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Supplementary Health Insurance and Moral Hazard in the Netherlands

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Abstract:

This paper investigates the role of risk aversion in the decision on the uptake of a supplementary health insurance and will consequently look at the effects of having such an insurance on healthcare utilisation. The relationship between these aforementioned variables will be tested using OLS regressions and a multivariate probit model. This study provides evidence that risk aversion has a positive effect on the probability of opting for a supplementary health insurance. Additionally, healthcare utilisation is found to be higher due to the uptake of health insurance. This research did not manage to show whether this relationship is caused by moral hazard or adverse selection.

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1. Introduction

Every year, all Dutch individuals aged over 18 have to make a decision regarding their health insurance package for the upcoming year. The health insurance system in the Netherlands combines a mandatory basic health insurance with a voluntary supplementary insurance, to cover the healthcare services not included in the basic package. Both types of insurance are founded on different principles, which results in two markets with contrasting characteristics. Whereas solidarity is a key principle in the basic health insurance, the supplementary health insurance market is a free market in which insurers are free to set their premiums and are allowed to restrict or deny coverage. Even though consumers are allowed to purchase basic and supplementary health insurance from different insurers, most consumers obtain both products from the same insurance company (Roos and Schut, 2012).

In determining the optimal insurance package, consumers take several considerations into account. Purchasing a supplementary health insurance has to be financially profitable. As stated by van Winssen, van Kleef and van de Ven (2018), financial profitability of the supplementary health insurance depends on the individual's predicted claims for the upcoming year, the premiums set by the insurers and the individual's risk attitude. In general, it is not possible to have perfect expectations on future health status, but some healthcare interventions can be expected on beforehand, irrespective of one's health status developments. Semi-annual dental check-ups and physiotherapy for longer term conditions [3] are examples of these types of healthcare services. Furthermore, a consumer's level of risk aversion tends to determine their general preference for insurance. Based on common sense, we would expect risk averse agents to opt for supplementary insurance more often than risk neutral and risk loving agents do, to eliminate the possibility of incurring excessively high costs in the uncertain event of a severe health shock. However, as we often see, not all individuals act as perfect, fully rational agents. How does the average Dutch inhabitant decide on the content of his health insurance package and how does risk aversion play a role in it?

The research questions that will be dealt with in this paper are two-fold. To start, I will investigate the role risk aversion has in the decision on taking out supplementary health insurance. Subsequently, I will elicit the changes in behaviour when an individual has

[3] Physiotherapy for some chronic conditions is included in the basic health insurance package. For the complete list of these conditions, I refer to https://wetten.overheid.nl

opted for a supplementary insurance package. Does someone who opted for a dental insurance visit the dentist more often than someone who does not have such an insurance? This phenomenon is referred to as moral hazard and is considered to be a market failure. As previously mentioned, the market for basic health insurance utterly differs from the market for supplementary health insurance in the Netherlands, which results in a different impact from market failures, such as moral hazard. In this paper, I will try to identify the presence of moral hazard in the supplementary insurance market, taking the degree of risk aversion of the insured into account. By using data from Dutch households, I will test whether the expectations from economic theory coordinate with the outcomes in reality.

In times of an ageing population and rising costs of healthcare, studying the topic of health insurance is highly relevant. Quite some research has been conducted on risk aversion and health insurance so far. In a note on ex post moral hazard and health insurance, Picard (2016) states that a higher level of absolute risk aversion implies a higher optimal coinsurance rate, but this property does not tend to hold in the case of ex post moral hazard. By focussing on supplementary insurance rather than coinsurance rates, this paper will contribute to the current literature by investigating the relationship between risk aversion and moral hazard in another, related market. This market has also been studied by Roos and Schut (2012), however these authors adopted a different approach than I will do in this paper. Roos and Schut (2012) investigated the spillover effects of supplementary on basic health insurance, from a macroeconomic perspective. Inasmuch as this study provides some useful insights, studying the market from a micro-oriented perspective will contribute to a better understanding of decision making under uncertainty in the field of health insurance. The methods I will use in this research are similar to those adopted in a paper by Finkelstein and McGarry (2006), to distinguish between the multiple dimensions of asymmetric information in the health insurance market.

In the next section, a brief description of the Dutch health insurance market will be provided. This regulatory background is considered to be useful for understanding concepts discussed later in this report. The paper continues by discussing the existing literature on health insurance, moral hazard and adverse in section 3 and is followed by section 4, in which the collection of the data is explained thoroughly . Section 5 elaborates on the methodology used to establish the relationships of interest and the results of these regressions are presented in section 6. A discussion of the results, their limitations and

some policy recommendations will be presented in section 7. The final section of this paper contains a conclusion and suggestions for future research.

2. Regulatory framework

Health insurance in the Netherlands is arranged according to the Health Insurance Act, which was implemented in 2006. The renewed health insurance market combines a mandatory basic insurance with a voluntary supplementary insurance, to cover the healthcare services not included in the basic insurance package. Additionally, individuals have to pay a limited annual deductible of €385 (in 2018)[4], which can be voluntary increased with an additional amount. The main motivation of this reform was to increase efficiency on the supply side, by encouraging health insurers to purchase high quality care on behalf of their customers (van de Ven and Schut, 2009).

The market for basic health insurance is founded on the principle of solidarity, which translates into the following components. As explained in Healthcare in the Netherlands, a report by the Ministry of Public Health, Welfare and Sports (2016), all Dutch inhabitants aged above 18 are obliged to have a basic health insurance package [5], which is homogenous and available to all residents. Insurance companies are obliged to accept all customers, regardless of their health status, which evidently stems from the key principle of solidarity. In order to make sure customers are not selected based on their risk profile, the Dutch government established a Health Insurance Fund to adjust the risks incurred by the insurance companies and to create a level playing field. As argued in another report from the Ministry of Health, Welfare and Sports (2008), risk adjustment compensates insurers for the possible high healthcare costs associated with insuring high-risk individuals. Next, the premium of the basic health insurance is community rated and insurers have a care duty. Furthermore, the content of the basic insurance package is set by the government. For this decision, they are advised by an independent organisation called the National Health Care Institute (Zorginstituut Nederland). The basic health insurance covers for instance general practitioner (GP) visits and maternity care [6].

Next to the basic insurance, individuals might choose to purchase supplementary health insurance, to cover certain healthcare interventions that are not included in the

[4] For the level of mandatory deductible for previous years, please consult Zorgthermometer: Verzekerden in beeld 2018 (Vektis, 2018)
[5] Children below the age of 18 are co-insured for free with one of their parents' health insurance
[6] For the complete list of healthcare interventions that are covered in the basic health insurance, please consult: https://www.rijksoverheid.nl

basic insurance package. Dental care, physiotherapy and alternative medicine are prevalent types of healthcare for which individuals decide to buy additional insurance packages. While the content and the premium of the basic health insurance package are set by the government, the insurers are free to set the premiums of their supplementary health insurance packages themselves. On top of this, insurance companies are allowed to use medical underwriting and ultimately deny coverage, contrary to the required acceptance for the basic health insurance. Applicants may be asked to provide a statement from their dentist about their dental health status, before being granted an insurance for dental care [7]. Roos and Schut (2012) found that in 2009, 4.1% of all insured individuals decided not to switch to another health insurer, solely because they were afraid that they would not get accepted for a supplementary health insurance at a new insurance company. However, as shown in the same study, very few insurance companies use medical underwriting in practice. Ultimately, the market for supplementary health insurance can be described as a private insurance market.

Vektis provides an annual overview of the Dutch health insurance market every year in a report called De Zorgthermometer. This report shows, among others, the annual premiums for both basic and supplementary insurance and the percentage of individuals that purchased a supplementary health insurance. Some general conclusions can be drawn from these annual reports (Vektis, 2015; Vektis, 2016; Vektis, 2017; Vektis, 2018). The percentage of Dutch inhabitants with a supplementary insurance has slightly decreased over the past 10 years and is now stabilizing around 84%. As can be seen in Table 1, the majority of all declarations in the supplementary insurance were for dental care, followed by paramedical care, which includes physiotherapy. These two types of healthcare appear to be the main rationale for individuals to opt for supplementary health insurance (Vektis, 2017). The average annual premiums in 2016 for the basic and supplementary insurance were €1,262 and €319 respectively. For previous levels of these premiums, I refer to Tables 2 and 3 in appendix A.

The decision of Dutch inhabitants to purchase supplementary insurance on top of their basic health insurance package might have several different explanations. Various sources of literature (see e.g. Bhattacharya et al, 2014; Lieberthal, 2016) claim risk aversion to be an important determinant in the decision on purchasing health insurance. Risk aversion, next to other possible motives for opting for health insurance, will be discussed in the next

[7] Please consult Table 1 in appendix A for a list of health insurers that ask for additional information about one's health status before granting a supplementary health insurance

section. Moreover, the behavioural changes after the purchase of insurance, referred to as moral hazard, will be debated. Section 3 will elaborate on the current literature regarding these topics, to illustrate the distinct characteristics of the supplementary health insurance market and its corresponding obstacles.

Table 1
Average healthcare costs for supplementary health insurance per insured individual in Euro's

	2009	2010	2011	2012	2013	2014	2015	2016
Dental care	€106.62	€104.01	€116.81	€117.79	€112.28	€118.05	€118.94	€126.24
Paramedical care	€65.22	€64.39	€71.17	€68.27	€70.52	€72.25	€73.14	€80.61
Care equipment	€15.79	€15.04	€21.81	€23.30	€21.75	€20.16	€21.84	€21.72
Care for abroad	€4.91	€4.40	€4.50	€5.16	€4.77	€5.12	€5.54	€5.20
Alternative care	€11.20	€12.15	€12.99	€13.77	€12.83	€12.90	€13.42	€14.43
Pharmaceuticals	€3.92	€3.69	€4.55	€4.54	€4.46	€3.72	€4.18	€3.80
Other	€21.35	€25.74	€23.93	€33.28	€32.72	€33.10	€28.02	€29.62
Total	€229.01	€229.42	€255.76	€266.13	€359.34	€265.29	€265.08	€281.62

Note: Information on average healthcare costs is not yet available for 2017 and 2018.

Source: Zorgthermometer: Verzekerden in Beeld (Vektis, 2018)

3. Theoretical framework

3.1 Health insurance & risk aversion

Illness is unpredictable and might be accompanied by high costs. In general, people are risk averse and prefer to know when future health shocks and financial damage will occur. However, most health shocks cannot be predicted neither prevented. As stated by Donaldson and Gerard (2005), it is not possible to insure against ill-health, but it is possible to insure against the costs associated with these health shocks. Next to eliminating the risk of incurring high costs, individuals also gain access to healthcare interventions that would otherwise be too expensive, by taking out a supplementary health insurance. (Nyman, 1999).

The demand for health insurance stems from two types of private information, the individual's risk type and their risk preferences, as argued by Finkelstein and McGarry (2006). The former refers to being a high- or low-risk type in terms of health status, whereas the latter refers to an individual's level of risk aversion. A high-risk type individual will opt for supplementary insurance more often than a low-risk type would and likewise, an individual with a strong preference for risk (e.g. risk loving), will opt for supplementary insurance less often than a risk averse individual would. These multiple dimensions of private information work in opposite directions, which makes it difficult to determine the demand for insurance on an individual level. Van Winssen et al (2018)

demonstrate that the demand for insurance depends on its financial profitability, which is determined by the individual's predicted claims for the upcoming year, the premiums set by the insurers and the individual's risk attitude. These findings correspond to the multiple dimensions of private information, as studied by Finkelstein and McGarry (2006), since predicted claims emerge from an individual's current health status and risk type. This paper will mainly focus on the effects of risk preferences on the uptake of supplementary insurance, but it is crucial to keep the distinction between these dimensions in mind.

Risk averse individuals prefer to receive a certain amount of money rather than joining a lottery with the same expected value, i.e. they would reject a fair bet. Considering the fact risk averse agents are willing to eliminate uncertainty, we would expect them to opt for a higher coverage than agents who are risk neutral or risk loving. Quite some evidence has already been found on the positive relationship between risk aversion and insurance. In 1976, Rothschild and Stiglitz demonstrated a positive relationship between demand for insurance and risk occurrence and a few decades later, these findings were challenged by De Meza and Webb (2001). This study incorporated the individual's risk preferences in the traditional models on insurance coverage and risk occurrence. Their research shows that risk averse individuals are more likely to opt for insurance than individuals with lower levels of risk aversion. Another striking finding is the fact that these individuals are also more reluctant in taking precautions to improve their health status. This finding, however, relates to the topic of moral hazard, which will be discussed in the next section. Furthermore, Chatterjee and Nielsen (2010) found a positive correlation between risk aversion, intelligence and health insurance and Bardey et al (2016) revealed a link between a higher level of risk aversion and a lower level of copayments.

In this paper, the aforementioned claim on risk aversion and supplementary health insurance will be tested, using data on a representative sample of Dutch households, to see whether the expected relationship is also present in practice. Therefore, the first hypothesis in this study will be the following:

Hypothesis 1: Individuals who are risk averse are more likely to opt for a supplementary health insurance than individuals who are less risk averse.

3.2 Moral hazard

Even though risk averse agents are expected to insure themselves against uncertain events, according to Pauly (1968), purchasing insurance might not be the optimal solution. As stated before, the Dutch supplementary health insurance system can be described as a private market, which is associated with a low level of government intervention. Free markets might be prone to a number of market failures, among which moral hazard. One useful definition of moral hazard is given by Baker (1996), who states that moral hazard is 'the tendency for insurance against loss to reduce incentives to prevent or minimize the cost of loss'. However, this type of moral hazard is referred to as *ex ante* moral hazard and does not capture the change in behaviour I would like to study in this research. As stated in Bhattacharya et al. (2014), *ex post* moral hazard is the change in one's behaviour after an insured individual occurs a health shock. Due to the purchased insurance, a price distortion arises and insured individuals make their decisions based on the new, lower prices they face, which differ from the true costs of these healthcare interventions. Consequently, insured individuals demand more healthcare and more expensive treatments. This might result in overconsumption of medical care and ultimately in higher premiums for all individuals in the same insurance pool. This market failure might potentially be a threat to the entire existence of the health insurance market. However, there are methods to mitigate the effects of moral hazard. Examples of these methods are coinsurance and deductibles. The common idea behind both of these measures is that individuals are less likely to overconsume healthcare when the insurance companies do not fully reimburse all costs.

Bohm (2012) tried to explain the phenomenon of moral hazard from an economic theory of rational agents. He claims that individuals are economic agents that are always seeking to maximize the returns on their investments. In terms of insurance, the investment made is the premium paid by the insured individual and to justify these cost, these agents are determined to receive a certain level of healthcare in return. One remark made by Bohm (2012) is that only those healthcare interventions that the individual would not have paid for themself while uninsured, can be labelled as moral hazard. However, given the available data, I am not able to determine which healthcare an individual would have purchased when uninsured. Therefore, from this point onwards when I refer to moral hazard, I refer to the definition of ex post moral hazard from Bhattacharya et al. (2014).

The relationship between ex post moral hazard and health insurance has been studied before, among others by Picard (2016). In his technical note on this phenomenon, Picard

(2016) makes quite a strong, but useful assumption. By assuming information on health status is the only private information individuals have, implying risk preference is something that can be observed by the insurance companies, it is possible to focus on moral hazard without the need to correct for adverse and advantageous selection. Since the study by Picard (2016) is on coinsurance rates, the conclusions drawn from this study may differ from studying supplementary insurance. Coinsurance refers to reimbursement of a share of the incurred health costs, while supplementary health insurance in general refers to full reimbursement. The consequences of ex ante moral hazard is therefore expected to be more distinct when studying behaviour of the insured in the supplementary health insurance market than in the coinsurance market.

Market failures arise due to the presence of asymmetric information, which stems from individuals having private information the insurance companies do not have. As stated before, Finkelstein and McGarry (2006) show that individuals have multiple dimensions of private information. Standard models assume individuals only have private information on their risk type, as in Picard (2016), whereas Finkelstein and McGarry also take the individual's risk preferences into account. A positive correlation between risk occurrence and insurance coverage could stem both from moral hazard and adverse selection. In the case of adverse selection, individuals with a high risk type will opt for an insurance policy with a high coverage (Arnott and Stiglitz, 1988), whereas this causality is reversed in the case of moral hazard.

To test for the presence of moral hazard, I will look at the probability of opting for a supplementary health insurance and I will study two different types of healthcare interventions. A positive correlation between insurance coverage and healthcare utilisation will point towards the presence of moral hazard or adverse selection in this market. As proven in the literature, it might be difficult to distinguish between these two phenomena. However, without drawing any preliminary conclusions on the causal relationship between insurance coverage and healthcare utilisation, the second hypothesis will be aimed at the correlation between these two variables.

Hypothesis 2: Individuals who are insured for a certain type of healthcare, will make use of that type of healthcare more often than individuals without insurance.

4. Data

The research in this paper is conducted using data from the LISS (Longitudinal Internet Studies for the Social Sciences) Panel. The data in the LISS Panel is collected by CentERdata, which is associated with the Tilburg University in the Netherlands. The panel consists of 4500 households, comprising 7000 individuals, and it is a representative sample of Dutch households. The households participate in monthly internet surveys and those without internet access were provided a computer and internet connection, to prevent selection bias. Also, the participants are paid for every completed questionnaire.

For this study, I have pooled data from five waves and focussed on some particular elements of the Health questionnaire. Since this questionnaire has not been conducted in 2014, the waves used in this research are wave 6 (2012), wave 7 (2013), wave 8 (2015), wave 9 (2016) and wave 10 (2017). To enrich the data from these waves, I added a set of socio-economic background variables. Considering the purpose of paper to study the choice of supplementary health insurance for a certain year, the background variables of the last month of the prior year have been selected. The rationale for this decision is the fact that individuals have to make a choice concerning their health insurance before the first day of the upcoming year, which implies that this decision is often made in December. Furthermore, I have made use of a larger survey of the LISS Panel, which was aimed at risk preferences, called Measuring Higher Order Risk Attitudes of the General Population. Section 4.2 will elaborate on the methods used in this particular study and how the variable for risk aversion is constructed using this data set.

This approach resulted in panel data set with a total of 10,050 observations, comprising of 2,500 individuals from 2,122 households over 5 waves. A number of observations was lost due to the fact that the survey 'Measuring Higher Order Risk Attitudes of the General Population' was conducted only in 2010 and moreover due to attrition and incomplete questionnaires. Also, individuals with an age below 18 were removed from the dataset, since they do not have to make a decision regarding their health insurance package.

4.1 Supplementary health insurance & healthcare utilisation

The Health questionnaire is a survey that is focussed around health perception and the relationship between health and jobs. This research is aimed at determining the relationship between supplementary health insurance and the utilisation of those health

interventions while being insured. In this survey, individuals are asked to provide the number of times they have visited a certain health practitioner and furthermore, individuals have to elaborate on different aspects of their health insurance package.

Respondents were asked whether they have opted for a supplementary health insurance for a certain year. However, since the respondents could only answer this question by 'yes' or 'no', it is not possible to determine for which type of healthcare the respondent took out a supplementary insurance package. As previously stated in Table 1, the majority of all reimbursed costs from supplementary insurances is for dental care, immediately followed by paramedical care (including physiotherapy). Based on these findings, it is safe to assume that expected costs for dental care and physiotherapy are the main motives for individuals to opt for supplementary health insurance. This research aims at testing the relationship between supplementary health insurance and healthcare utilisation. Taking the former assumption into account, I will focus on two types of healthcare, namely dentistry and physiotherapy. From the Health questionnaire, I also selected the questions in which respondents had to state the number of times they have visited a dentist and a physiotherapist in a certain year. These values can range from 0 to 999. The distribution of these variables can be found in Table 2. In this table I already divided the sample into two subsamples, to compare the distribution of dentist and physiotherapist visits between individuals with and without a supplementary health insurance. Next to these continuous variables, I also created two binary variables for both healthcare interventions. The continuous variable will show the number of visits for both types of healthcare, while the binary variable only captures whether the respondent visited the healthcare practitioner or whether he did not. As can be noted from Table 2, most respondents tend to visit the dentist never, once or twice a year. Taking into account that in 2016 the average annual premium for a supplementary health insurance was €319 [8] and the costs for two annual basic dentist check-ups were only €40,16[9], it would not be cost-efficient to purchase supplementary insurance for dental care when individuals only need a semi-annual check at the dentist. Based on these findings, it would be useful to study whether there exists a significant difference between individuals visiting the dentist more than twice a year and individuals that do not. The binary variable d_dentist2 was created to capture this difference. Note that the number of visits is a self-reported value and might therefore suffer from a response bias. Considering the prior revelation that, generally, both

[8] Zorgthermometer: Verzekerden in Beeld (Vektis, 2018)
[9] Tandheelkundige zorg - BR/CU-7164 (Nederlandse Zorgautoriteit, 2016)

dentistry and physiotherapy are not included in the basic health insurance, studying these types of healthcare utilisation in the light of supplementary health insurance might give rise to some interesting outcomes.

Table 2

Distribution of the outcome variables on healthcare utilisation, with a distinction between a subgroup with and a subgroup without supplementary health insurance

	Without supplementary insurance				**With supplementary insurance**			
	Dentist		**Physiotherapist**		**Dentist**		**Physiotherapist**	
Number of visits	**Freq.**	**Cum.**	**Freq.**	**Cum.**	**Freq.**	**Cum.**	**Freq.**	**Cum.**
0	905	39.35%	1,991	86.57%	1,607	20.74%	5,552	71.64%
1	701	69.83%	40	88.30%	2,256	49.85%	187	74.05%
2	7566	94.43%	27	89.48%	2,977	88.26%	137	75.82%
3	62	97.13%	31	90.83%	475	94.39%	140	77.63%
4	34	98.61%	17	91.57%	228	97.33%	146	79.51%
5	11	99.09%	21	92.48%	92	98.52%	161	81.59%
6	11	99.57%	40	94.22	52	99.19%	196	84.12%
7	4	99.74%	10	94.65%	19	99.43%	75	85.05%
8	1	99.78%	12	95.17%	16	99.64%	167	87.24%
9	0	99.78%	9	95.57%	1	99.65%	61	88.03%
10	3	99.91%	15	96.22%	14	99.83%	169	90.21%
11	0	99.91%	2	96.30%	0	99.83%	12	90.36%
12	1	99.96%	13	96.87%	6	99.91%	126	91.99%
13	0	99.96%	0	96.87%	0	99.91%	8	92.09%
14	0	99.96%	2	96.96%	1	99.92%	20	92.35%
15	0	99.96%	11	97.43%	2	99.95%	74	93.30%
16	0	99.96%	6	97.70%	0	99.95%	28	93.66%
17	0	99.96%	0	97.70%	0	99.95%	5	93.73%
18	0	99.96%	1	97.74%	1	99.96%	31	94.13%
19	0	99.96%	0	97.74%	0	99.96%	5	94.19%
20	0	99.96%	10	98.17%	3	100%	108	95.59%
>20	1	100%	42	100%	0	100%	342	100%
Total	2,300	100%	2,300	100%	7,750	100%	7,750	100%

4.2 Risk aversion

In 2009, a single wave study was performed on measuring the level of risk aversion, prudence and temperance of individuals. Following the procedure as in Noussair et al (2012) and Noussair et al (2013), one parameter for risk aversion can be established from the results of this questionnaire. Since this study was only performed once, using this measure of risk aversion assumes that an individual's level of risk aversion does not change over the period of interest. From this point onwards, it is assumed that an individual's level of risk aversion is constant between 2012 and 2017.

In order to measure the level of risk aversion, the respondents had to make 5 pairwise choices between a risky lottery and a safe, fixed amount of money[10]. First, the respondents were divided in four separate groups: RealNorm (30%), RealLow (10%), Hyponorm (30%) and Hypohigh (30%). Participants in the first two groups were informed that they might actually earn money by participating in this survey. Respondents that were assigned to the latter group were confronted with slightly different amounts, since their amounts are multiplied by a factor of 150 (based on the average annual income of the entire panel). Next, some participants faced the position of the panels mirrored and also a share of the sample faced the question in a reversed order [11].

All five questions display a choice between a lottery and a safe choice. The lottery always represents a hypothetical roll of a die, with equal chances of winning €5 or €65. The safe amount varies per question, ranging from €20 to €40, ascending in equal steps of €5. Note the expected value of the lottery always equals €35. Risk aversion will be measured as the number of safe choices, which results in a variable ranging from 0 to 5. A risk neutral individual would only prefer a safe amount of €40 over the lottery and would be indifferent between the lottery and an amount of €35. This amounts to a total of one or two safe choices. Individuals with an outcome of more than two safe choices are considered to be risk averse.

As mentioned before, the subjects could be confronted with low, normal or high stakes in the lottery experiment. Holt and Laury (2002) investigated whether the respondents' degree of risk aversion changes when confronted with higher stakes. Their findings reveal that increasing the magnitude of stakes in an experiment does significantly increase the degree of risk aversion. It must be noted that this increase in risk aversion is much sharper

[10] An example of such a choice between a lottery and a safe option can be found in appendix B

[11] The dataset is already corrected for this reversed order, since the respondents only faced the question in a different order. The questions were still administered in the same manner for all participants.

for the real treatment group compared to the hypothetical treatment group. However, a paper by van Leeuwen (2014), which made use of the same study on risk aversion as I do in this paper, shows that using real stakes in experiments does not significantly affect outcomes compared to using hypothetical stakes. It also does not decrease the degree of inconsistency in choices made by the respondents. To take the findings of Holt and Laury (2002) into account, I will include a dummy variable which takes a value of 1 when the subject is confronted with high stakes and a value of 0 otherwise.

4.3 Background variables

To control for other factors that might influence an individual's level of risk aversion, I included some background variables collected the month prior to the choice of health insurance had to be made. Gender and age are known to affect risk preference, which is why I included these in the background variables. The quadratic form of the age variable is also included, to allow for changes in the age coefficient when individuals mature. As mentioned before, evidence shows intelligence is also correlated to risk aversion (Chatterjee and Nielsen, 2010), so I created three categories of education and included two in the model, based on the six levels of education as categorized by CBS (Statistics Netherlands), ranging from only primary schooling to having obtained a university degree. On top, I added a variable labelled goodhealth, to capture the self-reported health status of the respondents. This dummy variables takes a value of 1 if the respondents reported their current health status to be good, very good or excellent. Consequently, the dummy equals 0 for those individuals who perceive their health status to be moderate or poor. Individuals' beliefs on their current health status are considered to influence the decision on health insurance and are added in this research to control for these influences. Another variable that might give some insight in the respondent's health status and demand for healthcare, is the healthcare utilisation of the year prior to the year studied. This information is captured by the variables lagdentist and lagphysio, which represent the number of visits to the dentist and the physiotherapist respectively in the previous year.

In the previous section on risk aversion, I explained the reasoning behind the dummy variable for respondents facing high stakes in the risk aversion survey. However, the impact of facing these high stakes is determined by the respondent's level of wealth. To proxy this initial wealth, I included the natural logarithm of net household income to correct for differences in the impact of high stakes. The reason for including household income rather than individual income, is the fact that individuals make a decision on the

uptake of their health insurance, taking their income level into account. However, as one of the members of the household might be unemployed or engaged in volunteer work, the income of the other household members might influence their decision as well. I used the natural logarithm of this variable, to make the variable less sensitive to outliers in the data. The level of income might also influence the demand for a supplementary health insurance, which supports the decision to incorporate some measure of income in this research. For a detailed description of all variables, I refer to the list of variables in appendix C.

The upcoming section will elaborate on the methods used to establish the relationship between supplementary health insurance, risk aversion and healthcare utilisation.

5. Methodology

The first step in answering both research questions, is to study the raw data. Section 6.1 will elaborate on the descriptive statistics of all variables. Analysing the mean values and standard deviations of these variables will already provide some insight in the distribution of the observations in the sample. Also, a comparison can be made between two subsamples, the respondents with and without a supplementary health insurance, to evaluate the differences between the outcomes of these distinct groups. By comparing the mean values of the variables of interest, and checking whether these differences are significant, some preliminary conclusions can already be drawn. The raw data and the potential differences between subgroups might give rise to some expectations for the outcomes of the regressions in the next sections.

5.1 Risk aversion

After analysing the descriptive statistics of the dataset, the next step in this empirical strategy is aimed at determining the relationship between risk aversion and the uptake of a supplementary health insurance. Following Bolhaar et al (2012), this relationship will be tested using an ordinary least square (OLS) regression.

$$shi_{i,t} = x'_{i,t}\beta_1 + r_i\beta_2 + \varepsilon_{i,t} \quad (1)$$

The dependent variable, $shi_{i,t}$, is a binary variable that takes on a value of 1 when the household member opted for a supplementary health insurance and a value of 0 when he

did not. On the righthand side, I included a column vector of individual characteristics ($x'_{i,t}$) that might influence the household member's decision to purchase insurance and accordingly a vector of parameters, captured by β_1. The variables that are included in this vector are the background variables, previously mentioned in section 4.3. r_i measures the individual level of risk aversion, which is assumed to be constant over time and $\varepsilon_{i,t}$ is a normally distributed error term. The robust standard errors of the model will be clustered on an individual level, since this dataset is structured as a panel data set of individual observations over a period of 5 waves. Additionally, I will test the same OLS regression with fixed effects, to test for unobserved heterogeneity within the sample.

A positive and significant β_2 implies risk aversion has a positive effect on the uptake of supplementary health insurance, which provides evidence for my first hypothesis. Any significant β_1 will reveal which individual characteristics have influence on the purchase of supplementary insurance.

5.2 Asymmetric information

The test the hypothesis regarding moral hazard and adverse selection, I will adopt a similar method as used by Finkelstein and McGarry (2006). First, I will model the relationship between a number of individual characteristics, including risk aversion, and the number of visits to the dentist and the physiotherapist, using two separate OLS regressions.

$$dentist_{i,t} = x'_{i,t}\delta_1 + r_i\delta_2 + u_{i,t} \quad (2)$$

$$physio_{i,t} = x'_{i,t}\lambda_1 + r_i\lambda_2 + v_{i,t} \quad (3)$$

In Equation (2), the number of visits to the dentist is the dependent variable on the lefthand side, whereas this reflects the number of visits to the physiotherapist in Equation 3. On the righthand side, both formulas are similar. $x'_{i,t}$ includes all background variables as previously discussed. In Equation 2, I included only the lagged variable for dentist visits and consistently, the vector of individual characteristics in Equation (3) only includes the lagged values for physiotherapist visits. r_i indicates the level of risk aversion of the respondent and $u_{i,t}$ and $v_{i,t}$ are both normally distributed error terms.

To continue the research, I will use a probit model to estimate the probabilities of having a supplementary health insurance, visiting a dentist and visiting a physiotherapist. Contrary to the OLS regression in Equations (2) and (3), I will use the variables d_dentist and d_physio rather than dentist and physio, since probit models are only suitable for binary variables. The probit model is presented as follows:

$$shi_{i,t}^{*} = x_{i,t}'\beta_1 + r_i\beta_2 + u_{i,t}^{shi} \tag{4}$$

$$d_dentist_{i,t}^{*} = x_{i,t}'\delta_1 + r_i\delta_2 + u_{i,t}^{dentist} \tag{5}$$

$$d_physio_{i,t}^{*} = x_{i,t}'\gamma_1 + r_i\gamma_2 + u_{i,t}^{physio} \tag{6}$$

The Equations (4), (5) and (6) represent the latent variable specifications, in which β_2, δ_2 and γ_2 show the coefficients for the effect of risk aversion on insurance coverage and healthcare utilisation for dentistry and physiotherapy respectively.

$$shi_{i,t} = \begin{cases} 1 \; if \; shi_{i,t}^{*} > 0 \\ 0 \; if \; shi_{i,t}^{*} \leq 0 \end{cases} \tag{7}$$

$$d_dentist_{i,t} = \begin{cases} 1 \; if \; d_dentist_{i,t}^{*} > 0 \\ 0 \; if \; d_dentist_{i,t}^{*} \leq 0 \end{cases} \tag{8}$$

$$d_physio_{i,t} = \begin{cases} 1 \; if \; d_physio_{i,t}^{*} > 0 \\ 0 \; if \; d_physio_{i,t}^{*} \leq 0 \end{cases} \tag{9}$$

In Equations (7), (8) and (9), the observed values of the variables shi, d_dentist and d_phsyio are stated. The error terms in Equations (4-6) are normally distributed as follows:

$$\begin{pmatrix} u_{i,t}^{SHI} \\ u_{i,t}^{Dentist} \\ u_{i,t}^{Physio} \end{pmatrix} | \; x_{i,t}, r_i \sim N\left[\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho_{12} & \rho_{13} \\ \rho_{21} & 1 & \rho_{23} \\ \rho_{31} & \rho_{32} & 1 \end{pmatrix}\right] \tag{10}$$

In order to interpret the coefficients of a probit model, the average margins of the coefficients have to be calculated. This method should provide the same outcomes as an OLS regression on the same variables.

The next step in the analysis is to implement a correlation test for asymmetric information. Following Chiappori and Salanie (2000), I estimate two bivariate probit models, in an attempt to find the correlation between having a supplementary health insurance and visiting a healthcare practitioner. In order to perform a test for asymmetric information, I estimated 2 bivariate probits by combining Equations (4) and (5) and Equations (4) and (6), to estimate the outcomes of multiple binary outcomes jointly. After estimating these two bivariate models, I obtain the correlation between the error terms of the individual probit models. From the correlation coefficient matrix in Equation (10), we can identify the correlation coefficients of interest. Since we would like to know whether there is a positive correlation between having a supplementary health insurance and having visited a dentist in one year, the coefficient ρ_{12} (ρ_{21} will provide the same outcome) is particularly interesting. Rationally, the coefficient ρ_{13} (and ρ_{31}) will provide the correlation between the insurance coverage and whether the respondent visited a physiotherapist. These bivariate probit models will first be executed without the variable on risk aversion and in a second stage, this variable will be added to the model. Furthermore, this model will first be tested on the whole sample and subsequently, I will apply the same procedure on a subsample that faced high stakes in the survey Measuring Higher Order Risk Attitudes of the General Population. The measure for risk aversion used in this paper is expected to be more reliable for the respondents in this subsample, as previously stated. As a sensitivity analysis, I will use the former methodology and estimate a bivariate probit of insurance coverage (shi) and having visited a dentist more than twice a year (d_dentist2). This will reveal whether individuals with a supplementary health insurance visit the dentist more than two times a year (e.g. more than the regular semi-annual check-ups).

When these aforementioned correlation coefficients turn out to be positive, we have evidence that there is a relationship between the insurance coverage and healthcare utilisation. However, we do not know the nature of this relationship. The only conclusion that can be drawn is on the presence of asymmetric information. Asymmetric information is present in the model if the correlation coefficient (ρ) is positive, which implies that it is possible to reject the null hypothesis of symmetric information. Whether the supplementary health insurance market suffers from adverse selection or moral hazard, will not be determined using this method.

6. Results

6.1 Descriptive statistics

For the analysis of the results, it is useful to start by studying the descriptive statistics as presented in Tables 3 and 4. The former presents a summary of statistics for the whole sample used in this research, containing the number of observations, mean values, standard deviation and minimum and maximum values for all variables. The former presents the same categories, however the sample is divided in subsamples, to compare the outcomes between respondents who did opted for a supplementary health insurance and those who did not. All individual characteristics that are included in the vector of background variables, which are already explained in section 4.3, are included in this summary, next to the two different types of healthcare utilisation and the risk aversion parameters.

Table 3

List of descriptive statistics for the whole sample

	(1)	(2)	(3)	(4)	(5)
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
female	10,044	0.506	0.500	0	1
age	10,044	54.652	16.030	18	93
edumed	10,049	0.587	0.492	0	1
eduhigh	10,049	0.341	0.474	0	1
logincome	9,152	7.847	0.508	3.689	12.123
shi	10,049	0.771	0.420	0	1
dentist	10,049	1.424	1.364	0	30
d_dentist	10,049	0.750	0.433	0	1
d_dentist2	10,049	0.103	0.304	0	1
lagdentist	7,549	1.430	1.413	0	30
physio	10,049	3.162	9.550	0	150
d_physio	10,049	0.249	0.433	0	1
lagphysio	7,549	3.089	9.513	0	150
goodhealth	10,049	0.815	0.389	0	1
high stakes	10,049	0.286	0.452	0	1
r	10,049	3.400	1.681	0	5

First of all, by looking at Table 3, we immediately see the number of observations for net household income is lower than for the other variables, which lowers the total number of observations we can use for the regressions in the next sections. About 50% of the sample is female and the average age lies between 54 and 55. The average level of risk aversion of the sample is 3.4, which refers to the number of safe choices out of 5 lottery questions. This value shows the sample is quite risk averse, since we stated that all values above 2 are associated with risk aversion.

Table 4 presents an interesting comparison between the subsamples of individuals with and without a supplementary health insurance. Column 7 provides the p-values of a two-sided t-test to compare the means of the two specified subgroups. Since the focus of this paper is on the relationship between healthcare utilisation and health insurance, the comparison between the number of dentist and physiotherapist visits between these two subgroups might point towards the presence of moral hazard in this insurance market. Firstly, the mean values of the number of visits can be compared by looking at columns 2 and 5. The average number of dentist visits for respondents with a supplementary health insurance is 1.538, while this number is only 1.037 for individuals without this insurance The same trend can be found for the average number of physiotherapist visits, which is 3.623 in the former subgroup and 1.613 in the latter. Both t-tests for dentist and physiotherapy provide a p-value of 0.000, which implies that the null-hypothesis of no difference between the mean values of these two groups is significantly different from zero. This result provides already some prima facie evidence pointing towards the presence of moral hazard or adverse selection in the supplementary health insurance market.

The first hypothesis in this research states that we expect risk averse agents to opt for supplementary health insurance more often than agents who are risk neutral or risk loving. Based on this statement, the average level of risk aversion is expected to be higher in the subgroup of respondents that opted for a supplementary insurance. Consulting Table 4, we see the average level of risk aversion is slightly higher in this group, compared to the subgroup without this type of insurance. However, the p-value is quite large, which implies this difference is not significantly different from zero.

Table 4

List of descriptive statistics for subsamples with and without supplementary health insurance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	With supplementary health insurance			Without supplementary health insurance			
Variable	**Obs**	**Mean**	**Std. Dev.**	**Obs**	**Mean**	**Std. Dev**	**p-value from two-sided t-test**
female	7,746	0.531	0.499	2,298	0.423	0.494	0.000
age	7,746	55.210	15.437	2,298	52.780	17.759	0.000
edumed	7,746	0.593	0.491	2,300	0.567	0.496	0.021
eduhigh	7,746	0.336	0.336	2,300	0.358	0.480	0.050
logincome	7,089	7.854	0.503	2,063	7.828	0.528	0.044
dentist	7,749	1.538	1.362	2,300	1.037	1.298	0.000
d_dentist	7,749	0.793	0.406	2,300	0.607	0.490	0.000
d_dentist2	7,749	0.117	0.322	2,300	0.057	0.229	0.000
lagdentist	5,765	1.536	1.390	1,784	1.085	1.432	0.000
physio	7,749	3.623	10.010	2,300	1.613	7.600	0.000
d_physio	7,749	0.284	0.451	2,300	0.134	0.341	0.000
lagphysio	5,765	3.560	9.962	1,784	1.570	7.700	0.000
goodhealth	7,749	0.807	0.395	2,300	0.841	0.366	0.000
highstakes	7,749	0.288	0.453	2,300	0.277	0.448	0.310
r	7,749	3.405	1.677	2,300	3.386	1.693	0.641

Another interesting finding is the difference between the self-assessed health status between the subgroups. Respondents in the subgroup without a supplementary health insurance have a better self-assessed health status, which difference is significant at the 1% level. This would suggest individuals with a lower self-assessed health status opt for a supplementary health insurance more often. This self-selection into insurances is referred to as adverse selection. Likewise, the lagged values of both types of healthcare utilisation tend to be lower for the subsample without supplementary insurance, which might also indicate a better health status for this subsample. The regressions in the next sections will be aimed at determining the presence of moral hazard and/or adverse selection in a more explicit manner.

6.2 Risk aversion

The first hypothesis will be tested using two OLS regressions, with and without fixed effects to check whether there indeed is a positive relationship between one's level of risk aversion and the uptake of a supplementary health insurance. Table 5 shows the results of these regressions.

Table 5

OLS estimates, regular and with fixed effects, to test for the relationship between several individual characteristics, including risk aversion and the uptake of supplementary health insurance

	(1)	**(2)**	**(3)**	**(4)**
	OLS		**OLS with fixed effects**	
	Whole sample	**Subsample that faced high stakes**	**Whole sample**	**Subsample that faced high stakes**
Variables	**shi**	**shi**	**shi**	**shi**
r	-0.005	0.014	0	0
	(0.005)	(0.009)		
female	0.079***	0.072**	0	0
	(0.016)	(0.028)		
age	0.014***	0.009*	-0.289**	-0.322
	(0.003)	(0.005)	(0.012)	(0.218)
age^2	-0.000***	-0.000	0.000**	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
logincome	0.011	0.061**	-0.020	0.333
	(0.015)	(0.026)	(0.026)	(0.038)
edumed	0.010	-0.05	-0.032	-0.202
	(0.031)	(0.053)	(0.093)	(0.147)
eduhigh	0.010	-0.077	0.125	-0.006
	(0.033)	(0.059)	(0.090)	(0.182)
goodhealth	-0.010	0.010	0.008	0.025
	(0.014)	(0.024)	(0.018)	(0.029)
lagdentist	0.008**	-0.002	-0.004	-0.015**
	(0.004)	(0.008)	(0.004)	(0.007)
lagphysio	0.002***	0.001	0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)
constant	0.259*	-0.007	1.776***	1.634**
	(0.135)	(0.246)	(0.375)	(0.678)
Observations	6,869	1,980	6,869	1,980
Overall R^2	0.032	0.028	0.008	0.006

Standard errors clustered at individual level and are presented between parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% level respectively.

In the first column the results for the whole sample are presented and its shows a negative coefficient for β_2, which is the opposite of what we expected it to be. One possible explanation could be that our measure of risk aversion is not appropriate. Holt and Laury (2002) found that individuals facing high stakes in an experiment tend to be more risk averse, which could indicate more rationalized choices in the experiment conducted. To take these findings into account, I also ran the regression using only the subsample that faced high stakes in the risk aversion questionnaire. This method will drastically narrow the sample, however the measure of risk aversion is expected to be more accurate. The results of this OLS regression can be found in column 2. Comparing the outcomes to column 1, we observe a switch in the sign for coefficient β_2. The coefficient for the level of risk aversion is now positive, however not significant, which provides little evidence for my first hypothesis. The regression was also performed using fixed effects, to test for unobserved heterogeneity. However, the time-invariant variables on risk aversion and gender dropped out due to this FE regression. The remainder of the coefficients can be interpreted in the same manner as the general OLS coefficients, however by using fixed effects, the coefficients capture the variation over time per individual respondent. Nonetheless, the goodness of fit of this model, captured by the overall R-squared, tends to be lower for the latter regression. This might be explained by the omitted variable female, which captures the effect of gender on the purchase of insurance. This variable seems to be significant and by using fixed effects, this significant variables drops out of the equation and impairs the fit of the model.

Furthermore we can conclude age and gender have a significant effect upon the uptake of supplementary health insurance, which is confirmed by a p-value of zero from a simple chi-squared test. Also, the level of education tends to be a contributor to opting for additional insurance, confirming the previous findings from Chatterjee and Nielsen (2010). All these individual characteristics are important variables that affect the decision on insurance coverage and healthcare utilisation. According to Finkelstein and McGarry (2006), any individual characteristic that affect these decisions, can be considered as an indication of asymmetric information and consequently of moral hazard or adverse selection. The next section will further investigate the presence of these phenomena.

6.3 Moral hazard and adverse selection

Discrepancies between the private information and the information available to the insurance companies might lead to market failures, such as moral hazard and adverse

selection. The previous regression showed that there exists individual characteristics, which might not be known to the insurer, that influence an individual's decision on the uptake of a supplementary health insurance. This section will test for the presence of asymmetric information and whether this private information might also affect one's healthcare utilisation. Table 6 presents the outcomes of a simple OLS regression to test for the effect of having a supplementary health insurance on the number of visits to the dentist and the physiotherapist. I again included a number of individual characteristics, to correct for the effects of the respondent's preferences and health status. As we expected, we observe a positive effect of having a supplementary health insurance on the number of visits, for both types of healthcare interventions. This effect is significant at the 1% level for both. Also the lagged values of both types of healthcare utilisation have a significant effect on the decision on the purchase of supplementary insurance, which might stem from a continuous bad state of health and could be evidence for advantageous selection.

Some other interesting conclusions can be drawn from the individual characteristics. Females visit both healthcare practitioners more often than men do and surprisingly, older respondents tend to visit the dentist more often, while this trend is not observed for physiotherapy. Compared to respondents having had no education at all or have a low level of education, individuals who completed college or university tend to visit both practitioners significantly more often. This might be due to the fact that these respondents tend to be more cautious and take more preventive measures, or due to the nature of their occupation (which would only be a suitable explanation for a higher number of visits to the physiotherapist). Another remarkable result is the effect of having a good self-reported health status, which differs for the number of visits to the dentist and to the physiotherapist. Having a good health does not significantly impact the number of times an individual sees the dentist, however it does significantly decrease the number of visits to the physiotherapist. However, taking into account the fact that individuals tend to visit the dentist semi-annually for a check-up, gives rise to the expectation that the self-assessed health status could be a significant determinant of the variable d_dentist2. This effect will be tested in a probit model later in this section.

The positive, significant relationship between having a health insurance on healthcare utilisation, gives rise to the expectation of moral hazard. However, as stated before, the causality between insurance coverage and healthcare utilisation can also be reversed, pointing towards adverse selection. To test for moral hazard and adverse selection, we

look at the outcomes of the bivariate probit models, to see whether there is an indication of asymmetric information present in the model.

Table 6

OLS estimates to test for the relationship between having a supplementary health insurance and the number of visits to the dentist and the physiotherapist

	(1)	**(2)**
Variables	**dentist**	**physio**
shi	0.297***	0.979***
	(0.039)	(0.198)
female	0.156***	0.889***
	(0.031)	(0.245)
age	0.020***	-0.068
	(0.006)	(0.043)
age^2	-0.000***	0.001**
	(0.000)	(0.001)
logincome	0.050	0.185
	(0.031)	(0.207)
edumed	0.116	0.525
	(0.071)	(0.490)
eduhigh	0.244***	0.673
	(0.077)	(0.509)
goodhealth	-0.044	-2.290***
	(0.045)	(0.345)
lagdentist	0.357***	0
	(0.025)	
lagphysio	0	0.540***
		(0.053)
r	-0.003	0.015
	(0.009)	(0.633)
constant	-0.358	0.992
	(0.273)	(1.687)
Observations	6,869	6,869
Overall R^2	0.179	0.365

Standard errors are clustered on individual level and are presented between parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% level respectively.

Whereas the OLS regression had the number of visits to a healthcare practitioner as the dependent variable, the probit regressions will use the binary variables d_dentist and d_physio as variables of interest. Since the coefficients of these probit regressions can not be interpreted in the same manner as an OLS regression, I calculated the average margins of these coefficients. The outcome of this calculation should be equal to the coefficients of an OLS regression on the same variables. Table 7 presents the average margins of the probit equations in which the variable shi is also included as an independent variable, to capture whether having an insurance affects the probability of visiting a healthcare practitioner. As a sensitivity analysis, I also ran the regression on the binary variable d_dentist2.

Table 7

Average margins of three probit regressions, to test for the determinants of the probability of visiting the dentist, the physiotherapist or the dentist more than twice.

	(1)	**(2)**	**(3)**
Variables	**d_dentist**	**d_physio**	**d_dentist2**
shi	0.094***	0.101***	0.055***
	(0.012)	(0.014)	(0.010)
female	0.119***	0.118***	0.030***
	(0.014)	(0.013)	(0.008)
age	-0.000	0.002*	0.001***
	(0.001)	(0.001)	(0.000)
logincome	0.063***	-0.009	-0.011
	(0.012)	(0.012)	(0.080)
edumed	0.104***	0.028	-0.001
	(0.026)	(0.025)	(0.017)
eduhigh	0.181***	0.066**	0.014
	(0.028)	(0.026)	(0.018)
goodhealth	0.021	-0.121***	-0.029***
	(0.013)	(0.013)	(0.009)
r	-0.001	-0.001	0.007***
	(0.004)	(0.004)	(0.003)

Standard errors are clustered on individual level and are presented between parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% level respectively.

The aim of this section is to test for the presence of moral hazard or adverse selection in the market for supplementary health insurance and Table 7 shows that there definitely is a positive and significant effect of having a supplementary health insurance on the probability of visiting a dentist or a physiotherapist. Also, having such an insurance has a positive impact on the probability of visiting the dentist more than two times in one year. Another striking outcome is the coefficient on the risk aversion variable, which is only positive and significant in column 3. Even though only marginally, this points towards evidence that risk averse individuals demand more healthcare than those individuals that are less risk averse. In the case of having a supplementary health insurance, this could be an example of moral hazard. Additionally, the dummy variable goodhealth only appears to be significant in the regression on d_dentist2, which implies that having a worse health status does not influence the probability of going to the dentist in a year, but it does impact the probability of visiting the dentist more than twice. Combined with the positive coefficient for health insurance coverage, this could be an indication of advantageous selection. To further investigate whether we are dealing with advantageous selection or adverse selection, we need to inquire the outcomes of a bivariate probit regression in order to determine the correlation coefficient of these individual probit models.

Table 8 presents the outcomes of the bivariate probit models and immediately shows that the correlation between the error terms is positive for both bivariate probits. As previously explained, this is evidence for the presence of asymmetric information and consequently for the presence of moral hazard and/or adverse selection. To increase the reliability of the risk aversion measure, the same bivariate probit regressions are also ran on the same subsample as for the OLS regression. However, the differences between the correlation coefficients in the whole sample and the subsample are negligible.

As a sensitivity analysis, I conducted the same bivariate regression, but I used the variable d_dentist2 rather than d_dentist. The results of this regression are presented in Table 9, which has the same structure as Table 8. When comparing the correlation coefficients for d_dentist and d_dentist2 we observe the latter to be slightly lower for both samples, however all coefficients appear to be positive. The results in Tables 8 and 9 indicate that there is evidence for residual asymmetrical information. The insurance companies do not know all characteristics of the insured individual, therefore it might be the case that an individual's level of risk aversion is perceived to be private information and a cause for information asymmetries in the market for health insurance.

Table 8

Relationship between supplementary health insurance and healthcare utilisation, based on bivariate probits

	(1)	(2)	(3)	(4)
	Whole sample		**Subsample that faced high stakes**	
	Without risk aversion	**Including risk aversion**	**Without risk aversion**	**Including risk aversion**
Correlation coefficient SHI and d_dentist	0.298	0.297	0.309	0.301
	(0.026)	(0.026)	(0.045)	(0.045)
Correlation coefficient SHI and d_physio	0.272	0.272	0.256	0.258
	(0.025)	(0.025)	(0.046)	(0.046)
Observations	9,152	9,152	2,646	2,646

Standard errors are presented between parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% level respectively.

According to Finkelstein and McGarry (2006), a positive measure of correlation for this bivariate probit model provides evidence for the presence of moral hazard or adverse selection in this market. Therefore, we are able to conclude that individuals with a supplementary health insurance are more likely to visit the dentist and the physiotherapist, which confirms the second hypothesis of this paper. The direction of this causal relationship is, unfortunately, not determined within this model.

Table 9

Relationship between supplementary health insurance and whether individuals visited the dentist more than twice a year, based on bivariate probits

	(1)	(2)	(3)	(4)
	Whole sample		**Subsample that faced high stakes**	
	Without risk aversion	**Including risk aversion**	**Without risk aversion**	**Including risk aversion**
Correlation coefficient SHI and d_dentist2	0.203	0.203	0.209	0.204
	(0.034)	(0.034)	(0.052)	(0.052)
Observations	9,152	9,152	2,646	2,646

Standard errors are presented between parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% level respectively.

7. Discussion

Section 6 showed the results of several econometric measures to test whether the two hypotheses stated in the beginning of this paper hold, using data on Dutch households. Now that the regressions provide evidence confirming the aforementioned hypotheses, I will discuss whether the conclusions drawn are universal and what their policy implications could be.

7.1 Generality of results

The previous analysis shows the relationship between risk aversion, healthcare utilisation and supplementary health insurance coverage. As stated in the theoretical framework, individuals are risk averse, on general, and are therefore expected to avoid uncertainty. The findings in Tables 4 and 5 have shown that the individuals with a higher level of risk aversion are associated with a higher probability of opting for a supplementary health insurance, which is in line with the aforementioned theory. Since the measure for risk aversion was found to be lacking, I selected a subsample of those who faced high risks in the experiment, to optimize the adequacy of the self-reported choices. This lowered the sample substantially, however it resulted in a significant coefficient on risk aversion in the decision-making process for insurance coverage. Another explanation for the weakness of the risk aversion measure, is inconsistency of choices. Respondents are expected to have one switching point in their preferences between the lottery and the safe choice (van Leeuwen, 2014) and multiple switching points are associated with inconsistent behaviour. Correcting for these inconsistencies lies beyond the scope of this research, but would be interesting to incorporate in future studies.

To continue, a test was performed to see whether asymmetrical information is present in this model. Positive and significant correlations of the error terms provide evidence for information asymmetries and the coefficients of both the probit and the OLS regressions are pointing towards a positive correlation between insurance coverage and healthcare utilisation. Even though these results are significant, they do not reveal whether the uptake of supplementary health insurance affects the number of visits (ex ante moral hazard) or whether there is an unobserved individual characteristic that affects the overall demand for healthcare and simultaneously the demand for health insurance, indicating adverse selection. One solution for this problem, might be to incorporate a more extensive measure of health status in the model. Self-reported health status is already included in the

vector of background variables, however this simple measure only allows for five categories ranging from bad health to excellent health and might suffer from self-reporting bias. As can be seen from Table 7, it does have a significant negative effect on the number of visits to the physiotherapist, but the variable fails to be a significant explanatory variable for the number of dentist visits.

7.1 Policy implications

The findings in this paper are in line with findings in the current literature, however one should keep in mind that the conclusions about decision making on insurance coverage largely depends on the system adopted by a country. Due to the structure of the Dutch health insurance market, including the free market characteristics of the supplementary insurance market, risk aversion tends to have a significant effect on this decision. This effect might be different in another system, implemented by another government with other intrinsic values and objectives.

The portion of respondents with a supplementary insurance in our sample is 77.11%, which is more or less in line with the current trend[12]. One explanation might be that Dutch insured individuals tend to have a high level of risk aversion. This high level of risk aversion might also, perhaps partly, explain the high utilisation of healthcare after opting for a supplementary health insurance. When individuals are risk averse, they might visit a healthcare practitioner more often for a check-up, to prevent worsening of their health status due to negligence. If this would be the case, moral hazard does not necessarily play a role in this market. Individuals do not change their behaviour due to a lower perceived cost of a healthcare intervention, but they rather use the healthcare intervention as a preventive measure. Since the LISS questionnaire does not specify the reason for the visits for both types of healthcare, it is not possible to confirm nor reject this justification. However, this explanation seems more likely to hold for visits to the dentist than for physiotherapist visits.

Since we are not able to determine which individuals have a high healthcare utilisation due to a worse health status and which due to moral hazardous behaviour, it is not possible to oversee the consequences for the healthcare system. However, as stated before, moral hazard can be tackled by adopting policies such as copayments and decuctibles, to

[12] Proportion of individuals with a supplementary is stabilizing around 84% according to Zorgthermometer: Verzekerden in beeld 2018 (Vektis, 2018)

increase the prices as perceived by the insured individual. Considering the characteristics of the supplementary health insurance market, insurance companies are free to set their premiums and determine the coverage of each insurance package. When these insurance companies expect moral hazardous behaviour, they have the freedom to adapt their premiums to tackle these issues, without further governmental intervention. Since evidence has shown that medical underwriting is already barely used by the insurers (Roos and Schut 2012), I also do not expect radical changes in insurance coverage and premiums when the presence of moral hazard is explicitly found in the market for supplementary health insurance.

8. Conclusion

The aim of this paper was to try to determine the effect of risk aversion upon the uptake of a supplementary health insurance and, thereupon the presence of moral hazard in this market. In times of an ageing populations and continually rising healthcare costs, the topic of health insurance is considered to be highly relevant. This paper is a valuable contribution to the current literature, since it uses data on Dutch households, gathered from the LISS panel, to analyse the decision making under uncertainty in a specific, distinct market, namely the Dutch supplementary health insurance market. This market differs from the Dutch market for basic health insurance, in terms of key values and consequently in the implementation of these values. The basic health insurance system is founded on solidarity, which is translated into universal medical acceptance, equal premiums and a care duty for insurance companies. Contrarily, the supplementary health insurance market can best be described as a free market, in which insurers are free to set their own premiums and are allowed to use medical underwriting and ultimately deny coverage. Looking at the differences between these two markets already shows the relevance of studying decision making behaviour in both these markets. The comparison between behaviour in these two distinct markets is highly relevant and interesting, but it is outside the scope of this paper. Taking the findings of this paper into account, this comparison could be an interesting topic for future research.

The research question in this paper is twofold, whereas the first one focusses on the relationship between risk aversion and insurance coverage, focusses the second on the possible increase in healthcare utilisation after taking out an insurance package. For the first question, I used an ordinary least squares regression to test for a positive relationship

between risk aversion and the uptake of a supplementary health insurance. The results turned out to be negative and insignificant, however by only using the subsample of respondents who face high stakes in the survey on high order risk preferences, the coefficient did appear to be positive, while still insignificant. The rationale behind using this subsample is based on the findings of Holt and Laury (2002). Individuals confronted with high stakes in the risk aversion experiment were associated with higher levels of risk aversion, which would imply their decisions to be more accurate. Using the subsample resulted in a considerable loss in the number of observations, but the relationship between risk aversion and the uptake of supplementary health insurance now does turns out to be positive. This provides barely evidence for the first hypothesis, which stated that individuals with a higher level of risk aversion tend to opt for a supplementary health insurance more often than individuals who did not. A larger sample and a more accurate instrument for risk aversion might provide convincing evidence on the expected relationship between risk aversion and insurance coverage, as predicted by the literature.

The second hypothesis stated that individuals who are insured for a certain type of healthcare, will make use of that type of healthcare more often than individuals without such an insurance. Similar to the first research question, I started by running an OLS regression for both types of healthcare, to test whether there is indeed a positive relationship between having a supplementary health insurance and the number of visits to the dentist and the physiotherapist. The results of this regression confirm this positive relationship and for both healthcare interventions this positive relationship is significant at the 1% level. To continue this investigation, 1 looked at the average margins of three probit models, which study the probabilities of visiting a dentist or a physiotherapist. These coefficients are in line with the expectations and show a significant positive effect. Furthermore, a multivariate probit model is used to test for the presence of asymmetric information. Positive correlations between the error terms of both bivariate probit models show that there is enough evidence to reject the null hypothesis of symmetric information.

Even though we found this positive relationship by using multiple methods, none of these methods show the direction of this causal relationship. If the uptake of the health insurance influences the individual's behaviour while being insured and consequently the number of visits, we have evidence for moral hazard in this market. However, if there is an unobserved characteristic that influences both the probability of opting for a supplementary health insurance and the number of visits, which implies that the demand for healthcare is not determined by the uptake of this health insurance, we observe adverse

selection. Since we do not have the additional information required to make this distinction, we have to conclude the following. There is a positive and significant relationship between the insurance coverage and healthcare utilisation for both dental care and physiotherapy, which provides evidence for the presence of moral hazard and/or adverse selection in the market for supplementary health insurances.

Future research should be aimed at distinguishing between the presence of moral hazard and adverse selection on the health insurance market, to optimally tackle these market efficiencies. Even though the level of governmental intervention is quite low on the Dutch supplementary health insurance market, the information in this paper, and in future research, might still be useful for individuals making decisions regarding their own insurance coverage and for insurance companies, trying to overcome the consequences of market failures, for instance the increase in premiums due to adverse selection or the overutilization of healthcare due to low perceived costs. Decreasing the amount of asymmetric information will make the market more transparent, leaving less room for moral hazard and adverse selection and will increase the efficiency on this Dutch insurance market.

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Appendix A: The Dutch Health Insurance Market

Table A1

List of insurers and their offered insurance packages for which additional information on health status is required before granting a supplementary health insurance

Insurance company	Package
Avéro Achmea	T Royaal / T Excellent / Excellent
CZ	Uitgebreide tandarts
De Amersfoortse	Tand Extra/ Tand Uitgebreid/ Tand Optimaal/ Optimaal
De Friesland zorgverzekeraar	AV Tand Optimaal
De Goudse	Tandarts Uitgebreid Pakket/ Tandarts Totaal Pakket/ Tandarts Top Pakket
Delta Lloyd	TandenGaaf 100% tot € 1000
Interpolis	GebitActief (€ 1000,-) / GebitActief (€ 1250)
ONVZ	Tandfit B/ Tandfit C/ Vrije Keuze Optifit/ Vrije Keuze Topfit/ Vrije Keuze Topfit + Tandfit D
OZF Achmea	Tand Royaal
PNOzorg	Tandarts Extra/ Tandarts Compleet/ Extra/ Compleet
Pro Life	Tand Large
Salland	TandTop
Studenten Goed Verzekerd	Aanvullend Tand 3 sterren/ Aanvullend Tand 4 sterren
United Consumers	VGZ Tand Beter / VGZ Tand Best
Univé	Tand Beter Pakket / Tand Best Pakket
VGZ	VGZ Tand Beter / VGZ Tand Best
Zilveren Kruis	Aanvullend Tand 3 sterren/ Aanvullend tand 4 sterren
Zorgdirect	Tandtop

Source: https://www.independer.nl/zorgverzekering/info/afsluiten/medische-acceptatie.aspx

Table A2

Average annual premium for basic health insurance package in Euro's

	2009	2010	2011	2012	2013	2014	2015	2016	2017
Premium	€1,110	€1,145	€1,262	€1,287	€1,280	€1,157	€1,218	€1,262	€1,353

Source: Zorgthermometer: Verzekerden in Beeld (Vektis, 2018)

Table A3

Average annual premium for supplementary health insurance per supplementary insured individual

	2009	2010	2011	2012	2013	2014	2015	2016	2017
Premium	€278	€288	€308	€322	€314	€306	€311	€319	-

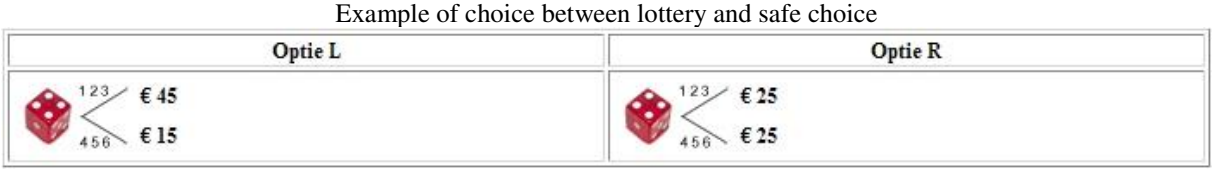
Note: Information on average annual premium for supplementary health insurance is not available yet for 2017.

Source: Zorgthermometer: Verzekerden in Beeld (Vektis, 2018)

Appendix B: Risk Aversion Survey

Figure B1

Example of choice between lottery and safe choice



Source: Measuring Higher Order Risk Attitudes of the General Population (LISS Panel, 2010)

Appendix C: Descriptive Statistics

Table C1

List of variables

Variable name	Label
Background variables	
nomem_encr	Number of household member encrypted
nohouse_encr	Number of household encrypted
wave	Year and month of field work period
female	Female
age	Age of the household member
logincome	Log of net household income in Euros
edumed	Secondary and vocational education
eduhigh	College or university
Health questionnaire	
physio	Number of physiotherapist visits in the past 12 months (0-999)
d_physio	Dummy variable indicating the individual visited a physiotherapist this year
lagphysio	Number of physiotherapist visits in the previous year
dentist	Number of dentist visits in the past 12 months (0-999)
d_dentist	Dummy variable indicating the individual visited a dentist this year
d_dentist2	Dummy variable indicating the individual visited a dentist more than 2 times
lagdentist	Number of dentist visits in the previous year
shi	Household member had a supplementary health insurance this year
goodhealth	Self-reported health status is good, very good or excellent
Risk aversion	
r	Number of safe choices from 5 lottery games (0-5)
high stakes	Faced high stakes in lottery game