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Can risk rating increase the ability of voluntary deductibles to reduce moral hazard?

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Abstract
Several regulated health insurance markets include the option for consumers to choose a voluntary deductible. An important motive for this option is to reduce moral hazard. In return for a voluntary deductible, consumers receive a premium rebate, which is typically community rated. Under community rating, voluntary deductibles are particularly attractive for low-risk consumers. Since these people use relatively little medical care, the total moral hazard reduction might be relatively small compared to the total healthcare spending. This paper examines the potential moral hazard reduction under risk-rated premiums. We use Chile as a case study due to institutional features that make it a valid benchmark for other countries. Our simulations show that in the presence of self-selection and under a uniform percentage moral hazard reduction across risk types, the absolute moral hazard reduction from a voluntary deductible is indeed expected to be larger in a system with risk-rated premiums than in a system with community-rated premiums. Nevertheless, sensitivity checks show that this conclusion might no longer hold as the percentage moral hazard reduction is lower for high-risk individuals compared to low-risk individuals.

Keywords Health insurance · Voluntary deductibles · Moral hazard · Premium regulation

Introduction

Several social health insurance markets include the option for consumers to choose a voluntary deductible in return for a premium rebate, that is, a discount on the premium paid compared to a plan with no voluntary deductible. A primary motivation for this cost-sharing option is to mitigate moral hazard (MH) (Cutler and Zeckhauser 2000). Examples include the mandatory health insurance schemes in the Netherlands and Switzerland, and the marketplaces in the U.S. (McGuire and van Kleef

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2018). In the Netherlands, premiums (and premium rebates) are community rated per health plan, meaning that all consumers with the same plan pay the same premium. In Switzerland, premiums can be differentiated according to age (to a limited extent) and canton. In the U.S. marketplaces, premiums can be differentiated according to age, tobacco use and geography, and so can the premium rebates for voluntary deductibles. In this paper we show how the premium structure in a health insurance market can influence the MH reduction (MHR) from voluntary deductibles.

Under community-rated premiums, voluntary deductibles are particularly attractive for applicants with relatively low expected spending *in the total population* (van Kleef et al. 2006). Under risk-rated premiums, on the other hand, voluntary deductibles are particularly attractive for applicants with relatively low expected spending *within their premium-risk group*. Thus, compared to community-rated premiums, risk-rated premiums are likely to increase take-up of voluntary deductibles among people with moderate or higher risk. Given the differences in expected spending between high and low-risk individuals, this outcome is particularly relevant from a policy perspective to reduce MH. The primary objective of this paper is to simulate and compare the potential MHR from voluntary deductibles under risk-rated and community-rated premiums. To do so, we construct three scenarios that vary by the degree of self-selection in the market: 'perfect self-selection', 'imperfect self-selection' and 'no self-selection'. Each of these scenarios makes an assumption about the sorting of risk types between a deductible and a non-deductible plan. Next, we calculate for each scenario the MHR due to the voluntary deductible.

Our simulations are carried out on data from Chile. The Chilean health system is characterised by a public/private mix in the insurance and provision of healthcare, where the private sector (i.e. Isapres market) is ruled under some principles of social insurance. The Isapres market combines premium regulations composed by a community-rated premium for GES services (GES premium)[1] and a regulated risk-rated part (currently, only age) for duplicative and additional services covered by the offered health plans, no open enrollment and a simple risk equalisation system. The Isapres market is an example of how potentially effective regulatory tools, if poorly implemented, exacerbate the inefficiencies of the market (Velasco et al. 2018). These structural features of the market have led to a proliferation of plans[2] that differ in many ways, such as benefits, cost-sharing and provider networks creating market segmentation (Velasco et al. 2018). Consumers face an overwhelming choice set that increases their transaction costs, ultimately hindering competition (Enthoven 1986). This dynamic also undermines the efficiency of sorting across plans (consumers do not enroll in the plan with the highest net value over cost) (van Kleef et al. 2018), lowering the effectiveness of cost-sharing to counteract MH. To solve these problems, the country in the current presidential cycle (2018–2021) pushed for reform proposals with the goal of increasing the fairness and efficiency of the

[1] This constitutes the basic benefit package common to the public and private market. Currently, it is composed of 85 healthcare conditions (Ministerio de Salud 2021).

[2] In January 2016, 64,012 health plans were reported in the system with 7610 of these plans actually being commercialised in the market (Superintendent of Health 2016).

private market. In recent proposals, both the premium setting, the option of a voluntary deductible and the improvement of the risk equalisation system have been proposed (Ministerio de Salud 2019). Understanding the interaction between the (MHR from) voluntary deductible and the premium structure is then of great interest from both an empirical perspective and a policy point of view. In the light of this reform proposal, this paper simulates whether the MHR from a voluntary deductible can indeed be expected to be larger under risk-rated premiums than under community-rated premiums.

Yet another system feature that can impact (the MHR from) voluntary deductibles is 'risk equalisation', i.e. a system that compensates insurers for predictable variation in medical spending in order to mitigate incentives for insurers to engage in risk selection. Risk equalisation can be found in many social health insurance markets, including the mandatory health insurance schemes in the Netherlands and Switzerland and the ACA marketplaces in the U.S., and is part of the Chilean reform proposals as well. With risk equalisation, it is not straightforward for insurers to offer attractive premium rebates for voluntary deductibles (van Kleef et al. 2008). The simple reason is that risk equalisation compensates insurers for predictable differences in spending between people who are likely to choose a deductible and those who are not. As risk equalisation 'better' compensates for this difference in spending between the two types of contracts, the difference in premiums between the two contracts will be smaller. In our empirical analyses we examine whether, in the presence of risk equalisation, insurers will still be able to offer attractive premium rebates in the different self-selection scenarios. More specifically, we calculate the difference in mean spending (from the insurers' perspective) between a deductible plan and a non-deductible plan, taking into account the risk equalisation system.

Results from our estimations on Chilean data may represent a benchmark for other countries with similar institutional features (e.g. consolidated public–private mix with tints of social insurance principles—such as Ireland and Australia) and to those debating the structure of their health systems to manage expenditures while keeping up with consumers expectations (i.e. Australia, New Zealand, Switzerland, the Netherlands, the U.S.) (Robson and Paolucci 2012; McGuire and van Kleef 2018; Henriquez et al. 2019). Indeed, the regulatory tools discussed in the paper are commonly implemented in insurance markets to balance efficiency and fairness (van Kleef et al. 2018): voluntary deductibles can help counteract moral hazard; premium rate restrictions (i.e. community rating (CR)) can improve fairness (but also introduce selection incentives); and risk equalisation mitigates incentives for risk selection by insurers. The findings in this paper imply that these three features should not be considered in isolation. A better understanding of the interactions among these tools can enhance healthcare system design.

The rest of the paper is structured as follows. The "Conceptual framework" section presents a conceptual framework on deductibles and moral hazard. The "Data and methods" section provides a description of the data and methods used in our empirical simulations. The "Results" section describes the results. Finally, the "Conclusion and discussion" section discusses the main findings.

Conceptual framework

Our empirical estimations require assumptions on moral hazard and deductible choice. In this conceptual framework we appraise the effect of voluntary deductibles on MH as reported in the literature and then analyse the main factors that affect people's choices for deductibles.

Deductibles and moral hazard

The effectiveness of deductibles in reducing MH has been detected in several studies with different designs. The RAND Health Insurance Experiment was the first randomised control trial (RCT) on health insurance, designed to identify the effect of consumer cost-sharing on medical spending and health (Manning et al. 1987) (Newhouse 1993). The study found that the average arc price elasticity (how much medical spending changed when cost-sharing was varied) among the different cost-sharing options was around − 0.2 (Keeler and Rolph 1988). A second and more recent study was the Oregon health insurance experiment. This project investigated the impact of expanding public health insurance (Medicaid) to a sample of low-income people. The previous findings were confirmed with different outcomes: the increase of health insurance coverage (free health insurance in this case) increased health care utilisation (Baicker and Finkelstein 2011).

The difficulties in conducting RCTs has led researchers to apply other types of empirical methods, such as quasi-experimental designs. Gerfin et al. (2015) analysed the Swiss health insurance market and found a 27% reduction of use for individuals enrolled in high deductible plans. In the U.S., Stockley (2016) found that a USD 10 increase in monthly out-of-pocket (OOP) costs due to deductibles reduces total spending by 1.1%. Brot-Goldberg et al. (2017) ran a natural experiment exploiting the mandatory switch for all the employees of a self-insured firm from an insurance plan that provided free healthcare to a non-linear, high-deductible plan. The authors found a spending reduction of between 11.8% and 13.8%. Klein et al. (2018) focused on the mandatory deductible in the Dutch market, restricting the analysis to individuals without voluntary deductibles. They found that, on average, individuals spent 36% less before the deductible's threshold than in the months where they exceeded it. Concerning MHR due to the introduction of voluntary deductibles, several studies have been applied to the Swiss health insurance market. Van Kleef et al. (2007) found a 7.1% average reduction in the Swiss health insurance market. The magnitude of MHR varied widely across the different deductible levels. For example, the reduction detected for the CHF 600[3] deductible was around 15.1%, while that of the CHF 1200 deductible was 12.9%. These findings confirm the prior estimation made by Gardiol et al. (2005), where the CHF 600 deductible produced a reduction of 16.1% and the CHF 1200 only 5%. Trottman et al. (2012) confirmed the reduction in the Swiss system, finding a higher average reduction of 23% due to the introduction

[3] Around USD 610.

of voluntary deductibles. Overall, the effect of the deductible is consistently smaller for inpatient spending, suggesting that consumers are less price sensitive when they face more serious medical episodes (Aron-Dine et al. 2013).

An important consideration in consumers' response to a voluntary deductible is the assumption of which price consumers respond to in making their medical spending decision (Aron-Dine et al. 2013). The literature does not provide a unique answer. A first assumption is that consumers should respond to their expected end-of-year price, i.e. the expected (OOP) price on the last dollar of healthcare spending, given current information (Ellis 1987). According to this assumption, consumers are fully forward-looking. A second assumption is that consumers are myopic to some extent, as they respond to the actual (realised) end-of-year price (Eichner 1998; Kowalski 2009; Marsh 2012). Lastly, some studies found that consumers are fully myopic, responding heavily to the 'spot price' of healthcare, i.e. the OOP price of the next dollar of healthcare spending (Ellis et al. 2017; Brot-Goldberg et al. 2017; Dalton 2014). Aaron-Dine et al. (2015) found mixed evidence. In their specific setting, consumers did appear to take into account the non-linear budget set, revealing forward-looking behaviours, but they were also responsive to the 'spot price' of healthcare, revealing some degree of myopia.

Determinants of deductible uptake

Assuming a risk-averse utility maximising consumer, the voluntariness of the deductible choice leads individuals to choose it only when a gain in expected utility is expected. Evidence shows, however, that individuals are not completely able or are unwilling to exploit advantages regarding uptake (van Winssen et al. 2015; van Kleef et al. 2007). For the aim of our analysis, we categorise the determinants of deductible uptake into three types: (a) the expected OOP spending; (b) the premium rebate; and (c) behavioural factors. Each of these will be explained below.

Expected out-of-pocket spending

The expected OOP expenditure is an important determinant in the uptake of a deductible. For a given premium rebate, the financial attractiveness of a voluntary deductible decreases with expected OOP spending. An insured might not opt for a deductible in a year if she expects high spending (van Winssen et al. 2016). Health-care spending is known to vary with individual characteristics, such as age and sex, health status, and socio-economic status. For a given premium rebate, a voluntary deductible is likely to be more attractive for people in good health than those in poor health.

Premium rebates

Another critical determinant is the premium structure. Individuals opting for a voluntary deductible are rewarded with a premium rebate, that is, a discount on the premium paid compared to a plan with no voluntary deductible. The premium can be community rated or risk rated. A risk-averse utility maximising consumer is willing to opt for the deductible only when she faces a gain in expected utility. This is the case when the expected OOP spending due to the deductible is lower than the premium rebate offered by the insurer.

Risk-rated premiums In the theoretical case of 'complete' risk rating (RR), that is, all predictors of expenditure are used to set the premiums (i.e. there is no restriction or friction in the premium setting) the premium will perfectly reflect applicants 'expected' risk. In this case, the premium rebate that an insurer offers to the consumer is equal to the reduction in the insurer's expected costs for that consumer. This reduction has two components: (1) a shift of spending from the insurer to the consumer (i.e. the OOP payment due to the deductible) and (2) the reduction in MH. Assuming that consumers are more interested in opting for a deductible as the premium rebate exceeds their expected OOP spending, the magnitude of MHR is crucial for the attractiveness of a deductible in this theoretical setting. Under perfectly risk-rated premiums, a deductible becomes more attractive with larger MHR, ceteris paribus.

Community-rated premiums In regulated health insurance markets, such as the Swiss and the Dutch systems, premiums are typically community rated (or only partially risk rated) to ensure cross-subsidisation between high-risk and low-risk individuals. This premium setting implies that individuals who opt for the same insurance policy and deductible level face the same premium (rebate), independent of his or her risk. In a real-world scenario, the premium rebate offered by the insurer does not have two, but three components: (1) the OOP payment due to the deductible, (2) the MHR and (3) *the selection effect*.[4] Self-selection is a concept used to describe the tendency of high-risk individuals to buy more coverage than low-risk individuals in the same premium-risk group in a way that is similar to the dynamics described in the seminal work of Akerlof (1970). Referring to premium rebates, we use the term self-selection to describe the greater incentive of healthy insureds to opt for a deductible compared to unhealthy individuals, given a premium rebate level. The community-rated feature makes the voluntary deductibles particularly attractive for applicants with relatively low risk in the total population (van Kleef et al. 2006). In the presence of self-selection, the premium rebate for a voluntary deductible (which is based on the difference of the insurer's cost between the deductible and non-deductible plan) is not only affected by OOP spending and MHR, but also by the fact that people choosing a deductible are healthier than those not choosing a deductible.

Risk equalisation system In reality, regulated health insurance markets include risk equalisation. This instrument aims to reduce selection incentives by compensating insurers for differences in predicted expenditure between low-risk and high-risk indi-

[4] In health insurance systems where consumers send the bills to insurers to get reimbursed for medical services, a fourth component should be considered in the premium rebate: the reduction in administrative costs. For simplicity we do not consider this component in the analysis.

viduals (Ellis et al. 2018). Risk equalisation, however, also reduces the potential premium rebate for a voluntary deductible. The simple reason is that risk equalisation compensates insurers for the difference in healthcare spending between the relatively healthy people who opt for a deductible and the relatively unhealthy people who do not. When risk equalisation perfectly compensates for the difference in expected spending between these groups, the premium rebate will not be influenced by self-selection. Instead, the premium rebate can only consist of the MHR and OOP spending in the deductible plan compared to the non-deductible plan. When risk equalisation imperfectly compensates for the difference in expected spending between people who choose a deductible and those who do not, the premium will be influenced by self-selection (van Winssen et al. 2016).

Behavioural factors There is evidence that consumer behaviour cannot only be explained by maximising gains. People for whom the choice of a deductible would produce an expected gain (premium rebate > expected OOP spending) may not choose it. In the case of voluntary deductibles, van Winssen et al. (2015) shows that in 2014 choosing the high voluntary deductible level was profitable for 48% of the Dutch insured population. However, only 11% of the population actually chose a deductible. These findings are in line with the research by van Kleef et al. (2007) on the Swiss insurance market, where significant financial gains were not exploited by the insured.

The unexploited gains indicate that other factors affect deductible choice too. One of these factors is risk aversion: the more risk averse, the less likely consumers are to opt for a deductible in return for a given premium rebate (van Kleef et al. 2008). Other potential factors are inertia, ambiguity aversion, omission bias due to decision fatigue or transaction costs, debt aversion and liquidity constraints. For a broader description of such behavioural factors refer to van Winssen et al. (2016a, b).

Data and methods

Data

The data for this study is provided by the Superintendence of Health and consists of two years (2016–2017) of anonymised information of all enrollees of the Chilean private health insurance market, Isapres. The dataset reports information on expenditure, demographic, socioeconomic, inpatient diagnostic and plan characteristics for individuals enrolled in the system. We use a sample of individuals (N = 2,150,513) that comprises those enrolled continuously in both years of data, belonging to open insurers[5] and of adult age (> 18 years old).[6] Individual yearly data for both years are considered in the simulation. Throughout the analysis, data in $t = 1$ (2017) will be used as the dependent variables for our simulation and data in $t - 1$ (2016) will be

[5] Two types of Isapres exist: 'Isapres Abiertas' (open insurers) that individuals are free to enroll in and 'Isapres Cerradas' (closed insurers), which have a different market regime with specific rules and insure individuals from specific economic sectors and firms.

[6] We restrict the sample to adults since they are typically the purchasers of insurance coverage and we want to consider an insurance market at the individual level.

used to improve the predictive power of the models implemented. Such prospective models usually require sample exclusions of those to which records in the prior year are unavailable (Ellis et al. 2018).

Table 1 reports some descriptive statistics. The average age in the sample is 41 years with most people (50.5%) classified in the age group 18–39 and only 7.6% in the age group 80+. The enrollees in the Isapres market are relatively younger than the general population in Chile. Roughly 37% of the Isapres enrollees fall within the 20–39 age range, and around 3.1% in the + 70 group (Superintendence of Health 2017), while 31% of the whole Chilean population falls in the first age range and 7.4% in the + 70 group (Census 2017). Furthermore, in the sample, males make up 54.8% and people living in the Metropolitan Region make up 60.0%. Mean health expenditures (composed by the sum of the prices of all services consumed by the enrollees at the individual level during the year) are USD 1425.5 per year (with a standard deviation of USD 6172.7). OOP healthcare spending accounts for 35.7%. Outpatient expenditures average USD 489 while inpatient expenditures average USD 695.[7] Finally, the population seems to be fairly healthy as the largest share (95.1%) did not have any pathology (inpatient diagnosis based on hospital discharges).

Methods

The first goal of our empirical analyses is to compare the potential MHR under two premium structures (CR versus RR) with a voluntary deductible option. Our second goal is to calculate the potential premium rebates that insurers might offer in the two settings, and in the presence of risk equalisation. The method used comprises four steps. In the first step, we correct the data for spending variation due to existing differences in the cost-sharing design. In the second step, we consider three scenarios of self-selection in the deductible option. In the third step, we estimate the MHR due to the introduction of the deductible. In the fourth step, we compute the potential premium rebates, given our assumptions on sorting into the deductible, consequent OOP spending, MHR, and the risk equalisation system. Each of these steps will be explained in more detail below. In addition, we present the sensitivity analysis of our estimations.

[7] These expenses exclude GES, physiotherapy, mental health, transportation and protheses expenditures.

Table 1 Descriptive statistics

Variable	Percentage	Mean (std dev.)
Age groups		41 years old (14.9)
18–39	50.5	
40–59	36.6	
60–79	5.3	
80+	7.6	
Gender		
Male	54.8	
Female	45.2	
Cities		
Region Metropolitana	60.0	
Antofagasta and Calama	4.4	
Valparaiso, Viña del Mar, Concon	3.9	
Concepcion and Talcahuano	2.5	
Temuco	1.8	
Other	27.7	
Health expenditure 2017 (in USD)		1425.5 (6173)
Health expenditure 2016 (in USD)		1288.8 (5034)
Out of pocket		509.5 (2537)
Hospital expenditure 2017 (in USD)		695 (5199)
Ambulatory expenditure 2017 (in USD)		489 (1435)
Coinsurance rate for ambulatory coverage (%)		
0	3.5	
10	11.3	
20	37.9	
25	0.8	
30	42.4	
30>	4.0	
Coinsurance rate for hospital coverage (%)		
0	46.0	
5	0.4	
10	44.8	
15	0.4	
20	5.4	
20>	3.0	
Pathologies[a]		
0	95.1	
1	4.6	
2>	0.4	
Days of hospitalisation		0.4

[a]Ash (1989)

Step 1: Correcting the health expenditure

The current cost-sharing design is mainly composed of coinsurance rates that differ according to the plan chosen by the individuals. Given the fragmentation among insurance plans offered by the insurers in the Chilean health insurance market, the nominal cost-sharing design varies significantly (Velasco et al. 2018). The available data provides the nominal share of the cost born by the enrollees for ambulatory and hospital care, respectively (see Table 1). For ambulatory care the cost-sharing is significant since 42% of the sample chose a 30% coinsurance rate, while 38% and 11% of the sample opted for a 20% and 10% coinsurance rate, respectively. Regarding hospital care, the risk assumed decreased since 46% of the sample chose the full coverage (0% coinsurance), while 45% opted for a 10% coinsurance rate, with 6% of the population having a coinsurance rate of 20%. On average, 86% of the population has a coinsurance rate that varies between 10 and 20%. Only 3% of the sample has full coverage (0% coinsurance rate). The remaining share of enrollees faces a coinsurance rate above 30%.

This variation does not match the simpler insurance cost-sharing schedule examined in our estimations, i.e. a deductible versus a non-deductible plan. We corrected for the existing variation in consumer cost-sharing by 'reintroducing' the MH reduction from the current cost-sharing arrangements. In absence of information on the actual MH reduction, we relied on the outcomes of the RAND experiment. For comparable coinsurance rates, the RAND experiment found a 17% spending reduction compared to the free care plan (Keeler and Rolph 1988; Zweifel and Maninng 2000). To compute the corrected healthcare expenditure, we then amplify the expenses of all enrollees that chose a contract with some coinsurance rate in 2017 by 1.17. Throughout the paper we will use the corrected spending for our estimations.

Step 2: Sorting scenarios

A rational, risk-averse, individual is supposed to opt for a voluntary deductible when a financial gain is expected. The financial gain arises when the expected OOP is lower than the premium rebate offered by the insurer. Ideally, we might want to compare these two variables in order to simulate the sorting of individuals toward the deductible. A challenge here, however, is that the premium rebate is endogenous: a change in premium rebate is expected to result in a change of the population opting for a deductible, which leads to a different rebate and so on. To overcome this challenge, we follow an alternative approach which is to simply assume three 'sorting scenarios' with different degrees of self-selection.

An important input parameter of our simulation is the share of the population that would opt for the deductible. We base this parameter on the share of the individuals currently opting for some cost-sharing in the Chilean market. Specifically, we looked at the decision on hospital coverage since it represents the highest expenditure item in the market and consequently the riskiest decision for enrollees. Thus, in line with the Chilean experience where 54% of the enrollees in the Isapres' system voluntarily opts for a coinsurance rate for hospital care, we assume that 50% of the population opts for a deductible plan. For simplicity, we consider there to be a single deductible option, in contrast to the reform proposal (Ministerio de Salud 2019) where there are two options on top of full coverage.

In the next step, we make assumptions about the people who are in this 50% group. With strong selection, this 50% will consist mostly of low-risk people. With weak or no selection, it will consist of a mixture of low-risk and high-risk people. To operationalise individuals' risk we predict their spending using an ordinary least squares (OLS) regression[8] with corrected health expenditure as the dependent variable and the following factors as independent variables: age group (18–39, 40–59, 60–79, 80+), gender, the interaction between age and gender (four classes of age interacted with gender[9]), city, prior expenditure (in 2016) and the number of days of hospitalisation in 2016. The results of the regression are reported in Table 4 in the Appendix. Based on the predicted spending, we rank individuals from low risk to high risk.

More specifically, the following scenarios are constructed for our analysis:

(a) Perfect self-selection:

- CR: 50% of the population that chooses the deductible plan corresponds to the bottom 50% of predicted spending.
- RR: 50% of the population that chooses the deductible plan corresponds to the bottom 50% of predicted spending per age group.

(b) Imperfect self-selection:

- CR: 50% of the population that chooses the deductible plan is randomly selected from the bottom 70% of predicted spending.
- RR: 50% of the population that chooses the deductible plan is randomly selected from the bottom 70% of predicted spending per age group.

(c) No self-selection:

- CR: 50% of the population that chooses the deductible plan is randomly selected from the total population.
- RR: 50% of the population that chooses the deductible plan is randomly selected from each age group.

Step 3: Calculating the moral hazard reduction

In the third step, we calculate the MHR for each of the scenarios. The MHR is determined as a given percentage of the corrected mean actual spending (step 1) of those with a deductible plan. To overcome the uncertainty on how individual consumers respond to the deductible plan highlighted in the conceptual framework,

[8] Standard practice in the empirical literature to predict healthcare expenditure is to implement OLS regression (Ellis et al. 2018). With our data, OLS performed relatively better in terms of adjusted R^2 (0.197) compared to OLS with log transformation (0.129).

[9] Since the relationship between age, gender and health spending is not linear, the interaction term is used.

we simply calculate the *average* effect for the consumers in the deductible group. Looking at the average effect of the group allows us to relax some assumptions on individual consumers' response to the voluntary deductible (e.g. whether consumers are myopic or forward-looking). We introduce a deductible amount (D) that we set at USD 500.[10] For our analysis we assume the MH to be 15% of the mean corrected spending of the deductible group. This percentage is based on previous research investigating the average MHR due to voluntary deductibles. To make our analysis comparable with the findings in the literature, we use as the reference point the ratio between the deductible amount and the corrected mean actual spending. In our estimations the ratio represents less than one third of the mean spending of the sample (0.30 = USD 500/USD 1659). In the studies, the comparable deductible of CHF 600 represented a range of average healthcare expenditure of 21% to 24% (van Kleef et al. 2007; Gardiol et al. 2005), with a consequent average MHR of 15.1% to 16%, respectively. Based on these findings we assume an average 15% MHR for the estimations.

Step 4: Examining the potential premium structure

The final step of the analysis details the computation of the potential premium structure with both CR and RR, with and without the presence of risk equalisation.

For simplicity, we assume that premiums equal the mean expected spending for insurers in a premium-risk group. We refer to this as the 'insurer's mean plan responsibility' ($\overline{IPR}$). Starting from the corrected mean actual spending in a premium-risk group, the $\overline{IPR}$ for that group is constructed in two stages. First, we subtract the MHR, which is calculated as a percentage (15%) of the spending in a group. For groups without a voluntary deductible plan, the MHR equals zero (step 3 above). In the second stage, we subtract the OOP due to the deductible. To compute the OOP, as mentioned, we assume a USD 500 deductible. Those with a deductible, will be assigned the maximum OOP of USD 500 if their observed spending exceeded that threshold, while individuals whose spending did not exceed the deductible amount threshold, will be assigned their observed spending.

In our results section we will first look at the potential premium in the absence of a risk equalisation scheme. Under the CR setting, we calculate the premium $\left(P_d\right)$, only for two groups (deductible d = USD 0 and d = USD 500). This will be represented by $P_d = \overline{IPR}_d$. Under the RR setting, we calculate the premium ($P_{d,age}$) for the two deductibles options by the four age groups we use to risk rate the insurers' premiums. This will be represented by $P_{d,age} = \overline{IPR}_{d,age}$. The difference between the spending of the enrolees who choose the deductible and those who choose the full coverage indicates the potential premium rebates which might be offered by insurers.

In the second part of our results we introduce the risk equalisation scheme and the risk equalisation payments (*REP*) to detect whether attractive premium rebates can be offered in the presence of risk equalisation in the Chilean insurance market.

[10] The deductible amount is chosen based on the current average OOP expenditure in the data sample.

We represent the inclusion of risk equalisation into premiums by the following formulas:

$$P_d = \overline{IPR}_d - \overline{REP}_d \tag{1}$$

$$P_{d,age} = \overline{IPR}_{d,age} - \overline{REP}_{d,age} \tag{2}$$

In this way, after the implementation of risk equalisation, premiums equal mean plan responsibility minus the mean *REP* in a premium-risk group, where *REP* is calculated as the expected spending for an individual (that would have occurred under full insurance coverage—no deductible plan) according to the risk equalisation model minus the overall mean expected spending in the population. We assume the risk equalisation scheme is fully internally funded, which means there are no external subsidies present in the system. This implies that low-risk or low-premium individuals will see an increase in their payments when risk equalisation is implemented. The opposite situation will occur for high-risks or high-premium payers.

The risk equalisation scheme is estimated using a concurrent model (using 2017 expenses modelled on 2017 insured characteristics) through OLS regression. The dependent variable is the total spending that people would have had in case of full coverage (step 1). As risk adjustors, we use the gender variable and the pathologies' classification as specified by Ash et al. (1989). We do not use the age variable as a risk adjustor in order to avoid duplication in the prediction of the expenditure as it is already included in the premium as the discriminant for the risk.

Sensitivity analysis

As briefly summarised in the conceptual framework, the MHR from a voluntary deductible might vary depending on several dimensions (e.g. the type of the medical episode, the risk of the consumers, etc.). To check the robustness of the results from our simulation, we run two sensitivity checks varying some of the assumptions set for step 3. In the first one, we assume a different percentage of MHR for outpatient and inpatient medical episodes. In the second, we simulate two scenarios in which the MHR percentage is higher/lower according to the age of the consumers. In all checks, we keep the sorting scenarios simulated in step 2 and the methodology used to compute the MHR.

Sensitivity check 1: Inpatient vs outpatient medical episodes

Exploiting the richness of our dataset, we apply different rates of MHR to the mean inpatient and outpatient current spending of those in the deductible plan. The literature suggests that the demand elasticity for inpatient episodes is small or almost insignificant (Ellis et al. 2017; Aron-Dine et al. 2013). Duarte (2012) confirmed these findings in a natural experiment on the Isapres market in Chile.

In line with the literature, we assume a 15% MHR for outpatient episodes and a 5% MHR for inpatient episodes. We first calculate the mean of both types of

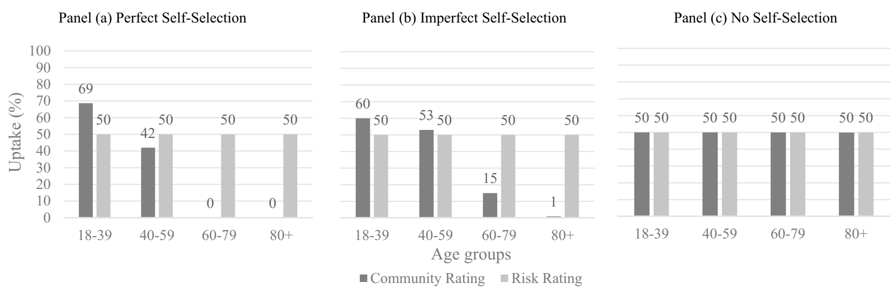

Fig. 1 Deductible uptake comparison among the three selected scenarios, by age group (%)

spending in the deductible group (and per premium-risk group) and then calculate the MHR as the 15% MHR of the mean current total outpatient expenditure and as the 5% MHR of the mean current total inpatient expenditure.

Sensitivity check 2: Young vs old consumers

In the second sensitivity check, we simulate the MHR controlling for the age of consumers (i.e. young vs old consumers). It could be possible that the two groups have a different response to the voluntary deductible. However, the literature does not provide empirical evidence to identify which of the two groups might be more (less) responsive to the deductible. Looking at the Chilean private health insurance market and controlling by the age of the enrollees, Duarte (2012) did not find any significant difference between young and old consumers. To overcome the lack of empirical evidence, we look at two alternative scenarios: one in which the percentage MHR (relative to mean spending) is lower for older groups than for younger groups, and one in which the percentage MHR (relative to mean spending) is higher for older than for younger groups. For simplicity, we assume a 15% and 5% MHR. To split our sample, we take as the reference the age groups reported in Table 1. Consumers between 18 and 59 years old are considered in the young group, whilst those above 60 years old are considered to be in the old group. If the MHR as a percentage of mean spending is lower (higher) for older age groups than for younger age groups, the conclusions of our analysis might change. If it is lower, then CR might result in a higher MHR than RR. If it is higher, then the increase of the MHR from RR compared to CR will be even bigger than suggested in our main analysis.

Results

In this section we describe the results of our estimations. In the "Sorting scenarios" section we report the distribution of insureds in the market given the scenarios considered (perfect self-selection; imperfect self-selection; no self-selection). In the " Moral hazard reduction" section, we describe the comparison between the potential

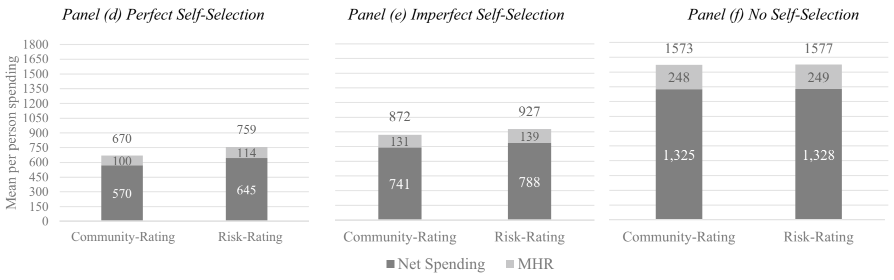

Fig. 2 Mean per person spending in the three scenarios estimated for the deductible plan, in USD

MHR under the two premium settings (CR vs RR). In the "Potential premiums and premium rebates" section we depict the premium structures under the two settings with and without the *REP*.

Sorting scenarios

The distribution of the individuals (see Fig. 1) simulated in the three scenarios (panels a, b and c) reflects the strength of self-selection assumed. We report the potential uptake comparing the CR and the RR setting by the age groups used in the RR premium setting.

In the RR setting the enrollees opting for the deductible represent 50% of the population within each age group in all three scenarios. Conversely, with the CR premium structure the share of insureds opting for the deductible varies with the level of self-selection. Indeed, when passing from the perfect self-selection scenario (panel a) to the mperfect self-lection scenario (anel b), we observe more people in the older age groups (60–79; 80+) opting for the deducible and a lower percentage of people in the youngest age group (18–39) opting for it. Overall, with the CR premium structure more people in the younger age groups opt for the deductible when self-selection holds in the market compared to the RR setting. When self-selection is absent (anel c), there is no distinction between the pools in the CR and the RR settings.

Moral hazard reduction

The magnitude of the MHR is strictly related to the amount of spending to which the deductible applies. When enrollees with relatively higher expenditure in the insurer's pool opt for the deductible plan it is reasonable to expect a larger MHR, ceteris paribus. Recalling our assumption that the MHR is simply a percentage (15%) of the average spending of those enrolled in the deductible plan, when the average spending increases, the MHR increases accordingly. In Fig. 2 the bars represent the mean spending of enrollees assigned to the deductible plan in the CR and the RR settings, for all three scenarios. We decomposed each bar into two components: (1)

Table 2 Premium structure and potential premium rebates in the community-rated setting, before and after risk equalisation

	Perfect self-selection		Imperfect self-selection		No self-selection	
	NVD	D	NVD	D	NVD	D
I. Average spending (AS)	2649	670	2448	872	1663	1656
II. Moral hazard reduction	0	100	0	131	0	248
III. Net AS = I–II	2649	570	2432	741	1663	1408
IV. Out of pocket	0	224	0	262	0	308
V. Premium = I–II–IV	2649	346	2432	489	1663	1100
VI. Potential premium rebate	2303		1943		563	
VII. Risk equalisation payment	− 356	356	− 294	294	0	0
VIII. New premium = V + VII	2293	702	2138	783	1663	1100
IX. Potential premium rebate	1591		1355		563	

NVD no voluntary deductible, *VD* voluntary deductible

the potential MHR and (2) the remaining average spending. We focus only on the deductible plans since we assumed no MHR for those in the full coverage plan.

Two main results come from Fig. 2, which directly affect the MHR. The first is that the mean spending of the enrollees who are predicted to opt for the plan with the deductible varies in the three selection scenarios assumed. Specifically, the spending in the deductible plan increases as the self-selection decreases. The MHR increases accordingly. The second is that in the case of (imperfect) selection, the RR setting leads to people with somewhat higher spending opting for a deductible compared to CR. This dynamic is in line with our theoretical consideration. Accordingly, under the assumptions made in the simulation, the former premium setting provides a larger average MHR. This applies in all three scenarios with a decreasing trend as the self-selection lowers. Indeed, the two premium settings provide similar average spending (USD 1573 and USD 1577) when self-selection is absent. The potential MHR will be similar accordingly. Overall, the difference in the MHR is not large when comparing the average (CR) and the weighted average of MHR (RR), as reported in Fig. 2. However, observing the potential average MHR per risk group in the RR setting, we report quite large values for older groups as reported in Table 2 and Table 5 in the Appendix. Considering the imperfect self-selection scenario, the average MHR for the 60–79 and 80+ age groups is, respectively, USD 213 and USD 341.

Potential premiums and premium rebates

In this section we describe the premiums that insurers may impose in the market for the deductible and non-deductible plans. As described, we assumed that premiums equal the average expected costs from the insurers' side for the two plan options, which we call *IPR* (insurer plan responsibility). The difference between the premium

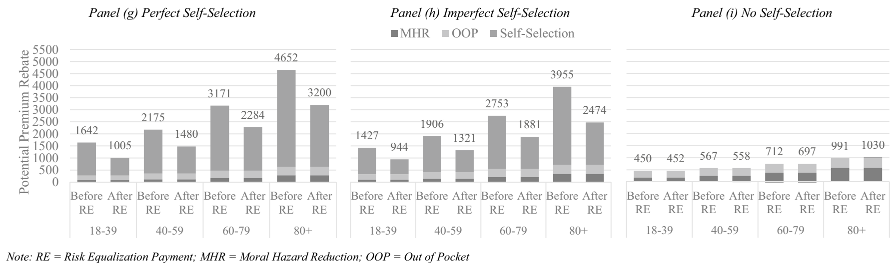

Fig. 3 Potential premium rebates in the risk-rated setting by age group, before and after the risk equalisation payment

for the deductible plan and the non-deductible plan indicates the potential premium rebates which might be offered by insurers. Recalling from the conceptual framework, an attractive premium rebate should be composed of three components: (1) the OOP payment due to the deductible, (2) the MHR and (3) the selection effect. The premium definition is equal in both premium settings. We report it for the community-rated setting in Table 2 (see the Appendix for the RR setting). In Fig. 3 we graphically show the premium rebates in the three scenarios under the risk-rated setting. We firstly analyse the CR setting and then the RR setting.

Community rating

In the CR setting the potential premium rebates are substantially larger than the deductible amount in all three scenarios, even in the presence of the risk equalisation system. Indeed, the morbidity-based risk adjustment does not completely eliminate self-selection. The results suggest that insurers can offer financially attractive premium rebates to their bottom-line spenders.

Table 2 reports the premium rebates and how they are defined (the same definition is applied to RR premiums, see Table 5 in the Appendix). We use the deductible plan with imperfect self-selection as the representative group to describe the results in Table 2. The potential premiums without the risk equalisation correspond to the IPR and are defined as the group mean spending (I) net the MHR (II) and the OOP (IV) due to the deductible (USD 489 = USD 882 – USD 131 – USD 262). The premium rebate (VI) is simply the difference between the premium for the enrollees in the deductible group and those in the non-deductible plan (USD 1943 = USD 2432–USD 489). To investigate the impact of the risk equalisation scheme on new premiums, the risk equalisation payment (VII) obtained by implementing the morbidity model is added to the premium (USD 783 = USD 489 + USD 294). The premium rebate will be the difference between the new premiums with and without the voluntary deductible.

Overall, the premium rebates decrease when self-selection decreases. The reason is twofold. Firstly, when self-selection is imperfect there is simultaneous growth of the average spending (I) for the group in the deductible (D) and a decrease for the non-deductible plan (NVD). This directly affects the premium rebate, reducing the selection component. Secondly, the reduction of the selection effect (− USD 403 = [(USD 2448–USD 872) − (USD 2649–USD 670)]) is larger than the growth of the MHR (USD 31 = USD 131–USD 100) and OOP (USD 38 = USD 262–USD 224), which are the other two components of the premium rebate. This second effect is maximised in the no self-selection scenario, where the reduction of the selection effect is at its maximum (− USD 1972 = [(USD 1663–USD 1656) − (USD 2649–USD 670)]).

The risk equalisation contributes to reducing the premium rebate within each scenario since it corrects the difference in expected spending between the groups in the two plans, lowering the selection component. Indeed, the highest *REP* is recorded when there is the maximum level of selection (USD 356).

Risk rating

Insurers can offer financially attractive premium rebates in all the scenarios even with the risk-rated setting, except for one case: the 18–39 age group in the no self-selection scenario. In this scenario the potential premium rebate is estimated to be USD 450, USD 50 below the deductible amount. In all other scenarios, the potential premium rebates computed far exceed the deductible amount for each age group considered. The gap between the potential premium of the two groups increases with age. The result is intuitive because the spending variation in high-risk groups (high-age groups in this case) is larger than in the lower-risk groups. Accordingly, the MHR and the OOP reduction are larger for these groups. All these components lead the premium rebates to be larger for the oldest groups with respect to the youngest ones.

Figure 3 reports the comparison of potential risk-rated premium rebates before and after the risk equalisation for the four age groups considered in the three scenarios (see the Appendix for the equivalent of Table 2). The bars represent the potential premium rebates for each group and are subdivided into the three components of the premium rebate: (1) MHR, (2) OOP due to the deductible, and (3) the selection effect. The premium rebates decrease when moving from perfect selection to no self-selection, ceteris paribus. This is because the selection effect represents the largest component of the premium rebate. As for the CR, when the self-selection lowers, the gap between the average spending of the two plan options decreases. For example, the premium rebate for the age group 40–59 in the perfect selection scenario without *REP* is USD 2175, it decreases to USD 1906 in the imperfect self-selection scenario and it is reduced to USD 567 in the no self-selection scenario. The selection component is also the only one affected by the introduction of the *REP*s. The risk equalisation leads to a significant reduction of this component when self-selection holds in the market. This is true especially for the riskiest groups, which see their premium rebates largely reduced. Taking into consideration the 80+ age group in the perfect selection scenario (panel g)), the premium rebate decreases by USD 1452 (USD 4652–USD 3200) after the *REP*.

Table 3 Sensitivity analysis

Age groups	Perfect self-selection				Imperfect self-selection				No self-selection			
	RR		CR		RR		CR		RR		CR	
Outpatient vs inpatient episodes												
	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In
18–39	36	10			45	13			67	27		
40–59	50	15			61	18			92	37		
60–79	67	25			81	30			117	62		
80+	90	45			107	55			149	105		
Average	47	15	45	13	57	19	57	18	85	38	85	38
Young vs old—1st scenario[a]												
18–39	81				101				183			
40–59	115				139				252			
60–79	59				71				127			
80+	94				114				194			
Average	93		100		114		129		206		205	
Young vs old—2nd scenario[b]												
18–39	27				34				61			
40–59	38				46				84			
60–79	176				213				381			
80+	282				341				583			
Average	58		33		71		45		126		126	

RR risk rating, *CR* community rating

[a]In the first scenario a 15% MHR is applied to the mean current expenditure of consumers in the young group (18–59 years old); a 5% MHR is applied to the mean current expenditure of consumers in the old age group (60 + years old)

[b]In the second scenario a 5% MHR is applied to the mean current expenditure of consumers in the young group (18–59 years old); a 15% MHR is applied to the mean current expenditure of consumers in the old age group (60 + years old)

Sensitivity analysis

The results of the sensitivity analysis are reported in Table 3. We implemented two sensitivity checks on the assumptions made for step 3 of our main analysis. In the first check, we applied different rates of MHR to the inpatient and outpatient mean actual spending of those assumed in the deductible plan. In the second, we applied different rates of MHR to young and old consumers.

Overall, the checks confirm the overall MHR increases as the self-selection decreases. Instead, we found weaker evidence that in the case of (imperfect) selection the risk-rated setting leads to people with somewhat higher spending opting for a deductible compared to CR. Indeed, when comparing outpatient and inpatient medical expenditure, we still found evidence of a potential higher effectiveness of

RR premiums to attract higher spenders, but the difference in the overall MHR is minimal compared to CR (USD 2 per person in the perfect self-selection scenario for both inpatient and outpatient care, whilst only USD 1 per person in the imperfect self-selection scenario for the outpatient care). We found a relevant difference applying different rates of MHR to young and old consumers. When we assume higher responsiveness for people in the young age group (18–59 years old), the results suggest that, with some level of self-selection, the CR is more effective with a voluntary deductible to increase the MHR. Conversely, when we assume the higher responsiveness for the consumers in the oldest group (60+ years old), the RR setting is more effective at increasing the MHR.

Conclusion and discussion

This paper investigated the interaction between the premium regime (CR vs RR) and voluntary deductibles when estimating MHR under the two premium settings. In addition, we examined the premium structures in these two scenarios with and without risk equalisation.

The simulation is based on the theoretical assumption that, compared to CR premiums, RR premiums are likely to increase take-up of voluntary deductibles among people with moderate or higher risk. As a direct consequence, the spending in the deductible group will be larger and, with larger spending, there is more potential for the deductible to reduce moral hazard, ceteris paribus. We tested this assumption with data from Chile. The outcomes of our empirical simulation show that in the presence of self-selection, RR premiums can lead to a higher MHR. The direction of the results is therefore in line with our expectations. Nevertheless, the result will likely depend on the assumptions set in the simulation and what will occur in practice, as well as the characteristics of the data being used. Our sensitivity check shows that when we change the assumptions then the magnitude might decrease or we can observe no differences. However, our simulation is run on individuals enrolled in the private health insurance market that are relatively healthier and younger compared to the general Chilean population. If higher-risk individuals would join the system, we can expect that the average difference in MHR between the two premiums setting would be larger and strengthen the results of our simulation.

Regarding the premiums, the estimations show that insurers can offer substantial and attractive premium rebates, also in the presence of risk equalisation, for all the scenarios (and premium risk-groups), except for the 18–39 age group in the no-self selection scenario. In absolute terms, the premium rebate between the non-deductible and deductible plan decreases when self-selection is lower in the market. With RR, the magnitude of self-selection increases with age. Accordingly, the potential premium rebates are larger in the older age groups than in the younger ones.

The estimations rely on a series of assumptions related to the sorting of the population in the market, the MHR and the level of the premiums. The first refers to the share of the population choosing the deductible plan. A risk-averse utility maximising consumer is supposed to opt for a voluntary deductible when he faces a gain in expected utility, that is, the expected OOP is lower than the premium rebate offered by the insurer (van Kleef et al. 2006). The endogenous relationship between premiums and deductibles represented a challenge in our analysis: a change in premium rebate is expected to result in a change in the population opting for a deductible, which leads to a different premium rebate and so on. We implemented a pragmatic approach to overcome this limitation by 'simply' defining a series of 'sorting scenarios' with different degrees of self-selection. In an ideal world, we might want to compare all the parameters listed in the conceptual framework under behavioural factors in order to take into consideration all the dimensions which affect the choice of the insureds.

A second assumption concerns the level of the MHR. A significant variation surrounds the effect (magnitude) of deductibles on individuals' spending, enhancing the uncertainty in the literature. To be as close as possible to the literature, we made a simple assumption considering a percentage MHR that reflects the average effects of voluntary deductibles at the group level, in line with similar papers from other insurance settings. Specifically, we assumed a 15% MHR of the mean spending of people that opt for the deductible based on previous studies (van Kleef et al. 2006; Gardiol et al. 2005) that share similar features with our estimation. The estimations are not aimed at detecting the *exact* magnitude of the MHR, rather, they aim to shed light on which premium setting might be more efficient; any rate of MHR can be used by the reader without altering the conclusion displayed in the analysis. For future research, it might be interesting to refine this assumption and simulate the MHR at the individual level. However, it is challenging as researchers will need much more information about the differences in this response across consumers that is not available in the literature yet. For example, researchers need to know whether consumers are myopic or forward-looking and if there are any differences in forward-looking or myopic consumers among risk types (e.g. healthy vs high-risk consumers, young vs old consumers, well educated vs poorly educated consumers, etc.) or among medical episodes.

A third assumption is also worth underlining. The premium rebates presented in the analysis are *potential* premium rebates that insurers may impose and do not represent exact premium rebates that could be implemented. Indeed, they are far larger than the deductible amount, confirming the previous findings of van Kleef (2006) in the Swiss health insurance market. The magnitude of the premium rebates estimated may affect our assumptions on the population sorting. Nevertheless, even in this case our aim is not to estimate the *exact* magnitude of the premium rebates but to investigate the potential for insurers to offer financially attractive discounts in the presence of risk equalisation. It is also important to underline that we did not consider loading fees and additional costs insurers may impose upon premiums, or the reduction in administrative costs in the simulation analysis (Bakker et al. 2000).

Our results are not only relevant for Chile, but also for other countries with social health insurance systems that rely on premium regulation such as the Netherlands, Switzerland, the U.S., Germany (McGuire and van Kleef 2018), Australia, Chile and New Zealand (Armstrong and Paolucci 2010; Radermacher et al. 2016; Henriquez et al. 2019; Velasco et al. 2018). It is well-known that some RR can help overcome risk selection by consumers and insurers (van Kleef et al. 2006, 2008;

Kifmann 2002). We provide another potential benefit from allowing (some) RR in social health insurance systems: in systems with a voluntary deductible, RR can lead higher risk enrollees to opt for a deductible resulting in a larger MHR than under community-rated premiums. Our findings imply that regulators should consider voluntary deductibles, premium regulation and risk equalisation in combination, rather than in isolation.

Appendix

See Tables 4 and 5.

Table 4 Regression on total health expenditure—OLS

Independent variables	Total expenditure	CI
Gender		
Male	−288.15***	[−318.8; −257.5]
Age group		
40–59	135.12***	[109.1; 161]
60–79	422***	[353.5; 490.5]
80+	890***	[801; 977.4]
Age-gender		
40–59*Male	104.2***	[75.4; 133]
60–79*Male	370***	[275.4; 465]
80+*Male	689.6***	[581; 798]
Cities		
Santiago		
Antofagasta y Calama	−145.8***	[−191.4; −100.3]
Viña, Valparaiso, Concon	−152.4***	[−201.5; −103.2]
Concepción y Talcahuano	−209.4***	[−262.9; −156]
Temuco	−203.8***	[−259.4; −148.2]
Other	−260.5***	[−287.3; −233.7]
Other covariates		
Days of hospitalisation (2016)	29.85*	[7.06; 52.63]
Total expenditure (2016)	0.604***	[0.54; 0.665]
Constant	577.9***	[531.6; 624.1]
Observations	2,150,513	
R^2	0.197	

95% confidence intervals in brackets. *Source* Authors' own Elaboration

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Table 5 Premium structure and potential premium rebates in the risk-rated setting, before and after risk equalisation

18–39 age group	Perfect self-selection		Imperfect self-selection		No self-selection	
	NVD	D	NVD	D	NVD	D
I. Average spending	1904	537	1771	670	1216	1225
II. Moral hazard reduction	0	81	0	101	0	183
VI. Out of pocket	0	194	0	225	0	276
VII. Premium = I–II–VI	1904	262	1771	344	1216	766
VIII. Potential premium rebate	1642		1426		450	
IX. Risk equalisation payment	−219	414	−144	339	98	96
X. New premium = VII + IX	1683	678	1627	683	1314	862
XI. Potential premium rebate	1005		944		452	
40–59 age group	NVD	D	NVD	D	NVD	D
III. Average spending	2585	765	2421	930	1672	1678
IV. Moral hazard reduction	0	115	0	139	0	252
VI. Out of pocket	0	240	0	276	0	321
VII. Premium = III–VI	2585	410	2421	515	1672	1005
VIII. Potential premium rebate	2175		1906		567	
IX. Risk equalisation payment	−341	354	−286	299	2	11
X. New premium = VII + IX	2244	764	2135	813	1674	1116
XI. Potential premium rebate	1480		1321		558	
60–79 age group						
I. Average spending	3869	1174	3625	1418	2502	2540
II. Moral hazard reduction	0	176	0	213	0	381
VI. Out of pocket	0	300	0	333	0	369
VII. Premium = III–VI	3869	698	3625	872	2537	1790
VIII. Potential premium rebate	3171		2752		712	
IX. Risk equalisation payment	−630	257	−622	250	−193	−178
X. New premium = VII + IX	3239	955	3003	1123	2309	1612
XI. Potential premium rebate	2284		1880		697	
80+ age group	NVD	D	NVD	D	NVD	D
V. Average spending	5898	1879	5507	2270	3891	3886
VI. Moral hazard reduction	0	282	0	341	0	583
VI. Out of pocket	0	351	0	377	0	403
VII. Premium = III –VI	5898	1246	5507	1552	3891	2900
VIII. Potential premium rebate	4652		3954		990	
IX. Risk equalisation payment	−1271	181	−1285	196	−525	−564
X. New premium = VII + IX	4627	1427	4222	1748	3366	2336
XI. Potential premium rebate	3200		2473		1030	

NVD no voluntary deductibe, *VD* volumtary deductible

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Data availability Available upon request at the Superintendencia de Salud de Chile.

Code availability Available upon request.

Declarations

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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