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Mathilde Péron

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Three essays on Supplementary Health Insurance

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Remerciements ~ Thanks

Pour écrire une thèse il faut trois choses : du travail, de la persévérance ... et du travail¹². Pour dire vrai, il faut bien plus que ça.

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¹d'après mon Papa, qui tient cela de Rocky, le coq volant dans Chicken Run

²si j'ai dit deux fois travail c'est qu'il faut deux fois plus de travail que de persévérance

Les mamans ça vous apprend plein de trucs, ça vous emmène en ballade, vous ramène à la maison quand la péniche tangué trop fort. De près ou de loin, elles gardent toujours un œil sur vous. Moi j'ai la chance d'en avoir cinq ou six des mamans... Et quand je serai grande, je ferai tout comme elles. Fanny, Cham, Aurore Schilte, Blan, Emilie... voilà, l'Enfant a enfin fini ses devoirs... Je peux aller jouer maintenant ?

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³...et des Jockey® gratos

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General Introduction

Health insurance plays a central role in funding medical care. It protects people against catastrophic medical expenditures that they could not afford without insurance coverage. Health insurance also contributes to reduce medical expenditures' impact on individuals' budget and mitigates the vicious circle between income and health when poor health results in poverty, and access to care is limited by income.

Designed to favor access to care, social health insurance systems ensure minimal coverage for a large proportion of the population and are widespread among developed countries. However, because of greater use of medical services and technology changes, healthcare expenditures grow faster than nations' GDP and put public finances under severe strain. Rather than increasing contributions, the chosen option is often to limit the perimeter of coverage either in terms of population, price or type of medical goods and services covered. This creates space for the development of a market where individuals can buy supplementary health insurance to enhance their coverage. A private market providing supplementary coverage is a mixed blessing. On the one hand, it releases public constraints, allows people to opt for the plan that is best for them and gives insurers incentives to increase efficiency and quality. On the other hand, supplementary insurance might create difficulties as regards efficiency of the healthcare system as a whole and fairness in access to care. First, if individuals increase their consumption in terms of quantity and/or quality due to a better coverage, supplementary insurance can contribute to the exponential growth of healthcare expenditures. The fact that supplementary coverage is voluntary can worsen the inflationary effect if those who decide to buy insurance are actually those who get the most from it and increase more sharply their demand for healthcare. Second, contrary to most common goods, like cars or computers, health insurance price can depend on

individuals' characteristics, especially their age, gender or health status. Competition also leads insurers to select individuals with lower expected healthcare expenditures. Consequently, providing supplementary insurance in a competitive market is likely to result in strong inequalities in the extent and the price paid for coverage and eventually the price paid for healthcare.

This thesis deals with questions regarding efficiency and fairness in mixed health insurance systems with partial mandatory coverage and voluntary supplementary health insurance. We focus on the potential inflationary effect of supplementary insurance on prices of medical services that are jointly covered by both mandatory and supplementary insurance. We also question, from the patient perspective, the fairness of supplementary insurance premiums when supplementary health insurance is voluntary. We adopt an empirical approach and set our analysis in the French context where mandatory insurance is universal yet partial and individuals can enhance their coverage by buying supplementary coverage in a competitive market. Our empirical analysis is performed on original individual-level data, collected from the administrative claims of a French insurer (Mutuelle Générale de l'Éducation Nationale, MGEN). The sample is made of 99,878 individuals observed from 2010 to 2012. Contrary to existing data in France, our database provides healthcare consumption and reimbursements from both mandatory and supplementary coverage.

Our analysis focuses on the relationship between individuals and insurers; precisely on individuals' choice of coverage, healthcare use and the price of insurance contracts. We do not address other issues raised by health insurance systems such as production of healthcare or relationships between insurers and care providers (see Cutler & Zeckhauser (2000) for an overview). As regards insurance design, we do not question the optimal size of public and private coverage neither co-insurance optimality. Also, regulation issues on the health insurance market such as the implementation of risk adjustment schemes are not examined in this thesis. Although our results give insights on the role of supplementary insurance on access to care, we do not directly estimate the effect of health insurance on health.

The general introduction is organized as follows. First, we characterize health insurance systems, define important concepts and further discuss the inefficiencies and inequalities created by a voluntary supplementary health insurance. We then present the main objectives of our thesis

and our methodology. Finally, we summarize the questions, methods and results of our three chapters.

Health insurance triad: mandate, premiums and benefit package

Health insurance systems can appear as diverse and complex. We first discuss the distinction between public and private insurance and then focus on three features of health insurance schemes: whether insurance is mandatory or voluntary, the way premiums are defined and finally the benefit package design.

Public, private and mixed health insurance systems

A classical taxonomy of health insurance would oppose public and private systems even if the distinction is not always straightforward. Colombo & Tapay (2004) propose a classification based on the source of funding; public insurance would refer to insurance schemes financed through taxation or payroll contributions whilst private insurance would imply that insurance schemes are financed through private premiums paid directly to the insurer. Consequently, systems where insurance is mandatory but provided by not-for-profit sickness funds or commercial companies would be classified as private. Yet, Germany, the Netherlands or Switzerland have adopted a form of ‘managed competition’, as defined by Enthoven (1993), where individuals are free to choose their insurer, yet insurance remains mandatory, the standard benefit package is standardized, premiums are uniform or income-based and insurers cannot refuse coverage. Which, in the end, make these systems very similar to a public system funded by taxes or payroll contributions. Furthermore, from the individual point of view, the way contributions to insurance are collected, by the government, their employer or an insurance company, does not really matter. We argue that what matters is whether insurance is mandatory or voluntary, to which extent contributions depend on health risk or income and whether the benefit package is standardized.

Because we do not adopt an institutional perspective but rather focus on the relationships between individuals and insurers, our description of health insurance schemes departs from the

taxonomy by Colombo & Tapay (2004). First, we do not distinguish between taxes, social contributions and direct payments and rather use ‘premium’ as a generic term to refer to the payment made by individual to be insured. We will discuss thoroughly health insurance premiums’ definition further in this section. Second, we define as ‘public insurance’ insurance schemes where insurance is mandatory, premiums are regulated, i.e. insurers cannot freely set their prices, and the benefit package is standardized. Public insurance can be organized by a single payer (French *Sécurité sociale* or Medicare in the USA), a public provider of healthcare as in the UK, or through managed competition as in Germany, the Netherlands or Switzerland. By contrast, ‘private insurance’ refers to voluntary insurance provided on an unregulated competitive market where insurers freely design their contracts in terms of prices and coverage. In practice, systems where healthcare expenditures are only funded through public or private insurance are rare, and the two sources of funding usually coexist in what is called a mixed health insurance system.

In mixed systems where public insurance finances the main part of health expenditures, the private health insurance market can assume different roles. It can be a substitute to public coverage: individuals can opt out from the public scheme and purchase coverage on a private health insurance market, as it is the case in Germany for high income groups and civil servants. When public coverage is universal but partial, households can limit their out-of-pocket expenses by contracting private health insurance. Mossialos & Thomson (2002) make a distinction between complementary and supplementary coverage. A complementary coverage is meant to cover co-pays or goods and services not covered by public insurance whilst supplementary coverage rather enhances patients’ choice and access to higher quality of care. We argue however that most of private insurance contracts have both features and ultimately aim at increasing coverage compared to mandatory basic insurance. We therefore choose not to distinguish in our analysis between complementary and supplementary coverage. We also consider as supplementary coverage private insurance contracts that ‘duplicate’ public insurance (Colombo & Tapay 2004, Vera-Hernández 1999). In the UK, Spain, Italy or New-Zealand for instance, individuals still have to contribute to public funding but they can buy private insurance to access higher quality care and avoid waiting lists. In this specific case, public and private insurance are in competition as regards basic healthcare coverage. This feature has important implications espe-

cially when one wants to estimate the impact of private coverage on public expenditures which depends on whether individuals decide to use private insurance as a substitute or a complement. As regards our main questions however, we rather focus on the supplementary feature, i.e. whether private insurance increases coverage compared to public insurance. To sum up, when considering mixed health insurance systems with partial public coverage and voluntary private insurance we use the term ‘National Health Insurance’ (NHI) to refer to basic coverage (mandatory with regulated premiums and a standardized benefit package) and ‘Supplementary Health Insurance’ (SHI) to refer to insurance contracts which complement and/or supplement NHI coverage.

Mandatory vs. voluntary

When insurance is mandatory, individuals are enforced by law to contribute to the NHI scheme and/or buy coverage on a private health insurance market. The mandate can be universal but specific groups can also be allowed to opt out (high-income individuals for instance). It is worth noting that the mandate can also concern employers by compelling them to provide health insurance coverage to their employees. When insurance is voluntary individuals are free to buy insurance or remain uninsured (and employers are free to provide coverage to their employees as a fringe benefit). This does not necessarily mean however that policy makers are not concerned by universal access to insurance. Vouchers for low-income individuals, tax exemptions or tax penalties can be used as incentives to maximize coverage in the population even when insurance is voluntary.

Health insurance premiums

As stated previously, we define a health insurance premium as a payment made by an individual (either because it is mandatory or voluntary) to an insurer (either public or private) in order to be covered against healthcare expenditures. The payment is made ex ante, i.e. before individuals actually use healthcare. In this respect it differs from ex post payments that directly depend on healthcare consumption such as out-of-pocket expenditures. It is worth noting that here, ex ante and ex post respectively refer to before and after healthcare use rather than before and after the realization of a health risk. This approach may not be conventional regarding the

theoretical literature on insurance but is meant to be more pragmatic. Indeed, an individual can be diagnosed with cancer (the health risk is realized) but her use of healthcare is still uncertain and, from this perspective, the premium remains an ex ante payment. A consequence of making an ex ante payment is that the individual does not bear her own risk of having healthcare expenditures but shares it with others. By paying a premium, the individual joins a ‘pool’ and agrees that her contribution will be used to finance the pool’s healthcare expenditures. As a matter of fact, health insurance always implies a form of ex post redistribution, e.g. low users of medical care will subsidize high users. Health insurance therefore differs from ‘self-insurance’ for which healthcare expenditures are financed through saving or borrowing.

However, the extent of risk sharing can dramatically vary depending on how premiums are defined and especially to which extent premiums are disconnected from individual characteristics. Two practices are commonly opposed: ‘community rating’ and ‘actuarial fairness’. Community rating (CR) implies that premiums are disconnected from the individual’s own risk. On the contrary, actuarial fairness requires insurers to use all information available at the individual level to predict the individual’s expected healthcare expenditures. However, in between those two principles, one can draw a continuum of premiums, based on a decreasing risk sharing from CR to actuarial fairness. The purest form of CR would be a uniform premium. A uniform premium is a flat fee, i.e. an equal contribution in absolute terms, paid by individuals regardless of their own risk. The premium therefore depends on the expected average expenditures of the whole pool and risk sharing is maximized. Further on the continuum, ‘adjusted community rating’ basically establishes a uniform premium among a restricted pool of individuals who share characteristics that define their risk profile: age, gender, location and so on. However, as soon as the criteria used to adjust for risk become more and more precise, the pool shrinks and risk sharing is reduced. The way premiums are defined is then getting closer to actuarial fairness principles. Indeed, besides socio-demographic characteristics, insurers will use all information available to estimate individuals’ risk, especially current and previous health state (known as ‘medical underwriting’) or healthcare expenditures from the previous years (‘experience rating’).

Contributions based on income stand apart from this continuum because income is not used by insurers to set premiums closer to individual risk. Motivations are related to concerns about

how premiums weight on individuals' income. When insurance is mandatory, a premium disconnected from income would make the poor contribute relatively more than the rich ('regressive payments'). When insurance is voluntary, the possibility that the poor remain uninsured and restrain their use of healthcare is an additional concern. It is important to note that even if income-based premiums are widespread in European social health insurance systems, they are not necessarily associated with public insurance (the Swiss system is financed through adjusted CR) nor antagonist with private health insurance (in France, several not-for-profit health insurers still make premiums depend on income). In mixed health insurance systems, an individual can pay different premiums. In France for instance, individuals contribute to public insurance with income-based premiums but purchase voluntary SHI with premiums which generally increase with age.

In practice, the way premiums are defined can be influenced by various factors. First, regulation can limit insurers' ability to freely set their prices. For instance in the EU, anti-discrimination laws ban gender-based premiums; in the USA, the Affordable Care Act bans medical underwriting. Second, premiums can reflect insurers' strategies or ethical principles. However, two main features of the health insurance scheme strongly influence how insurers define their premiums: whether insurance is mandatory or voluntary and the intensity of competition between insurers. It is difficult for an insurer to set premiums under CR principles when the competition attracts low-risk individuals with premiums adjusted on individual risk. The *mutuelles* in France as well as the Blue Cross and Blue Shield in the USA used to set uniform premiums mainly for ethical reasons but the intensification of the competition in the individual market have almost condemned pure CR.

Benefit package design

The extent of risk sharing in health insurance also depends on the extent of coverage, i.e the perimeter of the 'benefit package'. The benefit package is a three dimensions concept which includes (i) the list of medical goods and services covered, (ii) the population covered ('universal' or 'specific') and (iii) the extent of coverage in terms of reimbursed costs ('complete' or 'partial'). The list of medical goods and services included in the benefit package as well as criteria used to justify their coverage can be more or less explicit. Whether it concerns the whole package or

a specific treatment, coverage can also be conditional on individual characteristics such as age, health state or income. For instance, the Medicare program in the USA only covers individuals over 65, whereas the Medicaid program mainly covers very low-income individuals. Finally, coverage can be universal yet partial, meaning that insurance reimbursements do not cover the total cost of healthcare. These ‘co-payments’ between insurers and patients can take different forms: a deductible on the total of expenditures meaning that insurance reimbursements only start after a certain threshold; or, for a specific treatment a part of the cost, either expressed as a fix amount or a percentage, is not reimbursed. These co-payments are directly borne by patients and form ‘out-of-pocket’ (OOP) expenditures. OOP expenditures are simply the difference between the total cost of healthcare and insurance reimbursements. In several health insurance systems, especially in Germany and Switzerland, OOP expenditures are capped to ensure that payments related to healthcare do not weight too much on households’ budget.

It is difficult to describe precisely the benefit package of a specific country, especially in mixed health insurance systems. Indeed, a public benefit package usually coexists with a myriad of private healthcare package depending on whether individuals are privately insured or not and with which type of contract. Indeed, individuals can purchase SHI to upgrade the basic benefit package either by getting coverage on co-payments or by adding medical goods and services that are not covered at all by NHI.

Inefficiencies and inequalities in mixed health insurance systems with voluntary SHI

Theoretically, mixed health insurance systems are supposed to take the best from both public and private sides and reconcile equity and efficiency. A mandatory NHI ensures that individuals have financial access to essential healthcare and that their contribution does not weight too much on their available income. The private market, by offering voluntary supplementary coverage, allows individuals to express their preferences. Moreover, competition in the private health insurance market should guarantee productive efficiency by reducing costs and encouraging innovations. Unfortunately, this ideal picture ignores the specificity of health insurance. In the absence of a strict regulation, risk selection and moral hazard phenomena create inefficiencies

on both public and private sides and endanger the founding equity principles carried by social health insurance systems.

Inefficiencies

Mixed health insurance systems suffer from two types of inefficiencies. The first source of inefficiency is specific to the effect of risk selection in a competitive health insurance market and has a strong impact on premiums and access to SHI. The second source of inefficiency comes from moral hazard in a context where interactions between mandatory NHI and voluntary SHI are likely to create an increase in medical prices.

Increasing premiums and partial coverage: the adverse selection phenomenon

The health insurance market is subject to self-selection with individuals choosing the contract that maximizes their utility. For the same level of risk aversion, ‘low risk’ individuals, who expect rather low medical care expenses, should have a lower willingness to pay for insurance contracts than ‘high risk’ individuals. In a theoretical framework with perfect information, insurers are able to separate low risk from high risk individuals and price their contracts with actuarial premiums which depend on individuals’ expected expenditures. This would guarantee allocative efficiency in the market with coverage choices driven by individuals’ willingness to pay. In reality, the insurance market suffers from asymmetric information that yields adverse selection (Akerlof 1970). Individuals know their own risk but this information is private. Therefore, insurers are only able to price their contract with a uniform premium based on the pool’s average expenses and have to take into account strategic behaviors. If complete coverage is available with a premium based on low risk’s expected expenditures, high risk will also buy insurance and insurers will lose money. On the contrary, if premiums are based on high risk’ expected expenditures, low risk will not buy insurance. Rothschild & Stiglitz (1976) demonstrate that, when individuals have a better knowledge of their risk than insurers, low risk are only partially covered and the market equilibrium is Pareto dominated.

However, because they have access to rich data and complex statistical models, insurers are likely to have more accurate information on individuals’ risk than individuals themselves. When

asymmetric information benefits to insurers, Henriot & Rochet (1999) show that they can use their knowledge to offer contracts that attract low risk at the expense of high risk either by lowering premiums or segmenting contracts. Cutler et al. (1997) reach the same conclusion by considering the dynamic consequences of adverse selection. To maximize profit, insurers offer a set of contracts with different levels of coverage. Adverse selection, as described by Rothschild and Stiglitz yields low risk to buy partial coverage (plan P) whilst high risk remain with complete coverage (plan C). Yet, the equilibrium is unstable. If the premium gap is significant between plans P and C, individuals with the lowest risk among plan C will join plan P to benefit from lower premiums. Because of this loss, the pool's average expenses in plan C will increase, driving up premiums too. The premium gap between the two contracts keeps on enlarging and speeds up the loss of individuals with lower risk from complete to partial coverage. Eventually, this 'death spiral' condemns comprehensive plans and yields partial coverage for individuals with high medical expenditures.

Increasing medical prices: supplementary health insurance and moral hazard

The second source of inefficiency is peculiar to mixed health insurance systems. The economic rationale for partial mandatory coverage is to contain moral hazard. Indeed, health insurance lowers the price of medical care faced by patients. Assuming that demand for medical goods decreases with prices, individuals are likely to increase their consumption. According to Pauly (1968), this over-consumption is inefficient because the social marginal cost of healthcare exceeds individuals' marginal utility. The dynamic consequences of moral hazard also yield inefficiencies by increasing medical prices and eventually insurance premiums (Feldstein 1970, 1973, Sloan 1982, Chiu 1997, Vaithianathan 2006). Blomqvist & Johansson (1997) therefore conclude that a mixed health insurance system is less efficient than an unregulated competitive market or a NHI. There is however an alternative interpretation of moral hazard by Nyman (1999). Nyman considers moral hazard not only as a pure price effect but also as an income effect which traduce better access to care. Thanks to insurance, which can be interpreted as an income transfer conditional on the use of healthcare, individuals can have access to medical goods that were otherwise unreachable considering their budget constraint. Non-desirable price effects must therefore be balanced with desirable income effects that enhance social welfare by improving

healthcare access. Yet, regardless of how we interpret moral hazard, a mixed system loses on both sides. On the one hand, if moral hazard has to be contained, supplementary coverage would cancel out the effect of co-payments and be responsible for over-consumption and inflationary spirals on prices and premiums. On the other hand, if the increase in medical care consumption is desirable because it means better access to care, then co-payments cannot be justified by any economic rationale especially if voluntary supplementary coverage only benefits rich and healthy individuals who had already access to care anyway.

Indeed, voluntary supplementary coverage necessarily implies some self-selection phenomena likely to worsen inefficiencies. Pauly (2000) investigates the American Medigap market, where private insurers provide supplementary coverage for individuals over 65 who benefit from partial coverage with Medicare; the Medicare/Medigap system is in this respect very similar to the French system. Pauly notes that not only rich individuals are more likely to buy SHI, they are also more likely to consume medical goods in higher quantity and quality. Moreover, inefficiencies can also arise from a phenomenon of ‘selection on moral hazard’ in the SHI market. Indeed, independently of income, expected expenditures or risk aversion, Einav et al. (2013) show that individuals who are very sensitive to prices and therefore more likely to increase their consumption once they are insured, are also more likely to ask for comprehensive coverage. As a result, they drive up healthcare prices and SHI premiums. This eventually results in an increase in OOP expenses for individuals without coverage and makes SHI even more essential but also less affordable for low income and/or sick individuals.

Seminal contributions by Arrow (1963), Pauly (1968), Phelps & Newhouse (1974), Manning et al. (1987), Nyman (2003) have extensively analyzed the moral hazard phenomenon. Yet, it benefits from a renewed interest in the context of voluntary SHI. First, moral hazard can concern both the quantity and the quality of medical goods. Second, it creates spill-over effects on the public system which also bears the increase in medical prices. Finally, moral hazard is likely to be heterogeneous among individuals and related to selection phenomena when insurance is voluntary. Therefore, it is critical to open the moral hazard ‘black-box’ to understand the effect of SHI on medical prices and access to care.

Inequalities in SHI coverage

A voluntary SHI, provided by insurers who compete on an unregulated market, creates inequalities in terms of access, coverage and premiums paid. These inequalities can be related to individuals' income, occupation, gender, age or health state and are likely to be cumulative.

In France, the proportion of individuals covered by SHI significantly increases with income. Despite public programs targeting low-income population, 14.3% of individuals with a monthly income below €650 declared to be uninsured in 2014. They were only 1.6% with a monthly income above €2000 (DREES 2016). Similar pro-rich inequalities in SHI access have been stressed out in Switzerland (Dormont et al. 2009), in the UK (Jones et al. 2006), in Belgium (Schokkaert et al. 2010) as well as on the Medigap market in the USA (Fang et al. 2008). There are mainly three reasons for these inequalities. The first reason is specific to France where employees with a permanent and full-time job have an easier access to SHI through subsidized employer-based contracts. Note that, on top of unequal access to SHI in terms of income, this situation also enlarges the gap between 'insiders' and 'outsiders'. Insiders, integrated to the labour market, probably wealthier and healthier, have an easier access to insurance coverage whereas outsiders – students, unemployed and pensioners – likely to have tighter budget constraints and/or higher medical needs have to buy insurance on the individual SHI market. Second, in the individual market, premiums rarely depend on income which makes payments regressive: the share of income dedicated to SHI premium can represent only 2.9% of the wealthiest households but up to 10.3% for the poorest (Kambia-Chopin et al. 2008). Finally, independently of affordability concerns, the willingness to pay for SHI possibly increases with income. At first glance, this seems contradictory with a commonly assumed decreasing risk aversion with income. However, as noted by Dormont et al. (2009), SHI also includes coverage for high quality medical goods (private room in hospital, shorter waiting lists or fancy glasses) for which high-income groups are likely to have higher willingness to pay.

Inequalities in SHI access and premiums paid also arise when insurers use individuals' characteristics to price their contracts. For instance, age is a good predictor of medical expenditures and age-based premiums are easy to implement. Insurers therefore offer contracts for which premiums can vary with a ratio of 1 to 3 depending on age. This obviously creates inequalities

in terms of premiums paid between younger and older age groups and has immediate consequences on access to SHI and level of coverage. According to a French survey conducted in 2013 (DREES 2016), among the 60+ age-group, 40% of SHI policyholders benefits from a very basic supplementary coverage (co-payments only, no balance billing coverage and limited coverage on dental and optical care) versus 29% among the 25-59 age group. On average, individuals over 60 are also less covered on every type of medical care: the average coverage for specialist consultations is €13, versus €18 for the 25-59 age-group; coverage for complex optical devices is also 20% lower for the 60+ age-group compared to the 25-59. Residential location, family composition, gender or medical history can also be used to price contracts leading to the same kind of inequalities.

As stated previously, selection phenomena can also yield inequalities in coverage related to individuals' health state. It is worth noting that theoretical predictions about adverse selection in insurance – e.g. higher risk individuals should seek for more comprehensive coverage – are not always verified on the SHI market. Indeed, several empirical studies focusing on SHI markets, either in the USA, in Australia or in the Netherlands, report 'advantageous selection' (Fang et al. 2008, Buchmueller et al. 2008, Bolhaar et al. 2008): healthier individuals are more likely to buy insurance. This can be partly explained by institutional settings (employer-based contracts for instance) or correlations between income, risk aversion and health. Especially, Hemenway (1992) argues that advantageous selection can occur if highly risk-averse individuals are both more likely to buy insurance and to make efforts to reduce their health risk. Advantageous selection can also be the result of successful cream-skimming strategies from insurers who attract individuals with lower risks. As a result, when insurance is voluntary, wealthier, younger and healthier individuals are likely to get more comprehensive insurance coverage than the poor, old and sick.

Because unequal insurance coverage eventually means unequal medical prices faced by patients, the measure of a causal impact of SHI coverage on healthcare inequalities is incontestably of interest. Yet, it is difficult to evaluate SHI impact empirically. Several papers identify significant correlations between SHI coverage and healthcare consumption. In France, individuals with SHI tend to visit specialists more often (Buchmueller & Couffinhal 2004). Van Doorslaer et al.

(2004) confirm that in France, Switzerland, Ireland and the UK, a significant part of pro-rich inequity in healthcare use is linked to private health insurance. However, the positive correlation between private insurance and healthcare use does not necessarily mean that SHI encourages medical consumption. Indeed, selection effects are likely to explain a significant part of the correlation. Nevertheless, Jones et al. (2006) use individual data from four different countries (Italy, Portugal, Ireland and the UK) and show that even when controlling for selection bias, SHI significantly increases visits to specialists. They also note that the rich are more likely to buy supplemental coverage and therefore conclude that SHI contributes to ‘pro-rich’ inequalities in the use of specialists. However, although it is crucial for policy recommendation, it remains difficult to assess whether the increase in healthcare use due to SHI is a non-desirable over-consumption or a desirable access effect.

Finally, the way SHI premiums are defined is responsible for most of the differences in access, healthcare payments and possibly inequalities in healthcare use. Medical underwriting or experience rating disadvantage sick individuals, age-based premiums make older age-group contribute more, uniform premiums represent a higher share in poor households’ budgets and income-based contributions might be difficult to impose to high-income groups. The impact of SHI premiums on the distribution of healthcare payments is therefore also a critical question.

Objective of the thesis

This thesis deals with two questions relative to efficiency and fairness in mixed health insurance systems with partial mandatory coverage and voluntary supplementary health insurance:

- the potential inflationary effect of supplementary insurance on medical prices;
- the fairness of supplementary insurance premiums in a context of voluntary insurance.

We set the analysis in the French context and perform empirical analyses on original individual-level data, collected from the administrative claims of a French insurer (MGEN). The sample is made of 99,878 individuals observed from 2010 to 2012.

The inflationary effect of SHI on medical prices: the case of balance billing coverage in France

The first two chapters focus on the inflationary effect of SHI on medical prices. In chapter I, we estimate the causal effect of SHI on patient's decision to consult physicians who balance bill their patients, i.e. charge them more than the regulated fee set by NHI. Chapter II further investigates the relationships between demand for balance billing, SHI coverage and moral hazard.

The relationship between balance billing and SHI coverage is symptomatic of the policy concerns raised by voluntary SHI coverage, both on efficiency and equity grounds. On the one hand, balance billing increases physician's earnings with, in theory, no additional burden on the NHI. It also allows patients to have access to a higher level of healthcare quality, by visiting highly-skilled physicians and/or by reducing waiting time. They can also purchase SHI coverage to limit OOP payments. On the other hand, because of moral hazard and unequal coverage, there are rising concerns about an increase in medical prices and inequalities of access to specialists. In France, for the last 15 years, the continuous increase in balance billing, that now amounts to €2.3bn, has been concomitant with an extension of balance billing coverage by SHI. Still, coverage remains very unequal and half of the population states that it is not well covered against balance billing. This situation is not specific to France: Canada, Australia, Belgium, the USA and the UK share the same concerns. There is indeed a crucial need for evidence on the causal effect of SHI on the demand for balance billing as well as insights on potential access problems.

Our investigation on the impact of SHI coverage on balance billing is also motivated by the opportunity to measure moral hazard on two dimensions of healthcare use: quantity and quality. When changes in prices are marginal, the impact on the number of visits to a specialist can be rather low (Chiappori et al. 1998), either because of a low price-elasticity of healthcare demand or because of important non-monetary costs due to waiting lists or travel time that reduce the impact of insurance on the real price face by patients (Phelps & Newhouse 1974). However, the impact is potentially much higher when SHI covers medical goods with a higher level quality. Indeed, even if they do not visit specialists more often, individuals can use their SHI coverage to visit more expensive physicians. This substitution effect eventually increases the average price of healthcare.

Finally, voluntary SHI necessarily yields selection phenomena which are interesting from both methodological and policy points of view. Indeed, contracts with more comprehensive coverage may attract individuals whose healthcare consumption would increase more strongly. Defined as ‘selection on moral hazard’ by Einav et al. (2013), this phenomenon has yet received little attention in the literature. The French context with SHI coverage on balance billing is particularly appropriate for investigating selection on moral hazard. Indeed, the demand for specialists who balance bill relies strongly on preferences and beliefs in quality of care. These unobservable characteristics may influence both the response to better coverage and the decision to take out SHI, resulting in selection on moral hazard. As regards econometrics methods, taking into account selection on moral hazard requires to model explicitly the effect of individual unobserved heterogeneity in the demand for healthcare, in the demand for coverage and in moral hazard. From a policy point of view, considering the relationships between demand for higher quality of care, demand for SHI coverage and the response to better coverage also gives insights on the role of health insurance, especially in terms of access to care.

Are SHI premiums fair? The impact of age-based premiums on risk sharing and vertical equity

In the third chapter, we focus on the equity concerns raised by the generalization of age-based premiums in the French SHI market. The French SHI market has two important features: insurance is voluntary and insurers can compete on premiums and coverage. Twenty years ago, not-for-profit insurers, the *mutuelles*, provided most of the SHI contracts. These contracts usually took the shape of a unique plan: standardized coverage financed through uniform premiums, i.e. a flat fee, independent from individuals’ characteristics. However, new entrants, attracted by the increase in SHI perimeter, tend to provide tailor-made contracts with premiums adjusted on the individual risk. The *mutuelles* are experiencing the ‘adverse selection death-spiral’ (Cutler et al. 1997): they lose their low-risk clients attracted by lower premiums. The higher share of high-risk in a *mutuelle*’s portfolio yields an increase in premiums and speeds up the loss of low-risk. To survive, the *mutuelles* give up on uniform premiums and price their contracts with premiums increasing with age in order to be closer to the individual risk. In 2005, only 66% of SHI contracts provided by the *mutuelles* in the individual market were priced with age-based premiums. It now concerns 90% of the contracts. By regulating the individual health insurance

market, the USA are experiencing an opposite change. The Affordable Care Act (ACA) bans medical underwriting, a practice that strongly disadvantage sick people, and only allows insurers to adjust premiums on age and gender. In this context, compared to medical underwriting, age-based premiums are regarded as a movement toward more community rating.

Age-based premiums raise concerns about inequalities both in the level of premiums and in the extent of coverage. Correlations between age, income and healthcare consumption make it difficult to predict the impact of age-based premiums on transfers between low and high healthcare users and high and low income groups. Furthermore, because age-based premiums are a cross-breed between CR and actuarial fairness principles, they are likely to limit the death spiral without preventing it completely: in each age-group, the lower risk might still have incentives to remain uninsured or ask for lower premiums. The theoretical literature essentially focuses on efficiency issues and barely analyzes the distributional impact of health insurance premiums. On the other hand, empirical contributions focus essentially on vertical equity and tend to ignore the adverse effects of a voluntary insurance. More importantly, because the literature usually considers only the NHI level, results are difficult to generalize to the SHI context. Indeed, SHI is meant to cover a different type of risk than NHI. Especially in the French context where NHI covers inpatient care and does not charge co-pays for patients with chronic disease, expenditures covered by SHI are likely to be less extreme, possibly more predictable for the individuals too. For the same reasons, adverse selection phenomena, well documented in the case of basic health insurance, might be different in the SHI market. Furthermore, because of a lack of data, we have seldom knowledge about the distribution of healthcare expenditures effectively covered by SHI. Correlations between SHI reimbursements, age, income and health condition, which are critical to understand the distributional impact of age-based premiums, have not been documented either.

To bridge this gap, we exploit an original database of 87,110 individuals, aged from 25 to 90 years-old, for whom we observe their SHI reimbursements and final OOP. We focus on ex post outcomes to fully take into account the specificity of SHI in terms of distribution of expenditures and correlations with age, income and health status. Our objective is to compare the impact of age-based premiums with other regimes of premiums on the extent of transfers between low

and high users of healthcare ('risk sharing') and between low and high income groups ('vertical equity').

Methodology

In this section we present our methods and the data we use. Our empirical strategy is meant to deal with the challenges implied by a voluntary health insurance, especially selection phenomena. Our estimates are based on an original dataset that provides, for the period 2010-2012 and across 99,878 individuals, detailed information on healthcare expenditures, NHI and SHI reimbursements as well as OOP expenditures.

Methods

Identifying the causal impact of SHI on balance billing consumption

Estimating the causal impact of health insurance coverage on healthcare consumption represents an empirical challenge. Indeed, when individuals can choose their level of coverage, the observed relationship between insurance coverage and healthcare is influenced by endogeneous selection. Unobserved individual characteristics are likely to explain both healthcare consumption and the demand for better coverage. Different empirical strategies can be implemented to deal with selection. One can consider exogeneous changes in the level of coverage, either by creating an experimental design (Manning et al. 1987, Newhouse 1993) or exploiting quasi-natural experiments (Chiappori et al. 1998). Studies that use cross section data often rely on simultaneous equation methods to control for selection (Cameron et al. 1988, Holly et al. 1998). We use individual panel data and estimate the causal effect of SHI on balance billing on individuals who initially were not covered against balance billing and decided to enhance their coverage. We control for selection by using individual fixed effects and instrumental variables. Individual fixed effects control for unobserved characteristics likely to explain balance billing consumption. Instrumental variables control for the non exogeneity of the decision to switch: our instruments explain the decision to take out better coverage but are not correlated with a change in balance billing consumption.

Taking into account the heterogeneous impact of SHI and possible selection on moral hazard

As mentioned previously, the decision to take out insurance may not only be related to heterogeneous demand for healthcare ('classical adverse selection') but also to heterogeneous response to better coverage ('selection on moral hazard'). In the econometric literature, selection on moral hazard is more generally known as selection on returns or essential heterogeneity. Marginal treatment effects (MTE) estimators have been developed to capture the impact of a treatment likely to vary within a population in correlation with observed and unobserved characteristics, in a setting where individuals select themselves into treatment. First defined by Bjorklund & Moffitt (1987), MTE have been comprehensively described by Heckman & Vytlacil (2001) and Heckman et al. (2006). We argue that MTE are appropriate tools to investigate the effect of voluntary SHI on the demand for balance billing. First, MTE allow for heterogeneity in moral hazard and can identify selection on moral hazard. Second, MTE rely on a structural approach that links the output (the demand for balance billing), the decision to take the treatment (take out SHI) and the treatment effect (moral hazard). We can therefore associate the heterogeneous treatment effect to different mechanisms related to income, supply side constraints or preferences. In other words, we are able to give some 'content' to moral hazard, especially in terms of access to specialists, and go beyond the homogeneous price effect usually reported in the literature.

Simulating the impact of age-based premiums on risk sharing and vertical equity

Questioning the fairness of age-based premiums presents a double methodological challenge. The first challenge lies in the measure of fairness. Besides the difficulty to define what a fair premium is, we also need a synthetic measure in order to compare the respective impact of different regimes of premiums. First, we choose to focus on ex post outcomes and precisely what we call 'healthcare payments', i.e. premiums paid and OOP payments. Second, we focus our analysis on the distribution of healthcare payments among low and high healthcare users ('risk sharing') and low and high income groups ('vertical equity'). We rely on the literature on equity in healthcare finance (Wagstaff & Van Doorslaer 2000) and use inequality indexes and concentration curves to compare the impact of different types of premiums. An original

contribution of our work is to adapt the indexes traditionally used for the measure of vertical equity to also evaluate the impact of premiums on risk sharing.

Second, it is not possible to directly observe the impact of the way premiums are defined on ex post outcomes. Because of the diversity of contracts available in the French SHI market, the observed enrollment rates, average premiums paid and OOP payments will be the result of various premiums regimes and coverage levels. Therefore, we use a simulation approach to study how age-based premiums impact the distribution of healthcare payments. We define a simplified framework where there is only one standardized SHI contract (one type of premium and one level of coverage): individuals have only the choice to take out SHI or not. In this framework, we are able to compute different types of premiums, predict whether individuals will take out SHI or not and calculate their subsequent premium and OOP payments. We calibrate the simulation with individual level data from MGEN for which we know that all policyholders benefit from exactly the same level of coverage. Our simulations are not meant to have a strong predictive power. However, they illustrate how SHI age-based premiums impact the distribution of healthcare payments, given correlations between age, risk and income and adverse selection phenomena.

Data

Our empirical investigations are performed on individual-level data collected from a French insurer, the Mutuelle Générale de l'Éducation Nationale (MGEN). For historical reasons, MGEN processes claims on behalf of NHI for teachers and ministry of education employees. MGEN also provides voluntary SHI coverage (MGEN-SHI) which takes the shape of a unique contract: the level of coverage is identical for all MGEN-SHI policyholders and premiums depend on income and age.

Twelve months have been necessary to build a database relevant for research from raw expenses claims. The sample has been randomly drawn from the 2.3 million individuals for whom MGEN processes both NHI and SHI claims. We systematically checked for observations with errors and missing data. The final sample is made of 99,878 individuals. From January 2010 to December 2012, we observe their annual consumption of healthcare as well as reimbursements from the

NHI and from MGEN-SHI. Our population is made of two different groups: (i) a representative sample of MGEN enrollees for which MGEN processes NHI claims and who are covered by MGEN-SHI from January 2010 to December 2012, we call them the ‘stayers’, and (ii) all the individuals who were covered by MGEN-SHI in 2010 and switched to another insurer in 2011, we call them the ‘switchers’. From January 2012, the switchers have therefore a different SHI contract than the stayers. However, because MGEN still processes switchers’ NHI claims, we are still able to observe their healthcare consumption.

As regards healthcare consumption, our database includes the number of acts, annual healthcare expenditures as well as NHI and SHI reimbursements for different type of care: GP consultations, specialists consultations (including the specialty), technical acts, dental care, optical care, the number of days spent in hospital⁴. We also have at our disposal socio-demographic information on gender, age, place of residency and whether individuals are diagnosed with a chronic disease. We use the fact that MGEN premiums depend on wages to reconstruct a proxy for individuals income. This information is updated at the beginning of each year. We also add data related to supply side organization, precisely the number of specialists for 100,000 inhabitants who do and do not balance bill at the *département* level. Data stem from the *Syndicat National Inter Régimes* and are provided by the NHI (*Caisse Nationale d’Assurance Maladie des Travailleurs Salariés*).

Building an individual-level database suitable for econometric analysis from raw administrative data is long work which took almost a year. The different steps imply getting authorization from the insurer, identifying relevant variables, designing the sample, writing endless SQL codes, monitoring the extraction of variables and finally building individual-level panel data. Nevertheless, it was worthwhile to devote to the building of this original database which is an incredible source of information on the role of SHI in the consumption of healthcare. The existing individual-level databases in France do not link NHI and SHI reimbursements. They are also mostly cross-sectional or without many observable shock in terms of coverage which preclude the identification of causal impacts. On the contrary, our MGEN database stems from administrative data which provide reliable information on healthcare consumption as well as

⁴We were not able however to reconstruct healthcare expenditures during the hospital stay

NHI and SHI reimbursements. We are especially able to measure the final OOP, after NHI and SHI reimbursements. Our two subsamples, the ‘stayers’ and the ‘switchers’ are used respectively as a control and a treatment group and allow us to estimate a causal impact of SHI coverage on healthcare consumption.

Outline

This thesis considers mixed health insurance systems where individuals can voluntarily purchase SHI coverage in a market where neither the benefit package nor premiums are standardized. Chapter I focuses on the inflationary effect of SHI on medical prices and estimate the causal effect of SHI on patient’s decision to consult expensive physicians. Chapter II further investigates the relationships between demand for healthcare, SHI coverage and moral hazard with a model that allows heterogeneity in moral hazard. Chapter III analyzes the impact of SHI age-based premiums on risk sharing and vertical equity when insurance is voluntary.

Chapter I

In the first chapter, we measure the causal impact of SHI coverage on patient’s decision to consult physicians who balance bill, i.e. charge more than the regulated fee set by the NHI.

We use individual-level panel data to estimate the impact on patient behavior of a better coverage of balance billing taking into account supply side drivers. Our database stems from administrative data provided by the MGEN. For the period 2010-2012 we are able to observe healthcare claims, NHI and SHI reimbursements for 43,111 individuals. In 2010, the whole sample was covered by the same SHI contract, MGEN-SHI, which does not cover balance billing. We observe the same individuals in 2012 after that 3,819 among them had decided to switch to other supplementary insurers which do cover balance billing. So we have at our disposal a treatment group, the ‘switchers’ who increased their balance billing coverage between 2010 and 2012, and a control group, the ‘stayers’ who remained MGEN-SHI enrollees during the whole period, with no balance billing coverage. We deal with the endogeneity of the decision to switch by introducing individual fixed effects into the specifications and by using instrumental variables for the estimations.

On the whole sample, we find that individuals respond to better coverage by increasing their proportion of consultations of specialists who balance bill by 9%, resulting in a 32% increase in the amount of balance billing per consultation. However, the magnitude of moral hazard strongly depends on the availability of physicians who charge the regulated fee. We find no evidence of moral hazard in areas where physicians who charge the regulated fee are readily accessible. On the contrary, when physicians who charge the regulated fee are scarce, a change in coverage has a strong impact: individuals raise their proportion of consultations of specialists who balance bill by 14%, resulting in a 47% rise in the amount of balance billing per consultation. In these areas where the supply of regulated fee consultations is very constrained, balance billing coverage also leads to an increase in quantity of specialist consultations.

To sum up, we find evidence of a moral hazard effect on quality of care: an increase in the proportion of consultations of specialists who balance bill. In addition, we find for some individuals a moral hazard effect on quantity of care: better coverage leads them to increase their number of consultations of specialists, which suggests that balance billing limited their access to specialists. Another important result is the absence of impact of better coverage when physicians who charge the regulated fee are widely available, enabling people to choose between physicians who balance bill and physicians who do not. These results suggest that the most appropriate policy to contain medical prices is not to limit insurance coverage but to monitor the supply of care in order to guarantee patients a genuine choice of their physicians.

Chapter II

In the second chapter, we further investigate the relationships between the demand for health-care, the decision to take out health insurance and the behavioral response to better coverage. When insurance is voluntary, the estimated relationship between healthcare use and insurance is influenced by endogeneous selection: individual characteristics are likely to explain both individuals' consumption of healthcare and decision to buy insurance. Following Einav et al. (2013) we distinguish two forms of selection: classical adverse selection and selection on moral hazard. Classical adverse selection is linked to individual heterogeneity as regards the demand for healthcare. Because they consume more healthcare than others some individuals may decide to buy insurance to be covered against this financial risk. Selection on moral hazard is linked

to individual heterogeneity as regards their response to better coverage. Individuals may buy insurance because they expect an increase in their consumption due to better coverage.

We set the analysis in the French context where individuals can voluntarily take out SHI which covers medical services with higher quality and quicker access than the benefit package covered by mandatory national health insurance (NHI). We focus on the demand for specialists who balance bill their patients, i.e. charge them more than the regulated fee set by NHI. The demand for specialists who balance bill relies on preferences and beliefs in quality of care. Individuals are likely to be heterogeneous in their preferences and beliefs, while these unobservable characteristics both drive demand for care and decision to take out SHI, resulting in selection on moral hazard. Heterogeneity in moral hazard might as well be influenced by observable characteristics, especially income. We can expect that low income individuals benefit more from the income effect associated with better coverage and increase their balance billing consumption more strongly than rich individuals.

In the econometric literature, selection on moral hazard is generally known as ‘essential heterogeneity’. Marginal treatment effects (MTE) estimators have been developed to capture the impact of a treatment likely to vary across individuals, when they select themselves into treatment (Björklund and Moffitt 1987; Heckman, Urzua, and Vytlačil 2006).

We use MTE to estimate the causal effect of SHI coverage on balance billing consumption. We take into account observed and unobserved individual heterogeneity in the demand for consultations with balance billing and in response to better coverage (moral hazard). Our empirical analysis is built on a model that links (i) the demand for balance billing, (ii) the decision to take out more comprehensive SHI and (iii) the behavioral response to better coverage. Thanks to this unified framework we are able to give insights on the determinants of the demand for higher quality of care and the role of health insurance in terms of access, especially for low income individuals.

Our database stems from MGEN administrative data. In 2012, we observe, for 58,519 individuals, healthcare claims and reimbursements by the NHI and SHI. We take advantage of two groups of individuals: the MGEN-SHI enrollees and the better-SHI enrollees. In 2012,

the MGEN-SHI enrollees have no balance billing coverage. On the contrary, the better-SHI enrollees, who quit MGEN-SHI in 2011 for another SHI, now benefit from better balance billing coverage than MGEN-SHI enrollees.

We find evidence of individual heterogeneity in the response to better coverage and of selection on moral hazard. Individuals with unobservable characteristics that make them more likely to ask for comprehensive SHI are also those who exhibit stronger moral hazard, i.e. a larger increase in balance billing per consultation. As concerns the influence of observable characteristics, we also find that individuals' income is a determinant of balance billing consumption and influences the behavioural response to better coverage. Without coverage, the poor consume less balance billing than the rich but increase their consumption more sharply once covered. They are also more likely to take out better coverage.

In a context where SHI is voluntary, the inflationary impact of SHI coverage on balance billing might be worsened by selection on moral hazard. Our policy conclusions as regards the role of income are of different nature. The negative effect of income on the demand for balance billing consultations coupled with its positive effect on moral hazard provides evidence that insurance plays an important role in terms of access to care for low-income individuals.

Chapter III

In the third chapter we focus on the equity concerns raised by the generalization of age-based premiums in the French SHI market. Indeed, the *mutuelles*, not-for-profit insurers, are keeping away from their founding solidarity principles. To avoid the adverse selection death spiral, they give up on uniform premiums and set premiums increasing with age. Age-based premiums raise concerns about inequalities both in the level of premiums and in the extent of coverage.

Because the theoretical and empirical literature usually only considers the NHI level, it is critical to take into account the specificity of SHI in terms of correlations between age, income and healthcare expenditures to illustrate adverse selection phenomenon and the distributional impact of SHI premiums. Furthermore, due to a lack of data, we have seldom knowledge

about the distribution of healthcare expenditures effectively covered by SHI and their impact on income distribution.

In a context of voluntary SHI, we investigate how age-based premiums impact the extent of risk sharing between low and high healthcare users and the extent of income redistribution between low and high income groups. We adopt an empirical approach and use simulations to compare age-based premiums with other regimes. We focus on ex post outcomes to fully take into account the specificity of SHI in terms of distribution of expenditures and correlations with age, income and health status.

We consider a simple framework where individuals have only the choice to subscribe to SHI or not. There is only one contract available with the same level of coverage and the same regime of premiums for all policyholders. We focus on expenditures meant to be covered by SHI, i.e. the part of healthcare expenditures not covered by NHI. Firstly, we use simulations to compute different regimes of premiums (uniform, age-based, income-based, income-based adjusted with age, medical underwriting and experience rating), predict whether individuals will take-out SHI or not and calculate their subsequent healthcare payments (premiums plus OOP payments). We allow for possible adverse selection effects when premiums are based on a form of community rating. Secondly, we use concentration curves and equity indexes to measure the impact of different regimes of premiums on income distribution. An original contribution of our paper is to adapt these tools to measure the impact of premiums on transfers between low and high healthcare users.

To take into account the specificity of SHI, the simulation model is calibrated with data stemmed from MGEN. We use individual-level observations on 87,110 individuals, aged from 25 to 90 years old, who are all covered by the same SHI contract (MGEN-SHI) from January 2010 to December 2012. Additionally to information on socio-economic characteristics and health state, we are able to observe their healthcare expenditures, NHI and SHI reimbursements and their final OOP.

Based on our simulations, we derive three results on the impact of age-based premiums in the SHI market: (i) in a context of voluntary SHI, age-based premiums is the best solution to preserve

risk sharing; (ii) however, they achieve risk sharing at the expense of vertical equity; (iii) the absence of a mandate limits the impact of SHI on risk sharing and vertical equity, especially when premiums are based on a form of community rating. We show that in a context of voluntary SHI, age-based premiums limit the effect of adverse selection and still allow risk sharing. This would support the generalization of age-based premiums at the expense of uniform premiums in France and the change from actuarial premiums to adjusted community rating in the USA. However, our simulations also point out that age-based premiums yield regressive payments and raise legitimate concerns about the affordability of insurance and income inequalities due to healthcare payments.

This thesis is organized as follows. The main features of the French SHI market are presented as a prelude. Chapter 1 estimates the causal impact of SHI coverage on patient's decision to consult physicians who balance bill their patients. Chapter 2 further investigates the relationships between demand for healthcare, SHI coverage and moral hazard. Chapter 3 analyzes the impact of age-based SHI premiums on risk sharing and vertical equity. The final section concludes.

Résumé

Objectifs de la thèse

Cette thèse est consacrée à deux questions en lien avec l'efficacité et l'équité des systèmes mixtes d'assurance maladie où la couverture publique obligatoire peut être complétée par une assurance privée (complémentaire santé) :

- le potentiel effet inflationniste des complémentaires santé sur le prix des soins ;
- l'équité des primes des complémentaires dans un contexte d'assurance facultative.

Le chapitre 1 estime l'effet causal d'une couverture complémentaire généreuse sur la consommation de dépassements d'honoraires. Le modèle développé dans le chapitre 2 tient compte du fait que l'impact d'une meilleure couverture sur les dépassements (aléa moral) varie d'un individu à l'autre et que cette hétérogénéité peut être corrélée à la demande d'assurance. Le chapitre 3 simule l'impact de la tarification à l'âge sur les niveaux de primes et la décision de s'assurer en prenant en compte les corrélations entre âge, état de santé et revenu.

Méthode

Les analyses empiriques sont réalisées sur données françaises. Cette base de données originale regroupe les consommations de soins de 99878 affiliés à la Mutuelle Générale de l'Education Nationale (MGEN) entre 2010 et 2012.

La MGEN gère les remboursements pour le compte de l'Assurance maladie obligatoire, notamment pour les employés du Ministère de l'Education Nationale. La MGEN propose également

une couverture complémentaire facultative sous la forme d'un contrat unique : le niveau de couverture est identique pour tous les affiliés et les primes dépendent majoritairement des revenus salariés ou pensions de retraite des affiliés.

Près de douze mois ont été nécessaires pour construire cette base à partir des données administratives de la MGEN. Sur les 2,3 millions d'affiliés pour lesquels la MGEN gère à la fois la couverture obligatoire et complémentaire, un échantillon de 99878 individus a été tiré aléatoirement et anonymisé. De janvier 2010 à décembre 2012, nous observons leur consommation de soins ainsi que les remboursements de l'assurance maladie obligatoire et complémentaire. Notre échantillon est composé de deux groupes distincts : (i) un échantillon représentatif des affiliés MGEN pour lesquels la MGEN gère à la fois la couverture obligatoire et complémentaire de janvier 2010 à décembre de 2012, nous les appelons les « stayers » ; et (ii) l'ensemble des affiliés couverts par la couverture complémentaire de la MGEN en 2010 mais qui ont décidé de souscrire un nouveau contrat auprès d'un autre assureur en 2011, nous les appelons les « switchers ». A partir de janvier 2012, les switchers ont par conséquent un contrat complémentaire différent de celui des stayers. Toutefois, parce que la MGEN gère toujours leurs remboursements liés à l'assurance maladie obligatoire, nous sommes toujours en mesure d'observer la consommation de soins des switchers.

Pour ce qui est des consommations de soins, nous disposons pour chaque individu du nombre de consultations, du total annuel des dépenses et des remboursements de l'assurance obligatoire et complémentaire pour différents types de soins : consultations généralistes et spécialistes (par spécialité), actes techniques, soins dentaires, optique ainsi que le nombre de jours d'hospitalisation. Nous disposons également d'information socio-démographiques telles que le genre, l'âge, le lieu de résidence ainsi que le statut ALD (affection longue durée). Nous utilisons le fait que la MGEN calcule ses primes sur les revenus de ses affiliés pour reconstruire un proxy du revenu individuel. Ces informations sont mises à jour au début de chaque année civile. Des données sur la densité des médecins spécialistes dans le département de résidence des affiliés (nombre de médecins spécialistes pour 100,000 habitants) viennent compléter la base de données.

Le temps nécessaire à la construction d'une base de données adaptée à l'analyse micro économétrique

à partir de données brutes administratives a été compensé par l'incroyable source d'information que cette base offre quant au rôle de l'assurance complémentaire sur la consommation de soins. Les bases existantes en France et en Europe ne font pas le lien au niveau individuel entre remboursements de l'assurance obligatoire et des couvertures complémentaires facultatives. De plus, les données disponibles sont généralement en coupe ou ne sont pas construites pour estimer l'impact causal d'un choc de couverture. A l'inverse, notre base de données est issue de données administratives qui permettent une analyse fiable et précise des consommations de soins et des remboursements de l'assurance obligatoire et complémentaire. Nous sommes particulièrement en mesure d'estimer le reste à charge final, après remboursements des assurances obligatoire et complémentaire. Les deux groupes qui constituent l'échantillon, les « stayers » et les « switchers », peuvent être utilisés respectivement comme groupe de contrôle et de traitement pour estimer l'impact causal de la complémentaire santé sur la consommation de soins.

Résumé des chapitres

Chapitre 1

Le premier chapitre estime l'effet causal d'une couverture complémentaire généreuse sur la demande de consultations de spécialistes qui pratiquent des dépassements d'honoraires, i.e. pratiquent des tarifs supérieurs à ceux fixés par l'assurance maladie obligatoire.

Les données individuelles en panel issues de la MGEN sont utilisées pour estimer l'impact d'une meilleure couverture des dépassements sur la demande de consultations des patients tout en prenant en compte les effets d'offre. Sur la période 2010-2012 nous observons les demandes de remboursements, adressées aux assurances obligatoire et complémentaire, de 43111 individus. En 2010, la totalité de l'échantillon avait souscrit à la même complémentaire santé, la MGEN, qui ne couvre pas les dépassements d'honoraires. Nous observons les mêmes individus en 2012 après que 3819 d'entre eux aient décidé de changer leur couverture complémentaire. Comparé à leur ancienne couverture, ce nouveau contrat ne peut être qu'identique ou plus généreux en termes de couverture des dépassements. Nous disposons donc d'un groupe de traitement, les « switchers » qui ont vu leur couverture contre les dépassements augmenter entre 2010 et 2012 et un groupe de contrôle, les « stayers » qui sont restés affiliés à la couverture complémentaire de la MGEN (sans

couverture des dépassements) de 2010 à 2012. La méthode des variables instrumentales associée à la spécification d'effets fixes individuels dans les régressions en panel permet de contrôler de la possible endogénéité liée à la décision de changer de contrat d'assurance.

Les résultats sur l'ensemble de l'échantillon montre que les individus qui bénéficient d'une meilleure couverture complémentaire augmentent leur proportion de consultations avec dépassements d'honoraires (secteur 2) de 9% avec pour conséquence une augmentation de 32% du montant moyen de dépassements par consultation. Toutefois, l'importance de l'impact dépend fortement de la densité de spécialistes qui ne pratiquent pas de dépassements (secteur 1). Les estimations ne montrent pas d'aléa moral dans les départements où l'accès aux spécialistes de secteur 1 est facilité compte-tenu de leur forte densité sur le territoire. A l'inverse, quand la densité de spécialistes de secteur 1 est faible, une modification de la couverture a un fort impact sur la demande de dépassements. Les patients augmentent de 14% la proportion de consultations en secteur 2, entraînant une augmentation de 47% du montant moyen de dépassements par consultation. Dans les départements où l'offre de consultations sans dépassements est très restreinte, bénéficier d'une couverture contre les dépassements conduit également les patients à augmenter leur nombre de visites spécialiste.

Les estimations montrent ainsi la présence d'aléa moral sur la qualité des soins via une augmentation de la proportion de consultations avec dépassements d'honoraires. En outre, pour certains patients l'assurance a un impact sur la quantité de soins : une meilleure couverture des dépassements leur permet d'augmenter le nombre de visites chez le spécialiste. Ce dernier résultat suggère que les dépassements d'honoraires pourraient créer des problèmes d'accès aux soins. Un autre résultat important est l'absence d'effet d'une meilleure couverture dans les départements où les spécialistes de secteur 1 sont largement accessibles, ce qui permet aux patients de choisir librement entre consultations avec ou sans dépassements.

En termes de recommandation de politique publique, ces résultats suggèrent que restreindre l'accès à une couverture des dépassements d'honoraires ne semble pas être la mesure la plus appropriée pour limiter l'effet inflationniste des couvertures complémentaires. Une régulation de l'offre, pour assurer un libre choix entre spécialistes du secteur 1 et du secteur 2, respecterait les préférences des patients pour les dépassements sans créer d'effet inflationniste.

Chapitre 2

Le chapitre 2 analyse les relations entre la demande de soins, la décision de souscrire à une assurance complémentaire et le comportement des individus une fois qu'ils sont mieux couverts. Lorsque l'assurance est facultative, l'estimation de l'impact de l'assurance sur la consommation de soins est influencée par des phénomènes de sélection : les caractéristiques individuelles peuvent expliquer à la fois la consommation de soins des individus et leur décision de souscrire à une assurance. En se basant sur les travaux d'Einav et al (2013), nous distinguons deux formes de sélection : l'antisélection classique (« classical adverse selection ») et la sélection sur aléa moral (« selection on moral hazard »). L'antisélection classique est liée à l'hétérogénéité individuelle en termes de demande de soins. Certains individus peuvent consommer plus de soins que les autres et décider de se couvrir contre ce risque financier. La sélection sur aléa moral réfère à l'hétérogénéité individuelle en termes de réponse à une meilleure couverture. Les individus peuvent vouloir se couvrir parce qu'ils anticipent que leur nouvelle couverture leur permettra d'augmenter leur consommation de soins.

L'analyse empirique est menée dans le contexte français où les individus ont le choix de souscrire une assurance complémentaire qui peut leur donner accès à des soins de meilleure qualité et à des temps d'attente réduits comparé au panier de soins couvert par l'assurance maladie obligatoire. L'analyse se focalise sur les dépassements d'honoraires. Les individus peuvent avoir des préférences et croyances hétérogènes concernant la qualité associée aux consultations avec dépassements. Ces préférences, inobservables pour l'économètre, sont susceptibles d'expliquer à la fois la demande pour des consultations de secteur 2 et la demande pour une meilleure couverture des dépassements, créant de la sélection sur aléa moral. L'hétérogénéité en termes d'aléa moral peut également être expliquée par des caractéristiques observables telles que le revenu. Les individus avec un faible revenu peuvent en effet bénéficier davantage que les autres d'une couverture assurantielle en augmentant de façon plus importante leur consommation de soins.

Dans la littérature économétrique, la sélection sur aléa moral renvoie au concept d'« essential heterogeneity ». L'estimateur des « marginal treatment effects » (MTE) a été développé précisément pour capturer l'impact d'un traitement susceptible de varier d'un individu à l'autre,

lorsque ces individus ont le choix de participer ou non au traitement (Björklund and Moffit, 1987 ; Heckman, Urzua and Vytlačil, 2006).

Les estimations sont réalisées sur un échantillon de 58519 individus issus de la base de données MGEN. Nous observons la consommation de soins et remboursements en 2012 de deux groupes : les affiliés MGEN, qui ne sont pas couverts contre les dépassements et les individus qui bénéficient d'une meilleure couverture complémentaire.

Les résultats montrent l'existence d'hétérogénéité individuelle dans la réponse à une meilleure couverture et la présence de sélection sur aléa moral. Les individus dont les caractéristiques inobservables les rendent plus à même de souscrire à une couverture complémentaire généreuse sont aussi ceux qui augmentent le plus fortement leur consommation de dépassements une fois couverts. En ce qui concerne les caractéristiques observables, le revenu apparaît comme un déterminant à la fois de la demande de consultations avec dépassements et de la réponse à une meilleure couverture. Sans couverture contre les dépassements, les bas-revenu consomment moins de dépassements que les haut-revenu mais augmentent plus fortement leur consommation une fois couverts. Ils sont aussi plus susceptibles de souscrire à une couverture complémentaire plus généreuse.

Dans un contexte où la complémentaire santé est facultative, l'effet inflationniste de la couverture contre les dépassements est accentué par un phénomène de sélection sur aléa moral. Les conclusions tirées de l'impact du revenu sont d'une autre nature. L'effet négatif du revenu sur la consommation de consultations avec dépassements associé à son effet positif sur la réponse à une meilleure couverture témoignent du rôle critique de l'assurance concernant l'accès aux soins des individus à bas-revenu.

Chapitre 3

Le troisième chapitre examine les questions d'équité soulevées par la généralisation de la tarification à l'âge sur le marché français des complémentaires santé. Sous l'effet de la concurrence, les mutuelles, assureurs sans but lucratif, s'éloignent de leurs principes fondateurs. Pour éviter les phénomènes d'antisélection et de « spirale de la mort », les mutuelles abandonnent les primes

uniformes au profit de primes augmentant avec l'âge, potentiellement au prix d'importantes inégalités en termes de primes et de couverture.

La littérature théorique et empirique qui s'est intéressée à la tarification assurantielle ne considère généralement que le cas de l'assurance de base. Il est donc critique d'aborder ces questions en prenant en compte les spécificités de l'assurance complémentaire et particulièrement les corrélations entre âge, revenu et dépenses de santé pour illustrer les phénomènes d'antisélection et mesurer l'impact redistributif des primes d'assurance complémentaire. Dans un contexte où l'assurance complémentaire est facultative, nous simulons l'impact de la tarification à l'âge sur la redistribution horizontale, entre malades et bien portants, et sur la redistribution verticale, entre haut et bas revenus. L'impact de la tarification à l'âge est mesuré ex post et comparé à d'autres formes de tarification.

L'analyse s'inscrit d'un cadre théorique simplifié, dans lequel les individus ont seulement le choix de souscrire ou non un contrat d'assurance complémentaire. Il n'y a qu'un contrat proposé avec le même niveau de couverture et le même régime de primes pour tous les assurés. L'analyse empirique concerne uniquement la part des dépenses de santé qui peut être couverte par l'assurance complémentaire, i.e. sur les dépenses qui ne sont pas couvertes par l'assurance maladie obligatoire. La première étape consiste à simuler différents régimes de primes (primes uniformes, tarification à l'âge, au revenu, primes basées sur l'âge et le revenu, « medical underwriting » et « experience rating »), prédire la demande individuelle pour le contrat d'assurance complémentaire et calculer pour chaque individu les primes et reste à charge en fonction de leur décision d'être couverts ou non. Lorsque le régime de primes repose sur une forme de « community rating », les effets d'antisélection sont pris en compte dans la simulation. La deuxième étape mesure l'impact des différents régimes de primes sur la distribution de revenu ex post à partir de courbes de concentration et d'index d'inégalités. Une contribution méthodologique importante de ce chapitre est d'adapter ces outils à la mesure des transferts entre malades et bien portants.

Le modèle est calibré sur les données de la MGEN. Nous utilisons les données de 87110 individus, âgés de 25 à 90 ans, qui sont tous couverts par le même contrat d'assurance complémentaire de janvier 2010 à décembre 2012. Nous observons leur revenu, leurs dépenses de soins annuelles,

les remboursements de l'assurance obligatoire et complémentaire ainsi que leur reste à charge final.

Les simulations donnent trois résultats principaux : (i) dans un contexte d'assurance facultative, la tarification à l'âge est le régime le plus à même de préserver la redistribution horizontale ; (ii) en revanche, cela se fait au détriment de la redistribution verticale ; (iii) l'absence d'une obligation de s'assurer limite l'impact de l'assurance complémentaire sur la redistribution horizontale et verticale, notamment lorsque le régime de primes est basé sur une forme de « community rating ».

Lorsque l'assurance est facultative, la tarification à l'âge limite donc l'antisélection et permet d'assurer une forme de redistribution horizontale. Ce résultat tend à supporter le mouvement des mutuelles vers la tarification à l'âge. En revanche, les simulations montrent également que la tarification à l'âge induit des paiements régressifs et crée des inquiétudes légitimes quant à l'accessibilité financière de l'assurance complémentaire et aux inégalités de revenus accentuées par les dépenses de santé.

Prelude

The French supplementary health insurance market

The French health insurance system is a mixed system based on a mandatory, universal yet partial National Health Insurance (NHI). The NHI is mainly funded through contributions based on income and organized by a single payer. The private health insurance market provides contracts that have both complementary and supplementary features. For the sake of simplicity, we will refer to the French private health insurance market as a ‘Supplementary Health Insurance’ market (SHI). SHI contracts usually cover at least co-payments but most of them also cover medical goods and services out of the public benefit package such as complex dental care, optical devices, alternative medicines as well as private practice in hospitals or visits to physicians out of the regulated fee system. The way premiums are defined varies from pure CR to medical underwriting, even income-based premiums for some employer-based contracts and few not-for-profit insurers. Age-based premiums are widespread though on the individual market.

Although voluntary, SHI coverage is considered as essential in access to care in France. Indeed, OOP expenditures are not capped and can represent an important part of individuals’ budget. Public programs therefore provide either free SHI or vouchers to low-income groups⁵ ensuring that vulnerable individuals will be at least covered for co-payments. Patients with chronic disease⁶ are also exonerated from co-payments for healthcare related to their condition. Since 2016, all private sector employers, even small businesses, also have to provide subsidized health insurance coverage to their employees. However SHI is still voluntary in the individual market.

⁵These programs are known as *Couverture Maladie Universelle Complémentaire* (CMU-C) and *Aide au paiement d’une Complémentaire Santé* (ACS)

⁶*Affection Longue Durée* (ALD)

One of the reason could be that supplementary insurance covers luxury medical goods, that do not raise any equity concerns. There are two limits to this reasoning. First, the frontier between complementary and supplementary coverage is actually not always easy to draw, especially for visits to physicians. Indeed, in France, some physicians, mostly specialists, are allow to balance bill their patients, that is charge them more than the regulated fee. As a result, on top of co-payments, patients bear more or less out-of-pocket expenses depending on their coverage. A limited SHI coverage can therefore limit access to specialists, as co-payments would do. Second, by separating basic from supplementary healthcare and coverage issues, we tend to ignore spillover effects, which can be important especially on medical care prices.

In 2014, 13.5% of the total healthcare expenditures have been financed through the SHI market in France. Indeed, the NHI is universal yet partial and covers on average 78% of the total healthcare expenditures. The remaining 8.5% is directly borne by households. Although health insurance systems combining public and private funds are common among OECD countries, the French health insurance system remains very peculiar. First, the share of expenditures funded through SHI is one of the most important among European countries (Figure 1). Second, the market is very competitive and far less regulated in terms of benefit package and premiums than the German, Dutch or Swiss systems.

The increasing role of SHI in France

It might be puzzling to notice that the relatively high rate of public coverage in France did not prevent the SHI market from expanding. The reasons are historical, economical and political. Back in 1900, private health insurers, essentially not-for-profit companies, were already providing health insurance coverage to almost 2 million individuals. When the mandatory public scheme, the *Sécurité sociale*, has been endorsed in 1946, private insurers bridged the gap left by a partial public coverage (about 60% of total expenditures) by offering complementary health insurance. They have seen their market share increased since, especially from the end of the 80's, taking advantage of the combined effects of a continuous increase in healthcare expenditures and the political will to slow down public expenditures. To be fair, the average share of public funding did not dramatically drop: it reached its maximum in 1980 with a 80% coverage, and has decreased since to amount 76%. However, this statement hides two important facts. First,

in absolute terms, the constant increase of health expenditures logically increases year after year the potential size of the SHI market: from 33.5 billion euros in 2006 to 41.9 billion euros in 2014. Average figures can also be misleading. First, the average NHI coverage drops to 64% for ambulatory care and 32.5% for dental care (Figure 2). Second, public expenditures are highly concentrated on patients with chronic diseases who benefit from complete coverage for health-care related to their condition. As a result, the average NHI coverage for individuals without co-payment exemption (that is 87% of the population) only reaches 55%. Finally, considering the highly skewed distribution of healthcare expenditures and the absence of any mechanism to cap OOP payments, the financial risk borne by households after NHI reimbursements remains important. Focusing on the top of the distribution of expenses after public reimbursements, 5% of the population has OOP payments that exceed €1600 per year (HCAAM, 2009). OOP expenses rise above €3250 for the last centile.

Although 95% of the French population declares to be covered by a SHI contract, inequalities are striking. Indeed, this high coverage rate hides an important heterogeneity in terms of coverage and premium paid. One of the consequences is that access to SHI strongly depends on occupation and income (Figures 3 and 4). Very low-income individuals, who represent 6% of the population, benefit from a public supplementary coverage (CMU-C). Individuals who work in the private sector and their families benefit from employer-based contracts, largely subsidized and usually financed through community rating. These contracts also offer on average more generous coverage. In 2014, 35% of the population was covered with an employer-based contract (DREES 2016). The remaining 54%, mostly students, independent and part-time workers, civil servants and pensioners have access to supplementary coverage only through the individual market where premiums mostly depend on age. The extent of coverage varies also dramatically from a contract to another which is likely to create unequal access to care, especially when it concerns co-payments on basic healthcare. For instance, 80% of individuals insured with an employer-based contract are covered for balance billing, and therefore benefit from an easy access to specialists. They are only 40% in the individual market.

A competitive and attractive market

Not-for-profit and for-profit companies compete in the SHI market, offering individual as well as employer-based coverage. The historical *mutuelles*, not-for-profit organizations, still outnumber commercial insurance companies but the market keeps on being more and more concentrated (Figure 5). Insurance companies are seeking for critical size to deal with a highly competitive market as well as more and more demanding prudential rules. This is especially true for not-for-profit insurers for whom health insurance is their main activity and represents 84% of their revenues on average. On the contrary for-profit companies consider health insurance more as a diversification strategy (only 5% of their revenues) and are likely to benefit from higher scale returns and network externalities. In 2002, there were 1,520 distinct companies in the SHI market, but 120 only were for-profit. In 2014, the market counted only 573 businesses, including 94 for-profit (DREES 2016). The top 10 of health insurers, each with a revenue over 1 billion euros, account for 35% of market-wide revenues. Although the SHI market is highly subsidized through tax exoneration for employer-based contracts and vouchers for low-income individuals, it is also heavily taxed. Not-for-profit insurers used to benefit from a lower tax rate, around 3.5%. Since 2012 however, their tax rate has been increased to reach 7% of their revenues, a similar rate than for for-profit companies.

Segmented contracts and age-based premiums

Not-for-profit insurance companies are progressively losing market shares on both individual and employer-based contracts; it dropped from 60% in 2001 to 53% in 2014 (Figure 6). In this respect, the situation is quite similar to what Blue Cross and Blue Shield experienced on the American market (Thomasson 2002). These not-for-profit insurers also used to rely on solidarity principles with community rating and generous coverage. However, they could not compete with actuarial premiums and tailor-made contracts offered by for-profit companies which especially attract young and healthy individuals. Most of the not-for-profit companies disappeared and those who survived had to abandon uniform premiums and offer contracts with higher deductibles. Though limited by higher public coverage rates than in the USA (Buchmueller & Couffinal 2004), we can observe the same adverse selection effects on the French market, especially for individual coverage. While uniform premiums and equal coverage were the two

founding principles of the *mutuelles*, more than 90% of the contracts are now priced with age-based premiums and the market has never been so segmented. Note that experience rating is forbidden in France⁷ and insurers have strong fiscal incentives to avoid medical underwriting⁸. Therefore, age remains the only predictor for the individual risk. Fiscal incentives also constrain insurers to offer a minimal coverage, i.e. reimbursements of NHI co-pays for ambulatory and inpatient care. Yet, insurers target low risks by tailoring contracts with different levels of coverage for medical goods outside of the NHI benefit package: birth control, optical and dental care, hearing devices or balance billing.

As a result, the unregulated competition on the SHI market, where companies offer dozens of contracts with heterogeneous coverage and premium schemes, not only prevent consumers from comparing offers but also rise serious concerns about the efficacy and fairness of the French health insurance system. A French survey conducted in 2013 (DREES 2016) reveals indeed important differences in the extent of coverage among age groups (Table 1). Especially, individuals over 60, despite increasing medical needs, appears to be less covered on all types of care than individuals between 25 and 59 years old.

⁷Loi n° 89-1009 du 31 décembre 1989, Loi Évin

⁸To be certified by the French government as '*Contrats solidaires*', insurers cannot use medical questionnaires

Tables and Figures

Figure 1 – Financing health care: international comparison

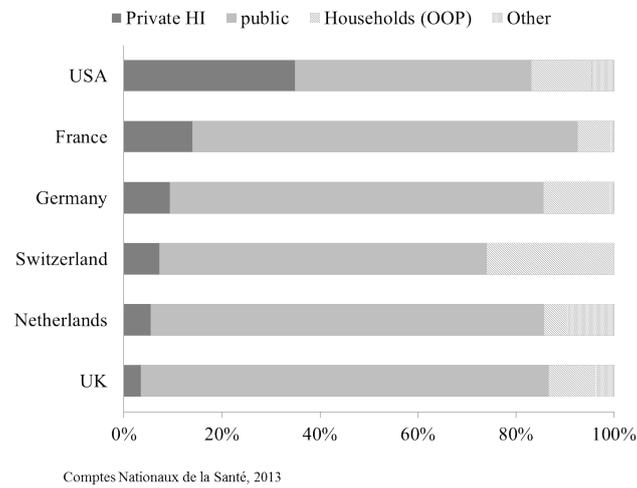


Figure 2 – Average coverage by type of care in France in 2014

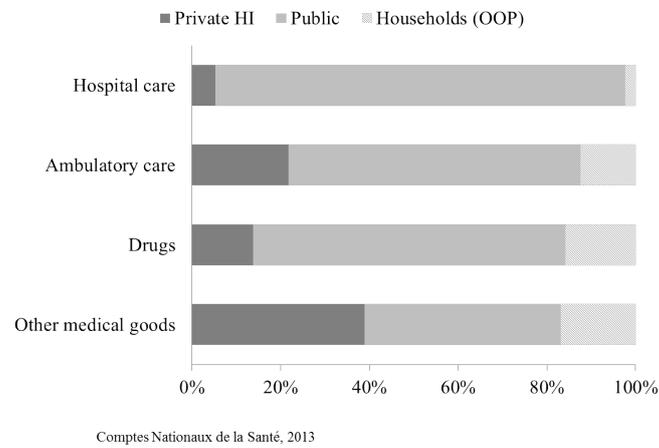


Figure 3 – SHI coverage in France in 2014: type of contracts by occupation

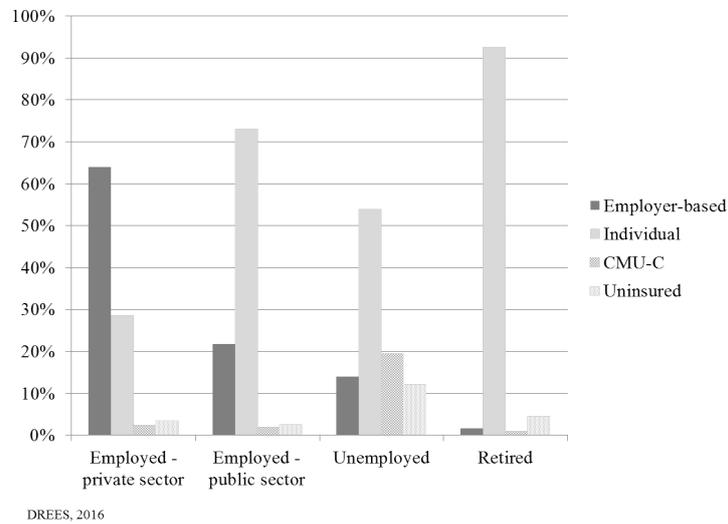


Figure 4 – SHI coverage in France in 2014: type of contracts by income groups

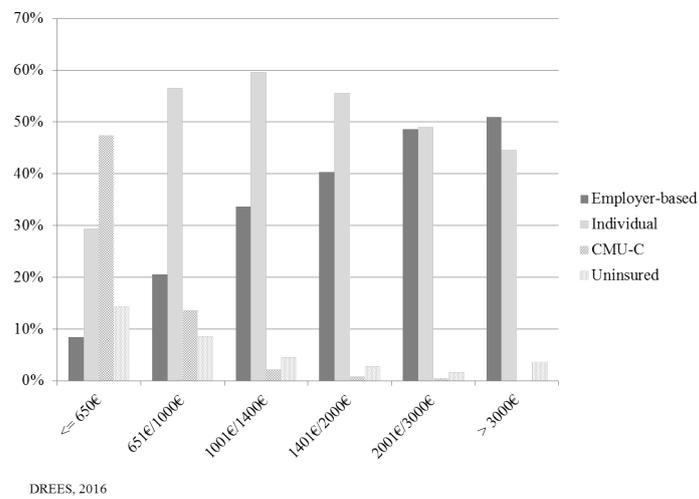


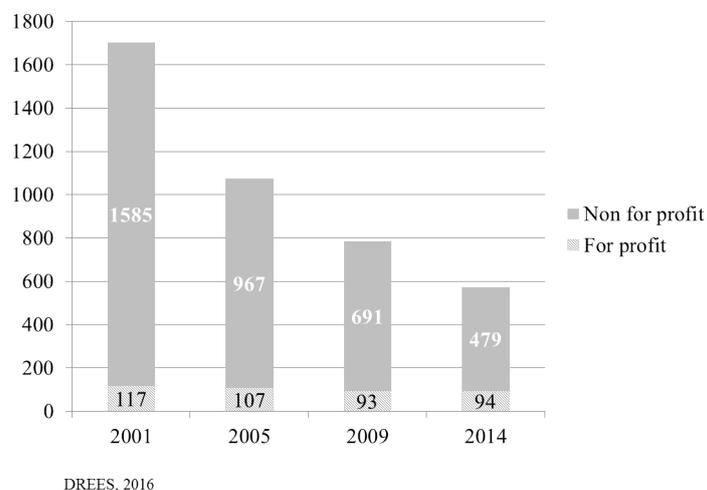
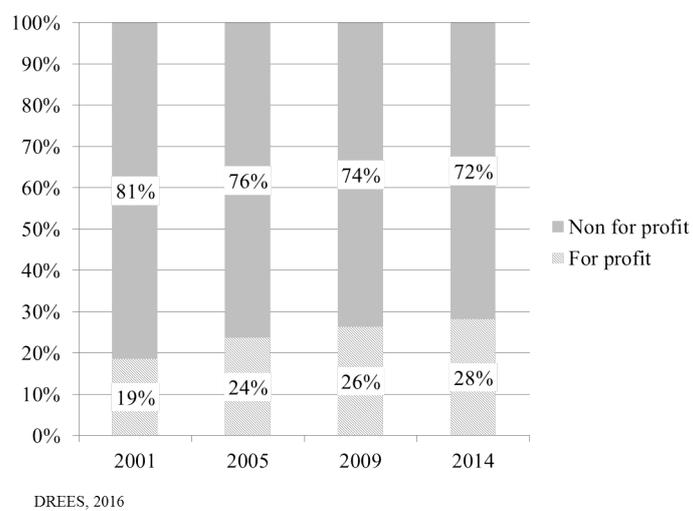
Figure 5 – Number of firms on the French health insurance market, 2001-2014**Figure 6** – Market shares on the French health insurance market, 2001-2014

Table 1 – Average coverage in euros, by age-group, in 2013

Type of medical care	under 25 y.o	25-59 y.o	60+ y.o
Visit to a specialist	12	18	13
Surgeon fees	117	192	135
Simple optical devices	155	230	181
Complex optical devices	237	361	282
Hearing devices	585	1,012	928

DREES, 2016

Chapter 1

Does health insurance encourage the rise in medical prices? A test on balance billing in France

1.1 Introduction

Designed to favour access to care for all, social health insurance is widespread in the European Union and most developed countries. Many debates have focused on the ability of health care systems to contain health expenditure growth, but little attention has been devoted to the fact that effectiveness of coverage depends on the regulator's ability to control medical prices. For ambulatory care, national health insurance (NHI) systems usually set prices or sign agreements with physicians that set a regulated fee, which is the basis for NHI reimbursement. Nevertheless, physicians can sometimes balance bill their patients, i.e. charge them more than the regulated fee.¹ Because balance billing can generate high out-of-pocket expenditures, patients often purchase supplementary health insurance (SHI) to cover this financial risk. However, generous health insurance coverage can cause welfare loss, not only because it might favour excessive consumption of care, but also because healthcare providers can increase their prices (Pauly 1968, Feldstein 1970, Feldman & Dowd 1991). Hence, comprehensive coverage might encourage

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¹The terms "extra billing" or "*dépassements d'honoraires*" (in French) can also be found in the literature

demand for expensive physicians, resulting in an increase in balance billing. This increase leads to a rise in SHI premiums, and jeopardizes coverage for patients who are covered by NHI alone.

The aim of this paper is to measure the causal impact of a positive shock on SHI coverage on recourse to physicians who balance bill. The econometric analysis is performed on a French database of 43,111 individuals observed between 2010 and 2012 and covers specialist consultations in ambulatory care. In addition to measuring the impact of insurance coverage on balance billing, we address two related issues: the influence of supply organization on balance billing (i.e., ease of access to physicians who do not balance bill) and the possible impact of balance billing on access to care.

Balance billing became a political issue in the USA in the late 1980s. Physicians were allowed to charge Medicare patients more than the copayment set by Medicare, the social health insurance system for people aged 65 or more. In 1984, balance billing amounted to 27% of total out-of-pocket payments charged to Medicare beneficiaries for physician consultations. Concerns about possible degradation of healthcare coverage led several states to restrict balance billing, and the federal government followed suit. The Omnibus Budget Reconciliation Act of 1989 restricted balance billing. It was eventually limited to a maximum of 9.25% of the Medicare fee in 1993 (see McKnight (2007) for a full description of Medicare's balance billing reform). Balance billing for physician visits and hospital stays also exists in Canada, Australia, France and Belgium (Epp et al. 2000, Gravelle et al. 2013, Lecluyse et al. 2009).

In France, a large proportion of specialists are allowed to balance bill their patients. The population is covered by mandatory NHI and for each service provided, a reference fee is set by agreement between physicians and the health insurance administration. NHI covers 70% of the reference fee for ambulatory care. Individuals can take out supplementary private insurance: either voluntarily on an individual basis, or through occupational group contracts. Currently, 95% of the French population is covered by SHI. Supplementary insurance contracts cover the 30% of ambulatory care expenses not covered by NHI. In addition, they can offer coverage for balance billing.

Concern about balance billing is mounting in France because it has doubled over the last 15

years and now represents 2.3 billions euros. This expansion is due to an increase in both the average amount of balance billing – which rose by an average 1.7% per year between 2004 and 2011 (DREES 2013)– and the share of doctors (mostly specialists) who balance bill their patients. For policy makers, balance billing has the advantage of permitting an increase in physicians’ earnings with no additional burden on social health insurance. However, it raises out-of-pocket payments and might lead to a two-tier healthcare system where only rich people can afford to see certain doctors. Moreover, the last 10 years have been marked by continuous extension of balance billing coverage by supplementary insurers, together with a continuous increase in the amount of balance billing. This suggests that coverage encourages balance billing. In keeping with this idea, the French government has recently introduced tax reductions for insurers who offer contracts that limit coverage of balance billing.

Balance billing in the context of social health insurance raises several policy questions. Should it be forbidden? Should it be restricted, as for Medicare patients in the USA? Should coverage of balance billing be discouraged as in France? On the contrary, should the government favor balance billing to promote better care quality? Or should the government only monitor the supply of care, to ensure that all patients have a genuine choice, i.e. effective access to physicians who do not balance bill?

In this paper, we evaluate the impact on patient behavior of a shock consisting of better coverage of balance billing, while controlling for supply side drivers. In our framework, the impact of coverage on healthcare use depends both on patients’ beliefs regarding the quality of care provided by physicians who balance bill, and on access to physicians who do not balance bill. Focusing on balance billing enables us to study the impact of insurance coverage (moral hazard) on two dimensions of care use: quality and quantity.

Our database stems from administrative data provided by the Mutuelle Générale de l’Education Nationale (MGEN). We use a panel dataset of 43,111 individuals observed between January 2010 and December 2012, which provides individual information on healthcare claims and reimbursements provided by national and supplementary health insurance. Our data make it possible to observe enrollees when they are all covered by the same supplementary insurer (MGEN-SHI), which does not cover balance billing, and after some of them switched to other supplementary

insurers which do cover balance billing. So, we have at our disposal a treatment group, the 'switchers', and a control group, the 'stayers', made up of those who did not leave MGEN supplementary insurance. Because the decision to switch to a more generous insurance coverage is likely to be non-exogenous, we introduce individual fixed effects into the specifications and use instrumental variables for the estimations.

On the whole sample, we find that better coverage leads individuals to raise their proportion of consultations of specialists who balance bill by 9%, resulting in a 32% increase in the amount of balance billing per consultation. However, the impact of the coverage shock depends on local availability of physicians who charge the regulated fee, measured by the local specialist : population ratio for these physicians. We find that a coverage shock has no significant effect on recourse to expensive physicians or on the amount of balance billing when physicians who charge the regulated fee are readily accessible. On the contrary, when physicians who charge the regulated fee are scarce, a coverage shock has a strong impact: individuals raise their proportion of consultations of specialists who balance bill by 14%, resulting in a 47% rise in the amount of balance billing per consultation; in addition, there is evidence of limits in access to care for a sizeable minority of individuals in this situation (30% of the sample).

To sum up, we find evidence of a moral hazard effect on quality of care: an increase in the proportion of consultations of specialists who balance bill. In addition, we find for some individuals a moral hazard effect on quantity of care: better coverage leads them to increase their number of consultations of specialists, which suggests that balance billing limited their access to specialists. Another important result is the absence of impact of a coverage shock when physicians who charge the regulated fee are widely available, enabling people to choose between physicians who balance bill and physicians who do not. On the basis of these results, it seems that the most appropriate policy is not to limit insurance coverage but to monitor the supply of care in order to guarantee patients a genuine choice of their physicians.

This paper is organized as follows. Section 1.2 summarizes the related literature. Section 1.3 describes French regulation of ambulatory care, and formalizes patients' decisions to consult a physician who balance bill in the French context. In section 1.4, we present our data and em-

pirical strategy. Econometric specification and estimation are presented in section 1.5. Results and robustness checks are presented in section 1.6 and section 1.7 concludes.

1.2 Insurance coverage, medical prices and balance billing: results from the literature

The literature devoted to the impact of health insurance on the market for health care can shed light on the question of the impact of health insurance on balance billing. If more insurance raises demand, this should increase medical prices. Papers studying the influence of health insurance on suppliers' medical pricing date from the 1970s. According to Feldstein (1970, 1973) physicians respond to health insurance coverage by increasing their fees. Using US data, Sloan (1982) showed that a \$1 increase in health insurance coverage results in a 13 to 35 cents increase in physicians' fees. These results are in line with theoretical predictions (Chiu 1997, Vaithianathan 2006). On the demand side, moral hazard depends on the sensitivity of demand to prices (Einav et al. 2013): assuming a negative price-elasticity of demand, better coverage leads to an increase in health care use. However, as pointed out by Phelps & Newhouse (1974), the impact of insurance coverage on demand for health care may depend significantly on time costs associated to access to a doctor, such as travel time or queues in the office. Demand for goods with relatively low time costs is likely to be more sensitive to a change in health insurance coverage.

What is the impact of balance billing on social welfare? After restrictions on balance billing were enacted in the USA, several theoretical papers attempted to predict the effects of this reform on social welfare. Papers by Paringer (1980), Mitchell & Cromwell (1982), Holahan & Zuckerman (1989) assume that physicians face a downward-sloping demand curve and do not differ in the quality of care they provide but are able to price discriminate their patients. If physicians agree to treat patients who pay only the regulated fee, social welfare is unchanged: balance billing results in a transfer of surplus from patients with a high willingness to pay to physicians. More recent papers assume that physicians are not homogeneous and discriminate between patients in price and quality of care (Glazer & McGuire 1993, Kifmann & Roeder 2011). These authors conclude that balance billing improves welfare because quality is higher for both regulated-

fee and balance-billed patients. A key assumption is that physicians have perfect information about patients' willingness to pay and are able to price discriminate perfectly. Jelovac (2013) points out that this assumption is unrealistic. She assumes that physicians do not have perfect information about patients' ability to pay. On this basis, she finds that balance billing can reduce access to care and therefore decrease social welfare.

Empirical evidence on limits to access to health care due to balance billing is rather scarce and inconclusive. Using US data, McKnight (2007) finds that restrictions imposed on balance billing reduced out-of-pocket payments by 9%. However, she does not find any evidence of an increase in healthcare use, which supports the idea that balance billing acts solely as a mechanism of surplus extraction without hindering access to care. On the other hand, a descriptive analysis of French data indicates that healthcare use is reduced in regions where balance billing is widespread (Despres et al. 2011).

1.3 French regulation of ambulatory care and balance billing

In France, ambulatory care is mostly provided by self-employed physicians paid on a fee-for-service basis. Since 1980, physicians can choose between two contractual arrangements with the regulator. If they join 'Sector 1', physicians are not permitted to balance bill. They agree to charge their patients the reference fee (€23 or €25 in 2012 for a routine visit to a generalist or a specialist), and get tax deductions in return. If they join 'Sector', they are allowed to set their own fees. Access to Sector 2 has been closed to most GPs since 1990, so most of them are in Sector 1: 87% in 2012. Hence balance billing concerns mostly specialists. On average, balance billing adds 35% to the annual earnings of Sector 2 specialists. In 2012, 42% of specialists were in Sector 2. However, this proportion varies greatly across regions and specialties: for instance, the proportion of specialists in Sector 2 is 19% for cardiologists, 73% for surgeons and 53% for ophthalmologists.

Patients' out-of-pocket payment for a consultation depends on the sector of the specialists they consult, and on their supplementary insurance coverage. Coverage of balance billing varies between SHI contracts: statistics are not complete, but 52% of individual SHI subscribers are

not covered for balance billing; in polls, 48.5% of all SHI subscribers - both individual and occupational group subscribers - state that they are well covered for balance billing (Célant et al. 2014).

1.3.1 The decision to consult a Sector 2 specialist

Sector 1 and Sector 2 specialists are supposed to provide the same medical service and balance billing is supposed to amount to charging a higher price for the same thing. However, access to Sector 2 has been restricted since 1990 to physicians who have been practicing in a qualifying hospital setting, which suggests that they have higher level of education and of skill. Apart from this, patients have no other information on differences in quality of care provided by physicians. In this context, a physician's choice to belong to Sector 2 can be seen as a signal about skill (Spence 1973) and patients might prefer to consult a Sector 2 physician in order to have a better chance of getting high quality care (Batifoulier & Bien 2000). Nevertheless, beyond the issue of care quality, other potential differences between Sector 1 and 2 specialists are observable: if there is a local shortage in Sector 1 specialists, consulting a Sector 1 specialist exposes the patient to search costs, waiting time and transportation costs, whereas Sector 2 specialists can be more readily accessible.²

Consider a utility maximizing patient who chooses the levels of consumption of non-medical goods (z) and of consultations of Sector 1 and Sector 2 specialists (x_1 and x_2) in order to maximize $U(z, h(x_1, x_2))$ under a budget constraint. h is the level of the patient's health, given by a subjective health production function: $h = h_0 + g(x_1, x_2)$, where h_0 is the level of health without any specialist consultation. The output provided by $g(x_1, x_2)$ depends on a patient's beliefs regarding the productivity and quality of Sector 1 and Sector 2 specialists.

Consider p the regulated fee and bb the level of balance billing. As stated earlier, all supplementary insurance contracts cover the share of the regulated fee which is not covered by NHI, i.e. 30% for a consultation.³ In addition, some SHI contracts cover balance billing. We denote γ the

²A website of the National Health Insurance provides information on available specialists, if they belong to Sector 1 or 2, and indications of their fee level.

³In France SHI contracts are allowed to cover copayments, except for a negligible copay of €1 per consultation which was introduced in 2004.

rate of coverage by mandatory NHI, c the minimal rate of coverage offered by all supplementary health insurers (copayment coverage), and s the balance billing coverage offered by some SHI contracts. The cost of access to Sector 1 or 2 specialists is also influenced by their availability. We denote d_1 and d_2 search costs, as well as transportation and waiting time costs associated to access to a Sector 1 or a Sector 2 specialist. d_1 and d_2 are linked to local specialist : population ratios.

Hence, the total cost of a consultation of a Sector 1 specialist is as follows: $p_1 = p(1 - \gamma - c) + d_1$; and the total cost of a consultation of a Sector 2 specialist is $p_2 = p(1 - \gamma - c) + (bb - s) + d_2$. Given that all individuals in our sample are fully covered for co-payments⁴, $p(1 - \gamma - c) \simeq 0$. The relative price of a Sector 2 consultation is given by⁵:

$$\frac{p_2}{p_1} = \frac{(bb - s) + d_2}{d_1} \quad (1.1)$$

Given this formalization, the decision to consult a Sector 2 specialist is based on cost minimization for a given level of health production $g(x_1, x_2) = h - h_0$. If the patient believes that consultations of a Sector 1 and Sector 2 physician are not perfectly substitutable, the isoquants of the health production function are not linear. Given that the iso-cost lines have a slope equal to the relative price $\frac{p_2}{p_1}$, an increase in balance billing coverage (say, from $s = 0$ to $s > 0$) induces an increase in the use of Sector 2 physicians. The magnitude of the impact depends on the availability of Sector 1 physicians. Indeed, the variation of the relative price with respect to s is $\frac{\partial \frac{p_2}{p_1}}{\partial s} = -\frac{1}{d_1}$.

Note that when Sector 2 physicians are very scarce, $\frac{p_2}{p_1} \rightarrow \infty$ whatever the value of s : in this situation, a change in SHI coverage should have no effect on recourse to Sector 2 physicians. Another specific case is when the patient believes that Sector 1 and Sector 2 physicians are perfectly substitutable: this leads to corner equilibria, with only Sector 1 or only Sector 2 consultations, depending on the value of $\frac{p_2}{p_1}$ and on $g(\cdot)$ parametrization.

⁴Except for the negligible €1 copay.

⁵Given that most contracts impose a ceiling on balance billing coverage, s is not a coverage rate (it is fixed and not proportional to balance billing), but this does not affect the model's predictions.

1.3.2 Availability of Sector 1 and Sector 2 specialists

As stated previously, supply organization can influence recourse to Sector 2 specialists. Figure 1.1 provides geographical information about the specialist : population ratio of Sector 1 and Sector 2 specialists for the 95 *départements* of continental France. The specialist : population ratio is an indicator of physicians' availability, i.e. search, transportation and waiting time costs associated to access to a Sector 1 or a Sector 2 specialist. Medical density is used here as an indicator of distance (in the geographical and time sense) to the doctor. We are not interested in using a concentration index for comparing market power of Sector 1 versus Sector 2 specialists because what is important in our analysis is to measure the distance for patients to any single doctor of each type. Of course the specialist : population ratio is an imperfect indicator because there are border effects and geographical areas do not coincide with practice areas.

Figure 1.1 shows that there is not always an inverse relation between specialist : population ratios for Sectors 1 and 2 specialists: on the Mediterranean coast, both types of specialists are numerous. Conversely, in Brittany (the North-West of France), there are many Sector 1 specialists and very few Sector 2 specialists. The Parisian region, on the other hand, has many Sector 2 specialists and very few Sector 1 specialists. Figure 1.2 gives the proportion of Sector 2 specialist consultations and average balance billing per consultation for each *département*, as computed on our sample. The comparison with Figure 1.1 suggests a strong impact of supply side drivers on both propensity to see a Sector 2 specialist and the amount of balance billing.

1.4 Data and empirical strategy

We use a panel data set from a French supplementary insurer: *Mutuelle Générale de l'Éducation Nationale* (MGEN). For historical reasons, MGEN processes claims from NHI in addition to offering supplementary insurance (MGEN-SHI). Our data stemmed from administrative MGEN data: they provide, for each policyholder, detailed information about medical bills and reimbursements for both national and supplementary insurance.

MGEN is a *mutuelle*, i.e. a non profit insurer which administrates mandatory health insurance for teachers and ministry of education employees. Most of them are civil servants. MGEN also supplies supplementary health insurance in the form of a single contract which offers minimal coverage: it covers co-payments but not balance billing. The premium is defined as a proportion of wages for working members and of pensions for retirees. People subscribe to this supplementary insurance on a voluntary basis. The fact that its premiums are proportional to wages gives MGEN an odd position in the SHI market. Most supplementary insurers charge a premium that does not depend on wage or income. In the short term, young, healthy and wealthy teachers should be better off purchasing coverage with a premium that depends on age. However, the MGEN-SHI contract becomes more valuable as individuals grow older. In order to avoid free riding, MGEN-SHI penalizes late entry and does not allow members who leave to return later on. Currently, MGEN processes NHI claims for 3.3 million individuals (all teachers and ministry of education employees, their families and pensioners). Among them, 2.3 million subscribe to the MGEN-SHI contract.

1.4.1 Empirical strategy

Our empirical strategy is based on MGEN-SHI enrollees who switched to other supplementary insurers during our observation period. Since MGEN-SHI covers only co-payments, i.e. the minimal coverage offered by supplementary health insurers, we can assume that this switch entails equal or better coverage.

From the MGEN database, we built two samples over the period 2010-2012: one with 87,291 'stayers', the other one with 7,940 'switchers'. The former remained MGEN-SHI enrollees over the observation period (2010-2012), the latter was MGEN-SHI subscribers in January 2010, but terminated their contracts in 2011. Because MGEN still processes their NHI claims in 2012, we observe their health expenditures over the whole period. Switchers' decision to leave in 2011 creates a positive shock on their insurance coverage. Therefore, we can use Stayers and Switchers as control and treatment groups (Figure 1.3).

We do not observe switchers' coverage for balance billing after they have left MGEN-SHI. However, since MGEN-SHI coverage of balance billing is zero, we know that their new coverage

will be at least as good as, and probably better than the MGEN-SHI coverage. Hence our estimated impacts should be interpreted as 'intent-to-treat' (ITT) effects. These are likely to understate the real impact of better insurance coverage and should be interpreted as lower bounds.

The original sample was composed of 91,629 stayers and 8,249 switchers. For the purpose of the study, we decided to over-represent switchers: in our data the proportion of switchers is not representative of the actual switching rate of 0.5%. We excluded the people who live outside continental France (territories such as Guadeloupe, Martinique, and so on) and the top 1% of care users in 2010 or 2012 (more than 28 consultations a year for stayers, 30 for switchers). As stated above, balance billing is not an issue for GPs, so we focus on specialists. More precisely, we measure the effect of insurance coverage on the decision to visit a specialist who balance bills, conditional on consulting a specialist. Therefore, we restricted the sample to individuals who consulted a specialist at least once in 2010 and in 2012 ($spe = 1$). They represent 45% of stayers and 48% of switchers. To sum up we use a sample of 43,111 individuals: 39,292 are stayers and 3,819 switchers; they are observed from 2010 to 2012 and consulted a specialist at least once in 2010 and in 2012.

1.4.2 Variables

Our data provide information at the individual level about the total number of specialist consultations (denoted Q), the number of consultations of Sector 2 specialists ($Q2$) and the total amount of balance billing (BB). Our variables of interest are the number of specialist consultations Q , the proportion of consultations of Sector 2 specialists $Q2/Q$, average balance billing per consultation BB/Q and average balance billing per Sector 2 consultation $BB/Q2$ (the last indicator is computed for individuals with at least one visit to a Sector 2 specialist ($Spe2 = 1$)).

Using these four indicators allows us to distinguish between patients' use of specialists, patients' decisions to consult a Sector 2 specialist, and the amount of balance billing. Of course, the average amount of balance billing per Sector 1 or 2 consultation (BB/Q) is influenced both by the proportion of Sector 2 consultations and, on the supply side, by $BB/Q2$ the prices set by Sector 2 specialists.

At the individual level, we can only compute average balance billing. Indeed, our data provides information on the number of consultations for each specialty in Sector 1 and Sector 2 but not on the fee associated with each consultation. However, we can take advantage of the specialties needed by patients to control for the extent of their choice of Sector 1 or 2 specialists. In France, gynecologists, ophthalmologists, surgeons and ENT⁶ specialists balance bill in a much larger proportion than their colleagues. As a result, it is more difficult to avoid a Sector 2 physician for a patient who needs to consult one of these types of specialists, inducing more balance billing per consultation. To deal with this heterogeneity, we introduce a dummy variable for "expensive physicians" (*Exp.Phy*), which is equal to 1 when the individual sees at least one of these specialists.

Demand characteristics include gender, age, income and health status. Our income variable is based on the individual's wage. It is computed using the fact that MGEN-SHI premiums are proportional to individuals' wages. Because premiums are limited by lower and upper bounds for monthly wages lower than €1,000 and higher than €4,900, this proxy is close to a truncated individual wage. As concerns health status, we know if the patient has a chronic disease ($CD = 1$). Supply side characteristics include visits to a GP, specialist : population ratios and the *Exp.Phy* dummy variable. In France, one can consult a specialist without seeing a GP beforehand. Patients do not need their GP's agreement to consult gynecologists or ophthalmologists. For other specialties, GPs are gatekeepers and their consent determines the extent of NHI reimbursement.⁷ We control for this arrangement with a dummy indicating that the patient consulted a GP at least once in the current year. Supply side organization is taken into account using information provided by the NHI⁸ about specialist : population ratios at the *département* level in Sector 1 (SPR1) and 2 (SPR2). We introduce an interaction between Sector 1 and 2 specialist : population ratios to allow for non linear effects.

⁶Ear, nose and throat specialists.

⁷Reimbursements are reduced in case of recourse to a specialist without a GP's referral and incentives are given to SHI to not cover this penalty.

⁸SNIR (*Syndicat National Inter Régimes*), provided by CNAMTS (*Caisse Nationale d'Assurance Maladie des Travailleurs Salariés*)

1.4.3 Basic features of the data

Because MGEN enrollees are mostly teachers, the sample is not representative of the French population (Table 1.1). There are many women (65%), their average age is 55, and the average monthly wage is €2434, which is higher than the average wage in France. We warn against generalizing our results to different settings, because we are dealing with a population which is likely to have specific habits concerning health, specific values and a particular degree of risk aversion.

Most studies of competition in health insurance find a higher propensity of young, healthy and highly educated individuals to switch companies (Dormont et al. 2009). We find the same characteristics for people who decided to leave MGEN-SHI: they are much younger (42.5 versus 55.4) and healthier than stayers (only 6.8% have a chronic disease, versus 17.5%). However, our switchers have a lower income than stayers. This is because wage variability is reduced for teachers in comparison with the whole population; moreover, teachers' wages are strongly correlated with age because promotions are mostly based on seniority. Here, switchers have a lower income partly because they are thirteen years younger than stayers on average.

Table 1.2 displays statistics about recourse to specialists, proportion of Sector 2 consultations and amount of balance billing for stayers and switchers in 2010, when both groups had no coverage for balance billing. These statistics depict heterogeneity in preferences and situations for individuals with the same coverage. On average, stayers and switchers consulted specialists respectively 3 and 3.2 times in 2010. The proportion of Sector 2 consultations is significantly higher for switchers than for stayers: 51.6% versus 44.6%. As a result, switchers pay significantly more balance billing in total (€41 versus €30) and per consultation (€12.8 versus €10.2). So, even when they had no coverage for balance billing, switchers consulted Sector 2 specialists more often and paid more balance billing than stayers.

The second column of Table 1.2 gives the mean and standard deviations for observations that are higher than the 99 percentile (average of the top 1%) for each indicator. The top 1% average values of balance billing show that, even with a SHI contract, individuals are not

protected against high out-of-pocket expenditures: €433 per year for stayers and €505 per year for switchers.⁹

The two last columns of Table 1.2 display mean and standard deviations computed for individuals living in areas characterized by low or high levels of Sector 2 specialist : population ratio. We find a strong influence of supply side organization: differences between stayers and switchers are significant only in places with many Sector 2 specialists (last column).

1.5 Econometric specification and estimation

The causal impact of a positive coverage shock on our variables of interest can be identified by estimating a model with individual fixed effects on the panel obtained by pooling years 2010 and 2012. To compare switchers and stayers, we include in the regressors a dummy variable named *QUIT* which represents leaving MGEN-SHI in 2011 ($QUIT = 1$ for Switchers in 2012, $= 0$ in 2010). We also include a dummy variable for the year 2012 ($I_{2012} = 1$ for $t = 2012$, $I_{2012} = 0$ for $t = 2010$) to allow for a possible trend that would induce changes in behavior for both switchers and stayers. We also control for time varying demand and supply variables denoted X_{it} and S_{it} . Vector X_{it} includes variables recorded at the individual level: income, chronic disease and GP consultation. S_{it} is a vector of regressors relative to supply organization: specialist : population ratios for Sector 1 and Sector 2 in the *département* where the patient lives, and the dummy variable indicating the patient's need for expensive physicians *Exp.Phy*.

$$Y_{it} = \beta_0 + \tau QUIT_{it} + \lambda I_{2012,t} + \beta_1 X_{it} + \beta_2 S_{it} + \alpha_i + \epsilon_{it}, \quad t = 2010, 2012 \quad , \quad (1.2)$$

Y_{it} denotes the dependent variable, which is one of the four indicators of interest: $\log(Q)$, $\log(Q2/Q)$, $\log(BB/Q)$ and $\log(BB/Q2)$. We introduce individual fixed effects α_i . The disturbance ϵ_{it} is supposed to be iid $(0, \sigma_\epsilon^2)$.

Specifying a fixed effect α_i allows for potential nonexogeneity of the decision to leave MGEN-SHI if this decision were correlated with individual unobserved heterogeneity. These effects

⁹This is especially true because these figures are computed on a sample where the top 1% of care users have already been excluded: on the whole sample, we find average annual balance billing for the top 1% of care users equal to €638 for stayers and €914 for switchers.

are likely to be connected to switchers' permanent belief in better quality of care in Sector 2, or specific tastes that would induce higher disutility of time consuming travel and search efforts. The decision to leave MGEN-SHI might also be induced by a transitory shock in health care needs (the onset of illness which we cannot observe perfectly, although we observe and control for the onset of chronic disease) or by an information shock that affects beliefs regarding quality of care in Sector 2. In this case, there is a correlation between ϵ_{it} and the decision to leave MGEN-SHI. For this reason, we have performed an instrumental variable estimation of equation (1.2), in order to obtain a consistent estimation of the causal impact of improved coverage on Y_{it} .

A reliable instrument must be correlated with the decision to leave MGEN-SHI (*QUIT*) and must not directly affect the dependent variable Y_{it} . We have at our disposal two variables that are good candidates to be relevant instruments, and appeared to be exogenous and well correlated with *QUIT*. We used the decision to retire in 2011 for people younger than 55 and a change of *département* of residence in 2011. The threshold chosen for retirement age refers to a specific right for public school teachers and other civil servants that allowed those who raised three or more children to retire before they were 55.¹⁰ This right was revoked recently and eligible teachers had to use this opportunity before January 2012. This retirement policy change created an exogenous shock that gives us a good instrument. As shown in Figure A1 (in the online appendix), a large number of teachers retired in 2011 before they were 55 (300 in our sample) and half of them decided to leave MGEN-SHI the same year. MGEN pricing rules raise premiums from 2.97% of wages before retirement to 3.56% of pensions after. This shock on premiums can encourage people to switch, irrespective of any shock on care needs or beliefs in the quality of care in Sector 2. We also use the decision to move from one *département* to another in 2011 as an instrument for the decision to leave MGEN-SHI.¹¹ Because MGEN has separate agencies in each *département*, MGEN-SHI policy holders who move to a new *département* face high administrative costs in order to transfer their records to a new agency. Individuals who hesitated to switch before moving because of switching costs, may decide to switch upon moving because they face administrative costs in any case.

¹⁰Civil servants who raised three children or more were eligible for early retirement if they had worked in the civil service at least 15 years.

¹¹In our sample, 1,415 individuals decided to move from one *département* to another in 2011, of which 287 decided to leave MGEN-SHI the same year.

Even though it was encouraged by an exogenous policy change, early retirement might be linked with a negative health shock. To address this concern, we checked that individuals who retired before 55 in 2011 were not different in 2010 from those who remained active, as regards chronic disease, GP and specialist consultations, as well as drug consumption (Table AI in the appendix). We also found that future movers were not different in 2010 from non-movers either. Another difficulty arises if exogenous incentives to switch because of early retirement or *département* change are concomitant with a health shock. To rule out this possible source of bias, we checked if our compliers experienced any shock in their number of GP consultations and drug consumption between 2010 and 2012. Indeed, because MGEN-SHI fully covers co-payments for GP visits and drugs, a shock on SHI coverage together with no change in health care needs should induce no change in recourse to GPs or drug consumption. Results displayed in Table AII show that we have not found any significant change between 2010 and 2012 in use of GPs or drugs for switchers who moved or took early retirement. Conversely, a negative health shock should increase both GP visits and drug consumption. Hence the strong impact of the onset of a chronic disease on the number of GP consultations (+13%) and drugs consumption (+64%), see Table AII.

1.6 Results

Our results are displayed in Tables 1.3 and 1.4. Table 1.3 gives the estimates of the causal impact of better coverage on the four indicators Y_{it} . Table 1.4 presents the estimations for the other regressors and individual fixed effects.

Several tests support the consistency of our instrumental variable estimates. Sargan tests all lead to non rejection of instrument compatibility.¹² In addition, we examined whether our estimations could be subject to the weak instrument problem. For this purpose, we tested for the significance of the excluded instruments in first stage regressions. We found a large significance of the partial correlation between the excluded instrument and *QUIT*, with high F statistics (larger than 92, see Table AIII in the appendix). Following Bound, Jaeger and

¹²For dependent variables $\log(Q)$, $\log(Q2/Q)$, $\log(BB/Q)$ and $\log(BB/Q2)$, we obtain very small values for the Sargan statistic, with p-values that are equal, respectively, to 0.94, 0.85, 0.71 and 0.10. We obtain similar results when we split the sample into sub-samples relative to different levels of SPR1.

Baker (1995), this suggests that we can rule out instrument weakness. We rely on IV results when Hausman tests lead to rejection of *QUIT* exogeneity. Otherwise we can rely on OLS estimates, which are consistent with IV estimates when *QUIT* is exogenous. All estimations include individual fixed effects.

1.6.1 The impact of better coverage on the use of Sector 2 specialists and balance billing

Table 1.3 provides the OLS and IV estimates of the impact τ of the coverage shock for the whole sample (1) and various sub-samples (2-4), on the use of specialists, the proportion of Sector 2 consultations and the amount of balance billing per consultation. For each sub-sample and each dependent variable we also provide the Hausman test p-value. As stated previously, we control for unobservable individual heterogeneity and potential non-exogeneity of *QUIT*. Note that a more simple difference-in-differences approach comparing stayers and switchers in 2010 and 2012 led to results that were similar to our fixed effect OLS estimates.

For the whole sample (1), better coverage has no impact on the use of specialists ($\log(Q)$) but increases the share of Sector 2 consultations by 9%, which results in a 32% increase in the amount of balance billing per consultation. Hence, because it raises demand for Sector 2 physicians, better coverage by supplementary health insurance is likely to encourage the rise in medical prices. However, we do not find a significant effect of better coverage on the price of Sector 2 consultations ($\log(BB/Q2)$): patients who normally visit S2 specialists do not take advantage of their better coverage to see even more expensive physicians. This also suggests that physicians do not adjust their prices to their patients' coverage, at least in the short run.

As concerns significant coefficients, we find 2SLS estimates that are larger than the OLS estimates (see, for instance, Table 1.3, (1)). At first glance, it seems surprising to find a negative endogeneity bias, given that people presumably switch insurers to enjoy better coverage for balance billing. In fact, such a negative bias is quite possible: given that our specification allows for an individual fixed effect, the IV estimation mostly corrects bias due to transitory health shocks. These shocks can be positively or negatively correlated over time, but a negative correlation is more likely because the onset of a chronic disease is already captured through a dummy variable

in the regressors. Let us take the example of a tibia fracture in 2010. The patient experiences many consultations with large balance billing and she decides to quit MGEN-SHI in 2011 to get better coverage. In 2012, her need for Sector 2 specialist consultations is lower because she has recovered (however, our IV estimates show that, for a given level of needs, she uses more Sector 2 specialists than before quitting, because of the improvement in coverage).¹³

1.6.2 The effect of supply side organization on the impact of better coverage

As shown in Figure 1.1, local availability of Sector 1 specialists varies dramatically across geographical areas (*départements*). This is likely to induce heterogeneity in the impact τ of better coverage because the relative price of a Sector 2 consultation is not only influenced by balance billing coverage s , but also by search and transportation costs d_1 and d_2 to reach a Sector 1 or 2 specialist. Because $\frac{p_2}{p_1} = \frac{(bb-s)+d_2}{d_1}$, one has $\frac{\partial \frac{p_2}{p_1}}{\partial s} = -\frac{1}{d_1}$, suggesting that the impact of a coverage shock depends on the availability of Sector 1 specialists. Precisely, assuming that search costs, transportation costs and waiting time decrease with the number of Sector 1 specialists, the impact of insurance coverage should be higher in regions where the number of Sector 1 specialists is relatively low.

To investigate this, we split the sample into two sub-samples,¹⁴ one with areas with high Sector 1 specialist : population ratios (*SPR1*), the other with medium and low levels. The results are striking: when Sector 1 specialists are numerous (Table 1.3, (2)), a coverage shock has no impact on the use Sector 2 specialists and balance billing. In other words, when patients have a

¹³A simple model enables us to compute the bias. For individual i , denoting the year by $t = 10, 11$ or 12 , we have:

$$bb_{i,10} = v_i$$

$$quit_{i,11} = a bb_{i,10} + u_i + \varepsilon_{i,11} + \xi_{i,11}$$

$$bb_{i,12} = \tau quit_{i,11} + v_i + \eta_{i,12}$$

where bb is the use of balance billing and $quit$ is the decision to quit in 2011. Formally, the model above removes all control variables (density levels, income, chronic disease indicator, etc.) by taking the residuals of the projections of balance billing and $quit$ on these control variables (Frish-Waugh theorem). v_i (respectively, u_i) is an individual fixed effect referring to the disutility of transportation costs for i (respectively, to i 's risk aversion). u_i and v_i are supposed to be uncorrelated. ε and η are transitory health shocks influencing the decision to quit and the use of specialists who balance bill their patients. ξ is the transitory policy shock related to the repeal after 2011 of the possibility to retire before 55. ξ is supposed to be uncorrelated with v , ε and η . Denoting $\hat{\tau}_{ols}$ the OLS estimator of τ , one has: $p \lim \hat{\tau}_{ols} = \tau + a \frac{\sigma_v^2}{\sigma_q^2} + \frac{\sigma_{\varepsilon\eta}}{\sigma_q^2}$, where σ_v^2 and σ_q^2 denote the variances of v and $quit$, and $\sigma_{\varepsilon\eta}$ denotes the covariance between $\varepsilon_{i,11}$ and $\eta_{i,12}$. In fixed effect estimations, v_i is removed from the specification and the asymptotic bias becomes: $p \lim \hat{\tau}_{ols,FE} = \tau + \frac{\sigma_{\varepsilon\eta}}{\sigma_q^2}$. It has the same sign as $\sigma_{\varepsilon\eta}$, which can be positive or negative.

¹⁴We have performed estimations allowing coefficient τ to vary across local proportions of sector 1 specialists. These estimations provide coefficients that are similar in magnitude and precision to what we obtain when splitting our sample into various sub-samples, as presented in this section.

genuine choice, we do not find evidence of moral hazard. Conversely, when Sector 1 specialists are scarce (Table 1.3, (3)), we find larger impacts: better coverage yields a 14% increase in the proportion of consultations of Sector 2 specialists, and a 47% increase in the average amount of balance billing per consultation.

Finally, we find evidence of limits in access to care on a sub-sample (Table 1.3, (4)) restricted to areas where Sector 1 specialists are scarce. This is the only case where we find that better coverage induces a significant rise in the quantity of specialist consultations Q (+ 42%), in addition to impacts on the share of Sector 2 consultations and on average balance billing per consultation. This result suggests that the lack of Sector 1 specialists in these areas creates a shortage in affordable care, leading some individuals to give up on specialist consultations. This evidence of limits in access to care concerns a sizeable minority of individuals in our sample (30%).

1.6.3 Other determinants of balance billing

We now focus on the respective effects, *ceteris paribus*, of supply side organization, income and chronic diseases on specialist visits, use of Sector 2 specialists and average amount of balance billing per Sector 2 consultation. Table 1.4 presents the estimates of parameters λ , β_1 and β_2 resulting from OLS applied to equation 1.2 with fixed effects, for the four indicators Y_{it} . For these coefficients, magnitude and significance of 2SLS estimates are similar. Table 1.4 also displays the OLS estimates of dummy $Switcher_i$, equal to 1 if individual i quits MGEN-SHI in 2011 on estimated fixed effects obtained in the panel data estimation.

On our reduced form, the impact of medical density results, on the demand side, from distance to Sector 1 or 2 specialists and, on the supply side, from the process of price setting by Sector 2 specialists. We find that a higher proportion of Sector 2 specialists at the local level leads to an increase in the price of Sector 2 consultations, with a reduced impact if there are many Sector 1 specialists. An increase from 15 (Low SPR2) to 25 (High SPR2) Sector 2 specialists per 100,000 inhabitants increases the average price of a Sector 2 visit by 5% in Low SPR1 but only by 1.6% in High SPR1. Given that the proportion of Sector 2 specialists is especially high (above 50%) for gynecologists, surgeons, ophthalmologists or ENT specialists, patients who need to

consult one of these specialists have little choice. Our estimates show that a visit to one of these specialists increases the average amount of balance billing per consultation by 79%.

Other determinants such as income or health status do not affect the consumption of balance billing. An increase in income does not change the use of Sector 2 specialists.¹⁵ However, we find a significant impact on the total number of visits to a specialist: a 10% increase in income increases the annual number of visits by 1.6%. Individuals with greater health care needs do not change their use of Sector 2 specialists either. Indeed, patients who suffer from a chronic disease are likely to increase the number of visits by 19% but do not change their proportion of Sector 2 visits.

Demand for Sector 2 consultations can also be explained by unobservable individual preferences (beliefs in Sector 2 quality, desire to avoid waiting lists). Actually, we find evidence of individual heterogeneity between stayers and switchers. To do so, we regress the dummy $Switcher_i$ on the estimated individual fixed effects obtained in the panel data estimation. Obviously, with a 2-year panel, we cannot expect our estimates of α_i to be consistent. Nevertheless, it is interesting to examine the correlation between these estimates and recourse to Sector 2 specialists. We find that the average amount of balance billing per visit is 21% higher for switchers than for stayers. Regardless of their insurance coverage, switchers visit Sector 2 specialists more often (the share of Sector 2 is 4% higher for switchers) and those specialists charge them higher fees (+8%). So, we find that switchers, i.e. people who seek better coverage, have also a higher utilization of Sector 2 specialists.

1.6.4 Robustness checks

Given the exogenous shock on retirement rules in 2011, 'early retiree in 2011' is a very convincing instrument. Unfortunately, if we use it as the only excluded instrument for QUIT, we end up with a relatively small number of compliers. In order to increase our estimators' precision we use it together with the instrument 'move in 2011'. In Table AIV (in the appendix), we show that most results remain similar in magnitude when using only the 'early retiree in 2011' instrument.

¹⁵Because our specification entails fixed effects, the estimated impact of income here measures the effect of a *change* in income for a given individual. Actually, the level of income is positively correlated with the use of balance billing: between individuals, the fixed effects are significantly correlated with income levels.

However, the result on the quantity of consultations in Low SPR1 seems mainly driven by the people who move in 2011.

Our results are also very robust to a change in the definition of SPR1 categories. We checked that results do not change when using the median to split our sample. Results are also robust when we exclude areas where there are very few Sector 2 specialists from the sample (see Table AV in the appendix). Indeed, when the number of Sector 2 specialists is very low, having better coverage for balance billing does not have any effect, because people do not have access to a Sector 2 specialist in any case. Our estimations confirm this idea but we decided not to present this result because the number of switchers in these areas is too small.

1.7 Conclusion

In this paper we evaluate the causal impact of an improvement in health insurance coverage on the use of specialists who balance bill. We use panel data to control for unobservable individual heterogeneity and rely on instrumental variable methods to deal with possible non-exogeneity of the decision to switch to an insurer that offers better coverage for balance billing.

In France, the use of Sector 2 specialists (who balance bill) can be due to a belief that they provide better quality of care, or to difficulties in gaining access to other doctors, i.e. Sector 1 specialists, who do not balance bill. If the latter is not numerous, patients face search costs, waiting time and transportation costs in order to consult a specialist who does not charge more than the regulated fee. As a matter of fact, we find a large heterogeneity between individuals in the propensity to use Sector 2 specialists. In particular, people who decided to leave MGEN-SHI, i.e. switchers, are more likely to consult Sector 2 specialists, *ceteris paribus*.

Our estimations show that better coverage increases the demand for specialists who balance bill. On the whole sample, we find that better coverage leads individuals to raise their proportion of consultations of specialists who balance bill by 9%, which results in a 32% increase in the amount of balance billing per consultation. However, the effect of health insurance clearly depends on supply side organization. We find no evidence of any impact of a coverage shock on

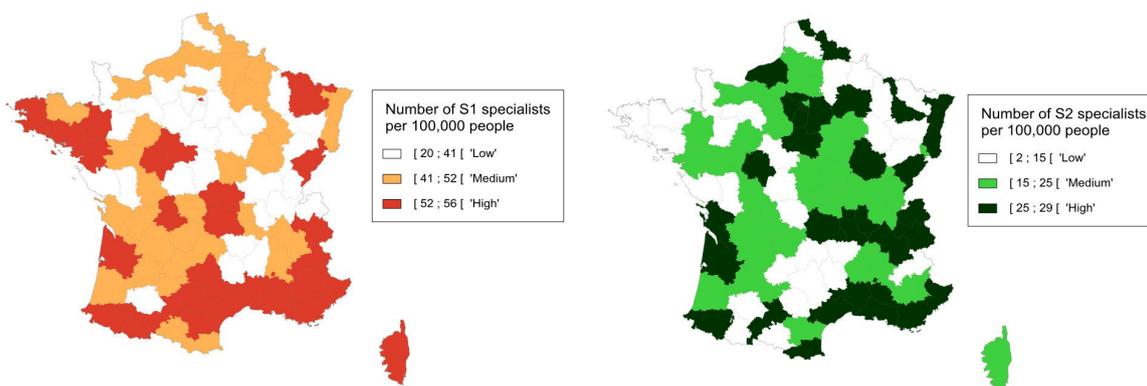
the use of Sector 2 specialists in areas where there are many Sector 1 specialists. About 42% of the sample live in these areas and therefore would not increase their use of expensive physicians if their coverage for balance billing improved.

On the contrary, when Sector 1 specialists are scarce, a coverage shock has a strong impact: individuals raise their proportion of consultations of Sector 2 specialists by 14%, which results in a 47% rise in the amount of balance billing per consultation (this concerns 58% of the sample). In addition, we find evidence of limits in access to care due to balance billing in areas where Sector 1 specialists are scarce. Indeed, better coverage enables people living in these areas to increase their number of consultations. Evidence of such limitation concerns 30% of our sample, a sizeable minority. Given that low-income individuals are under-represented in our sample which consists mostly of teachers, our estimated effect of better coverage on access to specialist care should be interpreted as a lower-bound. Consequently, this result suggests that balance billing is likely to induce non-negligible limits in access to specialists in France.

Our results enable us to deal with current policy questions regarding regulation of balance billing and SHI. We have found that generous supplementary coverage can contribute to a rise in medical prices by increasing the demand for specialists who balance bill. However, this inflationary impact appears only when few specialists charge the regulated fee. When people can choose between physicians who balance bill and physicians who do not, a coverage shock has no impact. When the number of specialists who charge the regulated fee is sufficiently high (e.g., more than 52 specialists for 100,000 inhabitants), there is no evidence of limits in access to care, or of an inflationary effect of supplementary coverage. In consequence, the most appropriate policy to guarantee access to care while containing the price of care is to monitor supply in order to give patients a genuine choice of physicians. Furthermore, we have found heterogeneity in preferences such that some individuals prefer to consult specialists who balance bill. Hence, this policy allows for an improvement in welfare through insurance contracts offering balance billing coverage for those who want it. However, if policy makers are not able to ensure a sufficient supply of specialists who charge the regulated fee, limiting insurance coverage can be a second best solution to contain the increase in medical prices.

Tables and Figures

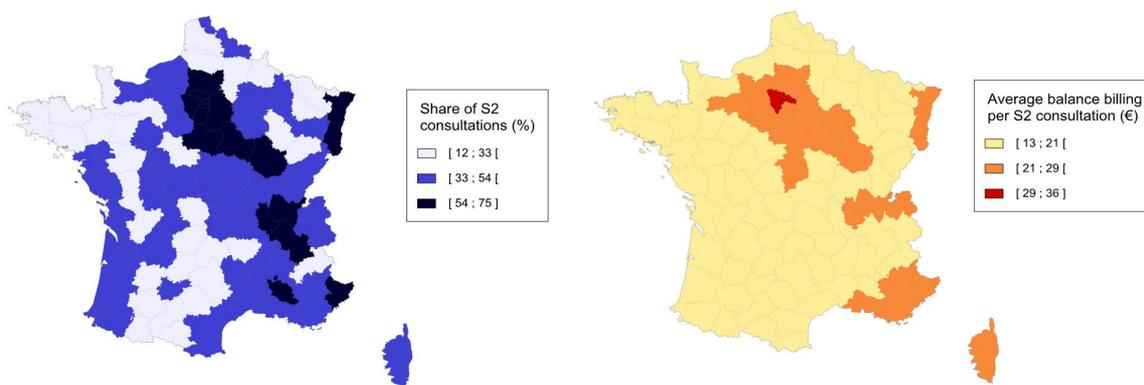
Figure 1.1 – Specialist:population ratio at the *département* level for Sector 1 and Sector 2 specialists in 2010



Source: SNIR data

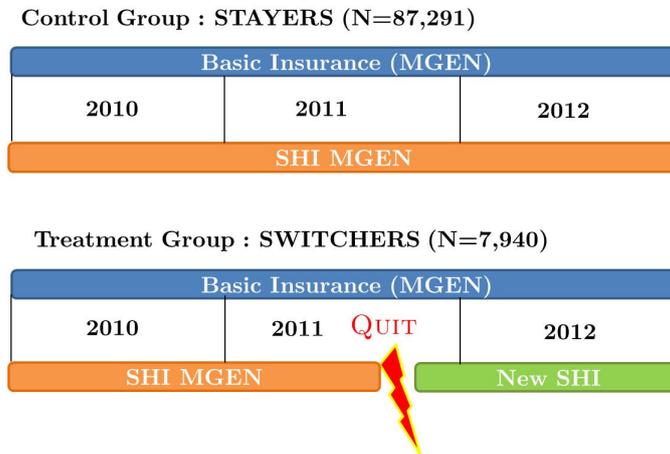
Source: SNIR data

Figure 1.2 – Share of consultations of Sector 2 specialist ($Q2/Q$) and average balance billing per Sector 2 consultation ($BB/Q2$) in 2010



Source: MGEN sample, N=58,336

Source: MGEN sample, N=34,536

Figure 1.3 – Control and treatment groups**Table 1.1** – Number of Stayers and Switchers and individual characteristics in 2010

	Whole sample N	if Spe=1 N	if Spe2=1 N	Women %	Age mean (sd)	Income mean (sd)	CD %
Stayers	87,291	39,292	17,848	65	55.4 (15.3)	2434 (774)	17.5
Switchers	7,940	3,819	2,101	71 ***	42.5 ^ (13)	2399 *** (770)	6.8 ***

CD: Chronic Disease

*** Significantly different from Stayers, $p < 0.01$

Table 1.2 – Number of specialist visits and amount of balance billing in €uros in 2010

		Whole sample mean (sd)	Last centile† mean (sd)	Low SPR2 mean (sd)	High SPR2 mean (sd)
Q	Stayers	3 (3.2)	21.4 (2.7)	2.6 (2.7)	3.2 (3.5)
if Spe=1 in 2010	Switchers	3.2 *** (3.4)	22 (3.1)	2.7 (2.8)	3.4 ** (3.6)
Q2	Stayers	1.3 (2.0)	14 (4.2)	0.6 (1.3)	1.6 (2.3)
if Spe=1 in 2010	Switchers	1.6 *** (2.4)	15.5 *** (3.5)	0.7 (1.5)	1.9 *** (2.6)
Q2/Q	Stayers	44.6% (0.44)	100% b (0.00)	25.2% (0.38)	53.4% (0.43)
if Spe=1 in 2010	Switchers	51.6% *** (0.44)	100% (0.00)	28% (0.40)	60% *** (0.42)
BB	Stayers	30 (58.9)	433 (184)	11.5 (31.2)	42 (74)
if Spe=1 in 2010	Switchers	41 *** (72.8)	505 *** (164)	13 (26.7)	53.6 *** (85.5)
BB/Q	Stayers	10.2 (12.5)	62 (14.7)	4.6 (8.5)	13.5 (13.9)
if Spe=1 in 2010	Switchers	12.8 *** (13.6)	65 (10.8)	5.1 (8.7)	16 *** (14.5)
BB/Q2	Stayers	22 (11.5)	76.8 (17.2)	18 (10.2)	25 (12)
if Spe2=1 in 2010	Switchers	24 *** (11.8)	76 (11.3)	18 (10)	26 *** (12)

*** Significantly different from Stayers, $p < 0.01$

** Significantly different from Stayers, $p < 0.05$

MGEN sample: 58,336 individuals with at least one specialist consultation in 2010

BB/Q2: subsample of 34,536 individuals with at least one S2 specialist consultation in 2010

† Highest percentile for each variable.

b 32% of stayers and 37% of switchers visited exclusively S2 specialists hence $Q2/Q = 100\%$

SPR2: Sector 2 specialist:population ratio

Low SPR2: départements where SPR2 is under 12 per 100,000 inhabitants (first quartile of SPR2)

High SPR2: départements where SPR2 is above 29 per 100,000 inhabitants (last quartile of SPR2)

Table 1.3 – Impact of better coverage on visits to a specialist, use of Sector 2 specialists and average amounts of balance billing

Estimations with individual fixed effects, T=2010,2012							
		N	%	log(Q)	log(Q2/Q)	log(BB/Q)	log(BB/Q2)
(1)	Whole sample / OLS	43,111	100%	-0.02 (0.02)	0.01 (0.01)	0.03 (0.02)	-0.00 (0.01)
	Whole sample / 2SLS			0.12 (0.12)	0.09** (0.04)	0.32* (0.18)	-0.16 (0.10)
	[Hausman test p-value]			[0.24]	[0.04]	[0.12]	[0.10]
(2)	High SPR1 / OLS	17,893	41.5%	-0.03 (0.03)	0.01 (0.01)	0.05 (0.04)	0.01 (0.02)
	High SPR1 / 2SLS			-0.05 (0.25)	0.05 (0.08)	0.13 (0.39)	-0.23 (0.19)
	[Hausman test p-value]			[0.93]	[0.66]	[0.86]	[0.20]
(3)	Low & Med. SPR1 / OLS	25,218	58.5%	-0.03 (0.02)	0.00 (0.01)	0.01 (0.03)	-0.00 (0.01)
	Low & Med. SPR1 / 2SLS			0.23 (0.14)	0.14*** (0.05)	0.47** (0.22)	-0.06 (0.11)
	[Hausman test p-value]			[0.07]	[0.00]	[0.03]	[0.60]
(4)	Low SPR1 / OLS	12,915	30%	0.00 (0.02)	0.01 (0.01)	0.04 (0.04)	-0.02 (0.02)
	Low SPR1 / 2SLS			0.42** (0.20)	0.14** (0.07)	0.61** (0.31)	0.08 (0.14)
	[Hausman test p-value]			[0.03]	[0.04]	[0.06]	[0.45]

MGEN sample: 43,111 individuals with at least one specialist consultation in 2010 and 2012

log(BB/Q2): subsample of 19,949 individuals with at least one S2 specialist consultation in 2010 and 2012

Other regressors: 2012, income, CD, GP, specialist:population ratio, exp.phy.

Instruments: "early retirees"; "movers"

Standard errors are shown in brackets ()

Hausman test: H0: *QUIT* may be treated as exogenous

SPR1: S1 Specialist:population ratio

High SPR1: départements where SPR1 is above 52 per 100,000 inhabitants (last third of SPR1)

Med. SPR1: départements where SPR1 ranges from 41 to 52 per 100,000 inhabitants (second third of SPR1)

Low SPR1: départements where SPR1 is under 41 per 100,000 inhabitants (first third of SPR1)

* p<0.1, ** p<0.05, *** p<0.01

Table 1.4 – Effect of demand and supply side drivers on visits to a specialist, use of Sector 2 specialists and average amounts of balance billing

OLS Estimations with individual fixed effects, T=2010,2012								
	log(Q)		log(Q2/Q)		log(BB/Q)		log(BB/Q2)	
2012	-0.00	(0.01)	-0.01***	(0.00)	-0.02**	(0.01)	0.05***	(0.00)
Chronic Disease	0.19***	(0.02)	-0.01	(0.01)	-0.01	(0.03)	-0.00	(0.02)
GP	-0.04***	(0.01)	0.02***	(0.00)	0.11***	(0.02)	0.01	(0.01)
log(Income)	0.16***	(0.03)	0.01	(0.01)	0.07	(0.05)	-0.00	(0.03)
log(SPR1)	-0.03	(0.21)	0.03	(0.07)	0.29	(0.33)	0.31	(0.20)
log(SPR2)	-0.02	(0.24)	0.15*	(0.08)	0.87**	(0.37)	0.47**	(0.22)
log(SPR1)*log(SPR2)	0.00	(0.06)	-0.03	(0.02)	-0.18*	(0.09)	-0.11*	(0.06)
Exp.phy.	0.26***	(0.01)	0.13***	(0.00)	0.79***	(0.01)	0.19***	(0.01)
<i>Estimated fixed effect</i>								
Stayer	ref.		ref.		ref.		ref.	
Switcher	0.05***	(0.01)	0.04***	(0.00)	0.21***	(0.02)	0.08***	(0.01)
N	43,111		43,111		43,111		19,949	

MGEN sample: 43,111 individuals with at least one specialist consultation in 2010 and 2012

log(BB/Q2): sub-sample of 19,949 individuals with at least one S2 specialist consultation in 2010 and 2012

Other regressor: QUIT

SPR1: S1 Specialist:population ratio ; *SPR2:* S2 Specialist:population ratio

Magnitude and signficancy of all coefficients remain the same with 2SLS estimation

For estimated fixed effect, second step standard errors are used for the test

* p<0.1, ** p<0.05, *** p<0.01

Appendix

Figure 1.4 – Number of MGEN enrollees who retired in 2010, 2011 and 2012, by age

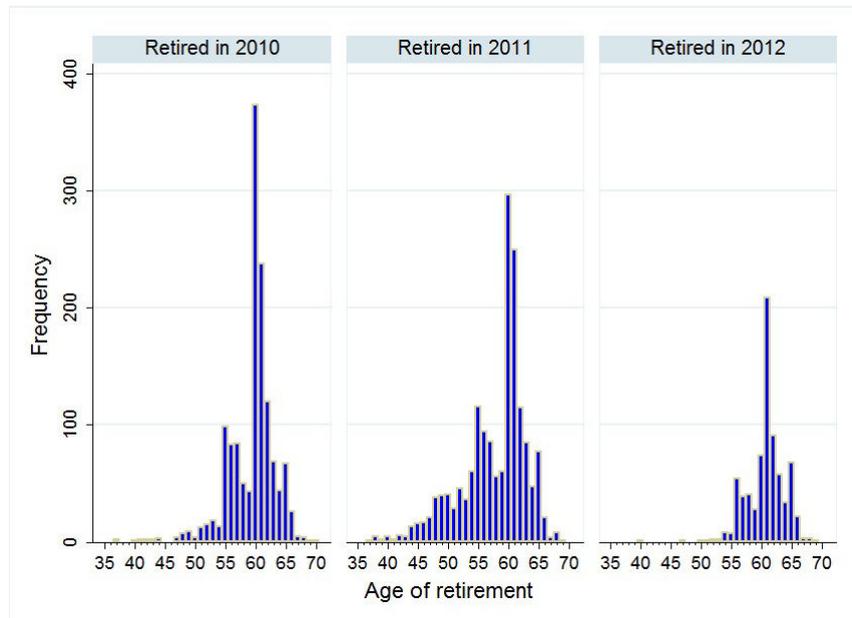


Table 1.5 – Characteristics of "early retirees" and "movers" in 2010 (Probit estimations)

	(A) Early retirees		(B) Movers	
	Coeff		Coeff	
Chronic Disease	-0.02	(0.09)	0.06	(0.04)
Log(GP visits)	-0.02	(0.04)	0.02	(0.02)
Log(Spe visits)	-0.01	(0.03)	0.03	(0.03)
Log(Drugs)	0.01	(0.02)	-0.02*	(0.01)
N	12,861		43,111	

* p<0.1, ** p<0.05, *** p<0.01

(A) Probability to retire before 55 in 2011 (ref: active, aged between 40 and 55)

(B) Probability to move out in 2011 (ref: individuals who will not move out in 2011)

Control variables: sex, age, income, Exp. Phy., SPR1, SPR2

Standard errors are shown in brackets ()

Table 1.6 – Impact of better coverage and chronic disease onset on GP visits and drugs consumption (Whole sample)

2SLS Estimations with individual fixed effects, T=2010,2012

	Log(GP visits)		Log(Drugs)	
QUIT	-0.04	(0.09)	-0.17	(0.16)
Chronic Disease	0.14***	(0.02)	0.62***	(0.03)

* p<0.1, ** p<0.05, *** p<0.01

Other regressors: 2012, income, SPR1, SPR2, Exp. Phy., GP (only for Drugs)

Standard errors are shown in brackets ()

Table 1.7 – Instruments: First stage coefficients and F-stat

	(1) Whole sample	(2) High SPR1	(3) Low & Med SPR1	(4) Low SPR1
First stage coeff / Early retirees	0.37*** (0.02)	0.37*** (0.03)	0.37*** (0.02)	0.39*** (0.03)
First stage coeff / Movers	0.11*** (0.01)	0.09*** (0.02)	0.14*** (0.01)	0.13*** (0.02)
First stage F-Stat on excluded instruments	337.75	92.37	210.14	92.99

* p<0.1, ** p<0.05, *** p<0.01

Standard errors are shown in brackets ()

Table 1.8 – Robustness check: impact of better coverage when using "early retirees" as the only excluded instrument

2SLS Estimations with individual fixed effects, T=2010,2012

	log(Q)		log(Q2/Q)		log(BB/Q)	
(2) High SPR1						
"Early retirees" only	-0.12	(0.28)	-0.00	(0.09)	-0.13	(0.42)
"Early retirees" + "movers"	-0.05	(0.25)	0.05	(0.08)	0.13	(0.39)
(3) Low & Medium SPR1						
"Early retirees" only	0.22	(0.17)	0.12**	(0.05)	0.41	(0.26)
"Early retirees" + "movers"	0.23	(0.14)	0.14***	(0.05)	0.47**	(0.22)
(4) Low SPR1						
"Early retirees" only	0.30	(0.22)	0.12**	(0.06)	0.42	(0.26)
"Early retirees" + "movers"	0.42**	(0.20)	0.14**	(0.07)	0.61**	(0.31)

* p<0.1, ** p<0.05, *** p<0.01

Standard errors are shown in brackets ()

Table 1.9 – Robustness check: impact of better coverage on different categories of SPR1 (2SLS)

2SLS Estimations with individual fixed effects, T=2010,2012

		log(Q)		log(Q2/Q)		log(BB/Q)	
(I)	High SPR1 (above median)	0.16	(0.23)	-0.00	(0.07)	-0.05	(0.35)
	Low SPR1 (below median)	0.27	(0.17)	0.13**	(0.06)	0.51**	(0.26)
(II)	High SPR1 * Medium & High SPR2	-0.01	(0.33)	0.17	(0.11)	0.74	(0.51)
	Low & Medium SPR1 * Medium & High SPR2	0.21	(0.15)	0.15***	(0.05)	0.63***	(0.23)

* p<0.1, ** p<0.05, *** p<0.01

Median of SPR1: 45 S1 specialists per 100,000 inhabitants

Medium & High SPR2: above 15 S2 specialists per 100,000 inhabitants

Standard errors are shown in brackets ()

Chapter 2

Selection on moral hazard in Supplementary Health Insurance

2.1 Introduction

It is critical for insurers to evaluate the possible effect of health insurance on care consumption when they design their contracts and set their prices. However, when insurance is voluntary, the estimated relationship between health insurance coverage and healthcare consumption is influenced by endogenous selection: individual characteristics, such as health status, age, gender, income, supply side constraints or preferences are likely to explain both individuals' consumption of healthcare and demand for health insurance. Einav et al. (2013) distinguish two sources of endogenous selection: classical adverse selection and selection on moral hazard. Classical adverse selection is linked to individual heterogeneity as regards demand for healthcare. Basically, some individuals consume more healthcare than others and are also more likely to buy insurance in order to reduce the financial risk associated with their healthcare expenditures. Selection on moral hazard appears when there is individual heterogeneity as regards the behavioral response to health insurance. In this case, some individuals might be more prone to buy insurance because they expect an increase in their healthcare consumption due to better coverage.

This chapter was jointly written with Brigitte Dormont.

Empirical contributions that aim to estimate the causal effect of insurance on healthcare use acknowledge that there is heterogeneity in the demand for healthcare and control for classical adverse selection (Cameron et al. 1988, Coulson et al. 1995, Holly et al. 1998, Vera-Hernández 1999, Schellhorn 2001, Buchmueller & Couffinhal 2004, Jones et al. 2006). In this literature, the response to health insurance is often assumed to be homogeneous across individuals and moral hazard is estimated through a single parameter associated with the price elasticity of demand for healthcare. In this framework, results based on randomization such as the RAND Health Insurance Experiment (Manning et al. 1987, Newhouse 1993), or quasi-natural experiments (Chiappori et al. 1998) are usually considered as a gold standard. Of course, randomization is an elegant solution to eliminate selection bias from the estimation of the impact of insurance on care use. But this approach is not necessarily of interest when insurance is voluntary. Because these analyses remove the endogenous choice component from the equation, they are not able to estimate a potential selection on moral hazard and predict the impact of a voluntary insurance on healthcare consumption. The question of selection on moral hazard has been addressed empirically by Einav et al. (2013). They use individual-level panel data from an American firm where employees can choose among different level of coverage. They find heterogeneity on moral hazard together with selection on moral hazard: individuals who buy more comprehensive coverage exhibit greater moral hazard.

Assuming that individuals select themselves in connection with their expected response to insurance can be particularly relevant, especially when one wants to predict the effect of copayments and deductibles on healthcare expenditures. Suppose that an insurer wants to supply an additional contract with better coverage. If he relies on average estimates of the price elasticity of demand¹, he will underestimate the increase in costs due to moral hazard. Indeed, contracts with more comprehensive coverage will attract individuals whose healthcare consumption would increase more strongly. On the contrary, if the insurer wants to introduce copayments to limit medical spending, he will overestimate the effect of such a decision: higher copayments will firstly attract individuals who are less sensitive to healthcare prices. Of course, these concerns are relevant only if the insurance under review is voluntary and not mandatory. Actually, this situation deserves attention because it is often encountered: it concerns all the cases where in-

¹That would be estimated, for instance, by a random assignment procedure like in the Rand experiment.

dividuals can buy supplementary health insurance. However, the empirical literature addresses issues that are relevant mostly in the case of mandatory health insurance.

In this paper we investigate the relationships between the demand for healthcare, the decision to take out health insurance and the behavioral response to better coverage with a structural model that specifies individual heterogeneity in demand for healthcare and response to insurance (i.e. moral hazard). We set the analysis in the French context where individuals can voluntarily take out supplementary health insurance (SHI) which covers medical goods and services with higher quality than the basic healthcare basket covered by mandatory national health insurance (NHI). We especially focus on the demand for specialist who balance bill their patients, i.e. charge them more than the regulated fee set by NHI. We estimate the causal effect of voluntary SHI on the demand of specialist consultations with balance billing, taking into account both classical adverse selection and selection on moral hazard. The econometric analysis is performed on a French database of 58,519 individuals observed in 2012.

In France, the NHI offers universal, yet partial, coverage. Individuals can take out SHI to enhance their coverage and limit out-of-pocket expenditures, either voluntary in the individual market or through their employer. For ambulatory care, the NHI sets a regulated price and reimburses only a fraction of it to patients (70% of the regulated fee for specialist consultations). On top of NHI copayments, patients may also have to pay balance billing. Indeed, patients have the choice to visit two types of specialists: ‘sector 1’ (S1) specialists are mandated to charge the NHI regulated fee whereas ‘sector 2’ (S2) specialists are allowed to balance bill, i.e. charge a fee that exceeds the regulated price, which is the basis for NHI reimbursement. S1 and S2 specialists are supposed to provide the same medical service. However, because S2 is restricted to physicians who have been practicing in a qualifying hospital setting, S2 consultations can be associated by patients with a higher level of quality. Because they charge higher fees, waiting lists are also likely to be shorter for S2 specialists. Almost 95% of the French population is covered by a SHI contract, which covers at least the 30% NHI copayment. Still, there are important differences between SHI contracts in terms of balance billing coverage: in polls, only 48.5% of SHI policyholders state that they are well covered against balance billing (Célant et al. 2014).

In the specific context of demand for balance billing coverage we can expect both forms of selection, e.g. classical adverse selection and selection on moral hazard. Indeed, in Dormont & Péron (2016) we gave evidence of individual heterogeneity in balance billing consumption related to demand for more comprehensive SHI coverage. Our estimates were based on a French panel data set of 43,111 individuals observed in 2010 and 2012. In 2010, the whole sample was covered by the same SHI contract, with no coverage against balance billing. We were able to observe the same individuals in 2012 after 3,819 of them had switched to other SHI contracts that cover balance billing. Using individual fixed effects and instrument variables we were able to deal with the non-exogeneity of the decision to switch insurer and estimate the change in balance billing consumption between 2010 and 2012 due to a better coverage. Our estimates show that those who ask for better coverage consume, *ceteris paribus*, more balance billing than the rest of the sample, even when they are not covered for balance billing. This would reveal classical adverse selection in the demand for balance billing coverage. Heterogeneity in the response to better coverage can be linked to unobservable individual heterogeneity, and to observable characteristics. First, the response to a better balance billing coverage is likely to be influenced by unobservable individual characteristics. Indeed, the demand for S2 visits relies strongly on perceived quality of care. Preferences and beliefs, which are unobserved, are likely to be heterogeneous: they can explain both heterogeneous response to a better coverage and decision to take out SHI resulting in selection on moral hazard. Second, heterogeneity in moral hazard might as well be influenced by observable characteristics such as gender, age, income or living area. In Dormont & Péron (2016) we found evidence of moral hazard only for individuals living in areas where there are few specialists who do not balance bill their patients (S1 specialists)². Turning to a possible impact of income, we can refer to Nyman's contribution to the debate on moral hazard (Nyman 1999, 2003). Traditional models of health insurance (Friedman & Savage 1948, Pauly 1968) see moral hazard as a pure price effect: because better insurance coverage reduces the price faced by patients and assuming the negative price-elasticity of health-care demand, patients with insurance coverage should increase their healthcare consumption. However, Nyman considers that better coverage also creates an income effect which releases the budget constraint and gives patients access to care that they could not afford without insur-

²This is because the effect of insurance on the relative price of S1 and S2 consultations depends on the search and waiting time costs associated with a S1 consultation, which are strongly influenced by S1 availability in each area

ance. Within this framework, low income individuals should react more to an improvement in coverage than rich individuals.

In the econometric literature, selection on moral hazard is more generally known as selection on returns or essential heterogeneity. Assuming that there is individual heterogeneity in treatment effects, essential heterogeneity arises when individuals decide to take the treatment in relation with their expected response to the treatment. Heckman & Vytlačil (2007) show that in the presence of essential heterogeneity, instrumental variable (IV) methods, which are frequently used to control for endogenous selection, do not estimate an average treatment effect (ATE), nor a treatment effect on treated. Indeed, IV methods only estimate a local average treatment effect (LATE), specific to individuals who would react to the shock induced by the instrument. In the presence of essential heterogeneity, this local effect cannot be extended to the average population. Another consequence is that different instruments are likely to give different estimates of the treatment effect because they rely on compliers with different reactions to the treatment. Beyond the objective to estimate unbiased causal effects, we can question the relevance of estimating an ATE in a context where individuals can decide to participate or not in the treatment. Indeed, in this case, we pay more attention to the treatment effect of those who are more likely to take the treatment rather than to the average effect on the whole population. Marginal treatment effects (MTE) estimators have been developed to capture the impact of a treatment likely to vary within a population in correlation with observed and unobserved characteristics, in a setting where individuals select themselves into treatment. First defined by Bjorklund & Moffitt (1987), MTE have been comprehensively described by Heckman & Vytlačil (2001) and Heckman et al. (2006). Empirically, MTE have been used to capture returns in education (Carneiro et al. 2011), breast cancer treatment effects (Basu et al. 2007) or the effect of family size on children's outcome (Brinch et al. 2012). Recently, Kowalski (2015) uses MTE in an experimental framework to assess the external validity of the Oregon health insurance experiment.

MTE are the appropriate tools when one focuses on the effect of voluntary health insurance on balance billing consumption. First, essential heterogeneity is only a concern if individuals can decide to take the treatment and if unobservable characteristics can influence their outcome. In our setting, individuals can choose their level of balance billing coverage while their

preferences for higher quality of care, which are unobservable to the econometrician, are likely to influence their balance billing consumption. Second, MTE rely on a structural approach that links the output (the demand for balance billing), the decision to take the treatment (take out SHI) and the treatment effect (moral hazard). This unified framework identifies complex relationships between demand for higher quality of care and comprehensive SHI. It allows to identify different motives of the demand for balance billing coverage, either to cover expected expenditures or to increase balance billing consumption. Third, MTE fully take into account individual heterogeneity in the response to treatment, due to both observable and unobservable characteristics. The structural approach further associates the heterogeneous treatment effect to different mechanisms related to income, supply side constraints or preferences. We are indeed able to give some ‘content’ to moral hazard, especially in terms of access to S2 specialists, and go beyond the homogeneous price effect usually reported in the literature.

In this paper, we estimate the marginal treatment effect of SHI coverage on balance billing consumption. We take into account observed and unobserved individual heterogeneity in the demand for S2 consultations and in moral hazard. We also control for classical adverse selection and selection on moral hazard. Our empirical analysis is built on a structural model that links (i) the demand for balance billing, (ii) the decision to take out more comprehensive SHI and (iii) the behavioral response to better coverage. Thanks to this unified framework we are able to give insights on the determinants of the demand for higher quality of care and the role of health insurance in terms of access to care, especially for low income individuals.

Our database stems from administrative data provided by a French insurer, the Mutuelle Générale de l’Education Nationale (MGEN). We use cross-sectional data which provide for 58,519 individuals information on healthcare claims and reimbursements by the NHI and SHI in 2012. We are able to observe two groups of individuals: MGEN-SHI subscribers and better-SHI subscribers. The former are not covered for balance billing. The latter were previously covered by the same MGEN-SHI contract but decided in 2011 to switch towards another SHI insurer: in 2012 they benefit from balance billing coverage. The better-SHI subscribers are used as a treatment group to estimate the heterogeneous effect of SHI coverage on balance billing consumption and test for the existence of classical adverse selection and selection on moral hazard.

We find evidence of individual heterogeneity in the response to better coverage and of selection on moral hazard. Individuals with unobservable characteristics that make them more likely to take out better SHI are also those who exhibit stronger moral hazard, i.e. a larger increase in balance billing per consultation. We also find that individuals' income is a strong determinant of balance billing consumption and influence the behavioral response to better coverage. Without coverage, the poor consume less balance billing than the rich but increase their consumption more sharply once covered for balance billing. They are also more likely to subscribe to comprehensive coverage.

The fact that unobservable characteristics influence both the decision to take out SHI and the magnitude of moral hazard is firstly a concern for insurers. Indeed, when providing comprehensive balance billing coverage, insurers have to take into account that their contract is likely to attract individuals who are more sensitive to healthcare prices and respond more sharply than average to better coverage. In a context where SHI is voluntary, the inflationary impact of SHI coverage might be worsened by selection on moral hazard. Our policy conclusions as regards the role of income are of different nature. We argue that the negative effect of income on the demand for S2 consultations coupled with its positive effect on moral hazard reveals that insurance plays an important role in terms of access to care.

This paper is organized as follows. Section 2.2 presents the MTE method. In section 2.3 we present our data and empirical strategy. The empirical specification is developed in section 2.4. Results are presented in section 2.5. Section 2.6 concludes.

2.2 Method: Marginal Treatment Effects

Allowing for heterogeneity in treatment effects potentially yields essential heterogeneity. This term means that the assignment to treatment, or the choice to be treated, is correlated with the treatment impact. In our case, some people would choose to take out better supplementary insurance because they know their healthcare consumption will respond positively to better coverage. As stated by Heckman et al. (2006), when treatment effects are likely to be heterogenous, it is reasonable to allow for a correlation between the choice for treatment and the treatment impact.

Consider the two potential outcomes $Y_{i,1} = \alpha_1 + U_{i,1}$ and $Y_{i,0} = \alpha_0 + U_{i,0}$ which are observed if the individual is respectively treated ($D_i = 1$) or not treated ($D_i = 0$). The observed outcome is:

$$\begin{aligned} Y_i &= D_i Y_{i,1} + (1 - D_i) Y_{i,0} \\ &= \alpha_0 + ((\alpha_1 - \alpha_0) + (U_{i,1} - U_{i,0})) D_i + U_{i,0} \end{aligned}$$

Here the treatment impact varies across individuals. One has: $Y_i = \alpha_0 + \tau_i D_i + U_{i,0}$ with $\tau_i = Y_{i,1} - Y_{i,0} = (\alpha_1 - \alpha_0) + (U_{i,1} - U_{i,0})$.

To estimate this model one has to deal with two possible selection problems: (i) a correlation between D_i and $U_{i,0}$, which is due to a selection on the level of the outcome without treatment; (ii) a correlation between D_i and τ_i , i.e. a selection on the expected impact of the treatment (essential heterogeneity). In case of essential heterogeneity, the use of instrumental variables is not straightforward. Firstly, the IV method does not provide a consistent estimation of the mean treatment effect $\bar{\tau}$.³ Secondly, if there is selection on the gains from treatment, the IV estimate must be interpreted as a local average treatment effect "which is only informative about the average causal effect of an instrument-induced shift in D " (Brinch et al. 2012). As shown by Heckman et al. (2006), the solution is to estimate marginal treatment effects (MTE). MTE are computed from a model that explicitly specifies the decision to be treated, and gives the treatment impact for someone who is at the margin, i.e. who is indifferent between being treated or not. Moreover, MTE produce a function that is invariant to the choice of instruments.

³One has: $\tau_i = (\alpha_1 - \alpha_0) + (U_{i,1} - U_{i,0}) = \bar{\tau} + \eta_i$

From $Y_i = \alpha_0 + \tau_i D_i + U_{i,0}$, one has: $Y_i = \alpha_0 + \bar{\tau} D_i + (U_{i,0} + \eta_i D_i)$

To provide a consistent estimate of $\bar{\tau}$, the IV Z must be uncorrelated with $U_{i,0} + \eta_i D_i$. In the case of essential heterogeneity this condition is not satisfied, even if Z is not correlated with $U_{i,0}$ and η_i . Indeed, $E(\eta_i D_i | Z_i) = E(\eta_i | D_i = 1, Z_i) \Pr(D_i = 1 | Z_i)$, and the first term of the right-hand side is different from 0 if the decision to treat is correlated with the individual gain of the treatment.

2.2.1 The Generalized Roy model

To introduce MTE, Heckman et al. (2006) consider the Generalized Roy model, which is a switching regression model that allows a structural approach to policy evaluation.⁴ For the sake of simplicity, the subscripts i are omitted hereafter. The model specifies the two potential outcomes (Y_0, Y_1) and the decision to participate in the treatment $(D = (0,1))$. The choice of receiving treatment is modeled as a function of observables Z and unobservables V , and linked to the observed outcome Y through a latent variable D^* . In addition to the previous model, we now assume that the outcomes depend on exogenous regressors X . Hence, the treatment has an impact on unobserved heterogeneity (from U_0 to U_1) and on the effect of covariates X (from β_0 to β_1):

$$Y = DY_1 + (1 - D)Y_0 \quad (2.1)$$

$$Y_1 = \alpha_1 + X\beta_1 + U_1 \quad (2.2)$$

$$Y_0 = \alpha_0 + X\beta_0 + U_0 \quad (2.3)$$

$$D^* = Z\gamma - V \quad (2.4)$$

$$D = \begin{cases} 1 & \text{if } D^* > 0 \\ 0 & \text{if } D^* \leq 0 \end{cases} \quad (2.5)$$

We assume that U_0 , U_1 and V are independent of Z , conditional on X . In addition, the probability of treatment is a non-trivial function of Z , conditional on X : $Pr(D|X = x, Z = z) \neq Pr(D|X = x)$ (Basu et al. 2007).

The propensity score $P(Z)$ is the probability of receiving treatment conditional on Z :

$$P(Z) \equiv Pr(D = 1|Z = z) = Pr(V < Z\gamma|Z = z) = F_V(Z\gamma)$$

where F_V is the cumulative distribution function of V , hence a monotonic and absolutely continuous function.

⁴Our description of the statistical framework follows closely that found in Heckman et al. (2006) and Brave et al. (2014).

An individual chooses to be treated if the latent variable D^* is positive:

$$D = 1 \Leftrightarrow D^* > 0 \Leftrightarrow Z\gamma > V \Leftrightarrow F_V(Z\gamma) > F_V(V) \Leftrightarrow P(Z) > F_V(V)$$

Defining $U_D = F_V(V)$, the condition to be treated is that the propensity score is greater than U_D : $P(Z) > U_D$.

Without a loss of generality we can assume that U_D is a uniformly distributed random variable between 0 and 1. In this case the p^{th} quantile of U_D is p and different values of U_D correspond to different quantiles of V .

The propensity score must be interpreted as the incentive to choose the treatment, for given covariates Z . As for U_D , it can be seen as the individual idiosyncratic disutility of taking the treatment. Conditionally on her characteristics z , which provide a propensity score p , an individual will ultimately take the treatment if her disutility u_D is lower than p (and be indifferent if $u_D = p$). For the econometrician, variables Z are observable and realizations u_D are not observed. Given that values of U_D are quantiles of V , it is possible to compare $P(Z)$ and U_D on the same interval $[0,1]$ on the horizontal axis (Figure 2.1):

2.2.2 Marginal Treatment Effects

In our framework, decision to participate in the treatment and treatment impact vary across individuals. MTE capture the treatment effect ($Y_1 - Y_0$) for the ‘marginal individual’ who is indifferent between being treated or not, conditional on her observable characteristics $X = x$. By definition, the marginal individual has a propensity score equal to her disutility of taking the treatment: $U_D = p$.

$$MTE \equiv E(Y_1 - Y_0 | X = x, U_D = p) \quad (2.6)$$

Heckman et al. (2006) show how MTE can be identified by taking the derivative of $E(Y | X = x, Z = z)$ with respect to $P(Z)$. First, note that

$$E(Y|X = x, Z = z) = E\{Y|X = x, P(Z) = p\} \quad (2.7)$$

Following Heckman & Vytlačil (2001), the observed outcome can be written as:

$$E\{Y|X = x, P(Z) = p\} = E(Y_0|X = x) + E(Y_1 - Y_0|X = x, D = 1)p \quad (2.8)$$

$$= E(Y_0|X = x) + \int_0^p E(Y_1 - Y_0|X = x, U_D = u_D)du_D \quad (2.9)$$

As a consequence,

$$\frac{\partial E\{Y|X = x, P(Z) = p\}}{\partial p} = E(Y_1 - Y_0|X = x, U_D = p) \quad (2.10)$$

Expression (2.10) shows how the derivative of $E(Y|X = x, Z = z)$ identifies marginal treatment effect, i.e the expected treatment effect conditional on X and U_D ⁵. As noted by Heckman et al. (2006), "a high value of $P(Z) = p$ identifies MTE at a value of $U_D = u_D$ that is high - that is associated with nonparticipation". Indeed, that individuals with a high propensity score are indifferent between being treated or not implies that they have a very high idiosyncratic disutility of taking the treatment u_D . Therefore, MTE with high p values identify returns for individuals who are less likely to take the treatment. Conversely, MTE with low values of p identify returns for individuals prone to take the treatment.

2.2.3 Estimation

Combining (2.8) with the expressions of Y_1 and Y_0 in (2.2)-(2.3), one obtains:

$$E\{Y|X = x, P(Z) = p\} = \alpha_0 + x\beta_0 + (\alpha_1 - \alpha_0)p + \{x(\beta_1 - \beta_0)\}p + K(p), \quad (2.11)$$

$$\text{with } K(p) = E\{U_0|P(Z) = p\} + E\{U_1 - U_0|P(Z) = p\}p \quad (2.12)$$

⁵The ATE, by contrast, is the average treatment effect, conditional on X . Note that the ATE can be constructed as a weighted average of MTE by integrating over U_D (Heckman & Vytlačil 2001, Heckman et al. 2006), providing that the support of U_D covers $[0,1]$: $ATE \equiv E(Y_1 - Y_0|X = x)$.

$K(p)$ serves here as a control function, as defined by Heckman & Robb (1985). It takes into account the fact that the difference between the outcome and the specification on the right-hand side is a function of p . Hence, a regression applied on (2.11) consistently estimates parameters $(\alpha_0, \alpha_1, \beta_0, \beta_1)$.

As stated above, the MTE are computed as the partial derivative of the conditional expectation of Y with respect to $P(Z)$:

$$\frac{\partial E\{Y|X = x, P(Z) = p\}}{\partial p} = (\alpha_1 - \alpha_0) + x(\beta_1 - \beta_0) + \frac{\partial K(p)}{\partial p} \quad (2.13)$$

The first step consists in estimating the propensity score for each individual, $\hat{P}(z) = Pr(Z\gamma > V|Z = z) = p$. The propensity score can be fitted by a probit or logit model⁶.

Writing $K(p)$ as a polynomial in p , equation (2.11) becomes:

$$E\{Y|X = x, P(Z) = p\} = \alpha_0 + x\beta_0 + (\alpha_1 - \alpha_0)p + \{x(\beta_1 - \beta_0)\}p + \sum_{i=1}^{\vartheta} \phi_i p^i \quad (2.14)$$

A parametric estimation of the MTE can be obtained from:

$$MTE\{X = x, P(Z) = p\} = (\alpha_1 - \alpha_0) + x(\beta_1 - \beta_0) + \sum_{i=1}^{\vartheta} i\phi_i p^{i-1}, \quad (2.15)$$

using the estimations of $\widehat{\alpha_1 - \alpha_0}$, $\widehat{\beta_1 - \beta_0}$ and $\widehat{\phi}_i$ obtained from the linear regression implied by (2.14).

Alternatively we can adopt a semi-parametric approach by running a local polynomial regression (Fan & Gijbels 1996) on

$$\tilde{y} = y - \widehat{\alpha}_0 - x\widehat{\beta}_0 + (\widehat{\alpha_1 - \alpha_0})p - \{x(\widehat{\beta_1 - \beta_0})\}p.$$

The semi-parametric estimator can only be estimated on the common support of the propensity score. Precisely, the common support assumption requires that there exist positive frequencies

⁶It is preferable not to consider a linear probability model because it does not allow to constrain the range of $\hat{P}(z)$ to be (0,1), see Brave et al. (2014).

of $\hat{P}(z)$ for individuals that receive ($D = 1$) and do not receive ($D = 0$) the treatment. It is worth noting that, although a parametric estimator of MTE can be estimated on the whole range $[0,1]$, its precision also crucially depends on the common support (Brave et al. 2014). Therefore, our interpretation of the results will be limited to the common support⁷.

2.3 Data and empirical strategy

We use a data set from a French supplementary insurer: *Mutuelle Générale de l'Éducation Nationale* (MGEN), which is a not-for-profit insurer who provides mandatory basic health insurance for teachers and Ministry of education's employees. MGEN also supplies supplementary health insurance in the form of a unique⁸ contract (MGEN-SHI) which offers a minimal supplementary coverage: it covers only copayments and not balance billing. People can subscribe to this MGEN-SHI on a voluntary basis, or take out another SHI. For historical reasons, MGEN manages both basic (NHI) and supplementary insurance (MGEN-SHI). Our data stemmed from administrative MGEN data: they provide, for each policyholder, detailed information about her medical bills and reimbursements for basic health insurance and for supplementary insurance when the individual is a MGEN-SHI subscriber.

In France, ambulatory care is mostly provided by self-employed physicians paid on a fee-for-service basis. Since 1980, physicians can choose between two contractual arrangements with the regulator. If they join "Sector 1", physicians are not permitted to balance bill. They agree to charge their patients the reference fee (23€ in 2012 for a routine visit), and get fiscal deductions in return. If they join "Sector 2", they are allowed to set their own fees. Access to Sector 2 being strongly limited for GPs since 1990, most of them belong to Sector 1: they are 87% in 2012. Hence the issue of balance billing concerns mostly specialists. Balance billing adds 35% to the annual earnings of Sector 2 specialists. The average proportion of specialists operating in Sector 2 amounts to 42% in 2012. This proportion varies dramatically across specialties: for

⁷We do not consider other methods that are available to estimate MTE. Heckman et al. (2006) estimate (2.13) using the Local Instrumental Variable (LIV) approach. However, Brinch et al. (2012) show that LIV does not identify MTE when the excluded instrument is binary. They develop a method to identify MTE in a fully non-parametric approach using a binary instrument and a single binary covariate.

⁸This is true for our observational period. From 2016 on, MGEN started to supply a choice between different contracts for SHI.

instance, the proportion of specialists operating in Sector 2 is 19% for cardiologists, 73% for surgeons and 53% for ophthalmologists.

Actually, we do not observe the coverage of balance billing for people who subscribed to another SHI than MGEN-SHI. However, MGEN used to send a questionnaire to people who switched to another SHI. This allows us to know, for people who have terminated a MGEN-SHI contract, if they have subscribed to another SHI. For this reason, we selected, for year 2012, a sample of subscribers of MGEN-SHI and of subscribers of another SHI, who were in 2010 subscribers of MGEN-SHI and have terminated their contract in 2011. In this case, we know that their new coverage will be at least equal and probably better than before, because MGEN-SHI coverage on balance billing is zero. We name this new contract ‘better-SHI’.

Because in France balance billing concerns mostly specialists, our analysis focuses on the impact of coverage of balance billing on the use of specialists. We leave the differences in differences approach used in Dormont & Péron (2016) to specify, on a cross section of individuals observed in 2012, a Roy model for the issue at stake. It is a switching regression model that explains together the decision to take out coverage for balance billing (better-SHI), and the demand for consultations with balance billing when the individual is – or is not – covered for balance billing. As stated above, such a specification enables us to estimate the impact of better coverage on the use of balance billing in case of essential heterogeneity. For that purpose, we use an instrument which explains the decision to take out better coverage and which is not directly related to balance billing consumption.

Our original sample was composed of 91,629 subscribers of MGEN-SHI and 8,249 subscribers of better-SHI. We excluded individuals who live outside continental France as well as the top 1% of care users in 2012. Because we focus on specialist consultations, we only keep individuals who have at least one visit to a specialist in 2012, with or without balance billing. Our final sample includes 58,519 individuals: 53,456 subscribers of MGEN-SHI and 5,063 subscribers of better-SHI, observed in 2012, who have visited a specialist at least once in 2012.

Our empirical strategy requires the use of an instrument to explain the decision to terminate MGEN-SHI contract in order to take out a better-SHI. A valid instrument must be correlated

to the decision to quit MGEN-SHI and, conditional on other observable characteristics, be uncorrelated to the consumption of balance billing (in the Roy model, we assume that U_0 , U_1 and V are independent of Z , conditional on X). The decision to retire in 2011 for people younger than 55 years-old, that we used in Dormont & Péron (2016), is a reliable instrument. The age threshold refers to a specific right for teachers and civil-servant who raised three or more children to retire before 55. This right has been revoked in January 2012, creating an important incentive for individuals meeting the criteria to retire in 2011. Indeed, MGEN-SHI premiums raise from 2.97% of wages before retirement to 3.56% of pensions after. We argue that this retirement policy change creates an exogeneous shock that gives individuals incentives to terminate their MGEN-SHI contract for a better-SHI, but has no reason to drive their balance billing consumption. In our sample, 368 individuals decided to retire in 2011 and half of them quit MGEN-SHI the same year. When including retirement before 55 as a covariate in a simple log-linear model that explains balance billing consumption, the coefficient is non significantly different from zero. Therefore, we decide to rely on the ‘early retirees’ instrument to explain the decision to subscribe to better-SHI⁹.

Our data provide, for each individual in 2012 the number of visits to a specialist Q , including the number of visits to S2 specialists who charge balance billing, $Q2$, as well as the total amount of balance billing, BB . We focus on four variables of interest: the number of specialist consultations, Q (with $Q \geq 1$), the proportion of S2 consultations, $Q2/Q$, the average balance billing per consultation, BB/Q and the average balance billing per S2 consultation $BB/Q2$ (computed only for individuals who have at least one S2 consultation in 2012). We are able to distinguish three dimensions in the demand for specialist consultations: quantity of specialist consultations, quality in terms of choice between S1 and S2 specialists and finally the average price per consultation to a S2 specialist, which might be linked to quality.

Given that our data do not provide the fee for each consultation, we compute for each indi-

⁹Note that the condition of independence between the instrument and balance billing consumption is more demanding with cross-sectional data than it was with panel data in Dormont & Péron (2016), where the specification of individual fixed effects makes it possible to deal with time-invariant sources of non exogeneity. In this framework, the need of excluded instruments was only dictated by possible unobservable health or information shocks that would have explained both the switch of SHI and a ‘change’ in balance billing consumption. Here we need an instrument that is not correlated with the ‘level’ of balance billing consumption. As explained above, this condition is fulfilled for ‘retirement before the age of 55’. But it is not the case for the fact of ‘moving out to another *département*’. We cannot use this variable as an instrument for our cross-section analysis.

vidual an annual average of balance billing per consultation. However, we are able to control for the individual's needs regarding medical specialties. This is important because, as shown in Dormont & Péron (2016), the availability of S1 and S2 specialists varies dramatically from a specialty to another in France. Gynecologists, ophthalmologists, surgeons and ENT specialists¹⁰ charge balance billing in a larger proportion than their colleagues. As a matter of fact, patients' choice to visit a S2 is likely to be far more constrained when they need to visit one of these specialties. We therefore use a dummy variable called 'expensive physicians' (*ExpPhy*) which equals 1 when the individual visited one of these specialists at least once in 2012.

Our information on individual characteristics include gender, age, income and health status. To make the interpretation of the results easier, we build three age groups, 20-40, 40-60 and over 60 years old. Our income variable is based on individuals' wage or pension used by MGEN to compute MGEN-SHI premiums. The dummy *CD*, which equals 1 if individuals have a chronic disease, is used as an indicator of health status. Access to S1 or S2 specialists is not only a question of price (balance billing or not), but also a question of geographical access (transportation costs) or waiting time. To measure the respective availability of S1 or S2 specialists, we use the 'specialist : population ratios' (SPR) provided by national statistics in 2012. The SPR is the number of specialists either in S1 (*SPR1*) or in S2 (*SPR2*) per 100,000 inhabitants in each *département*.

2.3.1 Basic features of the data

Table 2.1 displays the characteristics of the 58,519 individuals of our final sample: there is a high proportion of women (72.5%), the average age is close to 58 years, the average income amounts to €2,500 and 22% have a chronic disease. In comparison, the average wage is in France equal to €2,157¹¹ and 19.5%¹² of people have a chronic disease. These characteristics derive from the fact that (i) MGEN covers teachers and civil servant who have a certain education level and are mostly women; (ii) we have restricted our sample to those who visited a specialist at least once in 2012.

¹⁰Ear, Nose and Throat specialists

¹¹Average net mensual wage in 2012; source: INSEE

¹²source: ESPS survey

Compared to MGEN-SHI holders, better-SHI holders are on average 12 years younger, count more women (82% vs 72.5%) and less individuals with chronic disease (9.4% vs 22%). To sum up, those who decided to quit MGEN-SHI are on average younger and healthier. This is a common result in the literature on switching behavior: in the USA (Buchmueller & Feldstein 1997, Strombom et al. 2002), Switzerland (Dormont et al. 2009) or in the Netherlands (Duijmelinck & van de Ven 2016), switchers are invariably younger and also tend to be healthier. We discuss the motivations to subscribe to better-SHI further in the paper.

Table 2.2 displays statistics about the use of specialist visits and balance billing in 2010 and 2012 for MGEN-SHI holders and future better-SHI holders (who are covered by MGEN-SHI in 2010 and better-SHI in 2012)¹³. Of course, in 2012, better-SHI holders are likely to have a better coverage for balance billing than MGEN-SHI holders. Whereas the total number of visits (Q) is not significantly different between MGEN-SHI and better-SHI holders, the latter consume significantly more balance billing, both in quantity ($Q_2 = 1.7$ for better-SHI holders vs 1.3 for MGEN-SHI holders) and price ($BB/Q_2 = 26.1$ vs 24.2). Consequently, better-SHI holders' mean consumption of balance billing, (BB), amounts to €46.9 in 2012, which is 42.6% higher than for MGEN-SHI holders.

These differences might reflect adverse selection, as well as moral hazard and, if there is heterogeneity in moral hazard, possible selection on moral hazard. Actually, our data design enables us to observe the use of balance billing by better-SHI subscribers in 2010, before they take out better coverage. In 2010, all individuals in our sample, including future better-SHI, are all MGEN-SHI holders, hence not covered for balance billing. Table 2.2 shows that in 2010 the future better-SHI holders, who will quit MGEN-SHI the next year, consumed more balance billing than those meant to stay under MGEN-SHI contract. This reveals classical adverse selection: those who ask for better coverage consume more balance billing than others.

¹³This comparison is not possible for all the 58,519 individuals observed in 2012 since only 43,612 of them used at least a specialist visit in 2010.

2.4 Empirical specification

The aim of this paper is to estimate the effect of health insurance on the consumption of balance billing when moral hazard is heterogeneous. Assuming that moral hazard may be related to the decision to choose a better coverage for balance billing, we estimate MTE to capture heterogeneity in response to health insurance and to test for essential heterogeneity. Also, our estimation strategy enables us to evaluate the effect of observable characteristics, such as income, on the consumption of balance billing, on the demand for better SHI coverage and on moral hazard.

2.4.1 Model and estimation

Following the generalized Roy model presented in section 2.1, we specify a choice equation explaining the individual's decision to take out another SHI to enjoy better coverage (better-SHI) than the one provided by MGEN-SHI. The estimation of this choice equation enables us to understand coverage choices' determinants and provides the propensity scores that are used to identify MTE.

The choice is specified through the binary variable D , which is equal to 1 if the individual chooses to take out better-SHI in 2011. In 2012, people covered by better-SHI benefit from balance billing coverage whilst MGEN-SHI enrollees (those who stayed) do not. The decision depends on the sign of a continuous latent variable D^* :

$$D^* = x\gamma_1 + \gamma_2 \text{EarlyRetiree} - V = Z\gamma - V \quad (2.16)$$

$$D = \begin{cases} 1 & \text{if } D^* > 0 \\ 0 & \text{if } D^* \leq 0 \end{cases} \quad (2.17)$$

EarlyRetiree is our excluded instrument: the decision to retire before 55 years old is correlated with the decision to subscribe to better-SHI, but not with the consumption of balance billing. x is a vector of covariates which includes individuals' gender, age, income and whether they suffer from a chronic disease. It includes also local availability of specialists of sector 1 (S1,

not allowed to charge balance billing) and 2 (S2, allowed to charge balance billing) and for the individual's needs as regards medical specialty (the proportion of S2 specialists is particularly high for ophthalmologists, gynaecologists and ENT). V is an unobservable random variable corresponding to the individual idiosyncratic disutility of choosing better-SHI (linked with unobservable individual characteristics such as disutility of administrative switching costs, belief that sector 2 doctors provide better quality of care, and risk aversion, i.e. utility of coverage for given risk level).

$P(Z)$ is the propensity score, i.e. the probability of choosing better-SHI conditional on Z . As explained in section 2, it is useful to define $U_D = F_V(V)$, where F_V is the cumulative function of V . U_D is a random variable uniformly distributed between 0 and 1 and values of U_D correspond to quantiles of V . For a given level of Z , individuals who have a large U_D are less likely to take out better-SHI.

$$D = 1 \Leftrightarrow Z\gamma > V \Leftrightarrow F_V(Z\gamma) > F_V(V) \Leftrightarrow P(Z) > U_D$$

We rely on the parametric and semi-parametric approaches presented in section 2.3 to estimate MTE. We estimate the propensity score $\hat{P}(z) = p$ for each individual with a Probit model¹⁴. We then determine the common support, i.e. the values of $\hat{P}(z) = p$ for which we have positive frequencies of individuals who decided to take out better-SHI ($D = 1$) and of individuals who remained MGEN-SHI enrollees ($D = 0$).

Then we perform OLS on equation (2.14), assuming that the function $K(p)$ is a polynomial of degree 3:

$$y = \alpha_0 + x\beta_0 + (\alpha_1 - \alpha_0)p + \{x(\beta_1 - \beta_0)\}p + \phi_1p + \phi_2p^2 + \phi_3p^3 \quad (2.18)$$

y is the log-transformation of one of our four variable of interest: Q the number of specialists consultations, $Q2/Q$ the proportion of S2 consultations in the total of visits to a specialist, BB/Q the average amount of balance billing per visit, $BB/Q2$ the average amount of balance billing

¹⁴The results are robust to the use of a Logit model.

per S2 visit. As for the choice equation, x is a vector of covariates which includes individuals' gender, age, income, chronic disease, local availability of S1 and S2 specialists, and individual's needs regarding ophthalmologists, gynaecologists and ENT. Subscript 1 (respectively, 0) refers to better-SHI enrollees (respectively, to *MGEN*-SHI enrollees). Better-SHI enrollees benefit from balance billing coverage, but this is not the case for *MGEN*-SHI enrollees. According to the Roy model, when an individual chooses to switch from *MGEN*-SHI to better-SHI, his or her behavior switches from $Y_0 = \alpha_0 + X\beta_0 + U_0$ to $Y_1 = \alpha_1 + X\beta_1 + U_1$.

The parametric estimator of MTE is computed for given values x as

$$MTE\{x,p\} = (\alpha_1 - \alpha_0) + x(\beta_1 - \beta_0) + \phi_1 + \phi_2 p + \phi_3 p^2 \quad (2.19)$$

In our setting, MTE capture the effect of having better balance billing coverage for the individual 'at the margin', who is indifferent between subscribing to better-SHI or remaining enrolled in *MGEN*-SHI ($U_D = p$).

We also compute a semi-parametric estimator of MTE by running a local polynomial regression of \tilde{y} on p with:

$$\tilde{y} = y - \hat{\alpha}_0 - x\hat{\beta}_0 + (\hat{\alpha}_1 - \hat{\alpha}_0)p - \{x(\hat{\beta}_1 - \hat{\beta}_0)\}p. \quad (2.20)$$

Note that the semi-parametric approach differs only in the estimation of the unobservable component $K(p)$.

To run the estimations, we use the Stata command *margte* (Brave et al. 2014) with a polynomial of degree 3 to estimate the parameters of the MTE. We use an epanechnikov kernel function in the nonparametric estimation. Standard errors are computed using bootstrap (50 reps). Parametric and semi-parametric MTE are computed at mean values of x as in equations (2.21) and (2.22):

$$MTE\{\bar{x},p\} = (\alpha_1 - \alpha_0) + \bar{x}(\beta_1 - \beta_0) + \phi_1 + \phi_2 p + \phi_3 p^2 \quad (2.21)$$

$$MTE\{\bar{x},p\} = (\alpha_1 - \alpha_0) + \bar{x}(\beta_1 - \beta_0) + \frac{\partial \widehat{K}(p)}{\partial p} \quad (2.22)$$

2.4.2 Interpretation of the estimates

Our empirical specification allows for a detailed analysis as regards the impacts of observable characteristics:

- β_0 captures the impacts of individual characteristics on the demand for S2 consultations without balance billing coverage;
- γ captures their effect in the decision to switch;
- In addition, we estimate the change $(\beta_1 - \beta_0)$ in the impact of regressors which is due to better coverage.

Note that in our model the fact that the impacts of regressors can be modified by better coverage is a source of heterogeneity in moral hazard that comes in addition to the heterogeneity linked to unobserved characteristics. Suppose that $(\beta_1 - \beta_0) < 0$ for income. This would mean that low-income people react more strongly to insurance.

In what follows, we first examine the estimates obtained for β_0 , γ and $(\beta_1 - \beta_0)$. Then we compare their signs to identify the situations of *classical adverse selection* (relationship between β_0 and γ) and the situations of *selection on moral hazard* (relationship between $(\beta_1 - \beta_0)$ and γ).

As regards essential heterogeneity, Heckman et al. (2006) propose a simple test to explore the assumption of a variable treatment effect due to unobservable characteristics. The joint significance of the polynomial coefficients ϕ_1, ϕ_2, ϕ_3 in equation (3.4) reveals the presence of essential heterogeneity. Indeed, the signs of ϕ_2 and ϕ_3 determine the slope of the curve that characterizes the relationship between the treatment effect and the value of U_D . Precisely, $\phi_1 = \phi_2 = \phi_3 = 0$ would mean that the treatment effect does not vary with unobservable characteristics, i.e. there is no evidence of essential heterogeneity. On the contrary, depending on the values of ϕ_2 and ϕ_3 , one can find that individuals with a low (or high) disutility to switch benefit more (or less) from better balance billing coverage.

Because the common support is not defined for all values of U_D between 0 and 1, we are not able to compute an ATE with the semi-parametric approach. Note that although parametric

MTE are estimated on $[0,1]$, their precision strongly decreases for $U_D > 0.35$ which makes the value of MTE difficult to interpret for higher values of U_D . So, in any case, we restrict our analysis of MTE on the values corresponding to the common support.

2.5 Results

Results are presented in Tables 2.3 to 2.7. Table 2.3 displays the effects of observable individual characteristics on the demand for better-SHI. Table 2.4 displays the effect of observable characteristics on consumption for balance billing without coverage and on moral hazard. Table 2.5 summarizes the influence of observable characteristics and gives evidence of adverse selection and selection on moral hazard. Tables 2.6 and 2.7 show evidence of heterogeneity on moral hazard. Figures 2.3 and 2.4 display respectively parametric and semi-parametric MTE over U_D evaluated at mean values of x with 95% confidence intervals computed from a non-parametric bootstrap.

2.5.1 Influence of observable characteristics: consumption of balance billing without coverage

The determinants of the amount of balance billing paid by patient who do not benefit from insurance coverage are captured by the coefficients β_0 (Table 2.4). Income, medical needs and availability of S1 and S2 specialists appear as the main determinants. The average amount of balance billing per consultation significantly increases with income: a 10% increase in income drives up BB/Q by 5.3%. Individuals aged of 60 years old and more, those who suffer from a chronic disease or visit gynaecologists, ophthalmologists or ENT specialists consume also more balance billing than others. The availability of S1 and S2 specialists has also a very strong impact on the amount of balance billing paid by patients. BB/Q is 18% higher for patients living in *départements* where the number of S1 specialists is low and 56% higher for those who lived in *départements* where S2 specialists are numerous.¹⁵

¹⁵For the sake of interpretation, we use three categories for SPR1: low SPR1 includes the first third of *départements* in terms of SPR1 ($SPR1 \in [20,41[$), medium SPR1 the second third ($SPR1 \in [41,52[$), high SPR1 the last third ($SPR1 \in [52,56]$). We proceed with the same method for SPR2 but only present two categories: low SPR2 includes the first third of *départements* in terms of SPR2 ($SPR2 \in [2,15[$); medium and high SPR2 includes the second and last third ($SPR2 \in [15,29]$).

2.5.2 Influence of observable characteristics: demand for better coverage

The effects of observable individual characteristics on the probability of subscribing to better-SHI are captured through the coefficients γ in the first step of the estimation (Table 2.3). We find that in our sample, young and healthy (with no chronic disease, $CD=0$) individuals are more likely to quit MGEN-SHI. Low income individuals are more likely to take out better-SHI than high income. Individuals who live in *départements* where there are few S1 specialists or a lot of S2 specialists are also more likely to take out better-SHI.

2.5.3 Influence of observable characteristics: moral hazard

We find that better coverage induces significant changes ($\beta_1 - \beta_0$) in the impacts of regressors, resulting in heterogeneous moral hazard linked to observable characteristics (Table 2.4): moral hazard appears to be significantly heterogeneous between different levels of income, age, genders, availability of S1 specialist. More precisely, the effect of insurance on balance billing consumption is consistently and significantly decreasing with income: the poor react more to insurance than the rich. They increase more strongly their proportion of S2 visits and consult more expensive S2 specialists. Women react also more to a better coverage as concerns their number of consultations. The increase in quantity of consultations, Q , is 89% higher for women than for men. However, because the effect on the ratio Q_2/Q is also 19% lower for women, it seems that the quantity effect is mainly due to an increase in S1 visits. Compared to 40-60 years old, individuals over 60 react more to balance billing coverage. Finally, consistently with our results in Dormont & Péron (2016), moral hazard on BB/Q is 156% higher (+€21.11) in *départements* with low SPR1 and 178% higher (+€25.36) in *départements* with high SPR2.

2.5.4 Influence of observable characteristics: classical adverse selection and selection on moral hazard

Classical adverse selection means that patients with a higher balance billing consumption without coverage are more likely to take out better coverage: it can be captured through the relationship between γ and β_0 . Selection on moral hazard means that patients with a stronger

reaction to balance billing coverage are more likely to take out better coverage: it can be captured through the relationship between γ and $(\beta_1 - \beta_0)$. Table 2.5 summarizes our findings for different explanatory variables: it shows that classical adverse selection and moral hazard do not always go in the same direction.

Selection on moral hazard appears clearly as regards income. Indeed, the impact of income on the decision to take out better coverage is negative ($\gamma < 0$), positive for the use of balance billing BB/Q with no coverage for it ($\beta_0 > 0$), and its influence on balance billing decreases with better coverage ($\beta_1 - \beta_0 < 0$). We can deduce from this that low income individuals present a relatively low classical adverse selection but react strongly to health insurance and are more likely to switch. This findings that low income people react more to an improvement in coverage seems to us particularly interesting. Assuming that all individuals have the same marginal rate of substitution between medical services and consumption of other goods, such a result can be seen as an empirical evidence of Nyman's interpretation of moral hazard (Nyman 1999, 2003). Poor people would react more to coverage than others because better coverage not only changes the relative price of consultations with balance billing, but also releases their budget constraint.

Table 2.5 shows also that individuals living in *départements* with few S1 specialists show both classical adverse selection and selection on moral hazard, which explains their high motivation to switch. On the contrary, old individuals who also consume a lot of balance billing and would react strongly to health insurance are less likely to switch. The switching costs are probably too high considering that, for individuals over 60, MGEN premiums are on average lower than the competition which generally uses age-based premiums.

2.5.5 Heterogeneity in moral hazard depending on unobservable characteristics

Is moral hazard heterogeneous depending on unobservable characteristics? Is it related to the decision to quit MGEN-SHI? A simple test of joint significance on the terms of the propensity score polynomial shows that we have to reject the hypothesis of a homogenous treatment effect (Table 2.6). Furthermore, the signs of p^2 and p^3 give us the form of the MTE function depending

on U_D . Table 2.7 compares IV estimates, as well as semi-parametric estimates of ATE and MTE for different values of p . Figure 2.4 plots the semi-parametric MTE depending on U_D with 95% confidence intervals and all covariates at their mean value. Because the common support is relatively restricted (Figure 2.2), roughly for p included in $[0.02, 0.35]$, we cannot interpret the MTE results for $U_D > 0.35$. Similarly, Figure 2.3 plots parametric MTE depending on U_D with 95% confidence intervals and all covariates at their mean value. Results are very close to semi-parametric estimates.

The MTE of better health insurance on $Q2/Q$, BB/Q and $BB/Q2$ is decreasing in U_D . This shows selection on moral hazard: individuals who are more likely to take out better coverage have a stronger reaction to health insurance because of unobservable characteristics. We find the contrary for the MTE of better health insurance on Q : it is increasing in U_D : those who are the less prone to take out better coverage show moral hazard in the number of specialist consultations only (of any sector, 1 or 2).

To interpret this result, we need to go back to the model specified in equation (2.16). U_D corresponds to quantiles of V . For a given propensity score, the decision to take out better SHI depends on the value of V ($Z\gamma > V$). The lower V , the higher the probability of choosing better-SHI. V can be linked with unobservable individual characteristics such as disutility (V_1) of administrative switching costs, belief (V_2) that sector 2 doctors provide better quality of care, or risk aversion (V_3). Assuming for simplicity that risk aversion is homogenous across individuals, the decision depends on $V_1 - V_2$: better-SHI subscription is restrained by the disutility of switching costs (V_1) but encouraged by faith in better quality (V_2). Following this interpretation, individuals who are the more prone to switch for better SHI are those with the stronger faith in the quality of care provided in sector 2¹⁶.

Our findings give empirical support for such a story: the highest impact of better coverage on balance billing consumption (BB/Q) is observed for the first switchers. For the first decile of U_D (i.e. of V), they increase their balance billing per consultation by €111.9 (Table 2.7). Then

¹⁶In our specification, Z is by definition uncorrelated with V , U_1 and U_0 , while V can be correlated with the unobservable components, U_1 and U_0 , in the demand for balance billing or for consultations. While there is only one V driving the decision to switch, U_1 and U_0 are different for each of our four variables of interest Q , $Q2/Q$, BB/Q and $BB/Q2$.

MTE decrease for higher values of U_D and become non significant for values between 0.2 and 0.3 (Figure 2.4). Similar results are found for $\log(Q2/Q)$, $\log(BB/Q)$, and $\log(BB/Q2)$, which are all variables measuring the use of sector 2 consultations.

The reverse is found for $\log(Q)$, i.e. the number of specialist consultations (either in sector 1 or 2). For this variable, MTE are increasing with U_D as concerns the parametric estimation and are increasing with U_D but generally non significant in the non parametric estimation. In any case, they are not significant for low values of U_D . These individuals do not believe that sector 2 specialists provide better quality of care (or do not value this quality). Hence the disutility of administrative costs delays their decision to take out better-SHI. Also, the improvement in coverage has no impact on their use of sector 2 specialists. If any significant impact, it is only on the number of consultations without distinction between sectors.

Obviously, this interpretation is based on a story on the ‘content’ of the unobservable components of the decision to subscribe to better-SHI. Nevertheless, the contrast between the decreasing profiles of MTE regarding balance billing use ($Q2/Q$, BB/Q and $BB/Q2$) and the increasing or flat profile of MTE regarding the use of specialist consultations provide a strong support to our econometric approach. In any case, our results are coherent with the expected effect of heterogeneous beliefs in the quality of sector 2 specialists.

2.6 Conclusion

When insurance is voluntary, some individuals may buy insurance because they expect an increase in their consumption due to better coverage. Defined as ‘selection on moral hazard’ by Einav et al. (2013), this phenomenon is likely to play a preponderant role in a context of supplementary health insurance, where subscription is voluntary.

In this paper we investigate the relationships between healthcare use, decision to take out supplementary health insurance and response to better coverage. We use a model that specifies individual heterogeneity in demand for healthcare and in moral hazard. We focus on the demand for specialists who balance bill their patients, i. e. charge them more than the regulated fee

set by NHI. Indeed, the demand for specialists who balance bill relies on preferences and beliefs in quality of care. Individuals are likely to be heterogeneous in their preferences and beliefs, while these unobservable characteristics both drive demand for care and decision to take out SHI, resulting in selection on moral hazard.

In the econometric literature, selection on moral hazard is generally known as ‘essential heterogeneity’. Marginal treatment effects estimators have been developed to capture the impact of a treatment likely to vary across individuals. We use MTE to estimate the causal effect of SHI coverage on balance billing consumption on a French database of 58,519 individuals observed in 2012.

We find evidence of individual heterogeneity in the response to better coverage and of selection on moral hazard. Individuals with unobservable characteristics that make them more likely to subscribe to comprehensive SHI are also those who exhibit stronger moral hazard, i. e. a larger increase in balance billing per consultation. As concerns the influence of observable characteristics, we also find that individuals’ income is a determinant of balance billing consumption and influences the behavioral response to better coverage. Without coverage, the poor consume less balance billing than the rich but increase their consumption more sharply once covered. They are also more likely to take out comprehensive coverage.

In a context where SHI is voluntary, the inflationary impact of SHI coverage on balance billing might be worsened by selection on moral hazard. Our policy conclusions as regards the role of income are of different nature. The negative effect of income on the demand for balance billing consultations coupled with its positive effect on moral hazard provides evidence that insurance plays an important role in terms of access to care for low-income individuals.

Tables and Figures

Figure 2.1 – Treatment choice for given propensity score $P(Z)$ and values of disutility U_D

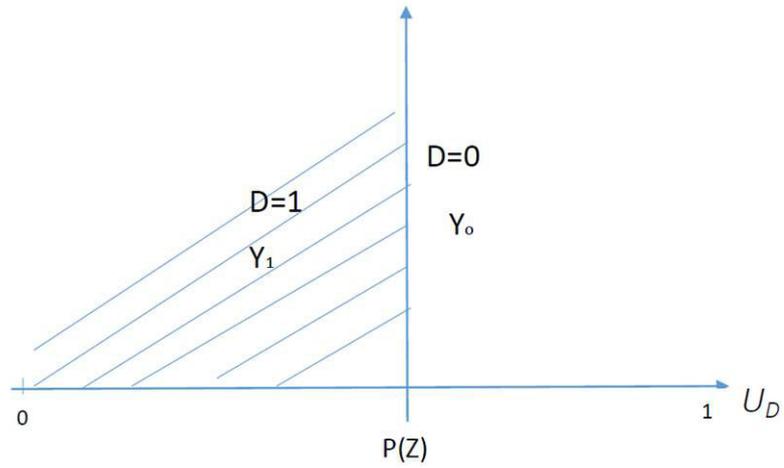


Table 2.1 – Number of MGEN-SHI and better-SHI holders and individual characteristics in 2012 for individuals with at least one visit to a specialist ($Q \geq 1$)

	N	Women %	Age mean (sd)	Income mean (sd)	Chronic Disease %
MGEN-SHI holders	53,456	72.5	57.7 (15.2)	2,499 (764)	22
better-SHI holders	5,063	82***	45.2*** (13.3)	2,406*** (712)	9.4***

*** Significantly different from MGEN-SHI holders, $p < 0.01$

MGEN sample: 58,519 individuals with at least one specialist consultation in 2012

Table 2.2 – Number of specialist visits and amount of balance billing in € in 2010 and 2012 for individuals with at least one visit to a specialist ($Q \geq 1$) in 2010 and 2012

	Q mean (sd)	Q2 mean (sd)	Q2/Q mean (sd)	BB mean (sd)	BB/Q mean (sd)	BB/Q2 mean (sd)
In 2010						
MGEN-SHI	3.6 (4.6)	1.5 (2.8)	44% (0.43)	35.1 (79.5)	10.4 (12.6)	22.8 (11.6)
Future better-SHI	3.7 (4.6)	1.8*** (3.0)	52%*** (0.43)	47.5*** (88.0)	13.2*** (13.6)	24.7*** (11.6)
In 2012						
MGEN-SHI	3.3 (3.4)	1.3 (2.1)	43% (0.43)	32.9 (68.1)	10.5 (13.4)	24.2 (11.7)
Better-SHI	3.3 (2.3)	1.7*** (2.4)	51%*** (0.43)	46.9*** (81.5)	13.7*** (14.3)	26.1*** (12.2)

*** Significantly different from MGEN-SHI holders, $p < 0.01$

MGEN sample: 43,612 individuals with at least one specialist consultation in 2010 and 2012

BB/Q2: subsample of 26,557 individuals with at least one S2 specialist consultation in 2010 and 2012

Table 2.3 – Effect of covariates and excluded instruments on the probability of taking out better coverage (PROBIT)

Pr(<i>QUIT</i> = 1)	coef.
γ	
Women	0.08***
Log(income)	-0.14***
20-40	0.60***
40-60	ref.
60+	-0.29***
CD	-0.20***
Exp. Phy	0.09***
High SPR1	ref.
Med SPR1	0.01
Low SPR1	0.21***
Low SPR2	ref.
Med & High SPR2	0.24***
<i>Excluded instrument</i>	
Early retirees	1.36***
N	58,519

Figure 2.2 – Common support

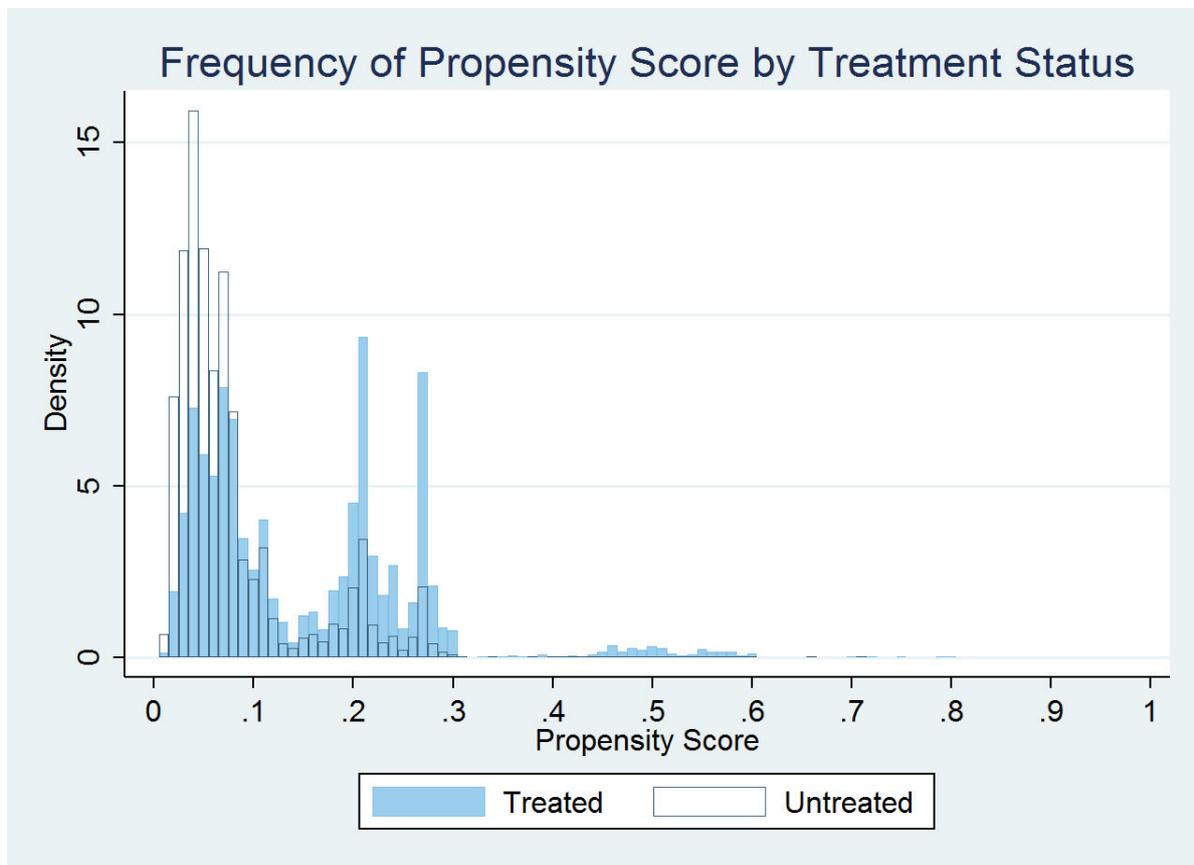


Table 2.4 – Effect of covariates on the consumption of balance billing and on moral hazard

	log(Q)	log(Q2/Q)	log(BB/Q)	BB/Q	log(BB/Q2)
α_0	0.70***	-0.68***	-4.40***	-52.63***	0.26
β_0					
Women	0.10***	-0.01	0.00	0.13	0.05**
Log(income)	0.01	0.09***	0.53***	6.11***	0.26***
20-40	0.25**	-0.00	-0.11	-3.74**	-0.24*
40-60	ref.	ref.	ref.	ref.	ref.
60+	-0.21***	0.02*	0.17***	2.45***	0.16***
CD	0.15***	0.01	0.17***	2.68***	0.13***
Exp. Phy	0.16***	0.14***	0.81***	4.22***	0.16***
High SPR1	ref.	ref.	ref.	ref.	ref.
Med SPR1	-0.13***	-0.01	-0.11***	-1.74***	-0.13***
Low SPR1	-0.03	0.05***	0.18***	0.22	-0.02
Low SPR2	ref.	ref.	ref.	ref.	ref.
Med & High SPR2	0.12***	0.12***	0.56***	2.73***	0.13***
$(\beta_1 - \beta_0)$					
Women	0.89***	-0.19***	-0.68***	-8.48***	-0.28*
Log(income)	-0.08	-0.19***	-1.27***	-15.26***	-0.74***
20-40	0.16	-0.15	-0.75	-7.59	0.11
40-60	ref.	ref.	ref.	ref.	ref.
60+	3.01***	0.69***	4.35***	48.34***	0.47
CD	1.19***	-0.12	-0.49	-8.23***	-0.09
Exp. Phy	-0.02	-0.01	0.15	8.48***	0.43**
High SPR1	ref.	ref.	ref.	ref.	ref.
Med SPR1	0.25**	-0.03	-0.01	0.77	0.17
Low SPR1	0.07	0.22***	1.56***	21.11***	0.69***
Low SPR2	ref.	ref.	ref.	ref.	ref.
Med & High SPR2	0.39*	0.27***	1.78***	25.36***	0.76***
N	58,519	58,519	58,519	58,519	33,332

Table 2.5 – Obervables: summary of relationships between probability of switching, demand for S2 specialists without coverage and moral hazard - average balance billing per consultation (BB/Q)

	Switch γ	Demand for BB β_0	Moral hazard $(\beta_1 - \beta_0)$
Women	+	+	-
Income	-	+	-
60+	-	+	+
CD	-	+	NS
Exp. phy.	+	+	NS
Low SPR1	+	+	+
High SPR2	+	+	+

Table 2.6 – Polynomial coefficients and joint test of significance

	$\log(Q)$	$\log(Q^2/Q)$	$\log(BB/Q)$	BB/Q	$\log(BB/Q^2)$
p	-6.02***	2.63***	17.41***	241.66***	10.80***
p^2	16.20***	-3.74**	-27.20***	-433.62***	-16.93***
p^3	-14.17***	3.05**	21.89***	325.62***	12.12**
chi-square statistic	14.50	12.22	25.79	56.76	19.50
p-value	0.002	0.007	0.000	0.000	0.000

Table 2.7 – Capturing Moral hazard and the effect of unobservables: OLS, IV, empirical ATE and semi-parametric MTE

	log(Q)	log(Q2/Q)	log(BB/Q)	BB/Q	log(BB/Q2)
OLS	0.02**	0.04***	0.21***	2.03***	0.07***
IV	-0.03	0.04	0.19	1.29	-0.06
Empirical ATE	0.72	0.56***	3.21***	30.22*	0.63
MTE p=0.1	-0.97	0.98**	7.04**	111.91**	3.69**
lower bound	-2.56	0.34	3.76	81.89	1.13
upper bound	0.62	1.62	10.33	141.94	6.24
p=0.2	1.15**	0.43**	2.23**	23.40**	0.48
lower bound	0.05	0.09	0.49	1.78	-0.54
upper bound	2.24	0.76	3.96	45.01	1.50
p=0.3	2.58*	0.43	0.15	25.99	0.40
lower bound	-0.04	-0.11	-0.10	-37.08	-1.97
upper bound	5.21	0.98	0.39	89.05	2.77

Empirical ATE: computed by STATA program 'margte' on the common support only

Figure 2.3 – Parametric MTE - $\log(Q)$, $\log(Q2/Q)$, $\log(BB/Q)$, BB/Q , $\log(BB/Q2)$

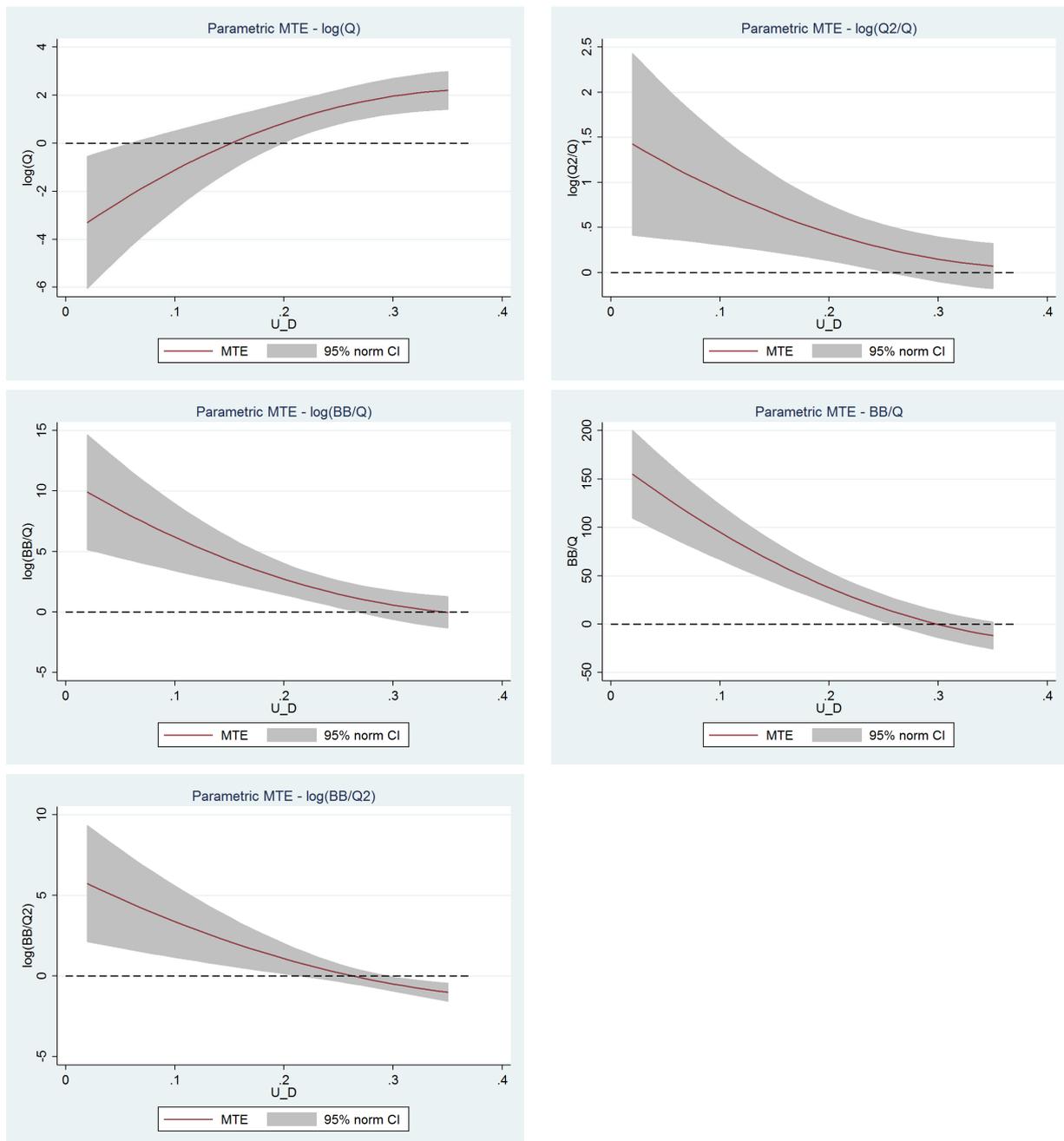


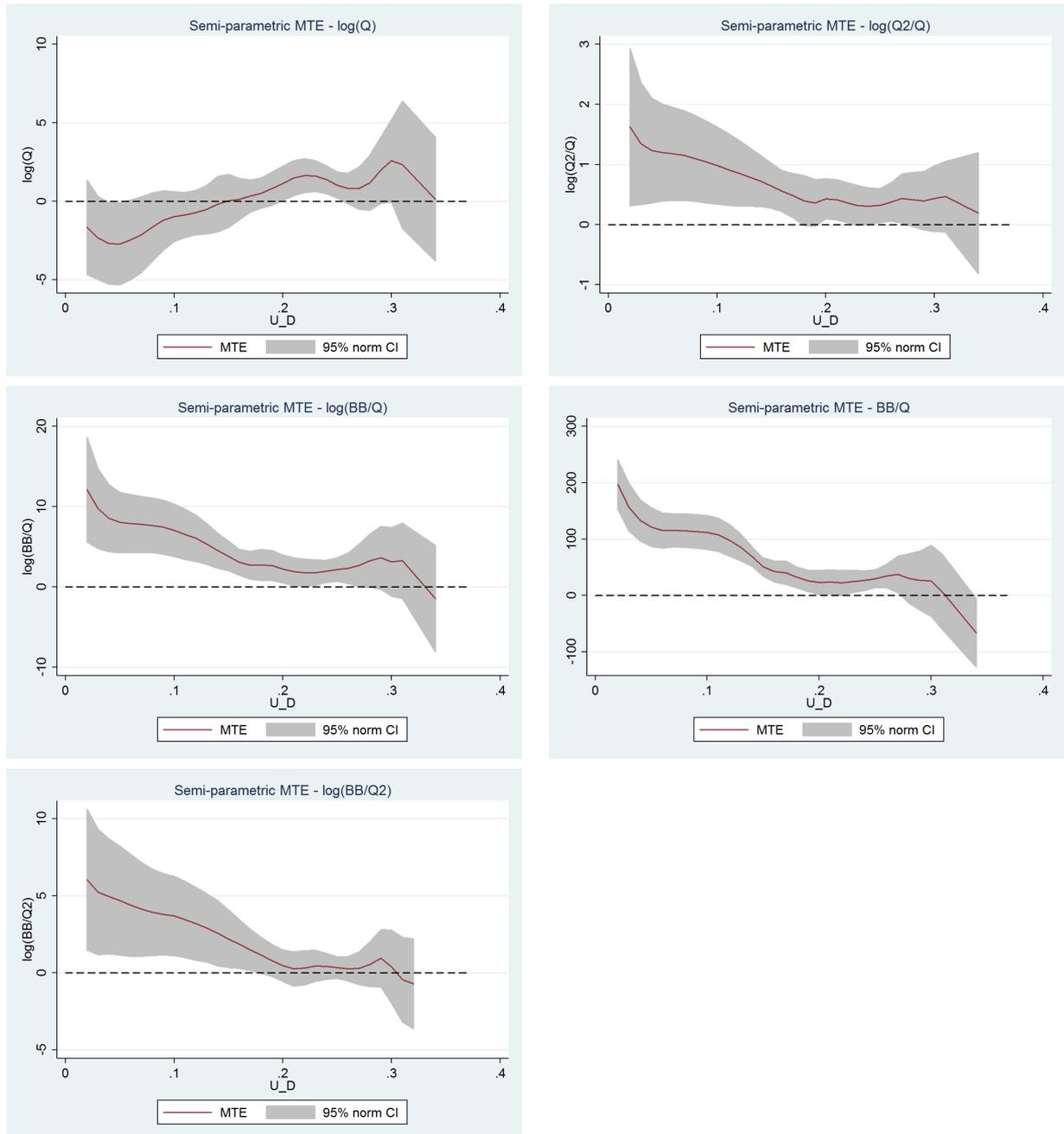
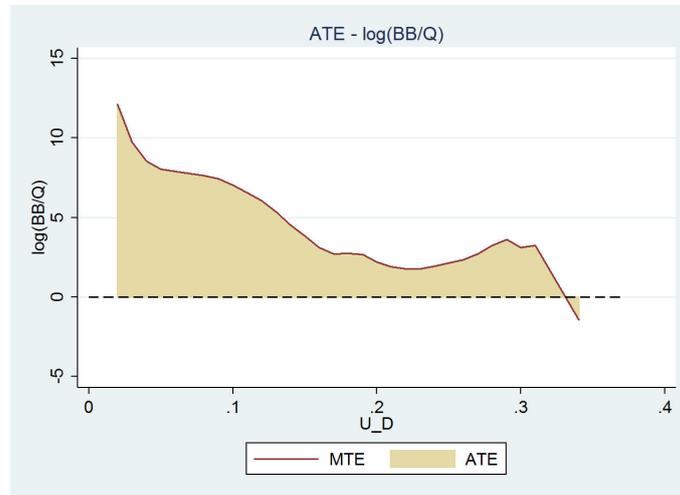
Figure 2.4 – Semi-parametric MTE - $\log(Q)$, $\log(Q2/Q)$, $\log(BB/Q)$, BB/Q , $\log(BB/Q2)$ 

Figure 2.5 – Empirical ATE on $\log(BB/Q)$



Chapter 3

Supplementary Health Insurance: are age-based premiums fair?

3.1 Introduction

In France, age pricing is widespread in the supplementary health insurance (SHI) market. The French system is a mixed public/private health insurance system where private insurers are allowed to provide supplementary coverage. 94% of the French population is actually covered by a SHI contract and private insurers finance to the amount of 14% of medical expenses. Historically, health insurance coverage was provided by not-for-profit insurers, the '*mutuelles*'. They relied on solidarity principles, stated in particular by Bourgeois (1912), to guarantee horizontal equity between high and low risks. Since the enactment of a National health insurance (NHI) system in 1946, the role of the *mutuelles* has changed; they now provide SHI coverage and cover co-payments and medical goods and services out of the NHI benefit package. During a long period, most SHI contracts had very simple features: a unique contract with uniform premiums, i.e. a flat fee, regardless of the individuals' characteristics or a premium proportional to the individual's income. Recently, the constant increase in healthcare expenditures together with a freeze of public coverage has made the SHI market very attractive. New entrants adopt aggressive strategies by providing tailor-made contracts with actuarial premiums, which depend on

I am very thankful to Marc Fleurbaey for his support, his expertise and his thoughtful comments in the course of this project.

the individual risk. The *mutuelles* are experiencing the ‘adverse selection death-spiral’ (Rothschild & Stiglitz 1976, Cutler et al. 1997): they lose their low-risk clients attracted by lower premiums. Therefore, a higher share of high-risk in a *mutuelle*’s portfolio leads to an increase in premiums and speeds up the loss of low-risk. To survive, the *mutuelles* are keeping away from their founding principles of equal access and solidarity. They give up on uniform premiums and price their contracts closer to the individual risk of illness.

In France, setting premiums on individuals’ previous healthcare expenditures is forbidden¹ and the use of medical questionnaires is strongly discouraged by fiscal penalties. Therefore, the *mutuelles* use age as a predictor for individuals’ risk. In 2010, 90% of individual insurance contracts provided by *mutuelles* were priced with age-based premiums, having been only 66% in 2005 (Le Palud 2013). For most of the contracts, premiums for a 75 years old are on average three times higher than for a 20 years old (DREES 2016). Fairness issues are not only a side-effect of market dynamics but also a political argument. In France, it is especially critical for *mutuelles* for which each major decision has to be voted by an assembly of representative of the enrollees. Indeed, the *mutuelles* have to convince their stakeholders that moving towards premiums adjusted on individual’s risk will not go too far against their founding principles in terms of risk sharing and access to insurance. Note that although the French SHI market has specific features, the questions raised by a voluntary SHI financed through age-based premiums find an echo on several health insurance systems such as Belgium, Switzerland, the Netherlands or the USA with Medigap.

Do age-based premiums endanger solidarity? To investigate this question, we propose to focus on healthcare payments bear by individuals. A given use of healthcare services is linked with a given level of healthcare costs. We call ‘healthcare payments’ what the individual ultimately pays, i.e. health insurance premiums and out-of-pocket (OOP) payments. In *mutuelles*’ founding principles, solidarity was expressed through two dimensions: (i) to which extent healthcare payments are disconnected from healthcare use; (ii) how healthcare payments bear on individuals’ available income. How age-based premiums impact these two dimensions? Is the impact different in a context of voluntary insurance?

¹Loi n° 89-1009 du 31 décembre 1989, Loi Évin

In order to focus on the effect of premiums, let's consider a very simple world where individuals can purchase a unique contract with standardized coverage. First, healthcare payments can be more or less disconnected from healthcare costs depending on the way premiums are defined. Because consumption of healthcare increases with age, age-based premiums are necessarily closer to individuals' healthcare costs than uniform premiums. However it is unclear how age-based premiums perform compared to income-based premiums or other forms of premiums closely related to the individual risk. Interestingly, compared to France, the USA are experiencing quite an opposite change. The USA increase regulation in the private health insurance market and use age-based premiums to move towards a system with a higher degree of solidarity. A paper by Stone (1993), *"The struggle for the soul of health insurance"*, deplored the extinction of traditional not-for-profit insurers in favour of insurance companies who discriminate according to risk of illness. Unaffordable actuarial premiums left the sick without any health insurance coverage. The main goal of the Affordable Care Act (ACA) is precisely to share the financial risk due to illness to a great extent. The ACA bans medical underwriting, a practice that highly disadvantages sick people, and endorses a community rating only adjusted by age and gender. In this context, compared to medical underwriting, age pricing is regarded as a movement toward more community rating. Note that the effect of age on premiums is limited since the Medicare program covers the elderly (65+) and is funded through contributions depending on income, mainly paid by workers. The second dimension of solidarity is related to income inequalities. Precisely, how age-based premiums bear on individuals' income. The answer is not clear either. It depends on the correlation between age, income and healthcare use. For instance, when the Mutuelle Générale de l'Éducation Nationale (MGEN) decided to increase the rate of income-based premiums for retirees, the main argument was that retirees were generally wealthier so they could contribute more (3.56% of their income vs 2.97%). Finally, the impact of age-based premiums depends on whether insurance is mandatory or voluntary. When insurance is voluntary, individuals can choose not to be insured, especially if premiums are too expensive compared to their expected healthcare expenditures. This impacts the distribution of healthcare payments in two ways. First, through the effect of adverse selection, premiums paid by those who remain insured are likely to increase. Second, those who decide to remain uninsured bear the risk of facing important OOP payments.

To our knowledge, the impact of premiums in the context of voluntary SHI has not been studied in the literature. Obviously, health insurance has been the focus of an important number of theoretical and empirical contributions. However, because the literature usually considers the NHI level, results are difficult to generalize to the SHI context. Indeed, SHI is meant to cover a different type of risk than NHI. Especially in the French context where NHI covers inpatient care and does not charge co-pays for patients with chronic disease, expenditures covered by SHI are likely to be less extreme, possibly more predictable for the individuals too. For the same reasons, adverse selection phenomena, well documented in the case of basic health insurance, are likely to be different in a context of a mixed system with mandatory NHI and voluntary SHI. Furthermore, because of a lack of data, we have seldom knowledge about the distribution of healthcare expenditures effectively covered by SHI. Correlations between SHI reimbursements, age, income and health condition, which are critical to understand the distributional impact of age-based premiums, have not been documented either.

To bridge this gap, we exploit an original database of 87,110 individuals, aged from 25 to 90 years-old, for whom we observe their SHI reimbursements and final OOP. We adopt an empirical approach and use simulation methods to compare the impact of age-based premiums with other regimes and illustrate adverse selection phenomena when insurance is voluntary. Simulations are calibrated with data specific to the SHI context. We focus on ex post outcomes to fully take into account the specificity of SHI in terms of distribution of expenditures and correlations with age, income and health status. In line with the literature on equity in healthcare financing (Wagstaff & Van Doorslaer 2000), we use concentration curves and inequality indexes to measure the impact of premiums on income distribution. An original contribution of our paper is to adapt these tools to measure the impact of premiums on transfers between low and high healthcare users.

3.1.1 Aim of the paper, methodological framework and contributions

In the context of voluntary SHI, this paper aims at measuring how age-based premiums impact the extent of risk sharing between low and high users and the extent of income redistribution between low and high income groups. We compare their impact with other regimes of premiums: from pure CR to actuarially fair premiums or income-based contributions.

We focus on expenditures meant to be covered by SHI, i.e. the part of healthcare expenditures not covered by NHI. We consider a simple framework where individuals have only the choice to subscribe to SHI or not. There is only one contract available with the same level of coverage and the same regime of premiums for all policyholders. Firstly, we use simulations to compute different types of premium (uniform, age-based, income-based, income-based adjusted with age, medical underwriting and experience rating), predict whether individuals will take-out SHI or not, calculate their subsequent healthcare payments (premiums plus OOP payments). Secondly, we use concentration curves to derive equity indexes on risk sharing and vertical equity from the simulated outputs. We also allow for possible dynamic adverse selection effects due to the fact that some individuals can choose not to buy SHI when insurance is voluntary. The simulation is calibrated using individual panel data from a French supplementary health insurer, the Mutuelle Générale de l'Éducation Nationale (MGEN). Our database stems from the administrative claims of 87,110 individuals, aged from 25 to 90 years-old, who are all covered by the same SHI contract from January 2010 to December 2012. Our data provide socio-economic and health status information as well as supplementary healthcare expenditures (SHE), supplementary health insurance reimbursements (SHIR) and OOP payments.

Our choice to focus only on supplementary healthcare expenditures is motivated by two reasons. The first reason is that the political debate in France about coverage inequalities, the extent of risk sharing and how premiums weight on households' budget concerns SHI. Although SHI covers a relatively limited part of total healthcare expenditure (13%), it is considered as essential in access to care². Supplementary health insurers themselves, especially the *mutuelles*, which are not-for-profit and headed by an elected board, are concerned about the fairness of their price strategy. On the one hand, market's dynamic force them to price their contracts closer to the individual risk. On the other hand, they have to convince their stakeholders that this will not endanger their founding principles based on solidarity and equal access. The second reason is practical: data availability dictates our decision to focus only on SHI. Although our database includes total healthcare expenditures and NHI reimbursements, data are missing on hospital expenditures which are mostly covered by NHI. On the contrary, available databases with comprehensive information on NHI reimbursements do not include SHI reimbursements

²This idea has led to the creation of a free SHI for very low income individuals in 2000, the *Couverture Maladie Universelle Complémentaire* (CMU-C)

and final OOP payments. This would preclude a complete analysis of the whole health insurance system (NHI plus SHI).³

We use a simple framework where only one contract is provided by one insurer with the same level of coverage and the same regime of premiums for every insured. Individuals have only the choice to be insured or not. We also assume null profits: because they are not-for-profit organizations, *mutuelles*'s objective is to break even, not make profits. A load factor is however charged by the insurer to cover administrative costs. There is no competition between insurers in our model, neither on premiums or level of coverage. This simplification allows us to focus on the effect of age-based premiums on individuals' healthcare payments, independently from the effects driven by coverage choices or imperfect competition. Several papers, that we present in more details in the next section, have already simulated the effects of competition on coverage (Handel et al. 2015) and premiums (Ericson & Starc 2015). A theoretical contribution by Goulão (2015) also studies the case where individuals have the choice between different types of premium. Furthermore, assuming a standardized contract is not very far from the reality of the French SHI market. Although the extent of coverage can vary regarding medical services outside the NHI benefit package (such as balance billing or optical devices), contracts are very homogeneous for coverage of NHI co-pays. Indeed, insurers benefit from fiscal advantages if their contracts are certified as a '*contrat solidaire et responsable*' by the French government. This especially implies full coverage for NHI co-pays on hospital and ambulatory care.

In our framework where insurance is voluntary insurance and contracts are standardized, we model the decision to take out SHI considering individuals as utility maximizers who face a distribution of expected health expenditure which depends on their characteristics. Simulations' results in terms of level of premiums or number of uninsured will depend strongly on the specificity of our sample and on the assumptions we make in terms of individuals' knowledge about their risk, their risk aversion or the form of their utility function. The accuracy of our results in terms of prediction if one of these schemes were implemented is therefore probably relatively low. However, precisely because we run simulations on the same sample, we are

³Note that because NHI in France is mandatory and universal and SHI is not a substitute to public coverage, we can analyze the impact of SHI premiums separately from the redistribution implied by the NHI. There are indeed no adverse selection issues on the NHI, as it could be the case in Germany for instance where individuals can opt out from NHI and buy private coverage instead (Panthöfer 2016).

able to compare different types of premiums, evaluate their impact on risk sharing and income redistribution and understand the consequences of adverse selection.

As we will justify it further, we focus on ex-post outcomes: how the way premiums are defined will impact the distribution of healthcare payments (premium + OOP payments) between low and high users and low and high income. Our approach departs from the welfarist approach considered in many papers devoted to health insurance (Blomqvist & Horn 1984, Rochet 1991, Cremer & Pestieau 1996, Henriët & Rochet 1998, Petretto 1999). Indeed, these papers consider the effect of health insurance on social welfare without further analysis on its distributional impact. Furthermore, their analysis is usually performed ex ante, based on individuals' expected utilities, rather than ex post, once the consumption of healthcare is realized and known. As advocated by Fleurbaey (2008), the ex post perspective takes into account more information than the ex ante perspective. Indeed, in a context of voluntary insurance, the ex post outcome in terms of healthcare payments (premium + OOP payments) will reflect both individuals' ex ante appreciation of risk (through SHI subscription) and the realization of healthcare expenditures.

Because we focus on ex post distributional impact of SHI, inequality indexes appear to be appropriate tools. In particular, concentration curves have been widely used to measure the effect of health insurance payments on income distribution (Wagstaff & Van Doorslaer 2000). They have the attractive advantage to represent in the same diagram income as well as healthcare payments distributions. From these curves, we are also able to derive several equity indexes that can be used to compare different regimes of premiums. These measures focus on vertical equity, on how premium regulation makes payments more or less progressive and contribute to reduce, or increase, income inequalities. It is also possible to adapt concentration curves to measure the extent of redistribution between low users and high users of healthcare. This way, we are able to explicitly distinguish the impact of age-based premiums on risk sharing and vertical equity in our analysis. Note that Aronson et al. (1994) suggest to decompose the redistribution effect into three components: pure vertical equity, reranking and horizontal equity. We argue that the measure used is not satisfying in terms of practical use and interpretation. Indeed, as noted by Wagstaff & Van Doorslaer (2000), even though the theoretical distinction between reranking (treatment of unequals) and horizontal equity (treatment of equals) is valid,

the empirical distinction is difficult and somewhat artificial because it depends eventually on the definition income groups' width. Furthermore, we consider that the concept of horizontal equity as defined by Aronson et al. (1994) is intrinsically different from what we define as 'risk sharing', i.e. the redistribution between low and high healthcare users. Indeed, measuring 'horizontal equity' implies to remain within the general framework of income distribution, taking the goal of redistributing income as granted. Yet, as noted previously, fairness of healthcare payments may also be considered from the narrower spectra of risk sharing, letting voluntarily income inequalities not due to differences in health aside.

This paper contributes to the economic literature on health insurance on three different ways. First, the analysis of an original database on supplementary healthcare expenditures and OOP payments characterizes the specificity of SHI in terms of distribution of expenditures and correlations with age, income and health status. Second, in the SHI context, our simulations illustrate how age-based premiums deal with adverse selection and impact the ex post distribution of healthcare payments. Third, we propose a methodological contribution to the literature on equity in healthcare financing by using concentration curves to measure the extent of redistribution not only between income groups but also between low and high healthcare users.

Based on our simulations, we derive three results on the impact of age-based premiums in the SHI market: (i) in a context of voluntary SHI, age-based premiums is the best solution to preserve risk sharing; (ii) however, they achieve risk sharing at the expense of vertical equity; (iii) the absence of a mandate limits the impact of SHI on risk sharing and vertical equity, especially when premiums are based on a form of community rating.

The paper is organized as follows. In section 3.2, we define 'healthcare payments' and review the literature focusing on the impact on efficiency and fairness of health insurance premiums. Section 3.3 presents the indexes we use to measure risk sharing and vertical equity. Section 3.4 describes how we model individuals' decision to take out SHI, compute premiums and simulate individuals' healthcare payments. Section 3.5 presents the data on which our simulations are based and descriptive statistics on SHE, SHIR and OOP payments distribution from our sample. Section 3.6 summarizes the results stemmed from the simulations. Section 3.7 concludes.

3.2 How to define and design fair healthcare payments?

In this section, we define ‘healthcare payments’ and compare the different types of health insurance premiums. We also review the economic literature on health insurance focusing on the design of healthcare payments and its consequences in terms of efficiency and fairness.

3.2.1 Healthcare payments: concepts and definitions

We previously defined ‘healthcare payments’ as the amount an individual will ultimately pay for healthcare, which is the sum of her health insurance premium and OOP payments.

A health insurance premium is a payment made to an insurer in order to be covered against future healthcare costs. The payment is made ‘ex ante’, i.e. before the individual consumes healthcare. Similarly to all other types of insurance, the financial risk, in this case related to healthcare consumption, is shared with all other individuals who took out insurance and joined the ‘pool’. Indeed, by paying a premium, the enrollee agrees that her contribution will be used to socially finance the pool’s healthcare expenditures. Health insurance premiums can be set in different ways. Two principles are usually opposed: ‘community rating’ and ‘actuarial fairness’. Community rating (CR) implies that contributions are disconnected from individual risk and rather depend on the average risk of the pool. On the contrary, actuarial fairness requires the premium to be as close as possible to the individual’s risk, measured ex ante by the expectancy of her healthcare expenditures. Consequently, the extent of ‘risk sharing’, i.e. the extent of ex post transfers between the ‘low-users’ and the ‘high-users’ of healthcare among the pool, will be more important with CR than with actuarially fair premiums. It is worth noting though that insurance always implies a form of risk sharing, even when the premium is based on the individual’s risk. Indeed, ex ante, when the premium is paid, the realization of healthcare consumption is still uncertain. Among those who paid a higher premium due to their higher risk, some will be low-users ex post and will subsidize high-users.

Theoretically, one can draw a continuum of premiums from total to limited risk sharing. ‘Uniform premiums’ would be the purest form of CR. A uniform premium is a flat fee, an equal

contribution paid by all individuals whom join the pool, regardless of their own risk. The premium therefore depends on the expected average health insurance reimbursements conditional to the pool. ‘Age-based premiums’ lie further on the continuum. Premiums will indeed increase with age because older individuals present a higher risk to be high-users of healthcare. Age-based premiums are usually classified as a form of ‘adjusted community rating’. Indeed, although linked to individual risk, age-based premiums also imply a form of CR among the pool of individuals who belong to the same age-group. Adjusted CR can also use gender or location to define premiums. Obviously, as criteria become more and more related to individual risk, the ‘adjusted pool’ shrinks as does risk sharing. At the right-hand side of the continuum, where risk sharing is very limited, insurers would use information about previous and current diseases, known as ‘medical underwriting’ or use directly previous healthcare consumption, known as ‘experience rating’. We are therefore closer to the actuarial fairness principle, where premiums depend on individual risk rather than on the average risk of the pool.

‘Income-based premiums’ stand apart from this continuum. Indeed, income is not used here as a risk predictor⁴. The rationale of income-based premiums is rather related to how health insurance premiums weight on individuals’ budget. Rather than risk sharing, the emphasis is indeed on ‘vertical equity’. As regards healthcare financing, vertical equity states that individuals with unequal income should contribute unequally to healthcare payments. Precisely, vertical equity implies that payments should be at least proportional to income (equivalent to a uniform tax rate) or progressive (equivalent to an increasing marginal rate). It is worth noting that vertical equity and risk sharing can be conflicting objectives. Indeed, whereas risk sharing is maximized when premiums are uniform, the ‘premium to income ratio’ (PIR) decreases with income and consequently the poor contribute relatively more than the rich: uniform premiums are regressive and do not achieve vertical equity. Moreover, if the rich consume more healthcare than the poor, income-based contributions will limit transfers from low to high healthcare users. When premium are based on income, the contribution can either takes the form of a uniform rate – the PIR will therefore be constant with income (proportional payments) – or be set with an increasing marginal rate (progressive payments).

⁴Although income-based premiums are actually similar to adjusted CR: premiums depend on the average expenditures of the pool and are adjusted to individuals’ income

Contrary to health insurance premiums, which are defined *ex ante*, the other component of healthcare payments occurs *ex post*: OOP payments depend on the realized healthcare consumption, and are entirely borne by the individual. OOP payments correspond to the share of healthcare expenditures not covered by the insurance contract: general deductibles (insurance reimbursements only start after a certain amount of expenditures), co-payments (a fixed or variable share of the price of healthcare is not covered) or costs of medical goods not included in the benefit package. Formally, OOP payments equal the difference between healthcare expenditures and health insurance reimbursements.

We investigate the following question: in a context of voluntary insurance, do age-premiums guarantee a fair distribution of healthcare payments? Note that when insurance is mandatory and covers a standardized benefit package, the respective impacts on risk sharing and vertical equity of health insurance premiums and OOP payments are disconnected and can be analyzed separately. Indeed, if the whole population benefits from the same coverage, the way premiums are defined has only an impact *ex ante*, before healthcare consumption. However when insurance is voluntary, the way premiums are defined is likely to influence individuals in their decision to take out health insurance. In this case, *ex post* OOP payments will be directly related to the *ex ante* payment of the premium. When insurance is voluntary, it is therefore critical to adopt an *ex post* approach, after healthcare use is realized, that considers the distributional impact of both health insurance premiums and OOP payments.

3.2.2 Literature: efficiency and fairness of healthcare payments

The political debate on how to define health insurance premiums is a mix of pure efficiency arguments and ethical considerations. The economic literature, either normative or positive, has mainly focused on efficiency issues, mostly investigating the welfare consequences of health insurance premiums by taking into account moral hazard behavior, adverse selection phenomena, reclassification risk or imperfect competition. A large part of the literature also aims at justifying income-based premiums in social health insurance systems on efficiency grounds. The specific impact of age-based premiums is seldom analyzed, except in recent contributions that followed the implementation of the ACA in the USA. As regards fairness, the literature on social choice acknowledges that different conceptions of a fair premium coexist. Empirical studies

which attempt to measure the redistributive effect of health insurance premiums are quite limited and do not take into account the extent of redistribution between low and high healthcare users. More importantly, the distributional impact of premiums in a context of voluntary SHI has not been studied.

According to Zweifel & Breuer (2006), uniform premiums harm efficiency since they preclude contracts' optimality in terms of ex ante and ex post moral hazard. Indeed, Zeckhauser (1970) and Blomqvist & Johansson (1997) show that a contract with a cost-sharing rule (i.e. level of deductibles and co-pays) that is non-linear in healthcare expenditure is generally optimal to limit moral hazard. For instance the rate of co-pays should decline after a certain amount of expenditures. This implies that contract design, in terms of coverage and ultimately in terms of premiums, must depend on individual characteristics; which is impossible to implement with uniform premiums. Rather than uniform premiums, Zweifel & Breuer (2006) therefore recommend to use actuarial premiums, even for NHI contributions. Indeed, premiums based on individual's risk and previous consumption reward those who invest in prevention and make effort to limit their healthcare expenditures.

Several papers attempt to estimate the adverse effect of community rating when it is implemented on a market without mandate. They compare the percentage of uninsured, usually across different states in the United States characterized by different rules for setting premiums. A first paper by Buchmueller & Dinardo (2002) does not report any evidence of such a death-spiral in the American market for 'small businesses' employer-based health insurance. Using data between 1987 and 1996, they do not find significant differences in the percentage of uninsured between the state of New-York where CR has been implemented in 1993 and other states where regulation on premiums was weaker. Herring & Pauly (2006) also find small differences in the employer-based market using more recent data but explain this result by the fact that, even when considering unregulated markets, pooling might be relatively important and makes unregulated and regulated markets eventually closer in terms of outcomes (coverage rates, type of contracts and premiums) than expected. However, evidence of adverse effects of community rating seems to be more striking in the individual market. Using US data from a national survey, Sasso & Lurie (2009) report that "young and healthy people were 20 to 30% more likely to be uninsured as a result of community rating".

The Affordable Care Act gave rise to a literature focusing on the impact of different forms of premiums on behaviors in a competitive health insurance market. These contributions especially enlighten interactions between premium regulation and market's dynamic. Handel et al. (2015) investigate the welfare implications of different regimes of premium (namely, CR or actuarial fairness) in a competitive market, when insurance is mandatory. They build a simulated market exchange where two contracts are offered: one with a 10% co-pay the other one with a 40% co-pay. Individuals are not allowed to opt-out and must choose among the available contracts, the whole population is therefore at least partially insured. The authors use employer-based health insurance data to estimate risk distributions faced by consumers. They can allow for heterogeneous risk aversion and estimate its correlation with individuals' objective risks. They target two sources of inefficiencies: adverse selection and reclassification risk. Adverse selection is likely to occur when regulation imposes a form of community rating: due to the adverse selection death spiral, the generous contract disappears and individuals have no choice but to be covered with high co-payments. Reclassification risk however is specific to actuarial premiums because individuals bear the risk of an increase in premium if their health state deteriorates. The simulation model gives, for each type of premiums, the contract each individual will choose. The authors are then able to compute the expected utility of an individual, starting at age 25 until 65, given her risk aversion and risk profile. To measure the welfare difference between two regimes of premiums, x and x' , they define the fixed yearly payment the individual should receive under regime x to be indifferent between regimes x and x' . The authors find that, although the adverse selection cost, in terms of social welfare, can be important with community rating, the reclassification risk cost, induced by actuarial premiums, is five times higher. Interestingly, age-based premiums do not seem to improve welfare compared to uniform premiums. Age-based premiums undo transfers from the younger to the older groups while not avoiding the adverse selection death spiral: the contract with generous coverage still disappears even for younger age groups.

Ericson & Starc (2015) also use a simulated exchange market to estimate the welfare effects of premium regulation. Unlike Handel et al. (2015) however, they release the perfect competition assumption and allow insurers to earn different markups according to consumers' price sensitivity. In particular, the authors assume that younger consumers are twice as price sensitive

as older consumers. Consequently, in the absence of a strict regulation on premiums, older consumers are likely to pay higher premiums due to higher markups. The authors conclude that restrictions on age-based pricing, from pure CR to bounded ratios, not only increase transfers from the younger to the older groups but also lower overall markups, increasing consumer and overall surplus. However, the authors also insist on the adverse consequences of regulation when insurance is voluntary: the marginal consumer, highly price-sensitive, is likely to opt-out leading on the market consumers with a low price-sensitivity on whom insurers will impose high markups. As a result, Ericson & Starc (2015) state that "a weak or absent mandate may negate the consumer surplus gains achieved from modified community rating". As a matter of fact, this literature stresses that the impact of premium regulation can be strongly modified when health insurance is voluntary in a competitive market. In particular, the potential adverse effects of CR on risk sharing cannot be ignored.

Although income-based premiums are widespread in European social insurance systems, the idea that health insurance should imply pro-poor transfers is far from consensual. Atkinson & Stiglitz (1976) argue that introducing redistributive instruments on top of income taxation is usually redundant or even inefficient. Breyer & Haufler (2000) further confirm that separating health insurance from income redistribution would yield substantial efficiency gains. On the contrary, there is an extensive literature advocating income-based contributions for social health insurance. Adopting a welfare perspective, several papers show that when low-income individuals also face higher risks a health insurance system that combines redistribution from the rich to the poor and from the healthy to the sick is better in terms of welfare than a pure optimal income tax (Blomqvist & Horn 1984, Rochet 1991, Cremer & Pestieau 1996, Henriet & Rochet 1998, Petretto 1999). Kifmann (2005) adopts a constitutional perspective to show that income-based premiums are likely to be socially accepted, even by high-income groups, provided that individuals face a reclassification risk in an alternative private market (their premium increases as they become sicker) and income inequalities are moderate. According to Kifmann (2005), this could explain why the US, where inequalities are more extreme than in most European countries, are very reluctant to endorse a universal system financed through taxes. A theoretical paper by Goulão (2015) shows that when individuals have the choice between a health insurance contract with income-based premiums and another contract with actuarially

fair premiums, some individuals are still willing to participate to the income-based premiums contract. Another result is that the presence of a contract with income-based premiums can increase efficiency in the health insurance market. Indeed, high risk individuals tend to prefer income-based premiums and therefore signal themselves as high risk. This reduces information asymmetry in the market.

In terms of political acceptability, fairness arguments may be as important as efficiency considerations. The first difficulty however is to define from a normative point of view what a fair premium should be. Stone (1993) wrote that individuals are not responsible for their medical expenses and so there is nothing fair about making the sick contribute more and only uniform premiums can guarantee fairness in healthcare financing. Interestingly, when advocating the efficiency of actuarial premiums, Zweifel & Breuer (2006) also refer to ethical considerations arguing that uniform premiums are unfair because they yield transfer from healthy but poor individuals to individuals likely to be wealthier and heavy users of medical care. As they state: "a healthy young worker would subsidize a wealthy older manager who is a heavy user of medical services". Furthermore, Pauly (1984) argues that because individuals are partly responsible for their medical expenses, due to their health behavior or overconsumption of health care, actuarial premiums are more equitable than uniform premiums. These apparent conflicting statements are in a sense all acceptable definitions of fairness, they are just built on different ethical grounds that eventually refer to different conceptions of social justice.

As noted by Fleurbaey & Schokkaert (2011) though, "there is a widespread conviction that health care is not a commodity like other commodities, because health care expenditures are largely imposed on individuals, rather than freely chosen. It follows that the financial burden should not disproportionately rest on those who suffer from illness". According to Culyer (n.d.), decoupling healthcare use from healthcare payments also ensures that health expenditures will not threaten the ability of households to purchase other goods with the same kind of ethical status such as education or housing. This pleads for the idea that health insurance should at least achieve horizontal equity, meaning that individuals with equal ability to pay eventually end up making equal payments. There is no consensus however on the extent of horizontal equity. As regards healthcare financing, perfect horizontal equity is achieved when healthcare

payments are entirely disconnected from healthcare expenditures, i.e. when risk sharing as we defined it previously is maximized. However, is this situation fair when differences in health care consumption are due to individual's behavior or preferences? The recent literature on equity, responsibility and compensation (Fleurbaey 2008, Roemer 2009) offers a useful framework to analyze the extent of solidarity that should be achieved in terms of healthcare payments. Especially, Fleurbaey & Schokkaert (2009) measure inequalities in health and healthcare consumption by introducing a distinction between explanatory variables leading to 'ethically legitimate inequalities', that engage individuals' liability, and those leading to 'ethically illegitimate inequalities' that should call for compensation. Schokkaert & Van de Voorde (2004) also used the fair allocation framework to differentiate legitimate from illegitimate factors in risk-adjustment models. Eventually, the criteria used to define premiums, such as age, gender, income, medical history, smoking behavior, should reflect what society considers as acceptable or unacceptable in terms of inequalities in healthcare payments and in which extent health insurance should compensate for it. Theoretically, age and sex would appear as 'illegitimate factors', for which it seems hard to engage individuals' responsibility, and health insurance should compensate for subsequent inequalities in healthcare use. In practice however, the conception of what is acceptable or not varies across countries and time. Premiums increasing with age seem to be easily accepted, or at least widely adopted by both European and American health insurance markets. Setting different prices for men and women has been considered as a discriminatory practice by the European Union (EU) and gender-based premium have been forbidden on EU health insurance markets since 2012.⁵ On the contrary in the USA, the ACA allows insurers to adjust premiums on age, gender as well as on smoking behavior.

There is no ethical consensus either on whether healthcare payments should increase with income. This principle is often referred to as vertical equity: households with unequal ability to pay should unequally contribute to healthcare finance. This conception of equity is also close to the venerable Marxist principle that originally founded most of the European social insurance systems: 'To each according to her needs, from each according to her ability to pay'. Even though there is no undisputable ethical principle to defend this conception, the fact that income-based premiums are widespread in social health insurance systems seems to express

⁵The decision was following the Court's judgement on 1st March 2011 in the Test-Achats case (C-236/09)

a political and social concern about how healthcare payments weight in households' budgets. Furthermore, in multiple payers systems where premiums are not related to income, as it is the case in Switzerland or in the American market exchange for instance, low-income individuals usually benefit from public subsidies.

As regards the empirical measure of inequality in healthcare payments and of equity in financing healthcare, methodological tools have been used to assess and compare the distributional effects of health insurance on income. This approach is derived from the literature on income inequalities and is based on the use of concentration curves; see Wagstaff & Van Doorslaer (2000) and De Graeve & Van Ourti (2003) for a review on methodology and results. Early estimations for France have shown the regressive impact of SHI (Lachaud & Rochaix (1995)). However, the data used for this study date from 1984 and are based on individuals' declaration about the premium they pay and their annual OOP payments. More recently, Duval et al. (2012) have investigated the nature of transfers induced by both NHI and SHI in France and conclude that premiums in the SHI market limit the redistribution between low and high risks. However, this study suffers from several drawbacks. First, the study is not focused on age-based premiums and it is actually impossible to disentangle in their results the respective effect of different types of premiums. Second, there are concerns about the quality of the data they use. They do not have access to comprehensive data on health insurance coverage and therefore use imputation methods to reconstruct SHI reimbursements and OOP payments. One of the consequences of imputation, besides the risk of approximations and measurement errors, is that the analysis is only performed on the deciles of the healthcare expenditures distribution. Therefore the study does not take into account the top of the distribution, where healthcare payments can be extremely important for a small number of individuals. Finally, the extent of redistribution is measured for specific groups of individuals (by income decile, age or health status) through a ratio contribution/benefit that ignores the correlations between risk, healthcare expenditures and income and makes the impact of age-based premiums on risk sharing and vertical equity unclear.

Our paper contributes to the literature by measuring the distributional impact of age-based premiums in a context of voluntary SHI. We adopt an empirical approach and use simulation

methods to compare the impact of age-based premiums with other regimes. Simulations are calibrated with data specific to the SHI context: we exploit an original database of 87,110 individuals, aged from 25 to 90 years-old, for whom we observe their SHI reimbursements and final OOP. We focus on ex post outcomes to fully take into account the specificity of SHI in terms of distribution of expenditures and correlations with age, income and health status. We use concentration curves and inequality indexes to measure the impact of premiums on income distribution. An original contribution of our paper is to adapt these tools to measure the impact of premiums on transfers between low and high healthcare users.

3.3 Measuring the extent of risk sharing and vertical equity

We use concentration curves to measure to which extent premium design will impact the distribution of healthcare payments between low and high healthcare users (risk sharing) and low and high income groups (vertical equity). We adopt an ex post approach and consider all healthcare payments, i.e. premium and OOP expenditures. We perform the analysis on the whole population, either insured or not (for SHI), to examine the effect of adverse selection on risk sharing and income transfers when insurance is voluntary. We use concentration curves to represent the income distribution, the distribution of healthcare costs and the expost distribution of healthcare payments. We compute Gini and Kakwani indexes to measure the impact of healthcare payments on income distribution (vertical equity). We use similar tools to examine to which extent healthcare costs are disconnected from healthcare payments (risk sharing). Formulas and the Stata code used to compute the indexes can be found in the appendix.

3.3.1 Vertical equity

Figure 3.1 presents schematically the concentration curves and the indexes we will use in our analysis. The North-West diagram represents the Lorenz curve of income. The Gini coefficient⁶, G^I , gives a measure of income inequalities, ‘at the start’, before healthcare payments. Concentration curves for payments plot the cumulative proportion of healthcare payments including premium and final OOP against the cumulative proportion of the population (ranked

⁶The Gini coefficient is twice the area between the Lorenz curve and the line of equality

according to income, as for the Lorenz curve) (North-East diagram). The diagonal represents strictly uniform payments. When the curve lies below the diagonal line, the concentration index for payments⁷, C_I , is positive, meaning that higher income groups bear a bigger share of ex post healthcare payments (premium + OOP). By comparing the concentration curves for payments with the Lorenz curve, we can measure whether a payment is progressive or regressive (South-West diagram). When the concentration curve lies above the Lorenz curve then the payment scheme is regressive: the lower income groups bear a relatively bigger share of the health care payments compared to their share in society's income. The Kakwani index, computed as $K_I = C_I - G^I$, will then be negative. The more negative is K_I , the more regressive the payments. Finally we can measure the effect of health insurance schemes on income distribution by comparing the Lorenz curves before and after healthcare payments (South-East diagram). Let's define $G^{I-(P+OOP)}$ as the Gini coefficients after healthcare payments. The redistribution effect of healthcare payments, $RE_I = G^I - G^{I-(P+OOP)}$ will be positive if healthcare payments yield income transfers from the rich to the poor.

3.3.2 Risk sharing

To measure risk sharing, we still use concentration curves and equity indexes but we adapt them to focus on the extent of transfers between low and high healthcare users (see Figure 3.2). Instead of using the cumulative population ranked by income in the horizontal axis we rank the population according to their total annual supplementary healthcare expenditures (SHE), i.e the amount that individuals would pay if they did not have SHI coverage. The Lorenz curve becomes a representation of the SHE distribution in the population (North-West diagram). A high Gini coefficient, G^{SHE} , means that SHE are concentrated at the top of the distribution. Similarly, the concentration curve of payments plots the cumulative proportion of healthcare payments, including premium and OOP expenditures (North-East diagram) against the cumulative proportion of the population ranked according to SHE. If the curve lies below the diagonal, then $C_R > 0$, meaning that high healthcare users contribute more than low users in terms of healthcare payments. On the contrary, $C_R < 0$ implies that low healthcare users contribute more than high healthcare users. This can be the case with comprehensive coverage (low OOP)

⁷The concentration index for payments is twice the area between the concentration curve and the line of equality

and higher premiums for low healthcare users. Note that without insurance, the premium is null and $OOP = SHE$, therefore $C_R = G^{SHE}$. A comparison between the concentration curve and the Lorenz curve assesses whether payments are regressive (South-West diagram). Indeed, high users might contribute more than low users in absolute terms but still bear a share of healthcare payments which is lower than their share in society's SHE. In this case, the Kakwani index $K_R = C_R - G^{SHE}$ will be negative. Finally, the overall redistribution between low and high users is measured as the area between the Lorenz curves with and without insurance, that is $RE_R = G^{SHE} - G^{P+OOP}$.

We argue that measuring the effect of health insurance premiums on vertical equity on the one hand and risk sharing on the other hand can accommodate different conceptions of fairness. If vertical equity is the main goal, a fair premium would imply $C_I > 0$ (the rich contribute more), $K_I > 0$ (payments are progressive) and $RE_I > 0$ (there is redistribution from the rich to the poor) and regimes can be ranked according to these criteria. If society's goal is to achieve horizontal equity and maximize risk sharing then a fair premium would imply $C_R < 0$ (low users contribute more), $K_R < 0$ (high users contribute proportionally less than low users) and $RE_R > 0$ (the distribution of SHE is less unequal after health insurance).

3.4 Decision to take out SHI, premiums and market's dynamic

Our purpose is to examine the impact of SHI healthcare payments (premiums + OOP) on risk sharing and vertical equity. We consider 6 regimes of premium, and model for each of them the decision to subscribe to SHI. When premiums are based on a form of CR, i.e. depend on the average healthcare expenditure of the pool of subscribers, we use an algorithm to simulate the consequences of subscription decisions on market size and premium levels.

3.4.1 Health insurance premiums

We consider six regimes of premium: uniform, age-based, medical underwriting, experience rating, income-based and income/age-based premiums where contributions are based on income but vary also depending on age groups. There are two different principles among the regimes

of premium: (i) premiums based on a form of CR, where the level of premium is, to a certain extent, disconnected from individual risk and based on the average expected expenditures of the pool of subscribers; (ii) actuarially fair premiums, only based on the individual expected expenditures and which do not depend on other subscribers' risk. CR premiums are: uniform, age-based, income-based and income/age-based premiums. They all imply a form of community rating: premiums depend on the average SHI reimbursements of the pool P . When insurance is voluntary, the pool can vary so that the level of CR premiums will be conditional to the pool. Actuarially fair premiums are: medical underwriting and experience rating. These premiums depend only on individuals' characteristics and do not vary with the pool. We assume null profits: as not-for-profit organizations, *mutuelles*'s objective is to break-even. A load factor of 20% is charged by insurers to cover administration costs (the estimated load factors on the French market ranges from 15% to 25%). For the sake of simplicity, the load factor does not appear in the equations below. We compute it as an extra 20% on individuals' premium.

When premiums are uniform, the premium π_U is simply the average insurance reimbursements of the pool: $\pi_U = E(SHIR|P)$. When insurers are allowed to adjust premium with age, the premium π_a is the average insurance reimbursements for age group a in the pool: $\pi_a = E(SHIR|a,P)$.

When premium are income-based, the contribution rate, τ , is the same for all level of income and satisfies $\tau = \frac{E(SHIR|P)}{E(y)}$ where $E(y)$ is the average income of the pool. The premium for individuals with income y_i is then $\pi_y = \tau * y_i$. To define income/age-based premium we follow the rule applied by the MGEN: individuals under 30 will face a rate τ_1 , those between 30 and 60 will face a rate τ_2 and those over 60 a rate τ_3 . An individual with an income y_i who belongs to age group j will pay a premium $\pi_{income/age} = y_i * \tau_j$. Appropriate contribution rates must satisfy:

$$E(SHIR|P) = \tau_1 * E(y_1) * \delta_1 + \tau_2 * E(y_2) * \delta_2 + \tau_3 * E(y_3) * \delta_3$$

with $E(y_j)$ the average income of individuals of age group $j = 1,2,3$ in the pool ; and δ_j the proportion of age groups j in the pool. Furthermore, MGEN sets $\tau_2 = 1.25 * \tau_1$ and $\tau_3 = 1.5 * \tau_1$. Thus,

$$\tau_1 = \frac{E(SHIR|P)}{E(y_1) * \delta_1 + 1.25 * E(y_1) * \delta_2 + 1.5 * E(y_3) * \delta_3}$$

The principle of actuarial premiums is that insurers can use individuals' characteristics to predict their future SHI reimbursements. We distinguish medical underwriting and experience rating on the basis of the information used to predict SHI reimbursements. Under medical underwriting, to compute individual i 's premium for year t , insurers use socio-economics characteristics, $X_{i,t}$, as well as information about previous and current health state, $H_{i,t}$, $H_{i,t-1}$, $H_{i,t-2}$ ⁸. Under medical underwriting individual i 's premium is therefore $\pi_{mu} = E(SHIR|X_{i,t}, H_{i,t}, H_{i,t-1}, H_{i,t-2})$. Note that the premium does not depend on the pool. Under experience rating, insurers can also use previous healthcare consumption, $SHE_{i,t-1}$, $SHE_{i,t-2}$ to predict future SHI reimbursements. Under experience rating, individual i will therefore pay a premium $\pi_{er} = E(SHIR|X_{i,t}, H_{i,t}, H_{i,t-1}, H_{i,t-2}, SHE_{i,t-1}, SHE_{i,t-2})$. Again, premiums do not depend on the pool.

3.4.2 Individuals' decision to take out SHI

Individuals are utility maximizers who share the same utility function $u(C)$, with $u' > 0$ and $u'' < 0$. They differ in income level y_i , and risk group, λ , which depends on socio-demographic characteristics, $X_{i,t}$, previous and current health status, $H_{i,t}$, $H_{i,t-1}$, $H_{i,t-2}$, as well as past medical consumption, $SHE_{i,t-1}$, $SHE_{i,t-2}$. Each risk group λ is associated with a distribution of supplementary healthcare expenditures $F_\lambda(SHE)$, SHI reimbursements $G_\lambda(SHIR)$ and final out-of pocket $\Phi_\lambda(OOP)$. By definition, OOP is the amount of medical expenditures borne by patients after health insurance reimbursements ($OOP = SHE - SHIR$).

Health insurance contracts are available at a premium $\pi_{i,g,P}$ which can depend on individual characteristics i , regime g and pool P . Note that in our framework where there is only one insurer and insurance is voluntary, the pool P is simply the group of individuals who decide to take out SHI. We suppose that contracts are standardized: there is only one contract available and the extent of coverage ($SHIR/SHE$) does not vary with individuals' characteristics nor premium design.

⁸We have data over 3 years hence the possibility to use information about the 2 previous years

Facing a premium $\pi_{i,g,P}$, individuals decide to be insured or not. If they decide to be insured, they pay a premium $\pi_{i,g,P}$, face an uncertain realization of SHE and pay out-of-pocket expenditures OOP . If they decide to be uninsured, they do not pay a premium but will bear the whole risk of their future supplementary healthcare expenditures SHE .

Because individuals are utility maximizers, they buy health insurance if their expected utility when being insured is higher than when uninsured. Formally, we can define expected utility when uninsured as:

$$EU_{y_i,\lambda}^{uninsured} = \int_0^{+\infty} u(y_i - SHE) dF_\lambda(SHE) \quad (3.1)$$

Similarly we define expected utility when insured as:

$$EU_{y_i,\lambda,g,P}^{insured} = \int_0^{+\infty} u(y_i - \pi_{i,g,P} - OOP) d\Phi_\lambda(OOP) \quad (3.2)$$

Therefore, under regime g and considering the pool P , individual i buys health insurance if $EU^{insured} > EU^{uninsured}$ and remains uninsured otherwise.

A key assumption of our model is that $F_\lambda(SHE)$ is assumed to be the same whether individuals are insured or not. Indeed, we are not able to estimate a counterfactual distribution when individuals do not subscribe to SHI. In other words, we have to assume that individuals' healthcare expenditures are orthogonal to insurance coverage. This is a strong assumption considering, on the one hand, evidence on foregone healthcare for individuals without SHI in France (Buchmueller & Couffinhal 2004) and, on the other hand, evidence of moral hazard for those who benefit from comprehensive SHI coverage (Dormont & Péron 2016). We discuss the implications of this assumption on our results in section 3.6.5.

3.4.3 Market's dynamic when insurance is voluntary

When insurance is mandatory, individuals have no choice but to be insured and the pool remains always the same. When insurance is voluntary and when premiums are based on a form of community rating, their level depend on the expected SHE of individuals who took out SHI

(the pool P). Hence, we must simulate individuals and insurer interactions on what we call the SHI market. Formally, when considering the dynamic at stake, the decision to take out SHI can be described as follows:

Step 1: individuals compute their expected utility without insurance $EU_{y_i, \lambda}^{uninsured} = \int u(y_i - SHE)dF_\lambda(SHE)$. This depends on individuals' characteristics only and will not be affected by pool composition.

Step 2: P_0 , the initial pool, is supposed to include the whole population. We suppose that the insurer sets premiums conditional on regime g assuming that all individuals want to be insured. In each subsequent iteration j , the insurer computes the premium level π_{i,g,P_j} linked to the new composition of the pool P_j .

Step 3: individuals compute their expected utility with insurance $EU^{insured} = \int u(y_i - \pi_{i,g,P} - OOP)d\Phi_\lambda(OOP)$ under regime g and pool $P = P_{j-1}$. If $EU^{insured} > EU^{uninsured}$ they buy insurance and stay in the pool P_j . Otherwise, they exit the pool and become uninsured.

We repeat Steps 2 and 3 for $j = 1$ to n until we reach an equilibrium, i.e. until P_j equals P_{j-1} and $p_{i,j} = p_{i,j-1}$. In reality, the iteration can result from anticipation by insurers of the market's dynamic or from an adaptive process, with insurers adjusting year after year their premiums to the pool. Note that there are two cases with no such dynamic: mandatory SHI and premiums set on individual risk only (actuarial fairness).

3.5 Empirical application

In this section, we present the database used for the simulations and descriptive statistics on the distribution of SHE, SHIR and OOP payments in our sample. We use these data to estimate individuals' risk, compute health insurance premiums for each regime g , expected utilities, decision to subscribe to SHI and final outcomes in terms of healthcare payments.

3.5.1 Data

We use a data set from a French supplementary health insurer, Mutuelle Générale de l'Éducation Nationale (MGEN). MGEN is a not-for profit insurer which mainly insures teachers and minister of education employees, active or retired. MGEN processes claims on behalf of mandatory NHI and also provides a voluntary SHI (MGEN-SHI): a unique contract that covers co-payments as well as medical goods and services not covered by the NHI⁹. The MGEN-SHI benefits are representative of the average coverage offered by other SHI contracts in the individual market in France: balance billing is not covered and optical and dental care coverage is limited (DREES 2016). We have at our disposal a sample of 87,110 individuals, aged between 25 and 90 and observed from 2010 to 2012. During this period, they are all covered by MGEN-SHI contract and consequently all benefit from the same coverage. Using MGEN's administrative data, we are able to identify, annually and for each individual, (i) supplementary healthcare expenditures not covered by mandatory public insurance (*SHE*) ; (ii) supplementary health insurance reimbursements (*SHIR*) ; (iii) final out-of-pocket payments (*OOP*). We also have information about socio-economic characteristics such as age and gender as well as whether individuals suffer from a chronic disease or the number of days they spent in hospital during the year. Because MGEN premiums are based on income we are also able to reconstruct individuals' income.¹⁰

3.5.2 Descriptive statistics

Table 3.1 summarizes the main socio-demographic characteristics of our sample. We confront these figures with the characteristics from the ESPS sample¹¹ deemed representative of the French population. Because MGEN-SHI covers mainly minister of education employees, women are over-represented. It is also possible that the MGEN sample is already adversely selected due to income-based premium. This is especially true for the youngest age group which seems to be under-represented in the MGEN pool compared to the whole population. However in terms of health condition, the percentage of individuals with a chronic disease among the MGEN pool

⁹Like most of the SHI contracts in France, the MGEN-SHI contract is a *Contrat solidaire et responsable*

¹⁰This proxy is actually close from a truncated wage. Indeed, there is a minimum premium for monthly income under €1000 and a ceiling for income above €4900. Also, premiums are only based on wages or pensions and therefore do not take into account other sources of income.

¹¹Enquête Santé et Protection Sociale (ESPS) is a bi-annual survey conducted on a sample of 8,000 French households, i.e. 22,000 individuals representative at 97% of French population

is very similar to the one reported by the ESPS survey.

Table 3.2 presents the empirical distribution of supplementary healthcare expenditures, SHI reimbursements and OOP payments from the MGEN sample in 2012. Because we focus on healthcare expenditures financed through SHI, the part reimbursed by NHI does not appear here. This explains why the average SHE per individual does not exceed €716 per year. However, the SHE distribution is highly skewed and SHE may amount to more than €16,000 per year. Furthermore, OOP payments are not capped in France and can reach €13,960 as observed in our sample. As a result, average figures on SHE or OOP payments do not say much about the risk actually faced by individuals and underestimate the role of SHI in the coverage of healthcare expenditures. We must therefore consider the whole distribution of SHE and especially look at the top users. Figure 3.3 presents the Lorenz curves and associated Gini coefficients of SHE (North-West diagram), SHI reimbursements (North-East diagram) and OOP payments (South-West diagram) from our *MGEN* sample in 2012. It is worth noting that the high concentration of total healthcare expenditures on the top users, well documented in France for the mandatory scheme (HCAAM 2013), is also valid for SHE in France. The last two deciles of our sample are responsible for 60% of the total SHE and the Gini coefficient, G^{SHE} , amounts to 0.54. The Lorenz curve for reimbursements (SHIR) presents roughly the same shape ($G^{SHIR} = 0.52$). OOP payments are more concentrated with a Gini coefficient of 0.66. Indeed, the last two deciles bear almost 70% of the total OOP expenditures.

As regards income distribution (Figure 3.4), our sample presents a Gini coefficient, G^I , of 0.18. By comparison, the Gini coefficient for the whole French population was 0.30 in 2012 (Houdré et al. 2014). Obviously, because most of MGEN-SHI enrollees are teachers, the MGEN population is more homogeneous in terms of wages than the whole population¹². Moreover, for our sample, healthcare utilization seems relatively orthogonal to income. Indeed, the concentration curves for SHIR and OOP are very close to the diagonal: concentration indexes for SHIR (-0.03) and OOP (0.004) slightly depart from zero. Note that the absence of a clear correlation between healthcare expenditures and income is not specific to our sample. Using a sample representative of the French population, Duval et al. (2012) do not give evidence of sizeable differences in healthcare expenditures across income deciles.

¹²Moreover, there is a truncation on top and bottom of the distribution of our income proxy

Finally, we come back to our main concern about age-based premiums by focusing on the first, fifth, ninety-fifth and ninety-ninth percentiles as well as the mean of SHI reimbursements by age, from 25 to 90 years old. Figure 3.5 shows that the mean and the variance of SHI reimbursements continuously increase with age, almost linearly. However, age only explains 6.5% of SHIR variability (Table 3.3). This makes age a quite convenient, yet not very precise, predictor of supplementary healthcare expenditures and confirm that age-based premiums are in between community rating and actuarial fairness.

3.5.3 Calibration and computation

We estimate individuals' own appreciation of risk, λ , by regressing SHE on socio-demographic characteristics such as gender, age and income. We also control for chronic disease and hospital stays that occurred within the last two years as well as their SHE for the two previous years such that $\widehat{SHE}_{i,2012} = E(SHE|X_{i,2012}, H_{i,2010-2012}, SHE_{i,2010-2011})$ (Table 3.4). We then use the prediction of SHE to build four groups λ_j with $j = 1,2,3,4$. The four groups correspond to the four quartiles of predicted SHE. Considering risk groups rather than directly the individual's expected SHE allows us to consider a whole distribution of SHE rather than an average expected value. Indeed, even though the individual is able, based on her characteristics and experience, to estimate her expected SHE, she still faces the risk that her actual SHI will be higher or lower. Despite the use of a rather simple predictive model, our four groups are very distinct in terms of ex post empirical average expenditures, from €333 for the lower risk group to €1215 for the highest; the variance also increases with λ . Besides, OOP payments also vary significantly between groups (Tables 3.5 and 3.6). We estimate for each group λ the empirical distribution of SHE, $F_\lambda(SHE)$, and OOP payments, $\Phi_\lambda(OOP)$, with a kernel function. Figure 3.6 displays the empirical distribution function of SHE for each risk group and shows the sizeable differences between groups. The empirical distributions of SHE and OOP conditional on risk groups λ are used to compute the values of expected utility respectively with and without insurance, as defined in equations (3.1) and (3.2).

The insurer perspective is different from the individual's own risk appreciation. First, the insurer focuses on SHI reimbursements rather than SHE. Indeed, OOP payments, by definition the expenditures not covered by SHI, do not directly intervene in premiums calcu-

lation. Second, the predicted SHIR is sufficient to compute individual's premium because among the pool, the sum of premiums will eventually equal the pool's SHIR. The explanatory variables used in the insurer's predictive model will depend on the way premiums are defined. Under medical underwriting, the insurer can use socio-demographic characteristics and information about health state recorded by a questionnaire filled at subscription (chronic disease, hospital stays): $\widehat{SHIR}_{i,2012} = E(SHIR|X_{i,2012}, H_{i,2010-2012})$. Because insurers cannot adjust the premium on previous consumption, individuals still benefit from private information. Under experience rating though, where previous SHE are used to predict individual's future SHIR, information is symmetric between insurers and individuals such that $\widehat{SHIR}_{i,2012} = E(SHIR|X_{i,2012}, H_{i,2010-2012}, SHE_{i,2010-2011})$.

To compute expected utilities of equations (3.1) and (3.2), we assume that the individual uses a von Neumann Morgenstern utility function of the form:

$$u(C) = -\frac{1}{\gamma} * e^{-\gamma C}, \quad (3.3)$$

where γ is the constant absolute risk aversion (CARA) parameter. We are here in line with the choice made by several papers when estimating risk aversion (see Einav et al. (2013)) or Handel et al. (2015))¹³. Unfortunately, our data do not allow us to estimate an individual risk aversion parameter. So we consider that risk aversion is homogenous across our population and set $\gamma = 0.0005$ (Handel et al. (2015) estimated a mean CARA parameter equals to 0.00044 on US data), with robustness checks for values lying between 0.0004 and 0.0006.

Finally, we use a VBA macro (the code is available in the appendix) to compute premiums and compare for each individual, her expected utility with and without insurance, taking into account market's dynamic thanks to a loop. Whatever the regime, there is always some individuals who want to subscribe to SHI and an equilibrium is reached after less than 11 iterations.

¹³As regards health insurance, the question of a decreasing, constant or increasing aversion with income is an interesting one. Dormont et al. (2009) analyze coverage choices in Switzerland and find that demand for basic insurance coverage decreases with income, suggesting a decreasing absolute risk aversion. However, demand for supplementary coverage increases with income. They explain this apparent paradox by the fact that supplementary insurance gives access to 'luxury' medical goods and so willingness to pay for these goods might well increase with income. In our case, French supplementary insurers actually cover both basic and supplemental medical goods. Assuming a CARA would then cancel out the two expected effects of income as regards demand for coverage.

3.6 Results

Our results are displayed in Tables 3.7 to 3.11. They stem from the simulations performed on the MGEN sample assuming a risk aversion parameter equal to 0.0005 and a load factor equal to 1.2. We first focus on the impact of voluntary SHI on insurance coverage and premiums paid. We then analyze the impact of age-based premiums on vertical equity and on risk sharing relative to other regimes of premiums, from pure CR to actuarial fairness. We finally provide robustness checks.

3.6.1 Consequences of voluntary SHI

Table 3.7 summarizes, for each regime of premium (uniform, age-based, medical underwriting, experience rating, income-based and income/age-based), the simulated average premium for the whole sample and for groups of interest when SHI is either mandatory or voluntary. The most important gap between age groups results from age-based premiums when insurance is voluntary with a ratio of 2.38 between the youngest (€311 for the 25-35 years old) and the oldest group (€742 for those over 65). With age-based premiums, the poor also contribute more than the rich: their premium is on average 12% higher. The premium ratio between low risks (λ_1) and high risks (λ_4) amounts to 1.88 and is significantly higher than for uniform premiums (1 by definition) or income-based premiums which show a ratio lower to 1 (0.93) because of the negative correlation between SHI reimbursements and income. On the contrary, the premium ratio between low and high risk groups is just slightly lower for age-based premiums than for medical underwriting (1.88 vs 2.13). Unsurprisingly, experience rating yields the biggest gap between high and low risks with a ratio of 2.86.

Because age is a predictor of SHI reimbursements, age-based premiums tend to share more common features with actuarial premiums than uniform or income-based premiums. The similarity between age-based and actuarial premiums implies that age-based premiums are less affected by the absence of a mandate on SHI, contrary to uniform and income-based premiums. Indeed, when insurance is voluntary, the average age-based premium increases by 5.7% whereas uniform premiums increase by 36% and income-based premiums by 52%. As a matter of fact, 50.6% of

our sample decide not to be insured when premiums are income-based and insurance is voluntary. As shown in Table 3.8, these leavers are mostly young and healthy individuals. Setting different contribution rates by income and age does not significantly limit the loss of insured (47.4%) and the average premium still increases by 40.5%. On the contrary, when premiums are based on the individual risk, non-insurance rates are much lower. Interestingly, medical underwriting presents roughly the same non-insurance rate than age-based premiums. This is explained by the proximity of the two regimes. Even though medical underwriting allows the insurer to use more variables to predict SHI reimbursements (gender, chronic disease, hospital stays), age is the main driver of SHIR. If we predict SHIR first based only on age groups and then add the other variables, the correlation between the two predicted values equals 0.89. When adding previous consumption of healthcare (as under experience rating), the correlation drops to 0.67. Experience rating is indeed closer to individuals risk and the proportion of uninsured is consequently very low (3.6%).

Who give up SHI? Table 3.9 displays the percentage of uninsured by income and risk profile for each regime. It shows primarily that healthy individuals, with a rather low expected SHE (λ_1 , λ_2), are more likely to be uninsured. This is especially true when premiums are disconnected from individual risk (uniform or income-based premiums). As stated previously, this adverse selection phenomenon has important consequences on the extent of risk sharing. First, premiums will increase for those who remain in the pool: CR premiums depend on the average expenditures of the pool which is now made of high healthcare users. Because of increasing premiums, the disconnection between healthcare payments (premiums + OOP) and healthcare expenditures (SHE) is lower for high healthcare users. Second, among those who are uninsured, risk sharing will be null by definition. Hence, we can expect an important reduction of risk sharing when insurance is voluntary and premiums based on CR. When premiums increase with risk (age-based premiums, medical underwriting and experience rating), low income individuals with high expected SHE are more likely to give up SHI than higher income groups. In a sense, considering their tight budget constraint, they prefer the uncertainty of high OOP payments rather than the certain payment of a high premium.

3.6.2 Age-based premiums and vertical equity

Table 3.10 displays the indexes previously defined in section 2 which measure the extent of vertical equity resulting from healthcare payments (premium and OOP payments). G^I is the Gini coefficient of income distribution before healthcare payments; $G^{I-(P+OOP)}$ is the Gini coefficient of the income distribution, after healthcare payments; C_I is the concentration index of healthcare payments relative to income distribution; K_I is the Kakwani index relative to income distribution; and finally RE_I is the income redistribution index. We report the index values for each of the six different regimes (uniform, age-based, medical underwriting, experience rating, income-based and income/age-based) when insurance is either mandatory or voluntary. We also report the index values in a situation without insurance. In order to make comparisons between the distinct regimes easier, Figure 3.7 displays for each regime, the concentration index, the Kakwani index and the redistribution index when insurance is mandatory or voluntary. Vertical equity would imply a positive concentration index, C_I and a positive Kakwani index K_I : high income groups would contribute more than low income groups and more than their share in society's income. The higher RE_I , the larger the income redistribution.

As regards progressive payments and income redistribution, age-based premiums perform poorly:

- When insurance is mandatory, age-based premiums are more regressive than uniform premiums ($K_I = -0.1933$ vs $K_I = -0.174$) and are even worse than a situation without insurance in terms of income redistribution ($RE_I = -0.0057$ vs $RE_I = -0.0055$). On the contrary, financing healthcare through income-based contributions achieves vertical equity: health care payments are still regressive due to OOP payments ($K_I = -0.06$) but the redistribution index is higher than for any other regime ($RE_I = -0.002$).
- When insurance is voluntary, because of a large number of uninsured when premiums are based on income, income distribution on the whole population is dramatically reduced: the redistribution index drops from -0.002 to -0.0043. By comparison, the redistribution index when premiums are based on age equals -0.0055. Although the percentage of insured is slightly higher when income-based premiums also depend on age, the effect on income redistribution is not really improved ($RE_I = -0.0043$).

3.6.3 Age-based premiums and risk sharing

Table 3.11 displays the indexes that measure the effect of each regime of premiums on risk sharing, when insurance is either mandatory or voluntary. G^{SHE} is the Gini coefficient for the SHE distribution; G^{P+OOP} is the Gini coefficient for the healthcare payments distribution; C_R is the concentration index of healthcare payments relative to SHE distribution; K_R is the Kakwani index relative to SHE distribution; and finally RE_R is the ‘risk redistribution’ index. Figure 3.8 displays the concentration index, the Kakwani index and the redistribution index when insurance is mandatory and voluntary. Of course, in any case, uninsured individuals are included in the computation of indexes. For interpretation, remember that a positive concentration index C_R implies that high users contribute more to payments than low users. There is risk sharing when the Kakwani index, K_R , is negative. In this case, the share of high users in payments is lower than their share in medical expenses (SHE). Finally, the higher RE_R , the higher the extent of risk sharing.

– Without insurance, the distribution of healthcare payments is similar to the distribution of SHE. The redistribution index equals zero. By contrast, if insurance were mandatory with complete coverage, uniform premiums would guarantee the highest level of risk sharing. No matter how unequal the distribution of SHE can be, uniform premiums would take the Gini coefficient back to zero. When coverage is partial however, the unequal distribution of OOP payments limits the effect of uniform premiums on risk sharing. Indeed, based on our sample, the Gini coefficient for the SHE distribution ($G^{SHE} = 0.5435$) is only reduced by 0.3131 points after insurance.

– When insurance is mandatory, age-based premiums are in between pure CR and actuarial premiums in terms of risk sharing. With a redistribution index of 0.2509, premiums adjusted on age limit the extent of redistribution between low and high users compared to uniform premium ($RE_R = 0.3131$) or even income-based premiums ($RE_R = 0.2690$) but still perform better than medical underwriting (0.2393) and experience rating (0.2095). These results give evidence of a continuum of premiums in terms of risk sharing from pure CR to actuarial fairness, and at the extreme limit no insurance. Age-based premiums are situated in between.

– When insurance is voluntary, the effect of premiums on risk sharing dramatically changes and the opposition between CR and actuarial fairness is no longer valid. Uniform and income-based premiums particularly suffer from adverse-selection. A large fraction of the population prefers to exit the pool and consequently premiums increase for those who remain insured. In the case of uniform premiums, 50.5% of our sample leave insurance and the redistribution index consequently drops from 0.3131 to 0.1238. The loss is more dramatic for the income-based regime which shows the lowest redistribution index ($RE_R = 0.1019$). One important result is that actuarial premiums (medical underwriting or experience rating) allow higher risk sharing than uniform and income-based premiums when insurance is voluntary, with respectively redistribution indexes equal to 0.2014 and 0.2024. Indeed, even if premiums are closer to the individual risk, the high proportion of insured guarantees a higher level of risk sharing than CR. This effect is reinforced by the fact that there is a large uncertainty regarding the ex post realization of required reimbursements (SHIR). Indeed, between 86 to 92% of SHIR variance is unexplained by individual characteristics and previous healthcare expenditures (Table 3.4). Similarly, age-based premiums resist to adverse selection and still allow community rating within age groups, hence achieving the largest risk sharing when insurance is voluntary ($RE_R = 0.2096$).

3.6.4 Robustness checks

Large OOP payments necessarily limit risk sharing: by definition, healthcare expenditures which are not covered by insurance cannot be socialized. In France, OOP payments after SHI have two elements: NHI co-payments that cannot be covered by SHI (€1 deductible per consultation for instance) and other goods only partially covered by SHI (balance billing, optical or dental care). It is difficult to draw clear conclusions about the impact of OOP payments on vertical equity, because OOP payments are directly related to healthcare use. Indeed, if OOP concerns normal goods or services for which demand increases with income, then the rich are likely to have higher OOP expenditures than the poor. In this case, payments would be progressive. However, because progressivity comes from the demand behavior of high-income individuals, it is hard to consider it as a fair situation. To examine whether our conclusions might be changed, we run the same analysis but limit the scope to expenditures that are covered by SHI. Table 3.12 shows that our conclusions do not change: when insurance is voluntary, risk sharing

is maximized with age-based premiums, still however at the expense of vertical equity.

Our results on vertical equity and risk sharing are very sensitive to the percentage of the population that chooses to remain uninsured. As we demonstrated previously, the way to define premiums plays an important role. However, two parameters are also likely to drive the results: the load factor and the risk aversion parameters. Our main simulation is based on a load factor of 1.2 and a risk aversion parameter of 0.0005. Table 3.13 provides the simulation results, when insurance is voluntary, for different values of the load factor (1.1 and 1.15) and of the risk aversion parameter, γ in equation 3.3 (0.0004 and 0.0006). A lower load factor reduces the price of insurance and is likely to encourage individuals to take out insurance. We are able to verify that a load factor of 1.1 rather than 1.2 as in our base-case slightly decreases the proportion of uninsured, especially for uniform premiums. However, age-based premiums still yield higher risk sharing than uniform or income-based premiums. Surprisingly, medical underwriting performs even better than age-based premiums. With a load factor of 1.15 results are unchanged compared to the base-case scenario. When individuals are less risk averse (0.0004 instead of 0.0005), the percentage of uninsured dramatically increases, even for age-based premiums. As regards vertical equity, income-based premiums, despite a large number of uninsured, still yield less regressive healthcare payments than other forms of premiums. However, when risk aversion is higher than in our base-case scenario (0.0006 instead of 0.0005), results are unchanged.

3.6.5 Discussion

Do the *mutuelles* deny their founding solidarity principles when using age-based premiums? Our simulations show that when insurance is voluntary, age-based premiums allow the largest transfers from low to high healthcare users. Indeed, age-based premiums are a cross-breed between CR and actuarial fairness: they better resist to adverse selection than uniform or income-based premiums and still guarantee more risk sharing than actuarially fair premiums. Remarkably however, age-based premiums are very close to medical underwriting in terms of level of premiums, profile of uninsured and impact on risk sharing and vertical equity. Indeed, even when using information on gender, chronic disease or hospital stay, age remains the main driver of SHI reimbursements. This is interesting because medical underwriting is strongly

discouraged in the French SHI market based on the idea that it is not fair. We show that premiums increasing with age are not very different in practice. At least as long as NHI covers a major part of inpatient care and do not charge co-pays for care related to chronic disease. To sum up, in a context of voluntary SHI, age-based premiums are best to preserve risk-sharing; but what about vertical equity?

When insurance is voluntary, there is a conflict between the objective to disconnect healthcare expenditures from healthcare payments and to guarantee vertical equity. It is especially true when comparing age-based and income-based premiums. On the one hand, age-based premiums maximize risk sharing but yield more regressive payments than income-based premiums. On the other hand, income-based premiums is the least regressive type of payments but also encourage healthy individual to be uninsured, which dramatically limits the extent of risk sharing. Should we give priority to risk sharing or vertical equity? According to the Welfarist literature, the key argument to use health insurance for income redistribution is that the correlation between risk and income has to be negative. However, in line with the results from Duval et al. (2012) on general population, we do not find in our data a strong correlation between SHE and income.

Note that this conflict between risk sharing and vertical equity is less striking when insurance is mandatory. In this case, income-based premiums are superior to age-based premiums both in terms of risk-sharing and vertical equity. This is related to another important result of our simulations: a voluntary insurance dramatically limits the extent of solidarity. In this respect, the negative impact of adverse selection on SHI coverage and level of premiums is not different from what the literature has reported for basic health insurance. Analyzing the introduction of a mandate in Massachusetts' individual health insurance market, Hackmann et al. (2015) report a growth in coverage associated with a significant reduction in the level of premium. They estimate an increase in welfare of 4.1% due to reduction in adverse selection alone. Our simulations show that we could expect the same outcomes in the context of SHI.

Our simulations illustrate how age-based premiums impact the distribution of healthcare payments taking into account correlations between age, risk and income in the context of SHI. They also emphasize adverse selection phenomena and reveal the conflict between risk sharing and vertical equity when insurance is voluntary. However, our results have to be interpreted

carefully considering the assumptions we make in our model and the inherent limits of equity indexes. We believe there is also room for improvement and propose possible extensions to this work.

When modeling individuals' decision to take out SHI, we rely on several assumptions. Especially, we do not take into account costs related to the decision to be uninsured such as switching costs or individuals' anticipation that their premium might increase if they subscribe to SHI too late. The percentage of uninsured for CR premiums resulting from our simulations might therefore be overestimated, compared to reality. For instance our model predicts that 47.4% of our sample would give up SHI if premiums were based on income and age. Yet, our sample is precisely made of MGEN-SHI enrollees who, despite income-based premiums, still subscribe to SHI. There are several reasons that can explain this apparent drawback. First, we do not take into account inertia. Studies on switching behavior in health insurance show that individuals tend to remain with the same insurance contract even if they would benefit from switching (Strombom et al. 2002, Marzilli Ericson 2014, Handel 2013). Second, because MGEN also processes NHI claims, enrollees can find easier to subscribe to MGEN-SHI. Finally, the MGEN-SHI includes benefits beyond healthcare such as invalidity and dependance insurance that can attract enrollees. The switching rate in MGEN-SHI is indeed relatively low (about 1.5% per year). However, they have difficulties to recruit new enrollees, especially among young teachers. We are more confident as regards the simulated proportion of uninsured for age-based premiums which equals 10%. Indeed, the proportion of individuals without SHI is about 6% in France, including private sector employees for which SHI is subsidized. The proportion of uninsured varies between 6 and 15% for unemployed, inactive and retirees, likely to buy SHI on the individual market where premiums are based on age (Perronnin et al. 2011).

Taking into account the articulation between NHI and SHI will be an important extension to this work. There are two questions we want to investigate: (i) Does SHI cancel out the solidarity implied by the NHI?; (ii) What would be the distributional impact of a change in NHI benefit package? The first question has been pointed out by Bozio & Dormont (2016). The authors emphasize the contradictory principles between NHI and SHI premiums, especially in terms of transfers between age group. It would be interesting to quantify to which extent

SHI premiums cancel out NHI transfers between income groups and age groups. The second question is related to the definition of the NHI benefit package, in its three dimensions (co-pays, list of medical services included, population). Mechanically, NHI benefits have a direct impact on SHE magnitude and variance. A change in NHI benefits will also change the correlations between age, health state and SHI, and therefore the impact of age-based premiums on risk sharing and on vertical equity.

Also, it is critical to consider issues around SHI affordability, i.e. situations where low income have to give up SHI because premiums are too expensive. However, concentration curves might not be the most appropriate tools for investigating this question. We show that when premiums increase with risk, low income individuals with high expected SHE are more likely to give up SHI than higher income groups. In terms of fairness, this situation is not desirable. Do vertical equity indexes reflect the loss of low income and high risk individuals? Not necessarily. It will depend on the realization of SHE. On the one hand, among low income-high risk individuals, the ‘lucky’ who have low realized expenditures contribute less than if insurance were mandatory. On the other hand, the ‘unlucky’ will bear important healthcare payments. Therefore, the effect on the overall progressivity of healthcare payments is unclear.

Another challenge comes from the ability to take into account the price elasticity of demand for healthcare. Remember that we assume that being uninsured will not modify individuals’ healthcare consumption. The impact of this assumption on our results is not straightforward. First, note that assuming a negative price elasticity does not give insights on whether a reduction in SHE when individuals are not insured is desirable (less moral hazard) or not (foregone healthcare). Furthermore, even if we were able to estimate SHE distribution without insurance and to agree that a reduction in SHE is not desirable, the results on vertical equity might be fallacious. Indeed, imagine a situation where, on the one hand, low income individuals cannot afford SHI and have to give up on care (resulting in low healthcare payments); and on the other hand, wealthy individuals pay health insurance premiums and consume important quantity of care (resulting in large healthcare payments). In this case, payments will be ‘progressive’ despite an obvious problem in terms of access to SHI and care.

Our difficulties to take into account questions about SHI affordability and access to care are

more generally due to our pragmatic definition of fairness. The narrow spectra of income and healthcare payments, without considering health or healthcare use, might be too limited to assess the impact of health insurance and premiums on well-being. Fleurbaey & Schokkaert (2011) state that equity in financing healthcare should be integrated within a broader concept of well-being, "including provision (of health and health care) and net material consumption as two relevant dimensions". In this framework, the adverse effect of expensive premiums, not affordable for low income individuals, would be captured through the negative effect of foregone care on health. This approach is more satisfying but also more demanding in terms of data. Indeed, it requires comprehensive information on individuals' income, health, healthcare use and healthcare payments.

3.7 Conclusion

In the French SHI market, the *mutuelles*, not-for-profit insurers, are keeping away from their founding solidarity principles. To avoid the adverse selection death spiral, they give up on uniform premiums and set premiums increasing with age. Age-based premiums raise concerns about inequalities both in the level of premiums and in the extent of coverage. Fairness issues are also a political argument. It is especially critical for *mutuelles* who have to convince their stakeholders that moving towards premiums adjusted on individual's risk will not go too far against their founding principles in terms of risk sharing and access to insurance.

Because the theoretical and empirical literature usually considers the NHI level, it is interesting to take into account the specificity of SHI in terms of correlations between age, income and healthcare expenditures to illustrate adverse selection phenomena and the distributional impact of SHI premiums. Furthermore, due to a lack of data, we have seldom knowledge about the distribution of healthcare expenditures effectively covered by SHI and their impact on income distribution.

We exploit an original database of 87,110 individuals, aged from 25 to 90 years-old, for whom we observe their SHI reimbursements and final OOP. We adopt an empirical approach and use simulation methods to compare the impact of age-based premiums with other regimes

and illustrate adverse selection phenomena in a context of voluntary SHI. We focus on ex post outcomes to fully take into account the specificity of SHI in terms of distribution of expenditures and correlations with age, income and health status. We use concentration curves and inequality indexes to measure the impact of premiums on income distribution and on transfers between low and high healthcare users.

Based on our simulations, we derive three results on the impact of age-based premiums in the SHI market. First, in a context of voluntary SHI, age-based premiums is the best solution to preserve risk sharing. A regime with age-based premiums better resists to adverse selection than uniform or income-based premiums and still guarantee more risk sharing than actuarially fair premiums. An interesting result is that, due to the absence of strong correlation between SHI reimbursements and other individual characteristics than age (gender, chronic disease or hospital stays), age-based premiums are not very different from medical underwriting. Yet, medical underwriting is strongly discouraged in the SHI market because it is seen as a very unfair practice. We show that age-based premiums are not very different, at least considering the current SHI perimeter. Second, simulations show that age-based premiums achieve risk sharing at the expense of vertical equity. Indeed a regime with income-based premiums, even if it suffers from adverse selection yields less regressive payments than age-based premiums. This conflict between risk sharing and vertical equity is barely discussed in the literature or in policy debates. Yet, it is striking when insurance is voluntary and deserves more attention. Finally, we illustrate in the context of SHI a common result in the literature: the absence of a mandate limits the impact of SHI on risk sharing and vertical equity, especially when premiums are based on a form of community rating.

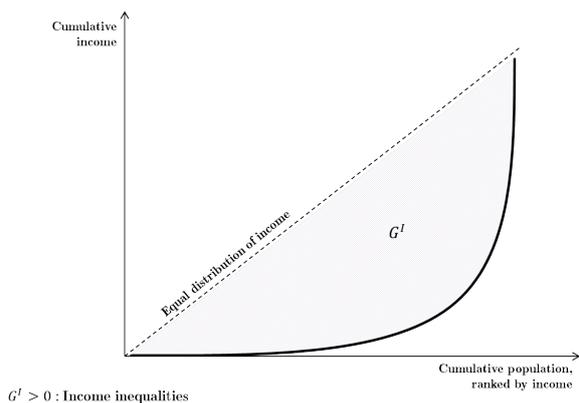
Our results enable us to deal with important policy questions as regards the regulation of health insurance and the way to define premiums. First, we stress out the importance of a mandate in SHI to avoid adverse selection mechanisms and ensure that healthcare payments are disconnected from healthcare expenditures and are ‘fairly’ distributed among income groups. The political position of the *mutuelles* in France, whom firmly reject the idea of a mandatory SHI while pursuing an ideal of community rating, seems therefore difficult to hold. Furthermore, this result should support the decision to impose a mandate on health insurance, despite the

apparent political difficulty to do it. As regards SHI in France, coverage has been mandatory for private sector employees since January 2016, but still remains voluntary on the individual market. This is likely to enlarge the gap between ‘insiders’ (employees) – usually benefitting from mandatory, subsidized and comprehensive coverage with uniform or income-based premiums – and ‘outsiders’ (unemployed, self-employed and pensioners) who have to purchase coverage in the individual health insurance market and face the consequences of adverse selection, i.e. increasing premiums and limited risk sharing. Second, we show that in a context of voluntary insurance, age-based premiums limit the effect of adverse selection and still allow for risk sharing. This would support *mutuelles*’ strategy to use age-based premiums. However, our simulations also point out that age-based premiums yield regressive payments and do not answer the question of insurance affordability and income inequalities due to healthcare payments.

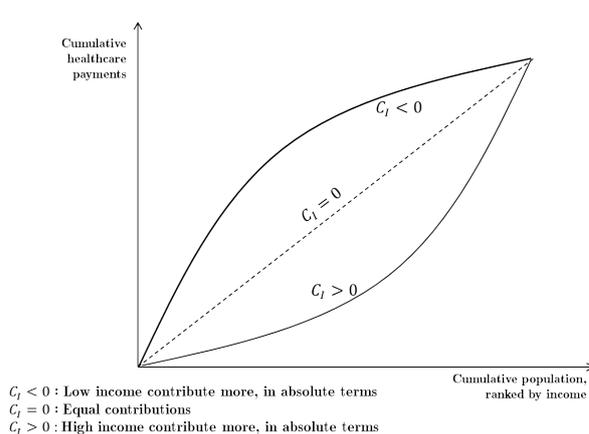
Tables and Figures

Figure 3.1 – Income, healthcare payments and vertical equity

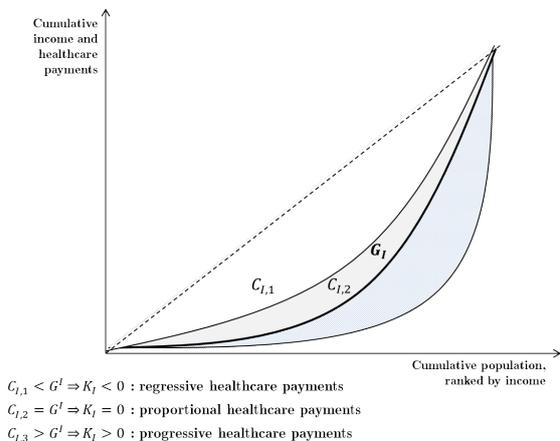
Lorenz curve of pre-payments income



Concentration curves of healthcare payments (premium + OOP)



Progressivity of healthcare payments



Redistribution from high income to low income

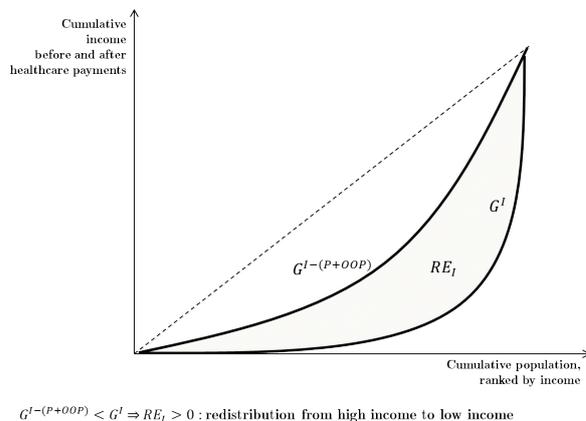


Figure 3.2 – Supplementary healthcare expenditures, payments and risk sharing

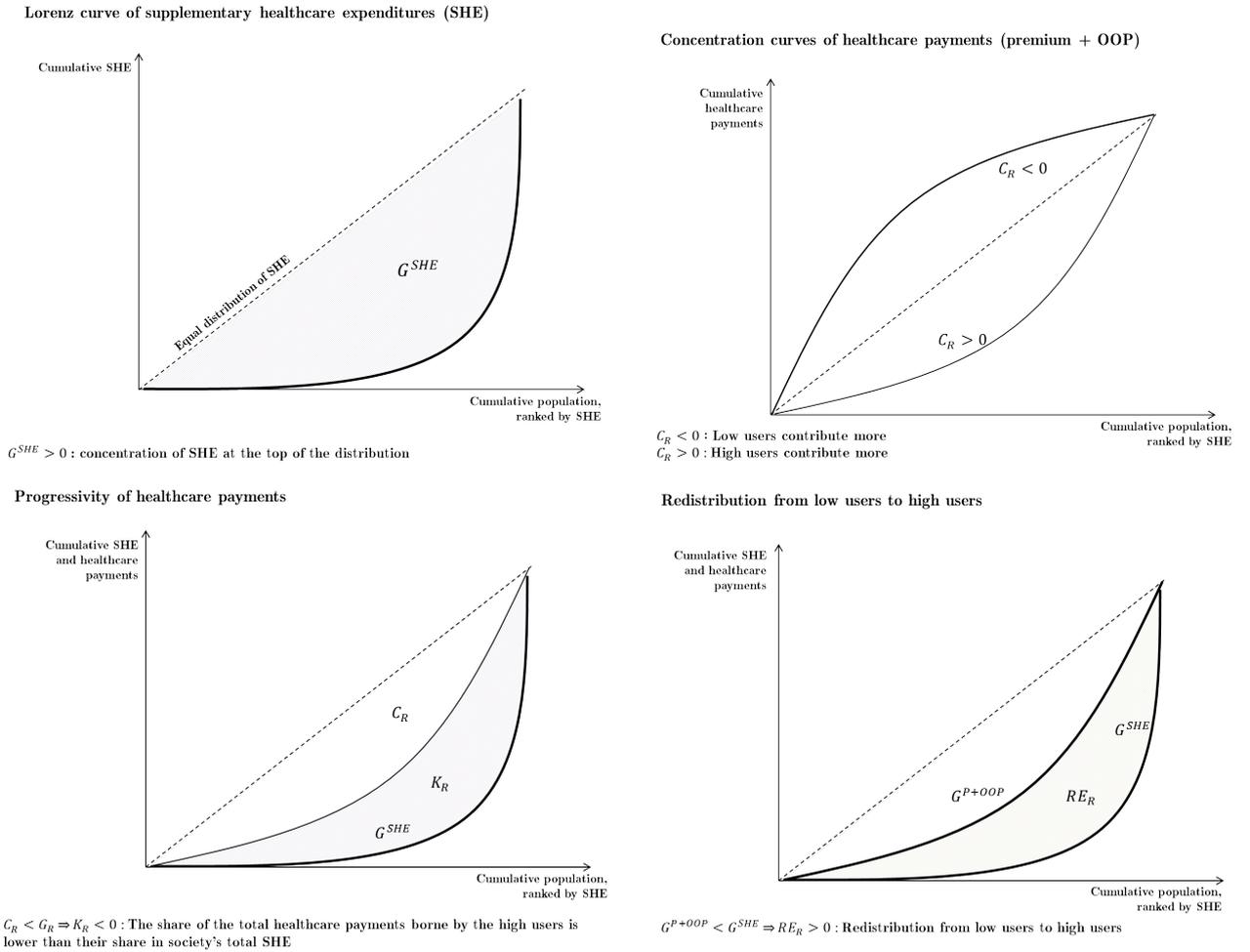


Table 3.1 – Socio-demographic characteristics - MGEN sample, 2012

	MGEN		ESPS
	N	%	%
Women	56,887	65.3	51.65
Men	30,223	34.7	48.35
25-35	6,609	7.6	16.6
35-45	14,729	16.9	19.5
45-55	15,785	18.1	23.0
55-65	20,080	23.1	20.4
65-75	18,745	21.5	11.9
75-90	11,162	12.8	8.7
Low income	18,476	21.2	NA
Average income	47,768	54.8	NA
High income	20,866	24.0	NA
No chronic disease	70,031	80.4	80.5
Chronic disease	17,079	19.6	19.5
No hospital stay	73,460	84.4	NA
Hospital stay in 2010 only	5,688	6.5	NA
Hospital stay in 2011 only	5,931	6.8	NA
Hospital stay in 2010 and 2011	2,031	2.3	NA

Low income: up to €2000 monthly wage
Average income: between €2000 and €3000
High income: above €3000

Table 3.2 – Empirical mean, standard deviation and percentiles of supplementary healthcare expenditures (*SHE*), SHI reimbursements (*SHIR*) and out-of-pocket payments(*OOP*), in €, MGEN sample in 2012

	N	Mean	s.d	min	p1	p5	p50	p95	p99	max
<i>SHE</i>	87,110	716.6	921.4	0	0	27.5	448	2243	4675	16681
<i>SHIR</i>	87,110	436.1	512.1	0	0	15	293	1343	2513	16370
<i>OOP</i>	87,110	281.2	533.1	0	0	3	117	1050	2550	13960

Figure 3.3 – Distribution of supplementary healthcare expenditures (*SHE*), SHI reimbursements (*SHIR*) and out-of-pocket payments(*OOP*), MGEN sample 2012

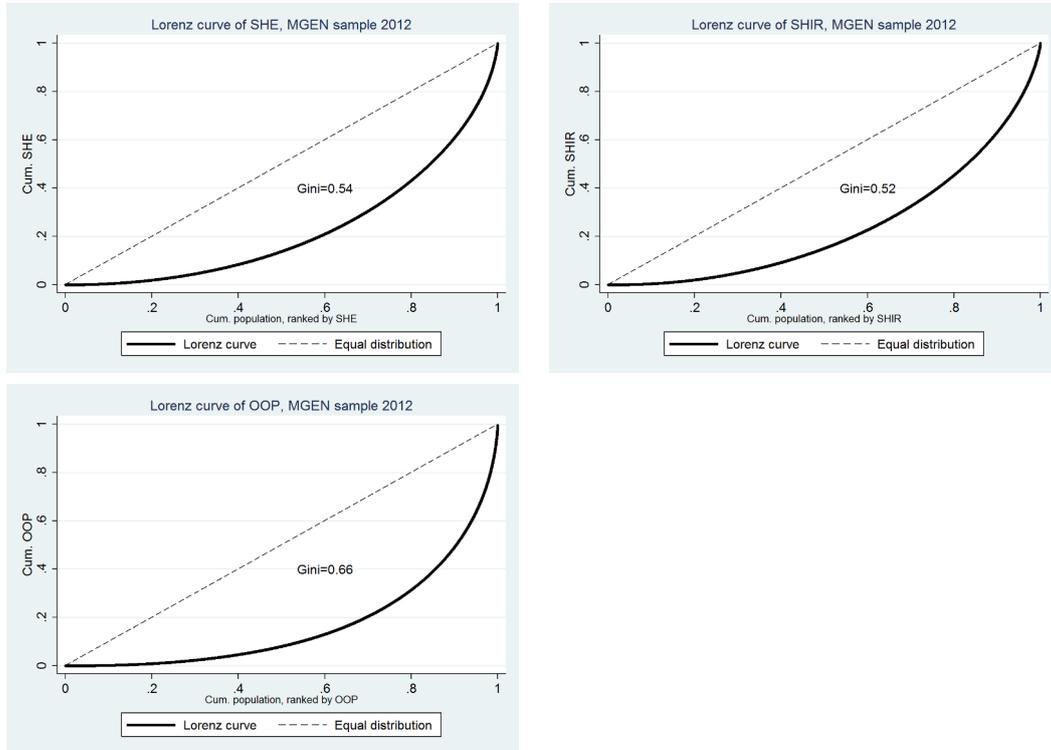


Figure 3.4 – Distribution of income and concentration curves for supplementary healthcare expenditures (*SHE*), SHI reimbursements (*SHIR*) and out-of-pocket payments (*OOP*), MGEN sample 2012

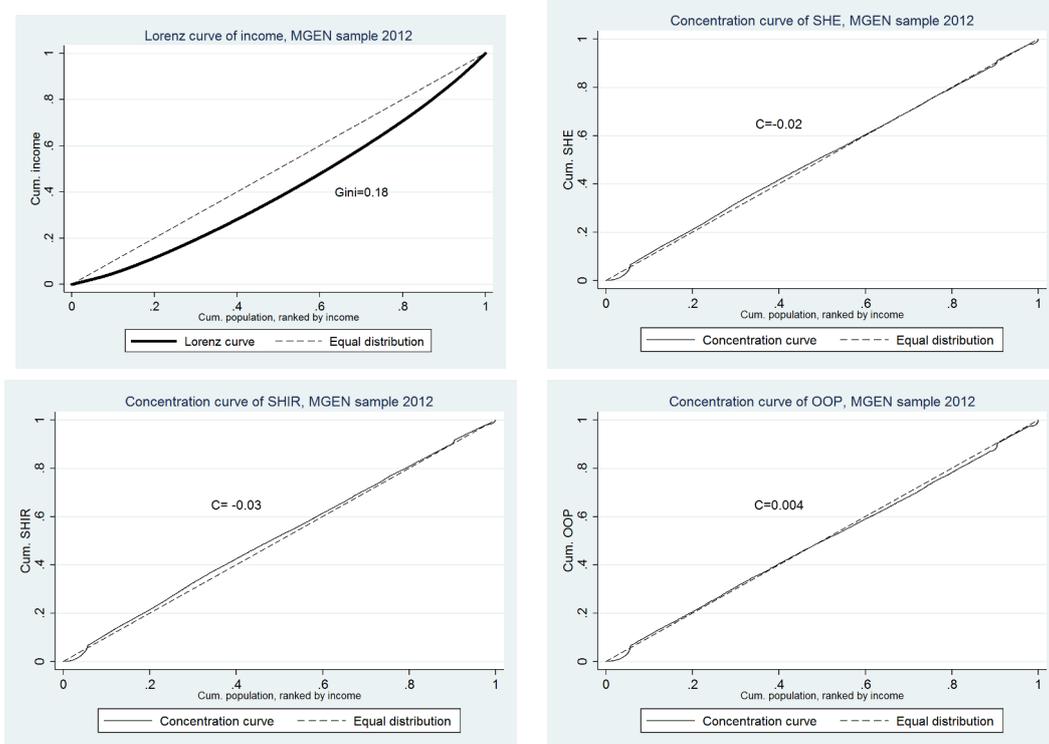


Figure 3.5 – Distribution of SHI reimbursements by age, MGEN sample 2012

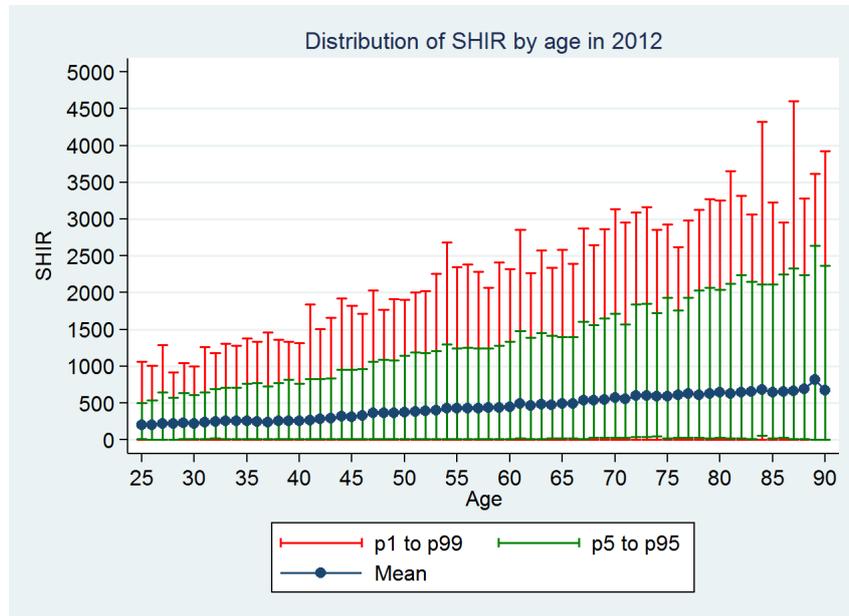


Table 3.3 – Correlation between SHI reimbursements (*SHIR*) and age

OLS	<i>SHIR</i>
Age	6.91*** (0.80)
Age ²	0.016** (0.007)
<i>R</i> ²	0.0648
N	87,110

* p<0.1, ** p<0.05, *** p<0.01

Table 3.4 – Predicted supplementary health care expenditures (*SHE*) and SHI reimbursements (*SHIR*)

OLS	Individual's risk <i>SHE</i>	Medical underwriting <i>SHIR</i>	Experience rating <i>SHIR</i>
Intercept	180.4***	184.6***	141.2***
Women	111.1***	66.1***	37.0***
25-35	ref.	ref.	
35-45	21.2*	33.0***	26.2***
45-55	140.9***	136.7***	103.5***
55-65	231.7***	211.9***	150.7***
65-75	343.3***	292.1***	208.0***
75-90	441.1***	368.9***	257.5***
Low income	-14.1***	-27.5***	-16.0***
Average income	ref.	ref	
High income	42.2***	-2.75	-9.6**
Chronic disease	49.0***	15.0***	4.82
No hospital stay	ref.	ref.	ref.
Hospital stay 2010 only	6.33	75.4***	21.4***
Hospital stay 2011 only	101.2***	159.9***	96.2***
Hospital stay 2010 & 2011	161.0***	290.4***	152.5***
SHE in 2010	0.14***	–	0.08***
SHE in 2011	0.18***	–	0.10***
R^2	0.14	0.08	0.14
N	87,110	87,110	87,110

* p<0.1, ** p<0.05, *** p<0.01

Table 3.5 – Empirical mean, standard deviation and percentiles of supplementary healthcare expenditures (*SHE*) by risk groups λ

<i>SHE</i>	N	Mean	s.d	min	p1	p5	p50	p95	p99	max
λ_1	21,778	333	429	0	0	6	207	1016	1938	9280
λ_2	21,777	556	660	0	0	20	368	1626	3257	11190
λ_3	21,778	762	871	0	0	67	522	2195	4447	15905
λ_4	21,777	1215	1263	0	38	149	866	3497	6460	16681

Table 3.6 – Empirical mean, standard deviation and percentiles of OOP payments by risk groups λ

<i>OOP</i>	N	Mean	s.d	min	p1	p5	p50	p95	p99	max
λ_1	21,778	118	219	0	0	0	48	457	1003	6820
λ_2	21,777	211	355	0	0	2	92	774	1715	6997
λ_3	21,778	298	509	0	0	12	140	1058	2404	13634
λ_4	21,777	498	790	0	4.5	31	250	1791	3867	13960

Figure 3.6 – Empirical distribution function of supplementary healthcare expenditures (SHE), by risk groups

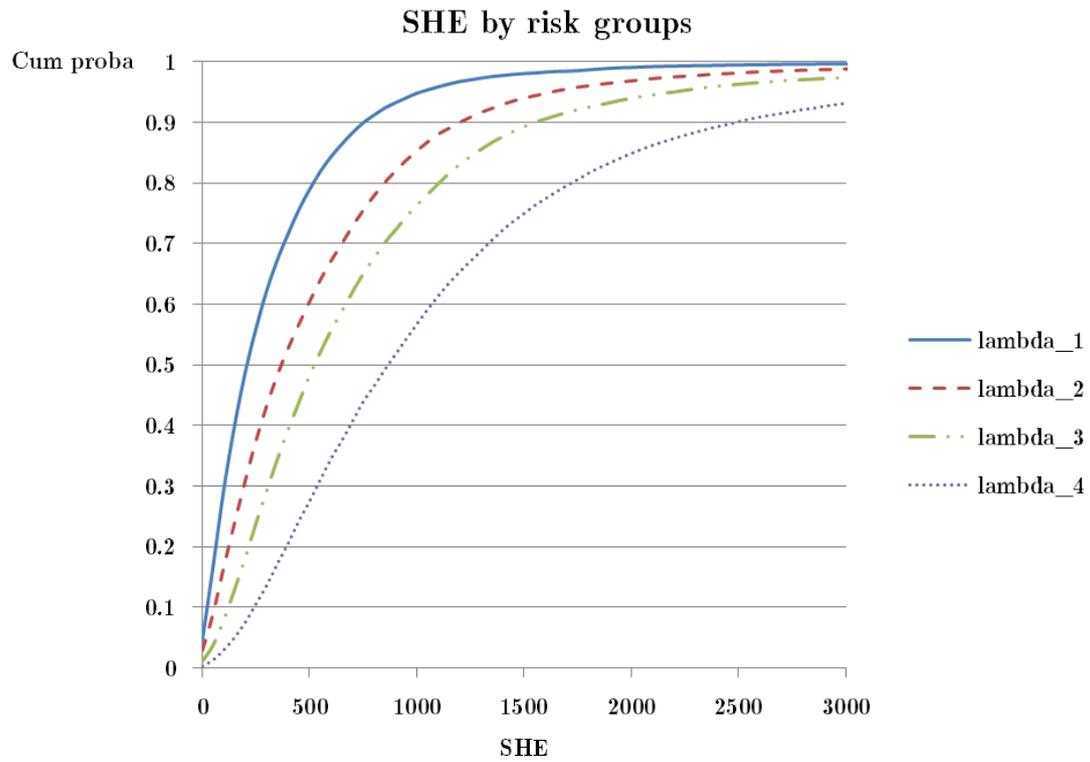


Table 3.7 – Adverse-selection spiral when insurance is voluntary: effect on premiums, results from simulations

Annual premium (in €)	Mean	Min	Max	Low risk	High risk	Low income	High income	Under 45 y.o.	Over 65 y.o.
Uniform									
Mandatory	523	523	523	523	523	523	523	523	523
Voluntary	712	712	712	712	712	712	712	712	712
Age-based									
Mandatory	523	286	767	349	658	571	509	311	697
Voluntary	553	286	803	361	697	604	543	311	742
Medical underwriting									
Mandatory	523	188	1110	325	700	562	496	311	697
Voluntary	527	188	1110	293	700	566	505	308	704
Experience rating									
Mandatory	523	150	8086	287	821	562	496	311	697
Voluntary	523	150	1642	276	808	562	494	309	689
Income-based									
Mandatory	523	209	1025	531	498	307	744	518	467
Voluntary	795	317	1558	807	756	467	1131	788	711
Income/age-based									
Mandatory	523	172	1074	485	535	315	733	496	518
Voluntary	735	242	1511	681	752	443	1031	659	728

Table 3.8 – Characteristics of insured and uninsured when SHI is voluntary, results from simulations

	Sample		Women	Age	Low income	Average income	High income	Chronic Disease	SHE
	N	%	%	mean	%	%	%	%	mean
All sample	87,110	100	65	57	21	55	24	19.6	717
Uniform									
Uninsured	44,021	50.5	58	47	19	56	25	8	448
Insured	43,089	49.5	73	67	23	54	23	32	991
Age-based									
Uninsured	9,258	10.6	26	60	35	40	25	13.5	438
Insured	77,852	89.4	70	57	19	57	24	20	750
Medical underwriting									
Uninsured	9,065	10.4	30	56	26	50	24	14	413
Insured	78,045	89.6	69	57	21	55	24	20	946
Experience rating									
Uninsured	3,136	3.6	42	53	32	58	10	10	571
Insured	83,974	96.4	66	57	21	55	24	20	722
Income-based									
Uninsured	44,126	50.6	57	47	10	56	35	7	465
Insured	42,984	49.4	74	67	33	54	13	32	974
Income/age-based									
Uninsured	41,263	47.4	55	48	8	57	35	7	459
Insured	45,847	52.6	75	66	33	53	14	31	948

Table 3.9 – Percentage of uninsured by income and risk profile, for each regime of premiums - results from simulations

	Uniform	Age-based	Medical underwriting	Experience rating	Income-based	Income-age based
UNINSURED	%	%	%	%	%	%
Whole sample	50.5	10.6	10.4	3.6	50.6	47.4
Low income	45.4	17.6	12.6	5.5	22.9	18.2
Average income	51.5	7.7	9.5	3.8	51.5	49.2
High income	52.8	11.2	10.7	1.5	73.2	69.0
Low risk: λ_1, λ_2	100	18.6	19.7	6	91.5	86.9
High risk: λ_3, λ_4	1.1	2.6	1.1	1.2	9.8	7.8
High risk (λ_3, λ_4)						
& Low income	4.4	10.8	4.4	1.6	0	0
& Average income	0	0	0	0.1	0	0
& High income	0	0	0	0.1	43.4	34.4

Table 3.10 – Vertical equity indexes, results from simulation - whole sample

	G^I	$G^{I-(P+OOP)}$	C_I	K_I	RE_I
No insurance	0.1754	0.1810	-0.0160	-0.1915	-0.0055
Uniform					
Mandatory	0.1754	0.1805	0.0014	-0.1740	-0.0051
Voluntary	0.1754	0.1810	-0.0162	-0.1916	-0.0056
Age-based					
Mandatory	0.1754	0.1811	-0.0179	-0.1933	-0.0057
Voluntary	0.1754	0.1810	-0.0125	-0.1879	-0.0055
Medical Underwriting					
Mandatory	0.1754	0.1812	-0.0206	-0.1960	-0.0058
Voluntary	0.1754	0.1810	-0.0194	-0.1949	-0.0056
Experience rating					
Mandatory	0.1754	0.1812	-0.0195	-0.1949	-0.0058
Voluntary	0.1754	0.1811	-0.0183	-0.1938	-0.0057
Income-based					
Mandatory	0.1754	0.1774	0.1154	-0.0600	-0.0020
Voluntary	0.1754	0.1797	0.0331	-0.1423	-0.0043
Income/age-based					
Mandatory	0.1754	0.1775	0.1098	-0.0657	-0.0021
Voluntary	0.1754	0.1797	0.0332	-0.1422	-0.0043

Figure 3.7 – Healthcare payments and vertical equity

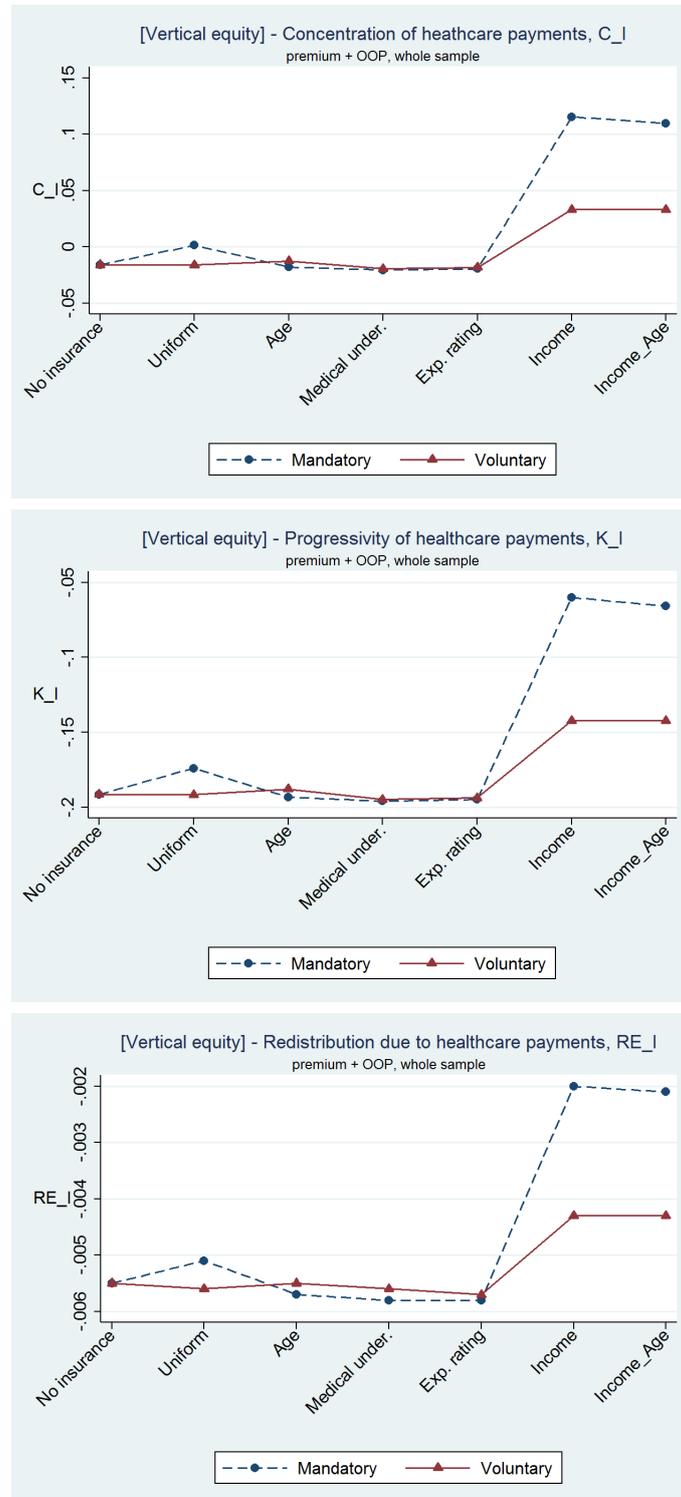


Table 3.11 – Risk sharing indexes, results from simulation - whole sample

	G^{SHE}	G^{P+OOP}	C_R	K_R	RE_R
No insurance	0.5435	0.5435	0.5435	0	0
Uniform					
Mandatory	0.5435	0.2304	0.2145	-0.3290	0.3131
Voluntary	0.5435	0.4197	0.3761	-0.1674	0.1238
Age-based					
Mandatory	0.5435	0.2926	0.2466	-0.2969	0.2509
Voluntary	0.5435	0.3335	0.2839	-0.2596	0.2096
Medical Underwriting					
Mandatory	0.5435	0.3042	0.2556	-0.2879	0.2393
Voluntary	0.5435	0.3421	0.2916	-0.2519	0.2014
Experience rating					
Mandatory	0.5435	0.3340	0.2854	-0.2581	0.2095
Voluntary	0.5435	0.3411	0.2931	-0.2504	0.2024
Income-based					
Mandatory	0.5435	0.2744	0.2099	-0.3336	0.2690
Voluntary	0.5435	0.4416	0.3818	-0.1617	0.1019
Income/age-based					
Mandatory	0.5435	0.2803	0.2194	-0.3241	0.2632
Voluntary	0.5435	0.4341	0.3735	-0.1700	0.1094

Figure 3.8 – Healthcare payments and risk sharing

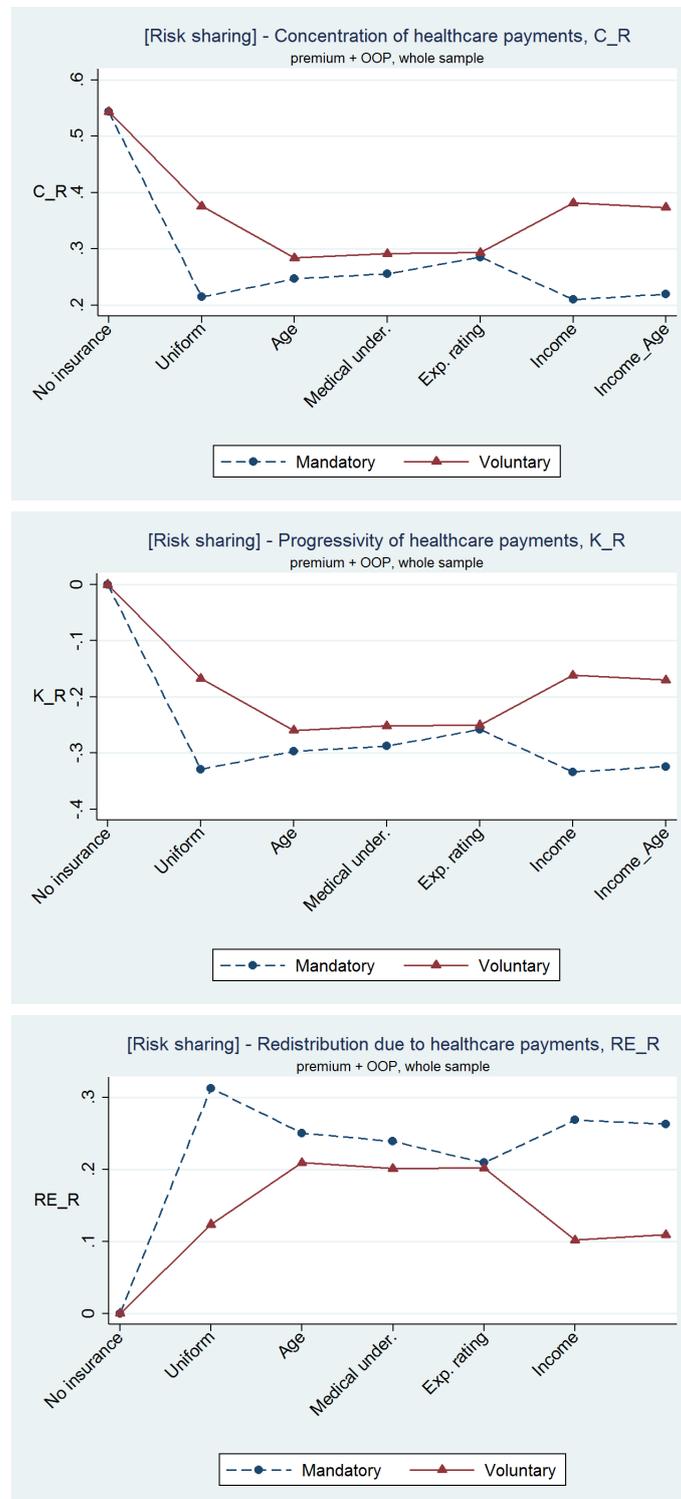


Table 3.12 – Vertical equity and Risk sharing indexes, results from simulation - SHIR only - Voluntary whole sample

	C_I	K_I	RE_I	C_R	K_R	RE_R
No insurance						
	-0.0294	-0.2048	-0.0033	0.5214	0	0
Uniform						
Voluntary	-0.0278	-0.2032	-0.0035	0.2450	-0.2764	0.1948
Age-based						
Voluntary	-0.0214	-0.1969	-0.0035	0.1054	-0.4161	0.2966
Medical Underwriting						
Voluntary	-0.0326	-0.2081	-0.0036	0.1097	-0.4117	0.2840
Experience rating						
Voluntary	-0.0305	-0.2059	-0.0037	0.1175	-0.4039	0.2834
Income-based						
Voluntary	0.0498	-0.1256	-0.0022	0.2531	-0.2683	0.1274
Income/age-based						
Voluntary	0.0498	-0.1256	-0.0022	0.2403	-0.2811	0.1380

Table 3.13 – Different values of load factor and risk aversion - Voluntary whole sample

	% uninsured	RE_I	RE_R
Load factor = 1.1			
Uniform	25.6	-0.0050	0.2035
Age-based	9.7	-0.0053	0.2061
Medical underwriting	5.7	-0.0053	0.2094
Experience rating	0.9	-0.0054	0.2002
Income-based	45.4	-0.0038	0.1150
Income/age-based	42.9	-0.0039	0.1194
Load factor = 1.15			
Uniform	50.5	-0.0055	0.1231
Age-based	9.7	-0.0055	0.2103
Medical underwriting	8.1	-0.00545	0.2058
Experience rating	1.9	-0.0056	0.2024
Income-based	48.6	-0.0041	0.1073
Income/age-based	45.2	-0.0041	0.1147
Risk aversion = 0.0004			
Uniform	52.8	-0.0054	0.1163
Age-based	31.8	-0.0055	0.1420
Medical underwriting	18.9	-0.0054	0.1709
Experience rating	6.6	-0.0057	0.1971
Income-based	73.5	-0.0055	0.0500
Income/age-based	72.1	-0.0054	0.0520
Risk aversion = 0.0006			
Uniform	25.6	-0.0053	0.2100
Age-based	6.8	-0.0056	0.2283
Medical underwriting	6.6	-0.0058	0.2166
Experience rating	1.4	-0.0057	0.2067
Income-based	39.0	-0.0036	0.1324
Income/age-based	35.3	-0.0037	0.1412

Appendix

A-3.1. Equity indexes: formulas and computation

Gini coefficient

The Gini coefficient is defined as twice the area between the Lorenz curve L , which plots the cumulative income (or SHE) against the cumulative population ranked by income (or SHE). A Gini coefficient of 0 expresses perfect equality, that is everyone has the same income (or SHE). A Gini coefficient superior to 0 implies an unequal distribution; the closer the Gini coefficient is to 1, the more unequal the distribution. Formally, the Gini coefficient is defined as

$$G = 1 - 2 \int_0^1 L(p) dp \quad (3.4)$$

For computation, we use the covariance approach derived in Pyatt et al. (1980)

$$G = \frac{2}{\mu} \text{cov}(y, r) \quad (3.5)$$

where y is the income (or SHE), μ its mean and r the fractional rank, ranging all individuals according to their income (or SHE) from the poorest to richest (from the lowest to the highest healthcare user). The weighted fractional rank is indeed defined as

$$r_i = \sum_{j=0}^{i-1} w_j + \frac{w_i}{2} \quad (3.6)$$

where w_i is the sample weight scaled to sum 1. Observations are sorted in ascending order of income (or SHE) and $w_0 = 0$.

Concentration index

The concentration index is defined as twice the area between the concentration curve L_{P+OOP} , that plots the cumulative healthcare payments against the cumulative population ranked by

income (or SHE). The concentration index is bounded between -1 and 1. Formally, the concentration index is defined as

$$C = 1 - 2 \int_0^1 L_{P+OOP}(p) dp \quad (3.7)$$

For computation, we use the covariance approach described in Jenkins (1988),

$$C = \frac{2}{\mu} \text{cov}((P + OOP), r) \quad (3.8)$$

where $P + OOP$ is the healthcare payments, μ its mean and r the fractional rank in the income (or SHE) distribution, as defined previously in equation 3.6.

Kakwani index

One way to measure the progressivity of payments, i.e. ‘comparing the share of income received by each income decile with its share of health care payments’ (Wagstaff & Van Doorslaer 2000), is to use the Kakwani index (Kakwani 1977). The Kakwani index is defined as twice the area between the Lorenz curve of income (or SHE), $L_I(p)$, and the concentration curve of health care payments L_{P+OOP} . The Kakwani index is therefore the difference between the concentration index for healthcare payments and the Gini coefficient for income (or SHE):

$$K = C - G \quad (3.9)$$

If the system is progressive, K is positive. If the system is regressive, K is negative. If payments are perfectly proportional to income (or SHE), then $K = 0$.

Redistribution index

The measure of the redistributive impact of healthcare payments, either on income or SHE distribution, can be measured by comparing the Gini coefficients before and after healthcare payments. Formally, if we focus on income distribution,

$$RE_I = G^I - G^{I-(P+OOP)} \quad (3.10)$$

where G^I is the Gini coefficient for income before any healthcare payments and $G^{I-(P+OOP)}$, the Gini coefficients once individuals have paid their insurance premium and OOP payments. If we focus on risk sharing then,

$$RE_R = G^{SHE} - G^{P+OOP} \quad (3.11)$$

where G^{SHE} is the Gini coefficient for SHE and G^{P+OOP} , the Gini coefficients of healthcare payments.

Stata code

We provide here the Stata code used to compute the different indexes¹⁴. y represents the individual income before any healthcare payment, she the supplementary healthcare expenditures. hp are the healthcare payments borne by the individuals, that is the premium (if the individual is insured) plus OOP payments. For each regime x , and depending on whether SHI is voluntary or mandatory, we use the corresponding hp for each individual, obtained from the simulation. r is the fractional rank, computed as in equation 3.6. The Gini coefficient and the concentration index are computed respectively as in equations 3.5 and 3.8.

¹⁴The Stata code is derived from the one provided by the World Bank technical documents available on <http://siteresources.worldbank.org/INTPAH/Resources/Publications/459843-1195594469249/HealthEquityCh8.pdf>

Figure 3.9 – Stata code - vertical equity indexes

```

*Gini coefficient (Income)
*****
egen rank1=rank(y), unique
sort rank1
qui sum wt
gen wi=wt/r(sum)
gen cusum=sum(wi)
gen wj=cusum[_n-1]
replace wj=0 if wj==.
gen r=wj+0.5*wi

qui sum y [aw=wt]
sca m_y=r(mean)
qui cor r y [aw=wt], c
sca gini=2*r(cov_12)/m_y

*Concentration index
*****
foreach x of global X {
qui {
sum `x' [aw=wt]
sca m_`x'=r(mean)
corr r `x' [aw=wt], c
sca c_`x'=2*r(cov_12)/m_`x'
}
}

*Kakwani index
*****
foreach x of global X {
sca kk_`x'=c_`x'-gini
}

**Redistribution effect
*****
foreach x of global X {
qui{
gen ypost_`x'=y-`x'
sum ypost_`x' [aw=wt]
sca my_`x'=r(mean)
egen rank_`x'=rank(ypost_`x'), unique
sort rank_`x'
gen cusum_`x'=sum(wi)
gen wj_`x'=cusum_`x'[_n-1]
replace wj_`x'=0 if wj_`x'==.
gen r_`x'=wj_`x'+0.5*wi
corr r_`x' ypost_`x' [aw=wt], c
sca gini_`x'=2*r(cov_12)/my_`x'
sca re_`x'=gini-gini_`x'
}
}

```

Figure 3.10 – Stata code - risk sharing indexes

```

*Gini coefficient (SHE)
*****
egen rank1=rank(she), unique
sort rank1
qui sum wt
gen wi=wt/r(sum)
gen cusum=sum(wi)
gen wj=cusum[_n-1]
replace wj=0 if wj==.
gen r=wj+0.5*wi

qui sum she [aw=wt]
sca m_h=r(mean)
qui cor r she[aw=wt], c
sca gini=2*r(cov_12)/m_h

*Concentration index
foreach x of global X {
qui {
sum `x' [aw=wt]
sca m_`x'=r(mean)
corr r `x' [aw=wt], c
sca c_`x'=2*r(cov_12)/m_`x'
}
}

*Kakwani index
foreach x of global X {
sca kk_`x'=c_`x'-gini
}

*Redistribution effect
*****
foreach x of global X {
qui{
gen hp_`x'=`x'
sum hp_`x' [aw=wt]
sca mh_`x'=r(mean)
egen rank_`x'=rank(hp_`x'), unique
sort rank_`x'
gen cusum_`x'=sum(wi)
gen wj_`x'=cusum_`x'[_n-1]
replace wj_`x'=0 if wj_`x'==.
gen r_`x'=wj_`x'+0.5*wi
corr r_`x' hp_`x' [aw=wt], c
sca gini_`x'=2*r(cov_12)/mh_`x'
sca re_`x'=gini-gini_`x'
}
}

```

A-3.2. Simulation

We import from Stata the empirical distribution of SHE and OOP payments estimated on our sample and use Excel to compute individuals' expected utility with and without insurance. We use the Simpson's rule (with quadratic interpolation) to approximate the integral. The decision to take out SHI is simulated thanks to a VBA macro, written by the author. We first compute the premium paid by the individual and her expected utility with insurance. If the expected utility with insurance is higher than without, the individual takes out insurance and remains in the pool. If not he exits the pool. When the premium depends on the pool (uniform, age-based, income and income-age based), we compute the premium again and repeat the steps until we reach an equilibrium, that is the pool after iteration j is the same than for iteration $j - 1$. Eventually, for each individual in our sample we get the premium he would have to pay, her expected utility considering this premium and her decision to remain insured or exit the pool. The last iteration identifies individuals who take out SHI and those who prefer to remain uninsured. We also compute the final premium paid by those who want to be insured, taking into account the equilibrium pool. Finally, results are exported to Stata to run the analyses and compute the vertical equity and risk sharing indexes. The Excel macro is coded using VBA language. We provide the code used to compute the expected utility as well as uniform premiums when insurance is voluntary. The macros for the other type of premiums as well as detailed simulation results are available on demand.

Figure 3.11 – Macro for computing expected utilities

```

'Compute Expected utility from income y, premium P, risk aversion g and OOP
distribution for risk group lambda
Function ExpU(ByVal Y As Double, ByVal premium As Double, ByVal lambda As
Integer, ByVal g As Double, ByVal ins As Integer)
'Determine the OOP distribution for a risk group lambda with insurance (Final
OOP) and without (HCE)
Dim T As Long
'With insurance
If ins = 1 Then
p = premium
If lambda = 1 Then
Set X = Sheets("oop_distribution").Range("C7:C41")
Set L = Sheets("oop_distribution").Range("B7:B41")
T = X.Rows.Count
ElseIf lambda = 2 Then
Set X = Sheets("oop_distribution").Range("F7:F63")
Set L = Sheets("oop_distribution").Range("E7:E63")
T = X.Rows.Count
ElseIf lambda = 3 Then
Set X = Sheets("oop_distribution").Range("I7:I78")
Set L = Sheets("oop_distribution").Range("H7:H78")
T = X.Rows.Count
ElseIf lambda = 4 Then
Set X = Sheets("oop_distribution").Range("L7:L113")
Set L = Sheets("oop_distribution").Range("K7:K113")
T = X.Rows.Count
End If
'Without insurance
ElseIf ins = 0 Then
p = 0
If lambda = 1 Then
Set X = Sheets("she_distribution").Range("C7:C67")
Set L = Sheets("she_distribution").Range("B7:B67")
T = X.Rows.Count
ElseIf lambda = 2 Then
Set X = Sheets("she_distribution").Range("F7:F100")
Set L = Sheets("she_distribution").Range("E7:E100")
T = X.Rows.Count
ElseIf lambda = 3 Then
Set X = Sheets("she_distribution").Range("I7:I130")
Set L = Sheets("she_distribution").Range("H7:H130")
T = X.Rows.Count
ElseIf lambda = 4 Then
Set X = Sheets("she_distribution").Range("L7:L170")
Set L = Sheets("she_distribution").Range("K7:K170")
T = X.Rows.Count
End If
End If
'Compute EU with integral function
Dim i As Long, ai As Double, bi As Double, ci As Double, yi As Double, yimoin1
As Double, k As Double
'Initialization
y1 = -(1 / g) * Exp(-g * (Y - p - L(i)))
y2 = -(1 / g) * Exp(-g * (Y - p - L(i)))
y3 = -(1 / g) * Exp(-g * (Y - p - L(i)))
a0 = ((y1 - y3) * (X(2) - X(3)) - (X(1) - X(3)) * (y2 - y3)) / ((X(1) ^ 2 - X(3)
^ 2) * (X(2) - X(3)) - (X(1) - X(3)) * (X(2) ^ 2 - X(3) ^ 2))
b0 = (y2 - y3 - a0) * (X(2) ^ 2 - X(3) ^ 2) / (X(2) - X(3))
k = 2 * a0 * X(1) + b0
'Algo
For i = 2 To T
If Y - p - L(i) >= 0 And Y - p - L(i - 1) >= 0 Then
yi = -(1 / g) * Exp(-g * (Y - p - L(i)))
yimoin1 = -(1 / g) * Exp(-g * (Y - p - L(i - 1)))
ElseIf Y - p - L(i) < 0 And Y - p - L(i - 1) >= 0 Then
yi = 0
yimoin1 = -(1 / g) * Exp(-g * (Y - p - L(i - 1)))
ElseIf Y - p - L(i) < 0 And Y - p - L(i - 1) < 0 Then
yi = 0
yimoin1 = 0
End If
'Polynome of degree 2: ax^2+bx+c
a1 = (yi - yimoin1 - k * (X(i) - X(i - 1))) / (X(i) - X(i - 1)) ^ 2
b1 = k - 2 * a1 * X(i - 1)
c1 = yi - a1 * X(i) ^ 2 - b1 * X(i)
'Integration: [ax^2+bx+c]
ExpU = ExpU + a1 * (X(i) ^ 3 - X(i - 1) ^ 3) / 3 + b1 * (X(i) ^ 2 - X(i - 1)
^ 2) / 2 + c1 * (X(i) - X(i - 1))
'Derivative at the starting point for continuity
k = 2 * a1 * X(i) - b1
Next i
End Function

```

Figure 3.12 – Macro for simulating adverse selection with uniform premiums

```

'Simulate Adverse selection when premium are Uniform
Sub adverse_selection_uniform()
'Parameters setting
'-----
'Define the first line number
Const F = 3
'Define the last line number
Const L = 87112
'Define the starting column
Const S = 377
'Define the number of iterations for the main loop
Const N = 5
'Define load factor
Const load = 1.15

'Define individuals characteristics used in EU computation
Dim CHI As Range, EUno As Range, income As Range, lambda As Range, gamma As
Range

Set CHI = Sheets("simulation").Range(Cells(F, 12), Cells(L, 12))
Set EUno = Sheets("simulation").Range(Cells(F, 19), Cells(L, 19))
Set income = Sheets("simulation").Range(Cells(F, 5), Cells(L, 5))
Set lambda = Sheets("simulation").Range(Cells(F, 8), Cells(L, 8))
Set gamma = Sheets("simulation").Range(Cells(F, 15), Cells(L, 15))

'Define sample size
Dim T As Long
T = income.Rows.Count

'Main Loop: N iterations to simulate adverse selection process
'-----
Dim EU(1 To N) As Range
Dim pool(1 To N) As Range
Dim premium(1 To N) As Range
Dim p As Double, k As Long, j As Long

'Initialisation
'-----
'Define the columns where EU(k) and Pool(k) will be displayed
Set premium(1) = Sheets("simulation").Range(Cells(F, 5), Cells(L, 5))
Set EU(1) = Sheets("simulation").Range(Cells(F, S + N), Cells(L, S + N))
Set pool(1) = Sheets("simulation").Range(Cells(F, S + 2 * N), Cells(L, S + 2 *
N))

'Compute premium - whole sample
p = WorksheetFunction.Average(CHI) * load

'Compute EU for each individual j and compare it with EU without insurance
'If EU insurance >= EU without insurance, then individual j stays in the pool
(pool(1)=1)
For j = 1 To T
    premium(1)(j) = p
    EU(1)(j) = ExpU(income(j), p, lambda(j), gamma(j), 1)

    If EU(1)(j) >= EUno(j) Then
        pool(1)(j) = 1
    Else
        pool(1)(j) = 0
    End If
Next j

'Loop
'-----
For k = 2 To N

'Define the columns where EU(k) and Pool(k) will be displayed
Set premium(k) = Sheets("simulation").Range(Cells(F, S - 1 + k), Cells(L, S - 1
+ k))
Set EU(k) = Sheets("simulation").Range(Cells(F, S + N - 1 + k), Cells(L, S + N -
1 + k))
Set pool(k) = Sheets("simulation").Range(Cells(F, S + 2 * N - 1 + k), Cells(L, S
+ 2 * N - 1 + k))

'Compute premium conditioning on pool(k-1)=1
p = WorksheetFunction.AverageIf(pool(k - 1), 1, CHI) * load

'Secondary Loop: for each individual j, compute EU with insurance and compare
with no insurance
'If EU with insurance >= EU without insurance, individual j stays in the pool
(pool(k)=1)
For j = 1 To T
    premium(k)(j) = p
    EU(k)(j) = ExpU(income(j), p, lambda(j), gamma(j), 1)

    If EU(k)(j) >= EUno(j) Then
        pool(k)(j) = 1
    Else
        pool(k)(j) = 0
    End If
Next j
End of secondary loop
Next k
End of main loop
End Sub

```

General Conclusion

The purpose of this thesis was to deal with two questions relative to efficiency and fairness in mixed health insurance systems with partial mandatory coverage and voluntary supplementary health insurance (SHI): (i) the potential inflationary effect of SHI on medical prices; (ii) the fairness of SHI premiums in a context of voluntary insurance.

Main results

Does SHI encourage the rise in medical prices?

We find that generous supplementary coverage can contribute to a rise in medical prices by increasing the demand for specialists who balance bill. Individuals with better coverage raise their proportion of consultations of specialists who balance bill by 9%, which results in a 32% increase in the amount of balance billing per consultation. In addition to moral hazard on quality of care, we also find for some patients evidence of an increase in the number of specialists consultations due to better coverage, which suggests that balance billing limited their access to specialists. However, the magnitude of moral hazard clearly depends on supply side organization. We find no evidence of moral hazard, neither in quantity nor quality, in areas where physicians who charge the regulated fee are widely available. In other words, when patients can readily choose between physicians who balance bill and physicians who don't, SHI has no impact on medical prices. On the basis of these results, it seems that the most appropriate policy to contain medical prices is not to limit SHI coverage but to monitor the supply of care in order to guarantee patients a genuine choice of their physicians.

Is there evidence of selection on moral hazard in SHI?

We find evidence of individual heterogeneity in the response to better coverage and of selection on moral hazard. Individuals with unobservable characteristics that make them more likely to ask for comprehensive SHI are also those who exhibit stronger moral hazard, i. e. a larger increase in balance billing per consultation. We also find that individuals' income is a determinant of balance billing consumption and influences the behavioral response to better coverage. Without coverage, the poor consume less balance billing than the rich but increase more strongly their balance billing consumption if they benefit from better coverage. They are also more likely to ask for comprehensive coverage. In a context where SHI is voluntary, the inflationary impact of SHI coverage might be worsened by selection on moral hazard. When providing comprehensive balance billing coverage, insurers have to take into account that their contract is likely to attract individuals who respond more sharply than average to better coverage. Our policy conclusions as regards the role of income are of different nature. The negative effect of income on the demand for consultations with balance billing coupled with its positive effect on moral hazard reveals that insurance plays an important role in terms of access to care.

Are SHI age-based premiums fair?

Our simulations show that when SHI is voluntary, age-based premiums allow the largest transfers from low to high healthcare users. Indeed, age-based premiums are a cross-breed between CR and actuarial fairness: they better resist to the adverse selection spiral than uniform or income-based premiums and still guarantee more risk sharing than medical underwriting or experience rating. In addition, we stress out the fact that voluntary insurance dramatically limits the impact of SHI on risk sharing and vertical equity, especially when premiums are based on a form of community rating. Finally, we show that there is a conflict between disconnecting healthcare expenditures from healthcare payments and guaranteeing vertical equity. Indeed, although age-based premiums imply a form of risk sharing especially when insurance is voluntary, they also yield regressive payments and raise legitimate concerns about the affordability of insurance and income inequalities due to healthcare payments.

Limitations

Our database provides valuable information and a useful design to explore the effect of SHI on medical consumption. Our empirical strategy is meant to control for endogenous selection and estimates are robust to different specifications. However this work suffers from some limitations. First, our sample is not representative of the French population nor of individuals likely to buy SHI in the market. Because they are mainly teachers and Ministry of education employees, MGEN policyholders have specific observable characteristics. Compared to the general population, our sample has significantly more women, average age as well as median wage are higher. As regards unobservable characteristics, we cannot rule out the possibility that MGEN policyholders are also different in terms of risk aversion, health preferences or moral hazard behavior. One of the important finding of this thesis is that individual heterogeneity in the demand for healthcare and response to better coverage is significant and plays a critical role in the demand for insurance coverage. Generalizing our results to a different setting and population would therefore require strong assumptions. However, estimating marginal treatment effects is a first step in acknowledging individual heterogeneity and evaluate how it impacts selection and moral hazard. Theoretically, we should be able to reconstruct policy relevant parameters from MTEs, and estimating the effect of SHI on balance billing consumption for any specific population. However our common support is too restricted at this point to go further. Another limitation of our data is that we do not have precise information about switchers' new coverage. Because MGEN does not cover balance billing, we know that switchers' balance billing coverage will be equal or higher and are therefore able to provide lower-bound estimates of SHI impact. However, we are not able to refine the analysis and estimate price elasticities without making further assumptions.

Our investigation on the impact of age-based premiums on risk sharing and vertical equity is still at an exploratory stage. Several methodological choices and assumptions we made are questionable although often dictated by data availability. We believe that a micro-simulation is relevant to answer this type of question. However, the predictive power of our model could be improved with more precise data. With the data currently available, we have to make strong assumptions about individuals' risk aversion and our model for health insurance demand is

not as refined as we wish it would be. Moreover, our analysis is restricted to the SHI benefit package because we are not able to observe in details hospital expenditures which are mainly covered by NHI. For the same reasons, we also probably underestimate the magnitude and dispersion of OOP expenditures. A last limitation of this work comes from our pragmatic definition of fairness. Restricting our analysis to healthcare financing, through the spectra of risk sharing and vertical equity, only partially answers the fairness question. A broader vision including healthcare consumption, net income and health would be far more satisfying. However this would require individual-level data that combine comprehensive information on health, healthcare use, net income as well as coverage choices and healthcare payments.

Policy relevance

Although we acknowledge the limitations of our results, we believe this thesis can contribute to critical policy debates as regards future evolutions of SHI in France and more generally in mixed health insurance systems. The definition of the benefit package and the articulation between NHI and SHI is a major policy question and will underly forthcoming reforms of social health insurance systems. The question of a mandatory SHI also regularly comes back in the public debate.

Should SHI coverage on balance billing be limited?

We have already emphasized the continuous increase of balance billing in France and the burden it causes to patients in terms of OOP payments and access to care. Two measures have been recently implemented by the French government to deal with balance billing. One consists in giving financial incentives to physicians for limiting consultation fees. The other one consists in giving incentives to insurers for limiting balance billing coverage. Physicians are invited to sign up a NHI agreement called ‘Contrat d’accès aux soins’ (CAS). This agreement is meant to discourage physicians to charge balance billing in exchange of fiscal advantages and a better remuneration of some clinical and technical acts. Note that the balance billing limit is quite flexible and not extremely restrictive since physicians only commit to charge fees, on average, up to 100% of the NHI reference fee. Is the CAS able to monitor the supply side and limit the

inflationary spiral between SHI and balance billing? First, the CAS does not encounter a great success: according to physician unions, less than a third of all practitioners has actually signed the agreement. Moreover, the CAS does not deal with what we identified as the main driver of the inflationary spiral: the scarcity of S1 physicians in some areas. We argue that it also increases complexity and uncertainty in the way specialists set their fees. The CAS agreement states that physicians must provide a given share of their consultations with the reference fee. It means that for some patients (which patients?) physicians are allowed to charge balance billing far above the 100% ‘average limit’. This increases uncertainty for patients as regards their OOP expenditures. Inciting physicians to price discriminate their patients also raises ethical questions as regards equal access to care.

If the supply side cannot be monitored, limiting SHI coverage could be a second-best solution. Most of the SHI contracts provided on the individual and the employer-based markets are certified as ‘Contrats responsables’. In order to benefit from fiscal advantages, insurers have to meet certain standards in terms of level of coverage and premiums. Since April 2015 the French government has included a limitation in balance billing coverage¹⁵. The rule is quite complex because it depends on whether the physician is part of the ‘CAS’ agreement or not. Basically, there is no limit in balance billing coverage if the physician signed up for CAS. However, the coverage is limited to 100% of the NHI reference fee if the physician did not sign up. On the basis of our results, we are sceptical about the efficiency of this measure. First, it assumes that patients are not only able to freely choose between S1 and S2 physicians but also to distinguish, among S2 physicians, between those who are part of the CAS agreement and those who are not. We also show that demand for S2 specialists is heavily constrained by S1 availability and that SHI actually enhances access to care for individuals with low income and/or living in areas with very few S1 specialists. We can therefore expect two consequences of limiting coverage in areas where S1 specialists are scarce: either an increase in OOP expenditures or mounting difficulties in visiting specialists for those who cannot afford balance billing.

Should the SHI perimeter expand?

¹⁵Décret n° 2014-1374 du 18 novembre 2014 relatif au contenu des contrats d’assurance maladie complémentaire bénéficiant d’aides fiscales et sociales

The right-wing candidate for the forthcoming French presidential election, Francois Fillon, explicitly considers SHI expansion as the answer to NHI deficit. According to Mr Fillon, universal and mandatory NHI should only cover ‘serious’ or chronic diseases and let SHI cover, well, basically everything else¹⁶. To be fair, since the beginning of the 90’s, the successive governments, irrespective of their political affiliation, have been keen to support SHI expansion in order to release the constraints on public finance. The idea of limiting public coverage to catastrophic expenditures and let individuals decide whether they want to be covered against ‘small risks’ is not new either. However, SHI expansion cannot be considered as a simple and harmless transfer from public to private finance of healthcare. This will necessarily have important consequences on inequalities in coverage and premium paid and will affect the extent of risk sharing and vertical equity. First, our results on SHI reimbursements and OOP expenditures distribution show that there is no such things as ‘small risks’. Indeed, the risk can not be assessed by looking at average expenditures, one has to consider the whole distribution and especially the highest percentiles. Although the average OOP expenditures after NHI reimbursement is approximatively €436 in our sample, it exceeds €1350 for 5% of individuals. SHI expansion will probably yield wider dispersion of expenditures meant to be covered by SHI, and transform the apparent ‘small risk’ in a substantial one. Second, we also show that SHI reimbursements are already highly correlated with individual characteristics, and especially with age. Increasing SHI perimeter would necessarily increase heterogeneity in terms of healthcare risk faced by individuals and consequently increase inequalities in premiums and out-of-pocket expenditures. Finally, we can expect adverse selection phenomenons to be worsened by the wider gap between low and high risks.

Should SHI coverage be mandatory?

Guaranteeing access to a SHI contract has been set as a priority objective by the French government since 2012. The main resolution consisted in making SHI coverage mandatory for all employees, through an employer-based contracts¹⁷. However, for those who are not employees

¹⁶"Pour assurer la pérennité de notre système de santé je propose de [...] focaliser l'assurance publique universelle sur des affections graves ou de longue durée, et l'assurance privée sur le reste" in <https://www.fillon2017.fr/participez/sante>

¹⁷The agreement is part of the *Accord National Interprofessionnel* It was signed by unions in January 2013 and implemented in January 2016

with long-term contracts, such as students, employees under short-term contracts, independent workers, civil servants, unemployed or retirees, SHI is still voluntary. What if SHI was also mandatory in the individual market?

The impact of a mandatory SHI would not be limited to the coverage of the currently uninsured population, which is quite marginal (only 5%). It could also have important benefits in terms of risk sharing and vertical equity. We showed in Chapter 3 that when insurance is mandatory, uniform or income-based premiums allow for higher transfers between low and high healthcare users as well as between low and high income. This would also reduce inequalities between insiders, who benefit from mandatory employer-based contracts, and outsiders (young and old people, working-poor, unemployed) who face higher premiums on the individual market. Would a mandatory SHI yield a rise in prices due to moral hazard? It would indeed create an increase in coverage for the 5% of the population which is not currently covered. However, this increase in healthcare consumption can be desirable for low-income individuals who could not access SHI before. Furthermore, given the evidence of selection on moral hazard, we can also expect that individuals who prefer to remain uninsured would not strongly increase their consumption with better coverage. It is true however that for individuals who are better off without SHI, a mandate would force them to over-consume health insurance .

Future research

We plan to pursue our research in three directions. Two of our projects continue to investigate the role of SHI in healthcare use and its articulation with NHI. The third project builds a bridge between the methods used in the thesis and specific challenges we face in Health technology assessment (HTA) studies.

We want to explore further the demand for SHI and its impact on healthcare use. Besides balance billing, optical and dental care are also of interest. Indeed, SHI coverage varies significantly on optical and dental care, prices keep on increasing and studies report important access inequalities. Up to now, we were limited by partial information on switchers' new coverage. This was sufficient to estimate moral hazard on balance billing but too limited to evaluate the

impact of SHI on optical and dental care. Furthermore, with precise information on level of coverage, we should be able to derive price elasticities and estimate welfare impacts. Hopefully, we may be able to ‘upgrade’ our database. Indeed, whereas the MGEN-SHI contract was identical for every policyholders, MGEN now offers new SHI contracts with three different levels of coverage. Individuals can ask for better coverage on balance billing as well as on optical and dental care. This change in MGEN’s offer potentially represents an incredible source of data to investigate the demand for SHI and the response to a change in coverage.

Our second project focuses on the articulation NHI/SHI. There are two questions we want to investigate: (i) Does SHI cancel out the solidarity implied by the NHI?; (ii) What would be the distributional impact of a change in NHI benefit package? Following the same methodology than for SHI premiums, we want to estimate the impact of NHI on risk sharing and vertical equity. We could then compare the distributional impact of NHI with SHI to reveal potential contradictory effects. We could also simulate the impact of a change in the NHI benefit package. For instance, if ambulatory care were only covered by SHI, how would it impact transfers between low and high healthcare users and between low and high income groups? To answer these questions, one of the main challenges lies in collecting appropriate data with comprehensive information on NHI and SHI reimbursements.

Our third project is methodological and focuses on the opportunity to apply Marginal Treatment Effect to HTA work. The effectiveness of a new treatment is usually assessed based on the results of a randomized trial. A randomized group of patients receive the standard treatment (control group) while others receive the new treatment (treatment group). The outcome difference between the two groups (survival rate for instance) gives the average treatment effect (ATE). However, mainly for ethical reasons, patients from the control group are sometimes allowed to also receive the new treatment. This ‘crossover’ introduces possible endogeneous selection and requires specific methods to estimate an unbiased average treatment effect (ATE). The methods commonly used are actually very close to matching or IV approaches and consequently rely on the same key assumption: the treatment effect is supposed to be homogeneous across patients. Yet, this might not be the case if patients are selected or select themselves according to their expected response to treatment. To deal with crossover issues, testing for essential heterogeneity

and applying MTE could therefore be appropriate. Basu et al. (2007) give evidence of essential heterogeneity in the choice for breast cancer treatments and stress out its impact on cost-effectiveness. However, there is a methodological challenge in applying MTE to trial data. Indeed, data available often includes small samples and limited covariates. The methodology developed by Brinch et al. (2012) and used by Kowalski (2015) in a context of randomized experiments could be an interesting starting point.

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Résumé

Cette thèse est consacrée aux systèmes d'assurance maladie mixtes où la couverture publique obligatoire peut être complétée par une assurance privée (complémentaire santé). Les questions abordées portent sur l'effet inflationniste de la complémentaire santé sur le prix des soins et sur l'impact de la tarification à l'âge sur les solidarités entre malades et bien portants et entre catégories de revenu.

Les analyses empiriques sont réalisées sur données françaises. Cette base de données originale regroupe les consommations de soins de 99,878 affiliés à la MGEN sur la période 2010-2012.

Le chapitre 1 estime l'effet causal d'une couverture complémentaire généreuse sur la consommation de dépassements d'honoraires. Une meilleure couverture augmente la demande pour les spécialistes qui pratiquent des dépassements d'honoraires, ce qui contribue à l'augmentation du prix des soins. Toutefois, cet effet inflationniste ne concerne que les départements où l'accès aux spécialistes est limité. Le modèle développé dans le chapitre 2 tient compte du fait que l'impact d'une meilleure couverture sur les dépassements (aléa moral) varie d'un individu à l'autre et que cette hétérogénéité peut être corrélée à la demande d'assurance. De fait, l'effet inflationniste de la complémentaire est accentué par des effets de sélection : les assurés qui recherchent une meilleure couverture sont aussi ceux qui montrent le plus d'aléa moral. L'impact de la couverture est également plus fort pour les bas revenus. Dans le chapitre 3, nous utilisons les données MGEN pour simuler l'impact de la tarification à l'âge sur les niveaux de primes et la décision de s'assurer en prenant en compte les corrélations entre âge, état de santé et revenu. Quand l'assurance n'est pas obligatoire, la tarification à l'âge permet de maximiser les transferts entre malades et bien portants au détriment toutefois de la solidarité entre hauts et bas revenus. 

Mots Clés

Assurance maladie ; Complémentaire santé ; Aléa moral ; Anti-sélection ; Dépassements d'honoraires ; Tarification à l'âge

Abstract

This thesis deals with two questions relative to efficiency and fairness in mixed health insurance systems with partial mandatory coverage and voluntary supplementary health insurance (SHI): (i) the potential inflationary effect of SHI on medical prices; (ii) the fairness of SHI premiums in a context of voluntary insurance.

We set the analysis in the French context and perform empirical analyses on original individual-level data, collected from the administrative claims of a French insurer (MGEN). The sample is made of 99,878 individuals observed from 2010 to 2012.

In Chapter 1, we estimate the causal impact of a generous SHI on patients' decisions to consult physicians who balance bill, i.e. charge more than the regulated fee. We find evidence that better coverage increases demand for consultations with balance billing, thereby contributing to the rise in medical prices. However, the impact is not significant when individuals have a real choice between types of physicians. In Chapter 2, we specify individual heterogeneity in moral hazard and consider its possible correlation with coverage choices (essential heterogeneity). We find evidence of selection on moral hazard: individuals who are more likely to ask for comprehensive SHI exhibit a larger increase in balance billing per consultation. The impact of better coverage is larger for low income people, suggesting that insurance plays a role in access to care. In Chapter 3, we use MGEN data to simulate the impact of age-based premiums on the level of premiums and on subscription to SHI. We take into account effective correlations between age, health state and income. Simulation results show that in a context of voluntary SHI, age-based premiums maximize transfers between low and high healthcare users but do not guarantee vertical equity.

Keywords

Health insurance; Supplementary health insurance; Moral hazard; Adverse selection; Balance billing; Age-based premiums