:=1 if respondent reports physically active	0.717	0.843
Financial situation		
Satisfaction of financial situation		
Not satisfied	0.096	0.035
Faily satisfied	0.265	0.144
Satisfied	0.639	0.822
Unemployment insurance: = 1 if respond receives	0.023	0.023
saving	2383	7711
Observations	2621	4562

expectation function of the outcome given the assignment variable at the kink. This can be done by running parametric polynomial models of the form

$$E[Y|W=w] = \mu_0 + [\sum_{p=1}^{\bar{p}} \gamma_p (w-k)^p + D \cdot \nu_p \cdot (w-k)^p]$$

where W is the assignment variable, which is income; D is a dummy indicator for being above the kink threshold when $W \geq k$; and the change in the slope of the conditional expectation function is given by ν_1.

The subsidy amount differs depending on household types, including marital status, number of children under 18, and number of dependent children under 25. To evaluate the impact of subsidy, I transfer the subsidy amount relative to the corresponding household income scale, here, the defined poverty line according to the canton regulation, as subsidy scale. For instance, an individual has a subsidy scale equates 0.9, indicating that his household income is 90% of the corresponding poverty line; hence, he receives 10% of the related income as the subsidy amount. In the core analysis, the outcome variable is set to one if a consumer selects the lowest deductible choice. I also cluster different subsidy scales into bins, such as 8%, 6%, and 4% of the relative household income. The dots in the result figures show the mean share of the lowest deductible choice in each clustered bin.

Note that the take up of the subsidy varies across different cantons. Incomplete take-up may affect the validity of the RK design if it causes the random local assignment assumption to be violated. The RKD requires that the presence of incomplete take-up does not generate a non-smooth relationship between the assignment variable and unobserved heterogeneity at the kink point. This requirement is more likely to be met according to my robust checks. Using the instrument variable method, I check whether take-up rate of the subsidy varies according to the cantonal policy, the preliminary results support this assumption.

4 Empirical analysis

In this section, I illustrate the empirical analysis of this paper. First, I study the causal inference of the subsidy on health insurance by presenting the RKD result. Second, I investigate how subsidies affect deductible choice by decomposing the income effect and subsidy effect (substitution effect). I explore the lag of the premium distribution scheme to disentangle the effect of the income effect and subsidy effect. Third, I exploit discontinuities in the availability of zero-premium plans, and investigate the subsidy effect in the channel.

The empirical result is only preliminary and incomplete in the current version.

4.1 Regression kink discontinuity

In this section, I present results of the estimated effect of subsidy on deductible choice. I start by assessing the validity of the RK design assumptions, and run main analysis together with several robustness of the RK estimates.

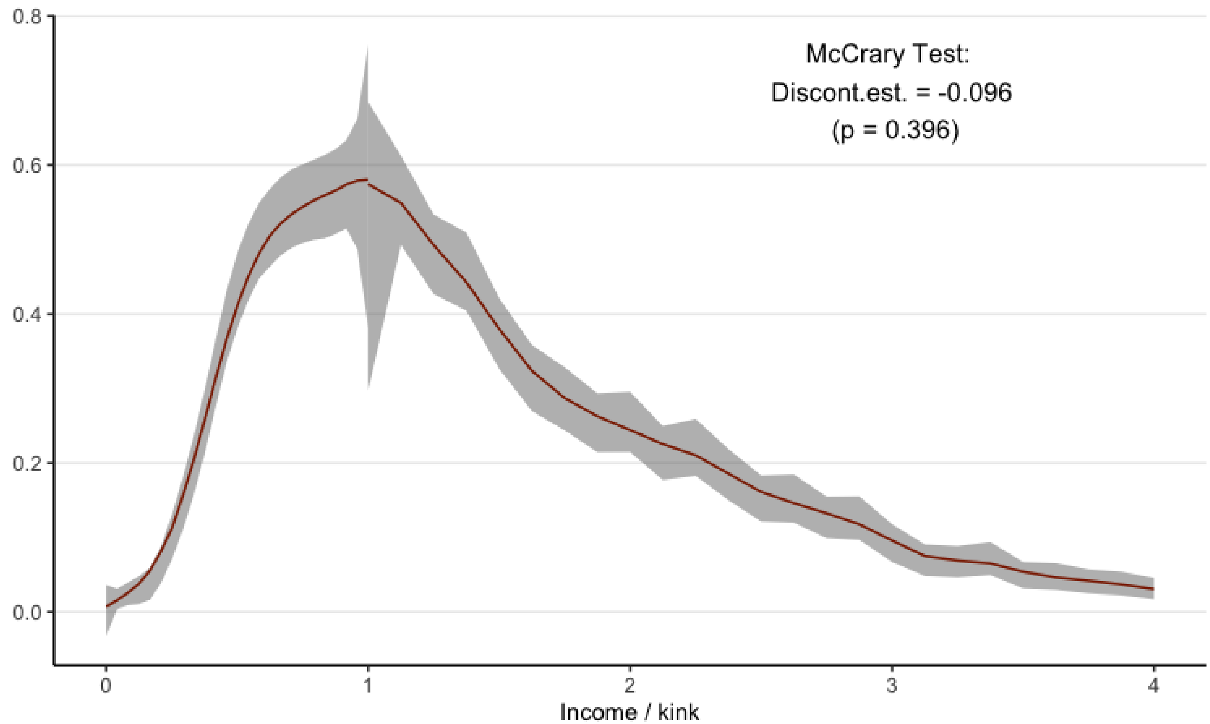

Figure 3: Assignment variable continuity test

Note: The graph assesses the validity of the assumptions of RKD by testing the smoothness of the distribution of the assignment variable at the bend point in the subsidy schemes. It shows the distribution of the income as proportion over the corresponding income threshold level, centered at the kink point.

Graphic evidence I begin by showing visual evidence in support of the RKD assumptions. First, I plot the distribution of the running variable to detect potential manipulation of the assignment variable at the kink point in Figure 3. The figure shows no signs of discontinuity in the relationship between the number of individuals and the running variable at the kink point. I also performed McCrary tests following the previous literature in Regression Discontinuity Design to confirm this graphical diagnosis. The estimate for McCrary test is insignificant ($p - value = 0.4819$).

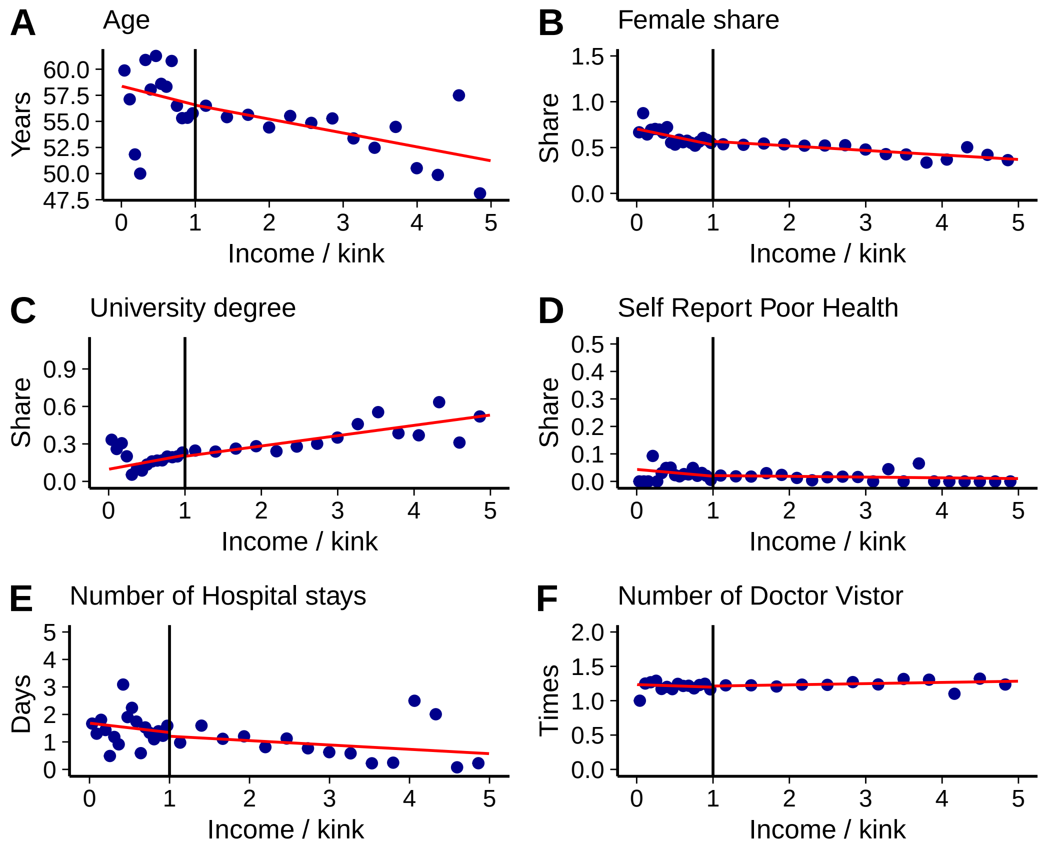

Figure 4: regression kink design result

Note: The figure shows discontinuities in enrollment of low deductible insurance contract (CHF 300) at the income thresholds (poverty line).

Another key testable identification of a valid RK design is that the conditional expectation of any covariate should be continuously differentiable at the kink. This can be visually tested by plotting the mean values of covariates in each assignment variable bin as shown in Figure 4. Panel A, B, and C of Figure 4 all suggest that the covariates evolve smoothly at the kink, in support of the identification assumptions of the RK design. It is reassuring that in Panel A, the average age of subsidy recipients is elder than the non-eligible ones. However, we see no discontinuous jump across the kink. In Panel B, females relative to males are more likely to be eligible for subsidies. In theory, high education could increase the income level and also be more resistant to avert employment shocks, therefore, less likely to be receiving government aid. In panel C, I investigate whether differences in education level may affect the local random assignment assumption of the RK design. To do so, I exploit the mean of the university degree earner in each bin, and the graph presents a visual continuity among the kink.

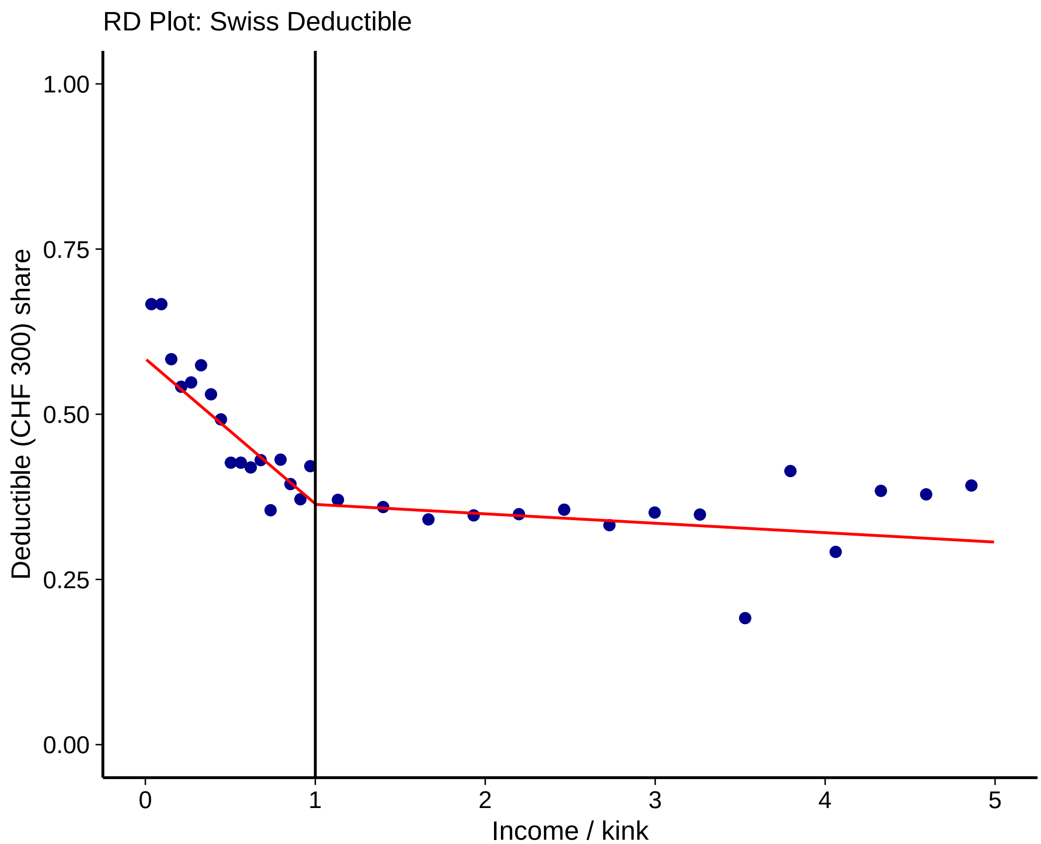

Figure 5: regression kink design result

Note: The figure shows discontinuities in enrollment of low deductible insurance contract (CHF 300) at the income thresholds (poverty line).

In panels D, E, and F of Figure 4, I investigate whether differences in ex-ante health conditions may affect the local assumption of the RK design. To do so, I exploit the self-report poor health condition (Panel D), number of doctor visits (Panel E), and number of hospital stays overnight (panel F). Although this is not a complete measure of ex-ante health risk, this is a good proxy so far for the health risk. Figure 4 panel C displays the relationship between the share of self-report poor health conditions and the assignment variable, which does not exhibit any discontinuity in slope at the kink. The results suggest a limited difference in objective health risk for the two groups. Formal estimates from tests are described in Table 3.

The pattern for the outcome variables in Figure 5 offers a striking contrast with that of covariates, as shown in Figure 5. There is a sharp visible change in the slope of the relationship between the deductible choice and the assignment variable at the kink of the subsidy schedule. The coefficient estimate is -0.886 ($p-value$=0.057). I provide various tests for the robustness of the RKD estimates, for instance, using different levels of bin size, and the result is still consistent with the main finding. Besides, the trend on the right-hand side of the cutoff in Figure 5 shows a slightly downward but relatively flat trend in the take-up rate of the lowest deductible. It suggests a small and insignificant effect of income on the take-up of the most generous plan for high-income non-subsidy recipients. The income effect on deductible choice can be classified into two channels: the wealth effect and the mental accounting effect. In the next step, I will test the mental accounting effect of income on deductible choice.

The central findings are illustrated in Table 5. Each coefficient corresponds to a regression estimating the effect of a one-point subsidy increase on deductible choice, each in percent terms. The estimates suggest that a one-point subsidy increase relative to their poverty line increases the likelihood of selecting the highest coverage plan by 2.9 percent. The result is robust to varied bandwidths and polynomial specifications. To evaluate the sensitivity of estimates to bandwidth, I vary the bandwidth while implementing the specification, the results of which are shown in Table 5, using different original bins. The estimates are robust to varied bandwidths. To evaluate the sensitivity of the bandwidth, we notice at bandwidths smaller than optimal, the estimates on deductible choices tend to be smaller.

4.2 Financial constraints and deductible choices

Consumers receive subsidies based on low income two years ago. And the financial constraints might change over the years. The lag of the subsidy distributions segments the population into four main groups in the table:

Table 6: Subsidy Groups

Groups	subsidy eligible and current financial condition
T_{s+c}	subsidy + constraints
T_{s+nc}	subsidy + no constraints
T_{ns+c}	no subsidy + constraints
T_{ns+nc}	no subsidy + no constraints

T_{s+c} refers to subsidy recipients who are still financially constrained in the current year; T_{s+nc} is low-income individuals who are entitled to subsidies for low income two years ago but have increased revenue in the current year; T_{ns+c} depicts individuals who face finance shock in the current year, but in the absence of subsidy; and T_{ns+nc} is individuals with continuous high income.

Table 5:

	RKD estimate	**age**	**female**	**university**	**hospital days**	**poor health self-report**	**doctor visit**
bin size: 0.833%							
conventional	-2.404	6.102	-0.077	0.464	-4.375	0.155	0.221
	(1.384)	(13.513)	(0.219)	(0.273)	(6.273)	(0.097)	(0.218)
p-value	0.082	0.652	0.727	0.09	0.486	0.11	0.311
bias corrected	-2.758	1.854	-0.18	0.851	-8.241	0.207	0.328
	(1.384)	(13.513)	(0.219)	(0.273)	(6.273)	(0.097)	(0.218)
p-value	0.046	0.891	0.412	0.002	0.189	0.033	0.132
Robust	-2.758	1.854	-0.18	0.851	-8.241	0.207	0.328
	(2.004)	(26.789)	(0.439)	(0.421)	(10.27)	(0.193)	(0.427)
p-value	0.169	0.945	0.682	0.044	0.422	0.283	0.443
obs	528	528	528	528	521	528	523
bin size: 0.625%							
conventional	-2.468	8.725	-0.055	0.395	-4.661	0.133	0.191
	(1.545)	(19.588)	(0.238)	(0.345)	(5.049)	(0.107)	(0.266)
p-value	0.11	0.656	0.816	0.252	0.356	0.216	0.472
bias corrected	-2.948	3.272	-0.11	0.806	-8.47	0.191	0.352
	(1.545)	(19.588)	(0.238)	(0.345)	(5.049)	(0.107)	(0.266)
p-value	0.056	0.867	0.643	0.02	0.093	0.075	0.186
Robust	-2.948	3.272	-0.11	0.806	-8.47	0.191	0.352
	(2.115)	(35.547)	(0.469)	(0.602)	(8.273)	(0.214)	(0.479)
p-value	0.163	0.927	0.814	0.181	0.306	0.372	0.462
obs	676	676	676	676	669	676	671
bin size: 0.417%							
conventional	-2.525	8.482	-0.072	0.421	-5.875	0.207	0.313
	(2.016)	(17.624)	(0.292)	(0.36)	(5.794)	(0.155)	(0.26)
p-value	0.21	0.63	0.805	0.243	0.311	0.181	0.228
bias corrected	-2.555	-0.909	-0.128	0.847	-10.556	0.273	0.465
	(2.016)	(17.624)	(0.292)	(0.36)	(5.794)	(0.155)	(0.26)
p-value	0.205	0.959	0.662	0.019	0.068	0.078	0.074
Robust	-2.555	-0.909	-0.128	0.847	-10.556	0.273	0.465
	(2.748)	(31.755)	(0.555)	(0.54)	(9.213)	(0.288)	(0.472)
p-value	0.352	0.977	0.818	0.117	0.252	0.343	0.325
obs	935	935	935	935	928	935	930

Note:
Bin size indicates the household income is within each 0.833% (0.625%, and 0.417%) of the corresponding porverty income level.

T_{ns+c} is the main interested group in this data. It captures the deductible selection under the financial constraints in the absence of subsidy and implicates the social cost of the government not providing financial aid. It helps to evaluate the welfare implication of offering subsidies to low-income adults.

Figure 6 plots the average individual share in different groups for financial situation change in 2017. Later analysis, with longer periods and larger data, allows me for a thorough event study. Hence, in the current stage, Figure 6 shows no pre-period trend. The figure shows a flat raw trend for different groups, including T_{s+c}, T_{ns+nc}, which is a mechanical result due to the stable financial condition of consumers in this group. We find the average share of the lowest deductible is 30 percent in the group T_{ns+nc}, compared to 45 percent subsidy recipients in the group T_{s+c}. Similar to the raw trends, the event study shows an average selection of the lowest deductible in the group T_{s+nc}. The lower take-up of high coverage remains roughly constant in the two years following the deprivation of subsidy. In 2017, individuals in T_{ns+c} experienced financial shock; they have an average of percent take-up of the lowest deductible. As the financial aid dwells in, the take-up of coverage swells progressively to 44 percent, which is the level of the coverage demand for subsidy recipients.

In addition, I plan to explore the effect of subsidies on healthcare utilization. I explore the variation of health risk (through the health cost risk scores) and the health spending to document the extent of moral hazard behavior incentivized by subsidies. The preliminary regression result is presented in the Appendix E. The result suggests that subsidy receipt increases the likelihood of doctor visits, however, it has slim effect on the frequency of doctor visits. In Later analysis, I investigate the effect of subsidy on hospital utilization behavior. An essential assumption for identification is that the health risk score effectively captures the observable information on health risk and is stable over time for the same individual. I use the difference-in-diference (DID) method to explore the variation between risk scores and health cost claims of the individual when given subsidies.

4.3 Subsidy generosity and deductible choice

This section explores the variation of the subsidy amount, which changed with the policy change over the years. For instance, the canton of Zug subsidizes the premium to 8 percent of the maximum household income and increases to 8.5 percent in the year 2018. While the canton of Zurich is adjunct to the canton of Zug remained 10 percent all over the years. I use the difference-in-difference methods to explore the changes in the deductible choice pattern over the years to detect the effect of subsidy generosity and deductible choice. I also run the analogous analysis with the cantons with the same level of GDP as the robust test.

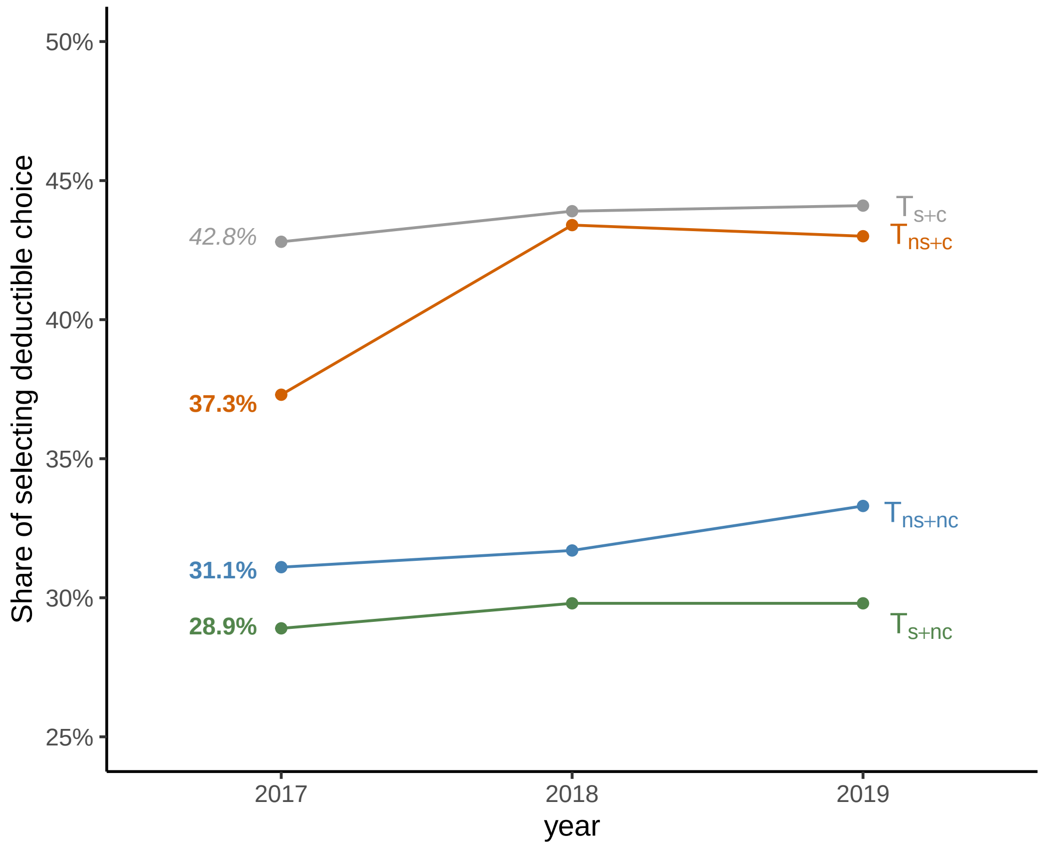

Figure 6: Low deductible shares for different groups

Note: The figures present the constructed willingness to pay and cost curves for different grouos: low-income group (panel A) and average income group (panel B).

5 Conclusion

This paper estimates the extent to which individuals' deductible choices are influenced by subsidy incentives. I find that subsidy levels increase the take-up of the most generous plan by 16 percent point. When decomposing the effect into the income effect and the subsidy effect, I find that, when facing financial constraints in the absence of subsidy, individuals increase their enrollment in the high-coverage plan by 8 percent point. Overall, my results confirm that the effect of financial constraints is substantial and that a provision of subsidy aid might be welfare increasing. However, the present analysis is still a work in progress, and the conclusions drawn here are only preliminary results. Later analysis will present supplementary evidence on the subsidy effect. In subsequent analysis, I will further estimate the heterogeneity in response to subsidy following Tebaldi (2017). Furthermore, I will extend the study on the income effect using the high-income non-subsidy group. This helps decompose the mechanism of the income effect to the wealth effect and the mental accounting effect.

This paper focuses mainly on the channel of the impact of subsidy on deductible choice. More research is needed to better understand the average level of subsidy amount on deductible choice, therefore facilitating the evaluation of the subsidy policy welfare effect. A uniform insurance package is offered with different market premiums with different subsidy generosity designs. The variation of the subsidy amount increased with the policy change over the years. On the other hand, this paper limited the focus on the subsidy effect, as in some cantons, the take-up of subsidy comes with transaction costs, according to the work of Drake et al. (2021). As such, future research can extend the subsidy effect to the administrative costs involved in implementing the health insurance policy.

Finally, I think the results of this study contribute to the research on the impact of financial constraints on health insurance decisions and also informs policy-makers globally. Prior to this study, the extant literature provided evidence to test the role of financial constraints in the decision-making process. This work, in contrast to the existing work, makes no behavioral assumptions, which provides some empirical evidence to disentangle the confounding effects involved in the decision-making process. Regarding its broader societal relevance, researchers argue that a generous subsidy plan benefits the provider instead of low-income individuals and drives up the premium for the whole population. My results show that, however, when facing liquidity constraints, individuals place greater value on the financial protection from health insurance than the premium burden from a high coverage plan. This paper sheds light on the future policy aiding low-income individuals.

6 Appendix

6.1 Appenxidx A: Cost distribution conditional on Canton

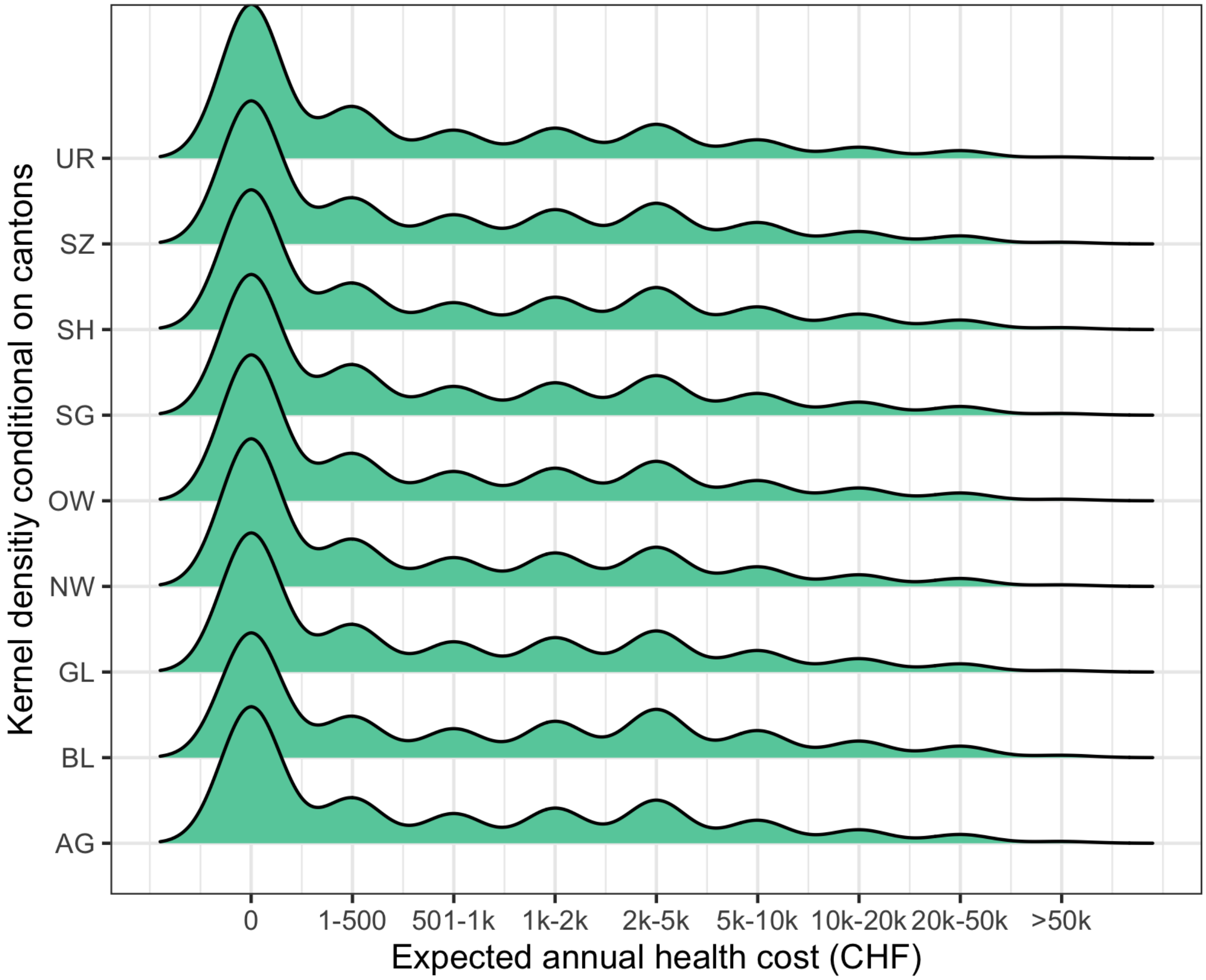

Figure 7: Cost distribution conditional on cantons

Note: The figures present the constructed willingness to pay and cost curves for different grouos: low-income group (panel A) and average income group (panel B).

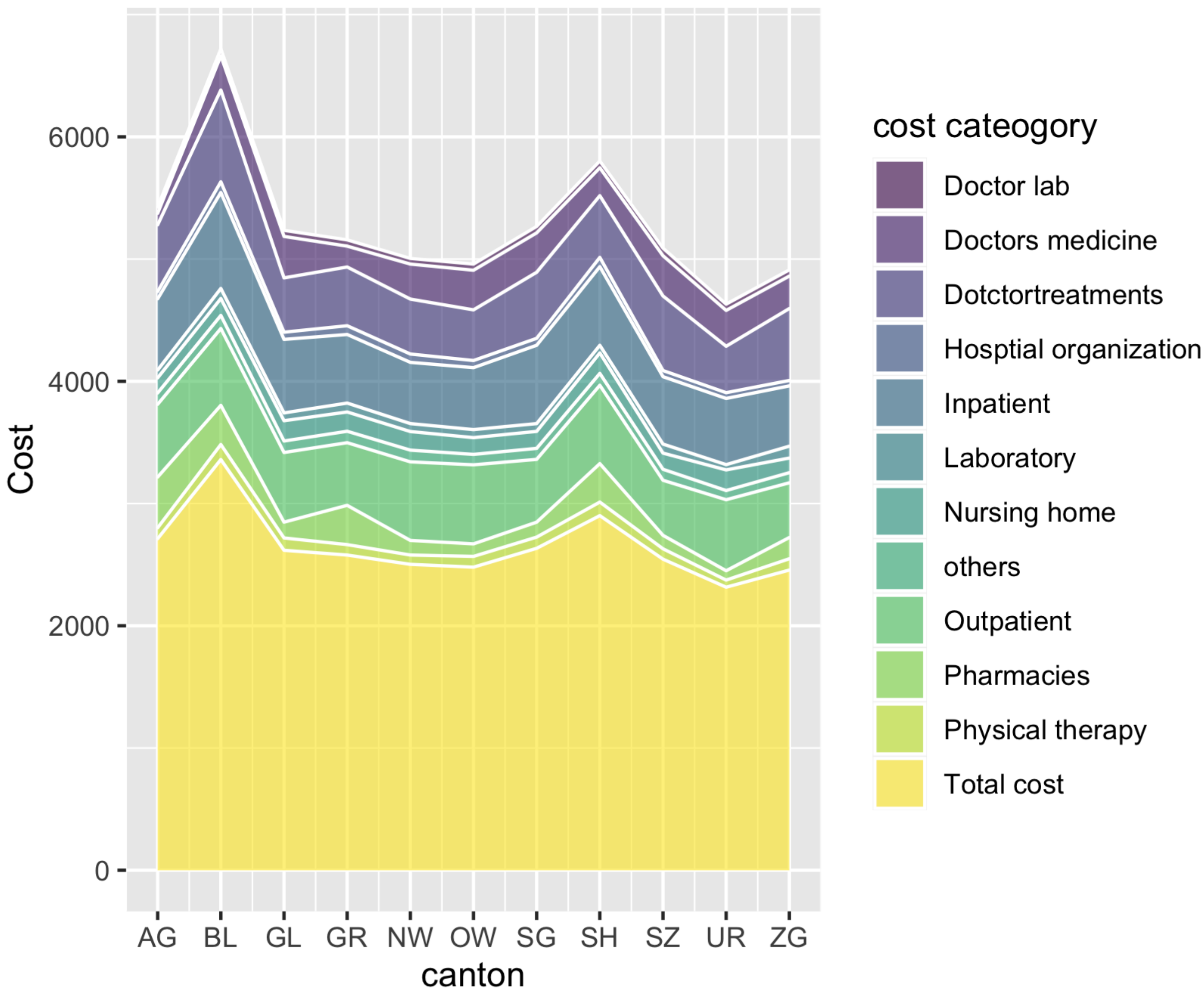

Figure 8: Cost distribution conditional on cantons

Note: The figures present the constructed willingness to pay and cost curves for different grouos: low-income group (panel A) and average income group (panel B).

6.2 Appendix B: Step-wise subsidy scheme

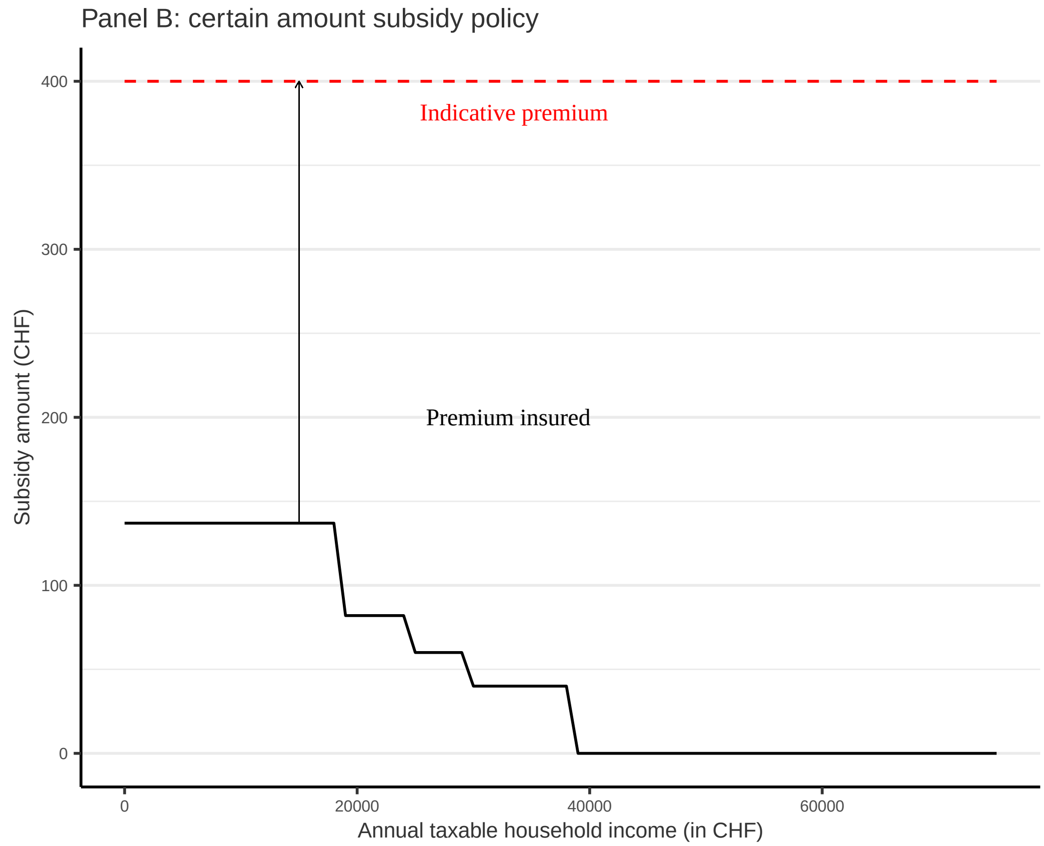

Figure 9: Subsidy structure: step-wise subsidy

Note: The figures show how subsidy amount vary across taxable household inccome for a single 30-year-old man in step-wise subsidy. It maps the relationship in the canton of Nidwalden, which implements income linear subsidy.

6.3 Appendix C : McCarary test distribution

6.4 Appendix D : Model set up and assumptions

A. Setup and assumptions

The basic methodology assumes that consumers make discrete choices about plans under uncertainty about their health; here, I only observe the generosity of the plan attributes.Assume a decision makers, labeled i, faces a choice among $j \in H, L$ alternatives. Although there are six vertically differentiated choices in the system, I define two insurance contract types j as high (contract H) and low deductible contract (contract L): contract H denotes the contract of CHF 300 default deductible plan, while L is all other plans on offer. Let α be the measure of contract generosity; therefore,$\alpha_H > \alpha_L$.

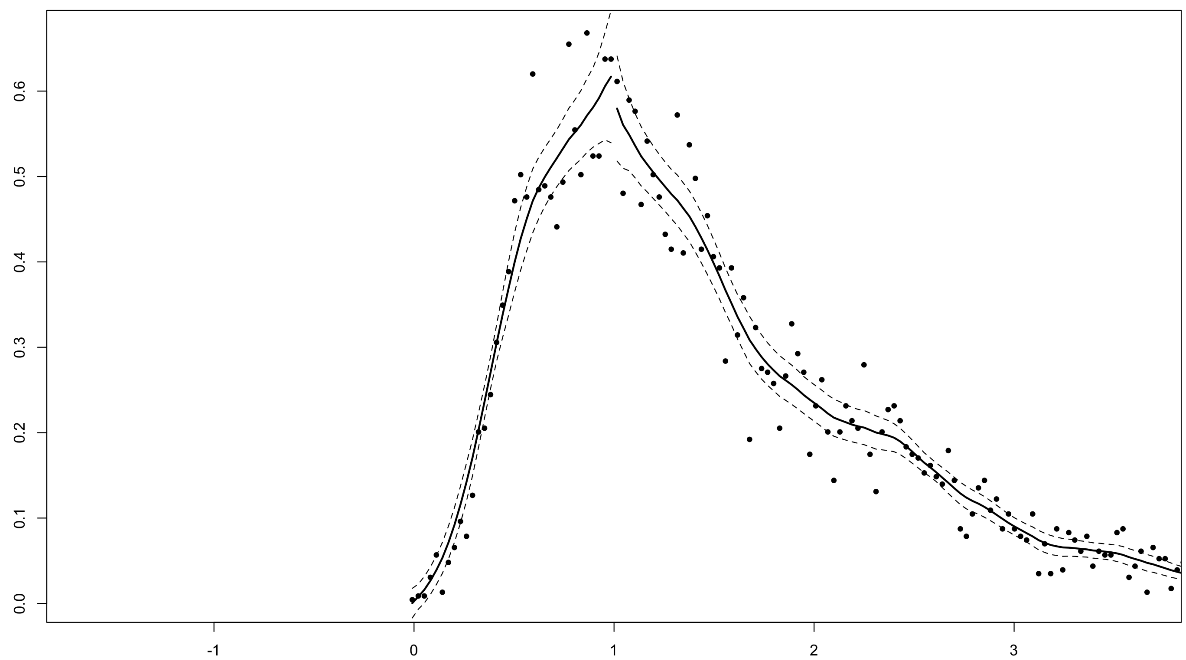

Figure 10: McCrary test:distribution of income

The utility that decision maker i obtains from choice j is that U_{ij}. Let $W(\alpha; i)$ be the willingness to pay of consumer i's willingness to pay for an α-generosity contract,and P_{ij} be the premium of contract j. I write the utility of consumer i for plan j as

$$U_{iH} = w(\alpha_H; i) - p_{iH}$$

I assume the willingness to pay (WTP) is known to the decision maker but not by me as the researcher. A decision maker chooses the alternative H if and only if $U_{iH} > U_{iL}$. The probability that decision maker i chooses alternative H is

$$\begin{aligned}
\mathrm{P}(iH) &= \mathrm{Prob}(U_{iH} > U_{iL}) \\
&= \mathrm{Prob}(\epsilon_{iH} - p_{iH} > \epsilon_{iL} - p_{iL}) \\
&= \mathrm{Prob}(\epsilon_{iL} - \epsilon_{iH} < p_{iH} - p_{iL}) \\
&= \mathrm{Prob}(\epsilon_{i\hat{H}L} < p_{iH} - p_{iL}) \\
&= \int_{\epsilon} \mathrm{I}(\epsilon_{i\hat{H}L} < p_{iH} - p_{iL}) f(\epsilon_i) d_{\epsilon_i}
\end{aligned} \tag{1}$$

where the probability is a cumulative distribution, namely, the probability that each random term $\epsilon_{iH} - \epsilon_{iL}$ is below the observed quantity $p_{iH} - p_{iL}$. Using the s as the index of preference, measuring the willingness to pay type for individual i valuing insurance contract j, I capture the distribution of the unobservant random term $\epsilon_{iH} - \epsilon_{iL}$. Note $p_{iH} - p_{iL}$ is fixed at each set of deductible choice, therefore, I capture the premium difference mainly by the default price p_{iH}.

Thus, we have:

$$W(\alpha; i) = W(\alpha; s)$$

,where $(1 - s) \in [0, 1]$ indexes willingness to pay for generosity, i.e., $s = 0$ is the highest WTP type and $s = 1$ is the lowest. Refer to Finkelstein, Hendren, and Shepard (2019)'s work for more details.

Demand curve : Following the framework outlined in Einav, Finkelstein, and Cullen (2010) and Finkelstein, Hendren, and Shepard (2019), I transform the WTP into the fraction enrolled in each plan. Let S^* be the point of indifference between the L and H plan when given default premium for contract H, which occurs where the willingness to pay for H plan

W_{iH} equals to P_{iH}. All types to the left of this enroll in plan H, and the demand for plan H equates to S^*.

Assuming that different markets have the same distribution of willingness to pay types, then

$$D_H(P_H) = S_H^*$$

where the demand for plan H depends on two price: (1) default indicative premium of the highest coverage plan; (2) the price different $P_H - P_L$.Since the price difference is universal across all markets and the health insurance coverage is mandatory (without opt-out option), the demand for contract H is therefore proxied solely by the indicative premium of the default contract H in each market.

Assume the demand is linearly associated with the price. Exploring the price variation across states, I observe the demand with different premium prices. I estimate the demand curve as follows:

$$D = \alpha + \beta P + \epsilon$$

cost curve: Following Finkelstein, Hendren, and Shepard (2019), the expected costs C_H represents the expected costs to the insurer of enrolling type s in plan H. Given the beneficial feature of Swiss health insurance market, the ex ante health cost I predicted using the cost model equals to the post risk adjustment health cost insurance company has to bear. I assume no moral hazard in the cost. I derive the average cost with type $\tilde{s} <= s$ as:

$$AC_H(s) = \frac{1}{s}\int_0^s C_H(\tilde{s})d\tilde{s}$$

Assuming the cost is linearly associated with the price, by observing the price variation, the cost curve can be estimated as follows:

$$C = \gamma + \sigma P + \eta$$

6.5 Appendix E: Regression for visiting doctors

% Table created by stargazer v.5.2.2 by Marek Hlavac, Harvard University. E-mail: hlavac at fas.harvard.edu % Date and time: Fri, Aug 19, 2022 - 13:29:29

Table 7:

	Dependent variable:	
	GP vistis (=1)	Number of GP visits
	logistic	*OLS*
	(1)	(2)
subsidy recieve	0.453**	0.431
	(0.199)	(0.644)
illness	2.321***	6.112***
	(0.370)	(0.565)
age	0.037***	−0.030
	(0.007)	(0.022)
number of kids	0.012	−0.012
	(0.089)	(0.338)
married	−0.031	−0.223
	(0.219)	(0.745)
female	0.550***	0.986*
	(0.149)	(0.503)
constant	−1.430***	5.185***
	(0.397)	(1.492)
Observations	1,159	881
R^2		0.123
Adjusted R^2		0.117
Log Likelihood	−553.030	
Akaike Inf. Crit.	1,120.059	
Residual Std. Error		7.319 (df = 874)
F Statistic		20.429*** (df = 6; 874)
Note:		*p<0.1; **p<0.05; ***p<0.01

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